LAYOUT OF A RESIDENTIAL SUBDIVISION FOR MICHIGAN STATE COLLEGE FACULTY

Thesis for the Degree of B. S.

MICHIGAN STATE COLLEGE

F. M. Bowers — J. K. Brennan

1949

Layout of a Residential Subdivision for Michigan State College Faculty

A Thesis Submitted to

The Faculty of

MICHIGAN STATE COLLEGE

of

AGRICULTURE AND APPLIED SCIENCE

by

F. M. Bowers J. K. Brennan

Candidates for the Degree of

Bachelor of Science

June 1949

Housing facilities provided by Michigan State College for its faculty have been very inadequate due to the rapid expansion of the teaching staff and the student body and the resultant shortage of suitable homes for them and their families. We feel that the college should remedy the situation by undertaking a small-home project somewhere on its property. With this idea in mind, we searched for a new subdivision location near the campus and finally chose a forty-acre piece of land at the intersection of Beaumont and Bennett Roads. We picked this location for the following reasons:

1. The area is far removed from truck routes or commercial areas that would create a noise nuisance.
2. It is the highest ground within miles, which permits excellent drainage of storm waters and sanitary wastes.
3. It is close enough to the college to make commuting easy.
4. The terrain is of a rolling nature, which makes more picturesque home sites.

We next set out to determine the legal boundaries of the land, and the first step was to find the center lines of Beaumont and Bennett Roads and to determine the distance from a corner of the land to the nearest section corner. With the help of Mr. Nothstine, of the Civil Engineering Department, we located a pipe at the intersection of Mt. Hope and Beaumont Roads, one at the intersection of Bennett and College Roads, and the buried iron at the corner between Sections 30, 29, 31, and 32 of Meridian Township at the intersection of Hagadorn and Bennett Roads. The approximate location of the buried section corner was located with a dip needle. The probable error in the approximate location was 0.2 feet, which means that the bearing of the line from College Road to Hagadorn Road may be in error by $\frac{0.2}{1.6}$ minutes, or seven and one-half seconds. Assuming that the section line runs due east and west, the angle between Beaumont and Bennett Roads will give the bearing of Beaumont Road directly. We measured this angle and found that the bearing of Beaumont Road was N 0° 11'W. We measured thirty-three feet from the centerlines to establish the standard four-rod county road width for both Beaumont and Bennett Roads. Next, we chained the distance from Bennett Road to a fence line partially enclosing the plot on the north and found it to be 1293 feet. The distance from the centerline of Beaumont Road to the fence on the east is 1328 feet. In order to make lot sizes more uniform, we made the bearing of the east boundary the same as that of Beaumont Road and that of the north boundary the same as that of Bennett Road. All streets in the plot run parallel to Beaumont Road or Bennett Road.

The lots are of a size to allow room for any style of home costing between $8,000 and $15,000 plus ample room for lawns and gardens without creating the crowded appearance one notices in city residential areas.

The street are placed in such a manner as to minimize the number of intersections with the county roads and still give access to all areas. This gives an air of privacy to the community without making it inaccessible. Two outlets were put on Beaumont Road, because most of the traffic into the community will come from this direction.

For engineering data on streets and sewer lines we took elevations at 100-foot intervals by the grid method, as shown on Plate One, and plotted two-foot contours by interpolating between these points. First it was necessary to run bench marks through the project that would be visible from any set-up of the level. We accomplished this by running a level circuit to the project from the Michigan State College Precise Leveling Bench Mark near the intersection of Mt. Hope and Beaumont Roads and another circuit from this new bench mark. From time to time during the level taking, we checked into one of these bench marks to make sure that the height of instrument we were using was correct. We set up a system of note-taking that required the height of instrument to be recorded with each foresight, since the rolling terrain required many set-ups to complete one line of levels. An investigation of our field notes will show that this was the wisest thing to do.

We used our own field method for cross-sectioning with which we covered the forty-acre tract in forty hours with only two men in the party. One man ran the level and took notes, and the other man carried the rod and did the taping unassisted. This was accomplished in the following manner:

(See grid system on Plate One.)

Wooden stakes were first set at 100-foot intervals along the east and west boundaries. Using line B as a center line and keeping in line with two of the three range poles set on the line, the rod man measured the 100-foot shots eastward by pinning down the hook end of the metallic tape with a chaining pin and measured the 100-foot side shots for lines A and C from 100-foot stations on B. This 200-foot section was carried all the way to the east boundary regardless of level set-ups necessary to carry the line. Then the range poles were moved 300 feet south and another 200-foot section was carried westward in the same manner. Extra length was applied when taping up or down hill by putting extra pull on the tape for small slopes and allowing five-tenths on slopes over ten per-cent. The fact that there is only ninety-five feet between rows 12 and 13 did not alter the method of note-keeping. The notes were reduced directly from the field book onto the grid system of Plate One.

When the contours had been plotted, it was easy to decide where the streets should run to give maximum drainage to low areas with minimum amount of grading or trenching. A low pocket exists at lot 59, defined by the 884-foot and 883-foot contours on Plate One. Obviously this particular spot would be useless as a building site, so we showed it as filled on Plate Three. The soil bounded by the 894-foot contour was pushed into the low spot from the hill on the east, making the spot level at the 888-foot elevation and allowing complete drainage into catch basins emptying into sewer line 15-16.

The centerline and sewer profile sheets were prepared from contours shown on Plate Three, which was prepared by an overlay of Plate One on Plate Two. Irregularities in the ground, shown by the shaded lines, were smoothed off by use of railroad curves as shown by the dark lines. Ground elevations at the graded surfaces were taken from the profile sheets to the nearest one-tenth foot to obtain slope between manholes for flow computations. True parabolic vertical curves were not computed because we did not think the short tangents warranted it. The curves used are very close to parabolic and make entirely satisfactory profiles from the standpoint of appearance and utility.

An estimated 500 gallons per day of sanitary sewage is expected from each lot, and it is assumed that sanitary sewage from any lot will flow into the line nearest the lot. This low sanitary flow is expected because the water supply is assumed to originate from individual wells.

Storm sewage run-off in cubic feet per second was calculated from the formula $Q=AIR$, in which A is in acres, I is the coefficient of run-off, and R is the rainfall in inches per hour. The value of R for each section of sewer line between manholes was determined by solving the formula $R=\frac{97}{t+15}$. This formula was suggested in article 279 of Water Supply and Sewerage, by Ernest W. Steel, for a storm intensity expected once in five years. The initial value of inlet time t was assumed as ten minutes, to which was added the time of flow through the pipe (column 23 on the date sheet) to obtain final value for substitution in the formula. Storm run-off into each line was calculated in three sections: one hundred per-cent run-off from roofs and concrete surfaces; twenty-five per-cent run-off from lawns; and one hundred per-cent run-off from paved streets. This was done because the contour map shows that in many cases the water from the lawn surfaces could not possibly drain into the line on which the lot faces. This situation is true for lots 1, 2, 3, 4, 55, 56, 57, and a few others. It is assumed that water from the 100 per-cent areas drains toward the street on which the lot faces. The area of 100 per-cent run-off from each lot, as shown on the diagram, is 4,030 square feet, or approximately .09 acre. The area of twenty-five per-cent fun-off is 10,970 square feet, or an average of 0.26 acre. The run-off coefficient of 0.25 was suggested by Professor Frank Theroux of the Civil Engineering Department. Knowing the slope between manholes and quantity of sewage entering a line, it was possible to determine pipe diameters to give feet per second, flowing full. We used flow diagrams derived from the Manning formula for circular pipes flowing full. The diagram is commonly used in preference to the formula, because it permits experimentation with combinations of slope, pipe-diameter, and velocity without going through lengthy computations.

It is appropriate to bring up at this time the problems inherent to a combined system. The lines must be deisgned to take care of the maximum storm run-off, which is many times greater than the sanitary flow; but the design is appropriate only to pipes flowing full. During periods of little or no rainfall the sanitary flow alone cannot fill the lines, and the resulting sluggish velocity may cause odors or stoppages. In addition, the treatment plant is overtaxed during rainy periods unless an interceptor system is devised to allow the excess flow to by-pass the plant and flow directly into the disposal system. In this case the designer depends on dilution and a dose of clorine to protect the public health. This practice is extremely objectionable, due to the uncertainty of the strength of the raw sewage and the unsightly appearance of the stream receiving the flow. On the other hand, the sanitary flow from a community this size is so pitifully small, it would seem a tremendous waste of money to design two pipe lines when a single line can be made to serve the same purpose. An investigation of the velocity column of the data sheet will show that wherever possible we have used velocities far in excess of the minimum of three feet per second. We designed for these higher velocities in order that during the periods of reduced flow the velocities would not be such that sedimentation would occur. A possible method of periodic flushing of pipes during dry spells would be to wash the pavements with a sprinkler once a week. It is assumed that similar housing areas will be layed out directly to the west and south of this subdivision and that a community water supply system will be installed. This would mean greater water consumption and a more efficient use of the sewers as we have designed them.

We suggest that the design of the water supply system and treatment plant would make good subjects for future thesis work. We chose this type of project because it allowed us to use three different courses of civil engineering which we studied at Michigan State College: Surveying and Leveling, Topographic Surveying, and Sewerage and Drainage. We realize that the methods used in determining road elevations and expected flow are approximate and can be used only for initial estimates. The data sheet included in this thesis is a combination of those set up by Mr. Steel for separate storm and sanitary sewer designs and requires no clarification.

We wish to extend our thanks to Mr. Nothstine for his advice in technical matters and his interest in the project, which enabled us to bring it to its conclusion.

LEVEL CIRCUIT
TO PROJECT

⊼	+BS	HI	-FS	EL.	
B.M.D				859.600	B.M. "D" MICH. STATE COL.
	6.79	866.40			
T.P.1			3.31	862.59	ROCK
	8.39	870.98			
T.P.2			4.73	866.25	ROCK NEAR BIG TREE
	3.92	870.17			
T.P.3			4.58	865.59	N.E. COR. CONC. CULVERT
	6.36	871.95			
T.P.4			1.16	870.79	
	11.09	881.88			
T.P.5			0.50	881.38	S. END METAL CULVERT
	12.90	894.28			
T.P.6			2.21	892.07	
	12.97	905.04			
B.M.A			2.26	902.78	ROOT OF LARGE MAPLE N.W. CORNER
	1.31	904.09			
T.P.1			8.63	895.46	
	0.27	895.73			
T.P.2			12.76	882.97	
	1.49	884.46			
T.P.3			3.09	881.37	<u>CHECK</u> - S. END METAL CULVERT
	2.76	884.13			
T.P.4			7.02	877.11	
	1.00	878.11			
T.P.5			7.29	870.82	
	3.00	873.82			
T.P.6			8.16	865.66	
	4.69	870.35			
T.P.7			4.10	866.25	
	4.38	870.63			
T.P.8			9.53	861.10	
	4.58	865.68			
B.M.D			6.09	859.59	<u>CHECK</u> - M.S.C. B.M. "D"

LEVEL CIRCUIT IN PROJECT

⊼	+B.S.	H.I.	-F.S.	EL.	
B.M.A				902.78	
	11.54	914.32			
			11.21	903.11	
	0.04	903.15			
			11.18	891.97	
	4.01	895.98			
B.M.B			7.13	888.85	ROOT OF LARGE TREE C-6
	9.73	898.58			
B.M.C			5.31	893.27	ROOT OF MAPLE E-10
	0.62	893.89			
			8.50	885.39	LARGE STONE NEAR FENCE G-10
	12.03	897.42			
			1.05	896.37	
	11.67	908.04			
B.M.D			3.34	904.70	LARGE ROCK I-0.
	0.21	904.91			
			9.88	895.03	TOP OF METAL POST
	2.99	898.02			
			11.70	886.32	
	5.94	892.26			
			10.65	881.61	
	2.14	883.75			
B.M.E			8.06	875.69	METAL CULVERT
B.M.D				904.69	
	1.75	905.84			
			12.46	893.38	
	1.15	894.53			
			8.63	885.85	
B.M.E	2.46	888.31			
			[illegible]	875.79	CHECK - METAL CULVERT

CROSS SECTION NOTES

	0	1	2	3
A	909.41 / 10.07	909.41 / 8.00	909.41 / 6.52	909.41 / 9.29
B	" / 5.91	" / 5.39	" / 4.20	" / 5.71
C	" / 0.73	" / 1.09	" / 2.33	" / 3.95
D	914.32 / 2.89	914.32 / 3.41	914.32 / 5.87	914.32 / 9.59
E	" / 2.09	914.32 / 3.02	" / 5.00	" / 9.99
F	" / 2.49	" / 3.33	" / 6.19	" / 12.32
G	" / 3.26	" / 4.64	" / 7.40	" / 11.72
H	911.76 / 4.62	908.04 / -0.15	908.04 / 3.65	908.04 / 5.93
I	908.04 / 3.42	" / 3.66	" / 4.50	" / 9.60
J	" / 6.05	" / 7.7	" / 10.6	" / 12.09
K	898.02 / 2.89	898.02 / 2.96	898.02 / 6.03	898.02 / 4.04
L	" / 7.20	" / 6.17	" / 8.85	" / 5.38
M	" / 8.93	" / 8.13	" / 10.36	" / 9.20
N	" / 9.16	" / 7.38	" / 10.31	" / 10.26

KEY : H.I. / F.S.

Cross Section Notes

	4	5	6	7
A	909.41 / 9.90	900.85 / 0.52	900.85 / 3.95	893.27 / 0.95
B	" / 7.64	" / 1.38	" / 4.16	" / 3.50
C	" / 12.37	" / 4.7	" / 8.5	" / 6.00
D	903.15 / 6.65	903.15 / 11.99	895.98 / 8.69	895.98 / 10.71
E	" / 10.52	" / 12.65	" / 10.35	" / 9.69
F	" / 10.93	11.90	12.5	" / 6.81
G	" / 9.13	" / 9.11	897.42 / -0.2	" / 5.14
H	908.04 / 11.24	908.04 / 10.54	" / 0.59	897.42 / 3.96
I	" / 9.36	" / 10.67	" / 2.60	" / 4.25
J	" / 10.80	" / 12.75	898.02 / 7.94	" / 5.1
K	898.02 / 3.66	898.02 / 5.75	" / 11.64	898.02 / 9.76
L	" / 7.33	" / 8.04	" / 14.10	" / 13.80
M	" / 9.75	" / 12.31	" / 14.80	892.26 / 10.06
N	" / 11.47	" / 13.30	" / 14.89	" / 9.80

Key — H.I. / F.S.

CROSS SECTION NOTES

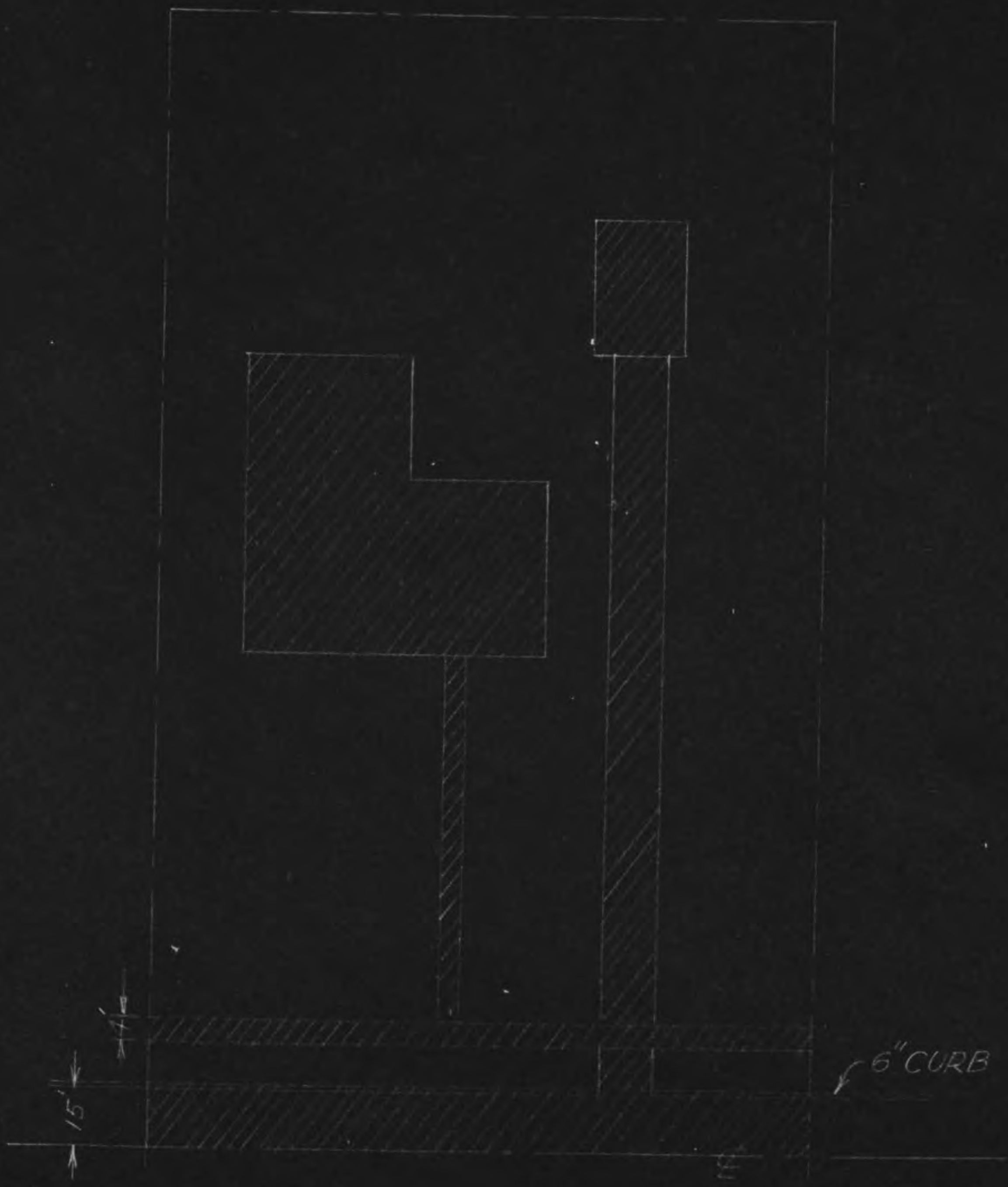
	8	9	10	11
A	893.27 / 5.43	893.27 / 10.45	893.27 / 12.0	893.27 / 10.7
B	" / 6.30	" / 8.73	" / 8.26	" / 6.46
C	" / 4.85	" / 5.0	" / 3.86	" / 3.00
D	900.85 / 10.44	900.85 / 8.48	898.58 / 5.61	898.56 / 4.38
E	" / 5.59	" / 5.15	" / 2.90	" / 6.00
F	" / 7.18	" / 8.32	" / 5.18	" / 9.22
G	893.89 / 5.00	893.89 / 5.95	893.89 / 6.18	893.89 / 8.83
H	897.42 / 8.16	887.41 / 3.1	887.41 / 7.00	887.41 / 9.46
I	" / 8.60	" / 3.86	" / 8.36	" / 11.42
J	" / 10.43	" / 3.93	" / 6.6	" / 9.08
K	892.26 / 4.98	892.26 / 9.62	883.75 / 4.07	883.75 / 6.60
L	" / 7.30	" / —	" / 1.29	" / 5.42
M	" / 8.01	" / —	" / 5.30	" / 7.83
N	" / 10.81	" / —	" / 4.72	" / 6.56

KEY = H.I. / F.S.

Cross Section Notes

	12		13
A	893.27 / 11.47		893.27 / 6.54
B	" / 6.45		" / 3.08
C	" / 2.3		" / 1.18
D	898.58 / 5.33		898.58 / 3.98
E	" / 6.03		" / 8.13
F	" / 10.37		" / 12.45
G	893.89 / 12.59		893.89 / 13.65
H	887.41 / 11.08		887.41 / 12.4
I	" / 13.3		" / 13.9
J	" / 13.0		" / 13.7
K	883.75 / 8.44		883.75 / 12.20
L	" / 8.70		" / 12.48
M	" / 9.33		" / 13.75
N	" / 12.00		" / 13.02

Key = $\frac{H.I.}{F.S.}$



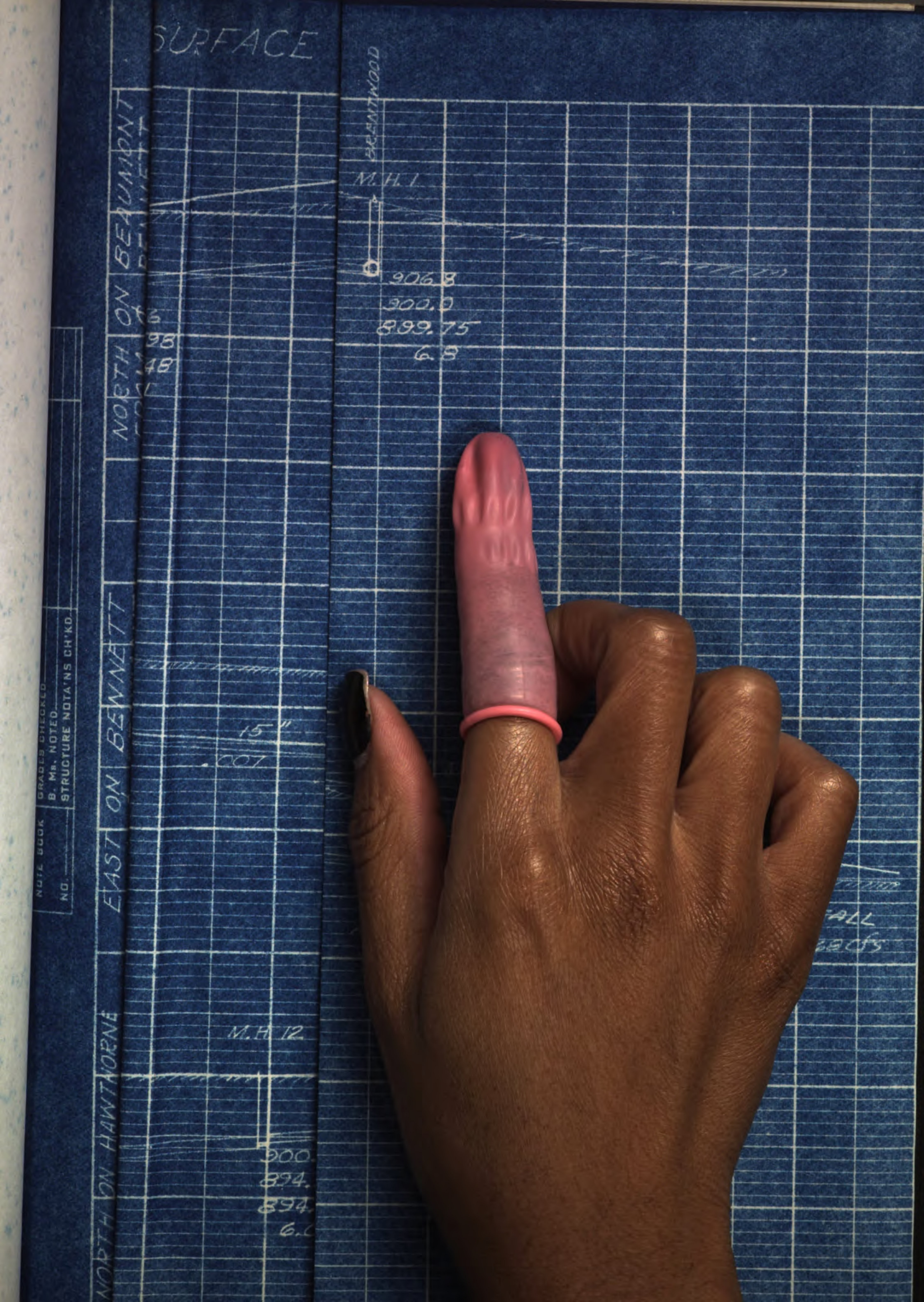
TYPICAL LOT, 100' X 150'
SHADED AREAS SHOW 100% RUNOFF AREA

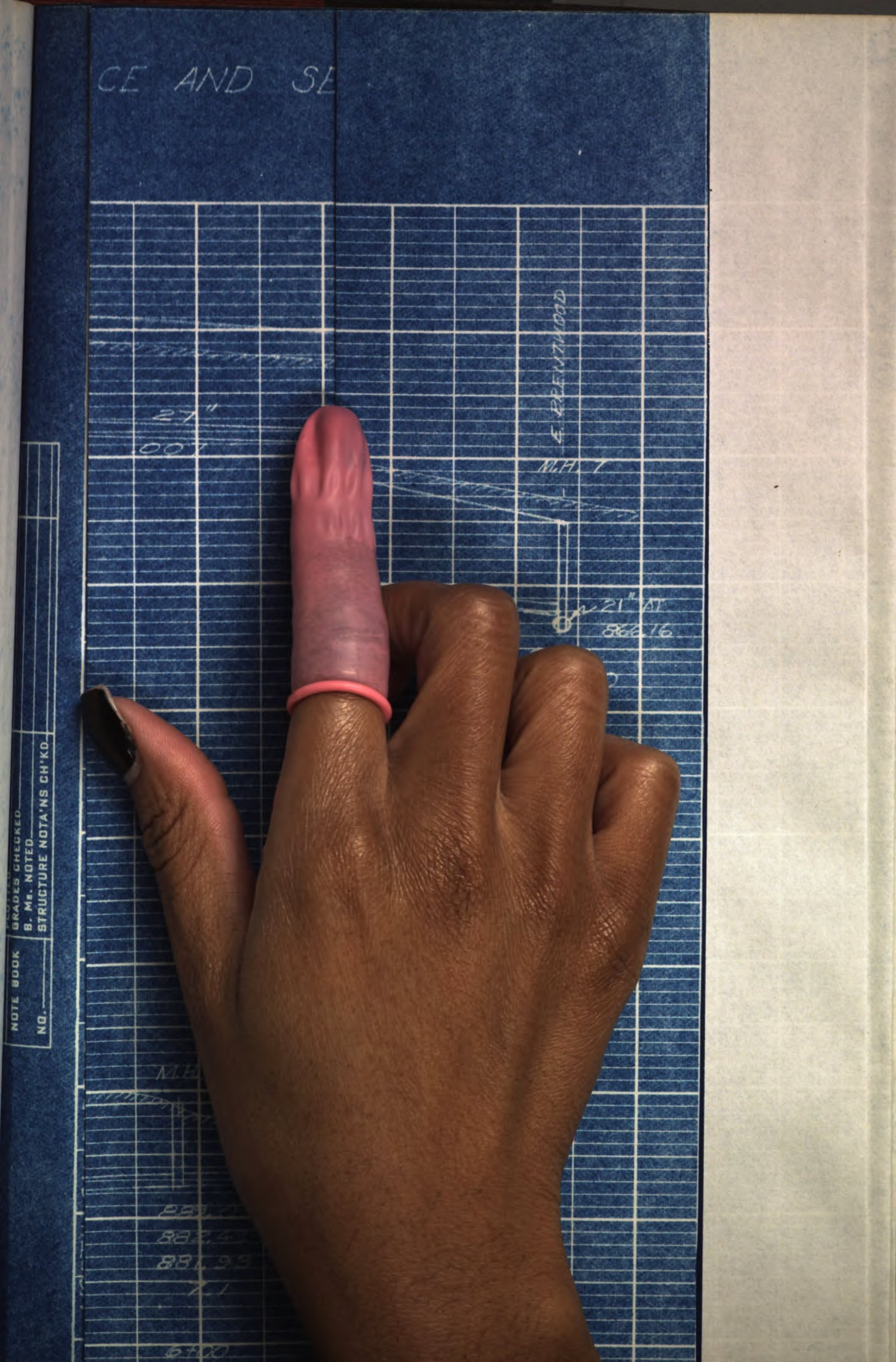
HOUSE: 2800 SQ.FT.
GARAGE: 280 "
DRIVE: 800 "
5' S.W.: 150 "
4030 SQ.FT. PER LOT

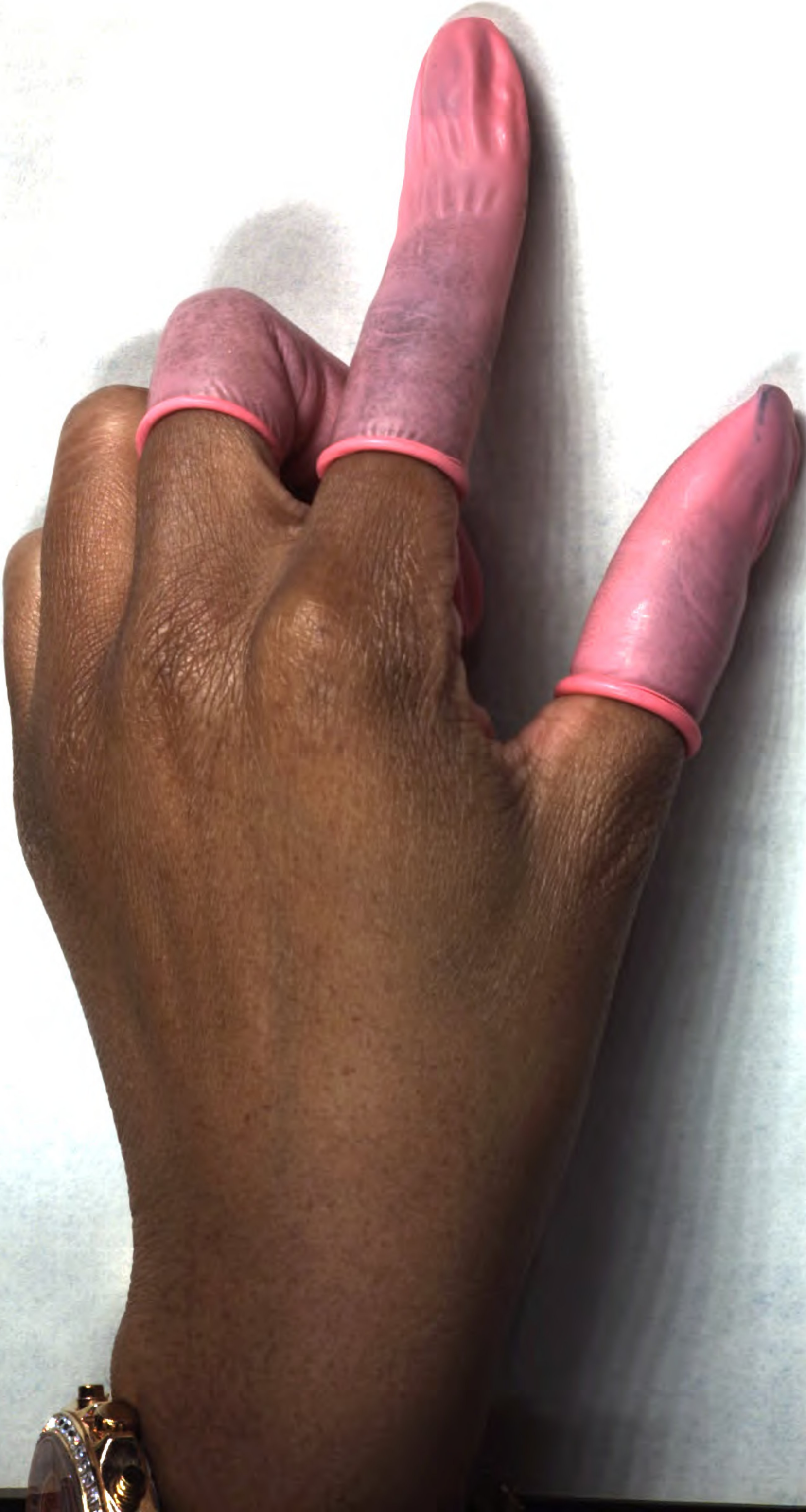
ROADS AND 4' S.W.,
39 SQ.FT. PER FT.
OF CENTERLINE

TYPICAL STREET SECTION

STREET	(16) + (17) TOTAL COMBINED SEWAGE C.F.S.	SLOPE
(1)	(18)	(19)
BEAUM	.6896	.015
EAST BRENTW	.8102	.008
"	.2923	.022
"	.7446	.0076
NORTH BRENTW	2.3102	.008
"	3.2554	.023
"	6.7484	.012
BEAUMO	.0096	.023
"	.0174	.0417
HODGE	.5228	.005
HAWTHOE	0.0159	.015
"	3.7318	[illegible]
"	9.5427	[illegible]
HODG	9.2947	[illegible]
DIBBL	0.0160	[illegible]
"	5.0250	[illegible]
"	0.2329	[illegible]
HODG	31.6768	[illegible]
NORTH BRENTW	51.5330	[illegible]
BENN	0.7584	[illegible]
"	3.5107	[illegible]
"	9.8230	[illegible]
	cfs	
	cfs	


SURFACE
BRENTWOOD
M.H. 1
906.8
900.0
899.75
6.8
NORTH ON BEAUMONT
EAST ON BENNETT
NORTH ON HAWTHORNE
15"
.007
M.H. 12
NOTE BOOK
NO.
GRADES CHECKED
B. Ms. NOTED
STRUCTURE NOTA'NS CH'KD.


CE AND SE
27"
E. BRENTWOOD
M.H. 7
21" AT
866.76
NOTE BOOK
NO.
GRADES CHECKED
B. Ms. NOTED
STRUCTURE NOTA'NS CH'KD
881.9
6+00



NOTE BOOK
NO.

PLOTTED
GRADES CHECKED
B. Ms. NOTED
STRUCTURE NOTA'NS CH'KD