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Academy for Educational Development, Inc.

An Analysis of Plans for the

VOCATIONAL TRAINING CENTER

AMMAN, JORDAN

A Joint Project of

THE VOCATIONAL TRAINING CORPORATION
and
U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

Report Prepared by

Academy for Educational Development
Harry Kriemelmeyer,
Walter Mietus,
Consultants

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TABLE OF CONTENTS

I. Purpose. 1

II. General Background 2-3

III. Specific Background. 4-5

IV. General Comments on Plan 6-12

V. Specific Comments - Facility. 13-29

VI. Specific Comments - Equipment & Tools. 30-42

VII. Summary. 43-44

Annex

A. Sources of Information

B. Indicators for Substitution

I. PURPOSE

The purpose of this review by a facilities specialist and an equipment specialist was to assess the suitability of construction plans and equipment lists which will build and equip the first Training Center in Amman for the Vocational Training Corporation. The specific charges are as follows:

A. In light of the proposed number of students (400), review the design criteria for:

1. The physical layout proposed, including the architectural and structural requirements.
2. The workshop concepts and proposed layout.
3. Requirements as to noise control, safety, and such items as lighting, electrical outlets, etc.
4. Such other aspects of the proposed facility as are mutually agreed on.

B. In light of the proposed number of students (400), levels of training, and industrial activities in Jordan, the consultant will review the specifications with respect to:

1. Required types of workshop equipment.
2. The specifications of that equipment.
3. The quantity of equipment required.
4. The installation and maintenance requirements of the specified equipment.
5. Availability of such equipment from U.S. sources.
6. Review estimates of costs of equipment.

II. GENERAL BACKGROUND

In 1976 the Vocational Training Corporation (VTC) was established to complement the work undertaken by the Ministry of Education in the field of vocational training and to make more effective use of on-the-job, in-plant training. A semi-autonomous organization with ties to both the Ministry of Labor and the Ministry of Education, the VTC is concerned with two types of training activities: apprenticeship programs with industry, and upgrading of new and already employed laborers.

Over the past 18 months USAID/Amman has been exploring the feasibility of assisting the VTC. The VTC is progressing on its own awaiting AID assistance and has prepared:

- A set of brief preliminary criteria to be used by a Jordanian engineering firm in design development for the facilities for the Amman Trade Training Center. The Center will provide instruction in the fields of plant maintenance, climate control, industrial electricity, automotives, and woodworking.
- Detailed specifications regarding workshop equipment required for the Amman Trade Training Center. The Amman Center will provide training in the fields of plant maintenance, industrial electricity, climate control, automotives, and woodworking. Based on these specifications, requests for bids to supply the equipment will be let.

USAID/Amman has indicated its desire to review these plans because of a probable involvement, and the VTC has agreed to have a U.S. consultant assess the Amman Center's design criteria and equipment list.

III. SPECIFIC BACKGROUND

The consultant team was able to conduct some field visits to existing facilities in addition to having access to various reports and other documentation. These visits and reports are listed in Annex A.

The project paper, "Vocational Training," sets forth the needs, benefits, and specific enablements to assist the Government of Jordan (GOJ) and its Vocational Training Corporation (VTC) to build and equip the first school of a planned chain of five or more to train students in specific technical fields. These students will become two-year apprentices at the secondary school level; in addition, more senior and experienced workmen will be upgraded to new technical levels through a shorter term, evening program or job release program. The project paper outlines the budgeting and implementation plan for the project. The project is to be completed 20 months after its start, and will cost $3,025,000 (including $2,125,000 USAID).

The referenced project paper establishes a clear need for this project. The consultant team did not discover anything to contradict this; indeed, the lack of mid-level technical talent is astoundingly evident almost wherever one assesses the progress of construction and manufacture.

The rate of construction and industrialization (predominately small companies) is growing rapidly to meet the desires of the population for a higher standard of living. Since many highly skilled and experienced technical people have left the

country to work in other nearby countries, the average talents of the surviving working population are below those needed for quality development. While the human resources remaining in Jordan are approximately adequate, they need training in new skills. The choices of training shown in the project paper are an important beginning, and are of direct benefit to the lower-economic-status young people.

IV. GENERAL COMMENTS ON PLAN

Specific sections which follow will give comments on the details of the plans for the facilities and the equipment lists of the VTC. It is intended that the comments in this section be more general or systematic in nature and address the interactive elements of facilities, equipment, and other parts of the proposed program.

A. The documentation furnished was not completely adequate to assess all elements of the plans. For example, the development of the modular approach will occur beginning at month +8 (current time is month ±2). Further, course syllabyi are not now available for all training sectors; the few available are in Arabic. Therefore, equipment lists cannot be tightly coordinated against the final instructional goals and approaches. In turn, the facility must be approached on more general terms than might otherwise be possible due to the above.

B. The implementation schedule (page 38) in the project paper identifies equipment arrival beginning at month 12; at this time, the building is not yet complete, and will not be until month 16-18. This places the equipment in considerable jeopardy from handling damage, small parts pilferage, and weathering. If closer coordination between equipment arrival and construction completion cannot be provided, specific methods for inspection and secure warehousing should be devised.

C. The visit to the Polytechnic School demonstrated severe lack of coordination in many aspects of the facility and the instructional program/equipment needed to be located in the shops area. This lack of coordination was evident in some shops by the conflicts of wiring power to the equipment, excess dust and poor environment control, poor classroom acoustics, inability due to defects in facility workmanship to maintain shops in an orderly and clean manner, and the provision of some equipment too large for the job at hand. Some equipment has latent damage which was not discovered until final floor placement in the shop; the equipment had arrived a year before, and claims for damage would be all but impossible to process at the time of final placement. Some small parts and cutters had been lost. The VTC project should learn from the experience at this school and be able to plan ways to avoid similar problems.

D. Equipment list selections show some bias to specify items similar to the Polytechnic. This may not represent the best choice for the VTC-type students. For example, it is not necessary to train a student on an eight-foot surface sander; the principles and the techniques may be taught on considerably lesser devices. Similar arguments extend into the machine tool and woodworking tool areas of several of the proposed shops.

In addition, where multiple machine tools are to be procured the team believes the student is best served by being able to work on a variety of sizes and capabilities of equipment. For example, the equipment list proposes eight identical, large, and sophisticated lathes. This adds considerable difficulty for the student when he attempts a small job--a sledge hammer has been given to him to drive a tack. Since there is little probability that a student upon completion of his certificate will use tools of an identical size and manufacture as that used for training, the student's future adaptability is greatly enhanced by having had apprenticeship experience on a diverse complement of equipment. The team's specific comments in the section on equipment reflect this philosophy. Additionally, savings in initial cost, operating costs, and repair costs will derive from reducing the average size/complexity of the proposed equipment.

E. The team held several meetings with Director General MASRI and Technical Director MUSTAFA, VTC. Their frankness was appreciated and their knowlege of and dedication to vocational training was most evident. Having developed the VTC in pilot operations prior to this program should enable the new school to be more effective more quickly than might otherwise be the case.

F. The team commends the concept of a "sister school" and exchange visits and participantships. It is important that the senior instructor in each training area have the time to observe several well-developed programs in his field. The need to establish the attitude of an orderly, safe, and uncluttered approach to practical training is paramount, and the development of this attitude among senior instructors can be provided in part by observation and discussion during visits to the U.S. This approach is preferred to the provision of in-situ U.S. "experts" to attempt to accomplish the same goal. The sister school should clearly not have the charge to assist in forming a Jordanian "image" school like the one in the U.S. However, it should be available on a readily accessible basis for assistance and advice in matters such as curriculum, procurement, organization, facilities, and a myriad of other important elements which will lead to a successful program.

G. Some of the review expected of this team is premature, because no building plans other than rudimentary sketches are available. Similarly, the equipment list is not yet expanded into instructional materials and audio-visual equipment. The specifications for equipment were in most cases derived from specific catalog items, albeit of unnamed manufacturers. The team was able to make exact matches in most cases. For the procurement to become truly competitive, bid analysis must be made before commitment.

Some vendors could offer alternatives which deviate from the specifications, and a judgment must be made whether the deviation is harmful, neutral, or possibly beneficial to the program. It is suggested that a U.S. expert review should be conducted in the U.S., so information could be solicited from the proposed vendors.

In like manner the paucity of building design information at this time and the suggestions made in this analysis report makes it important that final plans and specifications be reviewed by a U.S. expert. However, it may be more effective if this review is conducted in Jordan so that the building systems, components, and features which derive from local purchase can be investigated and determined to be adequate for the long term use of the facility for the VTC purposes. The goal of this training center is to graduate 400 people each year at a steady rate. The team verified with the VTC that this would include about 200 two-year apprentice graduates and about 200 students in short course or skills upgrading programs of six-month average duration.

The school would operate on a six-day week basis in a morning and early afternoon program principally for the two-year curriculum and late afternoons and evenings for the six-month programs (there might be some minor intermixture).

The above establishes an instant total enrollment of 400 in the day program and 200 in the evening program. The instant sum of student spaces is 437, including 207 in shops.

Therefore the student capacity of the classrooms and shops is correctly planned and is endorsed by the team.

I. The projected instructional faculty for the day school is 37. Since the day enrollment will be 400±, a student/faculty ratio of about 11/1 is provided. Assuming each faculty member has the qualifications indicated, this is an acceptable ratio.

The discussions with the VTC indicated shop supervision of not more than 15 students per on-station faculty member. Again, this is an acceptable arrangement.

The above numbers do not include the evening school faculty and students. Presumably similar assignments would be made utilizing part-time faculty.

J. The facility will include several elements which support the training mission. These can easily be used as an opportunity for small, adjunct training projects or as opportunities for local practical experience. For example:

1. Cafeteria: This will include cold stores, a steam generator, and food preparation and service. Therefore, with proper planning and installation, the cold stores and steam generator can be used for the measurement of operating parameters by students, and the food service can become a field program of the hotel management training school.
2. Stores: The flow of supplies and the attendant work of inventory, control, and replenishment could become the subject of a minor curriculum and training experience for clerks.

It is noted that some elements of the cafeteria and the stores might provide some opportunity for women to enter the program under this phase. The project paper identified the need for further studies and development of a subsequent training center before women can be fully served by the VTC.

V. SPECIFIC COMMENTS - FACILITY

These comments derive from the documents and discussions identified in Annex A, supplemented by field visits, ongoing observations during the team's stay in Jordan, and from personal experience of the team.

This section was principally written by H. Kriemelmeyer, but represents the collective opinion of the team.

A. The project paper does not identify the project facility size. Therefore the VTC facility report was used as the basis for analysis (see Annex A, document 4).

The team has determined the shops are adequate in size for the purpose of the program. While some reductions could be made as a result of size and capability reductions in the equipment list, most shop facilities suffer from too little space with resultant problems of safety, lack of flexibility, and task separation. Therefore, the team endorses the proposed shop sizes.

The classroom facilities are adequate, as are the administrative, library, drafting rooms, and cafeteria.

The team recommends a further development of the office area for faculty in recognition of the double set of faculty (full-time day and part-time night). Specifically, the 37-member faculty should be grouped not to exceed three related subject teachers per office of 20 square meters. More senior instructors should be housed two or more per office space based upon approximately $10m^2$ per person. It is doubtful that the office in each shop can be assigned as the sole office of some of the faculty due to the continuous

usage of the shop and the resultant lack of quiet and the difficulty of access. The shop office should be envisioned as a transitory office for the member in charge of the class. It is recommended that approximately 15 faculty offices of average size $15m^2$, totalling $225m^2$, be provided as suggested above.

It is also necessary to add an ancillary building for containment of the acetylene generator, explosive or combustible gasses, paints, cutting and lubricating oils, and solvents and thinners (see Section V-L-5).

It is noted that the space budgeting (Annex A, document 3) adds a 30 percent factor to develop gross, constructed space needs based upon net assignable (functional) space. This is a reasonable escalator applied to the administrative and classroom spaces, but the inclusion of the shop area in the computation distorts and inflates the gross facility requirements. The net to gross factor of the non-shop areas should be computed as shown, i.e.:

Non-Shop Areas	
Administrative offices	$80m^2$
Classrooms	250
Drawing Halls	160
Staff rooms (includes added $225m^2$)	265
Library	120
Cafeteria	100
	$975m^2$
Add 30% to net	300
	$1275m^2$ gross

Shop Areas

Plant Maintenance	400m^2
Industrial Electricity	300
Climatization	600
Automotive	350
Woodwork	300
Basic Training	350
General Store	300
	2600m^2 net
Add +10% to net	260
	2860m^2 gross

Non-allocated Costs

Workshed, Automotive Site Conditions, Walks, Paving	200m^2 gross (equivalent)
Hazardous Stores	20m^2
	4355m^2

This above space rebudgeting accomplishes the addition of 270m^2 offices, hazardous stores, and validates the space/cost budget of 4355m^2.

Recommendation Summary:

- Shop sizes as proposed are endorsed.
- Faculty offices are not adequate; add 15 office spaces of varying size totalling 225m^2.
- Add Hazardous Stores totalling 20m^2.
- The square meter budget is maintained in total at 4355m^2.

B. Facility Cost

Based upon the 4355m^2 gross facility, the budget provides for a contract cost of JD 320,000. This computes to about JD 73.5 per m^2. The USAID engineering office indicates this is a suitable number for a heavily electrified facility based upon their experience in the current FAR School

construction program in Jordan.

Comments cannot be made concerning the budgeted amounts for land and playing grounds.

Recommendation Summary:

- The budget for construction appears adequate but not excessive.

C. Site Layout

Detail studies of the function of each shop indicate that the plant maintenance shop and the basic training shop have many elements in common, i.e., both have precision machine tools and both train in welding techniques. In order to properly electrify and provide dust control, these similar needs should be placed nearby. Sharing equipment is also enhanced. Therefore, it is suggested that the placement of the woodworking and plant maintenance shops be interchanged, so that the plant shop will be adjacent to the basic shop (see Figure 1).

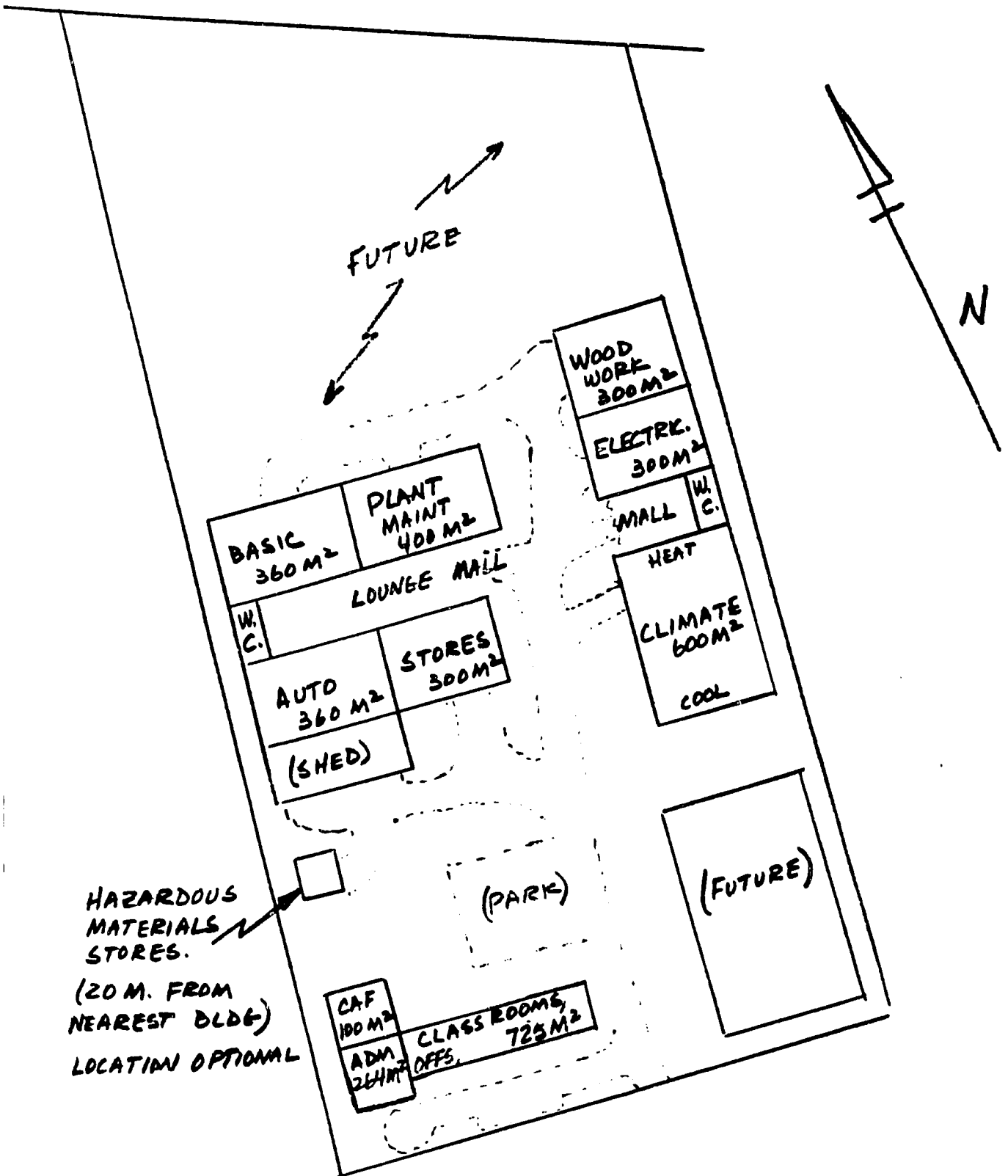
A minor benefit will be that the industrial electricity shop will have adjacent access to some woodworking facilities and stock in the wood shop which would be convenient for fabrication of special, winding fixtures and jigs.

Recommendation Summary:

- Relocate plant shop adjacent to basic shop.
- Relocate wood shop adjacent to electricity shop.

SECT V-C

FIGURE 1



REVISED SITE LAYOUT

(NOT TO SCALE)
(SPACE SIZES "NET")

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D. Shop Structure

The predominant structure used in Jordan is reinforced concrete with columns and flat slabs for floors and roofs. While this is appropriate for the administrative and classroom areas, it leaves much to be desired for shops. The flexibility of shops is enhanced when they are constructed clear-span, i.e, without columns on the active floor space of the shop. Further, some sun-shading should be provided for the east, south, and west windows (see Lighting, following). Shop lighting is enhanced by large amounts of north-facing windows, particularly in high ceiling areas. Also, machine tools such as lathes and mills generate some oil smoke from cutting operations, and therefore the shop needs some high exhaust and careful control of dust content of incoming air (see Ventilation, following)

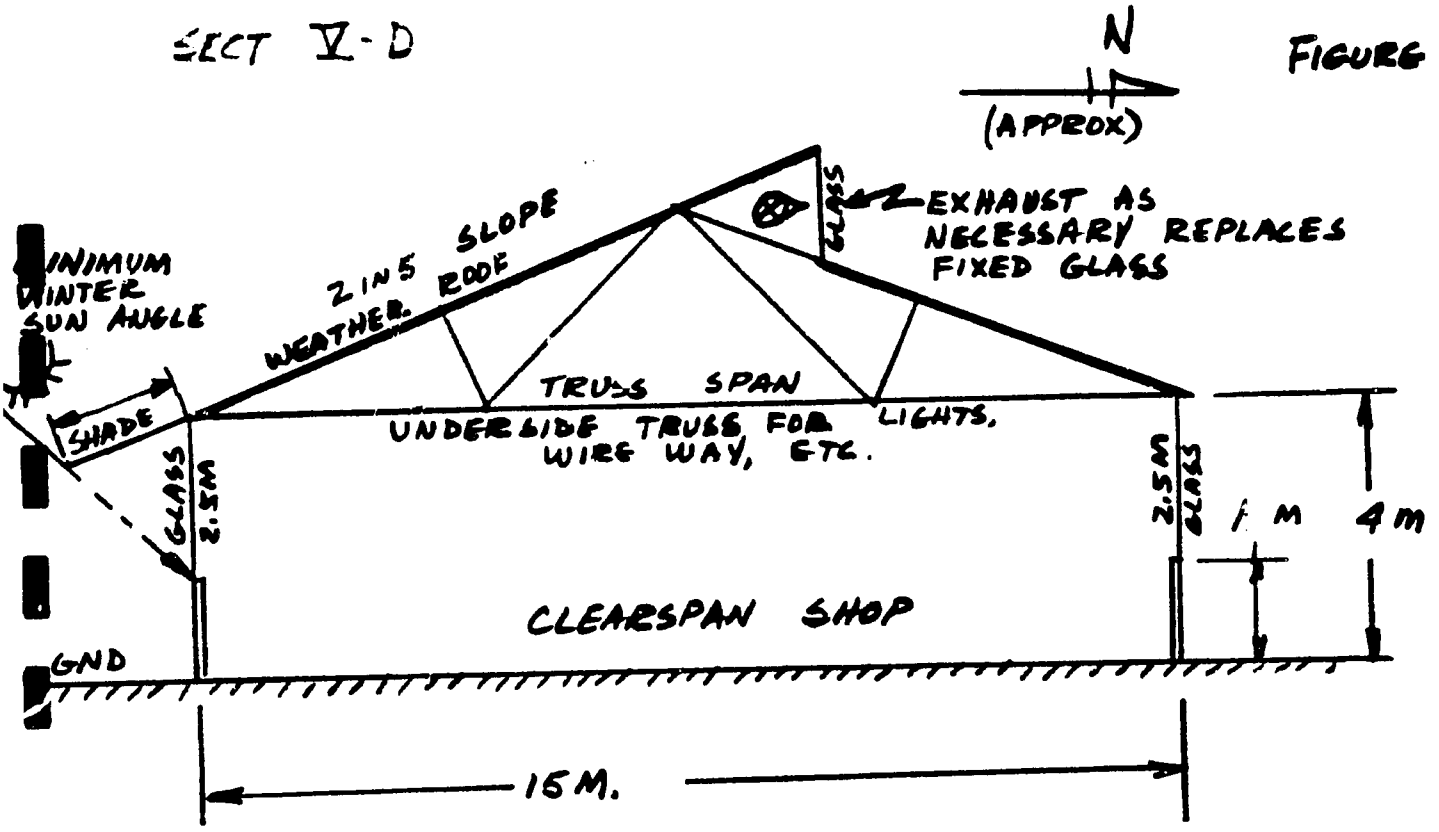
Other alternatives for structure include a beam roof without columns and a truss roof of steel and composition roofing. The team cannot ascribe a preference to either because of a lack of knowlege of comparative costs and lifetime, but it can be concluded that a simple slab and column arrangement will not be desired (See Figure 2).

Recommendation Summary:

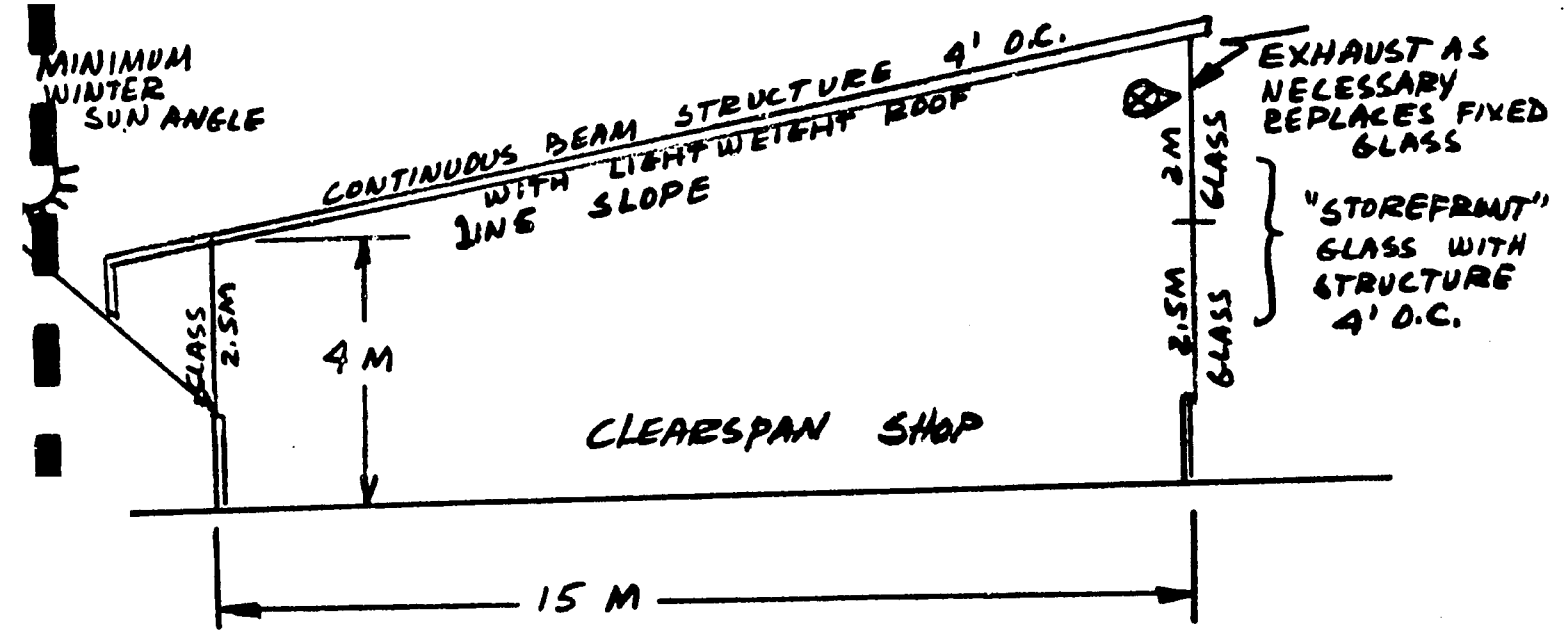
- Develop a beam or truss shop roof structure instead of simple, column-supported slab roof.

SECT V-D

FIGURE 2



TRUSS ROOF TO PROVIDE SKYLIGHTING



BEAM ROOF TO PROVIDE SKYLIGHTING

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ALTERNATIVE CLEARSPAN ROOF DESIGNS TO PROVIDE SKYLIGHT

E. Lighting

It is assumed that regular architectural guides will be followed for lighting in administrative, office, library and classroom spaces.

Shop lighting is a more complex problem, due to the need to:

- Minimize contrasts, which cause eye strain due to need for eye adaptation to different light levels.
- Minimize shadow causing fluorescent tube arrangements above work equipment.
- Minimize stroboscopic effect of 50 cycle fluorescent flicker on rotating equipment.
- Maximize use of daylight for energy savings.

Criteria for the lighting environment is suggested below.

1. Contrasts: The darker areas of shops should not be darker than one-third the brightness of the more intensely lit areas. For example, precision benchwork requires about 100 foot-candles (f.c.) of light to prevent eyestrain. Therefore, all areas of the shop should be lit to a minimum of 30 f.c. The more intense light levels can be economically provided by local supplementary lights, usually shielded incandescent lights mounted on easily adjustable supports. General lighting should be provided as follows:

- Wood workerbench, metal worker bench, wood and metal lathe, drill press, mill, shaper, grider, drafting table. 50 f.c.
- Circular saw, sander, sheet metal equipment, sheet metal bench, reference room, office, classroom, welding bench, stock areas, display area. 30 f.c.
- Welding bench, stock areas, display area. 20 f.c.
- Auxiliary lighting on lathe, bench, milling machine, etc. Supplement to 100 f.c.

2. Shadows: Daytime shadow elimination is enhanced by natural lighting being admitted on sidewalls and through the ceiling (of rooms about 15 meters wide) <u>but with complete absence of shafts of sunlight</u>. North facing skylight is ideal.

   Adequate natural light sources can reduce daytime lighting needs to almost zero, with attendant energy saving benefits. The natural light is of a desirable color frequency and does not burden the occupant with a sense of radiant heat common to all artificial lighting sources. Of course, night use of the facility or cloudy days still require provision of a complete artificial lighting system.

   The lighting designer must consider the shadow-casting effect along the axis of fluorescent fixtures. For instance, work bench orientation should be parallel to fluorescent lighting sources (i.e. the edge approached

by the benchworker during normal operations parallel to the lighting arrangement axis). An ideal arrangement, but seldom used in the U.S., would be a cluster of fluorescent tubes set 60 degrees apart around a common hub. This would free the designer of the worry about orientation with the lighting system. It is not known if such fixtures are readily available in Jordan or whether they can be custom fabricated.

3. Stroboscopic effect: A fluorescent tube turns on and off 50 times each second (at 50 Hz current). The human eye perceives the light to be continuous above about 40 Hz. However, when this light falls upon a rotating device in a lathe, it is possible to have a strobe, stop-motion effect if the device is turning at the proper speed (3000 rpm or sub-harmonics for a piece with several similar faces).

   To minimize this problem it is recommended that the fluorescent fixtures be uniformly distributed throughout the shop on each of the electrical supply phases. Therefore at each given area of the shop the basic light supply will diminish by only one-third intensity, at the rate of 150 cycles per second. This will essentially eliminate the strobe effect as observed by a machine operator.

Recommendation Summary:

- Use adequate lighting to minimize eyestrain.
- Use natural lighting to the extent possible.
- Organize the fluorescent lighting in proper orientation to work areas.
- Wire lighting to all three phases of power, with complete overlap of each phase across entire shop.

F. Ventilation and Climate Control

The climate in Amman escapes the extremes of hot and cold. During the winter the temperature reaches a minimum of about three degrees centigrade and occasional rain or snow can be observed. During summer, ventilation is required, but reasonable comfort can be maintained without air conditioning (in Amman). The team believes, however, that the precision machine tools which will be located in the plant and basic shops need protection against winter dampness and condensation, and, particularly, against dust and other abrasive particles. While similar protection is desirable in all the shops, it is of considerably less urgency and may be omitted.

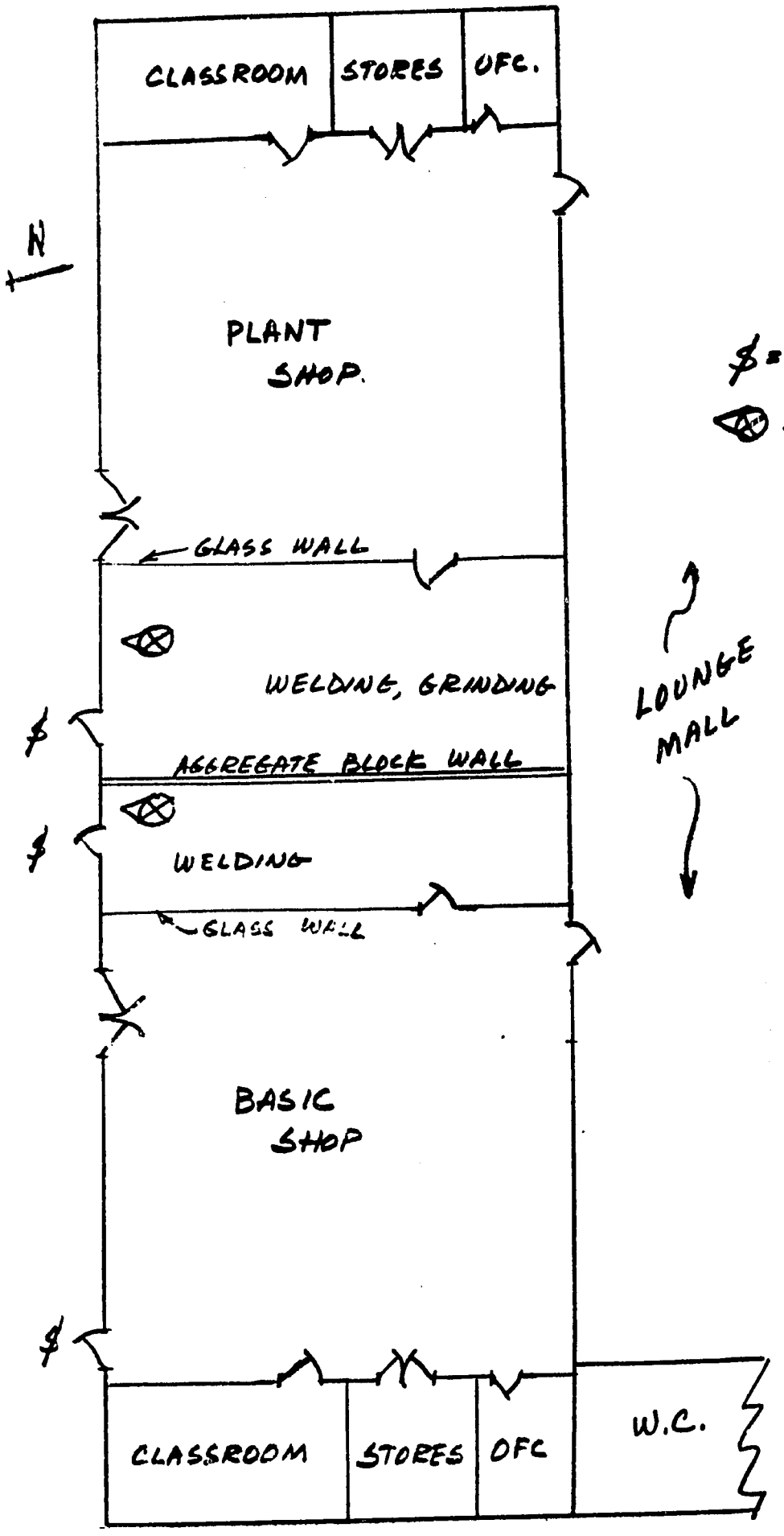
1. It is suggested that the climate laboratory furnace be located near the north of that laboratory. Steam or hot water can be piped across the open area to service a heat exchange coil in the heating/ventilation system for the machine tool subsection of the plant and basic shops. Since the temperature of the shop space is to be raised only above the dew point, or to approximately 60 degrees fahrenheit (15 degrees centigrade), heat supply would be needed on the basis of about 100 to 200 BTU/m^2 (400-800 kgCal per m^2). Therefore, the furnace should be about 360,000 kgCal/hr. The architect should verify

this capacity. The furnace appears in the equipment list.

2. The plant and the basic shops contain about $250,000 in precision machine tools. These tools can have a lifetime of 15 to 20 years if properly used, maintained, lubricated, and in particular, kept in a clean, abrasive free environment. Since the lifetime of the equipment would suffer an appreciable loss from exposure to dust and abrasives (estimated at an approximate one-half reduction), this creates a favorable cost benefit from the expenditure for a forced ventilation system which integrates dust control filtration. Such a system would cost less than $15,000, and would require very minimal maintenance except for filter replacement. To be effective, entry points to the shop should be constructed with sufficient precision to be able to seal against dust when closed. Since machine turning releases small amounts of oil smoke, a small room exhaust should be installed. The ventilating system should keep the shops' rooms under slight positive pressure to reduce dust infiltration.
3. The plant and basic shops also contain welding and grinding areas. These should be separated from the machine tool areas with a partition with large glass areas to allow visual supervision by the instructor but none the less sealed tightly to the structure and floor. The welding/grinding areas will contain specific exhaust hoods for the welding area booths. This floor mounted exhauster is

SECT V-K

FIGURE 3



ϕ = safety door

⊗ : EXHAUST AIR

REVISED SHOP LAYOUT (TO ALLOW FUTURE FLEXIBILITY)

(NOT TO SCALE)

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specified to be 3800 cfm, and is to be obtained under the equipment procurement schedule, item #40. In addition, a general room exhaust of about 1000 cfm should be installed.

4. Other shops would benefit from mechanical ventilating and air movement systems. The important point to remember is that instruction and student retention is enhanced, accidents decrease, and production increases in conditions which are clean, comfortable, and well lit.
5. The auto shop will need an area exhaust and a vehicle exhaust ducted manifold for the several inside bays which may contain vehicles with operating engines.

Recommendation Summary:

- Provide heat to plant and basic shops.
- Provide forced ventilation and dust control to machinery portion of plant and basic shops.
- Separate the welding and grinding areas, and provide their own exhaust.
- Provide a vehicle exhaust and a general exhaust system for the auto shop.
- Mechanical ventilating systems are preferred but not mandatory in other shops.

G. Power Wiring

Several existing training shops have been visited by the team. All displayed a lack of thought, safety, and equipment protection in their power wiring. One such shop is new! Since the power supplied to larger equipment will be 390 volt, three-phase, the existence of bare terminals and exposed

conductors is beyond acceptable standards. The following is recommended:

1. Distribution of power to machine tools should be through an overhead duct system, with a panel breaker supplied for each piece of three-phase apparatus. An earth ground should be solidly wired to each apparatus. In turn, the motor starter or the panel breaker of each machine should contain local fault protection on each phase.
2. The shop should be provided with a master power cut-off switch (with key lock), and remote "panic" buttons located at several accessible and clearly marked positions around the room.
3. Except in very unusual cases, overhead electric feeds are preferred to maintain arrangement flexibility. However, floor wiring to a table saw and similar equipment requiring 360° access is needed in order to maintain use versatility of such equipment.
4. The electrical distribution system should be specified carefully, and good inspection will be needed to ensure good workmanship and materials.

Recommendation Summary

- Carefully specify a high quality electrical distribution system which meets the above criteria in the shops.

H. Electrical Capacity

Time did not allow a detail check of electrical capacity in each shop. The plant shop was examined in detail and the minimum connected load was determined to be 440 amps. The

VTC recommended a 250 amp service, and since the demand factor for such a shop will be less than 0.5, the 250 amp recommendation appears adequate but not excessive.

Recommendation Summary:

- The VTC proposed electrical loads are acceptable for design purposes.

I. Noise

An environment composed of hard, reflective surfaces will create a difficult education environment where machine tools, saws, or similar equipment is in use.

Typical construction in Jordan is composed of hard, reflective masonry surfaces. Therefore, it is important to add sound absorption panels to walls (high) or on ceiling undersides in the noise producing shops and all of the classrooms.

Recommendation Summary:

- Add noise absorption panels to reduce sound levels.

J. Safety

The shop areas involve many processes which by their nature present severe safety hazards. Proper instruction in tool operation, the use of shields and guards on rotating equipment, and the mandatory use of eye protection by all shop occupants at all times will add to safety.

The construction of shops with adequate space and light, plus safety consciousness in equipment layout, will complement

the above and add to the safety of the environment. For instance, each machine has a "danger zone" due to flying chips, stock movement, etc. Another student station should not be placed in this danger zone.

Recommendation Summary:

- Be aware of machine/men conflicts when designing how equipment is to be placed.

K. Workshop Layout

As noted in section C, Site Layout, it has been suggested to locate the plant shop next to the basic shop, for reasons which have been explained. Other aspects of site layout are acceptable.

The layout of each shop can be improved by relocation of the subcomplex of office-storeroom-classroom to the far ends of each structure, instead of their being back-to-back. This will then allow a single wall to separate the two adjacent shops. It is further suggested that this wall be made of six-inch or eight-inch aggregate block. The advantage of this change would be the considerable ease that one shop could be expanded at the expense of the adjacent neighbor if desired in the future.

The general stores area should be equipped with the potential of being able to be changed into a shop should a new program be added (this implies a relocation to a new facility for the stores operation). This means it should be designed with proper natural light and have an adequate conduit for future electrical supply from the power substation.

Each shop is planned to be equipped with a materials handling large door. It is suggested that two personnel-access swing-type doors also be provided, one for normal access and the other located on the opposite wall for emergency exit.

The tool layout in each shop should avoid the possibility of a student facing a source of danger, such as flying chips, from another student's operation. Workbenches should be placed away from the machine tools, most of which need "elbow room" to be functional and safe. Further, nothing should obscure the instructor's view towards all of the machine tools from any position in the shop. The dirty operations of welding and grinding in the plant and basic shops should be separated from the precision tool areas with a glass wall (see Figure 3).

Recommendation Summary:

- Use two personnel doors in addition to the materials handling door.
- Lay out machine tools for operator protection and visibility of the supervising instructor.

L. <u>Shops Architectural Features</u>

1. Floors: All shops should have floors of a smooth masonry surface. The suggested cement tile floor is acceptable except for the automotive shop, where a smooth, monolithic cement floor with an applied grease resistant finish should be specified.

It is important that the floor be smooth enough in all shops to allow for chip and debris removal with pushbrooms.

2. Doors: The specified roll-up, die-formed sectional overhead doors should be excluded except in the automotive shop. It is much preferred that a special door buck including sill and double door arrangement be prefabricated and set into the masonry walls. This door set can provide a sufficient opening to move apparatus and stock, and would allow precision fitting of the apertures around the doors. The specified extruded section roll-up doors are essentially impossible to seal against infiltration wind which brings a 24-hour-day supply of dirt.

   The automotive shop exclusion is due to the need for rapid opening, closure, and to avoid door swing conflicts with the vehicles. It would be helpful if a better quality, possibly four or six section-type overhead doors be specified for the auto shop.

3. Windows: Most window units observed in Jordan have sufficient frame fit and seals to be adequate for exclusion of dust.

4. Exhaust fans: All general exhausts should be equipped with automatic sealing louvers to protect against dirt infiltration from backdrafts when turned off.

5. The acetylene generator, if purchased, should be located in a more remote part of the site away from the regular shops. A "hazardous stores" area for separated storage of cylinders, cutting and lubricating oils, paints, and the acetylene generator should be provided. It need not be larger than $20m^2$ surrounded by a security fence and yard.

Recommendation Summary:

- Floors should be smooth to allow cleaning.
- Two personnel doors should be provided.
- Extruded roll-up doors should be avoided.
- A "hazardous stores" should be constructed.

M. Water Supply System

The provisions indicated are endorsed.

VI. SPECIFIC COMMENTS - EQUIPMENT AND TOOLS

The equipment specialist reviewed the list of equipment and tools on the basis of considering: the contribution and compatibility with the stated objectives, and fields of training and types of training established for the VTC program. These are provided below and were derived from the documents in Annex A.

This section was principally written by Water Mietus, but represents the collective agreement of the team.

A. General Objectives

1. This center will play its role in the context of the country's emerging overall training policy, which is characterized by increasing reliance on an arsenal of modern, flexible training arrangements. These include short, intensive apprenticeship training and in-plant training.
2. To serve the economic development plans by supplying private and public institutions with a skilled labor force which is qualified to contribute towards meeting the standing and expected requirements in the industrial field.

B. Specific Objectives

1. To help in directing young citizens into industrial work through apprenticeship by full cooperation with industrial establishments.
2. To improve and raise the standard of performance of the already employed workers by providing training courses in the afternoons and/or evenings on a full-time or part-time basis.

3. To provide supervisory training to existing or future supervisors.
4. To prepare and/or upgrade on-the-job instructors and training officers in industry.

C. Fields of Training

1. Plant maintenance and fabrication (mechanical) to carry out high level of productivity in the existing industrial plants, besides producing new goods.
2. Industrial electricity, including the habitual skill range of electricians such as electrical installations, repairing of electrical appliances, electrical apparatus, and installation in industry and coil winding.
3. Climatization, including central heating systems, air conditioning and refrigeration, geared to application unit, medium and large scale heating and cooling plants.
4. Automotive occupations, including the repair and maintenance work of petrol and diesel fuel cars.
5. Woodwork, making and repairing of wooden frames, doors, windows, and cabinets.

D. Types of Training

Different types of pre-employment and in-service training will be offered which correspond to a variety of skill levels and skill mixes in the main, and wherever feasible, training will be organized in modular form to ensure easy adjustment of the skill composition and level of the worker to changing requirements of industry.

In particular the center will offer the following types of training:

1. The training of fully fledged skilled craftsmen who are competent in a wide range of occupational skills in accordance with their field of occupational activity.
2. The training of skilled industrial personnel who are competent in a relatively narrow range of occupational skills that may, however, be developed to a very high level.
3. The training of young persons who are not yet employed in a variety of basic skills in the form of pre-employment training either related to subsequent apprentice training or designed to improve their capability to receive informal on-the-job training in general.
4. Supplementary training and instruction.
5. Upgrading training to facilitate upward mobility of skilled workers and supervisors.

For most programs in industrial vocational education the curriculum or course syllabi offer the most effective base for reviewing equipment and tool needs. Due to the uniqueness of this program, pre-designed course curriculum would restrict the flexibility necessary to meet the needs of the students. The directors of the program are engaged in acquiring module type programs. To best implement such a program requires a variety of equipment and tools which demand different degrees of skills and reflect a variety of occupations.

E. Plant Maintenance and Fabrication (Shop 1)

The title designated to this shop may be misleading to the uninformed. It connotates a specialized occupation. However, it affords skill development possibilities into a cluster of occupations. These are machine operators such as: grinders, lathe operators, milling machine operators, metal workers, metal fabricators, iron worker architectural, welder gas, welder arc, sheet metal installer, sheet metal fabricator, pipe fitter, plumber, steel order filler, etc.

The equipment proposed and the experiences provided in plant maintenance and fabrication (Shop 1) can lead to specialized entry level jobs and occupations requiring a mix of skills. Thus a person can plan a career and progress in it by further upgrading at the VTC center.

1. Specifications and Item Analysis, 1 through 9

The following machines form the core of the machine center within plant maintenance and fabrication (Shop 1):

a. Lathe
b. Milling Machine and Universal Mill
c. Surface Grinder
d. Shaper
e. Grinder (Floor)
f. Tool Grinder
g. Radial Drill
h. Floor Drill
i. Power Hack Saw

The specifications as proposed call for high quality industrial types of machines. These are mostly homogeneous in type and capability. It is suggested that a better mix of sizes of machines can enhance the achievement

of the various objectives designed for the program. Different size machines would more reflect the real world of industry.

To extend the range of experiences afforded to the students and at the same time to leave a larger portion of the budget for operating peripherals required to keep the machinery center operational with continuity, it is recommended that:

a. The five lathes requested for the plant maintenance and fabrication (Shop 1) be distributed over the following: two with a 310 MM swing; two with approximately 250 MM swing; and another with some choice smaller swing and distance between centers.

b. The three lathes in the basic training shop (Shop 6) should also be equipped with a range of sizes. It is suggested that a machine ability development center which contains scaled down machines on one service bench be incorporated by dropping the request for two of the three 330 MM lathes (see Annex B, page 1). This service bench would include a lathe, horizontal and vertical milling machines, and a drill press. The same concepts and experiences are attainable as on large scale machines.

Two milling machines are called for in item 2, both are of a high sophisticated level. There are milling machines of durable quality with less horsepower and smaller size which can be obtained for significantly less cost. In accordance with the stated purposes written by the project leaders, the program would not be too sophisticated. The recommendation to obtain a less sophisticated

milling machine and other major pieces of equipment is reasonable. The variability of sizes of equipment within all shops would enhance the flexibility of the program to meet the various needs of industry and the diversified body of students.

The same operations of shaping, forming, and removing metal with precision are transferable to the industry of Jordan which no doubt also includes a wide range of sizes of machines and equipment. The principle of variability can be applied to all the items from one through nine. Care should be exercised in any substitutions so that the machine center always has the potential to produce precision parts for any piece of equipment that would need repair in the school.

2. Items 10 through 20: Welding

The equipment specified herein deal with welding gas and electrical arc. There is a well balanced listing for the shop. Questions have been raised by the team about the appropriateness of and the cost of the acetylene generator. The explanation and the rationale for using the device in the new center provided by the VTC officers were acceptable. Further research should be given to the safety of this device and its proximity to groups of students.

The peripheral equipment required for the welding center within the plant maintenance and fabrication shop and other shops can and should be fabricated by the advanced students. This would include the welding bench vise (item 210 and 213), the arc welding benches (item 292), and gas welding benches (item 293). This suggestion has been accepted by the officers of the VTC. They indicated that the inclusion of the items in the equipment list was mainly to show consideration of these in the planning of the shops. The fabrication of these would represent a considerable saving to the budget.

3. Items 31 through 52

Incorporated in this range of items are pieces of equipment for metal fabrication. In cases where the same equipment is specified for the plant maintenance shop and the basic training shop (Shop 6) it is recommended that smaller capacity metal fabrication systems be used. These are designed as budget saving devices (see Annex B, page 3). Various companies in the U.S.A. produce these systems.

It should be noted that item 40 in the equipment list is an exhauster which will be used with the welding center hood. Before purchasing this item, the building architects should be consulted and coordinated with other building systems under his responsibility.

Item 52 which is called for in the plant maintenance and the automotive laboratory should be substituted with a hand operated hydraulic press. An electrically powered press is rarely requisitioned in U.S. apprentice programs or vocational schools (see Annex B, page 4).

4. Items 53 through 83

Items 53 through 83 deal mainly with the major equipment for the automotive shop. The testing apparatus specified may be available from U.S. suppliers. However, it may be necessary to accept bids from other countries. Small engine repair should be introduced in this shop or in the basic training shop. Small engines propel portable saws, generators, pumps, air compressors, concrete mixers, etc., and offer a wide range of service occupations.

5. Items 84 through 90

Items 84 through 90 deal with the woodworking shop (Shop 5). The problem of keeping circular saws and band saws sharp needs to be tended to. A saw sharpener and a band saw welder would keep the shop operational and offer some skill development in this area.

6. Items 91 through 140

Items 91 through 140 deal with the equipment specifications for industrial electricity (Shop 2). The list is appropriate when considered in relationship to the number of students and quantity of items. It is recommended that the number of motors requested be reduced and an effort be made to have local industries contribute used surplus motors. The funds saved could be used for instructional

electricity and electronics packages or teachers' guides for electrical power.

7. Items 141 through 286

Items 141 through 286 include the hand tools necessary for all shops. In reviewing the number of stations and the number of students, the number and type of hand tools are appropriate. However, the type of sockets called for in item number 156 is inappropriate. The problem here is that a one-half inch drive for the sizes requested is not extending the capabilities of the tools purchased. The one-half inch drive sockets should pick up sockets from one-half inch up to one and one-quarter inch and another set picking up the larger metric bolt and nut sizes.

8. Items 287 through 307

Items 287 through 307 deal mainly with the types and numbers of chairs, benches, and desks for offices and shops. The list is appropriate. However, a considerable saving could be realized by having students take up as educational projects the making of work benches and demonstration tables for all shops. Steel frames for work benches can be fabricated by the plant maintenance shop and the wooden bench tops by the wood-working shops. The fact that these appear in the equipment list reflects good planning.

9. Items 308 through 313

This equipment belongs in the climatization shop. This equipment is listed in the equipment list but it does not show in the planning or document, Annex G, generated

by the VTC team. It is suggested that the VTC reconsider the need for two Lockformers, items 311 and 313. Perhaps one such machine would be sufficient.

10. Items 314 through 347

Items 314 through 347 deal with the equipment for the climatization shop. The number of pieces is appropriate. It is suggested that the horsepower ratings in item 347 be specified to eliminate the variability of ratings. Since the furnace will be a source of heat for the plant maintenance and fabrication and basic shops, its size should be specified in accordance with the architect.

Recommendation Summary:

The following statements are made on the basis of an analysis of the equipment list in relationship to the goals and purposes of the project. These are outlined specifically to the statement of work in purpose I, paragraph B.

1. Required Types of Shop Equipment

- Recommendations have been made as to which pieces of equipment should be substituted and the reasons for such recommendations have been provided.
- Suggestions have been made herein as to where budget monies can be saved or to better meet the purposes and goals of the program.

In summary, the overall planning for each shop has been done with a high degree of competence.

2. Specifications of Equipment

The overall specification list was well planned. Wherever modifications are recommended in this document, these need to be incorporated in the new revised equipment list.

- Some minor errors in the numbering of items, collating and misspelled words need to be corrected.
- Machinery specifications for the plant maintenance and fabrication shop should be grouped closer together.
- Items 308 to 313 should be incorporated in the planning document (Annex A, report #3) which shows the number of students per station.
- Item 214, pullers, has the wrong number in sequence.
- There is no item for 219.
- Item 209 is confounded with misspelled words that may mislead the bidder.
- It is recommended that there be more of an effort toward standardization of the electrical voltages, coils, and motor control devices.
- There is too wide of a range for electrical specifications. This has a significant relationship to proper maintenance and continuity to the function of the equipment.
- Dependable and well established suppliers should be consulted to suggest standardization. This will also reduce variability of stock requirements. Suppliers may also provide input as to the most frequent components that need replacements as they deal with training programs. These indicators should be taken seriously so that an adequate supply of breakables will be on hand.

3. Quality of Equipment

The quality of equipment has been analyzed in relationship to the proposed number of students and stations.

- Some recommendations were made to decrease the number of highly sophisticated machines.
- The hand tool list was in good order.
- Eye safety glasses need to be requisitioned.

4. The Maintenance of the Specified Equipment and Installation Requirements

- Evidence was found to indicate that minor accessories were purchased which would enable instructors to sharpen, recondition, rebuild and replace worn or broken equipment.
- The level of sophistication of the equipment will require the instructors to stress the cost benefits derived from increasing the expected life time of machines by regular and scheduled care and maintenance of tools and equipment.
- Suppliers should be consulted to determine the most frequent part replacements and repair manuals.

On site observations of school shops and several small industries made it evident that:

- There is a need for planning and placement of machinery in the shops. The industrial shops were poor models in terms of this criteria and safety considerations. There is reason to believe that instructors who come from the industrial scene have little awareness or application for proper maintenance, installation,and location of equipment. This would require guidance by a U.S. team.
- There is a need to give special attention to electric and mechanical standards for the installation of the new equipment in the new building.

5. Availability of Equipment from U.S. Sources

The equipment list includes an inventory of items that are available from many U.S. suppliers. Catalogues of two broad product lines, multiple manufacturer suppliers were checked by the team.

- There needs to be a further check into the availability of acetylene generators and selected automotive testing equipment for non-U.S. built cars.

- It is strongly recommended that the shipping of major pieces of equipment and the accessories of these be combined in such a way that they arrive in one package. Separation leads to loss of components, slower installation and readiness time. Special crating will add to costs.

6. Review Estimates of Costs

Due to the shortage of time, one shop, the plant maintenance and fabrication, was assessed for cost item by item.

- This shop represents the highest demand of tools and equipment.

- It was found that the budget was adequate but not excessive with a good margin for shipment costs.

- The request of the team to purchase less sophisticated equipment and other suggestions, where outlined in this report, would further assure adequacy and contribute to offset costs due to inflation.

VII. SUMMARY

The general plan (documents listed in Annex A) and most of the detail is endorsed by the team. The comments in the preceeding three sections represent the combined thought and agreement of the team. The content of this report has been discussed with the senior officers of the VTC and with USAID, to whom this report is formally submitted. The team has made suggestions concerning the layout of the planned facilities and attempted to set forth some specifics to be of assistance to the project architect. The construction budget, both in space and estimated cost, appears justified; adequate, but not excessive.

The equipment list was well prepared and will serve as a good basis for competitive procurement. However, in some instances, the team felt the items listed were too large or sophisticated for the goals of the VTC and the level of their students. Suggestions of specific modifications have been given in these cases. The equipment budget has been spot checked and validated.

The team could not validate the equipment lists against the precise curriculum and individualized modules because they are not complete. Similarly, the building layout and specifications exist only in a rudimentary form. These factors prevented the team from providing a final assessment of compatibility and suitability of all elements of the project.

The team believes that the project implementation will be more successful if final equipment bids are reviewed by a U.S. expert in concert with the VTC; also, final architectural plans

should be reviewed by a facilities expert. The equipment bid review should be within the U.S., and the plans review in Jordan.

The team is pleased with the preparatory work done by the VTC; it demonstrates the competence and professionalism of the VTC leadership.

ANNEX A

SOURCES OF INFORMATION

ANNEX A

SOURCES OF INFORMATION

Reports and Other Documents

1. Project Paper, Vocational Training, #278-038, USAID/Jordan.
2. Report, Vocational Training in Jordan, Cusac, March 3, 1979.
3. Report, Trade Training Center - Amman, VTC (was PP Annex G), Budget and Staffing.
4. Report, Amman Training Center - YAJOUZ; VTC Facility Description.
5. Equipment Specifications List, VTC.
6. Five Year Plan 1978-1982, VTC.
7. Training Institutes in Jordan, Ministry of Information, 1978.

Meetings and Discussions

A.	Mr. Frank Denton, USAID	8/13 & other dates
B.	Mr. Rex Cline and Mr. Abdallah Ahmad, USAID	8/14 & other dates
C.	Ms. Lois Richard, Acting Director, USAID	8/14 and 8/20
D.	Director General Masari, VTC	8/13, 8/14 & other dates
E.	Technical Director Mustafa, VTC	8/13, 8/14, 8/15, 8/19, 8/20
G.	Ms. Carol Steel, USAID	8/19 & 8/20
H.	Dr. James Turman, Education Officer, USAID	8/19 & 8/20

Visits

8/16 Polytechnic Institutes, Amman

8/16 Sheet metal and welding factory, Metal Industries Co., Amman

8/19 Amman Technical Secondary School

Various - Auto and bus trips through industrial suburbs north and south of Amman.

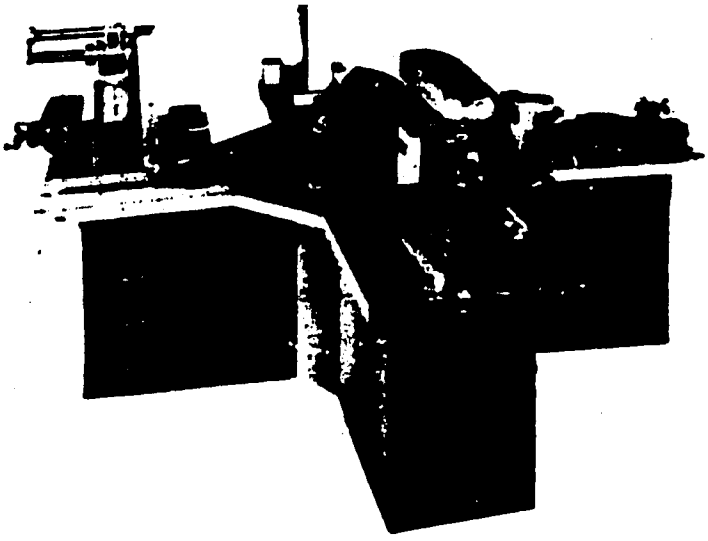
Various - Walking trips through Amman downtown area.

ANNEX B

INDICATORS FOR SUBSTITUTIONS

ANNEX B INDICATORS FOR SUBSTITUTIONS PAG. 1

MACHINE/ABILITY CENTER



To meet the demands of contemporary industrial education, Brodhead-Garrett presents a new, innovative "Machine/Ability Center."

Designed to enable three teams of students to explore the exciting world of metalworking technology. The Machinability Center features the Lathe, Horizontal Milling Machine, and Vertical Milling Machine. These three machines plus any combination of a Vega Universal Testing Machine, A Rockwell Drill Press, a Vega Electrical Discharge Machine or even the J-Line Numerical Control Trainer give you the completeness to present your students with a modern up-to-date program.

MACHINABILITY CENTER WITH N/C TRAINER

This Machinability Center features four machines:

The Atlas Lathe
The Benchmaster Horizontal Milling Machine
The Benchmaster Vertical Milling Machine
The Numerical Control Trainer

All are mounted on the B/G FleXenter eight-student work center.

These four machines allow four teams of students to work on the machines with room left over for other students to observe. Large, four section (36" W x 21" D x 31" H) table top surface gives each student ample work area, PLUS large storage space below for tools and materials. Additional surface area is provided for hand-tool finishing gauging, print-reading, etc.

These machines are especially engineered for constant student use. Each gives the individual student a chance to operate and understand the workings of the lathe, miller, and numerical control.

Stock No. 011066 Machinability Center "D" $7,985.00

These versatile machine tools need no introduction. For many year thousands of students have used them to learn the fundamentals metalworking technology. Each machine comes with complete electr cals, tooling, and instructor's guide. Because of its compactness, rel tive light weight, and 110/60/1 cycle electrical requirements, th Machinability Center is especially ideal for junior high and intermed ate school industrial arts, and high school metalworking program Technical and vocational schools can use these centers to provi their students with the first "Hands On" experiences.

MACHINABILITY CENTER WITH NON-METALIC TESTER

This Machinability Center features four machines:

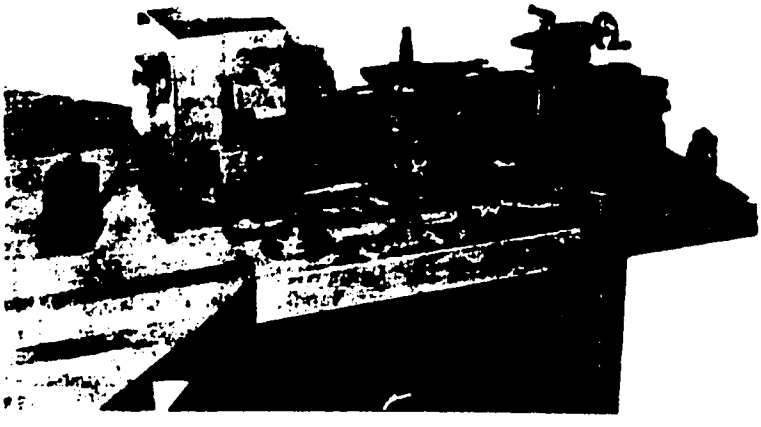
The Atlas Lathe
The Benchmaster Horizontal Milling Machine
The Benchmaster Vertical Milling Machine
The Vega Non-Metalic Tester

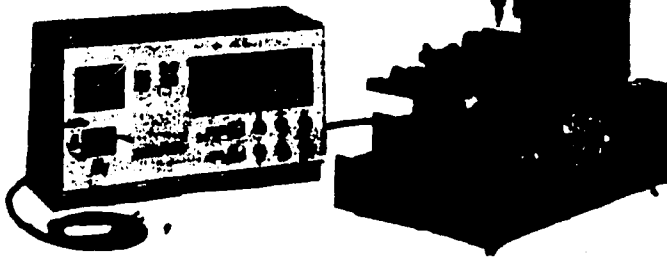
All are mounted on the B/G FleXenter eight-student work center.

These four machines allow four teams of students to work on t machines with room left over for other students to observe. Large, fo section (36"W x 21"D x 31"H) table-top surface gives each student a ple work area, PLUS large storage space below for tools and materia Additional surface area is provided for hand-tool finishing gaugi print-reading, etc.

These machines are especially engineered for constant student u Each gives the individual student a chance to operate and understa the working of the lathe, miller, and material testing.

Stock No. 011044 Machinability Center "B" ..... $3,138.

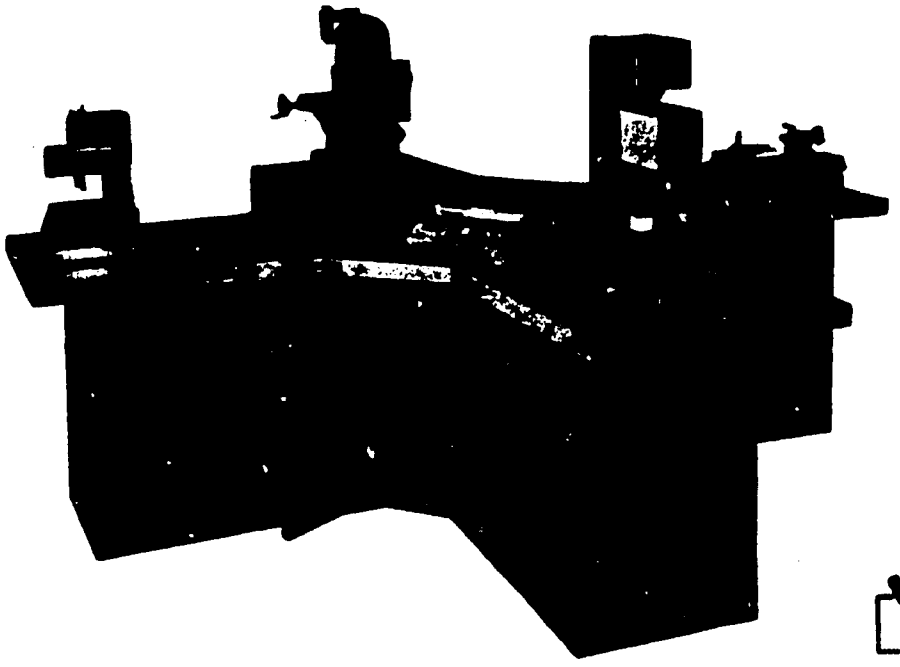




Brodhead-Garrett pays shipping charges on all orders over $100.00

INDICATORS FOR SUBSTITUTIONS

MACHINE/ABILITY CENTER



RECOMMENDED SCHOOL MODEL

MACHINABILITY CENTER WITH E.D.M.

This Machinability Center features:
The Voga Electric Discharge Machine
The Atlas Lathe
The Benchmaster Horizontal Milling Machine
The Benchmaster Vertical Milling Machine
All are mounted on the B/G FleXenter eight-student work center.

These four machines allow four teams of students to work on the machines with room left over for other students to observe. Large, four section (36"W x 21"D x 31"H) table-top surface gives each student ample work area, PLUS large storage space below for tools and materials. Additional surface area is provided for hand-tool finishing gauging, print-reading, etc.

These machines are especially engineered for constant student use. Each gives the individual student a chance to operate and understand the workings of the lathe, miller and EDM.

Stock No. 010627 Machinability Center A $3,661.00

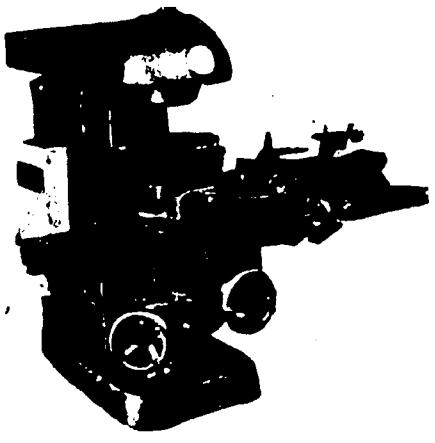
MACHINABILITY CENTER WITH DRILL PRESS

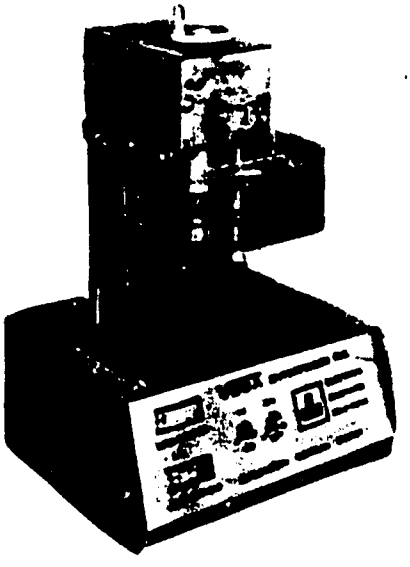
This Machinability Center features four machines:
The Atlas Lathe
The Benchmaster Horizontal Milling Machine
The Benchmaster Vertical Milling Machine
The Rockwell Drill Press
All are mounted on the B/G FleXenter eight-student work center.

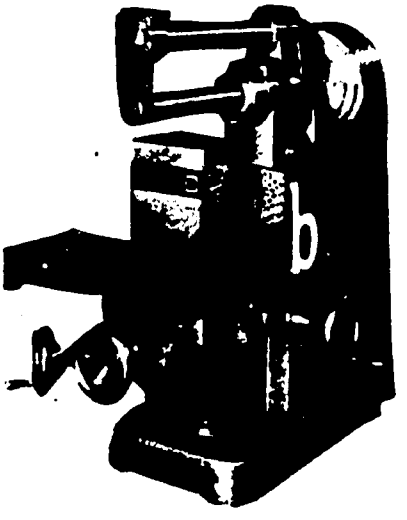
These four machines allow four teams of students to work on the machines with room left over for other students to observe. Large, four section (36"W x 21"D x 31"H) table-top surface gives each student ample work area, PLUS large storage space below for tools and materials. Additional surface area is provided for hand-tool finishing gauging, print-reading, etc.

These machines are especially engineered for constant student use. Each gives the individual student a chance to operate and understand the workings of the lathe, miller and drill press.

Stock No. 011695 Machinability Center "C" $4,990.00







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INDICATORS FOR SUBSTITUTIONS

Longtime favorites for metal training, industry accepted Di-Acro Precision Machines are economical, versatile, and permit interesting modern project work. Machines are available individually, but one of the Metal Fabrication Centers may fit your needs and save you money. If you desire a Fabrication Center other than shown, list your requirements (must be at least 3 machines and stands or table) and we will be glad to give you a dollar saving quotation. All machines are finished in two-tone color combination (vista green with buff highlights) and backed by a one-year warranty. Material capacities are based on 16 gauge mild steel. Heavy constructed steel benches and stands are predrilled for mounting machine, easily assembled.

—FOR SR. HIGH SCHOOLS & COLLEGES—

CENTER NO. 1 – $5454.00

No. 2 Di-Acro Bender – capacity 1/2" M.S. Bar, 3/4" steel tubing.
No. 2 Bender Stand – welded steel, 33" high two storage shelves.
No. 2 Bend-R-Pack.
No. 4 Di-Acro Roller – 24" width 20 ga. cap., cam actuated idler roll.
No. 24 Di-Acro Shear – 24" width 16 ga. cap., combination hold-down bar and safety guard.
No. 24 Di-Acro Box & Pan Brake 24" width 16 ga. cap., ten under cut interchangeable fingers.
Brake Stand – welded steel, 33" high, storage shelf.
No. 1 Di-Acro Notcher – 6" x 6" maximum notch, 16 ga. cap.
No. 12 Di-Acro Turret Punch Press – Maximum 2" Round 16 ga.
Punch Stand – 33" high storage shelf
Standard arrangement of round punches and Dies
Micrometer Back Gauge
72" x 36" Machinery Table

CENTER NO. 2 – $2626.00

No. 2 Di-Acro Bender – capacity 1/2" M.S. Bar, 3/4" steel tubing.
Bender Stand – welded steel, 33" high, two storage shelves.
No. 2 Bend-R-Pak.
No. 24 Di-Acro Shear – 24" width, 16 ga. cap., combination hold-down bar and safety guard.
No. 24 Di-Acro Box and Pan Brake – 24" width, 16 ga. cap., ten undercut interchangeable fingers.
No. 1 Di-Acro Notcher – 6" x 6" maximum notch, 16 ga. cap., 72" x 36" Machinery Table.

CENTER NO. 3 – $7458.00

No. 3 Di-Acro Bender – capacity 5/8" M.S. Bar, 1" steel tubing.
No. 3 Bender Stand – welded steel, 3" high, two storage shelves.
No. 3 Bend-R-Pak.
No. 6 Di-Acro Roller – 36" width, 22 ga. cap., cam actuated idler roll.
No. 36 Di-Acro Shear – 16 ga. cap., combination hold-down bar and safety guard.
Shear Stand – welded steel, 33" high, storage shelf.
No. 36 Box and Pan Brake – 36" width, 16 ga. cap., twelve undercut interchangeable fingers.
No. 1 Di-Acro Notcher – 6" x 6" maximum notch, 16 ga. cap.
No. 18 Di-Acro Turret Punch Press. Maximum 2" round 16 ga.
Punch Stand – 33" high storage shelf.
Standard arrangement of round punches and dies.
Micrometer back gauges. 72" x 36" machinery table.

—FOR MIDDLE SCHOOLS—

CENTER NO. 4 – $1857.00

No. 1 Di-Acro Bender – capacity 3/16" M.S. Bar, 3/8" 16 ga. steel tube.
No. 1 Bend-R-Pak.
No. 1 Di-Acro Roller – 6" width, 16 ga. capacity.
No. 1 Di-Acro Shear – 6" width, 16 ga. capacity.
No. 1 Di-Acro Box and Pan Brake – 6" width, 16 ga. cap.
No. 1 Notcher – 6" x 6" maximum notch, 16 ga. cap., 48" x 36" Machinery Table.

CENTER NO. 5 – $2882.00

No. 1A Di-Acro Bender – capacity 5/16" M.S. Bar, 1/2" 16 ga. steel tube.
No. 1A Bend-R-Pak.
No. 12 Di-Acro Shear – 12" width, 16 ga. cap., combination hold-down bar and safety guard.
No. 12 Di-Acro Box and Pan Brake – 12" width, 16 ga. cap.
No. 1 Di-Acro Notcher – 6" x 6" maximum notch, 16 ga. cap.
No. 1 Di-Acro Punch Press – 6" depth, 4 ton.
No. 2 Punch Pak.
72" x 36" Machinery Table.

—FOR VOCATIONAL SCHOOLS—

CENTER NO. 6 – $18,457.00

Di-Acro No. 14-48-1 117-ton Hydra-Mechanical Press Brake – ga. cap. 4-foot 50" long Die Pak.
No. 36P Di-Acro Power Shear – 16 ga. cap., 36" width.
No. 2P Di-Acro Power Tab Notcher – 6" x 6" maximum notch, 16 ga. capacity.
No. 18 Di-Acro Power Turret Punch Press – 2" round maximum diameter, 16 ga. capacity.
Standard Arrangement of Round Punches and Dies.

CENTER NO. 7 – $14,215.00

Di-Acro No. 18-48 12-ton Hydra-Mechanical Press Brake – 18 ga. cap., 4-foot 50" long Die Pak.
No. 36P Di-Acro Power Shear – 16 ga. cap., 36" width.
No. 1P Di-Acro Power Notcher – 6" x 6" maximum notch, 16 ga. capacity.
No. 18 Di-Acro Turret Punch Press – on stand.
Maximum 2" Round 16 ga.
Standard Arrangement of Round Punches and Dies.
Micrometer Back Gauges.

—FOR ELECTRICAL/ELECTRONICS CENTER—

CENTER NO. 8 – $13,845.00

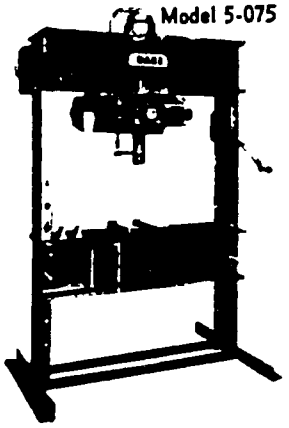
Di-Acro No. 16-36 12-ton Hydra-Mechanical Press Brake – 16 ga. cap., 36" width, 37" long Die Pak.
No. 1P Di-Acro Power Notcher – 6" x 6" maximum notch 16 ga. capacity.
No. 36P Di-Acro Power Shear – 16 ga. cap., 36" width.
No. 18 Di-Acro Turret Punch Press.
Maximum 2" Round 16 ga.
Punch Stand – 33" high storage shelf.
Standard Arrangement of Round Punches and Dies.
Micrometer Back Gauge.

CENTER NO. 9 – $5875.00

Di-Acro No. 16-24 Hand Press Brake – 16 ga. cap., 24" width, 8 ton, 25" long Die Pak.
Press Brake Stand – welded steel, 33" high, storage shelf.
No. 1 Di-Acro Notcher on table –6" x 6" maximum notch, 16 ga. capacity.
No. 36 Di-Acro Shear – 16 ga. cap., 36" width.
Shear Stand – welded steel, 33" high, storage shelf.
No. 12 Di-Acro Turret Punch Press.
Maximum 2" Round 16 ga.
Standard Arrangement of Round Punches and Dies.
Micrometer Back Gauge.
48" x 36" Machinery Table.

INDEX FOR SUBSTITUTIONS

DAKE ELEC-DRAULIC PRESSES



Model 5-075

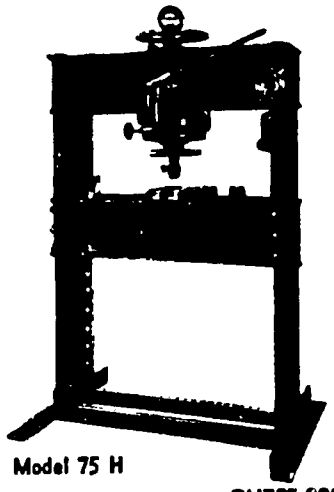
The ultimate in power presses —fast and easy to operate.

Rapid ram approach automatically changes to power speed when work is contacted. Ram speed variable from zero to maximum with fingertip control. Roller mounted workhead can be moved to any point along top channels for off-center work. Crank adjusts table height.

Equipment includes workhead; pressure gauge; 3 phase, 60 cycle 220/440 volt, 1800 rpm motor; safety valve; table lifting device, two table plates, two V-blocks; round and V-ram nose.

Model	5-050	5-075	5-150
Capacity, Tons	50	75	150
Height Overall, In.	86	90	102
Floor Space, In.	36 x 43½	36x55½	42 x 66
Table Travel, In.	35	32	20
Ram Travel, In.	10	10	16
Ram Speed, In./Min.			
Advance	40	28	16
Pressing	7	5	2¾
Max. work-width, In.	32¾	44	48
Max. work-height, In.	40	36	25
Max. work-arbor, In.	7¼	8¼	12¼
Shipping Weight, Lbs.	1320	1650	3000
Each	$3700.00	$3900.00	$5700.00

DAKE HAND-HYDRAULIC PRESSES



Model 75 H

Tremendous pressure with minimum physical effort — for bending, straightening, broaching, assembling.

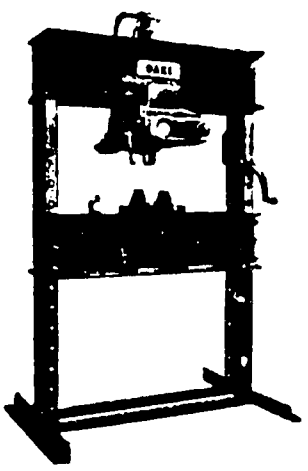
Screw-type ram quickly advanced to work; large pump speeds power travel. Self-contained workhead; table easily adjusted for height. 50-, 75-, and 125-ton models have roller - mounted workheads which can be centered over work, and locked in position with hand wheel. 25-ton press workhead is stationary.

Standard equipment includes workhead, pressure gauge, table hoist, table plates, V-blocks, round and V-ram noses.

Model	GH725-0007 25H	GH725-0008 50H	75H	125H
Capacity, Tons	25	50	75	125
Height Over-all in.	76	85	87	92
Floor Space, in.	30x42½	36x43½	36x55	42x66
Table Travel, in.	35	35	32	20
Screw Travel, in.	5	7	7	8
Max. Work — width	33½	32¾	44	48
Max. Work — height	39	40½	36½	25
Max. Work — arbor	5 3/16	7¼	8¼	12¼
Ram Travel, in.	5	4	4½	8
Screw Travel, in.	5	7	7	8
Shipping Wt., lbs.	450	775	1325	29[illegible]
Each	$995.00	$1400.00	$1800.00	$3950.00

See Page 686A and Page 686B for information and specifications on Dake Hydraulic Laboratory Presses.

DAKE AIR OPERATED HYDRAULIC PRESSES



Dake Air Operated Hydraulic Presses feature rapid ram approach and extra long stroke as standard features. Every plant with a compressed air supply will find this press ideal for bending, straightening and forcing work.

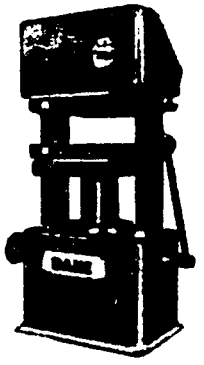
Models listed below operate from 90 pounds air pressure and are equipped with two pumps. These presses can also be furnished for operation from 145 pound pressure source and will give approximately double the ram speed indicated.

Standard equipment includes: self-contained hydraulic workhead; pressure gauge; safety valve; table hoist; table plates; V-blocks; V-ram nose; round nose and stroke indicator.

Model	6-425	6-450	6-475	6-850
Capacity, tons	25	50	75	150
Height, overall, in.	81	87	86	95
Floor Space, in.	30x42½	36x43½	36x55	42x66
Table travel, in.	35	35	32	20
Ram travel, in.	10	10	10	16
Max. work, width, in.	33½	32¾	44	48
Max. work, height, in.	36	40	36	30
Max. work, arbor, in.	5¾	7¼	8¼	12¼
Ram Speed, advance, IPM	100	55	40	22
Ram Speed, pressing, IPM	10	5	3½	2
Shipping weight, lbs.	1025	1150	1600	2900
Each	$2400.00	$2600.00	$2900.00	$4800.00

DAKE HYDRAULIC LABORATORY PRESSES

The 44 series is just right for rubber and plastic molding, testing, laminating and short run production. These presses are available in capacities 25 thru 75 tons with 2, 3 or 4 platen installations.



44 SERIES FEATURES: Self leveling precision ground electrically heated plug-in platens with water cooling. Precise temperature control from 100° thru 600° F.; a two speed hydraulic pump is used with unusual long pressure holding capacity; a two position ram affords two daylight dimensions; a conveniently located control panel houses all electricals, pilot lights and pressure gauge.

Model No.	44-225	44-226	44-250	44-251	44-275
Capacity Tons	25	25	50	50	75
Platens	8"x8"	9"x12"	12½"x12½"	12½"x18½"	19"x19"
Stroke In.	5"	5"	6"	6"	6"
Daylt. w Adaptor	5"	5"	6"	6"	6"
Daylt. w/o Adaptor	10"	10"	10"	10"	12"
Max. Temp. F.	600°	600°	600°	600°	600°
Watts per Platen	750	1500	2000	3000	4000
Voltage	115/1 ph.	115/1 ph.	230/1 ph.	230/1 ph.	230/3 ph.
Base Dim.	11" x 16"	11" x 16"	16" x 18"	16" x 18"	21" x 26"
Overall Ht.	36"	36"	40"	40"	50"
Approx. Wt.	400	430	800	900	1800
Each	$2100.00	$2250.00	$2700.00	$2800.00	$4300.00