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A
VOCATIONAL
TRAINING
BUILDING



PINE HILLS SCHOOL FOR BOYS

A VOCATIONAL TRAINING BUILDING FOR THE
PINE HILLS SCHOOL FOR BOYS

Part I

Undergraduate Thesis in Architectural Design

By

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Submitted to the School of Architecture as
partial fulfillment of the requirements
for the degree of Bachelor of Architecture

at

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"In the beginning, institutions for delinquents, whether they were for juveniles or for adults, were conceived to be places for the punishment of malefactors or for the safe-keeping of dangerous persons. Then the idea developed that removal from the evil influences of a bad environment would be helpful. In earlier days, when the word "treatment" was used, its meaning was limited. It signified kindly or cruel handling of children in custody. Today, among specialists, its significance is closely akin to the meaning of the word "treatment" in the field of therapeutics." (1)

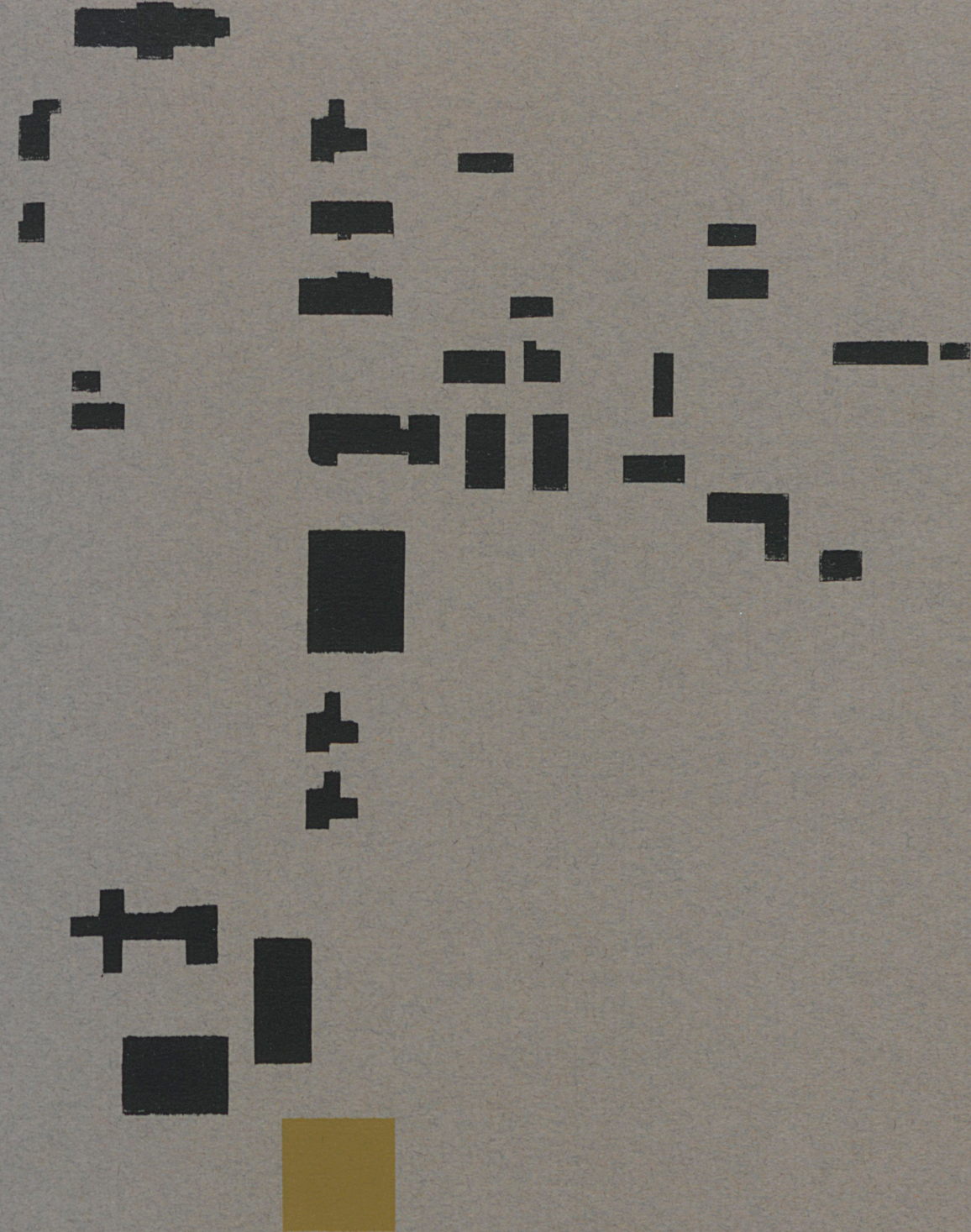
After it was found out that punishment did not do juvenile delinquents a great deal of good, reformation became the watchword of the committing courts and institutions. But it was easier to talk in general terms about reforming boys than it was to formulate an effective program that would accomplish that end. Therefore a period of experimentation followed.

There were several methods of treatment tried. Some believed that rigid discipline, preferably of a military character, would wipe out bad and inculcate good habits. Others were convinced that life in the country, close to nature, would somehow result in bringing about a spiritual reclamation. Others were certain a first-class academic education would

effectively reshape behavior patterns. Still others were sure that if the boys were given industrial training, taught trades, they would somehow be enable to stay within the bounds of accepted modes of behavior.

"Thus institutions that emphasized one or another or some combination of these types of training came into being. There were institutions where boys lived in small segregated groups in the country, engaged daily in agricultural pursuits, with some time given to academic study. There were still others where great emphasis was placed on industrial training. Unfortunately this type of institution frequently showed a tendency to specialize in teaching a boy how to do maintenance work for the institution, in the interest of economy, without sufficient consideration as to whether what he was learning would be of any use to him on his release."(1)

To imply that any of these programs would work for all boys would be to sidestep reality flagrantly. The institution's task is to discover each boy's assets and liabilities in relation to the social scheme, and then to go as far as possible in each case toward building up a personality capable of satisfactory self-direction.



CONDITIONS CREATING A NEED

The enrollment of the Pine Hills School in Miles City presently is 150 boys but as many as 191 have been enrolled at one time. Of this total, 69 boys or about half are participating in some kind of vocational training. Since the program is overcrowded in relation to the facilities and certified personnel, vocational training for each boys is optional. With a new vocational training building this program would be required for all boys.

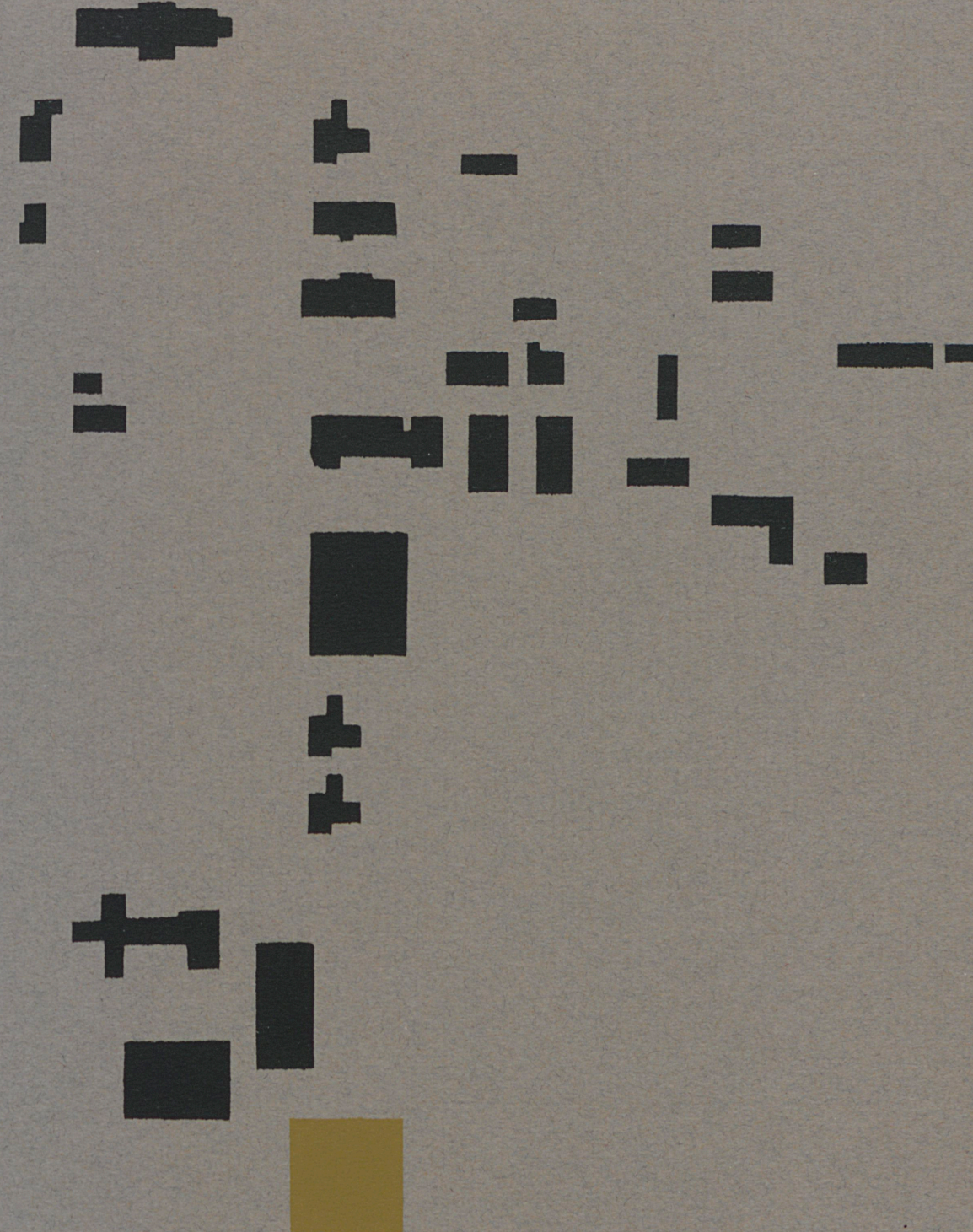
The present program for vocational training is taught by supervisors who are maintenance men, not certified instructors. There is no set program that the school follows because there is no certified personnel. These supervisors are responsible for 15 to 20 boys each when they should only be supervising 8 to 10 boys.

In order to have either an efficient vocational training program or maintenance department, the two must be separated. This facility would separate the two operations. This would make it possible for the vocational training programs to be developed on a par with the academic program. Likewise it would free the maintenance personnel from primary vocational training responsibilities.

This building would further enhance security by consolidating the vocational classes which are presently scattered throughout three buildings at the minimum. Vocational training facilities are currently located in old dilapidated buildings. Present facilities do not provide adequate protection for the health and safety of students and teachers. The State Fire Marshall's report of February 11, 1966 listed the present structures as being fire hazards. (7)

Everywhere there is evidence of need of additional space to carry on a proper vocational training program. After school hours a reporter observed 79 boys crowded into a carpenter shop which officials estimate could properly handle about 30. Also swarming with boys was the mechanic shop where the boys under the direction of an instructor keep the farm vehicles operating. (3)

This facility would contribute much to the total rehabilitation of the students. If the school is going to prepare boys to take their places in society they must train them in a vocation. The main purpose of this facility would be to prepare young men for a useful productive life when they leave the school.



LOCAL CONDITIONS

General

The Pine Hills School for Boys is on the outskirts of Miles City which is located 46° 40' north latitude, 105° 70' west longitude at an elevation of 2400'. Miles City is at the junction of the Tongue River with the Yellowstone River. The area around Miles City has low plateaus and undulating plains none of which are more than 300 feet higher than the city. The city of Miles City has a population of approximately 10,200.

History (5)

The Montana State Industrial School was established in March, 1893, with the signing of House Bill No. 184 by the Governor J. E. Richards. It was to be located two miles east of Miles City on the site of the old Women's Reformatory which had been erected during territorial days in 1884. The sum of \$65,000.00 was made available by the Legislature to start the building program. Forty acres of adjoining land were donated by citizens of Miles City and an additional forty acres were purchased in June, 1893.

Construction of the first new building, located where the present school building now stands, was commenced in June, 1893. This main building was to provide permanent quarters for the president and female

staff and inmates, and temporary quarters for male staff and inmates. The old Women's Reformatory, now the auto shop, was converted into a barn.

Mr. A. J. Hyltin was selected as the first president of the institution. By March 6 a teacher, a night watchman, a housekeeper, and a cook also had been employed. With the staff the school was officially opened March 15, 1894. Two weeks later the first admissions arrived, one boy and three girls from Lewistown.

The next three years brought much development. In July, 1895, two boys and a girl were paroled, the first to be released from the institution. The building to house male staff and inmates was erected in this year on the site of the present administration building. Livestock was purchased and additional land procured. A steam heating plant was built in 1896. It also housed a wash house and bath rooms, and had a work shop on the second floor. Presently this building, several times remodeled, is the clothing store and laundry.

In 1900, a record of population at that time reveals that there were 74 boys and 12 girls in the institution.

Mr. James B. Hawkins became president in January, 1903. He instituted manual training and physical training and had the first gymnasium, built of concrete blocks, constructed. The original girls' building burned on July 22, 1905, and what is now the school building was built on the same site that fall. An interesting record of that time reveals the boys and girls in the institution were receiving meat once a week. It was recorded that boys then were kept in gray uniforms for the purpose of uniformity and identification in the event of a "run".

Mr. H. W. George assumed the duties of president October 16, 1908, and served for over five years. Records show that he advocated good wholesome food, plenty of exercise, frequent bathing, lots of regular sleep, clean beds, and well ventilated dormitories. Meat was served once a day.

On June 5, 1914, Mr. A. C. Dorr succeeded Mr. George. He served as head of the institution for over 26 years and effected many improvements. In 1916 the dairy barn was built. A residence for the president and his family was moved onto the grounds in 1919. In 1922, the gymnasium was built, the old one being converted to use as a carpenter shop. In 1923, cottage "D"

was built and in 1925, the infirmary, the kitchen, and the industrial building were added. The latter housed a tailor shop, an auto shop, a print shop, and a shoe shop. In 1927, the present boilerhouse was built and the old boilerhouse was reduced to a one-story building, stuccoed, and remodeled to house the laundry and the cannery. In 1935, cottages "C" and "E" were constructed. During Mr. Dorr's administration the old title of Reform School was changed to Industrial School and a separate institution for girls, the Vocational School, was constructed at Helena. The site for this school was selected March 16, 1920, and by February 11, 1921, the last girl was transferred.

Mr. E. B. Winter of Miles City succeeded Mr. Dorr on December 9, 1940. A two-year high school course was added to the school program in 1941. Surveys were made of crop lands and the irrigation system. Mr. Samuel R. McCleery succeeded Mr. Winter on June 1, 1942. He initiated several changes in institutional operation prior to being succeeded by Mr. Carl Horn on July 15, 1943. In 1945 another notable advance was made when the high school course was expanded to provide four-year training and graduation. Music and dramatics were included and membership obtained in District 4 Class C athletic competition.

On November 5, 1951, the Board of Education placed Mr. Casper Wolhowe in charge as superintendent. Since that time the institution has undergone many changes. Some of the major improvements have been: establishment of the Dean's position, social services, and a Chaplaincy to give more attention to the human and spiritual needs of the boys; enlarging academic training, vocational training, and recreational activities; establishment of a central dining hall with good food service; sanitary milk and meat processing; sanitary water supply and standby connection to city water; centralization of stores; conversion from horse to machine farming; coral drainage; land leveling for better irrigation and increase crop production; landscaping of the grounds; and construction of a new administration building, a new store, three new cottages, a dean's residence, as well as remodeling and renovation of many existing structures. All of these improvements help the school in their every day training and preparation for community living.

Economics

Since the state of Montana has very little capital, budgets for state institutions have been kept small. The facilities at the school have come to a point where they can no longer be repaired, remodeled, or converted to other uses. There must be a very active building program in the future to counteract the higher costs of

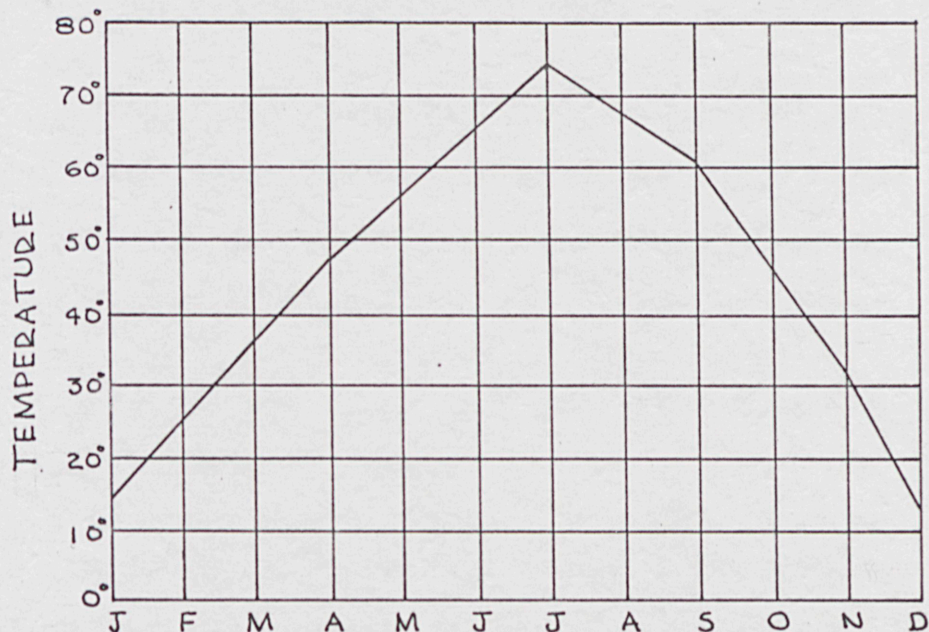
operation and maintenance of present facilities.

Even though the school provides 70% of its food through its gardens, livestock, and poultry, costs have increased. Since 1963 the cost per boy per day at the school has almost doubled. In June 1963 the cost was \$5.63, in December 1966 the cost was \$10.69. (4)

Climate (8)

Temperature

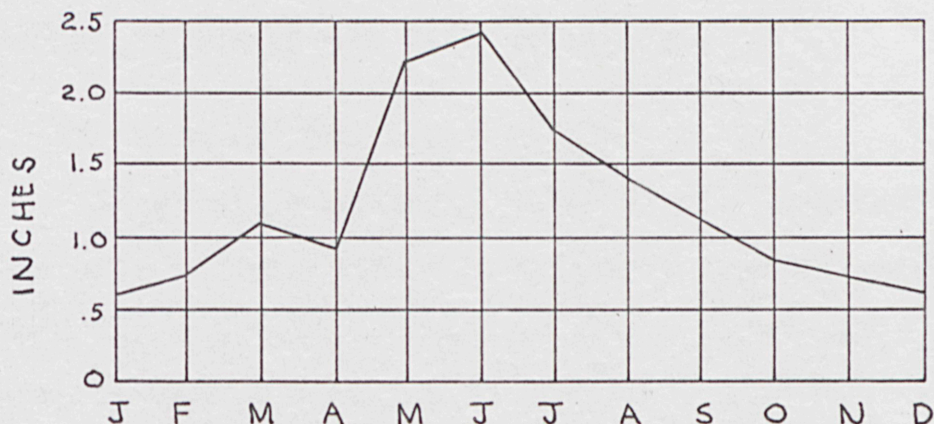
The maximum average temperature from April to September is 87° F, the minimum being 67° F. The maximum average temperature from September to April is 36° F, the minimum being 10° F. Extreme temperatures are not unusual, but they rarely last over a 10-day period.



MEAN TEMPERATURE FOR MILES CITY, MONTANA

Precipitation and Humidity

Miles City usually has very dry years, although recent years have shown an increase in moisture. Precipitation is usually about 14 inches annually, June being the month with the most moisture, December being the driest month.



MEAN PRECIPITATION FOR MILES CITY, MONTANA

Snowfall is quite light, the number of days with snow cover being limited to about 85 days. Most winters are comparatively snow free, the average amount of total snowfall being 10 to 15 inches.

Hail did not occur last year; nevertheless, hail damage is quite frequent.

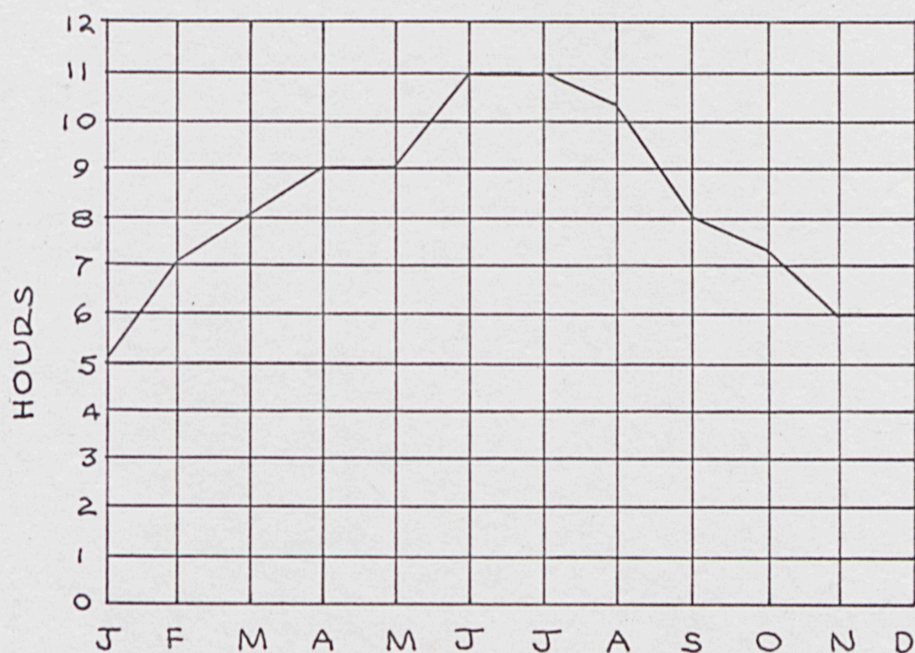
Humidity in Miles City is not a problem, averaging 29% during the summer. However, a rainfall of 5 to 6 inches in the spring causes humidity ranges from 75 to 85%.

Wind

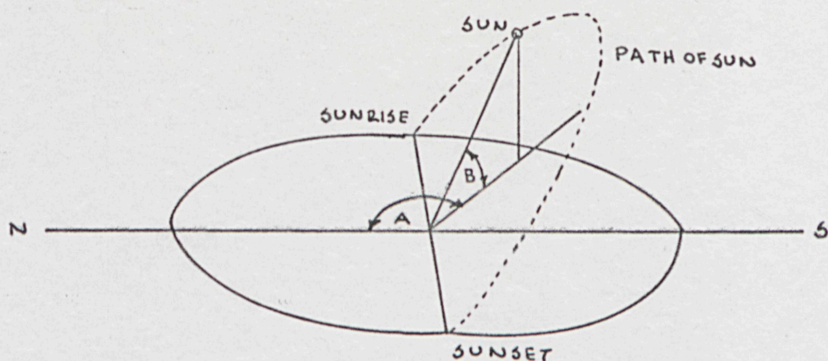
Miles City has few wind problems, although the wind has been known to reach 80 mph at least once a year. The average velocity of the wind is 6 to 8 mph. The direction of the prevailing wind is from the southeast during the spring and summer months, from the northeast during the fall and winter.

Sunshine and Sun Angles

Sunshine is probably Miles City's greatest asset, the city being cited as having more days of sunshine than any other Montana city. The average hours of sunshine and sun angles follow.

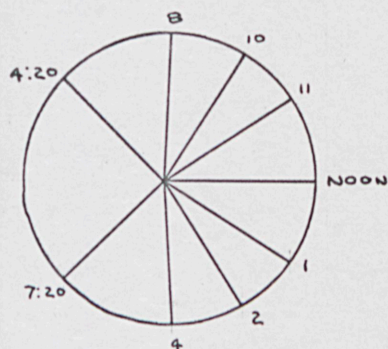


AVERAGE HOURS OF SUNSHINE
PER MONTH FOR MILES CITY, MONTANA

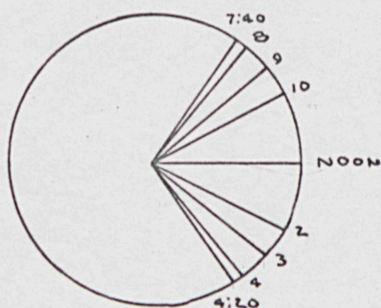


Angle A -- Azimuth
Angle B -- Altitude

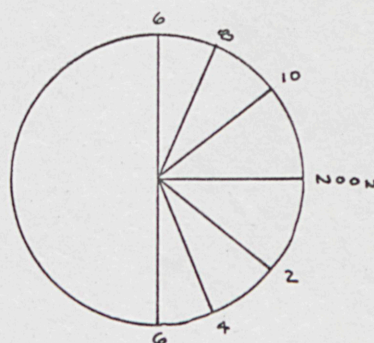
SOLAR ANGLES FOR MILES CITY, MONTANA



Summer
June 22



Winter
Dec. 22

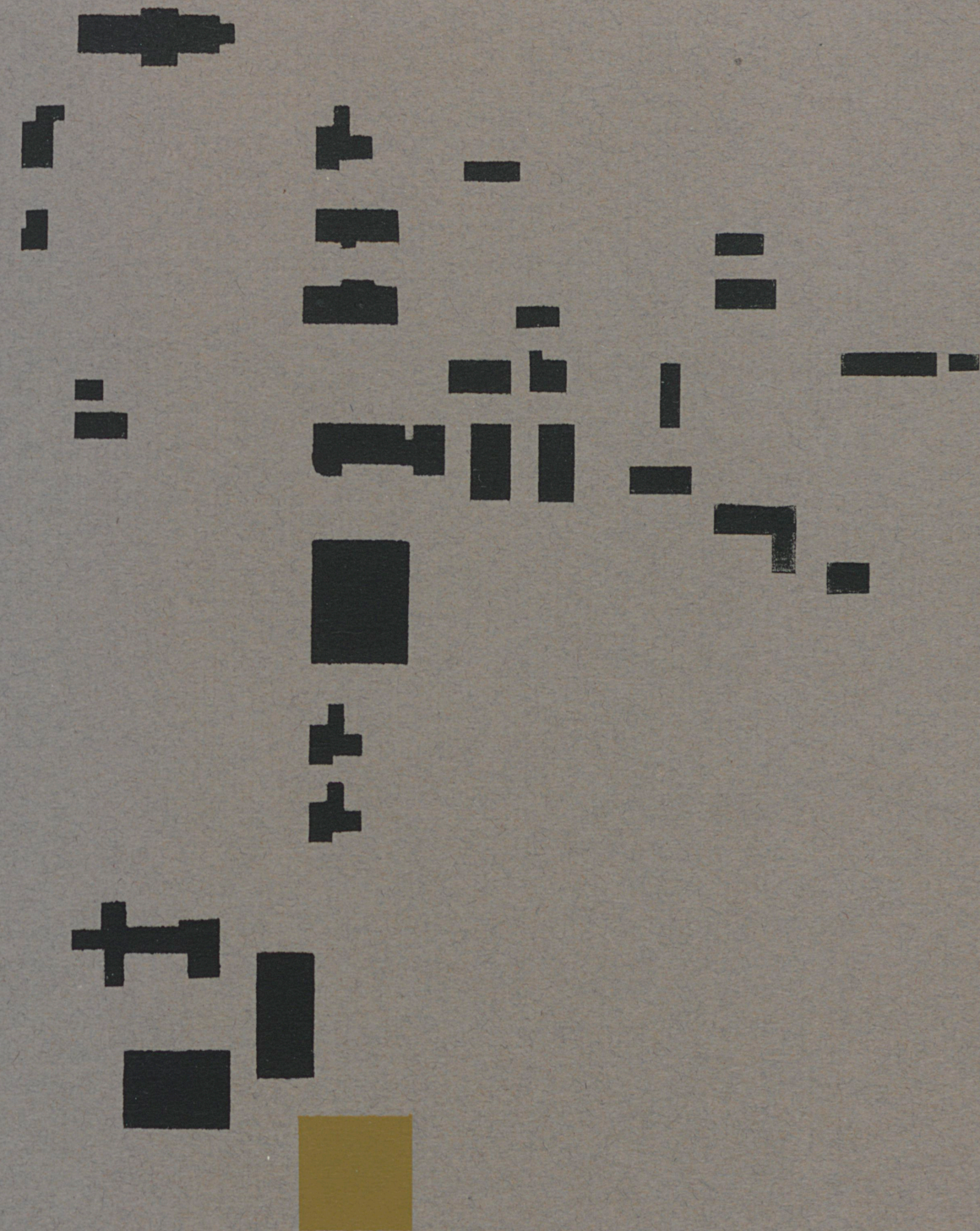


Spring - Mar. 21
Fall - Sept. 23

AM	AZIMUTH	ALTITUDE
4:20	55° 30'	0° 0'
8	93° 0'	37° 39'
10	121° 30'	57° 30'
11	145° 30'	65° 30'
N	180° 0'	68° 30'
PM		
1	145° 30'	65° 30'
2	121° 30'	57° 30'
4	93° 0'	37° 39'
7:40	55° 30'	0° 0'

AM	AZIMUTH	ALTITUDE
7:40	124° 30'	0° 0'
8	127° 30'	2° 30'
9	139° 0'	10° 0'
10	151° 30'	16° 0'
N	180° 0'	21° 30'
PM		
2	151° 30'	16° 0'
3	139° 0'	10° 0'
4	127° 30'	2° 30'
4:20	124° 30'	0° 0'

AM	AZIMUTH	ALTITUDE
6	90° 0'	0° 0'
8	112° 0'	20° 30'
10	141° 0'	38° 0'
N	180° 0'	45° 0'
PM		
2	141° 0'	38° 0'
4	121° 0'	20° 30'
6	90° 0'	0° 0'



SITE CONDITIONS

Orientation

Pine Hills School for Boys is located on the eastern outskirts of Miles City, (see map of Miles City, page 15). The site I have chosen for this building is located south of the new school now under construction and southeast of the new gymnasium, (see map of campus page 16). I chose this site because it is close to the other academic buildings, the new school and physical training building. There is also room for future expansion to the south and east, (see pictures of site, page 17).

Topography

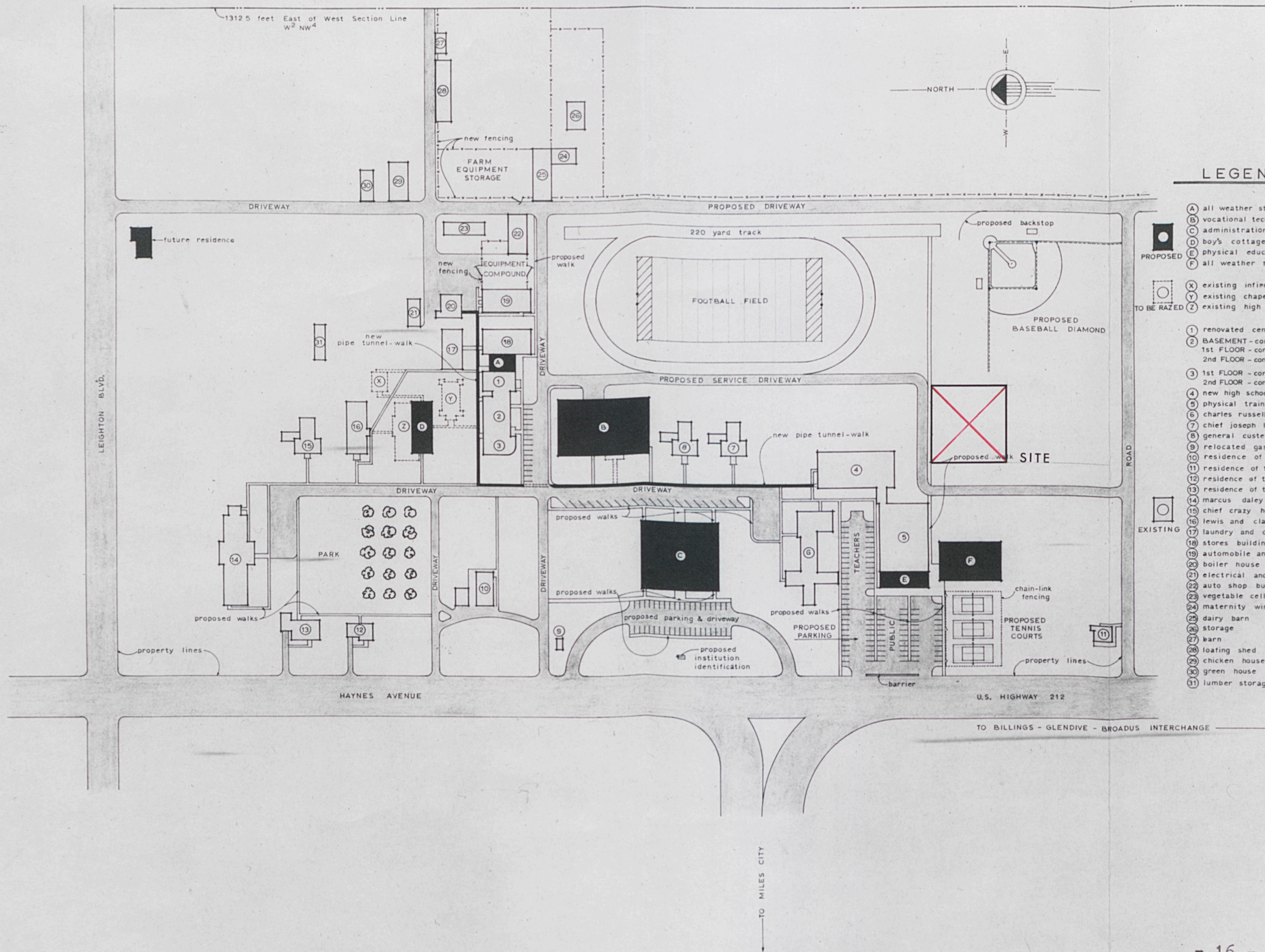
The site is flat. At present the site is used for growing alfalfa during the summer. This site will use only a small portion of this field.

Adjacent Environment

West of this building site there will be a all weather swimming pool which will be built next to the new gymnasium. To the east there is the school's crop land. To the South there is one open field and a neighboring farm. To the north is the new school, (see pictures, pages 18 and 19).

Vegetation

There are several large cottonwood trees adjacent to the site on the north. These trees will remain because it is very hard to grow trees in eastern Montana.



LEGEND

- (A) all weather staples storage.
- (B) vocational technical training center (approx. 20,000 sq.ft.)
- (C) administration, assembly & chapels (approx. 20,000 sq.ft.)
- (D) boy's cottage
- (E) physical education center entrance
- (F) all weather swimming pool (25 meter - enclosed)
- (X) existing infirmary
- (Y) existing chapel
- (Z) existing high school
- (1) renovated central kitchen
- (2) BASEMENT - convert to recreation hall
- (3) 1st FLOOR - convert to clinical dept., staff dining, visitation
- (4) 2nd FLOOR - convert to receiving dept. & infirmary
- (5) 1st FLOOR - convert to canteen
- (6) 2nd FLOOR - convert to receiving department
- (7) new high school, connected to physical training center
- (8) physical training center
- (9) charles russell lodge
- (10) chief joseph lodge
- (11) general custer lodge
- (12) relocated gas regulation house
- (13) residence of the superintendent
- (14) residence of the assistant superintendent
- (15) residence of the business administrator
- (16) residence of the director of education
- (17) marcus daley lodge
- (18) chief crazy horse lodge
- (19) lewis and clark lodge (discipline)
- (20) laundry and clothing storage
- (21) stores building
- (22) automobile and welding shops
- (23) boiler house
- (24) electrical and plumbing shop
- (25) auto shop building
- (26) vegetable cellar
- (27) maternity wing
- (28) dairy barn
- (29) storage
- (30) barn
- (31) loading shed
- (32) chicken house
- (33) green house
- (34) lumber storage

FUTURE CAMPUS PLAN

PINE HILLS SCHOOL for BOYS

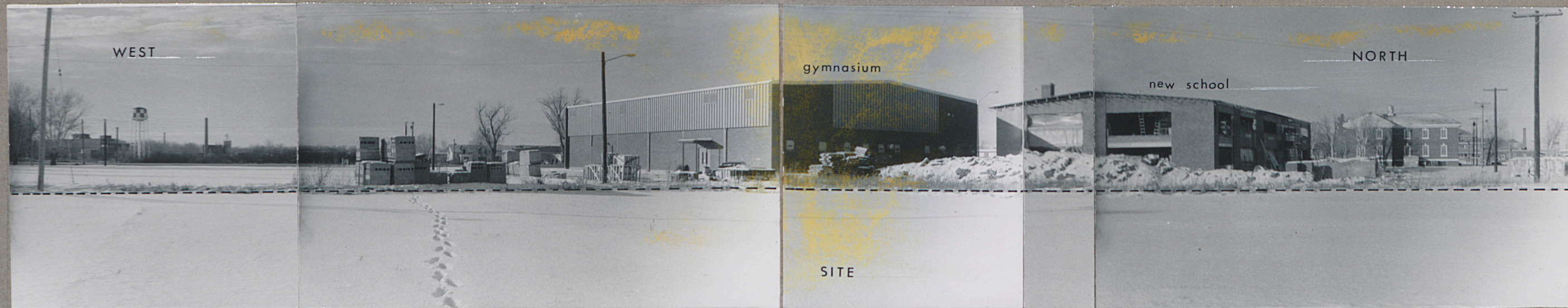
SCALE - 1" = 100'-0"

JAMES LAMONT

ARCHITECT

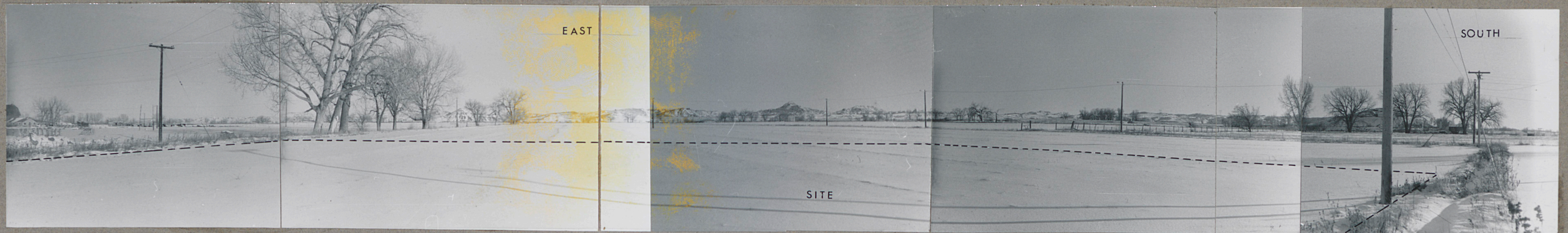
PROPOSED SITE PLAN	of	for
Desirable Interrelationships of Campus Facilities		
Future Development		
Pine Hills School for Boys, Miles City, Montana		
Mrs. Don Holladay, Superintendent		
drawn by: J.C.L.	date issued: May 22, 1967	checked by:
accepted by:	date accepted:	revised: June 1, 1967
consultant:		

SHEET NO.



The Site

The site is on the south side of the campus. The gymnasium and new school are to the northwest of the site, (top picture). The site uses only a portion of a field which is used for growing alfalfa in the summer, (bottom picture).





View towards the north



View towards the south

Zoning Regulations and Codes (10)

The building guide lines used by the State of Montana for this type of structure are the Uniform Building Code, National Electrical Code, National Plumbing Code, coupled with the State of Montana Revisions to the National Electrical and Plumbing Codes and code for Safety to Life, Pamphlet no. 101.

Soil Analysis (6)

The site is located in the broad Yellowstone River flood plain, just downstream from the junction of the Tongue and Yellowstone Rivers. The soil is alluvial deposits of the two streams, with some slope-wash from the valley slopes and small tributary streams.

The surface layer is a soft, wet silty clay to depths of from 14 to 17 feet. There are some discontinuous lenses and pockets of fine silty sand throughout this layer. Since the water table is at a depth of six to seven feet, and probably is higher at certain times of the year, this layer is very soft and unstable. It overlies a layer of poorly graded, fine, saturated sand which continues to a depth of 26 feet.

Below the sand strata is a 12 to 13 feet thick layer of sandy gravel, saturated, and medium loose to medium compact. The shale bedrock, which is at a depth of 39 feet is a claystone member of the Fort Union formation. It is a flat-bedded, dense, and a sound bearing stratum.

Prevailing Winds

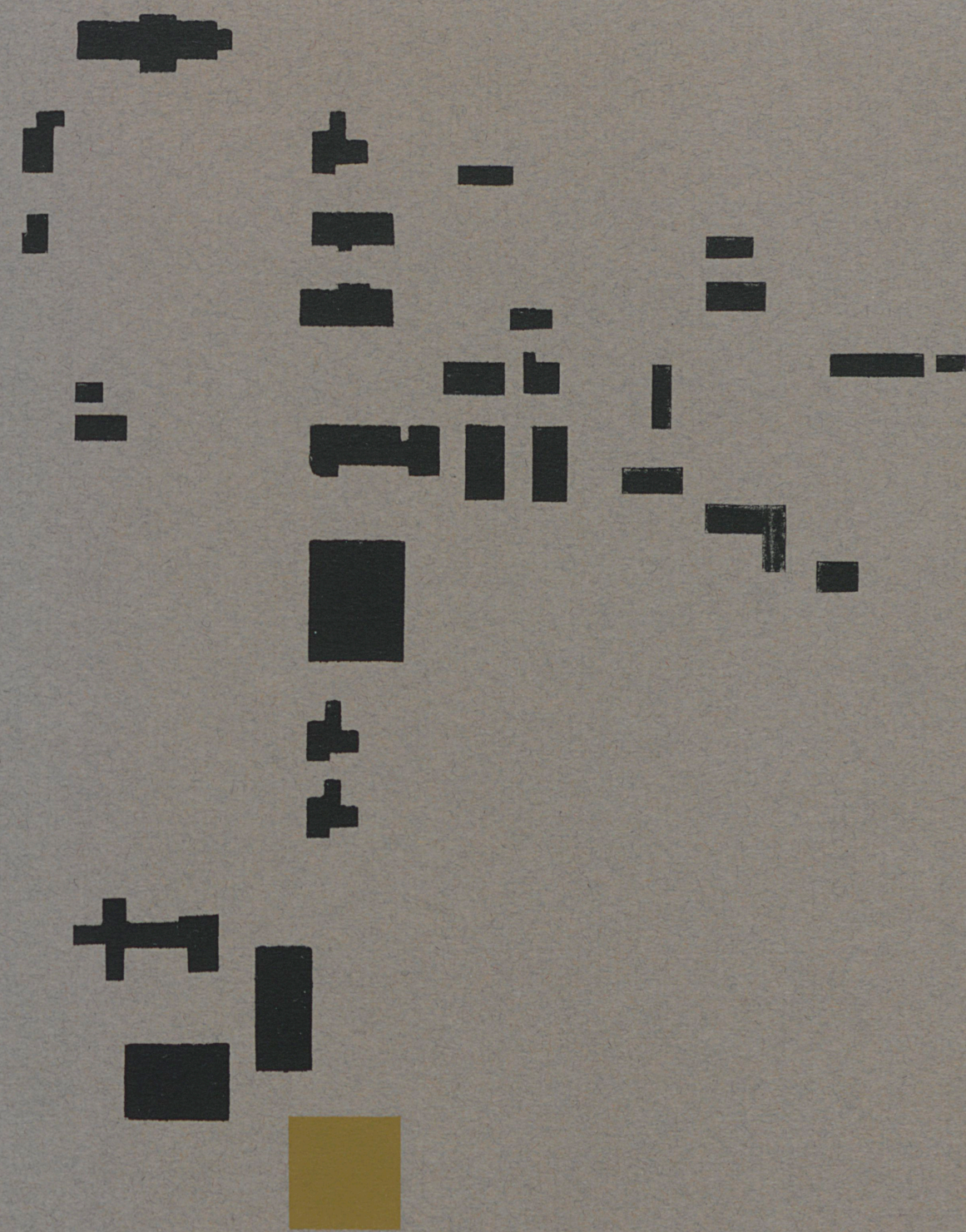
The average velocity of wind is six to eight mph. The direction of the prevailing wind is from the southeast during the spring and summer months, from the northeast during the fall and winter months.

Availability of Utilities

The school has its own hot water heating plant. There are connections with the city's electricity and water supply.

Traffic Patterns

There will be foot traffic between the academic buildings. There will also be foot traffic to and from the cottages. There will probably be vehicular traffic between the vocational training building and the service shops.



FUNCTION

The main function of this building is to house the Director of Vocational Education and the eight different vocations which will be taught.

The facility will serve an estimated 75-100 students and teachers at the recommended ratio according to the type of vocation being taught. In most areas there will be about 8 boys per class with 12 being the maximum. (9)

The eight different vocational areas that will be taught in this building are: automotive repair, drafting and related fields, graphic arts, industrial arts, welding, metalsmithing, electronics and electricity, and building construction. Related to these areas there will be sufficient storage for materials, tools, and projects and wash areas. For security purposes all storage areas must be locked.

There are many different activities, circulation patterns, and different space requirements for each piece of equipment in each shop area that it could not be covered adequately in this paper. This specific information will be referred to later when the actual designing takes place. For a comprehensive explanation of each item, see Modern School Shop Planning, by Lawrence Prakken.

The following is a breakdown of the eight different shop areas and its main functions.

Automotive Shop (2,80)

The main function of this area is the repair and maintenance of automobiles and the principles of construction and operation of gasoline motors.

Two problems are of particular importance in the automotive shop. One is the matter of exhaust fumes which must be taken care of through a venting system to the outside. The other is the matter of safety because of the moving of heavy objects such as engines and complete cars. Adequate space must be provided for the safe movement of these heavy items.

Care should be taken in laying out the shop so that overhead hoists will not be operating near work stations when occupied. Hydraulic hoists should be placed with plenty of clearance so their operation is not hazardous for other work stations.

For a list of equipment needed for the automotive shop see page 30.

Drafting (2,88)

Beginning mechanical and architectural drawing will be taught in this area.

Drafting-room planning should taken into special consideration the questions of lighting, storage, and the use of audio-visual aids.

For a list of equipment needed for the drafting area see page 30.

Graphic Arts (2,124)

Graphic Arts is a part of the important element in industrial society known as mass communications.

Graphic Arts consist of wood-cut, wood engraving, silk screen, photography, lithography, intaglio, and linotype. Since there are several different processes of printing there are many items which require storage. Each graphic-arts activity has its own storage problems which must be solved.

Aisles are very important in the graphic-arts shop as there is considerable movement of both materials and individuals. Paper stacks, printing forms, and finished printed pieces are constantly being moved about the shop. Good planning not only calls for plenty of space around machines and work stations but proper placement of them so that the most economical flow of materials will be made through the shop with the least interference with the work stations.

For a list of the equipment needed for the graphic-arts shop see pages 30 and 33.

Industrial Arts

Industrial arts consist of leather work, ceramics, woodcraft, plastics, art metal, and jewelry and lapidary.

Here again there are several different activities which require storage for the different types of equipment. For a list of equipment needed for this area see pages 29 and 31-36.

Failure to provide adequate project storage facilities for any shop is a major cause of confusion, inferior finished projects, and general discouragement. Therefore, storage for projects will also be required for this area.

Metalsmithing

The main function of this area is the layout and construction of sheet metal products.

Adequate working space is almost as much a vital item as the machines that are needed in a metalworking shop. Because projects in a metalworking shop are sometimes of large size or heavy, the shop should contain adequate space for them.

For a list of equipment needed for a metalworking shop see page 29.

Welding

In the welding area there are three types of welding which will be taught, arc welding, oxyacetylene welding, and a new method, tig welding, which is a combination of both gas and electricity.

One of the main considerations here is the protection from sparks, hot metals, and fumes. There should be an adequate venting system.

For a list of equipment needed for the welding shop see page 29.

Electricity and Electronics

The main function of this area is to teach the fundamentals of electrical theory, receiver construction, and operation, audio amplification, and receiver testing and repairing.

The most important consideration here is the accessibility and distribution of power.

For a list of equipment needed for the electronics shop see page 30.

Building Trades

In the building trades shop, rough and finish carpentry will be the main things taught but cabinet work, painting, and possibly masonry and plumbing will also be taught.

This area must be very versatile because of the different activities. In this shop the classes will build scaled-down models of houses, sometimes full scaled models of a certain area will be built.

For a list of equipment needed for this shop area see pages 28 and 29.

Equipping the General Shop

Lawrence Prakken, Modern School Shop Planning, 1961
pp. 59-67.

(High School)

THE following list of tools, machines, and equipment is from a handbook prepared by members of the Division of Vocational Education, of the Georgia State Department of Education.

The lists are not exhaustive but are presented as a guide for equipping a comprehensive general shop and the unit shops in the accompanying field.

WOODWORKING

Item	General Unit	Quantity
Lathe, wood, 14" swing	2	3
Router, electric, hand	1	1
Shaper, wood, spindle, floor model	1	1
Circular saw, 10", tilting arbor	1	1
Band saw, 14" to 28", floor model	1	1
Scroll or jig saw, 18" to 24"	1	1
Radial saw, 8"	1	1
Drill press, 1/2" chuck, floor model	1	1
Mortising machine, 1/4" to 3/4" cap	0	1
Jointer, 6" to 8", floor model	1	1
Planer, 12"-24", single head	1	1
Sanding machine, portable	1	1

Grinder, two-wheel, pedestal	1	1
Bench, woodworking, four-station	4	6
Saw, rip, 26", 5 or 6 point	2	2
Saw, cross cut, 26", 8 or 10 point	3	5
Saw, back, 12", 14 point	4	6
Saw, coping, 6 1/2"	6	6
Saw, turning, 14"	1	1
Saw, compass, 12"	1	1
Saw, dovetail, 8"	1	1
Saw, key hole, 10"	1	1
Miter box, steel, with saw	1	1
Saw set	1	1
Hammer, claw, curved, 20 oz.	1	1
Hammer, claw, curved, 16 oz.	2	4
Hammer, claw, 13 oz.	4	6
Hammer, soft face, regular, 8 oz.	0	1
Mallets, wood or rubber	4	6
File, cab., half-round, 2nd cut, 8"	4	8
File, cab., half-round, smooth cut, 8"	4	8
File, cab., half-round, 2nd cut, 12"	2	4
File, cab., half-round, smooth cut, 12"	2	4
Wood rasp, bastard cut, smooth cut, 8" ea.	6	10
Wood rasp, flat, bastard cut, 12"	4	6
Wood rasp, flat, smooth cut, 12"	6	8
File brush	4	6
Plane, block, 6" or 7"	2	2
Plane, smoothing, 9", 2" cutter	4	6
Plane, jack, junior, 11 1/2", 1 3/4" cutter	1	2
Plane, jack, 14", 2" cutter	4	6
Plane, jointer, 22", 2 3/8" cutter	1	1
Plane, rabbet, 8", 1 1/2" cutter	1	1
Plane, router, 1/4" to 1/2" cutters	1	1
Chisel, flat, 1/4" & 3/8", 1/2", ea.	2	2
Chisel, 3/4", 1" ea.	2	2
Gouge, inside, 3/8", 1/2", 3/4", 1" socket, ea.	1	1
Gouge, outside, 3/8", 1/2", 3/4", 1", ea.	1	1
Turning set, 8 chisels, 6"	2	3
Screwdriver, plastic handle, 4", 6" blade, ea.	2	2
Screwdriver, plastic handle, 8" blade	1	2
Screwdriver, plastic handle, 12" blade	1	1
Screwdriver, Phillips, No. 1-4	1	2
Screwdriver, Phillips, No. 5-9	1	2
Screwdriver, bit, brace, 3/16", 1/4", ea.	1	2
Screwdriver, bit, brace, 5/16"	1	2
Nail sets, 1/32", 2/32", 3/32", ea.	2	4
Try square, 10" blade	0	1
Try square, 6" blade	6	8
T bevel, 6", 8" blade, ea.	1	1
Square, standard, steel, 24" x 2"	2	3
Square, standard, steel, 16" x 1 1/2"	0	1
Square, combination, 12" blade	4	4
Scraper, cabinet	4	6
Scraper, swan neck	1	1
Scraper, blades, 3" x 4"	2	4

[illegible]

Bench, maple, 60" x 40" x 32"	1	2
DRAWING AND PLANNING		
Tables, drawing, adjustable, 42" x 30" with 6 lockers, vertical	10	20
Table, 36" x 60" (layout)	1	1
Stool, drawing, 34"	10	20
Boards, drawing, 21" x 26"	10	20
T-square, 24" (amber edge)	10	20
Triangles, 30° — 60°, 10"	10	20
Triangles, 45°, 6"	10	20
Instruments, set, 8 pc.	4	20
Letter guide	2	20
Scale, hardwood, 12"	10	20
Curve, French	2	10
Pens, speedball, set of 27 pts.	1	1
Protractor, 6", amber	1	4
Cabinet, supply storage	1	2
Cabinet, file, 11¾" x 9½", 4 dr.	1	1
Cutter, paper, card, 24"	1	1
Shears, trimming	1	1
Pointer, pencil, steel, magnetized	1	1
Blue-print machine	0	1

ELECTRICITY

Compasses, pocket or hand	2	4
Battery, wet cell, 6-v.	1	2
Battery, dry cell, No. 16	8	12
Irons, soldering, electric, 150-w.	2	4
Transformer, 115/10-v., 30—50-w.	2	4
Ammeter, dc, 10 scale	1	2
Ammeter, 0—30 scale	2	2
Voltmeter, dc, 1—10 scale	1	2
Voltmeter, ac, 0—150, 0—15 scale, ca.	1	2
Galvanometer, 50—0—50 scale	0	1
Rheostat, slide wire, 30-ohm, 4-amp.	1	2
Battery charger	1	1
Neon bulb, 2-w, split electrode	1	2
Watt-hour meter, 5 amp, 125-v., 60-c.	0	1
Circuit breaker, simple, 15-amp.	1	2
Screwdriver, plastic handle, 6" electricians	2	4
Screwdriver, plastic handle, 8"	2	4
Volt-Ohmmeter-Ammeter	1	1
Door bells	2	4
Door buzzers	2	4
Radio parts, crystals, tubes, headsets, etc.	As Needed	

PRINTING

Press, platen, 8" x 12"	0	1
Press, platen, 10" x 15"	1	1
Press, hand, pilot lever, 6" x 8"	1	1
Cabinet, type, double	2	6
Cabinet, type, sing., double compos.	6	10
Cabinet, press room	1	1
Cabinet, galley	1	2
Cabinet, stock	2	4
Composing sticks	10	20
Table, imposing	1	2
Stapler, heavy duty	1	1
Cutter, paper, lever	1	1
Table, bookbinding, 48" x 22"	1	1
Table, binding, 80" x 36"	1	1
Unit, silk screen:	1	1
Frame, 12" x 18"	1	1
Frame, 9" x 12"	1	1
Squeegee, 11"	1	1
Squeegee, 8"	1	1
Knife, putty	1	2
Knife, stencil	4	6

PHOTOGRAPHY

Darkroom, 6' x 8' or larger	1	1
Camera, box, plate	1	2
Camera, 35mm	1	1
Lamps, photofloods	3	6
Reflectors, photofloods	3	6
Tripod, camera	1	1
Light, developing safe	1	1
Printer	1	2

Trays, developing, 5" x 7"	3	6
Trays, developing, 10" x 14"	3	3
Tank, developing, plastic	2	3
Graduated glass, 16 oz.	1	2
Funnel, glass or plastic, 16 oz.	1	2
Thermometer, floating	1	2
Stirring rod	1	2
Tongs, print	3	4
Roller, print	2	3
Clips, film	4	6
Enlarger, with easel	1	1
Sink, with running water	1	1
Tank, washing	1	1
Cabinet, storage, light proof	1	1
Timer, interval	1	1
Dryer, print	1	1

THE following is a list of tools and equipment for a general shop offering instruction in auto mechanics. It has been compiled from a list prepared by the office of the Utah Superintendent of Public Instruction.

AUTO MECHANICS TOOLS AND EQUIPMENT

Caliper, 6", inside diameter	1	
Caliper, 6", outside diameter	1	
Carburetor tool kit	1	
Chisels, cape, ¼" and ⅜"	2	
Chisels, cold, ½" and ¾"	2	
Chisel, diamond point, ¼"	1	
Dies, taps and dies in sets NC and NF	2	
Divider, 6"	1	
Files, card	2	
Flaring tool, ⅜/16" to ⅝" O.D. tubing	1	
Gage, shoe and drum	1	
Gage, tire	1	
Gages, thickness	2	
Hammers, machinist, 12 oz.	3	
Hammers, machinist, 24 oz.	2	
Hammer, claw	1	
Hammer, sledge, 7 lb.	2	
Hammers, soft face	4	
Knife, putty	1	
Micrometer, inside diameter	1	
Micrometer, outside diameter	1	
Oilers	4	

Oil measures, 1 qt. and 2 qt.	2	
Piston ring inserter, set	1	
Pliers, flat nose	3	
Pliers, combination	4	
Pliers, diagonal cutters	3	
Punches, drive, no. of sets.	1	
Punch, center	1	
Rivet set	1	
Rules, steel, 12" x 1"	2	
Saws, hand, hack	2	
Screwdrivers, 3 each: 3", 6", and 9"	9	
Screwdrivers, offset, both ends	2	
Screwdrivers, Phillips, set of 4	2	
Screw extractor	1	
Scriber, ⅛" diameter	1	
Snips, tin, 2" straight	1	
Snips, curved, 3"	1	
Soldering irons, electric	2	
Square, combination	1	
Stamp, steel, ⅜/16", figures 1 to 0	1	
Stamp, steel, ⅜/16", letters A to Z	1	
Wrenches, adjustable	3	
Wrenches, monkey, 10" long	2	
Wrench, pipe, 10"	1	
Wrench, spanner, set of 3	1	
Wrenches, box, ¼" to 1", no. of sets	4	
Wrenches, socket, no. of sets	4	
Wrench handles	3	
Wrenches, extension drive	2	
Wrenches, ratchet	2	
Wrench, tappet adjusting	1	
Wrench, universal joint	1	
Air compressor and complete functional parts	1	
Aligning jigs, connecting rods, no. of sets	1	
Arbor press, 10 to 25 ton hydraulic	1	
Battery equipment, complete	1	
Bench, electrical test	1	
Brake equipment	1	
Chain hoist	1	
Cleaner, steam	1	
Cords, electric light	4	
Creepers	4	
Drill, electric, portable, ¼"	1	
Drill, electric, portable, ½"	1	
Drill press, 21"	1	
Dynamometers, 1 each: Chassis and Engine	2	
Furnace, gas, soldering	1	
Gage, cylinder	1	
Gage, compression meter	1	
Grinder, cylinder	1	
Grinder, electric bench	1	
Growler, 110-v, 60-c.	1	
Honing machine	1	
Jacks, floor roller, hydraulic	2	
Jacks, hand, stationary	2	
Lathe, metal, 9" swing	1	
Lift, automobile, twin post	1	
Radiator hydrometer	1	
Tester, coil, complete	1	
Tester, condenser	1	
Tester, distributor	1	
Tester, motor analyzer	1	
Tester, spark plug, cleaner	1	
Tire service, tube and tubeless equipment	1	
Valve reconditioning equipment	1	
Welding, portable, oxyacetylene	1	
Welding, arc	1	

INSTRUCTIONAL UNITS

Brake assembly, front and rear
 Carburetors
 Chassis, complete
 Differentials, complete
 Distributors
 Engines, cut away and operative, several
 Fuel pumps
 Generators
 Ignition coils and condensers
 Regulators
 Starting motors
 Steering gear assemblies
 Transmissions

Equipping the Shop

in the "Grades"

(K through 8)

THE following lists of tools and equipment for teaching industrial arts in grades K through six are from an elementary-grades, industrial-arts program guide prepared by Amos Coleman, Supervisor of Industrial Arts, Illinois Board of Vocational Education.

LOWER ELEMENTARY GRADES

Item	Quantity
Auger bits, 1/4", 3/8", 1/2", each	1
Bench, with two combination vises	1
Brace, 7"	1
Clamps, C, 4", 2", ea.	2
Drills, carbon, 1/16" to 1/4" by 16ths, set	1
Hand drill, 1/4" cap.	1
Duster, bench, for clean-up	2
File, 8", flat, wood	2
File, 8", smooth mill	1
Glass cutter	1
Hammer, claw, 10 oz.	2
Mallet, wood or rubber	1
Plane, block, 6" or 7", pressed steel bed	2
Pliers, combination 6"	1
Rulers, 12" wood, graduated by 16ths	4
Sandpaper, flint, fine, medium, coarse, quire, each	1
Saw, coping, 6", pin end	3
Saw, cross cut, 16", 11 point	1
Saw, hack, 10" frame	1
Scissors, 6" and 8", each	2
Screwdriver, 4", 3/16" tip	1
Screwdriver, 6", 1/4" tip	1
Square, try, 6" blade	1
Snips, tin, 8"	1
Steel wool, 2/0, lbs.	2

UPPER ELEMENTARY GRADES

EQUIPMENT lists for this level of instruction necessarily becomes more extensive and varied than in the less formal situations. The equipment would, of course, vary with the areas to be included in the program. The following lists are based on several typical areas of instruction in grades

4-6, and are representative of such lists for other areas. No effort is made to make the lists exhaustive for all possible areas of work. The list for modelbuilding and woodcraft follows:

Auger bits, 1/4" to 1" by 16ths, set	1
Benches, with vises, 4-student	3
Brace, ratchet, 8" swing	2
Can, safety, oil waste, 5 gallon	1
Chisel, socket, 1/4" to 2", set	1
Clamp, C, 4"	4
Clamp, C, 2"	6
Clamp, handscrew, 6"	6
Clamp, spring, 7"	6
Countersink, rose, brace, 3/4"	1
Drills, carbon, 1/16" to 1/2" by 16ths, set	1
Drill, hand, 1/4" capacity	3
Duster, bench	12
File, cabinet, 8", second cut, half round	2
File cleaner	3
File, flat, wood, 8"	2
File, mill, 8"	4
File, round, 8"	2
Grinder, 2 wheel, pedestal, 7"	1
Hammer, claw, 10 oz.	6
Hammer, soft face, 8 oz.	2
Knife, sloyd	6
Knife, putty	2
Mallets, wood or rubber	6
Oil can, 1/2 pt.	2
Plane, block, 6" or 7", pressed steel bed	4
Plane, smooth, 9" length, 1 3/4" cutter	1
Plane, irons, block	6
Pliers, combination, 8"	1
Pliers, needle nose, 6"	3
Rule, bench, 24" wood, brass tip	12
Sandpaper, flint, grits, 1, 1/2, 0, (quires, ea.)	3
Saw, back, 10", 14 point	4
Saw, compass, 12"	1
Saw, coping, 6 1/2", pin end	6
Saw, cross cut, 16" or 18", 10 point	1
Saw, jig, 18" to 24"	1
Scraper, hook	3
Screwdriver, plastic handle, 4", 3/16" tip	4
Screwdriver, Phillips, No. 1-4 and 5-9, ea.	1
Slip stone	2
Square, try, 6" blade	6

Square, combination, 12" blade	1
Steel wool, 2/0, lbs.	4
Stones, sharpening, carborundum	2
Wrench, engineers, 1/4" to 1", set of 6	1

The list for plastics follows:

Back saw, 10", 14 point	1
Buffing wheels, 30 ply, cotton flannel	8
Chisel, firmer, 1/8"	1
Chisel, firmer, 1"	2
Clamps, C, 2"	6
Drill, hand, 1/4" capacity	1
Drills, carbon, 1/16" to 1/2", set	1
Files, 8" smooth, mill	6
Files, 8" smooth, round	2
Files, 6" triangular	2
Files, 4" needle, set of 12	2
Hacksaw frame, 10"	2
Hand screw clamps, 2-0	4
Hammer, ball peen, 4 oz.	2
Oven for heating plastics	1
Polishing head, 8" buffs, 1/3-hp motor, V-belt, and pulley	2
Sandpaper, flint, 1, 1/2, 2/0 (quires each)	3
Screwdriver, small, 2" 1/8" tip	1
Saw, jeweler's adjustable, 5"	4
Square, steel, 7 x 12 x 1	6
Square, try, 6" blade	6
Scratch awl, 6"	6
Vise, metal workers, 3" jaw	2

The list for graphic arts (linoleum block) follows:

Linoleum block tools, set	2
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The list for ceramics follows:

Silk sponge, elephant ear, small	2
Rectangular sponge, 2" x 4" x 6"	2
Plastic sheet, 1 sq. yard	1
Ceramic pencil	1
Palette knife, 5"	1
Flexible steel scrapers	4
Wood modeling tools, 6"-8" long	6
Wire modeling tools	6
Knife	1
Kidney rubber	1
Square yard cloth (muslin)	2
Rubber syringe	1

Brushes:	
Pointed $\frac{3}{8}$ " red sable	2
Pointed $\frac{1}{4}$ " red sable	2
Chisel $\frac{3}{4}$ " red sable	1
Chisel $\frac{1}{4}$ " red sable	1
Pan, 2-4 qt. size	2
Kiln, electric	1
Turning tools	4
Molds	as needed
Scales	1
Mortars	3
Pestles	3
Sieve	1

The list for teaching art metal follows:

Awls, scratch	6
Chisels, chasing	as needed
Drill, hand, $\frac{1}{4}$ " capacity	3
Drills, twist, straight shank, set, 1/16" to $\frac{1}{2}$ "	1
File, flat, 8" bastard and smooth cut, each	2
File, flat, 8", 2nd cut	2
File, mill, 8", 2nd and smooth cut, each	2
File, needle, 4", set of 12	4
Grinder, 6", 2 wheel for buffing	1
Grinder, 7", 2 wheel stone	1
Hammer, ball-peen, 4, 6, 8 oz., each	2
Mallet, fiber	2
Mallet, rawhide	2
Mallet, wood, round	2
Saw, jeweler's, 5" deep	6
Saw, hack, 10" frame	2
Snips, tinner's curved, 6"	2
Snips, tinner's straight, 2"	1
Square, try, 6"	3
T stakes, patterns as desired	
Anvils, as desired	
Vise, small	2
Emery cloth, 1/0, 4/0 (quires each)	1
Steel wool, 2/0, lbs.	3

The list for teaching leather work follows:

Skiving knife	6
Tracers	4
Modelers	4
Deerfoot	4
Ball tool	4
Snap attaching set	1
Eyelet setting punch	1
Edge creaser	2
Mallet	8
Steel square	2
Steel saddle stamps, as desired, (basic)	
Nos. 723, 101, 103, 201, 213, 708, 431	—
Revolving punch, six tube	1
Thonging chisel, 4 prong, 3/32"	2
Thonging chisel, 4 prong, $\frac{1}{8}$ "	2
Thonging chisel, single, 3/32"	1
Thonging chisel, single, $\frac{1}{8}$ "	1

The list for teaching jewelry and lapidary follows:

Anvil, steel block	2
Asbestos block, 4" x 5"	2
Bench vise, 3" jaw	3
Benzine, qts.	2
Binding wire, iron, 1 lb. each, 14, 16, 18, and 22 gage	—
Brushes, camel hair, No. 2 and No. 5, each	3
Brushes, flux	3
Center punch	3
Charcoal blocks	4
Clamps, C, 4"	4
Dividers, 5"	1
Drill, hand, $\frac{1}{4}$ " capacity	3
Engraving tools, set	1
Files, needle, set	2
Files, half round, 8"	6
Files, flat, coarse, 8"	6

Files, flat, fine, 8"	6
Gravers, square end	3
Gravers, half-round end	3
Hammers, chasing	3
Hammers, planishing	3
Hammers, ball peen, 4, 6, 8 oz., each	2
Hammers, riveting	3
Lead block, 4" x 4" x 1"	1
Mallet, rawhide, medium	2
Mandrel, bracelet	1
Mandrel, ring	1
Metal snips	4
Nail set, 2/32	3
Pickle pan, copper	1
Plaster of Paris, lbs.	2
Pliers, flat nose, 6"	2
Pliers, round nose, 6"	2
Pyrex dish, small	2
Repousse tools, set	1
Saw blades, No. 2/0 and 1/0, doz.	3
Saw frame	6
Scraper, hollow triangular, 2"	3
Stamping tools, set	1
Tongs, 20" long	2
Trays, developing, hard rubber, 8" x 10"	2
Twist drills, No. 50	4
Chamois skin, 8" x 8"	2
Emery cloth, 1/0, sheets	9
Emery paper, 3/0, sheets	6
Hand buffs, felt	1
Hand buffs, chamois	1
Steel wool, 2/0, lbs.	3

THE following is a suggested list of tools and equipment for an industrial-arts program in the seventh and eighth grades. This list is from a program guide prepared by members of the State of Ohio Department of Education. The suggested list is estimated to provide for a class of 20.

GENERAL WOODWORKING

Bench, woodworking (54 x 64", locker type, 4-station, w/vises) depends on size of class	4-6
Power Tools:	
Lathe, wood (variable speed, thrust bearing, 12" swing, 38" between center, floor model). (Optional)	1
*Circular saw (10", tilting arbor, floor model)	1
Scroll saw or jig saw (18" to 24" throat, floor model)	2
Drill press ($\frac{1}{2}$ " capacity chuck, floor model)	1
*Jointer (6", floor model)	1
Grinder (up to 7", 2-wheel, pedestal mount or bench)	1
*For use of instructor only.	
Saws:	
Rip (26", 5 or 6 point)	3
Cross cut (26", 8 or 10 point)	4
Back (12", 14 point)	10
Coping (6 $\frac{1}{2}$ ")	12
Key hole (10")	1
Miter box; steel (w/miter saw, 28" x 5")	1
Saw Set	1
Hammers:	
Claw, curved, nail, 12 oz.	3
Claw, curved, nail, 16 oz.	12
Soft face, regular, 8 oz.	2
Mallets, wood or rubber	8
Files:	
Cabinet, half round, 2nd cut, 8"	8
Cabinet, half round, smooth cut, 8"	8
Cabinet, half round, 2nd cut, 12"	4
Cabinet, half round, smooth cut, 12"	4
Wood rasp, bastard cut, 8"	10
Wood rasp, smooth cut, 8"	10
Wood rasp, flat, bastard cut, 8"	6

Wood rasp, smooth cut, 8"	8
Auger bit	4
File brush cleaner	6
Planes:	
Block, 6" or 7"	6
Jack, 14", cutter 2"	10
Chisels:	
Flat, $\frac{1}{4}$ " (socket)	12
Flat, $\frac{3}{8}$ "	6
Flat, $\frac{1}{2}$ "	6
Flat, $\frac{3}{4}$ "	12
Flat, 1"	4
Screwdrivers:	
Handle, plastic, 4" blade	6
Handle, plastic, 6" blade	8
Handle, plastic, 8" blade	2
Nail Sets:	
Point, 1/32"	8
Point, 2/32"	8
Point, 3/32"	8
Squares:	
Try square, 6" blade	12
Try square, 10" blade	4
T bevel, 6" blade	2
Standard steel, 24" x 2"	4
Combination, 12" blade, steel	1
Scrapers:	
Cabinet	4
Blades, 2 $\frac{1}{2}$ " x 4"	6
Spoke shave, 10", 2 $\frac{1}{2}$ " cutter	6
Rules:	
Bench, steel, 12" x $\frac{3}{4}$ "	20
Bench, steel, 24" x 1 $\frac{1}{4}$ "	2
Bench, steel, 36" x 1 $\frac{1}{4}$ "	1
Gages:	
Marking, 6"	12
Jig, doweling, with guides, $\frac{1}{4}$ " to $\frac{1}{2}$ " by 16ths	2
Drills, hand and brace:	
Brace, ratchet, 10"	6
Drill, hand, $\frac{3}{8}$ " capacity	4
Expansion, cutter, $\frac{5}{8}$ " to 1 $\frac{1}{2}$ "	1
Countersink, rose, brace, $\frac{1}{2}$ "	4
Knives:	
Drawing, 8"	2
Sloyd, 2- $\frac{5}{8}$ " blade (No. 11)	8
Calipers and Dividers:	
Calipers, outside, 6" (Yankee)	2
Dividers, wing, 8"	6
Clamps:	
Bar, 4 ft.	12
C (Carriage), 3"	6
C (Carriage), 6"	10
C (Carriage), 10"	4
Hand Screw, No. 0	8
Hand Screw, No. 1	10
Hand Screw, No. 2	12
Pliers:	
Combination, 6"	2
Side cutting, 7"	2
Stones:	
Sharpening, carborundum, 2 face grit	2
Slip, medium grit	2
Slip, fine grit	2
Grinding-wheel tool dresser	1
Bench, glue, 60" x 24" x 32"	1

FOUNDRY

Melting furnace — #10 crucible capacity	1
Molding bench	1
Flasks, complete	4
Bench rammer	2
Trowel, finishing, 6"	2
Spoon and gate cutter	2
Slick and oval	2
Taper and leaf slick	2
Bulb sponge	1
Riddles, foundry	1
Bellows, molders	1
Crucibles	1

SHEETMETAL

Slip roll, former, 24"	1
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Bar folder, 24"	1
Tin snips:	
Straight lip, 3"	8
Curved lip	2
Hawk bill	1
Compound lever, 8"	1
Rivet sets:	
No. 3	2
No. 4	2
Dividers, wing, 10"	6
Hand groovers:	
No. 2	2
No. 3	2
Hand seamer	2
Straight shank drills, 1/16" to 1/2" by	
64ths, high speed, set	1
Soldering irons:	
Electric, 1/2" tip	3
Coppers, 1/2 lb.	2
Coppers, 1 lb.	2
Furnace, bench, gas (soldering coppers) ..	1
Bench, sheetmetal, with stake plate, 3	
shelf, 60" x 40" x 32"	1
Stakes, bench:	
Hollow mandrel	1
Double seaming	1
Blowhorn	1
Conductor	1
Needle case	1
Creasing	1
Candle mold	1
Square	1
Rules:	
Steel, flexible, 12"	12
Circumference, 3'	1
Vise, bench, swivel base	6
Awls, scratch, ring, tinnners	12
Punches:	
Prick, 3/8" stock	6
Hammers:	
Riveting, tinnners (cross peen), 12 oz.	4
Setting, tinnners, 12 oz.	4
Ball peen, 8 oz.	4
Ball peen, 12 oz.	12

ART METAL

Drill press, 1/2" chuck	1
Saws:	
Jewelers, 5" deep	6
Files:	
Flat, 8", bastard cut	6
Flat, 8", 2nd cut	10
Flat, 8", smooth cut	6
Mill, 8", 2nd cut	8
Mill, 8", smooth cut	8
Needle, 4", set of 12	8
Hammers:	
Ball peen, 8 oz.	6
Ball peen, 12 oz.	6
Ball peen, 16 oz.	6
Chasing, 1" face	4
Art peening, 4-3/8", 5 oz.	3
Planishing, 3-3/4", 10 oz.	3
Embossing, 6 oz.	3

Chisels:	
Chasing, smooth, high polished surfaces	
..... as needed	
Matting, various shapes and patterns	
..... as needed	
Engraving (tools), plat, round pt., diamond	
..... as needed	
Stakes (art metal):	
T stakes of desired patterns	4
Anvils:	
Anvil base, 4" high, 5" wide	2
Grinder, 6", 2 wheel, buffing	1

BENCH METAL OR COLD IRON WORK

Vises:	
Bench, swivel base	4
Jig, bending, peg	2
Hammers:	
Ball peen, 16 oz.	2
Cross peen, 16 oz.	2
Drills, twist, straight shank, high speed,	
1/16" to 1/2" by 64ths, set	1
Tap and round dies, national coarse, set ..	1
Tap and round dies, national fine, set	1
Chisels:	
Cold, 3/8"	4
Cold, 1/2"	3
Punch:	
Prick, 3/8" stock	3
Wrenches:	
Crescent, 6"	2
Crescent, 8"	2
Crescent, 10"	2
Monkey, 12"	1
Drills, hand	2
Scriber	6
Calipers:	
Dividers, wing, 12"	4
Dividers, 6", Yankee	4
Clamps toolmakers, 2"	4
Saws, hack, frame, 12"	2
Shears, bolt, cutters, No. 0, 18"	1

DRAWING AND PLANNING

Tables — determined by class size	15
Boards, drawing, basswood, 21" x 26"	30
T-square, 24" (amber edge)	15
Triangles:	
30°-60°, 8"	15
45°-45°, 6"	15
Instruments, set, complete	2
Instruments, supplementary, dividers,	
compasses, each	15
Scale, hardwood (preferably ivory edge),	
12"	10
Curve, French (assorted shapes)	6

ELECTRICITY

The materials and equipment for this	
area will vary with the program planned.	
Magnets, permanent, bar	10
Magnets, permanent, "U"	10
Magnets, electro	6
Coil, magnetizing-demagnetizing	2

Compasses, packet or hand	2
Battery, wet cell, 6v	2
Battery, dry cell, No. 16	12
Wire, No. 22, copper, enamel coated, lb.	20
Wire, No. 18, magnetic, enamel coated	
cotton, lb.	20
Door bell or buzzer	20
Push button	20
Staples, insulated, lb.	6
Pliers:	
Side cutting, 7"	8
Needle nose, 6"	8
Round nose, 6"	6
Irons, soldering, electric	6
Transformer, 115/10 v, 30 to 50 w.	4
Ammeter, dc, 0-10 scale	1
Ammeter, ac, 0-5 scale	1
Ammeter, ac, 0-30 scale	1
Voltmeter, dc, 1-10 scale	1
Voltmeter, ac, 0-150 scale	1
Voltmeter, ac, 0-15 scale	1
Battery charger	1
Receptacle, single	8
Receptacle, duplex	6
Switch, single pole, toggle, flush type	6
Switch plates, for toggle switches	8
Switch, three way, toggle	8
Screwdrivers:	
Plastic handle, 6"	8
Plastic handle, 8"	4

GRAPHIC ARTS

Press, hand, pilot lever, 8 x 10	1
Cabinet, type, single, double composing	1
Cabinet, stock	1
Composing stone	1
Proof press	1
Paper shears	1

CERAMICS

Kiln, electric	1
Sink, large, with basin trap	1
Metal-lined clay bins, ceramic jars, or gal-	
vanized cans	2
Metal-lined damp cabinet	1
Bench, wedging	1
Drying cabinet	1
Bench or table, working	1
Whirler, bench	2
Assorted tools, set	1

LEATHER WORK

Quantity will depend on extent of the	
program.	
Embossing tools	
Skiving knives	
Snap fastener set	
Modeling tools	
Thong chisels	
Revolving head punch	
Leather-carving stamps	
Lacing pliers	
Lacing needles	
Wood mallets	

THE following list of tools for a leathercraft instructional program is adapted from a list prepared by the Virginia State Board of Education.

LEATHER CRAFT

Item	Quantity
Bevel-point knife	6
Cobbler's hammer	3
Combination punch	3
Dividers, 6"	1
Draw gage	1
Edge creaser	1
Creasers, metal	2
Creasers, wood	2
Edge beveler	1
Embossing wheels, set	1
Eyelet setter	2
Head knife	1
Mallet, rawhide	3
Modeler tools, sets	2
Needles, glover's and harness, assortment	
Needle, lacing	12
Oblong punch	1
Pliers, long-nose (or lacing)	6
Revolving punch, 6 tube	2
Round drive punch	2
Rules, 12", steel	6
Saddle stamps, assorted (kitform), sets	2
Scratch awl	2
Automatic awl	1
Shears	3
Skiving knives, assorted sq. and bevel point	14
Square, 12", steel	2
Space marker, 5 stitches per inch	1
Snap-button fastener	1
Stippler	1
Swivel knife, with pro-gage attachment	1
Thonging chisel, 4-, 3-, 2-, 1-prong, of each	2
Tool cabinet, portable, 2 doors w/lock	1

THE following list of tools and equipment for a ceramic center in a comprehensive general shop is

Equipping to Teach the Crafts

from a list prepared by the New York State Education Department.

CERAMIC CENTER

Board, wedging	1
Booth, spray	1
Bags, plastic storage	24
Ball mill	1
Cabinet, damp (discarded refrigerator)	1
Cabinet, display	1
Cabinet, drying, with shelves	1
Cabinet, steel	1
Crocks, 10 gal. with lids	2
Crocks, 1 gal. with lids	2
Dishpans (small)	2
Gun, spray (glaze applying)	1
Jars, sprayer and storage	12
Kiln, with minimum firing chamber of 11" x 11" x 11", and appropriate kiln furniture	1
Pyrometer, kiln	1
Cut-off, automatic cone type (for kiln)	1
Knives, fettling, sets	1
Pitchers, aluminum or galvanized, large	2
Pins, rolling	2
Potter's wheel	1
Rubber, finishing	1

Scales, kitchen	1
Scraper, finishing, flexible	2
Sieve, kitchen, 2"	1
Sieve, kitchen, 5"	1
Tools, boxwood modeling	12
Tools, finishing and turning, sets	1
Tools, sgraffito, sets	1
Whirlers, bench (decorating wheels)	3

SUPPLIES FOR CERAMIC CENTER

Brushes, sable -decorating, No. 0, No. 2, No. 3, each	2
Brushes, flat glaze	2
Brushes, small, squirrel hair	6
Clay, plastic modeling, no. of lbs.	200
Clay, dry casting, no. of lbs.	200
or	
Casting slip, prepared, no. of gals.	20
Colors, underglaze decorating, sets	2
Cones, junior-size, No. 07, 06, 05, 04, 03, boxes of each	1
Glaze, assorted colored, no. of lbs.	20
Glaze, transparent, no. of lbs.	5
Plaster, No. 1 pottery, no. of lbs.	100
Soap, liquid, mild, no. of qts.	1
Sponges, elephant-ear	6
Stilts, assorted, no. of dozens	6
Wash, kiln, no. of lbs.	5

THE following list of tools and equipment is from a suggested list prepared by the New York State Education Department. It is designed for a more extensive ceramics program than the preceding minimum lists.

GENERAL CERAMIC SHOP

Bench, demonstration, w/water-resistant top 21½" x 24" x 60", work surface 32" high, equipped with a woodworker's vise and a machinist's vise	1
Bench, mold making, with a water-resistant top, 30" x 48"	1
Bench, mold making, with a water-resistant top, 30" x 96"	1
Bench, slip casting, with a water-resistant top, 30" x 96"	1
Balance, triple beam, 1 decigram to 2610 gram cap.	1
Ball mill, with a ¼-hp motor, 2 1-qt. porcelain jars	1
Borundum grinding medium (for above mill), no. of lbs.	5
Grinder, 7", pedestal base	1
Grinding wheels, carborundum (fine), aluminum oxide	2
Kiln, test, electric (2300°F), top loading ..	1
Kiln, ceramic, electric, 1 cu. ft. firing chamber with furniture, pyrometer, automatic cutoff and alarm clock	1

Kiln, ceramic, electric, 18 to 20 cu. inch firing chamber, 200°F standard temp., with furniture, pyrometer, automatic cutoff, and alarm clock	1
Kiln, ceramic, electric, 14 cu. inch firing chamber, 2300°F high temp., with furniture, pyrometer, automatic cutoff, and alarm clock	1
Kick wheels, 10"-12", metal treadle type, with a water pot, 75-lb. flywheel	2
Modeling stand, steel, adjustable, with an 8" banding wheel	1
Potter's wheel, electric, 10" head with concentric circles, variable speed 1/3-hp motor; 0-180 rpm	3
Spray booth, 24" x 26" x 26", with a turntable and exhaust system to outside air	1
Spray outfit, including: compressor, spray gun, 2 aluminum 1-qt. containers, hose and motor (1/4-1/3-hp motor), pressure control 15-20 lbs.	1
Wedging boards, 22" x 15" x 14", with one wood and one plaster, water-resistant work surfaces	4
Art horses	2
Stools, 18" high, 14" wood seats	12
Stool, 26" high, 14" wood seat	1
Clay carts, 16" x 16" x 23 1/4", metal lined, rust-proof	2
Display cabinet, with shelves and lock, glass covered	1
Damp storage cabinets (zinc construction), 36" x 18" x 7"	3
Drying cabinets, with shelf frames of water-proof fiber peg board, 2 doors with locks	3
Kiln furniture and supply cabinet, 36" x 18" x 42", with adjustable shelves and lock	3
Table, all-purpose drawing, with provisions for work surface of 62" x 43", 30" high	1
Table, glazing, 48" x 96", 30" high, with water-resistant work surface	1
Table, kiln loading, 30" x 42" x 1 1/4", 30" high, on smooth-acting 2" rubber casters	2
Table, planning, 30" x 72", 30" high	1
Table, wedging board, 48" x 30" x 28", 28" high with water-resistant work surface	1
Table, whirler, 24" x 72", 30" high	2
Table, whirler, 24" x 72", 27" high	2

THE following tool and equipment lists for the craft areas are adapted from lists prepared by the Illinois State Board of Vocational Education. Designed for the seventh- and eighth-grade levels, the lists may be adapted for the higher grade levels.

WOODCRAFT AND MODEL BUILDING

	Students
Auger bits, 1/4" to 1" by 16ths, set	8 12
Benches, with vises, 4-student	2 3
Bench stop	8 12
Bevel, T, 8" iron handle	1 1
Brace, ratchet, 8" swing	2 2
Can, safety, oil waste, 5 gallon	1 1
Chisel, 1/4" to 2", set, socket	1 1
Chisel, 3/4", socket	4 6
Chisel, 1/4", socket	4 6
Clamp, C, 4"	2 4
Clamp, C, 2"	12 24
Clamp, I-bar, 48"	4 6
Clamp, I-bar, 24"	4 4
Clamp, handscrew, 10"	4 6
Clamp, spring, 7"	18 24
Countersink, rose, brace 3/4"	1 1
Dividers, 6" and 8", each	1 1

Drills, carbon, 1/16" to 1/2" by 16ths, set	1 1
Drill, hand, 1/4" capacity	4 6
Drill press, bench model, 1/2" chuck	1 1
Duster, bench	12 18
Expansion bit, 7/8" to 3"	1 1
File, auger bit	1 1
File, cabinet, 8", sec. cut, half round	2 2
File, cleaner	2 3
File, flat, wood, 8"	1 2
File, mill, 8"	4 8
File, round, 8"	1 2
File, saw, slim taper, 7"	4 6
File, saw, extra slim taper, 7"	4 6
Gage, auger bit	1 1
Gage, marking	2 4
Glass cutter	1 1
Gouge, inside 3/4", 1/2", 3/4", 1" socket, each	2 2
Grinder, 2 wheel, pedestal, 7"	1 1
Grinding wheel tool dresser	1 1
Hammer, claw, 13 oz.	1 1
Hammer, claw, 10 oz.	4 6
Hammer, soft face, 8 oz.	1 2
Hammer, upholsterer's, magnetic	1 2
Knife, sloyd	4 6
Knife, fiber board	1 1
Knife, putty	2 2
Mallets, wood or rubber	4 6
Nail sets, 2/32" and 3/32" each	4 6
Oil can, 1/2 pt.	4 4
Plane, block, 6" or 7", pressed steel bed	6 8
Plane, smooth, 9" length, 1 1/4" cutter	4 6
Plane, jack, 14" length, 2" cutter	1 2
Plane, irons, block	8 12
Pliers, combination, 8"	1 1
Pliers, needle nose, 6"	3 3
Pliers, side cutting, 8"	1 1
Rule, bench, 24" wood, brass tip	8 12
Sandpaper, flint, grits, 1, 1/2, 0, quires each	2 3
Saw, back, 10", 14 point	4 6
Saw, compass, 12"	1 1
Saw, coping, 6 1/2", pin end	4 6
Saw, cross cut, 16" or 18", 10 point	4 6
Saw, jig, 18" to 24"	1 1
Saw, rip, 20", 5 1/2 point	1 1
Saw, mitre and box	1 1
Saw set	1 1
Scraper, hook	2 3
Screwdriver, plastic handle, 4", 3/16" tip	6 8
Screwdriver, plastic handle, 6", 8", each	1 1
Screwdriver, plastic handle, 12"	1 1
Screwdriver, Phillips, No. 1-4 and 5-9, each	1 1
Slip stone	2 2
Spoke shave	1 2
Square, standard steel, 24" x 2"	1 1
Square, try, 6" blade	4 6
Square, combination, 12" blade	1 1
Steel wool, 2/0, lbs.	3 4
Stones, sharpening, carborundum	2 2
Wrench, crescent, 8" and 12", each	1 1
Wrench, engineers, 1/4" to 1", set of 6	1 1

PLASTICS

Back saw, 10", 14 point	1 1
Buffing wheels, 30-ply cotton flannel	4 8
Chisel, firmer, 1/4"	1 1
Chisel, firmer, 1"	2 2
Clamps, C, 2"	8 12
Drill, hand	1 1
Dies, 1/2"-13	1 1
Die stock, 7"	1 1
Drills, carbon, 1/16" to 1/2", set	1 1
Drill, No. 55	2 2
Drill, No. 50	2 2
Files, 8" smooth, mill	4 6
Files, 8" bastard, mill	2 4
Files, 8" smooth, round	2 2

Files, 6" triangular	1 2
Files, 4" needle, set of 12	1 2
Hacksaw frame, 10"	2 2
Hand screw clamps, 2-0	4 4
Hammer, ball-peen, 4 oz.	2 2
Oven for heating plastics	1 1
Polishing head, 8" buffs, 1/3-hp motor, V belt, and pulley	1 2
Sandpaper, flint, 1, 1/2, 2/0, quires, ea.	2 3
Screwdriver, small, 2", 1/8" tip	1 1
Saw, jeweler's, adjustable, 5"	5 7
Saw, jig, 18" or 24"	1 1
Square, steel, 7 x 12 x 1	4 6
Square, try, 6" blade	4 6
Scratch awl, 6"	4 6
Taps, N.C. No. 4, 6, 8, 1/4, ea.	1 1
Tap, pipe, 1/8"	1 1
Tap wrench, 7"	1 1
Vacuum forming press, 16 1/2" sq. cap.	1 1
Vise, metal workers, 3" jaw	4 6

ART METAL

Awls, scratch	4 6
Chisels, chasing, as needed	1 1
Divider, wing 10", 8" each	2 3
Drill, hand	1 1
Drill, press	2 3
Drills, twist, straight shank, set 1/16" to 1/2"	1 1
File, flat, 8" bastard and smooth cut, each	2 2
File, flat, 8" 2nd cut	4 6
File, mill, 8" 2nd and smooth cut, ea.	4 6
File, needle, 4", set of 12	2 4
Grinder, 6", 2 wheel for buffing	1 1
Grinder, 7", 2 wheel stone	1 1
Hammer ball-peen, 4, 6, 8, 12-oz. ea.	2 2
Hammer, peening	2 2
Hammer, chasing, 1" face	1 2
Hammer, planishing, 10 oz.	2 2
Mallet, fiber	1 2
Mallet, rawhide	2 2
Mallet, wood, round	2 2
Punch, center	2 3
Punch, prick	4 4
Saw, jeweler's, 5" deep	4 6
Saw, hack, 10" frame	2 2
Snips, tinner's, curved, 2"	2 4
Snips, tinner's, straight, 2"	3 4
Soldering coppers, electric, 1/2" tip	2 4
Square, try, 6"	4 6
T-stakes, patterns as desired	— —
Anvils, as desired	— —
Vise, small	4 6
Emery cloth, 1/0, 4/0, quires ea.	1 1
Steel wool, 2/0, no. of lbs.	2 3

JEWELRY AND LAPIDARY

Acid, nitric, no. of lbs.	1 2
Acid, sulfuric, no. of lbs.	1 2
Oxidizing pan	1 1
Anvil, steel block	1 2
Asbestos block, 4" x 5"	1 2
Asphaltum, no. of lbs.	1/2 1
Bench vise, 3" jaw	4 6
Benzine, no. of qts.	1 2
Binding wire, iron, 1 lb. each, 14, 16, 18, and 22 gage	— —
Blowpipe or blowtorch	2 3
Bunsen burner	2 3
Bottles, acid with glass stoppers	3 5
Brushes, camel hair, No. 2 and No. 5, each	2 3
Brushes, flux	2 3
Burnisher, curved	2 2
Carborundum stones, slip	1 2
Center punch	2 3
Prick punch	2 3
Charcoal blocks	6 8
Clamps, C, 4"	6 8
Dapping die	1 2
Dapping tools	1 2

Dividers, 5"	1	1	Pliers, chain	1	2	equipment that may be added to the above list.	
Drawplate, medium round	1	1	Pliers, flat nose, 6"	1	2	Gem-cutting unit, combination	1
Drill, hand	2	3	Pliers, round nose, 6"	1	2	Faceting unit	1
Engraving tools, set	1	1	Pyrex dish, small	1	2	Drilling unit, lapidary	1
Files, needle, set	2	2	Repousse tools, set	1	1	V-block, for faceting	1
Files, half round, 8"	4	6	Saw blades, No. 2/0, and 1/0, doz.	2	3	Dops, faceting, assorted, no. of sets	3
Files, flat, coarse, 8"	4	6	Saw frame	4	6	Trim saw, faceteer's, narrow blade	1
Files, flat, fine, 8"	4	6	Scraper, hollow triangular, 2"	2	3	Block, transfer, with a face plate, for dopping	1
Flux, assorted	—	—	Solder, silver, hard, medium, soft, each, no. of lbs.	1/2	2	Grinding unit, gem, with 10 1/2" wheels	1
Graduate, 16 oz. glass	1	1	Solder, lead and tin, no. of lbs.	1	2	Lapping unit, 24" x 24" x 9" work area with all vital parts shielded	1
Gravers, square end	2	3	Stamping tools, set	1	1	Sander, belt, dry	1
Gravers, half round end	2	3	Steel block, polished, 4" x 4" x 1"	1	1	Sander, belt, wet	1
Hammers, chasing	2	3	Tongs, 20" long	1	2	Sander, disc, universal	1
Hammers, planishing	2	3	Trays, developing, hard rubber, 8" x 10"	1	2	Polishing unit, motor with double end shaft and accessories	1
Hammers, ball peen, 4, 6, 8 oz.	2	3	Twist drills, No. 50	6	9	Polishing wheels, jeweler's assortment, sets	1
Hammers, riveting	2	3	Chamois skin, 8" x 8"	1	2	Wheel dresser, diamond, hand type	1
Lead block, 4" x 4" x 1"	1	1	Emery cloth, 1/0, no. of sheets	6	9	Knurling tools, milgrain, sets	1
Mallet, rawhide, medium	1	2	Emery paper, 3/0, no. of sheets	3	6	Templates, assortment of circles and oval forms or sets	1
Mandrel, bracelet	1	1	Hand buffs, felt	1	1	Flexible-shaft machine, with pencil-type handpieces	1
Mandrel, ring	1	1	Hand buffs, chamois	1	1	Magnifier, binocular type	6
Metal snips	3	4	Rouge stick, as needed	—	—		
Nail set, 2/32	2	3	Steel wool, 2/0, no. of lbs.	2	3		
Nippers, side cutting	2	2					
Oil stone, India	1	1					
Pickle pan, copper	1	1					
Pitch bowl with pitch	1	1					
Plaster of Paris, no. of lbs.	1	2					

For an extensive program in lapidary, the following is a suggested list of tools and



In the preceding section the material has been dealing with factual information needed for the building program. In this section I will try to convey my personal feelings concerning the character of this building.

Since the school's main purpose is the rehabilitation of the youths, the activity should be very vigorous. To stimulate vigorous activity the area must be well lighted and ventilated. In the past, shop areas usually have been dimly lit and have been dirt and grease catchers. They were usually crowded as the present facilities are because of the lack of storage space. Also walls separated different shop areas. Most of these shop in the past had very few windows for visual contact with other areas. I plan to open up the shop area for better visual contact and better supervision.

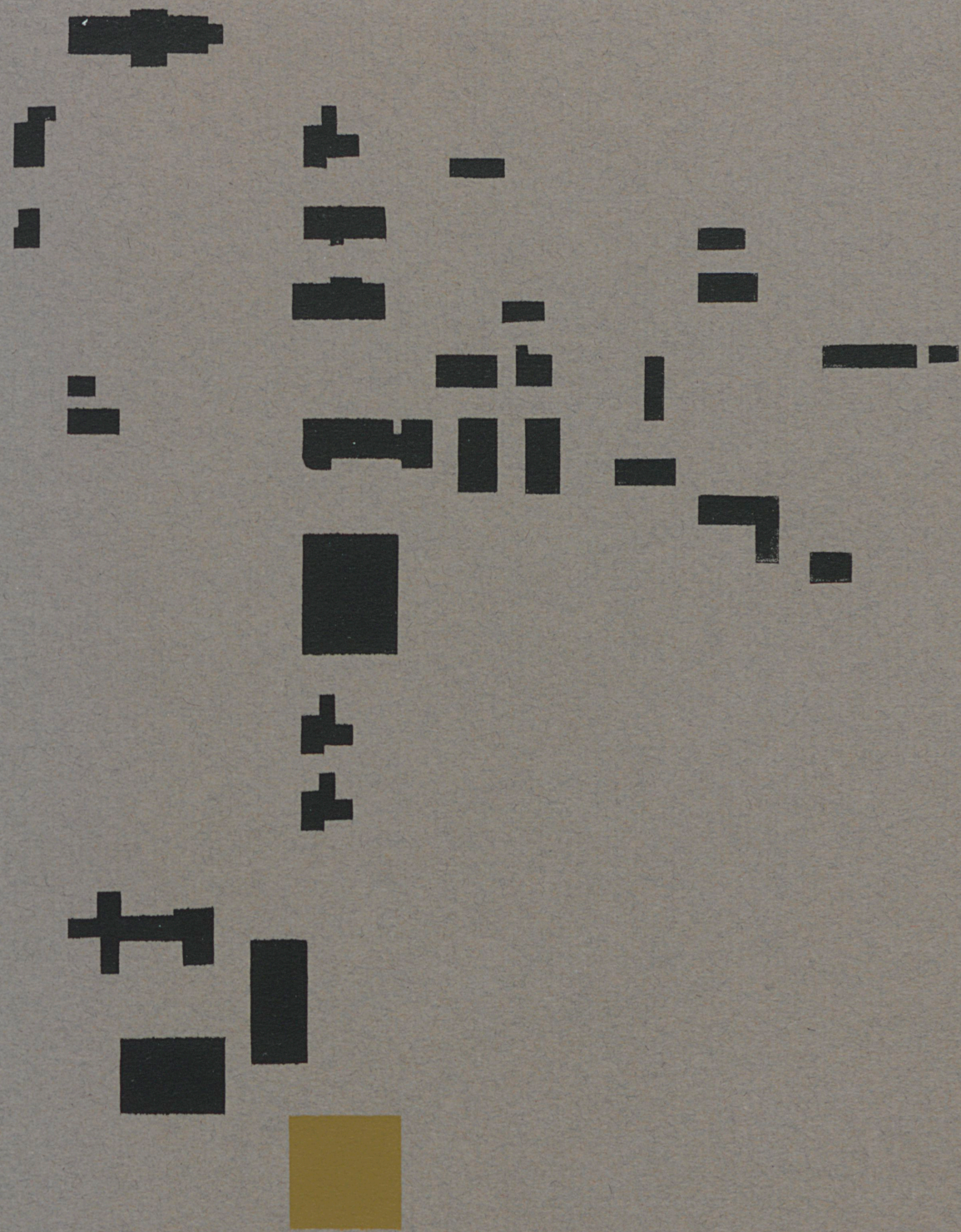
The shop areas should have a spacious feeling. The areas should flow from one space to another space visually by the use of structural glass. Careful arrangement of space can make the difference between a structure that only fills a functional need and an environment that is an exciting place to learn. Exciting in the sense that it arouses the boy's interest in learning.

The function of the building indicates that the material used in the construction of the facility be very durable and fireproof. If concrete is used to meet these requirements, it should not have the feeling of a cold-sterile prison. The arrangement of spaces and the introduction of texture and color could be used to liven up the hard-cold feeling of plain concrete. Each area could have an identifying color. This color could be placed on the door of that particular area.

Industry is now discovering the efficacy of good use of color in the work environment. In the shop, a great deal can be done in this field. Safety measures, such as making dangerous parts and machines in special colors, and blocking off dangerous areas with paint, are now in increasing use in shops.

The vocational training building will be more related to the gymnasium and the new school than the rest of the buildings on the campus. The gymnasium has a brick and colored steel exterior. The new school has a brick and precast concrete panel exterior. Both of these buildings have similar roof pitches. I will try to relate this pitch to the design of this building. Relating roof pitches could be one way which this building could be related to the other two buildings in this group.

The gymnasium, the new school, and the vocational training building will consist of the educational area for the school. Therefore, the general feeling of this group should be one that evokes the student's sensation and emotions in learning.



ECONOMIC CONSIDERATIONS

This facility, a vocational training building, was proposed for this current biennium (1967-1969); however, the 1967 Legislature did not appropriate monies for this facility. Therefore, the request for this building will again have to be presented to the 1969 Legislature with No. 1 priority for the 1969-1971 biennium.

Since at least eight different vocations would be taught in this building special equipment would be required. Following is a rough estimate of the costs from previous requests:

Automotive Equipment	\$ 20,000.00
Drafting Equipment	5,000.00
Electronics and Electricity	20,000.00
Graphic Arts	65,000.00
Machine Shop	50,000.00
Metal Work	20,000.00
Woodworking	15,000.00
Arts and Crafts	5,000.00
Total	\$200,000.00

The following is a list of the project costs (7):

Land Acquisition	\$	-0-
Preliminary Expenses		
Site Survey		500.00
Soil Testing		1,000.00
Others		250.00
Administration and Legal Expenses		250.00
Furnishings and Special Equipment		200,000.00
Consultant Services		-0-
Landscaping and Site Developing		2,500.00
Construction Costs		325,000.00
Architect's and Engineer's Services		25,000.00
Contingencies 5%		26,000.00
Total		\$581,000.00

The total cost of the project would be
\$581,000.00.



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BIBLIOGRAPHY

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Interview and Correspondence

- 9 Al Maier, Director of Vocational Education, Pine Hills School for Boys, January 19, 1968.
- 10 Jim Martin, Engineer's Assistant to the State Architect, State of Montana, January 31, 1968.

A VOCATIONAL EDUCATION BUILDING
FOR THE PINE HILLS SCHOOL FOR BOYS

Structural System - Reinforced concrete piers and columns with 36" c.c. Waffle slab., concrete slab throughout.

Other Materials - Exterior walls are used brick, acquired from the old gym that was torn down and the old school which is being torn down; and structural clay tile.

Heating System - Hot water heating from the main heating plant. Auxiliary heating units above wash and locker space.

Ventilation - Natural and blowing system.

The site I have chosen is closely associated with the other academic areas and still has access to the maintenance area. Since the overall height of the building is about 20 feet, it is shorter than the surrounding buildings.

The location of the building on the campus and use of the used brick on the exterior walls help relate the building to the other buildings.

Waffle pan system was used for two reasons:
1) for fire protection for this type of structure, and
2) to have a clean-looking ceiling with no hanging ducts, wires, or vents. All exhaust outlets are in the floor slab with the exception of the welding and metalsmithing areas.

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