A PLAN FOR THE DEVELOPMENT AND OPERATION OF A COAL MINE CAPABLE OF PRODUCING FIVE HUNDRED TONS PER DAY AND THE DESIGN OF THE TIPPLE HOUSE.

A great many assumptions will necessarily have to be made for the purpose of developing the subject and the first will naturally be that dealing with the character of the coal beds and the associated rock formations along with other geological data.

The general geological conditions will be taken as similar to those found in the Coal Creek District of Tennessee. The coal vein has a maximum dip of 2% to the East and the face or main cleavage of the coal makes an angle of 40 degrees with the dip. An average width of 42" of coal is found covered by 30" of hard slate and having underneath a soft bed of clay 1' in thick ness. The coal is bituminous and non-coking.

SYSTEM OF MINING.

The method of mining recommended as most suitable and most ecomical is that commonly known as the "pillar and stall" system. This is particularly well adapted for a strong roof and soft bottom and also with a comparatively weak and fragile coal.m The main double entries are driven with the dip on 60' centers and from these face headings are opened on 1300' centers at an angle of 50 degrees off there; butt headings are turned on 400' centers. The stalls are opened narrow with a width of 10' and widened out later to 18' or 20'. They are turned on 40' centers and driven on the face. The distance between all parallel headings

or entries is 60' (between centers) having a rib of 52'. Sixty foot ribs are left on the side of all main headings. The details are shown fully on the accompanying sketch. Double heads are driven for the facilitation of ventillation.

The work of drawing the pillars will be carried on simultaneously with the other working. By doing this the danger of the coal deterioating and becoming crushed is avoided; ventillation is more easily controlled than where the robbing is done after the whole bed has been worked out; the length of roadways to be kept up is decreased thereby cutting down a big item of operation. The drawing is accomplished in one lift, the roof being supported behind by five or six stulls which are not recovered. One panel is drawn at a time, the line of drawing being kept at 50 degrees with the face. When two panels have been worked out and work started on a third, all on the same cross heading, the first worked out panel is given to the robbing crew. If found better under the conditions of the mine the drawing may directly follow the work in the preceeding panel.

Mining will be carried on with Sullivan coal cutting machines of the chain type. The machine will be rated to cut a 6' swath. Supposing a machine to average a 5' cut and 150 liniar feet per day, the amount cut will be about 110 tons per day. On this basis 5 machines will be required.

Shooting will be done only when necessary and this will generally be in the corners of the rooms. Any of the permissible explosives as tested by the U. S. Testing station may be used and are recommended in preference to black powder.

The mine foreman shall be responsible for all work both above and under ground and shall see that it is carried on in the best and most economical manner. He shall see to it especially that the conditions under ground are such as to provide the utmost safety to the miners and to comply fully with the laws of the state.

TIMBERING.

In the main headings timbering will very probably be necessary and a 3 piece set should be used; and where the bottom is very soft a sill should also be used. Long-grained pine is advised for all timbering under ground. Material from above the coal seam can be shot or picked down to provide for sufficient height in the haulage-ways.

UNDERGROUND TRANSPORTATION.

Electricity is planned for the motive power in the primary haulage system and animals in the secondary. Electric locomotives will haul the cars in trains from the gathering stations to the surface. Mules will do the gathering from the rooms, entry driving, etc. On a 2% grade and supposing the use of Jeffrey locomotives, then 8 ton locomotives will be used. This locomotive is capable of hauling 36 tons load (coal and cars) on a 2% grade. This is equivalent to a train of 14 cars. On the supposition that the haul does not exceed 2 miles, one locomotive will be required to handle 500 tons per day of 10 hours.
But it would be better to have two in order to provide against

breakdowns and for an increase in output .

In case an incline is necessary for development and this is too steep for locomotive haulage (a comparatively short incline) a steam hoist will be installed. Supposing that the incline had a maximum dip of 20 degrees and a length of 800', the engine, rope, and power required will be calculated below.

One car =	1600 lbs.	Assuming three cars on each trip
Coal =	3400 lbs.	and each trip to be made in 3 min-
	5000 lbs.	utes.
3 cars =	15000 lbs.	
800' 7/8" rope =	960 "	1 ft. 7/8" rope equal 1.20 lbs.
	16000 "	

Calculating the pull on rope from the formula

$$T = (W + w + s) \sin a + (W + w + s)\, u \cos a$$

When W = wt. coal

w = " Car

s = " rope, approximate

a = slope of incline in degrees

u = 1/40 = coefficient of friction

Then T = 5848 lbs.

Usinf plow steel, the proper working load is 3.6 tons for 5/8" rope and so this would be the proper size under the assumed conditions. The horse power of the engine is calculated from the formula

$$\text{H. P.} = \frac{\text{Length of incline} \times \sin a}{\text{No. of minutes for hoisting}} \times \frac{(W + w + s)}{33000}$$

H. P. = 42. plus .

Allowing 50% for emergencies the H. P. required will be 60 H. P. For an out put of 500 tons 98 trips would have to be made a day or approximately 10 an hour. The engine would of course be capable of hoisting a greater tonnage, its maximum depending upon the speed in changing cars, switching, etc. These calculations give an idea of what would be required in case of an incline but a previous assumption says that the maximum grade does not exceed 2% and so this is merely to give an idea of a possible case.

METHOD OF VENTILLATION.

Ventillation shall be done by a suction fan run by an electric motor. The air shall be distributed by means of the split system, two splits being necessary, one for every 50 men. Fifty men for each split is well within most law requirements, though the number should not exceed 65 except in special cases. Splitting the mine into different ventillation districts enables each to be regulated separately thereby keeping the special conditions in each under better control.

Assuming 100 to be the maximum number of men to be worked in the mine and the use of 10 mules the quantity of air necessary for them is as follows:-

100 x 150 = 15000 cu.ft. per minute
10 x 500 = 5000 " " " "
20000 " " " " required allowing 150 cu. ft. per minute for each man and 500 for each mule. Allowing a sufficient amount for the dilution and carrying out of any mine

gasses, we may assume the capacity of the fan required to be 40,000 cu. ft. per minute, with 2" water guage. The fan most suited to do this and have a proper reserve is the Champion Ventillator 6' diameter having a capacity of 49,000 cu. ft. per minute at 2 inches water guage. In the most modern mines of the district a W.g. reading of 2" is found to be amply sufficient with a fan of the approximate size of the above recommended.

DRAINAGE.

The grade being against the natural water flow the water will have to be pumped. For a small quantity of water an electric pump would probably be the most economical but should a large amount be met with, a larger compressed-air pump is recommended. The size of pump and the power required can not well be figured upon until more is known of the under-ground conditions.

POWER PLANT.

The main power of the mine is to be developed at the surface station by Corliss steam engines and transformed into electric energy. The requirements are as follows:-

5 Coal cutting machines

250 Volts 28 Amps.---------- 140 Amperes ---35000 Watts.

2 Locomotives

250 Volts 100 " ---------- 200 " --------50000 "

1 Fan

250 Volts 100 " ---------- 100 " ------- 25000 "

300 Lamps

.250 Volts 1/4 Amps. ---------- 75 Amperes ---18750 Watts.

Total 250 " ---------- 515 " -----128750 "

128750 watts = 172(plus) H. P.

2 100 H. P. boilers will be required.

Therefore a generator or generators of a capacity of 515 amperes at a voltage of 250 Volts will be required and the power plant will be designed and bought on this main condition. It will probable be better to divide the power plant into two sections, having the lighting and ventillating system cared for by one generator and the mining machines and locomotives by another. The first section therefore carries the constant load and the second section carries the varying loads. Motors and all electric machinery work better and far more economically under a steady load than otherwise and this condition should accordingly be given the utmost care in the design of the surface power plant. In case a compressed air pump or other air machinery is necessary a compressor will of course have to be installed. General Electric Co.'s. motors and generators are recommended.

THE TIPPLE.

The tipple, as shown on the accompanying drawing, is designed to handle 500 tons of run of mine coal per day of 10 hours, and is equipped with a Sullivan cross-over dump. Weighing is done just previous to dumping, each car having its number enabling the keeping of proper records. The coal dumps directly

on a 4" grizzby, thence on to a 1-1/2" or nut size grizzly. The sizes thus made are lump, nut, and slack. Aprons may be placed on either the first or second grizzly thus making possible a variety of grades. The different shoots and screens are to be adjusted by experience and so no definite slopes are given on the drawing. The shoots empty into standard railroad cars, no bins being erected.

The timber used in the construction of the tipple must be pine or oak and shall be well seasoned and free from injurious know-holes. Bents- The different bents are built up as shown in the drawings. The posts and caps are made up of 10" x 10" timber and are cross-braced with 3" x 10" planks and 6" x 8" and 10" x8" timbers. This bracing, in order to insure greater stability may be better done wholly with 6" x 8" struts using a few planks in addition. The caps are secured to the posts by 5/8" drift bolts and 60 d. nails. The posts rest on concrete piers and are held in place by 5/8" drift bolts set in the concrete. The caps are long and may be spliced in the middle, but they should be obtained whole if possible.

The floor system consists of 8" x 10" and 4" x 10" timbers, the 8" x 10" timbers being secured by 5/8" bolts as well as being spiked; the 4" x 10" stuff is spicked only. The rails are laid directly on the 8" x 10" girders. The longitudinal bracing consists of 3" x 10" planking spiked to the oblique posts in the manner of cross-bracing and of 6" x 8" and 8" x 10" struts between the vertical posts. The flooring is 2" planking laid across the girders. The roofing and siding is galvanized iron.

MINE CARS.

The mine cars shall be designed to carry 45 bushels of coal (3400 lbs.) and to have a weight of 1600 lbs. Cars shall be made of wood with iron bracings. The car shall have an over-all width of 56", a 9' length, a track guage of 42 inches and the wheels to be 2' apart (center to center).

DIMENSIONS OF ALL TIMBERS IN FRAMING.

Side Elevation.

M.	No.	Dims.		M.	No.	Dims.	
1 c	4	8x10x21'3"		12	2	8x10x14'6.5"	
1 a	3	4x10x "		13	2	8x10x11'8.5"	
1 b	2	2x8x "		14	2	8x10x13'1.5"	
1 d	2	2x6x10'	L.C.B.	16	10	3x10x20'	
1e	2	2x6x77'		17	16	3x10x18'	L.C.B.
2 c	4	8x10x12'10"		19	1	10x10x6'	
2 a	3	4x10x "		20	14	8x10x9.72'	
2 b	2	2x6x "		20a	2	8x10x6'	
3 c	4	8x10x15'3"		21	4	4x6x8'	
3 a	3	4x10x "		22	3	10x10x13'7"	
3 b	2	2x6x "		23	2	6x8x17'3"	
4 a	1	4x10x 10'5"		23a	2	6x8x17'6"	
4 c	2	8x10x "		24	2	6x8x17'1-1/2"	
7 a	3	4x10x13'6"		24a	2	6x8x17'3"	
7 c	3	8x10x "		25	2	6x8x18'8"	
5 c	2	8x10x13'10"		25a	2	6x8x18'10"	
5 a	1	4x10x "		26	2	6x8x16'5"	
6 c	2	8x10x14'3"		26a	2	6x8x16'7/1/2"	
6 a	4	4x10x "		27	2	6x8x15'10-1/2"	
6 e	1	2x6x14'3"		27a	2	6x8x15'11"	
8 c	1	10x10x8'6-1/2"					
8 a	1	4x10x5'1/2"					
9	4	10x10x11.57'					
10	1	8x10x20'					
11	4	8x10x12'1.5"					

Mem.	No.R.	Bent.1	2	3	4	5	6
1	2	10x10x13.3'	13.03'	12.75'	12.49'	12.37'	10.39'
2	2	10x10x13'1"	12'10"	12'6.8"	12'3.15"	12'1.65"	10'2"
3	2	10x10x14.03'	-----	------	9.8'	4.06'	-----
4	2	10x10x13'10"	-----	------	9'7"	3'10"	-----
5	1	10x10x20'	-----	------	-----	-----	-----
6	10	3x10x18'	-----	------	-----	6 Reg.	6Reg.
7	2	6x8x8.2'	-----	------	------	-----	-----
17	2	8x10x9.3'	-----	-----	-----	-----	-----
18	2	--------	-----	Line	-----	10x10x9.5"	10x10x1'11.2
19	1	--------	-----	"	-----	" x11"	" x2-1/2
16	1	10x10x24'	----	------	-----	------	-----

ROOF TRUSS

3	2			10'	8'9.1"
9	2	2x6x11'			
10	1	2x6x20'			
11	2	2x6x12'			
12	2	2x6x5'			
13	4	2x6x77'	over 8' lengths		
14	1	2x8x77'			
15	12	2x6x77'	Studs for roof		
	10	2x6x77'	" " siding		
	5	2x6x20'	" " end		
	2	2x6x8'9.1"	posts for end.		
Flooring		2x77 (2x12x8') + 40(2x12x8')			

CORRUGATED IRON

Roof Area = 77 x 2 12 = 1848

Side " = 77 x 2 10 = 1540

End " = $\frac{6x20}{2}$ + (10x20) = 260

3648 Sq. Ft.

BILL OF LUMBER TO BE ORDERED IN DETAIL AND POSITION OF EACH PIECE.

Bent. View Numeration

-1-

Mem.	No.Re.	Demensions
1 c	4	8 x 10 x 22'
1 a	3	4 x 10 x 22'
1 b	6	2 x 8 x 8'
1 d	2	2 xx4 x 10'
1 e	2	2 x 6 x 77'
2 c	4	8 x 10 x 14'
2 a	3	4 x 10 x 14'
2 b	4	2 x 8 x 8'
3 c	4	8 x 10 x 16'
3 a	3	4 x 10 x 16'
3 b	4	2 x 8 x 8'
4 a	1	4 x 10 x 14'
4 c	2	8 x 10 x 14'
7 a	3	4 x 10 x 14'
7 c	3	8 x 10 x 14'
5 c	2	8 x 10 x 14'
5 a	1	4 x 10 x 14
6 c	2	8 x 10 x 16'
6 a	4	4 x 10 x 16'
6 e	2	2 x 6 x 8'
8 c	1	10 x 10 x 10'
8 a	1	4 x 10 x 6'

-2-

Mem.	No.re.	Dimensions
9	4	10 x 10 x 12'
10	1	8 x 10 x 14'
11	4	8 x 10 x 14'
12	2	8 x 10 x 16'
13	2	8 x 10 x 12'
14	2	8 x 10 x 14'
16	10	3 x 10 x 20'
17	16	3 x 10 x 18'
19	1	10 x 10 x 6'
20	14	8"x10" x 8'
21	4	4 x 6 x 8'
22	3	10 x 10 x 14'
20 a	2	8 x 10 x 6'
23	2	6 x 8 x 18'
23 a	2	6 x 8 x 18'
24	2	6 x 8 x 18'
24 a	2	6 x 8 x 18'
25	2	6 x 8 x 20'
25 a	2	6 x 8 x 20'
26	2	6 x 8 x 18'
26 a	2	6 x 8 x 18'
27	2	6 x 8 x 16'
27 a	2	6 x 8 x 16'
Extra	4	10 x 10 x 12'

Bent. View Nemeration

Mem.	No.Re.	Dimensions
1	10	10 x 10 x 14'
1	2	10 x 10 x 12'
2	10	10 x 10 x 14'
2	2	10 x 10 x 12'
3	8	10 x 10 x 14'
4	8	10 x 10 x 14'
5	6	10 x 10 x 20'
6	52	3 x 10 x 18
7	8	6 x 8 x 10'
17	8	8 x 10 x 10'
16	5	10 x 10 x 24'
8	22	2 x 6 x 10'
9	22	2 x 6 x 12'
10	11	2 x 6 x 20'
11	22	2 x 6 x 12'
12	11	2 x 6" x 10'
13	32	2 x 6 x 10'
14	8	2 x 8 x 10'
15	216	2 x 6 x 10'
Floor.	175	2 x 12 x 8'

Bill of Lumber

Size	No.Re.
8 x 10 x 22'	5
8 x 10 x 14'	17
8 x 10 x 12'	3
8 x 10 x 16'	8
8 x 10 x 10'	32
4 x 10 x 14'	14
4 x 10 x 16'	7
4 x 10 x 22'	3
10 x 10 x 14'	39
10 x 10 x 12'	12
10 x 10 x 10'	1
10 x 10 x 20'	6
10 x 10 x 24'	5
2 x 6 x 12'	50
2 x 6 x 14'	303
2 x 6 x 20'	11
2 x 8 x 10'	14
2 x 12 x 8'	175
St. 3 x 10 x 18'	70
3 x 10 x 20'	10
6 x 8 x 10'	8
6 x 8 x 16'	4
6 x 8 x 18'	12
6 x 8 x 20'	4
4 x 6 x 8'	4

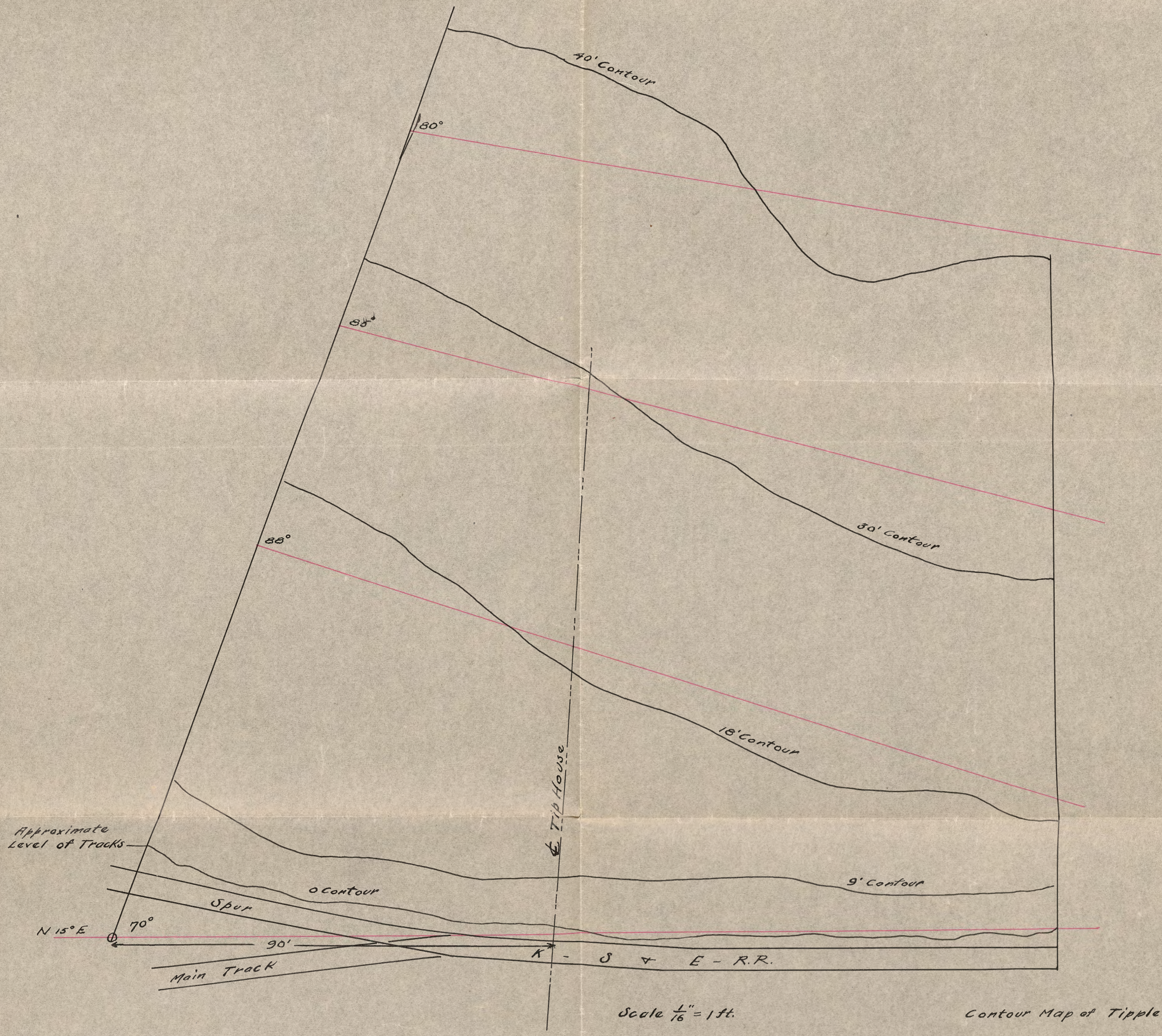
COST OF TIPPLE - ITIMIZED.

Timber.

5630 Ft (over 16') at $23		129.50
10830 " (under 16')"	20	216.60
11683 " (Small mat.)"	17	198.61
		544.71

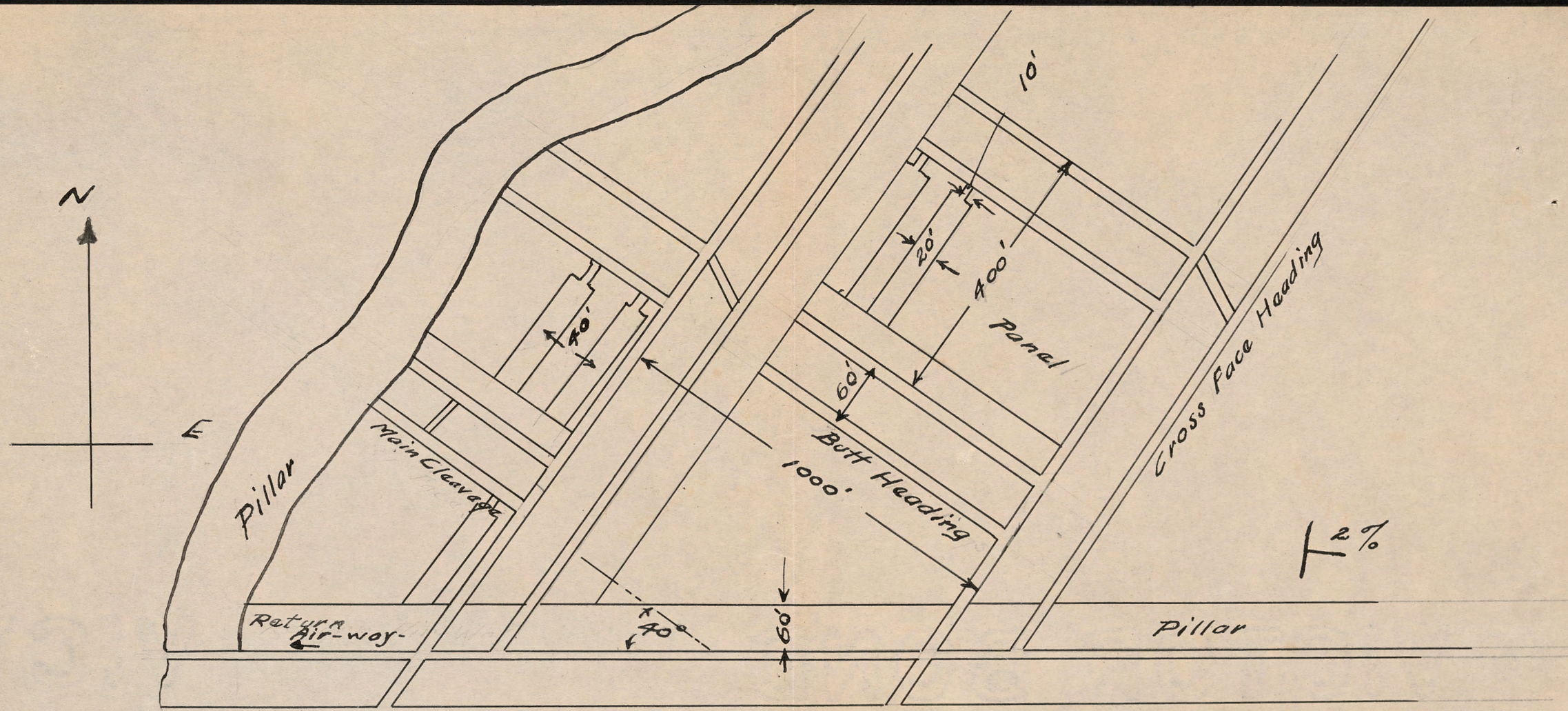
Hardware & Supplies.

800' 5/8" wr. iron (16' lengths)	
826 lbs. at .08c	66.00
100 # Nuts (Sq.) at 9.40	9.40
88 # Washers (Round) at	8.00
375 # 60 d. Nails	
150 # 30 d. "	12.60
1 keg Boat Spikes	4.00
294 cu. ft. concrete at 3.00 pr.sq.yd.	33.00
3 extra bents	150.00
1 Sullivan Dump	250.00
1 weighing scale	190.00
Shoots & Screens	150.00
Rail	50.00
3650 sg. ft. Galvanized Iron at $4 pr.sg.	148.00
Incidental	50.00
Labor	400.00
Profit	300.00
Total cost	$2365.

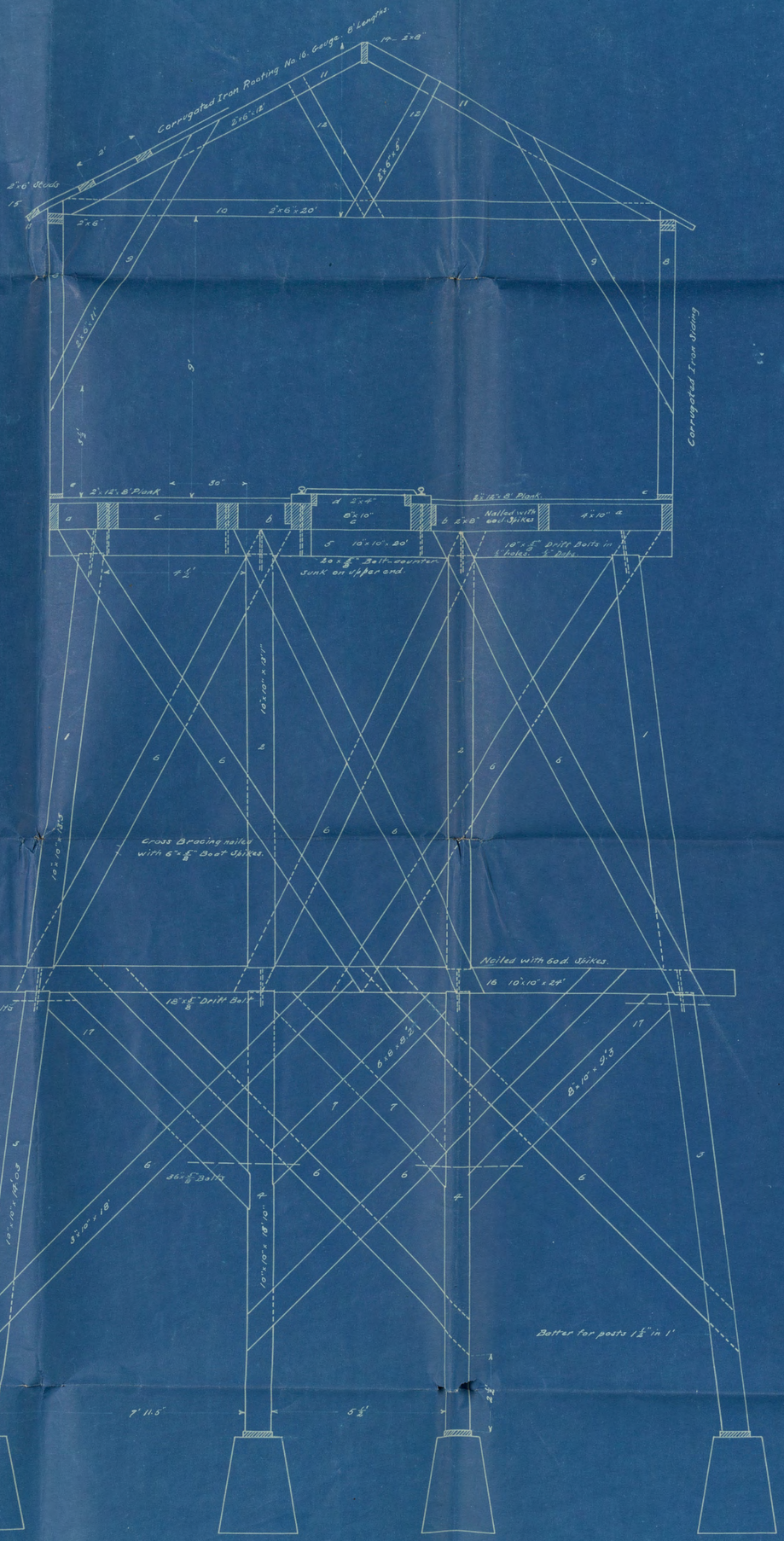


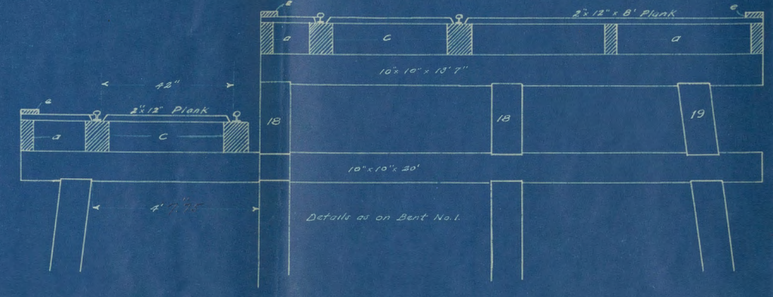
Scale 1/16" = 1 ft.

Contour Map of Tipple Site.



Sketch of Plan for Mining. (Proposed).





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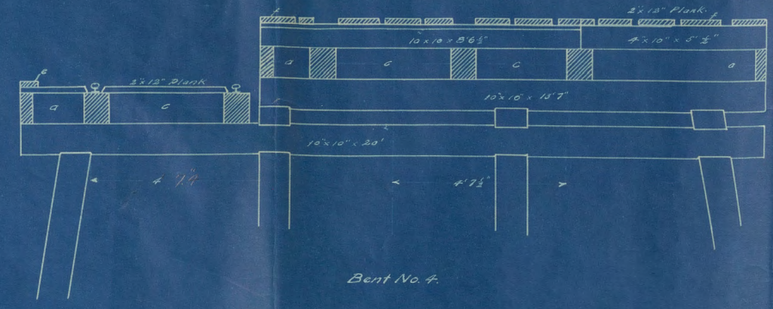

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SECTION VIEWS OF TIPPLE.

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DESIGN OF A COAL MINE TIPPLE

F. SIM NEELY — THESIS

SCALE ½" = 1 FT. — MARCH 28 - 1911.

5'3" 8' 8'

13'4" 12'3" 10' 7' 3'8"

2"x12" Flooring 1" apart

24" in 100' x 10 x

18" in 100'

2"x6"x13'6"

2"x4"x7'

8"x10"x21'3" 8"x10"x12'10" 8"x10"x15'3"

8"x10"x

Sullivan Croo

18" in 100'

8"x10"x 13

⅝"x9' Bolt

½" Dap

18"x⅝" Bolts

8' 8'

3"x10"x18' Planks also used for longitudinal cross bracing on oblique posts

Struts are dapped 2" at intersection and bolted to posts and nailed to caps

Screen 1. 4" Size

Screen 2. 1¼" Size

10"x10"x11'5"

10"x10"x15'1"

⅝"x12" Bolts

10"x10"x12'10"

10"x10"x12'6"

6"x8"x17'3"

6"x8"x17'11"

6"x8"x18'8"

6"x8"x10'5"

⅝" Roof Bolts

20"x⅝" Bolts

8"x10"x12'1.5"

8"x10"x13'1.5"

8"x10"x14'6.5"

½" Dap

8"x10"x9'12

8"x10"x

24"x⅝" Bolts

Shoot 1.

Shoot 2.

Shoot 3.

Shoot 4.

10"x10"x15'10"

10"x10"x13'10"

10"x10"x14'5"

18"x 1" Drift Bolt Set in Concrete. 2"x12" Plank

18" Square

1-2-4 Concrete

Batter 1" in 4"

Scale A to be placed here.

30 lb. Rail.

15"in 100'

Sullivan Cross Over Dump

12"in 100' from X

11.8"in 100'

Screen 1. 4" Size

Screen 2. 1¼" Size

Profile on Center Line

ELEVATION VIEW OF TIPPLE

UNIVERSITY OF TENNESSEE

DESIGN OF A

COAL MINE TIPPLE

F. SIM NEELY — THESIS

SCALE ½" = 1 ft. — MARCH 28-1911