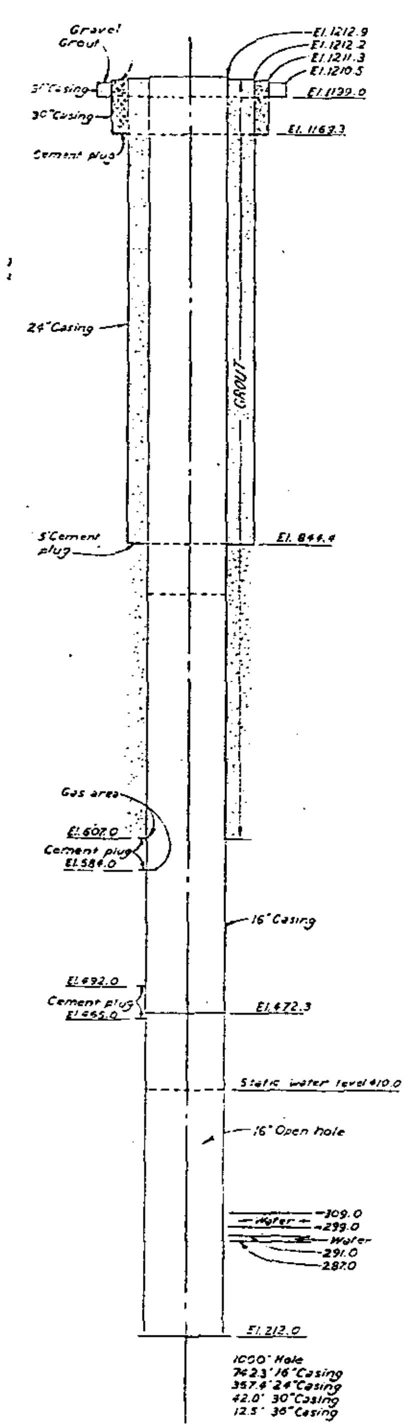
CORPS OF ENGINEERS



SCHEMATIC CROSS SECTION—WELL H52L

The equipment required to make a well-survey by the method described herein consists of a reel of small steel cable of such length as may be required to reach to the depth desired. A steel cage three feet long with an adjustable diameter, or a diameter approximately 1/2" less than the I.D. of the well casing and a small pulley.

PROCEDURE

The first step is to attach the pulley to a beam of sufficient strength to carry the weight of the cage and line without bending appreciably. The beam and pulley must then be supported horizontally at a height above the top of the well casing at least ten feet, or greater height if possible. The beam should be long enough and the supports so arranged that the location of the pulley may be shifted at least two feet in any horizontal direction by sliding the beam. Usually there is a derrick, and the girts may be used to support the beam, but in the absence of a derrick a tripod or some other means must be used to support the beam.

The cable is then run through the pulley, the center of the cage is attached to the end of the cable and allowed to hang just inside the well casing. And the pulley shifted about until the axis of the cage coincides with the center of the well.

Next establish with a straight edge four marks on the well casing or floor which can be used to determine two horizontal lines at right angles to each other, passing as near to the center of the well as the cable will permit without the cable being deflected from its center position. To simplify the procedure one of these lines should be parallel to the beam carrying the pulley. Usually the lines are laid off as north-south and east-west lines. The cage is centered and then lowered to the bottom of the well and then raised in 10' increments at a time. Deflections in the north or south or east or west directions being measured as shown in Sketch No. 3, at each ten foot interval. The distance of the center of the pulley above the level of the place at which deflection measurements are made must also be measured. The center of the pulley is called the Datum Point. When the cage reaches the top, it should be on center, if not, necessary corrections to equipment will be made and the test rerun.

Sketch No. 1 shows an elevation of a well with a cage in the well. And Sketch No. 3 shows a plan view of the top of the well with a straight edge in its two position. In making the measurements indicated it must be remembered that the straight edge was placed by the side of the cable. Since the cable was in the center of the well, the edge of the straight edge is not quite in a diameter and deflections must always be measured on the same side of the cable that the north-south, east-west lines were determined.

An inspection of Sketch No. 1 will show that if the well is crooked it may happen that the cable will swing over until it touches the side of the casing. Should this occur, any readings beyond this point with the pulley in its original position are valueless. It is therefore necessary to shift the pulley so the cable will be free from the casing. If the crook is above the water level, this condition may be easily observed. And if it is below the water level, it may be suspected if the location of the cable remains constant as the cage is lowered. It occasionally happens, however, that the well is actually slanting so it will give a constant reading for a while, and, since shifting the pulley is apt to introduce errors unless great care is used, it is best to be sure that the cable is touching before any shifts are made. If the well is so crooked that the cable touches at a second point after being shifted, it is impossible to survey it beyond this point by this method. If the data is worked up and plotted, it is always easy to see if any of the above difficulties are present. In general, a shift in one direction will be sufficient, but sometimes it is necessary to shift in the other direction also. The pulley should be shifted as far as the surveyor deems necessary and every shift it is important that the position (vertically and in both directions horizontally) of the datum point be accurately determined. Sketch No. 2 shows a well being surveyed with the datum point shifted.

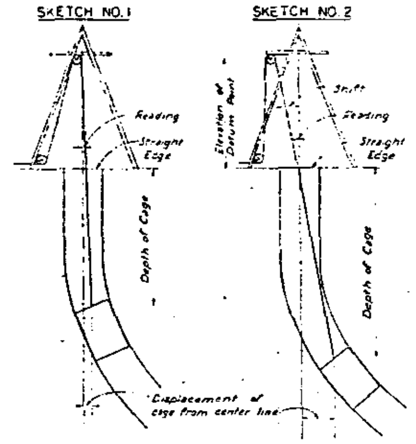
After the data has been calculated, it is plotted as shown on the graph sheet. The deflections for the true view are determined (graphically by determining the diagonals of parallelograms produced by plotting the displacement readings as shown in Sketch No. 4). Cross-section paper with one inch squares, divided into ten small squares to the inch, is very convenient for laying out the wells. If the depth is laid out with ten feet to the inch and the cage displacement with five inches to the inch, it usually results in a satisfactory representation of the well; although any scales may be used, the horizontal direction should always be greatly exaggerated to show the defects in the well clearly.

With the plot a string may be used to represent the cable to determine whether the cable was touching the casing at any point. In a plot it is indicated by an approach of the string to the side of the well.

If it is determined from the plot that the cable did not touch the well casing side during the survey it is an indication that the readings were accurate. In order to determine what size column pipe and bowl diameter can be safely operated in the well it is most preferable to construct from cardboard a cross-section of the column and bowl to the same scale as used in plotting the survey. If the model of column and bowls can be placed in the well without bind on the side of the well casing when inserted over the plot of the true view of the survey it may be assumed that the actual pump will do likewise.

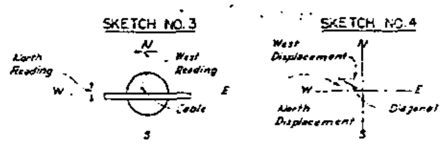
SKETCH NO. 1

SKETCH NO. 2

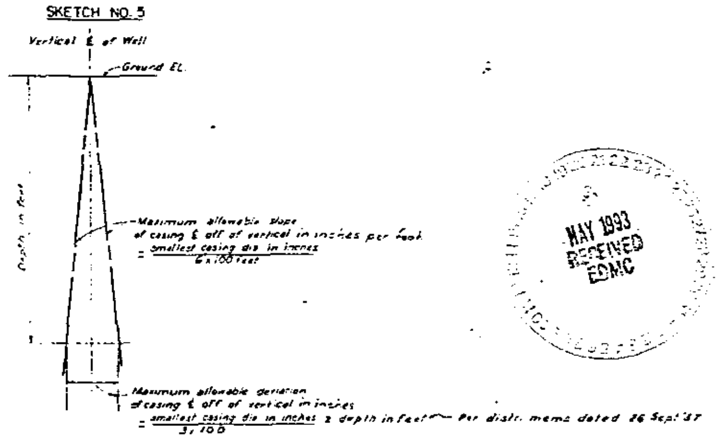


SKETCH NO. 3

SKETCH NO. 4



SKETCH NO. 5



SAMPLE DATA, CALCULATIONS AND PLOT OF AN 18" WELL - 100 FT. DEEP

Elevation of Datum point 20 ft. Water level 40 ft. Datum point shifted 12" north 80 ft.

DEPTH CAGE FEET	READINGS OF DEFLECTIONS OF CABLE INCHES				DISPLACEMENT OF CAGES INCHES			
	N	S	E	W	N	S	E	W
100	7.5		.44			15.	2.64	
90	7.8		.42			11.1	2.3	
80	8.		.4			8.	2.	
70		1.1	.4			4.75	1.8	
60		.5	.37			.2	1.48	
50			.35				1.25	
40	.1		.3		.3		.9	
30	.2		.2		.5		.5	
20	.15		.1		.3		.2	
10	.1				.15			

FORMULA

No. 1 Displacement of cage from center line =

$$\text{reading} \times \frac{(\text{depth of cage} + \text{el. of datum})}{\text{el. of datum}}$$

Sample calculation at 10 ft. depth:

$$\text{cage displacement} = \frac{.1 \times (10 + 20)}{20} = .15"$$

No. 2 Displacement of cage from center line when datum point is shifted =

$$= (\text{shift} \pm^{*} \text{reading}) \times \frac{(\text{cage depth} + \text{el. of datum})}{\text{el. of datum}} - \text{shift}$$

* Add the reading to the shift when shift and reading are on opposite sides of center line; subtract when shift and reading are on same side of center line.

Sample calculation at 80 ft. depth:

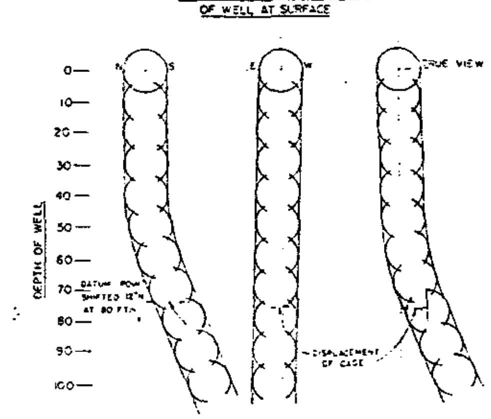
cage displacement =

$$(12 - 8) \times \frac{(80 + 20)}{20} - 12 = 8"$$

Since distance A (see Sketch No. 2) is greater than the shift, it is evident that the cage displacement is south from the center line.

Formula No. 1 is used in all east calculations in this case, but if there is a shift in the east-west direction, Formula No. 2 would have to be used in the same manner as for the north-south direction.

CENTER LINES INDICATE CENTER OF WELL AT SURFACE



REVISION	DATE	DESCRIPTION	BY
2		AS CONSTRUCTED (Contract 3104)	
1	6 JAN 53	AS CONSTRUCTED	

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER, WALLA WALLA, WASHINGTON

CAMP HANFORD
NORTH RICHLAND, WASHINGTON

WELL H52L

SCHEMATIC CROSS SECTION & DEEP WELL SURVEY METHOD

DRAWN BY: C. A. C.
TRACED BY: C. A. D.
DATE: 27 FEB 1957
SCALE AS SHOWN
SPEC NO. M-57-32
DRAWING NUMBER 71-05-37
DATE 27 FEB 1957