CONTINUOUS PILE FOOTING ANALYSIS

IBM 1620 COMPUTER PROGRAM

State Highway Department of Georgia

BRIDGE DEPARTMENT

BY

THOMAS S. MOSS, JR.

SEPTEMBER, 1966

CONTINUOUS PILE FOOTING ANALYSIS

The Continuous Pile Footing Analysis Program was written to reduce the cumbersome and time-consuming task of combining the various group loadings in order to arrive at the optimum design values.

No limitation is placed on geometric arrangement of the piles except the number of rows is restricted to fifteen and the number of piles per row to nine. Up to four columns can be entered.

The program closely follows the longhand method of finding the centroidal axes of the pile group, calculating moments of inertia of the group about these axes and resolving footing dead load (including bouyancy and surcharge), input dead, live and wind loads about the axes.

Each pile is then analyzed by the combined bending stress equation:

$$f = \frac{\frac{Pt}{N} + \frac{Mxx\ (Iyy) + Myy\ (Ixy)}{Ixx\ (Iyy) - Ixy^2}\ (Y) - \frac{Myy\ (Ixx) + Mxx\ (Ixy)}{Ixx\ (Iyy) - Ixy^2}\ (X)}{GRF}$$

where

"f" is the load on the pile in question:

"Pt", "Myy" and "Mxx" are the effective load and moments of the case being considered:

"N" is the total number of piles in the pile group:

"Iyy" and "Ixx" are the moments of inertia of the pile group about its centroidal axes:

"Ixy" is the product of inertia about the centroidal axes if present:

"X" and "Y" the co-ordinates of the pile in question:

"GRF" the group reduction factor (1.00 for Group I; 1.25 for Groups II and III).

For each case, the pile reactions are summed up and moments and shears calculated across the footing.

Maximum and minimum pile reactions are retained, along with identification of the loading cases which cause these reactions. Maximum absolute shears as well as maximum and minimum moments are given for each load group at each row and column.

Group loadings were restricted to Groups I, II and III, however the designer can simulate other group loadings by including the loading in question with a wind or live load after making the necessary adjustments to allow for group reduction. The program makes no allowance for reversibility of loads.

The designer can use up to five cases of Group II wind, five cases of Group III loadings and as many cases of Live Loading as are necessary. At least one case of each must be included however, even if it is a dummy case with all values equal to zero. Piles are assumed to have the capacity to take tension.

INPUT

(See Input Illustration)

Input Co-ordinate System - Any convenient co-ordinate system is acceptable so long as the same set of axes are used for both pile and column input. The axes must be oriented so that the first quadrant of the system is in the upper right-hand corner.

It should be noted that these axes need not agree with the centroidal axes of the pile group.

Sign Convention - Positive axial load (P) acts down, longitudinal moment (M_L) results from a force acting ahead, transverse moment (M_T) acts counter-clockwise on the footing, longitudinal shear (V_L) acts ahead on the footing and transverse shear (V_T) acts to the left on the footing. Negative numbers are designated by a minus sign preceeding the first significant digit.

IDENTIFICATION CARD - Project number, user's initials, date or any other pertinent information.

CARD 1 - LENGTH, WIDTH and DEPTH are footing dimensions, oriented so that design "strips" are taken parallel to the WIDTH dimension.

X-EDGE is the distance between the left edge of footing and the input Y axis.

Y-EDGE is the distance between the bottom of footing and the input X axis.

MT.ARM is the effective vertical distance between the plane at which horizontal shears act on the footing and the horizontal plane at which the footing is to be designed.

BOUYANCY is the unit weight of the immersing fluid and may be included when applicable. Only the footing itself is assumed to be bouyant.

FILL is the height of surcharge on the footing.

WT.SOIL is the unit weight of the fill material.

NO.ROWS is the number of rows of piles in the footing, not to exceed fifteen. Rows run parallel to the WIDTH dimension.

N2W is the number of Group II wind cases applied, not to exceed five.

N3W is the number of Group III loading cases applied, not to exceed five.

NLL is the number of Live Load cases applied with no limit on the number of entries.

CARD 2 - Under NC, give the number of columns, not to exceed four, and under the "X" and "Y" fields, give the co-ordinates to each column, using the same set of axes as with the pile co-ordinates.

CARD 3 - Under N/R, list the number of piles in the row starting with the leftmost row. The first co-ordinate field should contain the X co-ordinate of the row, followed by the Y co-ordinates of each pile in the row, the total number of Y co-ordinates corresponding to the entry under N/R. Up to nine piles per row may be listed. Additional sheets will be needed if the footing has more than ten rows.

CARD 4 - List the axial load, moments and shears to each column resulting from Dead Load on the structure, listing the columns in order from left to right. If more than two columns are present, continue on the next card after entering a "4" in c.c. 1 of that card.

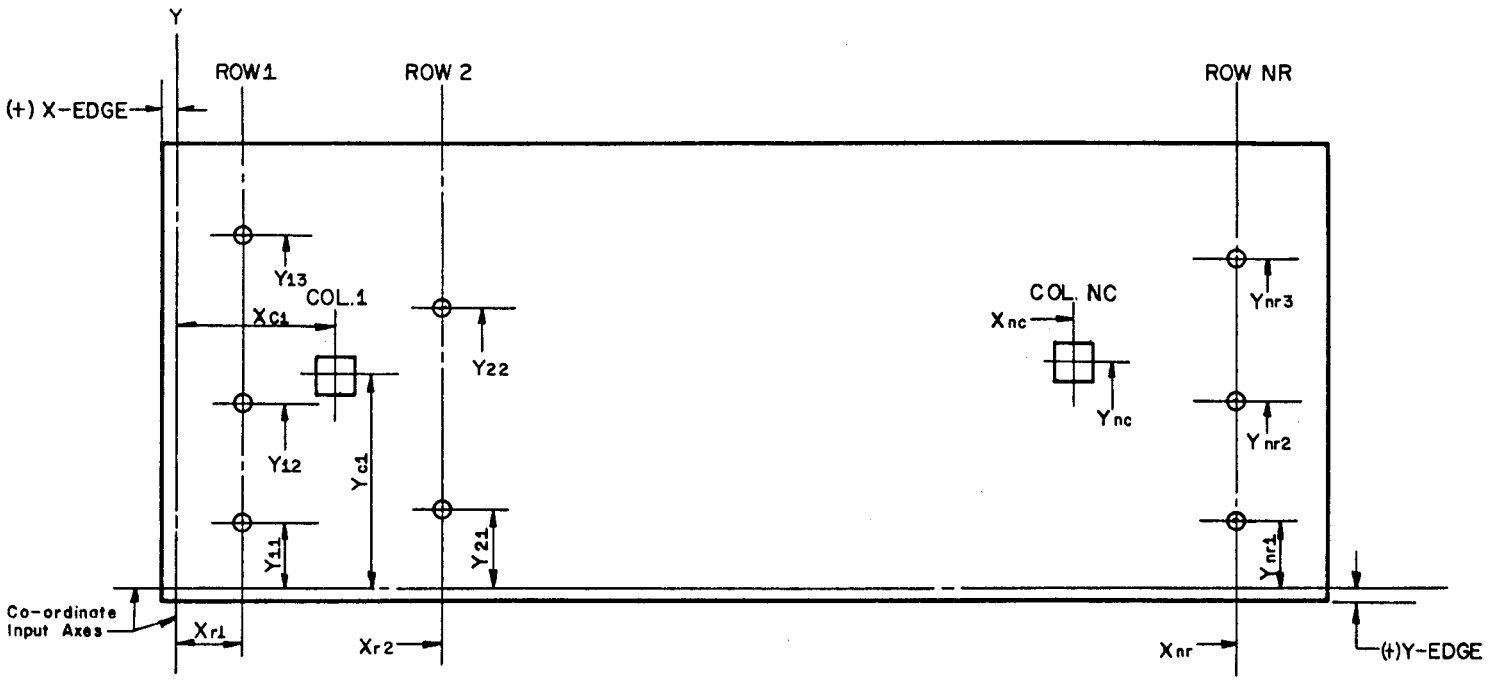
CARD 5 - Enter a "5" in c.c. 1 followed, as with Dead Load entries, by axial loads, moments, and shears resulting from Group II wind loading. A "5" should be present in c.c. 1 of every card containing Group II loading data.

CARD 6 - Entries should be made as with CARD 5 except a "6" should be entered in c.c. 1 and data is for Group III loading. Note that Group III forces which are not

included in Group I loading must be combined in each Group III loading case.

CARD 7 - Live Load data should be entered in these cards along with a "7" in c.c. 1 of each card. Centrifugal force and impact should be included with the Live Load cases when appropriate. Although as many Live Load cases as are necessary may be entered, some discretion should be exercised as each Live Load case appreciably increases the running time of the problem.

Output Sign Convention - Positive pile reactions act up. The footing is treated like a beam with positive shear resulting from positive pile reactions and positive bending moment resulting from positive shear.



INPUT ILLUSTRATION

GA. DEPT. OF TRANSPORTATION
BRIDGE DESIGN OFFICE

CONTINUOUS PILE FOOTING ANALYSIS

IDENTIFICATION

1	PROG	PROB.NO	9 PROJECT NO., COUNTY, NAME, DATE, REMARKS, ETC.
*	B, I, 2		

	LENGTH	WIDTH	DEPTH	X-EDGE	Y-EDGE	MT. ARM	BOUYANCY	FILL	WT. SOIL	NO. ROWS	N2W	N3W	NLL
1													

UNITS ARE FEET, POUNDS, OR SOME COMBINATION THEREOF.

	NC	X-COL. 1	Y-COL. 1	X-COL. 2	Y-COL. 2	X-COL. 3	Y-COL. 3	X-COL. 4	Y-COL. 4
2									

	N/R	X CO-ORDINATES TO ROWS AND Y CO-ORDINATES TO PILES									
3											
3											
3											
3											
3											
3											
3											
3											
3											
3											

	2 P 8	9 ML 15	16 MT 22	23 VL 28	29 VT 34	35 P 41	42 ML 48	49 MT 55	56 VL 61	62 VT 67
4										

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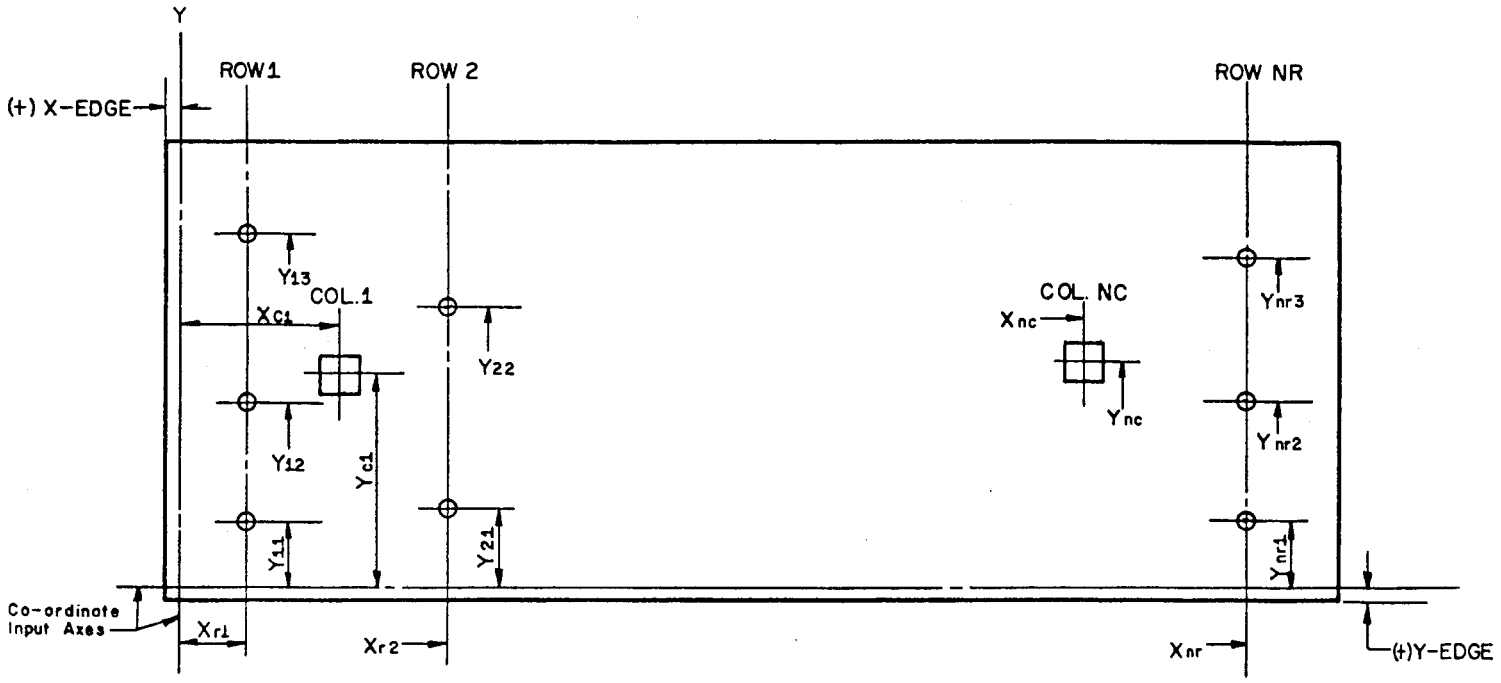

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2									

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3											
3											
3											
3											
3											
3											
3											
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3											

	2 P 8	9 ML 15	16 MT 22	23 VL 28	29 VT 34	35 P 41	42 ML 48	49 MT 55	56 VL 61	62 VT 67
4										