A STUDY TO DETERMINE A SUITABLE WAY TO MAKE THE RED CEDAR GOLF COURSE AVAILABLE FOR USE DURING THE EARLY SPRING MONTHS

THESIS FOR THE DEGREE OF B. S.

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Hammerschmidt

1933

Earthwork

Dikes (Engineering)

Tulsa Red Cedar golf course

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A STUDY TO DETERMINE A SUITABLE WAY TO MAKE THE RED CEDAR GOLF COURSE AVAILABLE FOR USE DURING THE EARLY SPRING MONTHS

A Thesis Submitted to

The Faculty of

MICHIGAN STATE COLLEGE

of

AGRICULTURE AND APPLIED SCIENCE

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We wish to express our gratitude to Professor C. L. Allen and the Civil Engineering Department of Michigan State College for the kind cooperation and guidance which has been shown us in the preparation of this thesis. We are also grateful for the use of the College-owned instruments, without which we would have been unable to complete the thesis.

A study to determine a suitable way to make the Red Cedar Golf Course available for use during the spring months.

This thesis problem was chosen by us because of several favorable conditions:

1. The City of Lansing had no topographical map of the Red Cedar Golf Course.

2. This gave us an opportunity to get on the course to study the effects of flood water and rainfall while we were making a topographical map. Our thesis work occurs during the months of April, May and June, fortunately the months when the Golf Course is most frequently inundated.

3. The City of Lansing is concerned about making the course available for use because the regular crew of workmen must be maintained to care for the greens and fairways that are not inundated.

4. The City has already made a payment of about 16⅔ of the total cost of a pump for its use this spring. This money already paid will go towards the total payment of the pump when it is bought by the City. The pump is satisfactory for the use our design will demand, but it is not practical under the present dyke and tile system. The present dyke is not sufficient to prevent the usual yearly flooding, and the tile system is not properly arranged to concentrate the water at the pump.

5. We find that the elevation of the Golf Course is lower than the usual Red Cedar River level during the months of April and May. This necessitates

a. A dyke to keep out the river water.

b. A tile system to concentrate the water at the pump.

c. A pump to lift the water about six feet over dyke to river.

The problem is divided up into five parts:

1. Mapping of Golf Course.
2. Determining past flood stages so as to determine a reasonable dyke elevation.
3. Earthwork and sod on dyke.
4. Tile system. (County drain)
5. Cost and cost distribution.

Part I

MAPPING OF GOLF COURSE

Part II

[illegible] BLOOD STAGES

The object of the following data is to obtain the height of water in the Red Cedar River adjoining the Red Cedar Golf Course during the past years (1922 to 1926; 1929 to 1933). The data which I have gathered is as follows:

1. Gage height readings for the month of April from 3 gages:
   a. United States Geological Survey gage located about 200 feet east of Farm Lane.
   b. United States Weather Bureau gage located on the bridge next to M. S. C. Gymnasium Building.
   c. Our gage located adjacent to the Red Cedar Golf Course.
2. United States Geological Survey gage height readings, measured cubic feet per second flow, and velocity of water, taken at 29 different times.
3. United States Weather Bureau station high water readings from their gage during the past years (March, April and May of 1922 to 1926 and 1929 to 1933).

The problem which presents itself now is to transfer the high water readings from the United States Weather Bureau gage to what the gage would have read at the Golf Course during the past years. This gives me a sound basis upon which to base the height of dyke to be designed to withhold normal flood waters so that the Golf Course would be available for use much earlier each Spring. The following paragraphs explain how the United States Weather Bureau gage height readings for the past years were transferred to gage height readings at the Golf Course.

1. I have data of the maximum and minimum Weather Bureau gage
r readings for the years 1922 to 1926 and 1930 to 1933 for the months of March, April and May.

2. I have 29 readings from United States Geological Survey giving gage height, velocity of water, and quantity.

   a. Average velocity is less than 1.9 feet per second, and is therefore useless to me as a source of power.

   b. If I make a graph gage height to quantity, I can obtain the quantity for any gage height

      (1) Assuming the quantity passing all three gages is the same on any day.

      (2) Take the quantity for each day of April from the graph and record it (quantity) for each corresponding day for the other two gages. Then draw two more curves (gage height to quantity) for the other two gages.

      (3) Using the old maximum gage heights I can get the quantities for those heights (United States Weather Bureau data).

      (4) Then using these quantities on my Golf Course gage curve, I can get the maximum water elevations for the years past as they probably were adjacent to the Golf Course.

Date		Culvert Gage	Weather Bureau Gym Bridge Gage	United States Stream Control & M.S.C. Gage E. of College Lane
1933				
Mar.	28	117.39		
	29	117.40		
	30	116.8		
	31	116.6		
Apr.	1	119.6	4.6	
	2	120.4	8.6	7.02
	3	120.4	8.8	
	4	119.5	7.5	5.0
	5	119.0	6.4	5.3
	6	118.9	5.6	5.2
	7	119.0	6.1	5.0
	8	119.0	6.0	4.8
	9		5.4	4.55
	10	118.0	4.8	4.3
	11	117.9	4.3	4.1
	12	117.8	4.1	4.07
	13	117.5		3.95
	14	117.3	3.6	3.9
	15	117.3	3.8	4.0
	16	117.6	4.2	4.15
	17	117.55	4.1	4.1
	18	119.0	5.8	
	19	119.2	6.1	
	20	118.55	5.5	
	21	117.7	4.7	
	22		4.0	
	23		3.5	
	24		3.2	
	25		3.0	
	26	115.1	2.9	
	27		2.8	
	28		2.7	
	29	114.9	2.7	
	30		2.7	
May	1			
	2			
	3			
	4	115.5		
	5			
	6	116.2		
	7	117.2		
	8			
	9			
	10	118.4		

PLOTTED POINTS TO OBTAIN PAST HIGH WATER READING

	U.S. Weather Bureau Gage Reading			Probable Height at Golf Course Gage			
Year	March	April	May	Feb.	March	April	May
1922	6.3	8.5	3.1		119.2		
1923	8.2	2.4	4.7				
1924	7.9	5.6	6.1		120.2	120.5	
1925	5.5	2.6	1.0				
1926	9.7	8.0	2.3		120.8	120.3	
1927	(See bound copy of						
1928	(1006 for missing						
1929	(records at Lansing.						
1930	5.7	5.4	4.7	120.6			
1931	2.6	2.3	2.2				
1932	6.3	4.7	6.2		119.2		119.0
1933	4.4		6.2			120.4	119.0

Extreme flood May 15, 1915. Weather Bureau gage read 12 feet.

Probable height at Golf Course - 125. This is the elevation of Michigan Avenue, and water up to Michigan Avenue

Part III

[illegible]

EARTHWORK FOR DYKE

1. Elevations carefully taken along proposed dyke centerline.
2. Distances between elevations carefully taken.
3. The shape of the dyke cross section drawn for each elevation.
4. Area of the cross sections taken with a planimeter.
5. Cubic yards figured by

$$\frac{\text{Area A} + \text{Area B} \times \text{distance}}{2} = \text{Cubic yards}$$

6. Sod to be placed upon the river side of the dyke.

VOLUMES

EARTH AND SOD

For dyke top elevation of 123 feet

	Borrow	Sod
A to B	610 cu. yds.	273 sq. yd.
B to C	827 " "	298 " "
C to D	390 " "	176 " "
D to E	259 " "	93 " "
E to F	107 " "	66 " "
F to G	252 " "	147 " "
G to H	321 " "	149 " "
H to I	58 " "	30 " "
I to J	15 " "	15 " "
	2839 " "	1217 " "

DYKE INVESTIGATION

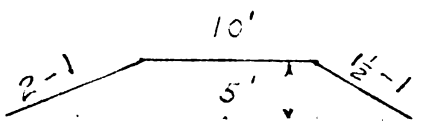
Borrow samples were tested from several hills close to the Golf Course to see if the earth was suitable for dyke fill. The one closest at hand is the high parking lot that touches the west side of the Golf Course. This sample tested as follows, and is considered suitable for a dyke fill.

Report on Subgrade Soil

Percentage of sand	6.6
Percentage of material retained on a #10 sieve	16.3
Percentage of silt	35.0
Percentage of clay	10.0
Moisture equivalent (percent)	7.4
Volumetric shrinkage (in percent)	0.0
Capillary moisture (in percent)	20.0
Liquid limit (in percent)	16.4
Plastic limit (in percent)	

The dyke was designed to have a top width of ten feet. This would furnish a tractor road if one were needed to drive the tractor over, from the west side of the county drain to the east of the county drain. A wide dyke was recommended by the City Forester and head of the Park and Cemetery Department for this purpose.

Checking the Safety of Investigation of Dyke for Slipping



Consider the rectangular section only.

Water pressure on the side = $\frac{1}{2}wh^2$

" " = $\frac{1}{2}$ x 62.5 x 9 = 281

w x u = 4500 x .5 = 2,250# can be resisted.

Safety factor = $\frac{2250}{281}$ = 8

COST FOR DYKE

Total volume of earth 2839 cu. yds.

$.30 per cu. yds. to place dyke (Engineering News Record prices)

$.30 x 2839 = $851.70

Total amount of sod 1217 sq. yds.

$.10 per sq. yd. for sod

$.10 x 1217 = $121.70

Total Cost for Dyke $973.40

Labor cost being so uncertain, the unit price was made rather high to cover for reasonably priced labor.

Part IV

TILT SYSTEM

TILE SYSTEM

By accurate survey the existing tile system was located and found to be entirely inadequate to drain the course in a satisfactory manner. With the new system which we have investigated, designed and laid out on the map it was found that the old tile could be salvaged and used in this new layout. The new system was designed to carry off all spring runoff and rain water. By locating the system as shown on map the laterals drain into the almost natural sump near river bank. These mains have manholes every so far and can therefore be washed out when necessary. This system which might seem rather elaborate, is sufficient to drain the course thoroughly in the wettest weather, thereby making the course available in early spring. The tile quantities have been cut down to the very minimum for excellent drainage, and by having the course available so early in the season, this system would pay for itself in the next two years.

COST FOR TILE

4" Tile		5716	
4" Salvage		300	
	Total		5416 lineal feet
6" Tile		1260	
6" Salvage		250	
	Total		1010 lineal feet
8" Tile		810	
8" Salvage		500	
	Total		310 lineal feet
	Total amount of tile		6736 lineal feet

Tile cost according to Engineering News Record prices - $40 per 1000 feet.

Total cost 6736 x $40 = $269.44

Part V

COST ANALYSIS

Dyke Work Cost	$ 973.40
Tile System Cost	269.44
Total Estimated Cost	$1242.84

This Golf Course opens approximately fifty days later per year than other golf courses in this vicinity. Assuming fifty people would play per day at $.25 each, the added income with no other cost except for the dyke and tile would be

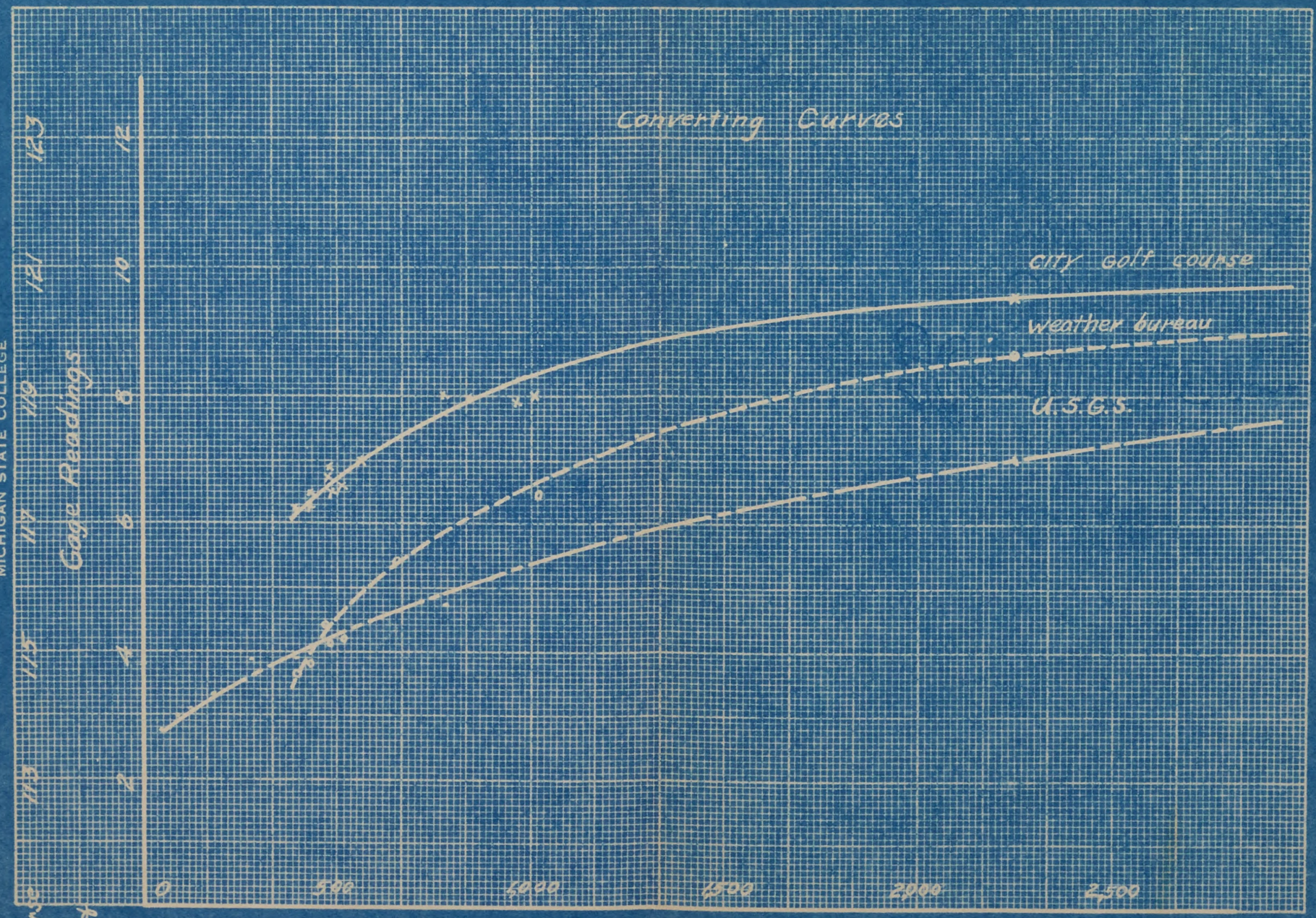
50 x 50 x $.25 = $625.00 per year

more income due only to spring playing. Playing time would also be increased during the summer and fall because of the quick removal of rainfall.

The dyke and tile system should pay for itself in two years.

This dyke and tile system should last over a period of twenty years or more.

Not only would this proposed system pay large profits to the City, but the system would prevent the adjoining property owners' lots and basements from becoming inundated.



City Golf Course
U.S.G.S. Weather Bureau

2 BLUE PRINTS

1. MAP OF REDCO

2. GRAPH OF R