

A QUANTITY AND COST ESTIMATE
OF THE VETERANS BARRACKS
APARTMENTS OF THE
MICHIGAN STATE COLLEGE

Thesis for the Degree of B. S.

MICHIGAN STATE COLLEGE

A. J. Kovalcik

1948

THESIS

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**SUPPLEMENTARY
MATERIAL
IN BACK OF BOOK**

A Quantity and Cost Estimate
of the
Veterans Barracks Apartments
of the
Michigan State College

A Thesis Submitted to
The Faculty of
MICHIGAN STATE COLLEGE
of
AGRICULTURE AND APPLIED SCIENCE
by

A. J. Kovalcik
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Bachelor of Science

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INTRODUCTION

The plans and specifications of the Married Veteran Students' Housing, Michigan State College, East Lansing, Michigan, were acquired from O. J. Munson, Architect, Lansing, Michigan. Using these plans and specifications of the construction as shown in the drawing, the following quantity and cost estimate was made.

The electrical and plumbing work was subcontracted and no plans were available; therefore, the quantity was approximated by direct take off and information was obtained from the maintenance men of the buildings.

Most references made to Construction Estimates and Costs by H. E. Pulver, B.S., C.E., University of Wisconsin, McGraw-Hill Book Co., Inc., 1947, will be indicated as "text". Other references were extracted from "Estimating Costs" by Dingman. References that could not be obtained from either text-book were secured through contact with business firms in Lansing, as indicated.

During the construction of the eleven buildings, materials were not available; therefore, high prices were paid by the contractor, The Christman Construction Company, Lansing, Michigan.

I further wish to indicate that certain approximations had to be made due to insufficient information on the Specifications and Drawings with regard to the materials.

General SummaryTotal

General Expense	\$ 8,625.20
Excavation--General	560.
Excavation--Special	341.60
Drains	269.40
Foundations (Concrete)	719.50
Walls (Concrete)	2,200.
Floors and Stairs (Concrete)	880.
Cement Finish and Terrazzo	586.52
Waterproofing (Concrete)	98.82
Steel Reinforcing (Concrete)	525.
Steel Reinforcing (Corrugated)	262.50
Structural Steel	12,552.
Brickwork	2,958.60
Brickwork (Incinerator)	2,200.
Masonry (Stone)	181.59
Masonry (Concrete brick and block)	404.38
Rough Carpentry and Sheathing	3,851.
Exterior Woodwork (Finish)	2,122.25
Interior Woodwork (Finish)	13,723.
Plumbing	12,187.42
Heating	6,586.50
Electrical Work	4,499.90
Roofing and Flashing	1,673.
Lath	6,417.25
Plaster	5,345.
Finished Hardware	3,500.
Painting and Decorating (Exterior)	94.06
Painting and Decorating (Interior)	1,763.35
Linoleum	1,188.
Asphalt tile	1,440.
Insulation	620.
	\$ 98,347.84
Performance Bond 1%	983.
Maintenance Bond 1%	983.
	100,313.84
Profit 10%	10,031.
	\$ 110,344.84

EXCAVATION

<u>Unit</u>	<u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
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Spec.--Excavate basement area, as indicated also crawl space under first floor corridor, and for exterior as shown by sections. Excavate for all pipe and drain trenches and all secondary work as required. Earth from excavations shall be used for filling in around building; the contractor shall level this earth around the building, banking it up against to height of finished grade as shown on prints. All surplus material to be leveled off in immediate area. The excavations shall be larger on all sides than required for walk and footing so that they may be properly built and the basement walk properly waterproofed. Soil and top soil need not be considered.

General Excavation

Basement	42.5'0" X 39'8" X 8'0"	
		= 13,500 cu. ft.
Crawler Space	105'0" X 39'8" X 3'0"	
		= 12,500 cu. ft.
Total		26,000 cu. ft.
		= 965 cu. yd.

*Text--Table 3-5, pg. 56

Shovel capacity 30 cu. yds./hour
Transportation for 1/2 cu. yd. shovel .60.
 $965 \div 30 = 32.2$ hrs. for power
shovel
1 truck--2 minutes to load plus
8 minutes for one round trip.
Sand hauled around temporary housing
and dumped. Therefore, the total is
10 minutes

*Text--"Estimating Costs" by Dingman

Shovel and operator	\$5.00 per hr.
2 trucks and operator	\$8.00 per hr.
Foreman	\$2.00 per hr.
Total	\$15.00 per hr.

\$15.00 X 32.2

<u>EXCAVATION (Cont'd)</u>	<u>Unit</u> <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Transportation of shovel on job			60.	
Transportation of 5 trucks			25.	
Cost/cu. yd. 560/965 is .57				
			560	<u>560</u>

Special Excavation

Spec.--Bottom of footing excavations shall be leveled, all loose material and all water shall be removed before pouring concrete. All excavations shall be shored to protect workmen from slides.

Footing and trench excavations

Crawler space 240'0" X 2'0" X 1'0" = 480 cu. ft.
Pit for pipe trenches 5.5'0" X 2'0" X 5'6" = 62 cu. ft.
8 concrete pile footings 4'0" X 4'0" X 3'0" = 384 cu. ft.

Footing trenches for basement

127.5'0" X 4'0" X 3'0" = 1530 cu. ft.
322.4'0" X 4'0" X 2'0" = 1555 cu. ft.
17'0" X 2'0" X 4'0" = 135 cu. ft.

Footing for Stairs

43'0" X 3'0" X 4'0" = 530 cu. ft.

Footing around Crawler Space

273.5'0" X 3'0" X 4'0" = 3320 cu. ft.

Sewers and water mains

326'0" X 2'0" X 3'0" = 1630 cu. ft.

Total cu. ft. is 9626 or 353 cu. yds.

*Text--Table 3-8, pg. 60

.80 labor hours per cu. yd.

\$1.00 per hour--common labor rate

<u>Summary</u>	<u>Unit</u> <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Excavation Cost				
\$1.00 X .80 X 353	1.00	287.		
Small tools			4.	

<u>Special Excavation (Cont'd)</u>	<u>Unit</u> <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Backfill with bulldozer \$10/hr. Capacity 0.01 hr/cu. yd.				
Backfill cost 10 X 0.01 X 358 = 35.80				\$ 35.80
Cost of moving bulldozer				15.
Total cost of hand excavation and backfill				<u>\$341.80</u>

DRAINS (Tile)

Spec.--Use 4" tile drain, tarpaper
all joints and fill with cinders.

Excavation:

4 X 26'4" X 2'0" X 1'0" = 210 cu. ft.
2 X 90'4" X 2'0" X 1'0" = 360 cu. ft.
4 X 39'0" X 2'0" X 1'0" = 315 cu. ft.

Total	<u>235 cu. ft.</u>
=	33 cu. yds.

*Text--Table 3-8, pg. 60

[illegible]

FOUNDATIONS

Column Footings

14 footings X 2'9" X 2'0" X 1'0"

<u>Cu.ft.</u>	<u>Sq.ft.</u>
100	77

Wall Footings

2 X 39'8" X 0'20" X 1'0"

133 79

4 X 26'4" X 0'20" X 1'0"

176 106

2 X 90'4" X 0'20" X 1'0"

302 180

2 X 17'9" X 0'20" X 1'0"

59 35

2 X 16'0" X 0'20" X 1'0"

53 32

1 X 11'6" X 0'20" X 1'0"

19 16

Total

842 448

Use 2" aggregate medium mix concrete

*Text--pg. 131--formulas

Use 1:2.5:4 mix by weight

Sacks of cement/cu. yd. of concrete = $\frac{42.5 \times 1}{1 \cancel{\cdot} .8 \cancel{\cdot} 2.5 \cancel{\cdot} 4}$
= 5.2 sack/cu. yd.

Lbs. of water/cu. yd. of concrete = $\frac{4000 \times .8}{1 \cancel{\cdot} .8 \cancel{\cdot} 2.5 \cancel{\cdot} 4}$
= 402 lbs. of water

$\frac{402 \text{ lb.}}{8.35} = 47.6 \text{ gal./cu. yd.}$

Tons of sand/cu. yd. of concrete = $\frac{2 \times 2.5}{1 \cancel{\cdot} .8 \cancel{\cdot} 2.5 \cancel{\cdot} 4}$
= 602 tons/cu. yd.

Tons of gravel/cu. yd. of concrete = $\frac{2 \times 4}{1 \cancel{\cdot} .8 \cancel{\cdot} 2.5 \cancel{\cdot} 4}$
= .962 tons/cu. yd.

Materials

*Text--Table 5-9, pg. 135

Cement 0.72 on the job	0.72/bag
Sand	2.00/ton
Gravel	2.30/ton

.520 sacks @ 0.72	0.38
.602 tons @ 2.00	1.20
.962 tons @ 2.30	2.30
	<u>3.88</u>

FOUNDATIONS (Cont'd.)

*Text--Table 5-12, pg. 139

Approximate cost per cu. yd.

Storage and weighing	\$0.17
Mixing	0.50
Placing	0.80
Curing	<u>0.15</u>
Total Plant Costs	\$1.62
Cost of Concrete	<u>3.88</u>
Total cost	\$5.50 per cu. yd.

Concrete delivered by Boichot, Lansing, Michigan, is
\$9.50/cu. yd.

Will use \$7.00/cu. yd. delivered on job.

*Text--Table 5-11, pg. 137

Labor required for concrete	
Placing in footings	1.5 hrs/cu. yd.
Curing in ordinary weather	<u>.7</u> hrs/cu. yd.
Total	2.2 hrs/cu. yd.

Hourly wage with foreman

3 laborers @ \$1.00/hr.

3 cement finishers @ \$2.00/hr.

1 foreman @ \$2.50/hr.

Average \$1.65/hr. X 2.2 = \$3.65/cu. yd.

Materials (Forms)

*Text--Table 5-2, pg. 119

Footings--lumber ft. b.m./100 sq. ft. of form surface
250 sq. ft.

Forms 468 sq. ft.

Nails, wires and bolts 10 lbs.

Lumber/1000 ft. b.m. = \$100

468 X 250 = 1170 ft. b.m.

\$100 X 1170 = \$117

Nails & bolts = 10

Total cost \$127/square

*Text--Table 5-3, pg. 121

Labor hours/100 sq. ft. of form surface

<u>Footings</u>	<u>Hrs.</u>
assemble	<u>5</u>
erect	3
strip & clean	<u>3</u>
Total	11

FOUNDATIONS (Cont'd)

Labor wage plus foreman wage
(average) is \$2.00/hr.
Labor hrs./100 sq.ft. is 11 hrs.
\$2.00 X 11 is \$22 per square

<u>Summary</u>	Unit <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Concrete (Materials 842/27 is 31.2)	7.00		218.	
(Labor	3.65	118.		
Forms (Materials 443 squares	127.		285.	
(50% salvageable	2.00	98.50		
(Labor				
		216.50	503.	<u>719.50</u>

WALLS

						<u>Cu. ft.</u>	<u>Sq. Ft.</u>	
2	X	73'4"	X	1'0"	X	4'0"	537	1174
2	X	26'4"	X	1'0"	X	4'0"	212	414
1	X	39'8"	X	1'0"	X	4'0"	159	308
1	X	39'8"	X	1'0"	X	7'6"	302	604
2	X	26'4"	X	1'0"	X	7'6"	395	790
2	X	17'0"	X	1'0"	X	9'9"	330	660
2	X	9'4"	X	1'0"	X	4'0"	74	148
1	X	33'6"	X	0'8"	X	9'9"	263	670
2	X	18'0"	X	0'8"	X	9'9"	238	700
2	X	18'0"	X	1'0"	X	7'6"	270	540
1	X	4'0"	X	1'0"	X	7'6"	30	60
						<u>2915</u>	<u>6068</u>	

50% of forms built at one time

Basement Floors

17'3"	X	35'0"	X	0'4"	187
24'4"	X	37'8"	X	0'4"	356

Basement Columns

6" diameter pipe in center of column								
3	X	9'9"	X	1'6"	X	1'6"	68	175
14	X	4'0"	X	1'6"	X	1'6"	126	336
Total							3652	6579

Assume same computations for walls, columns and floors as for footings.

<u>Summary</u>	<u>Unit</u> <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Concrete (Material (3652/27 =134 cu.yds. (Labor	7.00 3.65		937.	
Forms (Material 4120 ft.b.m. (50% salvageable (Labor 16.4 squares	100. 22.		412.	
		851	1349	\$2200

CONCRETE

Floors and Stairs

Spec.--Cement will be filled on #26 gauge corrugated sheet iron forming on the joist for the first and second floor slabs. Cement fill in pans of steel stairs.

<u>Floors</u>							<u>cu. ft.</u>	<u>sq. ft.</u>
(1)	8	X	24'4"	X	14'4"	X 0'2"	452	
(2)	2	X	98'4"	X	5'8"	X 0'2"	139	
(3)	4	X	90'4"	X	15'3"	X 0'2"	906	
(4)	4	X	7'0"	X	4'0"	X 0'2"	19	

Stairs (Steel Section)

4	X	16'0"	X	0'6"	X	3'6"	56	224
1	X	18'0"	X	0'6"	X	3'6"	32	63

Basement

24'4"	X	39'8"	X	0'2"	116
17'0"	X	35'8"	X	0'2"	112

Total 1383 237
= 69.7 cu. yds.

*Text--Table 5-6, pg. 132

Use 1:2:3 mix, 5 gal. water/sack
1 cu. yd. of concrete weighs 400 lbs.
Sack of cement/cu. yd. = $\frac{42.5 \times 1}{1 \cancel{.67} \cancel{2} \cancel{3}} = .64$ sacks

Tons of sand/cu. yd. of concrete = $\frac{2 \times 2}{1 \cancel{.67} \cancel{2} \cancel{3}}$
= .60 tons/cu. yd.

Tons of gravel/cu. yd. of concrete $\frac{2 \times 2}{1 \cancel{.67} \cancel{2} \cancel{3}}$
= .96 tons/cu. yd.

*Text--Table 5-6, pg. 132

Cost of Material

Cement	.64 sacks @ \$.72	\$.46
Sand	.60 tons/cu. yd. @ \$2.	1.20
Gravel	.96 tons/cu. yd. @ \$2.30	2.20
Total		<u>\$3.86/cu. yd.</u>

CONCRETE (Cont'd)

*Text--Table 5-12, pg. 139

Plant Costs

Storage and weighing	\$0.17
Mixing	.50
Placing	.80
Curing	.15
Total plant cost/cu. yd.	\$1.62
Concrete	3.86
Total	\$5.48

Concrete was delivered by Sablain Co.,
Lansing, Michigan for \$9.00/cu. yd., but
will use \$7.00/cu. yd.

Cost of labor for placing in concrete,
used previous figures @ \$3.65/cu. yd.

<u>Summary</u>	<u>Unit</u> <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Concrete (Material-69.7 cu.yds. (Labor	7.00 3.65		490.	
Forms for (Material 720 ft.b.m. Stairs (Labor 2.87 squares	100. 22.		72.	
		318	562	<u>\$880</u>

CEMENT FINISH AND TERRAZZO

Spec.--Cement finished floors shall be 1:2 concrete trowelled to a smooth finish. Cement floors, where left exposed, are to be marked off in panels and shall pitch to drains.

Basement

24'4"	X	39'3"	=	960 sq. ft.
17'0"	X	35'2"	=	605 sq. ft.

1st and 2nd floors

8	X	24'4"	X	14'4"	=	2780 sq. ft.
2	X	98'4"	X	5'3"	=	1110 sq. ft.
4	X	90'4"	X	15'3"	=	5500 sq. ft.
4	X	7'0"	X	4'0"	=	111 sq. ft.

Total 11066 sq. ft.

*Text--Table 5-16, pg. 151

Surface finish 1:2 mix by volume
per 100 sq. ft. for 1 inch thick surface

Concrete weighs approximately 4000 lbs/cu.yd.
Cement, lb. = 400
Aggregate, lb.= 800

Cement	11.066 squares	X	400 lbs/square	=	4200 lbs.
Sand	11.066 squares	X	800 lbs/square	=	8400 lbs.

Cement	4200 lbs.	=	45 sacks @	\$.72	=	\$32.40
	94 lbs/sack					

Sand	8400 lbs.	=	4.2 tons @	\$2.00	=	8.40
	2000 lbs/ton					

Total \$40.80

*Text--Table 5-17, pg. 152

Labor hours required for troweling

4 hrs./100 sq. ft. X 11.066 = 44.26 hrs.

Labor @ \$2.00 per hr. X 44.26 hrs. = \$88.52

CEMENT FINISH AND TERRAZZO (Cont'd)

Spec.--All floors and borders shall be subdivided with brass stripping as made by Manhattan Terrazzo Lock Strip or other similar or approved equal product. The brass strip shall contain #12 gauge brass. A 1/2 inch deep material recess shall be placed in all vestibules. Terrazzo shall extend six inches up the wall and 3/8 inch from wall line at the top. All terrazzo treads and landings of stairs shall have carborundum chips added to provide a non-slip surface.

4 X 18'3" X 7'0" = 508 sq. ft.

This part of the bid was sublet to Kalman Floor Company, Lansing, Michigan.

Labor and materials @ \$.90 per sq. ft.
508 sq. ft. X \$.90 = \$457.20

<u>Summary</u>	<u>Unit</u> <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Cement (Materials				
finish (11.066 squares	3.20		40.80	
(Labor 44.26 hrs.	2.00	88.52		
 Terrazzo (Materials and Labor				
(508 sq. ft.	.90			457.20
		88.52	40.80	<u>\$536.52</u>

WATERPROOFING

Spec.--The exterior side of all basement walls exposed to the earth shall have two brush coats of asphaltic waterproofing applied from and including the top of the footing to grade. Asphalt joints between floor and interior walls shall be poured hot.

<u>Exterior Walls</u>				<u>Sq. Ft.</u>
2	X	117'0"	X 4'0"	930
2	X	39'3"	X 7'5"	520
1	X	39'3"	X 4'0"	<u>159</u>
				1309

*Text--pgs. 208-211

Materials

Asphalt, 3 coats, 35 lbs. per coat
105 lbs./square X 16.09 squares = 168 lbs.
One gallon = 9.5 lbs.
Gallons needed = 17.7 gal.
Cost per gallon = \$.42
17.7 gal. X \$.42 = \$7.42

Labor

.9 hr. per coat per square
.9 hr. X 16.09 square = 14.4 hrs.
\$2.00 per hr. X 14.4 hrs. = \$28.80 per coat
Equipment-----\$5.00

<u>Summary</u>	<u>Unit</u>			
	<u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Materials	.42		7.42	
Labor	2.00	86.40		
Equipment (Plant)			5.00	
				<u>86.40</u>
				<u>12.42</u>
				<u>\$93.82</u>

STEEL REINFORCING -- CONCRETE

3---1/2" $\emptyset$ in footings
1/2" $\emptyset$ @ 12" vertical walls
1/2" $\emptyset$ @ 18" horizontal walls

3---1/2" $\emptyset$ bars @ 4l3	1239 lin. ft.
1/2" $\emptyset$ bars 12" c/c bars	
Vertical 4l3' X 7.5'	3140 lin. ft.
1/2" $\emptyset$ bars--18" c/c bars	<u>2030 lin. ft.</u>
	7409 lin. ft.

*Text--"Estimating Costs" by Dingman, Table 71,
pg. 89

1/2" round wt.--lbs. per lin. ft. 0.68 X 7409 =5100 lbs.

Labor hrs. per ton (1/2 to 5/8) rod, bending = 5

Labor hrs. per ton (1/2 to 5/8) rod, placing = 8

Total hrs. per ton 13

Base price \$3.00 per 100 lbs.

Freight .25 per 100 lbs.

Chairs, etc .30 per 100 lbs.

Total \$3.55

<u>Summary</u>	<u>Unit</u> <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Materials (7409 X 0.68 or 5100 lbs.)	3.55		265.	
Labor (13 X 2½ tons)	8.00	260.		
		260	265	<u>\$525</u>

STEEL REINFORCING--CORRUGATED SHEET IRON

Spec.--Provide cement fill on #26 gauge corrugated sheet iron framing on joists for first and second floor slabs, cement fill in pans of steel stairs to basement and places required.

Floors and Stairs

Previous figures indicate area of floors and stairs as 2266 sq. ft.

*Text, pg. 268

26" width--2" lapping--net width 24"
Total allowance for lapping 15% = 2600 sq. ft.

*Text--Table 9-3, pg. 269

U.S. gauge #26---0.98 lbs. per sq. ft.

Corrugated galvanized steel @ \$7.00 per 100lbs.

*Text, pg. 306

Labor

One hour per square
Metal worker and helper @ \$3.25 per hr.

<u>Summary</u>	<u>Unit Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Materials (2600 X .98)	7.		178.	
Labor (26 X \$3.25)	3.25	84.50		
		84.50	178.	<u>\$262.50</u>

STRUCTURAL STEEL

Materials

Weight

Mill Beams

2	8"--A.F17--116'3"	17 lbs/ft.	5650
14	6" pipe--.28" thick--7.5'	17 lbs/ft.	1890
32	Bearing plates--14" X 14" X 1.5"	83 lbs/plate	275
80'	3" X 4" X 5/16" angles	7.2 lbs/ft.	580

1st Floor

18	26'0"--8 X 2 $\frac{1}{2}$ " mill beams	6.5 lbs/ft.	2900
18	26'0"--8 X 2 $\frac{1}{2}$ " mill beams	6.5 lbs/ft.	2900
45	36'0"--8 X 2 $\frac{1}{2}$ " mill beams	6.5 lbs/ft.	10500

2nd Floor

18	26'0"--8 X 6 $\frac{1}{2}$ " mill beams	6.5 lbs/ft.	2900
18	26'0"--8 X 6 $\frac{1}{2}$ " mill beams	6.5 lbs/ft.	2900
45	36'0"--8 X 6 $\frac{1}{2}$ " mill beams	6.5 lbs/ft.	10500

Studs

1st and 2nd Floor

2 X	52 X 8'5"---3	5/8 X 2"	3 lbs/ft.	2140
2 X	16 X 8'5"---3	5/8 X 2"	3 lbs/ft.	815
2 X	17 X 8'5"---3	5/8 X 2"	3 lbs/ft.	840
2 X	18 X 4'-----3	5/8 X 2"	3 lbs/ft.	846
2 X	142 X 8'5"---3	5/8 X 2"	3 lbs/ft.	7200
2 X	23 X 8'5"---3	5/8 X 2"	3 lbs/ft.	1420

These studs are 2' center to center on the sides, corridors and between apartment walls

1st and 2nd Floor Partitions

48	8'5"---2	5/16" X 1 7/8"	2.2 lbs/ft.	900
18	4'6"---2	5/16" X 1 7/8"	2.2 lbs/ft.	179
100'	2" X 3 $\frac{1}{2}$ " angles		4.3 lbs/ft.	430
1860'	4" X 1 5/8" channels		5.4 lbs/ft.	8400

Roof Trusses

7800'	6" X 4"	8.5 lbs/ft.	66600
1980'	6" X 4"	8.5 lbs/ft.	16700

Tie rods were omitted

142	39' joists 8" X 6 $\frac{1}{2}$ "	6.5 lbs/ft.	42500
26	6' studs 4" X 4"	7.5 lbs/ft.	11700

Total Weight

150,515

or 75 tons of steel

STRUCTURAL STEEL (Cont'd)

Miscellaneous Materials

500----1/2" X 2 1/4" bolts @ \$.07 each
1000 lbs. of rivets @ \$4.00 per 100 lbs.
Paint--50 gallon @ \$2.00 per gallon

*Text--pg. 263

	<u>Cost per 100 lbs.</u>
Base plus extras	\$ 2.75
Fabrication	1.75
Freight	.72
Total	<u>\$ 5.22</u>

Labor

*Text--Table 9-6, 9-7, pg. 274

	<u>Labor hrs/ton</u>	<u>Total hrs.</u>
Handling and unloading steel	1.5 X 75 ton	115
Foundation work	6.5 X .9 ton	6
Beams and special channels	9 X 75 ton	675
Bolting (6 hrs/100 bolts)		30
Rivets (8 hrs/100 rivets)		80
Painting structural steel	.7 X 75 ton	<u>53</u>
Total hours		959

Average labor cost per hour is \$2.25

Plant

Crane and operator 80 hrs. @ \$7/hr.	\$ 560
Trucks for hauling steel one mile	
75 ton @ \$1.30/ton	1260
Hand tools for erection	60
Riveting compressor 75 ton @ \$2/ton	150
Riveting, other tools, 75 ton @ \$.50/ton	37
Painters' equipment	25
Scaffolding, 75 ton @ \$4/ton of steel	<u>300</u>
Total	<u>\$ 2378</u>

Summary

	<u>Unit</u>	<u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Structural Steel					
(150,000 lbs. @ \$5.22/cwt.	5.22			7825.	
Bolts (500)	.07			35.	
Rivets (1000 lbs @ \$4/cwt.	4.00			40.	
Paint (50 gallon)	2.00			100.	
Labor (959 hrs. @ \$2.25/hr.	2.25	2160.			
Plant				2392.	
		2160	10392		<u>12,552.</u>

BRICKWORK

Spec.--The face brick shall be shale brick and approved by the architect and shall be figured at \$50 per 1000, delivered at the site. Any difference in price of the brick finally selected will be adjusted at the completion of the contract.

Face brick laid below the first floor line will be backed by concrete blocks. From thereon up the wall veneered construction, whence the bricks shall be fastened by wall ties nailed to Stran-Steel construction, to come in every third course of brick. All face brick shall be laid in full bed of mortar; each brick shall be buttered at end and face and shoved into place so that no empty or void spaces are left in the wall.

The mix shall be determined by the quality of the materials and the bricklayers' requirement for plasticity. It shall not exceed 3 parts of sand (dry volume basis) to one part of active ingredients. Volume measurements govern proportions. Materials shall be accurately measured and thoroughly mixed.

All mortar joints shall be compacted and finished with a round finishing tool. At the proper time, all face brick work is to be properly cleaned and left free from all stains, marks or other blemishes.

<u>Face Brick</u>					<u>Sq. ft.</u>
2	X	39'3"	X	13'6-3/4"	= 1470
4	X	26'4"	X	20'0"	= 2105
4	X	26'4"	X	1/2" X 6'5"	= 332
2	X	90'4"	X	18'6-3/4"	= 3540
					<u>7447</u>
Area--deduct					<u>522</u>
					6925
2% breakage					<u>137</u>
					6783 Sq. ft. of brick

Materials

*Text--Table 6-2, pg. 169

Wall area per sq. ft.

18 sq. inches give 6.15 brick with 1/2" mortar

BRICK, ORK (Cont'd)

*Text--Table 6-4, pg. 172

Materials required for 1 cu. yd. of
mortar for brick.

Cement	4.50 sacks	@ \$.72	\$3.24
Lime	270 lbs.	@ .01	2.70
Sand	6 cu. yds.	@ 2.30	13.80
Total			19.74

*Text--Table 6-3, pg. 171

Required--.56 cu. yd. mortar per 1000
standard brick with 1/2" joint; therefore,
mortar per 1000 bricks is \$19.74 X .56 = \$11.00
6.738 X \$11 = \$74.50

6.15 bricks per 1½ sq. ft. = 4.1 brick/sq. ft.
4.1 bricks/sq. ft. X 6788 sq. ft. = 27,800 bricks
27,800 bricks X .50 per 1000 bricks = \$1380.

Wall ties--

1 tie per 6 ft. Use 1200 ties @ \$3.00 per 1000.
1200 ties X \$3.00 per 1000 ties = \$3.60

Labor

*Text--Table 6-5, pg. 171

Hours per 1000 brick, joints, struck = 15
A gang consists of 3 bricklayers and 3 helpers;
one bricklayer to act as strawboss.

Average wage will be \$3.50 per hr.

15 hrs. X \$3.50 = \$52.50/1000 brick
27.8 X \$52.50 = \$1460

Cleaning walls---\$1.00 per 100 sq. ft.

<u>Summary</u>	<u>Unit</u> <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Material (brick, mortar, ties)			1453.10	
Labor (27.8)	52.50	1460.		
Plant (Hods, hoes, barrows)	.60		16.60	
\$.60/1000 X 27.8				
Scaffolds (27.8)	.50		23.90	
		1460	1493.60	<u>12258.60</u>

BRICKWORK (Cont'd)

Incinerator and Stack

Spec.--Sidewall construction shall consist of 4" super duty fire clay brick, 4" insulating fire brick and faced with 4" hard burned common brick. The fire brick shall be laid entirely of header courses, using a dip method of applying mortar. There shall be a 1" space between fire brick and insulating brick.

Top of incinerator shall consist of 4" super duty fire clay brick supported on "T" irons, 4" insulating fire brick and 4" of insulating concrete.

The stacks for these incinerators shall be built independent of building itself so that it, in no way, will act as a portion of a wall or partition of the building which will receive plaster. Stacks shall have a 4" fire brick lining from top of incinerator to 2'0" above top hopper charging door.

Provide spark arrestor on top.

Note: This job was subcontracted, using Model H-2 manufactured by the Detroit Incinerator Corp., Detroit, Mich.

Cost of job, including steel	\$2200
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Total cost \$2200.

MASONRY

Stone

$$\begin{array}{rcll} 46 & \times & 0'4\frac{1}{2}" & \times 3'0" \times 0'5\frac{1}{2}" = 23.8 \text{ cu. ft.} \\ 16 & \times & 0'4\frac{1}{2}" & \times 2'6" \times 0'5\frac{1}{2}" = 6.6 \text{ cu. ft.} \\ & & & \underline{30.4 \text{ cu. ft.}} \end{array}$$

*Text--pg. 182

Cost of special stone crated = \$4.50 per cu. ft.

Anchor or dowels per cu. ft. of stone = \$.15

*Text--Table 6-7, pg. 182

Square stone masonry .15 cu. yd. of mortar
per cu. yd. of stone.

Used same mix and price of mortar used in
brick construction.

Laying stone--5 cu. ft. per hr.

Stone mason and helper \$3.50 per hr.

<u>Summary</u>	<u>Unit</u>			
	<u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Material (Stone)	4.50		137.	
Mortar--1 cu. yd.	18.84		18.84	
Dowels	.15		4.55	
Labor	3.50	21.20		
		21.20	160.39	<u>\$181.59</u>

Concrete Block

$$\begin{array}{rcll} 2 & \times & 12'0" & \times 4'0" = 152 \text{ sq. ft.} \\ 1 & \times & 6'0" & \times 4'0" = 24 \text{ sq. ft.} \\ 1 & \times & 6'6" & \times 9'4" = 62 \text{ sq. ft.} \\ & & & \underline{223 \text{ sq. ft.}} \end{array}$$

$$223 \text{ sq. ft.} \times \frac{144 \text{ sq. in.}}{123 \text{ sq. in./block}} = 256 \text{ blocks}$$

MASONRY (Cont'd)

Concrete Brick

As a rule concrete brick can be assumed to cost the same as concrete blocks per square foot.

*Text--"Estimating Cost" by Lingman, pg. 131

$$\begin{array}{rclcl} 2 & \times & 26'4" & \times & 1'6" & = & 79 \text{ sq. ft.} \\ 2 & \times & 90'4" & \times & 1'6" & = & 270 \text{ sq. ft.} \\ & & & & & & \hline & & & & & & 349 \text{ sq. ft.} \end{array}$$

349 sq. ft. $\times$ 4.1 brick per sq. ft. = 1400 bricks
Mortar space is disregarded.

Labor (block)

Mason	3.8 hrs/100 blocks
Helper	3.8 hrs/100 blocks
Mortar	
Mixer	<u>0.2 hrs/100 blocks</u>
	7.8 hrs/100 blocks

Labor (brick)---previous figures

\$52.50 per 1000 bricks $\times$ 1.4 = \$73.50
1400 brick @ 15 hr. per 1000 @ \$3.50 per hr.

Use mortar made of 1 part cement, 3 parts sand and 10% lime putty. The cost would be figured as follows:

2.23 barrels of cement @ \$2.80	=	\$6.38
.22 barrels of lime @ \$4.00	=	.98
.94 cu. yd. sand @ \$1.25	=	<u>1.18</u>
		\$8.44/cu. yd.
.2 cu. yds. of mortar per 100 blocks		
.3 cu. yds. of mortar per 1000 bricks		

MASONRY (Cont'd)

<u>Summary</u>	<u>Unit</u> <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Concrete blocks (256)	.17		43.50	
Concrete bricks (349 sq. ft.)	.52		181.48	
Mortar (9.32 cu. yd.)	8.44		78.60	
Concrete block (7.8 hrs.)	3.50	27.30		
Concrete brick (21 hrs.)		73.50		
		100.80	303.58	<u>404.38</u>

ROUGH CARPENTRY AND SHEATHING

Spec.--All timber used for framing work throughout the building shall consist of Southern Pine according to the Southern Pine Association and shall be #1 material.

Provide and apply 7/8" T. & G. #2, Southern Pine boards laid tight and securely nailed to Stran-Steel joists to receive roofing. Provide 25/32" thick wood to all exterior walls. This sheathing shall be waterproofed and rot-proofed. Sheathing shall be nailed directly to the Stran-Steel studs and other framing members.

Wall Sheathing (outside 25/32")

2	X	39'8"	X	18'8"	=	1485 sq. ft.
4	X	26'4"	X	18'8"	=	1970 sq. ft.
2	X	90'4"	X	18'8"	=	3350 sq. ft.
4	X	$\frac{1}{2}$ (26'4")	X	6'3"	=	328 sq. ft.
						7133 sq. ft.

Roof Sheathing

2	X	39'8"	X	14'0"	=	1115 sq. ft.
2	X	12'0"	X	$\frac{1}{2}$ (6'0")	=	72 sq. ft.
2	X	13'6"	X	13'6"	=	366 sq. ft.
4	X	9'6"	X	8'0"	=	427 sq. ft.
2	X	9'4"	X	19'0"	=	4360 sq. ft.
						6840 sq. ft.

Total 13,973 sq. ft.

Consider the following 1" because lumber is \$100 per 1000 ft.b.m. for 1" or smaller.

Materials

*Text--Table 8-9, pg. 337

Sheathing--15% waste

13,973 X 115% = 20,900 ft. b.m.

Cost----\$100 per 1000 ft. b.m.

Nails--8d, 25 lbs. per 1000 ft. b.m. @ \$.07 per lb.

ROUGH CARPENTRY AND SHEATHING (Cont'd)

*Text--Tables 8-11, 8-12, pg. 240

Labor

Assumed 3 carpenters (one acting as straw-boss) and two helpers, average hourly wage will be \$3.50 per labor hour.

Sheathing unmatched--Hours per 1000 ft. b.m. is 21 hrs.
21 hrs. X 20.9 = 428

Work benches--\$25.

Scaffolding (steel used) \$1.00 per 100 sq. ft.

<u>Summary</u>	<u>Unit</u> <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Material:				
Lumber (20.9 squares)	100.		2090.	
Nails (522 lbs.)	.07		37.	
Labor (428 hrs.)	3.50	1490.		
Plant (work benches)			25.	
Scaffolding (209)	1.00		209.	
		1490	2361.	<u>\$3351.</u>

EXTERIOR WOODWORK

Spec.--Exterior woodwork shall include all cornice work, entrance frames, window frames, and all sundry work required.

All work will be finished with white pine ready for paint and delivered on the job with prime coat of paint. Cornices shall be white pine, primed and painted.

Provide and install insect screens for all outside windows in all parts of the building. Frames shall be made of white pine, 2" rails and stiles and 3" bottom rack 1-1/8" thick. Screen cloth shall be 16 inch mesh bronze cloth 0.0013 inch diameter wires.

Item & Description	Mat. Cost	Labor Hrs.	Labor Cost
Moldings, water table fascia, freize, etc., 400 ft. @ \$75 per 100 ft.	\$ 300	96	\$ 196
2 outside door frames (ornamented)	60.	10	20.
15 12" X 18" windows and frames	75.	30	60.
48 5'2" X 32" windows and frames	720.	96	192.
12 3'3" X 32" windows and frames	120.	24	48.
Window screens--			
48 @ \$4.00	192.		
15 @ \$4.75	71.25		
12 @ \$1.50	18.		
	\$1606.25	256	\$516.
	Total		<u>\$2122.25</u>

INTERIOR FINISH AND MILLWORK

Spec.--Interior finish lumber of every description used throughout the building shall be kiln dried, absolutely clear face, and of the various kinds called for.

All finishing lumber shall be scraped, sanded, and free from marks, bruises, and other imperfections.

Provide and install moulded white casings and trim for all doors and wood windows.

Labor

Labor for carpenter and helper combined \$3.50 per hr.

Item and Description	Mat.	Labor	
		Hrs.	Cost
2--A--Entrance Doors---2 1/4"	50	6	21
2--M--Basement Doors---1 3/4"	40	6	21
16--F--Apartment Bedroom Doors--1 3/4"	350	48	168
16--F--Apartment Entrance Doors-1 3/4"	400	48	168
16--H--Doors to Bath----1 3/8"	320	48	168
4--L--Doors to Vestibule-----1 3/4"	44	12	42
4--E--Doors to Corridor-----1 3/4"	44	12	42
2--E--Door in Laundry and Drying Room---	40	6	21
16--J--Closet Doors--1 3/8"	320	48	168
78 Door Frames	468	592	2070
16 Cabinets and Shelving 50 hrs/apt. Finish Carpenter at \$2.50 per hr.	6400	800	2000
Interior Trim Base (800 ft @ \$15.00 per 100) plus nails for 1st and 2nd floors	120	40	100
Pattern Molds (800 ft. @ \$5.50 per 100 ft.)	44	10	25
Picture Mold (800 ft. @ \$5.50 per 100 ft.)	44	10	25
	<u>\$3684</u>	<u>1684</u>	<u>\$5039</u>
Total		<u><u>\$13,723</u></u>	

PLUMBING

Materials (Rough)

*Text--Table 13-1 to 13-11, pgs. 373-381

Sewer Line

100'	soil pipe 4" @ \$2.00 per 5 feet	\$ 40.
220'	sanitary sewers C.I. 4" pipe @ \$1.50/5 ft.	66.
150'	sanitary sewers C.I. 6" pipe @ \$2.25/5 ft.	67.50
175'	storm sewers C.I. 4" pipe @ \$1.50/5 ft.	52.50
20	fittings for 4" pipe @ \$.75 each	15.
1	basement floor and drain trap @ \$3.00	3.
16	apartment C.I. traps @ \$2.50 each	40.
15	elbows for 4" pipe @ \$2.00 each	30.
5	elbows for 6" pipe @ \$2.50 each	12.50
4	T's for 4" pipe @ \$3.00 each	12.
4	Y's for 4" pipe @ \$3.00 each	12.

Water Line

1500'	3/4" R.W. pipe @ \$6.00 per 100 ft.	90.
234'	3/4" pipe, galvanized steel	
	@ \$7.50 per 100 ft.	21.30
60	fittings @ \$.10 each	6.
20	faucets, 3/4" @ \$.100 each	20.
10	control valves @ \$1.50 each	15.
20	check valves @ \$1.00 each	20.
10	reducers @ \$.20 each	2.
12	couplings @ \$.38 each	4.60
12'	5" galvanized steel pipe @ \$50 per 100'	6.
12'	4" galvanized steel pipe @ \$46 per 100'	5.50
10'	3" galvanized steel pipe @ \$45 per 100'	4.50
500'	2 1/2" galvanized steel pipe @ \$34 per 100'	170.
4'	1 1/4" galvanized steel pipe @ \$13 per 100'	.52

Gas Line

300'	1" black steel pipe @ \$.17 per ft.	51.
75	Elbows @ \$.10 each	7.50
50	Couplings @ \$.10 each	5.00
Total		\$ 779.42

Labor (Rough)

*Text--Table 13-11, pg. 377

4 Plumbers @ \$2.00/hr.
4 Helpers @ \$1.00/hr.
Average team hr. is \$3.00/hr.

PLUMBING (Cont'd)

Sewer Line

50' long, 7' deep, dug and backfilled by laborers--45 hrs. @ \$1.00 per hr.	\$ 45.
Installing sewer pipe--	
200 joints, .30 team hrs./joint @ \$3.00/hr.	130.

Water Line

40 joints, 1½" to 4" pipe, .30 team hrs/joint @ \$3.00/hr.	36.
500 joints, ¾" pipe, .2 team hrs/joint @ \$3.00/hr.	300.

Gas Line

60 joints, 1" pipe, .15 team hrs/joint @ \$3.00/hr.	27.
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Miscellaneous

Laundry trubs, 5 hrs. @ \$3.00/hr.	15.
Floor Drain, 3 hrs. @ \$3.00/hr.	9.
Lead, oaken, and tools	100.
Gas charge (\$150 plus \$10 for building permit)	160.

Total	\$ 872.
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Materials (Finish)

*Text--Table 13-12, pg. 383

16 kitchen sinks and dishwashing compartments @ \$120 each	\$ 1920.
16 kitchen sink drains @ \$60 each	960.
3 water softeners @ \$300 each	900.
1 water tank (1000-gallon--hot water)	1500.
Insulation for water tank	50.
16 Bath tubs @ \$125 each	2000.
16 Lavatories @ \$35 each	560.
16 Water Closets complete @ \$50 each	800.
5 Laundry Tubs @ \$27 each	135.

Total	\$ 8825.
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PLUMBING (Cont'd)

Labor (Finish)

*Text--Table 13-13, pg. 384

Fixtures

16 Lavatories; 5 hrs. @ \$3.00/hr.	\$ 256.
16 Water Closets; 6 hrs. @ \$3.00/hr.	288.
16 Kitchen sinks, large, 8 hrs @ \$3.00/hr.	384.
16 Bath tubs; 10 hrs @ \$3.00/hr.	480.
3 Water softeners; 15 hrs @ \$3.00/hr.	135.
1 Water tank and insulation; 40 hrs., @ \$3.00/hr.	120.
16 Kitchen sink drains; 1 hr. @ \$3.00/hr.	48.

Total	\$ 1711.
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<u>Summary</u>	<u>Unit</u> <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Material (16 apartments)	600.28		9604.42	
Labor (16 apartments)	161.44	2533.		
			2533	9604.42
				<u><u>\$12187.42</u></u>

HEATING

Materials

*Text--Table 13-1, pg. 373

1500'	1½" pipe, galvanized steel @ \$15/100 ft.	\$ 225.
1500'	2½" pipe, galvanized steel @ \$45/100 ft.	675.
100	check valves @ \$1.50 each	150.
45	control valves @ \$2.30 each	107.
50	reducers and bushings @ \$.15 each	7.50
110	elbows, 1½" @ \$.35 each	38.50
84	T's 1½" @ \$.50 each	42.
200	Pipe hangers @ \$.30 each	60.
20	4' heaters and grills @ \$75 each	1500.
32	2½' heaters and grills @ \$50 each	1600.
3000'	asbestos insulation @ \$.15 per ft.	450.
100	elbows, 2½" @ \$.60 each	60.
84	T's 2½" @ \$.80 each	67.50
36	Thermostats--complete @ \$10 each	360.
32	sq. yd. asbestos-concrete insulation @ \$1 per sq. yd.	32.
Total		\$ 5374.50

Labor

*Text--Table 12-10, pg. 349

150 joints, 1½" pipe, .3 team hrs @ \$3.00/hr.	\$ 135.
150 joints, 2½" pipe, .3 team hrs @ \$3.00/hr.	135.
3000' asbestos pipe covering, 3 hrs/100 ft. @ \$3.00/hr.	270.
36 Thermostats, 5 hrs. @ \$2.00/hr.	360.
52 Convectors and grills, 2 hrs. @ \$3.00/hr.	312.
Total	\$ 1212.

<u>Summary</u>	<u>Unit</u>			
	<u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Material (52 units)	103.		5374.50	
Labor (52 units)	23.31	1212.		
				<u>1212. 5374.50 6536.50</u>

ELECTRICAL WORK

Spec.--Use 3/4" conduit in floor slab,
1/2" conduit in other than floor slab.
Mounting height of receptacles 18".
Conduits for telephones 1/2" except
1" in basement.

Materials (Rough Work)

*Text--Tables 14-5,6,7,8, pgs. 396-407

Basement

3	100 KVA breaker switches @ \$15.	\$ 45.
24	100A fuse and boxes @ \$2.25	54.
120	240 volt junction boxes, \$20/100	24.
6	100A--3P-575V transformers @ \$75.	450.
1	60A---3P-575V transformers @ \$55.	55.
16	Meters (company installed)	
16	35-60A cutout switches @ \$3.25	52.
300	ft. conduit (10 ft. lengths) 3/4" @ \$10/100 ft.	30.
1000	ft. conduit (10 ft. lengths) 1/2" @ \$9/100 ft.	90.
300	Couplings 3/4" @ \$10/100	30.
300	Locknuts 3/4" @ \$3/100	9.
100	Couplings 1/2" @ \$9/100	9.
100	Locknuts 1/2" @ \$3/100	3.
2000	Galvanized Steel Straps, @ \$2/100	40.

The above list was taken from Barker-Fowler Electric Co., Lansing, Mich. (Contractor's price), because the text is inadequate for data regarding installation of switches and transformers for a building of this size.

The following will be taken from the text.

600 ft. #14 rubber covered indoor wire @ \$5/1000ft.	3.
400 ft. #12 rubber covered indoor wire @ \$9/1000ft.	3.60
600 ft. #8 rubber covered indoor wire @ \$22.50/1000 ft.	13.80

1st, 2nd floors and halls

16 apartments--110' per apartment, #14 wire @ \$6.50/1000 ft.	11.40
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ELECTRICAL WORK (Cont'd)

2	Halls--441', #14 wire @ \$6.50/1000 ft.	5.70
2500	ft. conduit, 1/2" @ \$9/100 ft.	225.
250	Couplings, 1/2" @ \$3/100	7.50
250	Locknuts, 1/2" @ \$3/100	7.50
50	Adapters, 1/2" @ \$5/100	2.50
110	Connectors, 1/2" @ \$9/100	9.90
250	Metal Straps, 1/2" @ \$3/100	7.50
210	Outlets @ \$17/100	36.

Total

\$ 1224.40

Labor

*Text--Tables 14-9,10,11, pgs. 397-400

1	Main Switch @ 2 hrs.	2 hrs.
3	Breaker Switches, @ 1.5 hrs.	4.5 hrs.
120	240V junction boxes @ .3 hrs.	36.0 hrs.
7	Transformers @ 3 hrs.	21.0 hrs.
16	Meters, 480V-3P @ 1 hr.	16.0 hrs.
16	30-60A Cutout Switches @ 2.2 hrs.	35.0 hrs.
4000	ft. conduit, boxes, etc. @ 14 hrs/100 ft.	560.0 hrs.
210	Outlets @ .3	63.0 hrs.

Total hours

737.5

Average labor \$2.50 per hour

737.5 hrs. X \$2.50 per hr.

Total

\$1850.00

Materials (Finish)

*Text--pg. 403

Fasement

Hot Water circulating pump motor (220--3/4 H.P.--3P)	\$ 150.
2 Unit Heaters (Laundry) @ \$300.	600.
18 Ceiling Fixtures @ \$1.50	27.
2 Duplex receptacles @ \$.75	1.50
4 Single wall switches @ \$.50	2.

ELECTRICAL WORK (Cont'd)

Halls

20 Ceiling fixtures @ \$3.	\$ 60.
16 Buzzers, wire, etc. @ \$2.60	41.60
6 Female duplex receptacles @ \$.75	4.50
3 Three-way switches @ \$3.	9.00

Apartments

16 Six female plugs, 125V @ \$.20	19.20
16 Two wall light fixtures @ \$.2.	64.
16 Two overhead fixtures @ \$.2.25	91.20
96 Single wall switches @ \$.50	48.

Total

\$ 1118.

Labor

*Text--Table 4-11, pg. 404

2	Unit Heaters @ 5 hrs.	10.0 hrs.
70	Ceiling Fixtures @.5 hrs.	35.0 hrs.
16	Buzzers, phone & wire @ 1 hr.	16.0 hrs.
108	Receptacles @ .3 hrs.	32.0 hrs.
100	Single wall switches @ .3 hrs.	30.0 hrs.

Total hrs.

123.0

Average labor wage 2.50 per hr.

123.0 hrs. X \$2.80 per hr.

Total

307.50

Summary

<u>Summary</u>	<u>Unit</u> <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Materials (16 apts.)			2342.40	
Labor (16 apts.)		2157.50		
		2157.50	2342.40	4499.90

ROOFING AND FLASHING

Spec.--The entire roof of all buildings shall be covered with asbestos shingles. These shingles shall be made from pure asbestos fibres and Portland cement formed into shape under hydraulic pressure.

Roof slope is 1 : 2

Area

2 X 14'0" X 41'0" X 1.414	=	646 sq. ft.
2 X 3'6" X 41'0" X 1.414	=	334 sq. ft.
2 X 3'6" X 39'6" X 1.414	=	555 sq. ft.
2 X 90'4" X 19'2" X 1.414	=	4350 sq. ft.
		6435 sq. ft.

This job was subcontracted to Lansing Roofing Co., Lansing, Michigan. Their present prices are as follows:

Felt base, asbestos shingles, copper flashing,
copper valleys and nails ---- \$13.00 per square

Labor----- 13.00 per square

Total \$26.00 per square

Summary

	<u>Unit</u>	<u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Material (64.35)	13.			836.50	
Labor (64.35)	13.	836.50			
		836.50	836.50		<u><u>\$1673</u></u>

LATH AND PLASTER

Spec.--The walls and ceilings of all the rooms of apartments except the baths and spaces on sidewalls under linoleum and entire backwall behind cupboards in the kitchenettes, the walls and ceilings of all stair halls and corridors, and soffits of steel stairs, landing, etc. shall be a two-coat plaster on gypsum lath. Walls and ceilings of bathrooms shall be a three-coat plaster on metal lath. The ceilings will be suspended.

Gypsum lath shall be 16" X 48" X 1/2". Gypsum neat plaster shall be mixed in proportion of 1 part of gypsum neat plaster and not more than 2 parts sand by weight. Solid plaster shall not be less than 2 inches thick.

Plaster Surface

Basement

1	X	35'8"	X	17'0"	=	605 sq. ft.
2	X	35'8"	X	8'0"	=	570 sq. ft.
2	X	17'0"	X	8'0"	=	270 sq. ft.

Walls (1st and 2nd Floors)

16	X	137'6"	X	7'6"	=	22500 sq. ft.
----	---	--------	---	------	---	---------------

Walls (Vestibules)

4	X	34'4"	X	9'0"	=	1200 sq. ft.
---	---	-------	---	------	---	--------------

Walls (Halls)

4	X	90'4"	X	7'6"	=	2700 sq. ft.
---	---	-------	---	------	---	--------------

Ceilings

2	X	143'0"	X	37'8"	=	10700 sq. ft.
---	---	--------	---	-------	---	---------------

Total						43,545 sq. ft.
-------	--	--	--	--	--	----------------

No openings less than
2 sq. yds. were deducted.

LATH AND PLASTER (Cont'd)

Plastering

Materials

*Text--Table 10-7, pg. 322

Plaster per 100 sq. yds. of surface
1" thick 2.95 cu. yds./100 sq. ft.

Plaster lbs. per 100 sq. yds.

Gypsum---	1800 lbs @	\$22.00/ton	\$13.
Sand-----	3600 lbs @	\$ 2.50/ton	4.50
			<u>\$22.50</u>

43,545 sq. ft. or 16,200 sq. yds.

Labor

*Text, pg. 329

Scratch coat (Plasterer and helper)	10 hrs.
Finish coat (Plasterer and helper)	<u>11 hrs.</u>
Total hrs. per 100 sq. yds.	21 hrs.

Cost of plasterer and helper---\$5.00 per hr.

<u>Summary</u>	<u>Unit</u> <u>Cost</u>	<u>Labor</u>	<u>Mat.</u>	<u>Total</u>
Materials (16.2)	22.50		3650.	
Labor (339)	5.00	1695.		
		<u>1695</u>	<u>3650</u>	<u>\$5345</u>

LATH AND PLASTER (Cont'd)

Lathing

Materials

*Text, pg. 312

Metal furring---\$5.00/100 lin. ft.

Rocklath-----\$32.00/100 sq. yd.

Corner beads----#5.00/100 lin. ft.

Corner reinforcements (hall)s-- 3.00/100 lin. ft.

Nails-----4 lbs/100 sq. ft. @ \$.05 per lb.

Labor

*Text--Tables 11-2, 11-4, pg. 315

Labor for applying rocklath--

Hrs. per sq. yd. 16 c/c, 12 hr/1000 sq. yds.

Labor for applying metal lath--

Grounds and furring, 3 hrs/100 lin. ft.

Head and corner reinforcement 3 hrs/100 lin. ft.

2.50 per hr. lathers. This operation is done by plasterers also.

[illegible]

FINISHING HARDWARE

Spec.--All hardware shall be neatly packed in substantial packages, each properly labeled with the description of the location of the hardware in the building, and shall be delivered promptly from time to time so as not to cause delay.

All cylinder locks masterkeyed in one set. Furnish six master keys. Locks for A, E, C and D entrance doors and for M and F doors to basement. Service rooms shall be keyed alike.

A-B-C-D Entrance Doors--2-1/4"

1 Pair Butts 242 P 5 X 5
1 Two Cylinder Padlock 324 $\frac{1}{2}$ MK
1 Latchset 1000 X D 35 X 2 - D222
1 Door Stop and Holder 2864

M Basement Rooms--1-3/4"

1 Pair Butts 242P, 4 X 4
1 Cylinder Lock set 7790 MK X D035 X TCO
1 Door Stop 2812

F Apartment Bedroom Doors--1-3/4"

1 Pair Butts, 242 P 4 X 4
1 Latchset TCO 231
1 Door Stop 2815

F Apartment Entrance Doors--1-3/4"

1 Pair Butts, 242P, 4 X 4
1 Cylinder Lockset 7790 MK X D034 X TCO
1 Door Stop 2815

H Doors to Bath---1-3/8"

1 Pair Butts 242P, 4 X 4
1 Latchset TCO 231
1 Door Stop 2815

F Doors to Basement Storage

L Doors to Vestibule - Main Building 1 3/4"

E Doors in Corridors - 1 3/4"

E Doors Basement Laundry & Drying Rooms 1 3/4"

E Doors to Basement 1 3/4"

1 Pair Butts 242P, 4 X 4
1 Latchset TCO 231
1 Door Stop 2815

FINISHING HARDWARE (Cont'd)

Kitchen Cabinets, 3/4", 3/8" lip

- 1 Pair Hinges 1531 - type 6
- 1 Friction Catch #5 Best
- 1 Door Pull 476
- 1 Drawer Pull 476

Wardrobe, Coat & Linen Closet, Fire Ext. Doors 3/4"

- 1 1/2 Pair Hinges 1534P, 2 1/2" for tall doors
- 1 Pair Hinges 1534P, 1 1/2" for small upper doors
- 1 Friction Catch #10 Best for tall doors
- 1 Friction Catch #5 Best for small upper doors
- 1 Oak Knob 1 1/2" for tall doors
- 1 Oak Knob 1 1/4" for small upper doors

Package Doors, 3/4"

- 1 Pair Hinges 1534P, 1 1/2"
- 1 Friction Catch #5 Best
- 2 Door Pulls 476

K Janitor Closet Doors, 1 3/8"

- 1 Pair Butts 242P, 3 1/2 X 3 1/2
- 1 Deadlock 324 MK
- 1 Pull D034 X TCO X F2189

J Closet Doors, 1 3/8"

- 2 Pair Butts 242P, 3 1/2 X 3 1/2
- 1 Latchset TCO 231
- 2 Door Stops 2315
- 2 Flush Bolts, 393 1/2, 6" X 3/4" plate

Entrance Doors

- 1 Set of bronze name plates above doors

Summary

Due to lack of information, the above list was submitted to Schaberg-Dietrich, Lansing, Michigan, who gave me the following approximate estimate.

Labor for installation	\$2500.
Materials	<u>1000.</u>
Total	<u><u>\$3500.</u></u>

PAINTING AND DECORATING

Spec.--The entire interior of this building shall be finished. Trim, doors, windows, and ceilings of baths and kitchenette-dinettes shall be enameled. All other walls and ceilings shall be finished with flat paint.

Baths and kitchenette-dinettes

1 coat of paint
1 coat of half paint and half enamel
1 coat of gloss enamel

Basement

2 coats of paint

All other spaces including corridors

1 coat of paint
1 coat of half paint and half enamel
1 coat of semi-gloss enamel

Miscellaneous Iron

Outside pipe railings and wrought iron rails , balusters and posts shall receive two additional coats of dull black metallic paint.

All steel stairs shall have two coats of dull metallic black paint and one coat of satin finish black enamel.

Material

*Text--Table 15-2, pg. 411

Approximate covering capacity of paint material, square feet per gallon per coat.

Interior flat paint	450 sq.ft./gal.
Interior gloss paint	350 sq.ft./gal.
Varnish	300 sq.ft./gal.
Stain	400 sq.ft./gal.
Good ready mixed paint (exterior)	500 sq. ft./gal.

PAINTING AND DECORATING (Cont'd)

Labor

*Text--Table 15-4, pg. 414

Approximate labor hours required for painting different surfaces, hours per 100 sq. ft. for one coat.

Exterior Work:

Doors, windows, posts, rails, etc., .85 hr. per 100 sq. ft.

Interior Work:

Staining	.60 hr per 100 sq. ft.
Varnishing	.70 hr per 100 sq. ft.
Flat Paint	.75 hr per 100 sq. ft.
Enamel	.75 hr per 100 sq. ft.
Stair Posts	.30 hr per 100 sq. ft.
Cornices, etc.	.30 hr per 100 sq. ft.

Used 6 painters @ \$2.00/hr plus 1 foreman @ \$2.25/hr.

Average labor hour is \$2.35

Total surface area of plaster is 48,565 sq. ft.

1st and 2nd floor windows is 3720 lin. ft.

Floor and wall trim is 400 lin. ft/apartment

Doors for basement, 1st and 2nd floors is 82 doors
@ 42. sq. ft. per door or 3440 sq. ft.

Stair rails and balusters, 170 lin. ft. (2 coats of black enamel)

PAINTING AND DECORATING (Exterior)

Cornices and moldings

236'6" X 3'6" = 927 sq. ft.

Door frames and ornamental work

2 X 8'6" X 2'4" = 39 sq. ft.

Total 966 sq. ft.

Windows

3720 lin. ft.

Materials

Cornices, moldings, door frames and
ornamental work

2 coats--966 sq. ft./ 450 sq. ft. per gal.
@ \$3.00/gal. \$ 12.90

Windows

3720 lin. ft., .2 gal./lin ft.
@ \$3.00/gal. 22.30

Miscellaneous

Scaffolds and ladders (transportation) 10.

Labor

Cornices, moldings, door frames and
ornamental work

966 sq. ft., 1 hr per 100 sq. ft.
@ \$2.35 per hr. 22.56

Windows

3720 lin. ft., .3 hr per 100 lin ft.,
@ \$2.35 per hr. 26.30

Summary

Total \$ 94.06

PAINTING AND DECORATING (Interior)

Materials

Walls and vestibule:

1 coat flat paint, 40.1 squares/4.5 squares/gal.	270.
@ \$3.00/gal.	
1 coat half paint; 40.1 squares/4.5 squares/gal.	290.
@ \$3.25/gal.	
1 coat enamel; 40.1 squares/4.5 squares/gal.	310.
@ \$3.50/gal.	

1st and 2nd floor windows (3720 lin. ft.):

Stain--1 coat; .25 gal/100 ft. X 37.2	
@ \$2.10/gal.	15.60
Varnish--2 coats; .2 gal/100 ft. X 37.2	
@ \$3.20/gal.	46.

Doors:

Stain--1 coat; 3440 sq. ft./400 sq.ft./gal.	
@ \$2.10/gal.	18.15
Varnish--2 coats; 3440 sq. ft./400 sq.ft./gal.	
@ \$3.20/gal.	55.

Wall Trim (1st and 2nd Floors):

400 lin. ft./apartment--16 apartments	
.25 gal/100 lin. ft.	
Stain--1 coat; 400 X 16 X .25 X \$2.10/gal.	33.60
Varnish--2 coats; 400 X 16 X .25 X \$3.20/gal.	96.

Stairs and balusters:

2 coats--600 lin. ft.; .25 gal/100 lin. ft.	
@ \$3.00/gal.	9.

Labor

Walls and vestibules:

3 coats--40,100 sq. ft. @ .74 hr/100 sq. ft.	
@ \$2.35/hr.	210.

1st and 2nd floor windows:

3 coats--3720 lin. ft. @ .3 hr/100 lin. ft.	
@ \$2.35/hr.	78.50

Doors:

3 coats--3440 sq. ft. @ .7 hr/100 sq. ft.	
@ \$2.35/hr.	170.

Wall Trim (1st and 2nd floors):

3 coats--6400 lin. ft. @ .3 hr/100 lin. ft.	
@ \$2.35/hr.	136.

PAINTING AND DECORATING (Interior)-(Cont'd)

Stairs and balusters:

2 coats--600 lin. ft. @ .3 hr/100 lin. ft.

@ \$2.35/hr.

8.45

Total

\$1736.35

LINOLEUM

Spec.--All linoleum shall be 1/8" thick and shall be made by Armstrong-Cork Company or other equal and approved manufacturer.

The linoleum on the countertop shall be cemented to the felt which will be laid on the floor, with splash backs in the kitchen.

Area

8 apartments	20'4"	X	14'6"	=	2400 sq. ft.
8 apartments	45'2"	X	15'3"	=	5520 sq. ft.
			Total		7290 sq. ft.

The following cost of materials and labor was submitted by Clawson and Company, Lansing, Michigan.

Summary

Linoleum (Standard weight), felting, trim, and labor ---- \$1.35/sq. yd.

880 sq. yds.	X	\$1.35	=	<u><u>\$1188</u></u>
--------------	---	--------	---	----------------------

ASPHALT TILE

Spec.--Provide and lay an emulsified floor topping to level up concrete floor slabs in preparation for asphalt tile flooring over the entire area of the first and second floors of the building, where asphalt tile will be laid.

4 vestibules	26'4"	X	7'9"	=	750 sq. ft.
4 hallways	90'4"	X	5'6"	=	2000 sq. ft.
Total					<u>2750 sq. ft.</u>

The following costs for materials and labor were taken from Clawson & Co., Lansing, Michigan

Summary

Materials and labor @ \$.15/sq. ft.	
2750 sq. ft. X \$.15	\$ 415.
(Floor leveling)	

Materials and labor @ \$.35/sq. ft.	
2750 sq. ft. X \$.35	965.
(Asphalt tile--1/8" thick)	

Materials and labor @ \$.20/sq. yd.	
300 sq. yds. X \$.20	60.
(Metal Trim)	

Total

1440

INSULATION (Rock Wool)

Spec.--Provide an insulation fill on the second floor ceilings of all buildings. This fill shall be $2\frac{1}{2}$ " thick on corrugated iron forming carried on the steel joists.

<u>Area</u>				
2	X	26'4"	X	37'8" = 1920 sq. ft.
1	X	90'4"	X	36'0" = <u>3250 sq. ft.</u>
Total				5170 sq. ft.

The materials and labor costs were obtained from Murphy Supply Co., Lansing, Michigan

Summary

Materials and labor

$2\frac{1}{2}$ " thick rock wool (loose) \$.12/sq. ft.

5170 sq. ft. X \$.12 = \$620

General ExpenseLabor Mat. Total

Superintendent 4 mos. @ \$350.
Engineer 4 mos. @ \$300.
Timekeeper 4 mos. @ \$200.
Watchman 4 mos. @ \$150.
Office and Sheds
Equipment
Tools
Concrete Tower and Hoist
Temporary Water
Temporary Light
Temporary Heat
Temporary Phone
Barricades
Clean Up
Permit
Liability Insurance \$21,600 @ .3.
Fire Insurance (College)
Social Security 2% (\$21,600)
Michigan Sales Tax 3% (\$69,000)

\$1400.
1200.
800.
600.

400.
700.
380.
200.
15.
20.
30.
14.40
110.
170.
10.
73.80

432.
2070.

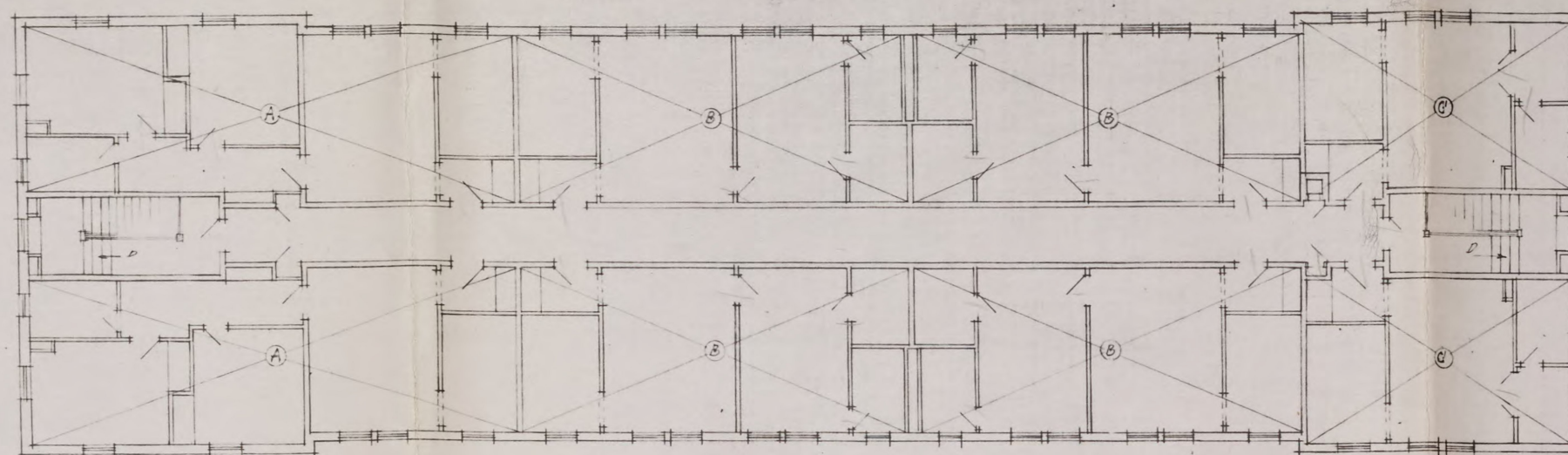
\$4000. \$4625.20 \$3625.20

CONCLUSION

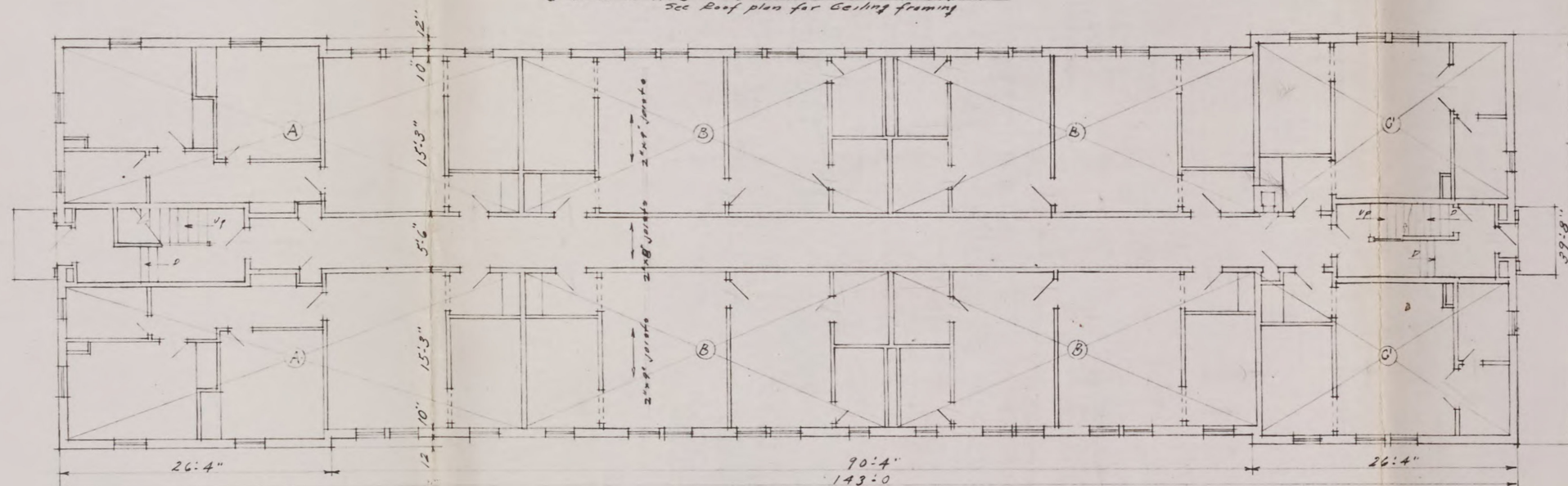
While writing this thesis, I have endeavored to present one possible approach to a quantity and cost estimate, especially without previous experience. I wish to emphasize the sole purpose was to incorporate the basic aspects of systematically dealing with this problem; therefore, the calculations were approximated with a slide rule and greater emphasis was placed on the actual extraction of material.

Some of the materials were purchased at a premium because the building was constructed on a cost plus basis. The prices taken from the text were the mean of the price and wage scales. Prices of material and labor that could not be obtained from the text source were obtained from local business establishments at 1948 prices.

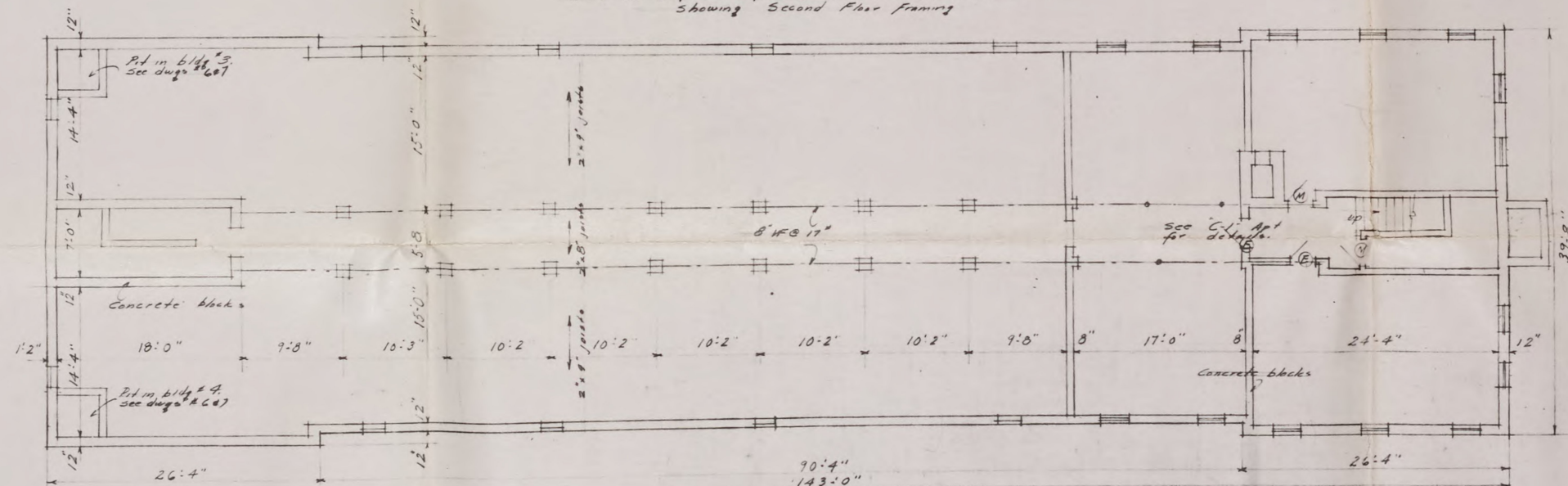
This quantity and cost estimate is a probable cost and not the actual cost. My objective was to present to myself a fairly complete picture of cost analysis. The actual cost for eleven buildings of this type was \$1,375,000. My estimate for one building was \$110,344.84.



SECOND FLOOR PLAN
See Roof plan for Ceiling framing



FIRST FLOOR PLAN
Showing Second Floor Framing



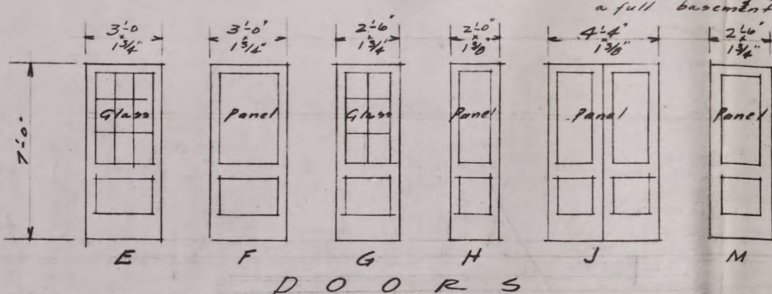
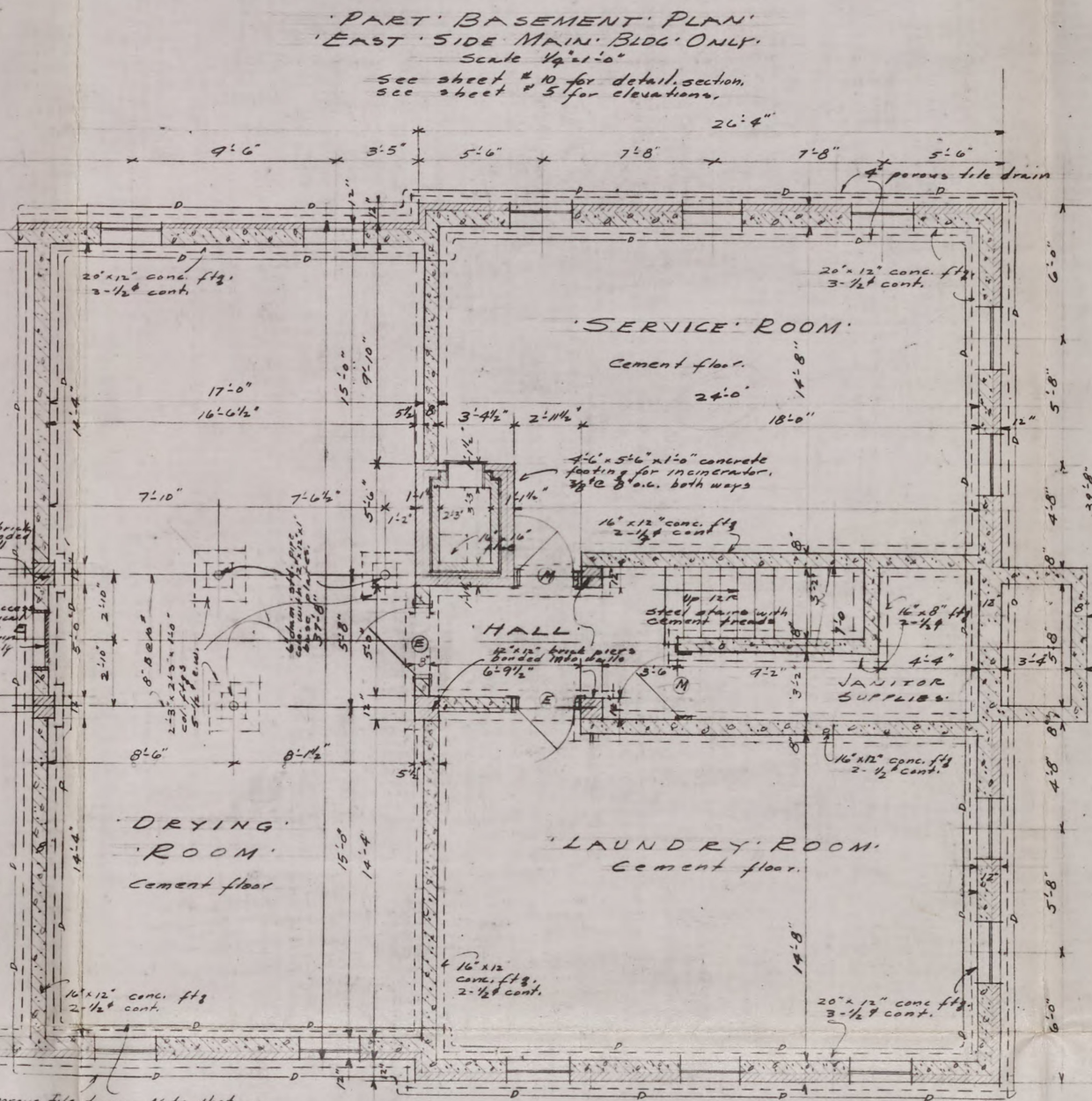
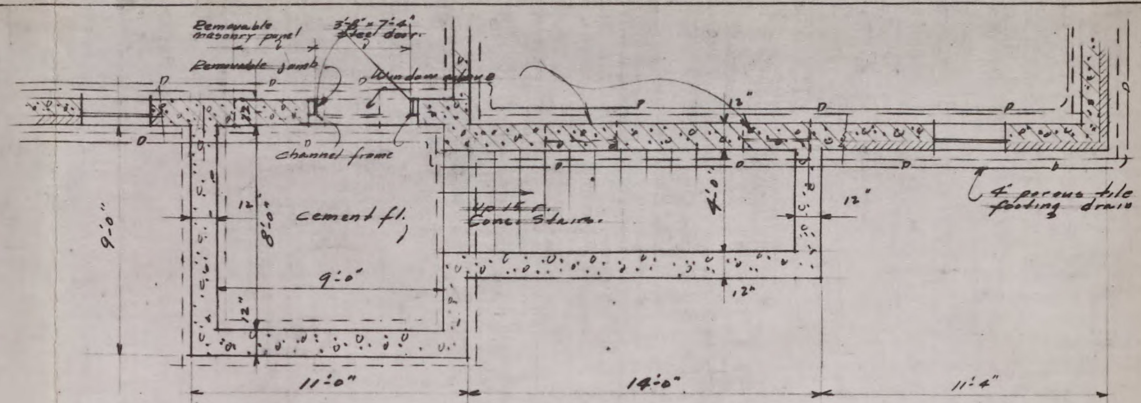
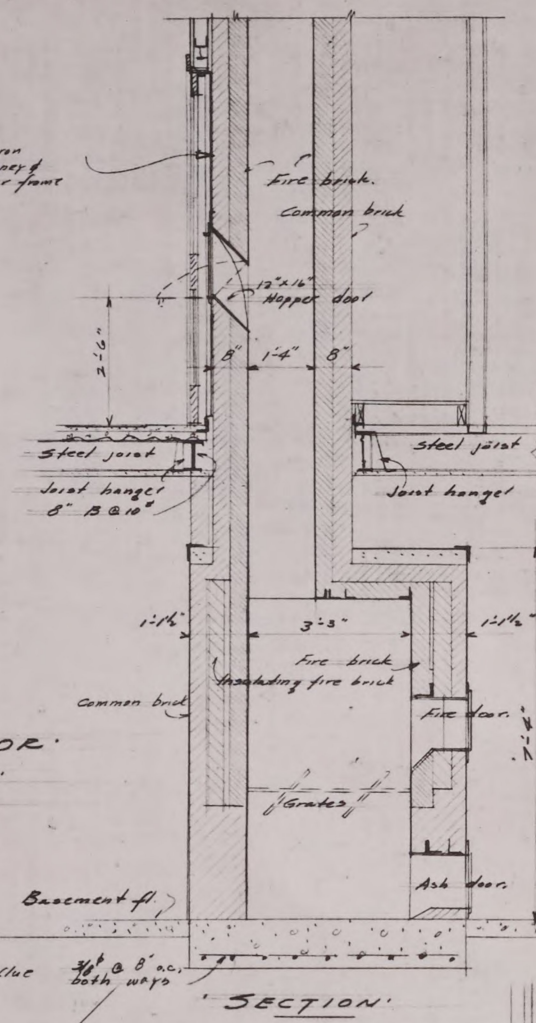
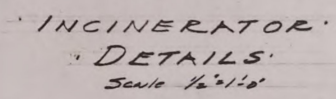
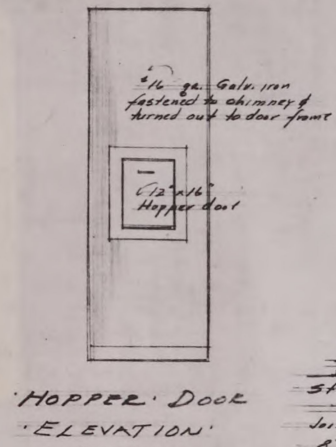
BASEMENT PLAN
Showing First Floor Framing

NOTE.- BUILDING #3 SHOWN
BLDGs. #5 & #6 SIMILAR.
BLDGs. #2 & #4 OPP. HAND
REVERSED.

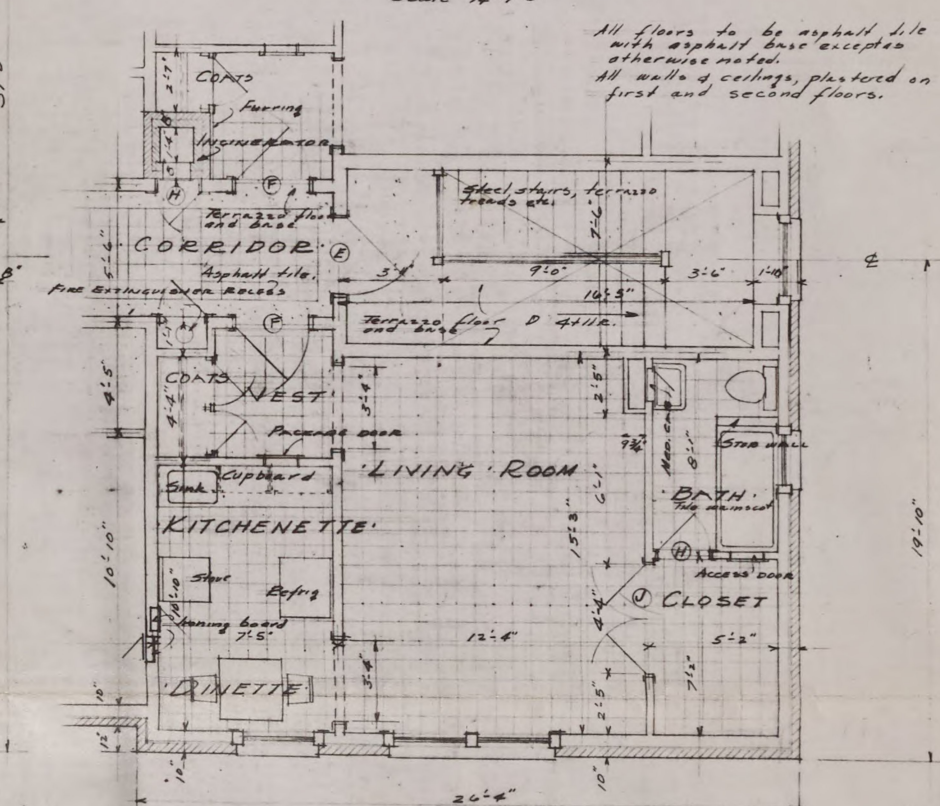
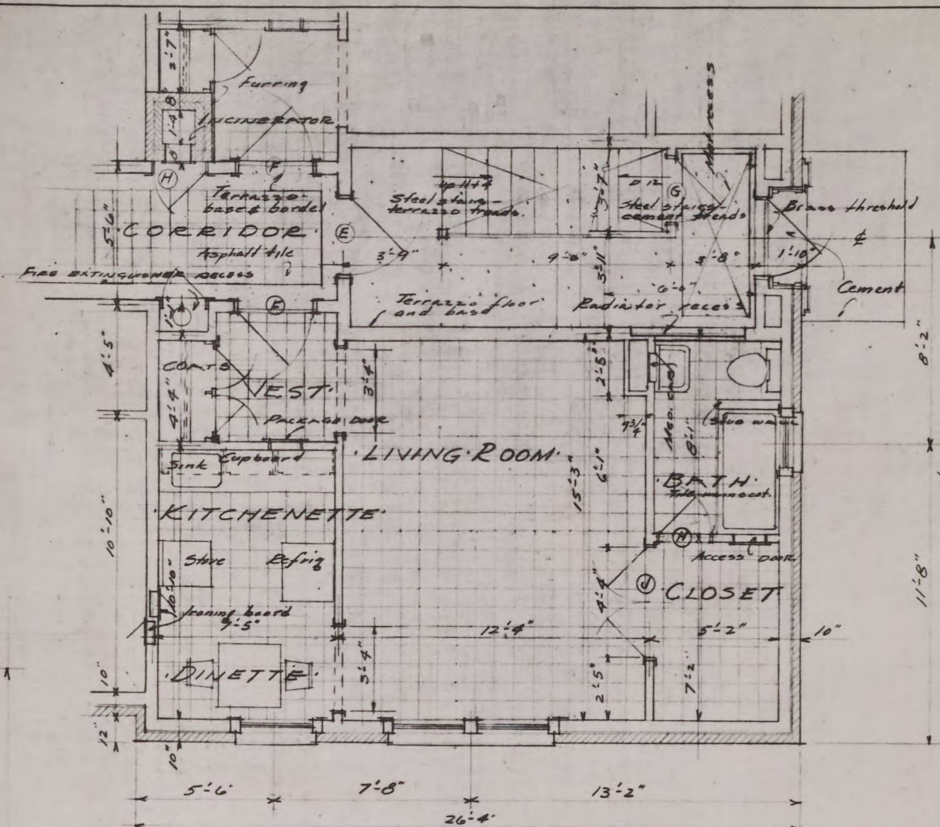
SEE PLOT PLAN ARRANGEMENT.

TYPICAL BUILDING

MARRIED VETERAN STUDENTS HOUSING
MICHIGAN STATE COLLEGE
EAST LANSING MICH

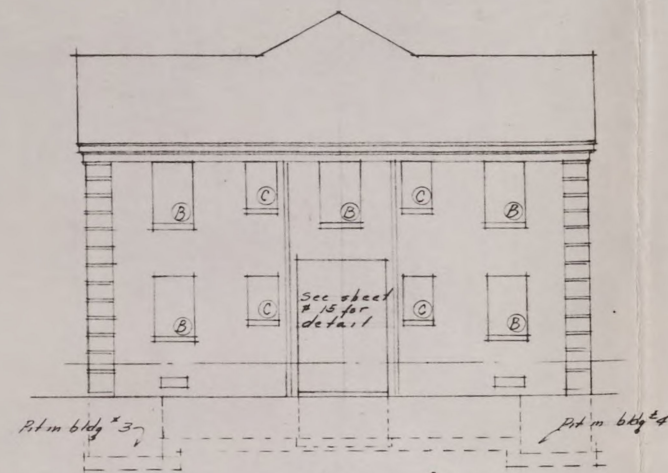


This plan applies as shown to all units of typical buildings, opposite hand as required. See plot plan & mechanical plans. South end of Main building will be same except opposite hand. North end of Main building will have no Laundry or Drying Room. See layout plan on sheet #4 for basement in Main Bldg.

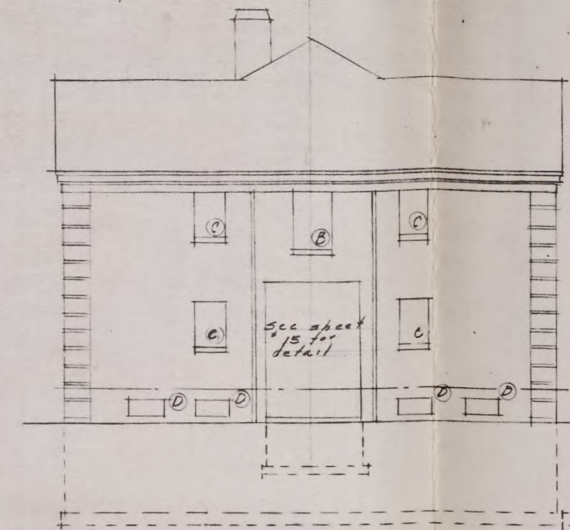


BUILDINGS ARE SYMMETRICAL ABOUT CENTER LINE EXCEPT AS OTHERWISE NOTED.

TYPE C-1. APARTMENT.
MARRIED VETERAN STUDENTS HOUSING
MICHIGAN STATE COLLEGE
EAST LANSING MICH.

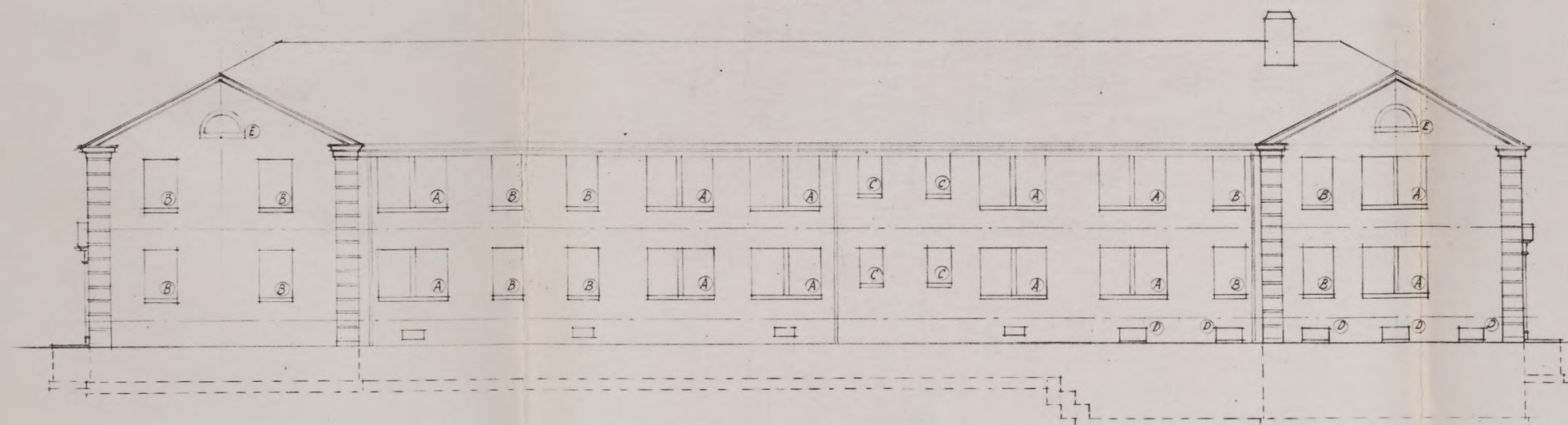


END ELEVATION
One elevation thus.

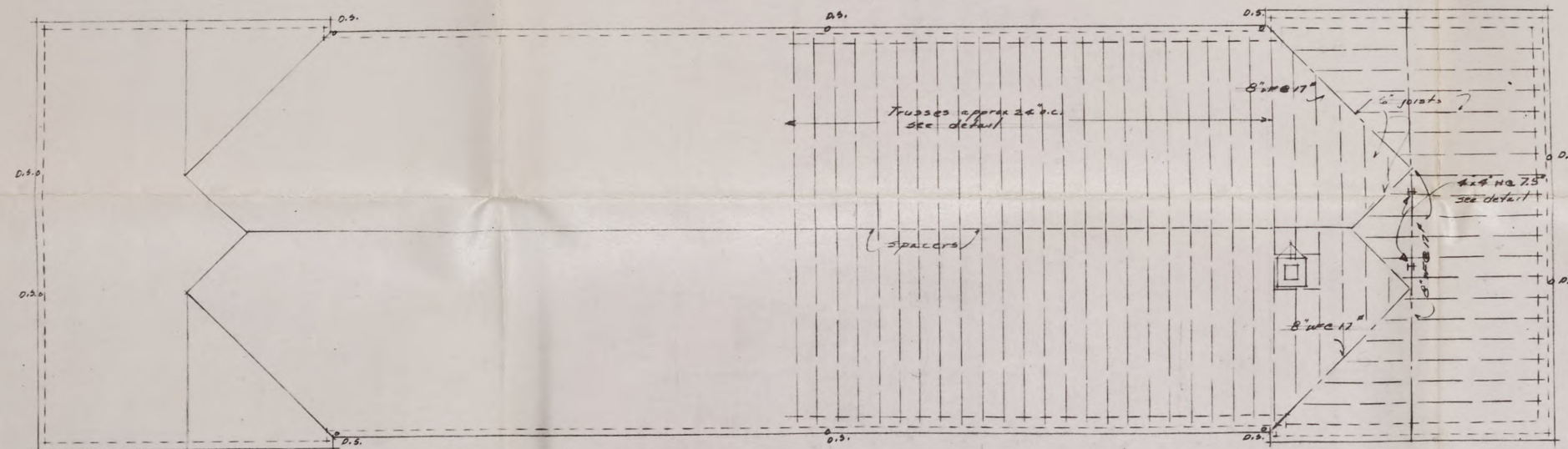


END ELEVATION
One elevation thus.

SCALE 1/8"=1'-0"

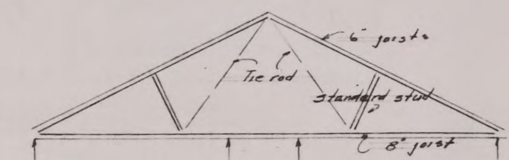


SIDE ELEVATION
Opp. side similar.

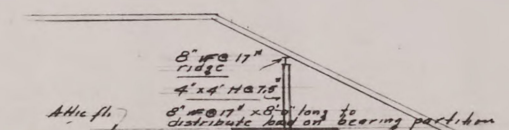


ROOF PLAN
SCALE 1/8"=1'-0"

Framing symmetrical about C.

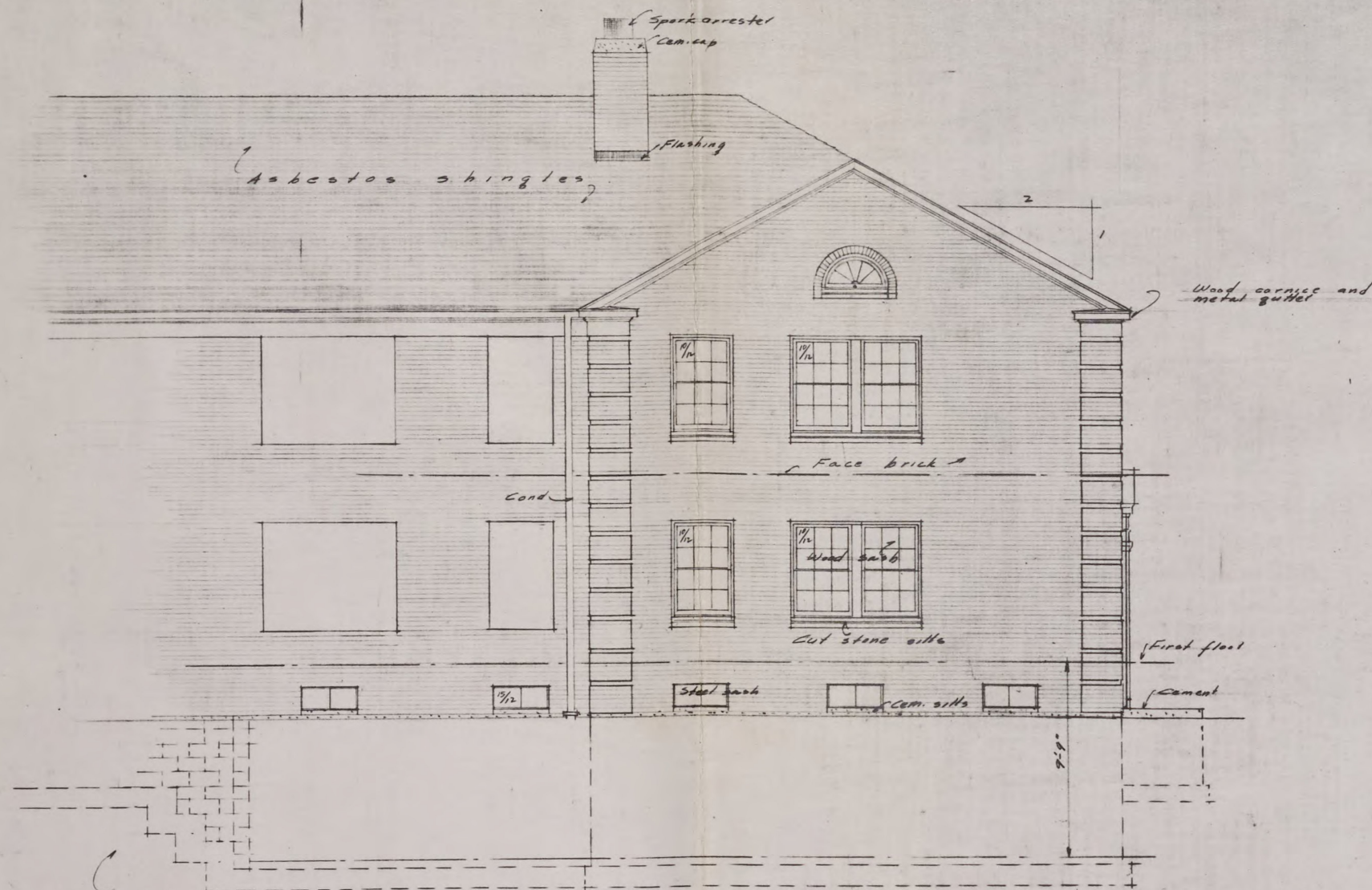


TYPICAL TRUSSES 24' o.c.
All joints welded.
No scale

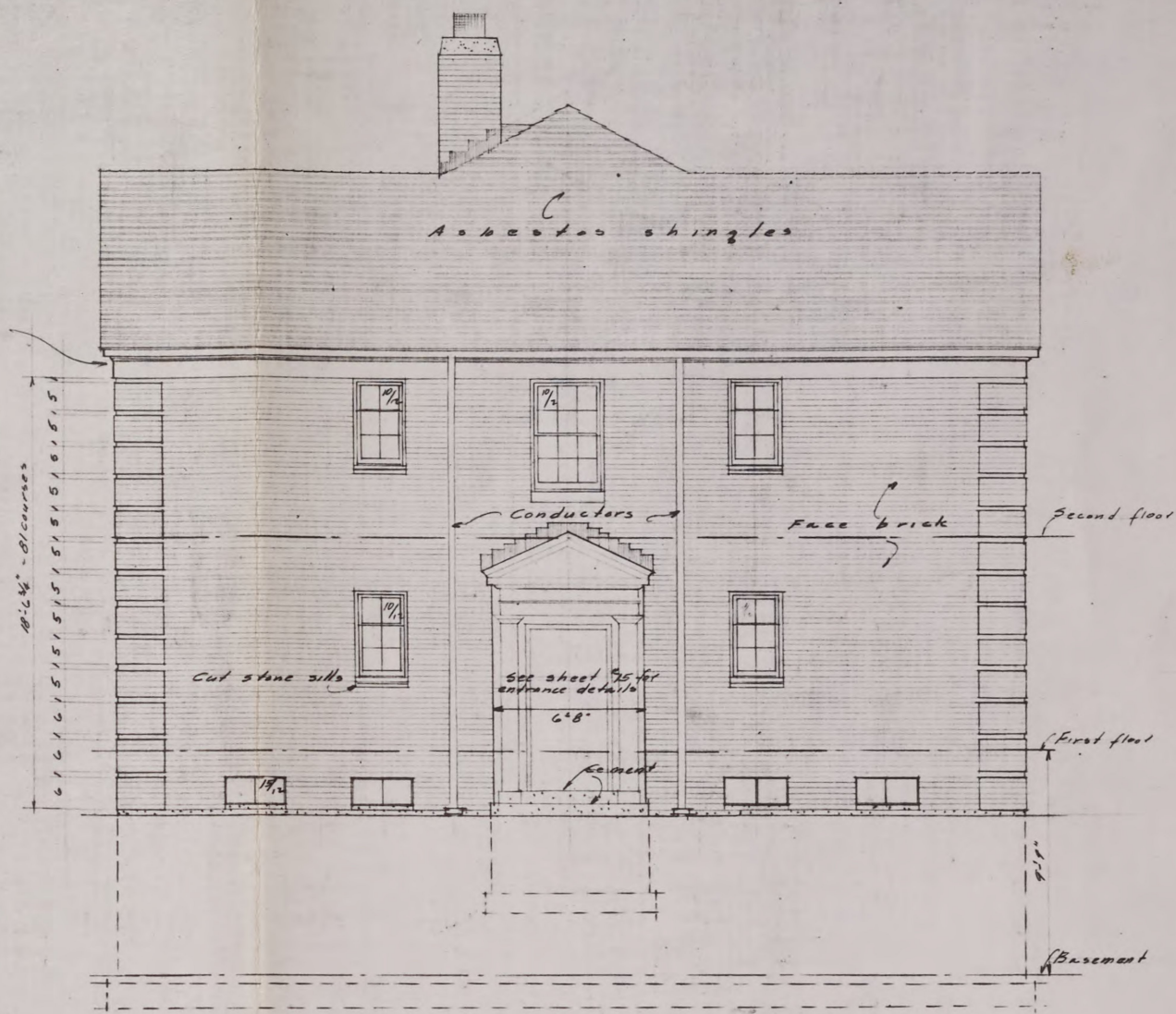


COLUMN DETAIL
No scale

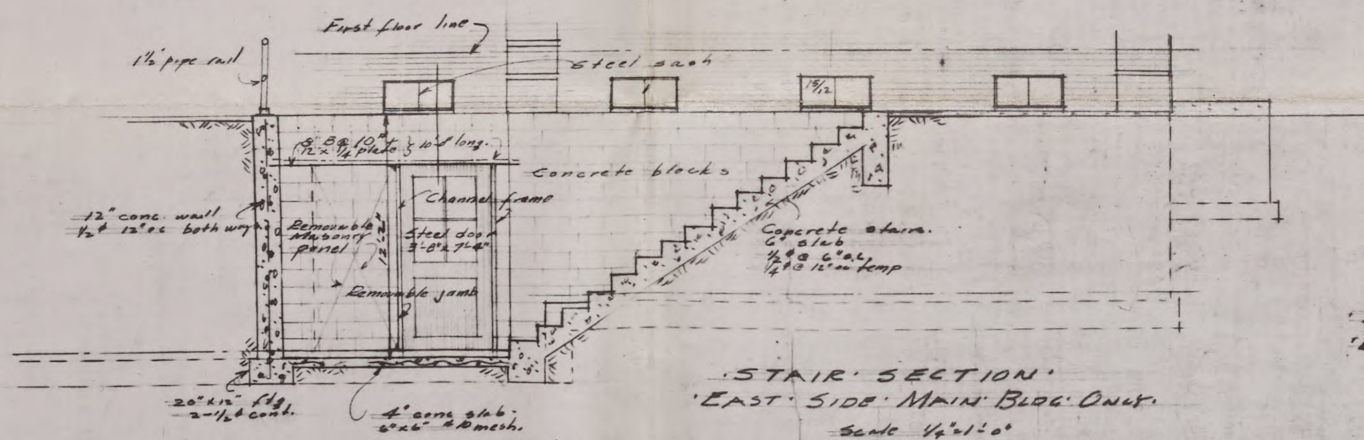
TYPICAL BUILDING
MARRIED VETERAN STUDENTS HOUSING
MICHIGAN STATE COLLEGE
EAST LANSING MICH



'SIDE ELEVATION'
'TYPICAL BUILDING'

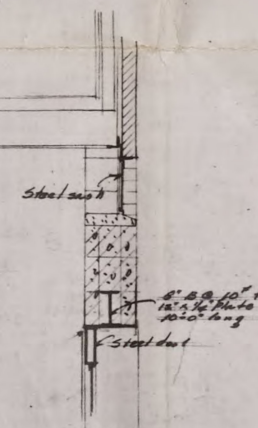


'END ELEVATION'

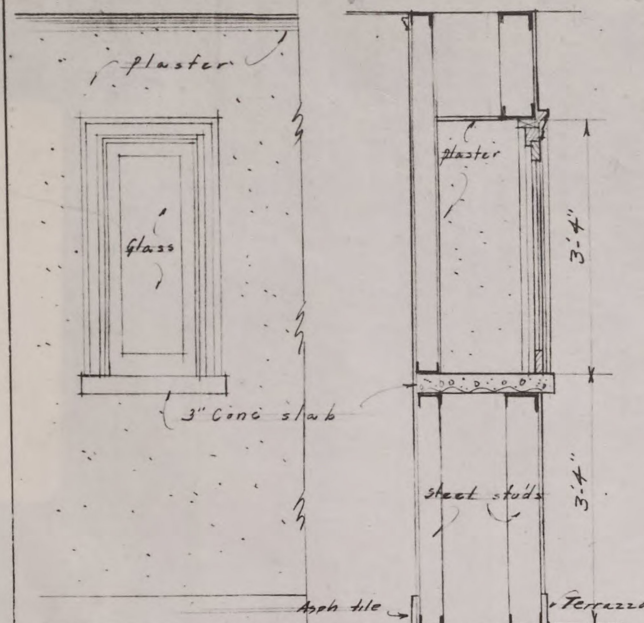


'STAIR SECTION'
'EAST SIDE MAIN BLDG. ONLY'
Scale 1/4"=1'-0"

'SECTION THRU
'DOOR HEAD'
Scale 1/4"=1'-0"

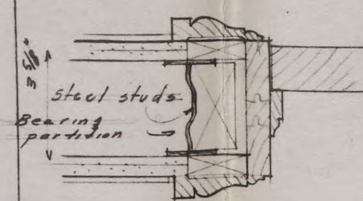


TYPE C-1 APARTMENT
MARRIED VETERAN STUDENTS HOUSING
MICHIGAN STATE COLLEGE
EAST LANSING MICH



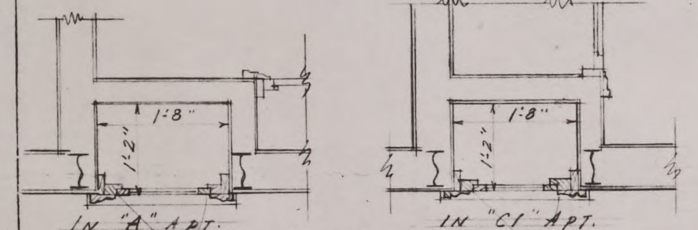
ELEVATION

SECTION

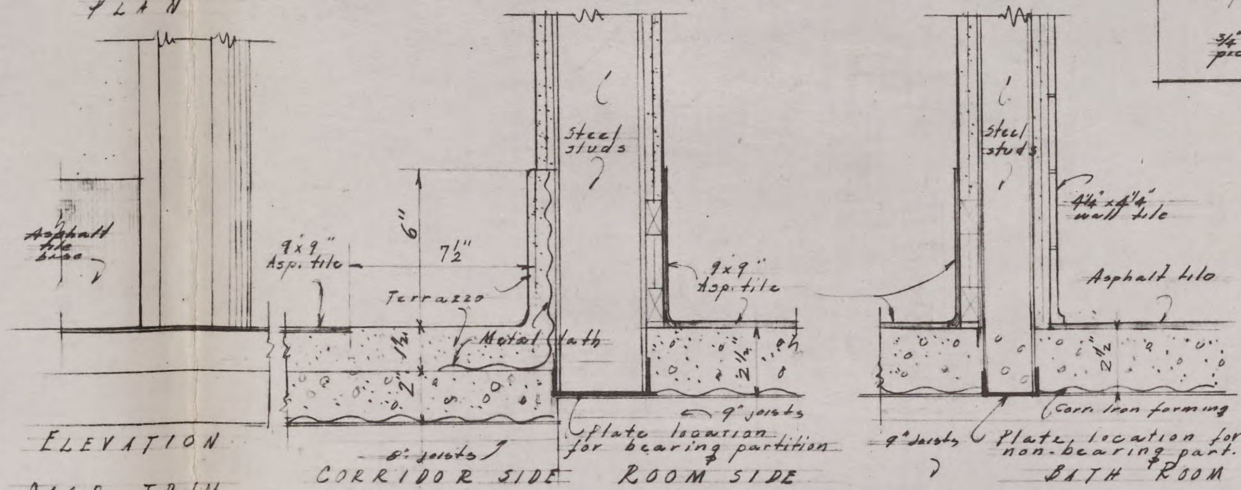


PLAN

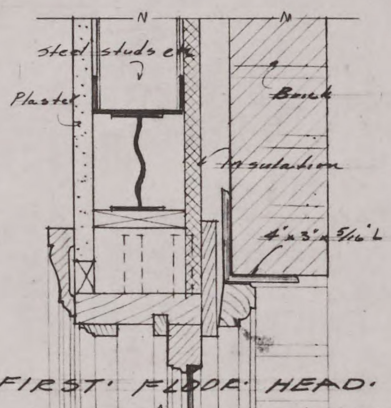
DOOR TRIM
DETAILS



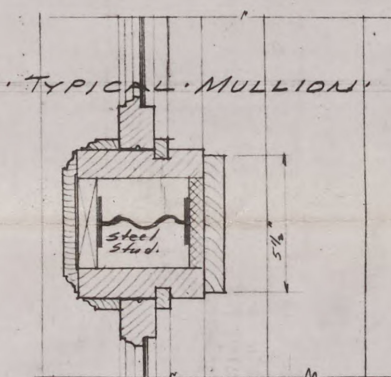
PLAN
FIRE EXTINGUISHER RECESSES
Scale 3/4"=1'-0"



FLOOR & WALL DETAILS
Scale 3/4"=1'-0"

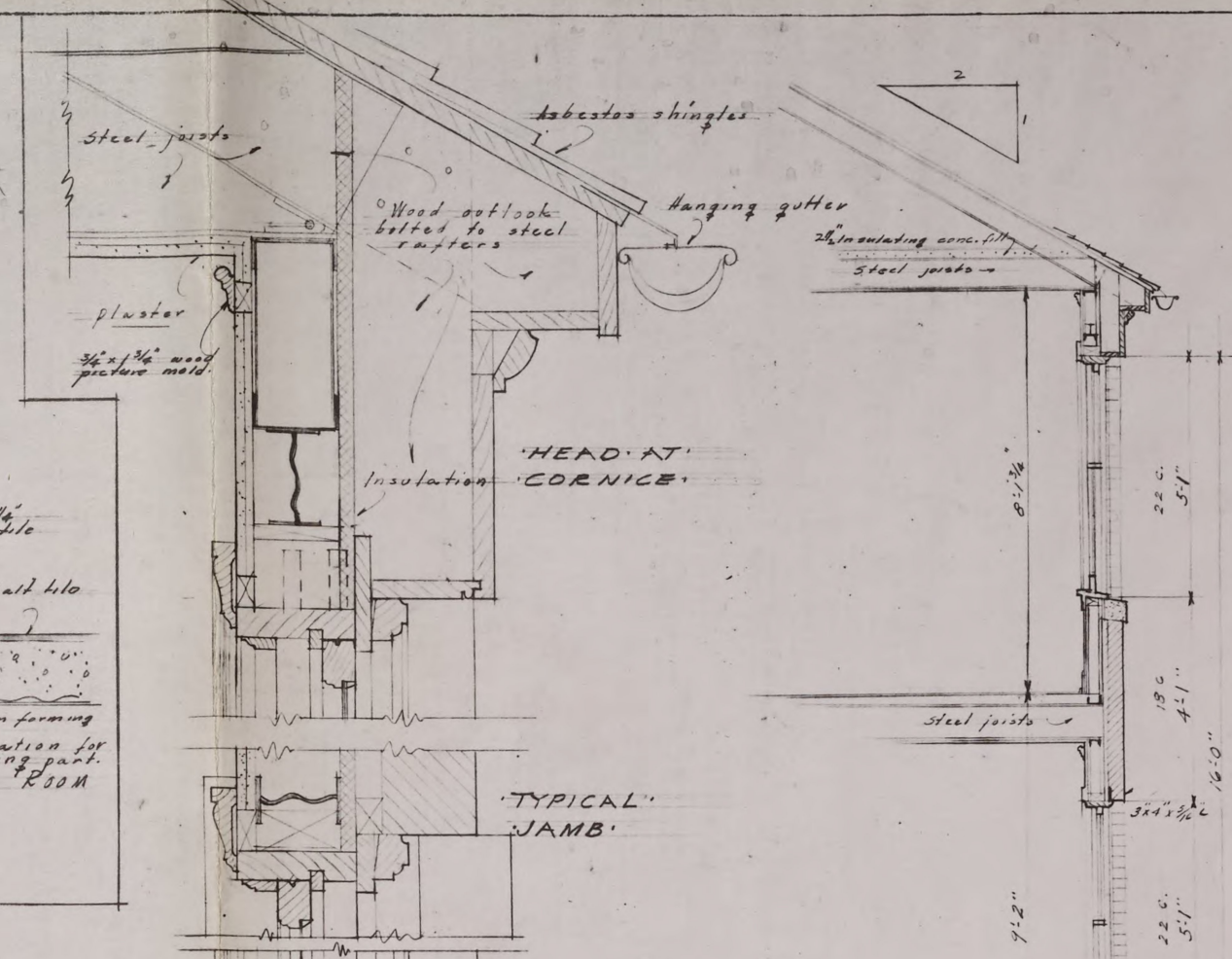


FIRST FLOOR HEAD

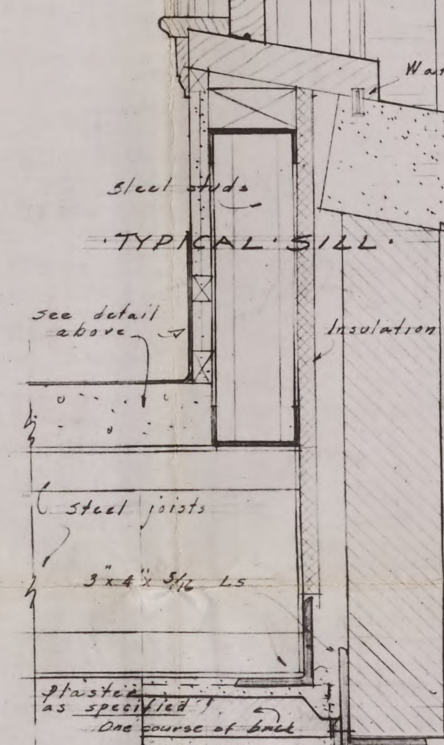


TYPICAL MULLION

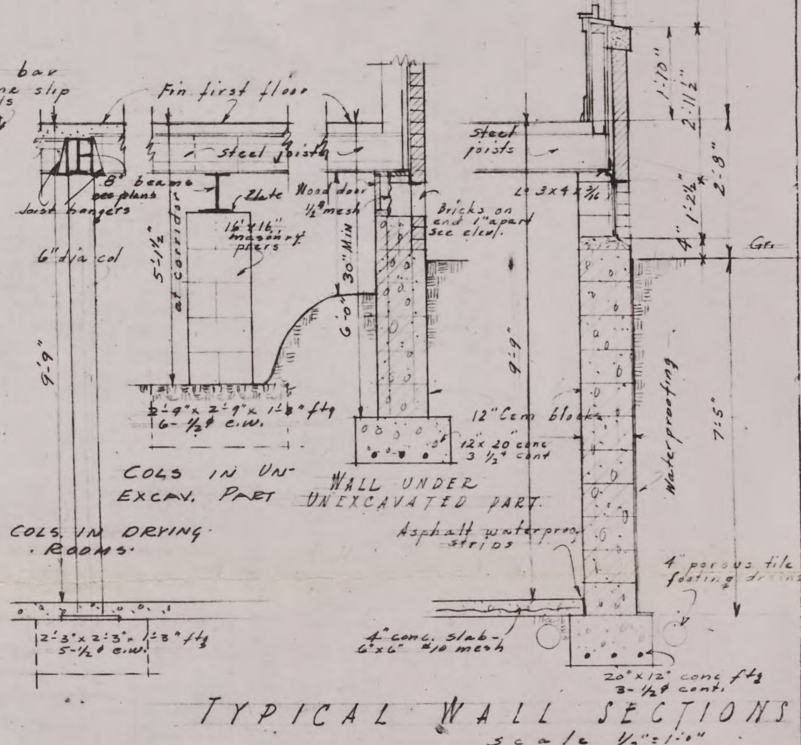
TYPICAL EXTERIOR WALL
AND WINDOW DETAILS
Scale 3/4"=1'-0"



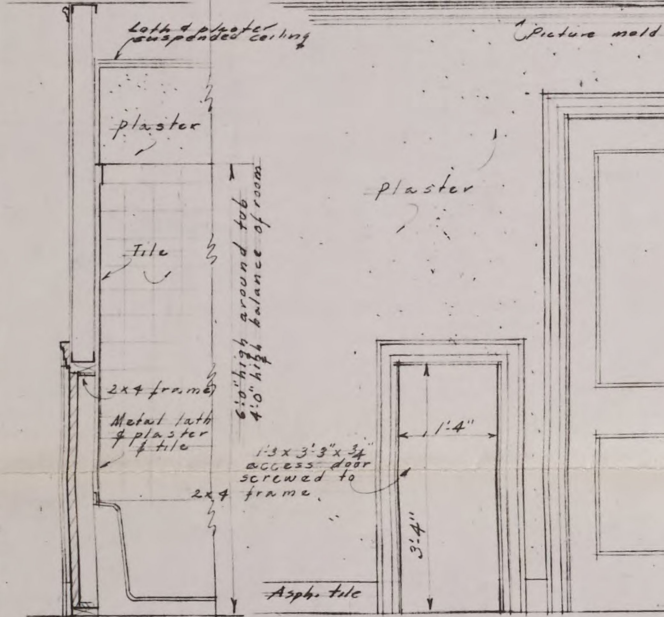
TYPICAL
JAMB



TYPICAL SILL



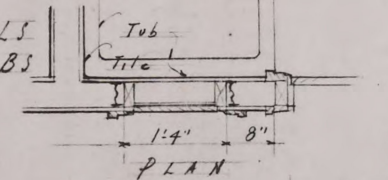
TYPICAL WALL SECTIONS
Scale 1/2"=1'-0"



SECTION

ELEVATION

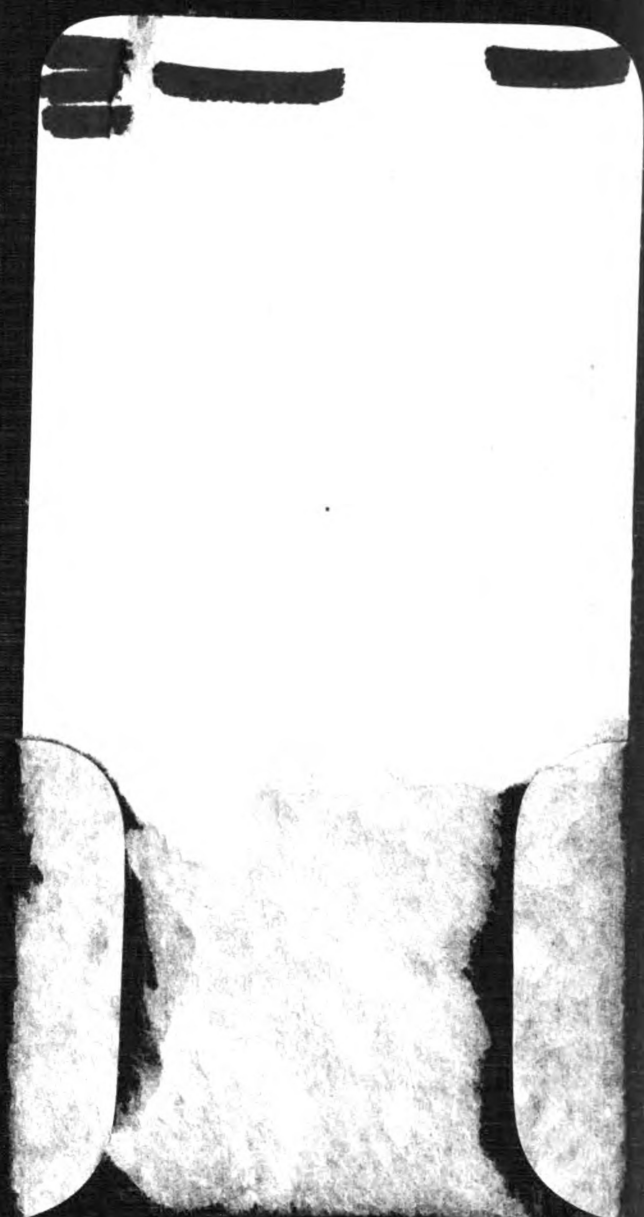
ACCESS PANELS
FOR BATH TUBS
Scale 3/4"=1'-0"



PLAN

TYPICAL BUILDING
MARRIED VETERAN STUDENTS HOUSING
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