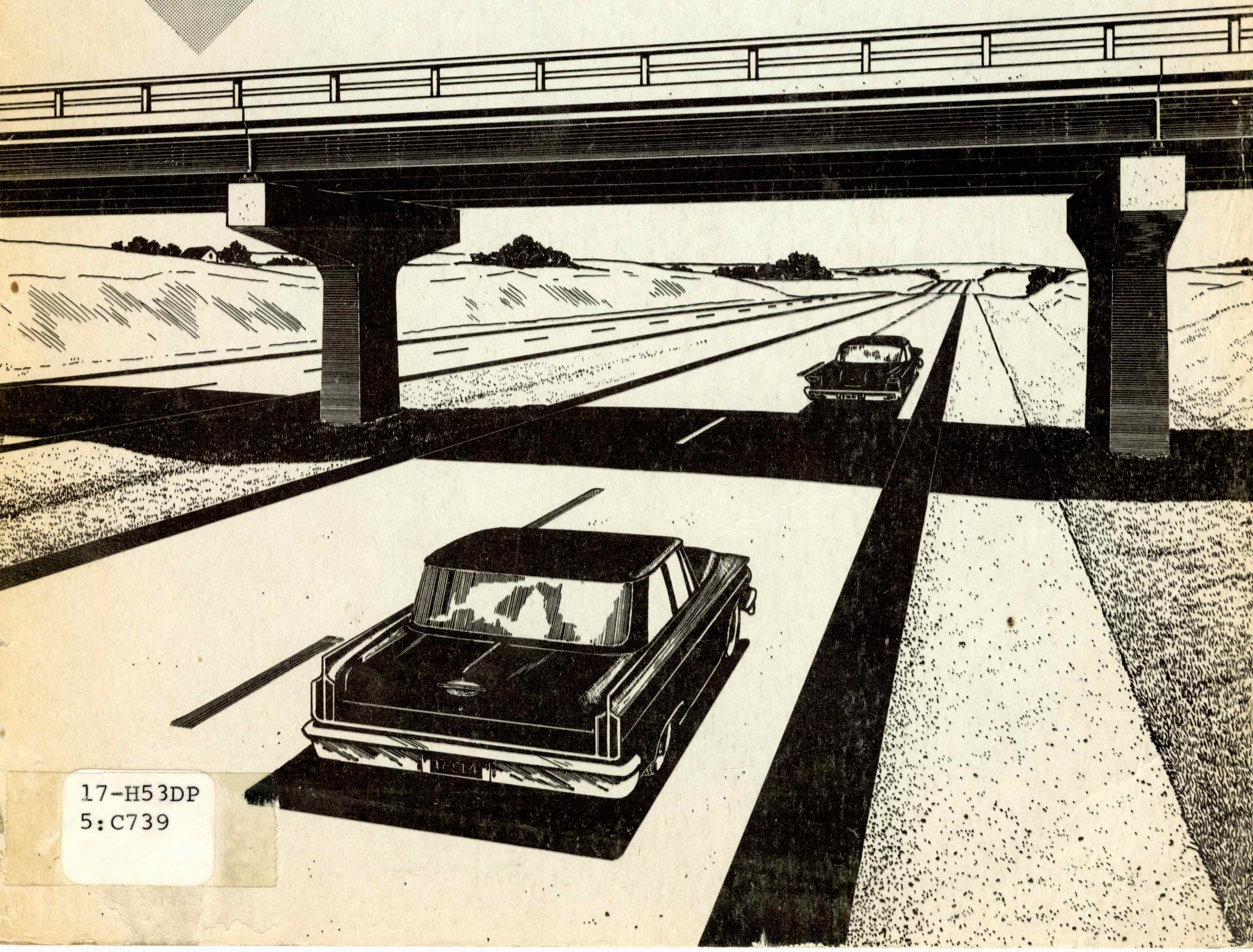
Computer Analysis of Continuous I-Beam Bridges

Program for the BRIDGE DESIGN DIVISION
by the COMPUTING CENTER
IOWA STATE HIGHWAY COMMISSION



COMPUTER ANALYSIS
OF
CONTINUOUS I-BEAM BRIDGES

Employing The

IBM 650 COMPUTER

Developed For

THE BRIDGE DESIGN DIVISION

Neil Welden, Bridge Engineer

by

James S. Hoffman

and

Albert R. Torkildson

Data Processing Dept.
COMPUTING CENTER

IOWA STATE HIGHWAY COMMISSION

AMES, IOWA

November, 1958

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November 4, 1959

Mr. John G. Butter
Chief Engineer
Iowa State Highway Commission
Ames, Iowa

Dear Mr. Butter:

Presented herewith is a copy of the program "Computer Analysis of Continuous I-Beam Bridges". This is the first project to be programmed utilizing the computer for the Bridge Design Division. This program has been well accepted by the Bridge Design Engineers.

Many computer applications exist in the field of continuous bridges. We anticipate developing other programs of this type in the future.

We wish to express our thanks to Neil Welden, Bridge Engineer, who developed the method used in this program and Mr. C. M. Daniel, Applied Science Representative of the IBM Corporation, for their help in the computer application. Through their efforts, this program has been made possible.

The write-up will be made available to all State highway departments. Program listings and card decks will be sent upon request.

Sincerely yours,

James F. Hoag

James F. Hoag
Electronic Computing Engineer

JFH:br

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COMPUTER ANALYSIS OF CONTINUOUS I-BEAM BRIDGES[1]

Neil Welden[2] A.M. A.S.C.E.
James S. Hoffman[3] J.M. A.S.C.E.
Albert R. Torkildson[4]

ABSTRACT

The paper presents a method of analyzing symmetrical continuous I-Beam bridges based on functions defining influence diagrams for moment and shear. These functions are derived from an application of the Conjugate Beam principle to Muller-Breslau's principle, and have been used for several years by the Iowa State Highway Commission. The method has been programmed for the analysis of 2, 3, 4, and 5 span symmetrical bridges, thereby increasing its usefulness.

The computer program is divided into three sections. Section 1 computes the values of the influence lines, the maximum moments at the piers and in the spans, the stresses at the points of maximum moment, the lengths of cover plates, and the point of zero moment for dead load. Section 2 computes the deflection at the quarter points between splices. Section 3 computes the reactions and shears.

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1. Presented at the A.S.C.E. Conference on Electronic Computation held in Kansas City, Missouri, in November, 1958, and originally printed as part of the Proceedings at that Conference.
2. Bridge Engineer, Iowa State Highway Commission
3. Programming Engineer, Iowa State Highway Commission
4. Programming Engineer, Iowa State Highway Commission

INTRODUCTION

Some time ago, the senior author developed a procedure for the derivation of the functions defining influence diagrams for moment and shear in continuous beams of constant moment of inertia. The procedure has been in use for several years and is rapid, simple, and accurate. The functions derived are rather simple cubic equations which are very well adapted to electronic computations, and the junior authors have used them to develop a program for the analysis of symmetrical continuous bridges of two, three, four, and five spans. It is the purpose of this paper to explain and describe this program. In order to do so, certain assumptions will be explained; the fundamental concepts and general procedure for the derivation of the functions will be stated; the procedure will be exemplified for certain functions of a three span symmetrical continuous beam; the constants required for the solution of two, three, four, and five span symmetrical continuous beams will be given; and the program will be explained in detail.

The program was developed for beams of constant moment of inertia because it has been the practice of the Iowa Highway Commission to assume that, for live load, beams of constant depth may be designed as though the moment of inertia were constant. Dead load moments resisted by the beams alone are, of course, affected by variations in moment of inertia caused by cover plates. This effect is taken into account by calculating moments at the interior supports for a beam of constant moment of inertia; increasing these moments by a percentage, which experience has shown to be approximately correct; and using the moments so increased as redundants for the calculation of the dead load moment. This increased moment is checked by calculating dead load deflections and is corrected if necessary.

Symmetrical spans were chosen because they constitute by far the largest proportion of the Iowa State Highway Commission bridge work. It was felt that if the design of these spans were facilitated by use of the computer, the designers would be able to concentrate on the unusual cases, where their experience and judgment would be more valuable.

STRUCTURAL THEORY

The fundamental concepts on which the derivation depends are the Muller-Breslau principle and the conjugate beam principle.

The Muller-Breslau principle is stated thus -

> If in a structure, any function is allowed freely to produce a very small corresponding deflection, delta, the load line of the structure will be deflected by the amount of the influence ordinates for that function, multiplied by delta.

The conjugate beam principle may be stated thus -

> If, for an actual beam loaded in such a manner as to produce moment in the beam, a conjugate beam be loaded with the M/EI diagram of the actual beam, then
> 1. The shear in the conjugate beam at any point is the slope of the elastic line of the actual beam at that point.
> 2. The moment in the conjugate beam at any point is the deflection of the actual beam at this point.

The general procedure for the derivation of the functions is as follows:

1. The actual beam is allowed to deflect freely at the point where the influence diagram is desired through a distance of 1/EI under the influence of (a) moment of (b) shear. The deflection for moment is a rotation of 1/EI radians and that for shear is a vertical separation of 1/EI units. This deflection will cause moments in the beam and these moments will vary uniformly between supports.
2. A trial conjugate beam is set up using arbitrary moments at the supports. Rotation for influence diagrams for moment is represented by a concentrated load of 1/EI and vertical displacement for influence diagrams for shear by a moment of 1/EI.
3. Using the conjugate beam principle, moments in the actual beam are evaluated and these moments, divided by EI, are used as loads on the true conjugate beam.
4. A series of functions of "x" is derived which define the moment at any point in the true conjugate beam.

5. These functions, multiplied by EI define the desired influence diagram.

It is apparent that if the loads on the true conjugate beams are not divided by EI, step 5 is unnecessary, and that the functions of step 4 will define the influence diagram. Then, the load on the true conjugate beam is the moment diagram of the actual beam, a unit concentrated load represents the rotation for moment, and a unit moment represents the separation for shear.

Note the following:

1. The conjugate beam is a simple beam between end supports of the actual beam.
2. As in any beam, the summation of shears at any point in the conjugate beam equals zero.
3. At points of zero deflection in the actual beam, the moment in the conjugate beam equals zero: that is, the interior supports of the actual beam may be considered hinges in the conjugate beam.

These principles are used to evaluate the moments at the supports of the actual beam. The general procedure is as follows:

1. A trial conjugate beam is set up using arbitrary moments at the supports. These moments are designated M_1, M_2, M_3, etc.
2. For each pair of adjacent spans, an equation is written, asserting that the sum of the shears at the intermediate support is equal to zero. The general case is shown below.
3. For a bridge of N spans, simply supported at the ends, the N-1 resulting equations are solved simultaneously and the required moments evaluated.

The general case of adjacent spans, referred to in 2, above, is shown in Figure 1.

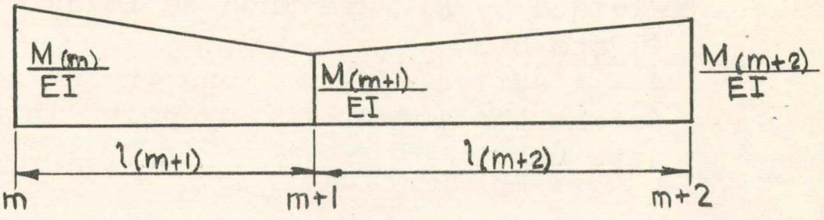


FIGURE 1

Setting the sum of the shears at point M+1 equal to zero, the following equation is written.

$$\frac{M_m l_{m+1}}{6EI} + \frac{M_{m+1} l_{m+1}}{3EI} + \frac{M_{m+1} l_{m+2}}{3EI} + \frac{M_{m+2} l_{m+2}}{6EI} = 0$$

Note that EI may be omitted. It will be omitted in future equations.

In the case where the influence diagram for moment at a support is desired, a unit load is placed at the support, and the sum of the shears at that point is increased by unity. For the case above, if theinfluence diagram for moment at support M+1 is desired, a unit load is placed at that point, and the resulting equation is -

$$\frac{M_m l_{m+1}}{6} + \frac{M_{m+1} l_{m+1}}{3} + \frac{M_{m+1} l_{m+2}}{3} + \frac{M_{m+2} l_{m+2}}{6} + 1 = 0$$

If the influence diagram for moment at a point in the span is required, a unit load is placed at that point, and the shear due to this load is included in the sum of the shears. Note that such a load will be included in two successive equations.

If the influence diagram for shear in a span is desired, a unit clockwise moment is placed in the span and the shear due to this moment is included in the sum of the shears. Again, this moment will be included in two successive equations.

This procedure is perfectly general for a beam of constant moment of inertia for any number of spans and any span lengths.

The procedure is exemplified for the special case of a symmetrical three span continuous beam of constant moment of inertia shown in Figure 2.

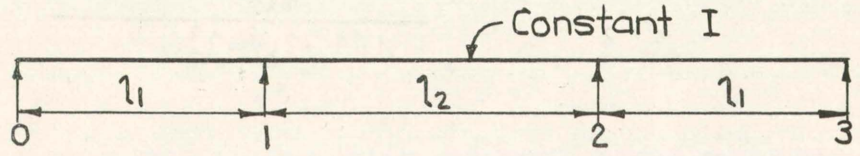


FIGURE 2

If the beam is allowed to deflect freely through an angle of 1/EI radians under the influence of a moment applied at Support 1, a trial conjugate beam may be constructed. This trial conjugate beam is shown in Figure 3.

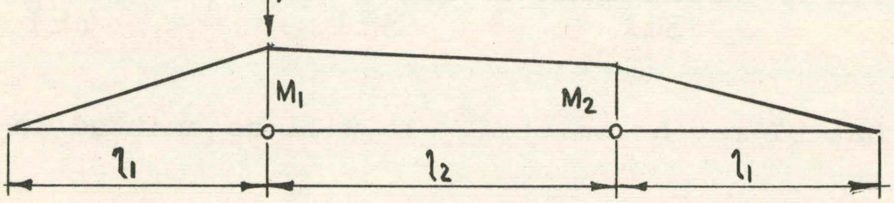


FIGURE 3

Since the sum of the shears at Point 2 equals zero, equation 1 may be written -

$$\frac{M_1 l_2}{6} + \frac{M_2 l_2}{3} + \frac{M_2 l_1}{3} = 0 \qquad (1)$$

Since the sum of the shears at Point 1 equals zero, equation 2 may be written -

$$\frac{M_1 l_1}{3} + \frac{M_1 l_2}{3} + \frac{M_2 l_2}{6} + 1 = 0 \qquad (2)$$

Solving these equations simultaneously, the following values are obtained.

$$M_1 = -\frac{12(l_1 + l_2)}{4(l_1 + l_2)^2 - l_2^2} \qquad (3)$$

$$M_2 = \frac{6 l_2}{4(l_1 + l_2)^2 - l_2^2} \qquad (4)$$

Then the true conjugate beam is shown in Figure 4. (Loads have been multiplied by EI.)

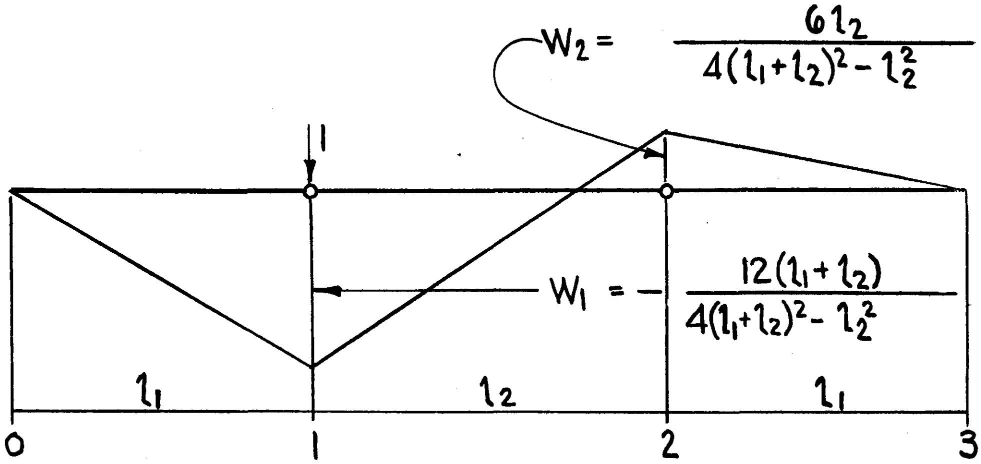


FIGURE 4

Under this load, the moment at any point in the conjugate beam is the influence ordinate at that point for the moment in the actual beam at Support 1. If L_1 and L_2, are in feet, the ordinate is in foot pounds for a 1 pound load.

In order to derive influence diagrams for moment at various points in any span the conjugate beam load is calculated in a similar manner.

Consider a point "D" in span 1-2 at a distance "d" from Point 1. A trial conjugate beam is drawn with a unit load at point "D" as shown in Figure 5.

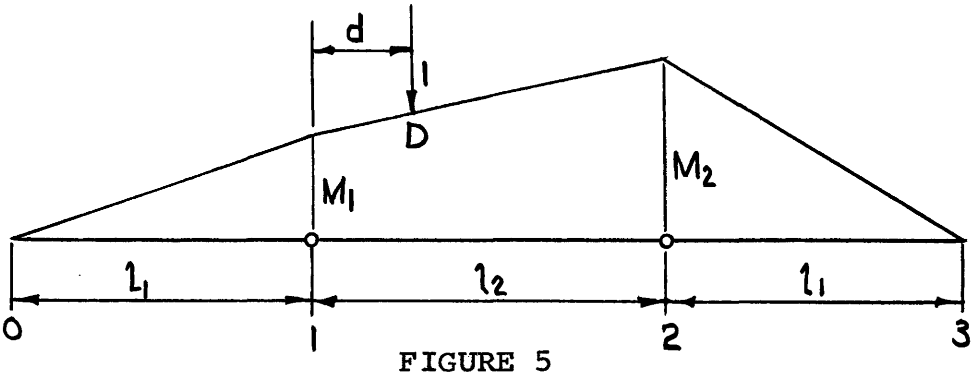


FIGURE 5

Using the moment diagram as a load on the conjugate beam, the sum of the shears at Point 1 is zero, hence -

$$\frac{M_1 l_1}{3} + \frac{M_1 l_2}{3} + \frac{M_2 l_2}{6} + \frac{l_2 - d}{l_2} = 0 \qquad (5)$$

$$\frac{M_1 l_1}{3} + \frac{M_1 l_2}{3} + \frac{M_2 l_2}{6} + \frac{l_2 - d}{l_2} = 0 \qquad (5)$$

Also, the sum of the shears at Point 2 equals zero, hence -

$$\frac{M_1 l_2}{6} + \frac{M_2 l_2}{3} + \frac{M_2 l_1}{3} + \frac{d}{l_2} = 0 \qquad (6)$$

Solving these equations simultaneously, the following values are obtained.

$$M_1 = - \frac{12(l_2 - d)(l_1 + l_2) - 6 d l_2}{l_2 \left[4(l_1 + l_2)^2 - l_2^2 \right]} \qquad (7)$$

$$M_2 = - \frac{12 d (l_1 + l_2) - 6 l_2 (l_2 - d)}{l_2 \left[4(l_1 + l_2)^2 - l_2^2 \right]} \qquad (8)$$

Then, the true conjugate beam is shown in Figure 6. (Loads have been multiplied by EI.)

$$W_1 = - \frac{12(l_2 - d)(l_1 + l_2) - 6 d l_2}{l_2 \left[4(l_1 + l_2)^2 - l_2^2 \right]}$$

$$W_2 = - \frac{12 d (l_1 + l_2) - 6 l_2 (l_2 - d)}{l_2 \left[4(l_1 + l_2)^2 - l_2^2 \right]}$$

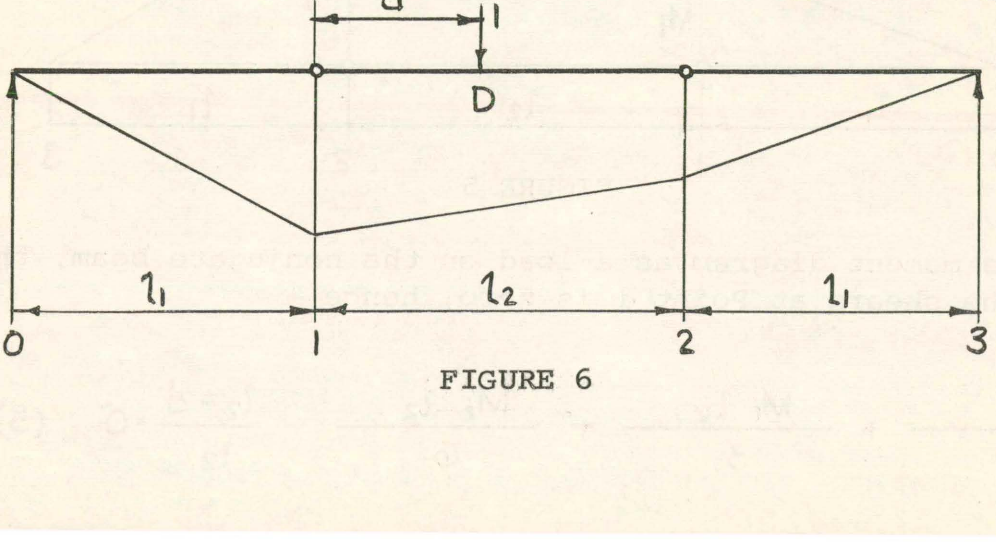


FIGURE 6

Under this load, the moment at any point in the conjugate beam is the influence ordinate at that point for moment in the actual beam at Point "D".

Influence diagrams for shear are particularly useful in the case of composite beams where horizontal shear is transferred by shear lugs between the slab and the beam. Influence diagrams for shear at the supports form envelope curves for shear diagrams at points between those supports, hence only diagrams for shear at the supports will be developed.

The unit vertical separation which occurs when the beam is allowed to deflect freely under the influence of shear is represented in the conjugate beam by a unit moment at the point where the separation occurs, and since it is customary to consider upward shear positive at the left end of a beam and negative at the right end, this moment will be in a clockwise direction.

For the case of shear in Span 1-2 of the beam previously considered, a trial conjugate beam is drawn as shown in Figure 7.

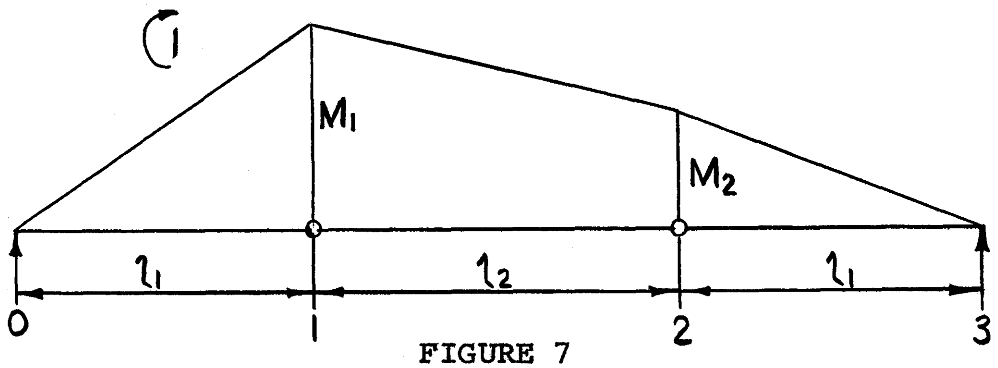


FIGURE 7

Since the sum of the shears at Point 2 is equal to zero:

$$\frac{M_2 l_1}{3} + \frac{M_2 l_2}{3} + \frac{M_1 l_2}{6} = 0$$

Since the sum of the shears at Point 1 is equal to zero:

$$\frac{1}{l_1} + \frac{M_1 l_1}{3} + \frac{M_1 l_2}{3} + \frac{M_2 l_2}{6} = 0$$

Solving these equations simultaneously, the following values are obtained.

$$M_1 = -\frac{12(l_1 + l_2)}{l_1\left[4(l_1+l_2)^2 - l_2^2\right]} \qquad (11)$$

$$M_2 = \frac{6l_2}{l_1\left[4(l_1+l_2)^2 - l_2^2\right]} \qquad (12)$$

The true conjugate beam is shown in Figure 8.

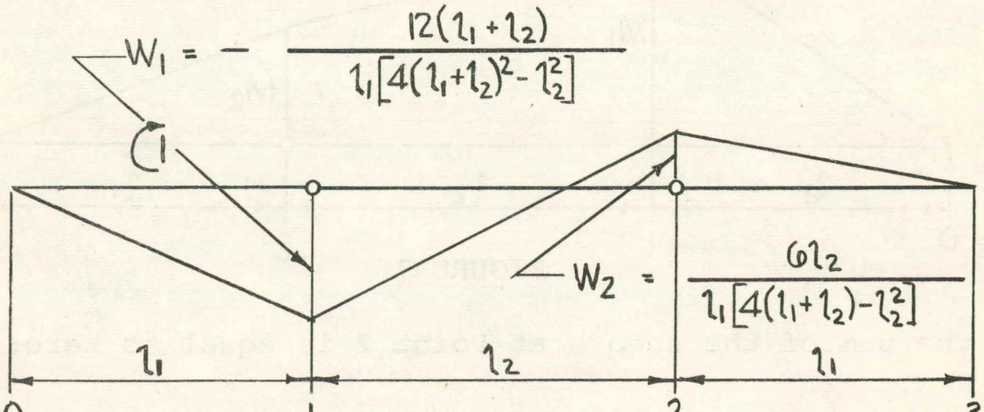
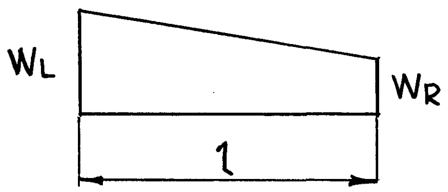
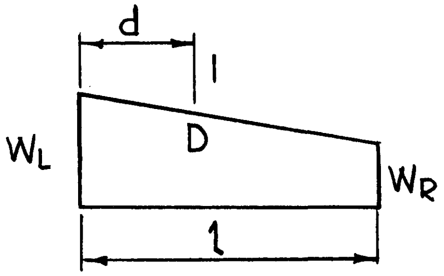


FIGURE 8

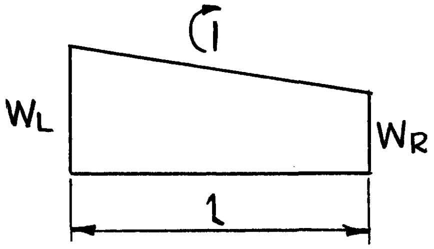
Examining Figures 4, 6, and 8, it is apparent that the load on any section of the conjugate beam corresponding to a span of the actual beam may be represented by one of the three following diagrams.



A



B



C

W_L or W_R may be positive, negative, or zero.

Diagram A exemplifies all spans of Figure 4 and spans 0-1 and 2-3 of Figures 6 and 8. Diagram B exemplifies span 1-2 of Figure 6, and Diagram C exemplifies span 1-2 of Figure 8. In general, diagrams B & C exemplify any span in which an influence diagram for moment or shear within the span is desired.

In diagram A, if x is measured from the left, the moment at any point is:

$$F(x_L) = \frac{(2W_L+W_R)lx}{6} + \frac{W_L x^2}{3} + \frac{(W_L-W_R)^2 x^3}{6l} \qquad (A_L)$$

If x is measured from the right (x is always positive):

$$F(x_R) = \frac{(2W_R+W_L)\ell x}{6} - \frac{W_R x^2}{3} + \frac{(W_R-W_L)x^3}{6\ell} \qquad (A_R)$$

In diagram B, the moment at any point between the left end and D (x measured from the left) is:

$$F(x_L-D) = \frac{(\ell-d)x}{\ell} + \frac{(2W_L+W_R)\ell x}{6} - \frac{W_L x^2}{3} + \frac{(W_L-W_R)x^3}{6\ell} \qquad (B_L)$$

and between the right end and D (x measured from the right):

$$F(x_R-D) = \frac{dx}{\ell} + \frac{(2W_R+W_L)\ell x}{6} - \frac{W_R x^2}{3} + \frac{(W_R-W_L)x^3}{6\ell} \qquad (B_R)$$

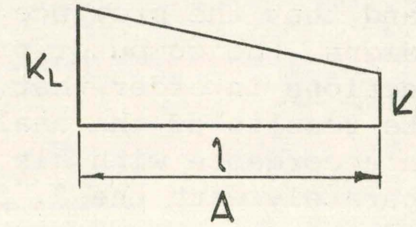
In diagram C, for shear at the left end, the separation is at the left, the moment is applied at the left, and x is most conveniently measured from the right. The moment at any point in the section is:

$$F(x_R) = \frac{x}{\ell} + \frac{(2W_R+W_L)\ell x}{6} - \frac{W_R x^2}{3} + \frac{(W_R-W_L)x^3}{\ell} \qquad (C_L)$$

For shear at the right end, the separation is at the right, the moment is applied at the right, and x is most conveniently measured from the left. The moment at any point in the section is:

$$F(x_L) = -\frac{x}{\ell} + \frac{(2W_L+W_R)\ell x}{6} - \frac{W_L x^2}{3} + \frac{(W_L-W_R)x^3}{\ell} \qquad (C_R)$$

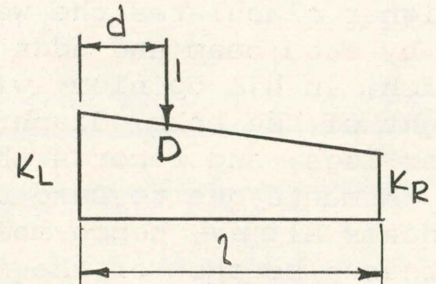
These functions define the appropriate influence diagram. The calculations of conjugate beam loading given above are exemplary only, and are intended to indicate the methods used. Constants $K(=\frac{W}{6})$ have been derived for symmetrical continuous beams of two, three, four, and five spans. The use of K changes the above equations as follows:



A

$$f(x_L) = (2K_L + K_R)\ell x - 3K_L x^2 + \frac{(K_L - K_R)x^3}{\ell} \qquad (A'_L)$$

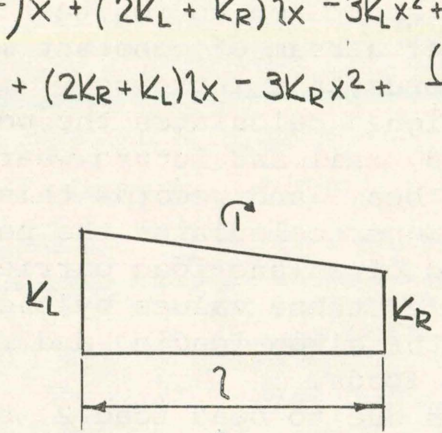
$$f(x_R) = (2K_R + K_L)\ell x - 3K_R x^2 + \frac{(K_R - K_L)x^3}{\ell} \qquad (A'_R)$$



B

$$f(x_L - D) = \left(\frac{\ell - d}{\ell}\right)x + (2K_L + K_R)\ell x - 3K_L x^2 + \frac{(K_L - K_R)x^3}{\ell} \qquad (B'_L)$$

$$f(x_R - D) = \frac{dx}{\ell} + (2K_R + K_L)\ell x - 3K_R x^2 + \frac{(K_R - K_L)x^3}{\ell} \qquad (B'_R)$$



C

$$f(x_R) = \frac{x}{\ell} + (2K_R + K_L)\ell x - 3K_R x^2 + \frac{(K_R - K_L)x^3}{\ell} \qquad (C'_L)$$

$$f(x_L) = -\frac{x}{\ell} + (2K_L + K_R)\ell x - 3K_L x^2 + \frac{(K_L - K_R)x^3}{\ell} \qquad (C'_R)$$

These equations are used as a basis for the computer program which is discussed in detail below.

DESCRIPTION OF COMPUTER PROGRAM

Since we believe that the design of a bridge is the province of the engineer and that the province of the computer is to analyze these designs, the computer program has been separated into three sections in order that the engineer may examine the intermediate results of the analysis and be able to change the design in accordance with his judgment. The first section deals separately with the 2, 3, 4, or 5 span bridges. The second and third sections combine the 2, 3, 4, and 5 span bridges.

The design procedure is as follows:

1. The designer is given a layout of the proposed bridge showing span lengths, roadway width, live loading and clearances.
2. The designer claculates the weight of slab carried by each beam and adds for each beam a load which, in his opinion, will approximate the weight of the beam, diaphragms, cover plates and shear lugs, and records this load as Dead Load 1. Moments due to Dead Load 1 are resisted by the beams alone, hence moments at the piers are increased because of the increased stiffness due to cover plates at these points. The designer estimates the increase percentages for each pier, usually about ten to fourteen percent, over the moment of a beam of constant moment of inertia, and records this increase.
3. The designer calculates the portion of the weight of curbs, rail and future wearing surface carried by each beam, and records this load as Dead Load 2.
4. The designer calculates the portion of a wheel load and of a lane load carried by each beam, multiplies these values by the weights appropriate to the given loading and records these weights as live loads.

   (Moments due to Dead Load 2, Live Load and Impact are resisted by composite action for positive moment and by the cover plated beam for negative moment and for the calculation of these moments, beams of constant depth, such as are considered here, are assumed to have constant moment of inertia.)

5. The designer chooses sections which, in his opinion, will adequately resist the maximum positive moments and records for each beam the properties of these sections for each positive moment area.
6. The designer chooses cover plates which, when applied to the beams chosen for the positive moment sections, will, in his opinion, adequately resist the maximum negative moments. Since composite action is not considered effective for negative moment, cover plates are made symmetrical on top and bottom of the beam. Properties of these sections are recorded.
7. The recorded data from steps 1 to 6 inclusive (span lengths, loads per beam, assumed moment increases at interior supports and section properties) are used as input for the first section of the program. The output is maximum moments, stresses, theoretical cover plate lengths and splice points.
8. The designer examines the output of the first section of the program. If the stresses are not satisfactory, he makes appropriate changes in the sections, and repeats the first section of the program. When he is satisfied with the stresses, he establishes cover plate cut-offs at least one foot beyond the theoretical cut-off points and locates the splice points near the theoretical point given in the output of the first section of the program.
9. Input for the second section is span lengths, section properties, loads, pier moment for Dead Load 2, and actual cover plate lengths and splice points. Output is deflections at the quarter points between splices and correct moment increases at the piers.
10. The designer examines the output of the second section of the program. If the moment increases at the piers are not in substantial agreement with the increases assumed in step 2, it is advisable to amend them to the values shown in the output of the second section, repeat the first section of the program and check the

stresses. If the stresses are not satisfactory, the beam sections are again changed as required, and the first and second sections of the program repeated.

11. Input for the third section is span lengths, loads, section properties, pier moments for Dead Load 1 and shear lug strength. The output is shears, reactions and shear lug spacing factor.
12. The designer uses the output of the third section of the program to establish the shear lug spacing.

This completes the design and the data obtained are sufficient to detail the bridge superstructure.

The 4 span bridge shown in Figure 10 will be used as an example to illustrate the procedure followed in the program, since it illustrates all of the conditions outlined above.

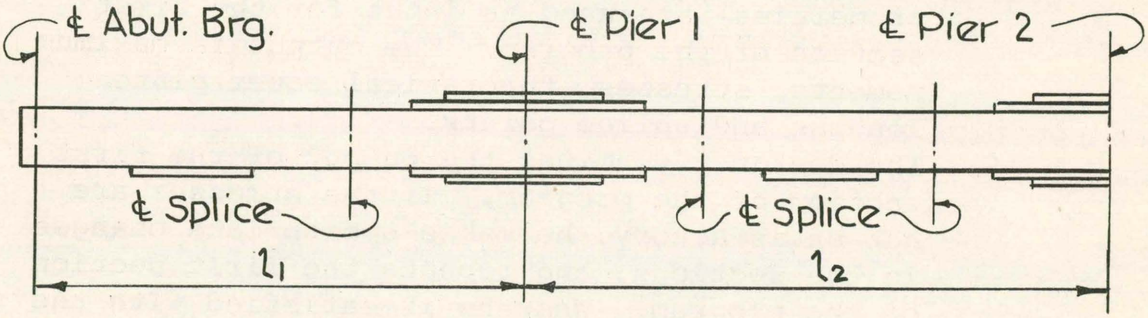


FIGURE 10

Positive moment cover plates may or may not be used in any positive moment section. There may be 1 or 2 pairs of cover plates at any pier.

SECTION I

In Section I of the program the relevant impact factors for the various conditions of loading are calculated in accordance with the AASHO specifications using the span lengths given with the input data. These are stored in the computer for use as the occasion requires.

Next, the maximum negative moment at Pier 1 is calculated. The K factors for the influence diagram for moment at Pier 1 shown in Figure 22 are evaluated, using the given span lengths. Since only two ordinates and four areas are required for calculation of moment, the complete influence diagram is not required, but, for reference purposes, the general form of this influence diagram is shown in Figure 11.

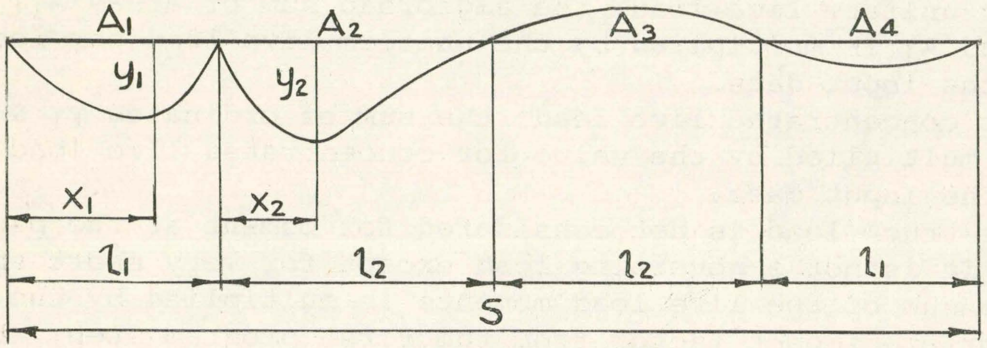


FIGURE 11

Areas A_1, A_2, A_3, and A_4 are determined by integrating equation A_L' or A_R' between 0 & l, using the appropriate K factors and lengths. The result of this integration is:

$$A = (K_L + K_R)\,\frac{l^3}{4} \qquad (13)$$

These areas are calculated and stored.

Equation 14 is obtained by setting the first derivative of Equation A_L' equal to zero and solving for x. It defines the location of the maximum ordinates shown as y_1 and y_2 in Figure 11.

$$x = \frac{l}{K_L - K_R}\left[K_L + \sqrt{\frac{K_L^2 + K_L K_R + K_R^2}{3}}\right] \qquad (14)$$

The values of ordinates y_1 and y_2 are calculated from equation A_L' using the values of x obtained from equation 14, appropriate K_L & K_R factors, and appropriate span lengths.

This data is sufficient for the calculation of maximum negative moment at Pier 1 and the procedure for each beam is as follows:

For Dead Load 1, the algebraic sum of areas, A_1, A_2, A_3, and A_4 is increased by a percentage given as input data and multiplied by the Dead Load 1 per foot from the input data.

For Dead Load 2, the algebraic sum of areas A_1, A_2, A_3, and A_4 is multiplied by the Dead Load 2 per foot from the input data.

For uniform live load, the algebraic sum of areas A_1, A_2, and A_4 is multiplied by the uniform live load per foot from the input data.

For concentrated live load, the sum of ordinates y_1 & y_2 is multiplied by the value for concentrated live load from the input data.

The truck load is not considered for moment at the piers, since it is not a governing load except for very short spans.

The sum of the live load moments is multiplied by the appropriate impact factor from the first program step, and the result recorded as impact moment.

Each of these moments is punched at output.

Section properties of the beam and cover plates at Pier 1 are read into the computer, and the moment of inertia with 1 and 2 pairs of cover plates is computed separately. The stress at Pier 1 is computed, using the total section, and the result punched as output.

Maximum moments and stresses at Pier 2 are then computed in a similar manner. The general shape of the influence diagram for moment at Pier 2 is shown in Figure 12.

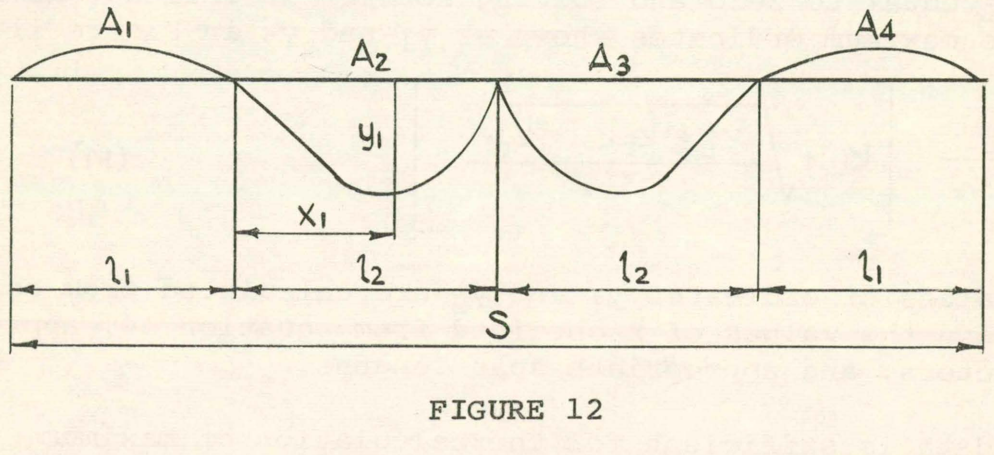


FIGURE 12

Since the diagram is symmetrical about Pier 2, only 2 areas and 1 ordinate need to be calculated. For calculating Dead Load 1 moment, the algebraic sum of A_1 and A_2 is doubled and increased by the percentage given in the input data; for Dead Load 2, the algebraic sum of A_1 and A_2 is doubled; for uniform Live Load A_2 is doubled, and for concentrated Live Load y_1 is doubled. The properties of the section given for Pier 2 are calculated and the individual moments and the maximum unit stress are punched as output.

The next step is the calculation of cover plate lengths. Since the procedure is similar for each pier, it will be exemplified by the calculation of lengths at Pier 1.

The method used is to compute values from influence lines for successive points, each one foot further from the pier and compute the stress in the beams at those points until the stress, without the outer cover plate, is less than 12,600[1] psi. Then the point is moved back toward the pier by 0.1 foot increments until 12,600 psi. is exceeded. This length plus 0.1 foot is the theoretical length of the outer cover plate. This procedure is repeated for the inner cover plate starting from the end of the outer plate.

Figure 13 shows the influence line for moment at a point near Pier 1.

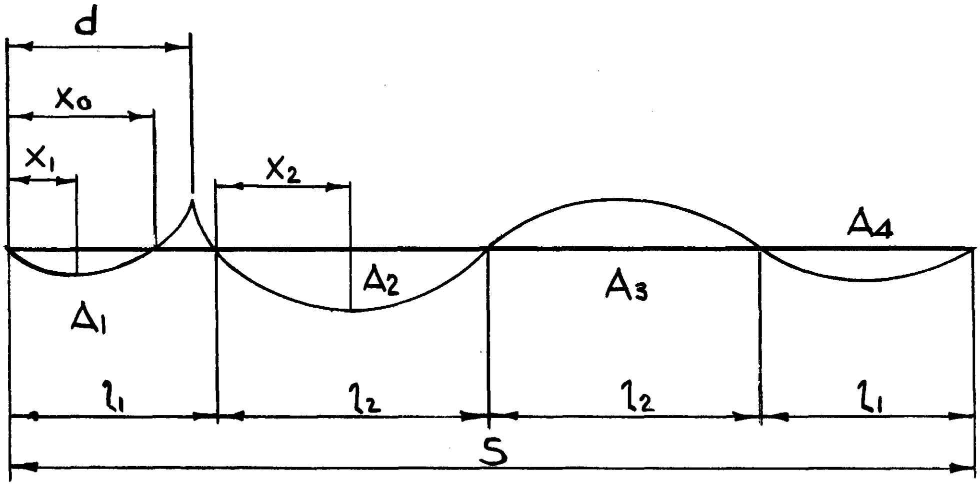


FIGURE 13

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[1] This is the allowable stress used by the Iowa State Highway Commission at the end of a welded cover plate in an unsupported compression flange.

Where: d = distance to the point of moment

x_o = distance to the point of zero moment

x_1 and x_2 = distance to the point of maximum negative ordinate

Note that for points near the pier, Span 1 must be partially loaded to produce maximum negative live load moment at that point. In such cases, it is Iowa Highway Commission practice to use concentrated loads in each span adjacent to the pier.

Since the moment at the piers due to Dead Load 1 and Dead Load 2 is known, the moment at any point is determined. The general expression for the coefficient to be multiplied by the given Dead Load is:

$$M_x = \frac{1}{2}(x)(l-x) + \frac{M_R x}{l} + \frac{M_L (l-x)}{l} \qquad (15)$$

Where: M_x = moment at a point in the span

x = distance from the left end to the point of moment

l = length of span

M_L = moment at the left end of the span, usually negative

M_2 = moment at the right end of the span, usually negative

For the live loads, the "K" factors are computed for the point being worked on. Areas 2 and 4 (see Figure 13) are computed using equation 13. To determine Area 1, the point of zero moment in span 0-1 of the conjugate beam must be found. This is done by setting equation B_L^0 equal to zero and solving for "x". Integrating this equation from zero to "x" produces equation 16 which gives Area 1.

$$A = \frac{x_o^2}{4l}\left[2(l-d) + K_L(2l - x_o)^2 + K_R(2l^2 - x_o^2)\right] \qquad (16)$$

Equation B_L^0 defines the ordinate at any point in the span between 0 and "D". By taking the first derivative of equation B_L^0 and setting it equal to zero, the point of maximum negative ordinate is found. Substituting this value of "x" in equation B_L^0 the maximum ordinate is computed for the end span. Using equations 14 and A_L^0 the maximum ordinate is computed for the interior span.

The uniform live load moment is computed by multiplying the sum of the areas (1, 2 and 4) by the load in kips per foot. The concentrated live load is multiplied by the sum of the two maximum ordinates. The total live load moment is increased by the impact factor.

This moment is used to compute the stress in the beam without the cover plate for which the length is being computed. This stress is compared to 12,600 psi. and the process is repeated if this value is exceeded. Cover plate lengths are punched as output.

After the cover plate lengths are computed in the end span, the interior end of the Pier 1 cover plates are computed in a like manner. A typical influence line is show in Figure 14.

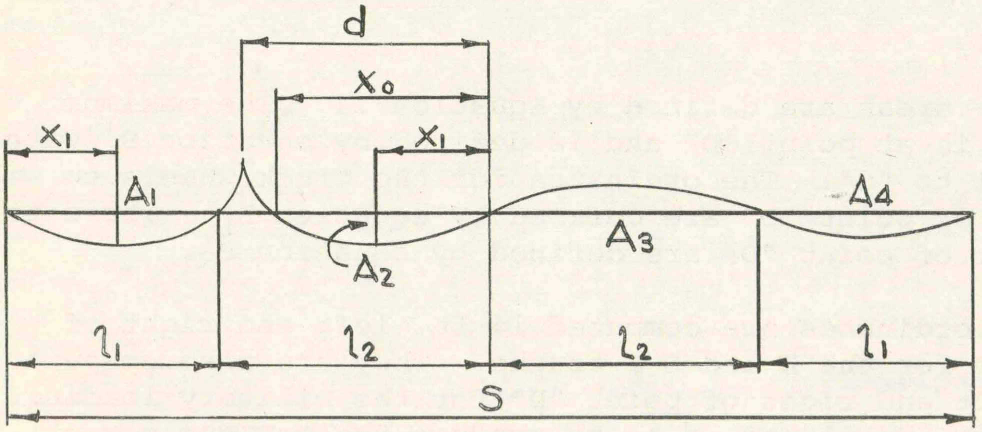


FIGURE 14

Cover plate lengths at Pier 2 are next computed, in a similar manner, and these lengths are punched as output.

The maximum positive moment in the end span is the next to be computed. Since the exact point of maximum stress varies with the span ratio, the maximum stress is found by computing the stress every 6 inches between the 0.35 and 0.45 points, measured from point 0.

To compute values from the influence line for moment at a point in the end span, the values of the "K" factors must again be computed. The influence line takes the form shown in Figure 15.

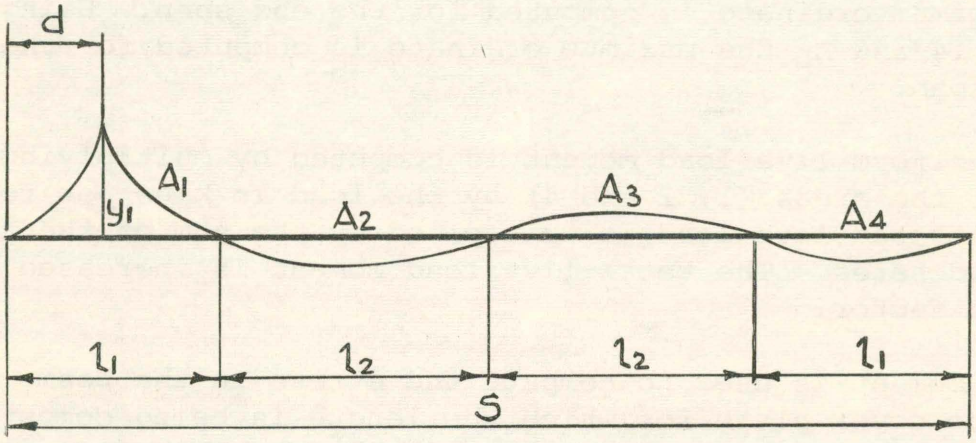


FIGURE 15

Area 1 is defined by equation 17.

$$A = \frac{(d)(l-d)}{2} + (K_L + K_R)\frac{l^3}{4} \qquad (17)$$

All other areas are defined by Equation 14. The maximum ordinate is at point "D" and is defined by equation B_L' with "x" equal to "d". The ordinates for the truck wheels to the left of point "D" are defined by equation B_L'. Those to the right of point "D" are defined by equation B_R'.

The ordinates are computed 14 ft. left and right of point "D" for the H and H-S trucks. They are also computed 4 ft. left and right of point "D" for the military loading. The trucks are placed so as to produce the maximum moment at point "D".

The moment due to Dead Load 1 and Dead Load 2 is computed from equation 15.

Moments of inertia for the beam and cover plate and for the composite section are computed and the stress is then computed by applying the Dead Load 1 moment to the beam and cover plate, if any, and the other moments to the composite section. The stress is computed for three cases of live load as follows:

1. Lane Load and concentrated load for the specified H or H-S loading.

2. H Truck

3. H-S Truck or military truck

The maximum stress is computed for each case and the absolute maximum stress and the corresponding moments punched as output.

The length of the cover plate, if any, is computed by starting at the 0.4 point in the end span and computing the moment and stress without the cover plate. The point is moved toward the abutment until stresses without the cover plate is less than 13,500[1] psi. The interior end of the cover plate is determined in a similar manner. This cover plate length and location is punched as output.

The interior span is handled in a similar manner and the same equations apply. The stresses are computed between the 0.45 and 0.55 point to find the maximum stress. The form of the influence line is shown in Figure 16.

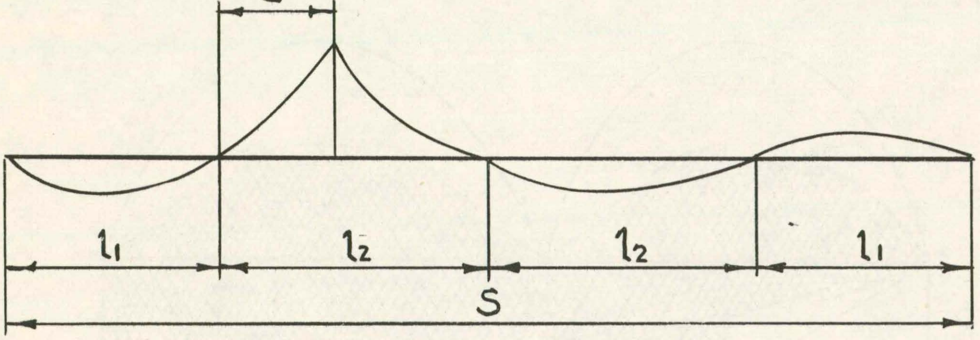


FIGURE 16

[1] 13,500 is the allowable stress used by the Iowa State Highway Commission at the end of a welded cover plate in a tension flange.

Maximum stress and corresponding moments are punched as output. The cover plate length is computed both ways from the 0.5 point and length and location punched as output.

The last part of the first section computes the point of zero moment in each span for dead load. The splices will be placed near these points by the designer.

At this point the designer must decide whether or not the stresses are acceptable. If he is satisfied, the exact length of the cover plates and splice points are set. He is then ready to use the second section.

SECTION II

In the second section, the conjugate beam principle has been used to determine total deal load deflections. This procedure is extremely convenient for programming in that a general method of determining deflections can be formulated which applies to any span of a 2, 3, 4, or 5 span bridge, thus reducing the memory storage required by the program.

The first step involves the finding of the correct Dead Load 1 moment at the piers with a variable moment of inertia. This is done by first finding the values of M_1 and M_2 for a uniform load of 1 kip per foot on the real beam.

Simple beam positive moments are calculated for each span and divided by the appropriate I which may be absolute or relative. Negative $\frac{M}{I}$ diagrams are drawn using the same I designating the moments at the piers simply as M_1 & M_2. See Figure 17.

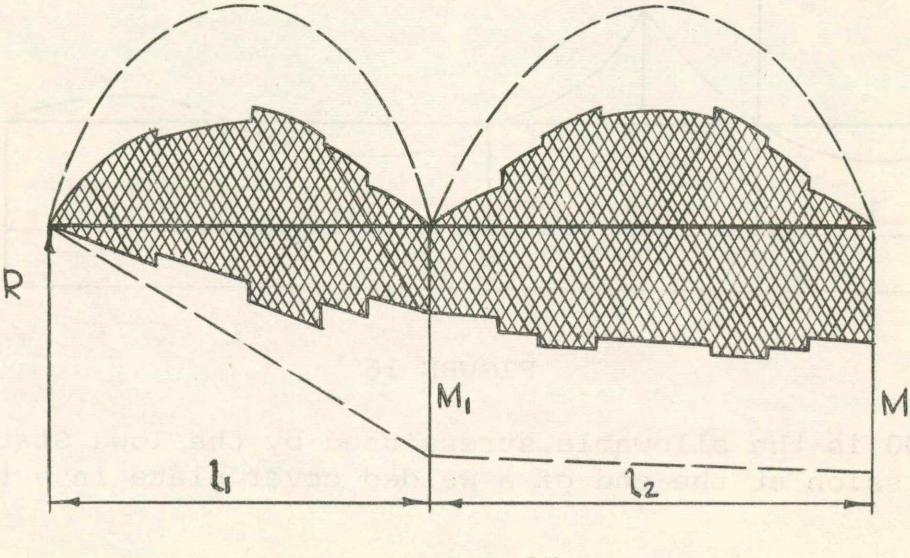


FIGURE 17

This is a conjugate beam with the loads multiplied by a constant and as in all such beams, moments are zero at the points of support of the actual beam, and the sum of the shears at any point is equal to zero. Since the beam is symmetrical, the slope of the elastic line in the actual beam and, therefore, the shear in the conjugate beam is equal to zero at point 2. Thus M_1 and M_2 may be evaluated by solving two simultaneous equations, one of which, by taking moments about point 1, asserts that the shear at point 2 equals 0, and the other by taking moments of the load in section 1-2 about point 2, and moments of the load on Section 0-1 about point 0, and asserts that the sum of the shears at point 1 equals 0. With M_1 and M_2, determined, the theoretical moment increase at the piers may be determined from equation 18.

$$F = \frac{Ma - Mu}{Mu} \tag{18}$$

Where: F = correct moment increase factor

Ma = Actual moment

Mu = Moment at pier on the basis of Uniform I

These increases are punched as output.

A true conjugate beam is established for calculating the deflections. In this conjugate beam, actual values of E and I are used and the beam must be dimensionally consistent, that is, if I is in inches^4 and E in lbs/sq. in., M must be expressed in inch pounds, and the deflections will be in inches. Deflections are determined by a process of integration and are equal to the moment in the conjugate beam, at the point where the deflection is desired. In order to do this, the shear in the conjugate beam at Point 0 and Point 1 must be determined. This is easily done, since the shear at point 1 is simply the area of the $\frac{M}{EI}$ diagram in section 1-2, and the shear at point 0 the sum of the $\frac{M}{EI}$ diagrams in sections 0-1 and 1-2. Deflections are determined at the quarter points between splices and punched as output.

SECTION III

Section 3 consists of the computation of maximum shears and reactions and determination of the shear lug spacing factor.

Shears, which are used to compute shear lug spacing, are calculated only for Dead Load 2 and live load. Dead Load 1 produces no shear between the slab and the beam, since the concrete is plastic when it is placed on the beams. Dead Load 1 reactions are calculated by the principles of statics. Influence diagrams are used to compute shears and reactions for Dead Load 2 and live load.

The influence line for shear in span 0-1 is shown in Figure 18. For loads in span 0-1, shear at the abutment is defined by curve 1-3-5, and shear at the left face of support 2 by curve 0-2-4. Shear at a point in the span is defined by 0-2-6-3-5.

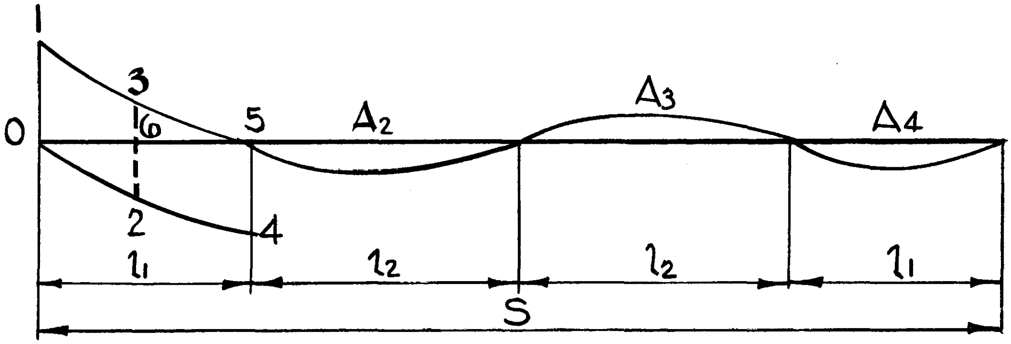


FIGURE 18

Area 0-1-3-5-6-0, which is the shear at the abutment for a unit uniform load in span 0-1 is defined by equation 19.

$$A = \frac{1}{2} + (K_L + K_R)\,\frac{l^3}{4} \qquad (19)$$

Areas A_2, A_3, and A_4 are defined by equation 14. Ordinates to curve 1-3-5 are defined by equation C_L', in which x is measured from support 1.

The coefficient for shear at the abutment due to Dead Load 2 is the algebraic sum of areas 0-1-3-5-6-0, A_2, A_3, and A_4. For uniform lane live load, the coefficient is the sum of areas 0-1-3-5-6-0 and A_3. The concentrated lane load, the rear wheel of the H & H-S trucks, and the one wheel of the military load, are placed at the abutment. The other truck wheels are placed 14 and 28 feet from the abutment and the other wheel of the military load at 4 feet from the abutment. Ordinates are determined at these points and the shear computed for the three loading cases designated previously. The maximum live load shear is determined, and the sum of the shears due to Dead Load 2, maximum live load, and impact is punched as output. This shear, plus the shear due to Dead Load 1, is punched out as the abutment reaction.

The positive and negative shear for Dead Load 2, Live Load and Impact is next determined at a point 0.4 L_1 from the abutment. Dead Load 2 shear for both cases is the abutment shear minus 0.4 L_1 times Dead Load 2 per foot. For positive shear the uniform lane live load is placed in all of span 2-3 and to the right of the 0.4 point in span 0-1. The area under the influence live in span 2-3 has already been determined for calculating the shear at the abutment. The area under the influence live to the right of the 0.4 point in span 0-1 is equal to:

$$A = \frac{x^2}{4l}\left[2 + K_R\,(2l-x)^2 + K_L\,(2l^2 - x^2)\right] \qquad (20)$$

with x equal to 0.6 L_1. The lane load concentration, the rear wheel of the H and H-S trucks and one wheel of the military load are placed at the 0.4 point with the other wheels to the right. Ordinates are determined for the concentrated loads, using equation C_L', and the shear for the three cases of live load are calculated. The shear due to Dead Load 2, maximum live load, and impact is punched as output.

Negative shear at this point is calculated in a similar manner. Concentrated loads are placed at, and to the left of, the 0.4 point. The lane live load is placed to the left of the 0.4 point and in spans 1-2 & 3-4. Ordinates are determined by equation C_R' and area 0-2-6-0 is determined from equation 21 with x equal to 0.4 L_1.

$$A = \frac{x^2}{4l}\left[-2 + K_L\,(2l-x)^2 + K_R\,(2l - x^2)\right] \qquad (21)$$

Areas A_2 and A_4 have been determined previously. Live load shear is calculated for the three loadings designated, and the maximum determined. Shears due to Dead Load 2, maximum live load, and impact are punched as output.

Maximum shear at the left face of support 1 is next determined for Dead Load 2 and Live Load. The coefficient for Dead Load 2 is the algebraic sum of areas 0-2-4-5-6-0, A_2, A_3, and A_4. Area 0-2-4-5-6-0 is determined from equation 22.

$$A = -\frac{l}{2} + (K_L + K_R)\frac{l^3}{4} \qquad (22)$$

The concentrated lane load, the rear wheel of the H and H-S trucks and one wheel of the military load are placed at support 1 and the other concentrations in span 0-1. The lane load is placed in spans 0-1, 1-2, and 3-4. Ordinates for the concentrated load are calculated, using equation C_R', and the coefficient for the lane load is determined from equation 22, plus the previously calculated A_2 and A_4. Maximum live load shear is determined and shears due to Dead Load 2, maximum live load, and impact punched as output.

Maximum positive shear at the right face of support 1, maximum positive and negative shear at the 0.5 point in span 1-2, and maximum negative shear at the left face of support 2 are calculated in a similar manner using the same equations. Figure 19 shows the influence diagram for shear in span 1-2 and indicates the manner in which the loads should be placed.

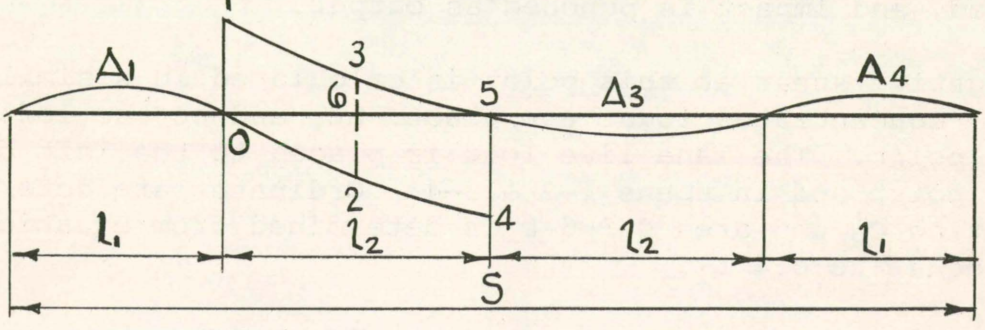


FIGURE 19

The maximum shears for Dead Load 2, Live Load and impact at the points specified are punched as output.

In computing shear lug spacing, the positive and negative shears are assumed to vary uniformly between the points for which they have been calculated. This assumption involves no serious inaccuracy and is conservative.

The maximum reaction at support 1 is determined next. This reaction is the algebraic difference of the shears left and right of support 1. Shears left and right of support 1 have already been determined for Dead Load 2 and uniform lane live load. From Figure 18, ordinates are calculated 14' left and right and 4' left and right of support 1 for shear to the left of support 1. From Figure 19, ordinates are calculated at the same points for shear to the right of support 1. The concentrated lane load, the middle wheel of the H-S truck, the rear wheel of the H truck and one wheel of the military load are placed at support 1. The ordinate is calculated from either Figure 18 or 19. The other concentrations are placed where their effect will be greatest. The live load reaction is calculated for the three loadings previously designated and the maximum determined. The reaction for Dead Load 1 is calculated by the principles of statics and the reactions for Dead Load 1, Dead Load 2, maximum Live Load and impact punched as output.

The maximum reaction at support 2 is determined by an application of the same principles. The influence diagrams for shear in span 2-3 is a mirror image of Figure 19 with the signs reversed, so that ordinates and areas calculated for shear left of Pier 2 may be used for shear to the right of Pier 2 by simply reversing the signs.

In most cases the simple equations are special cases of the more complicated ones. In programming such equations a subroutine is written for the more complicated cases and is used for all equations of that type.

CLOSURE

The foregoing method may be used as a manual process, but the use of the computer speeds up the actual calculations and enables the designer to make more trials and to find the most economical sections. The actual computer time is only a matter of a few minutes while the corresponding manual process would require several days. The authors believe that this program will be a great help to the designer by eliminating the routine calculations and enabling him to design to closer limits. A similar procedure may be used for the design of beams of variable moment of inertia, and the authors are now engaged in working out a program for the analysis of such beams.

Values of K for constructing influence diagrams for moment and shear at any point in a symmetrical continuous beam of two to five spans are given below.

TWO SPAN BEAM

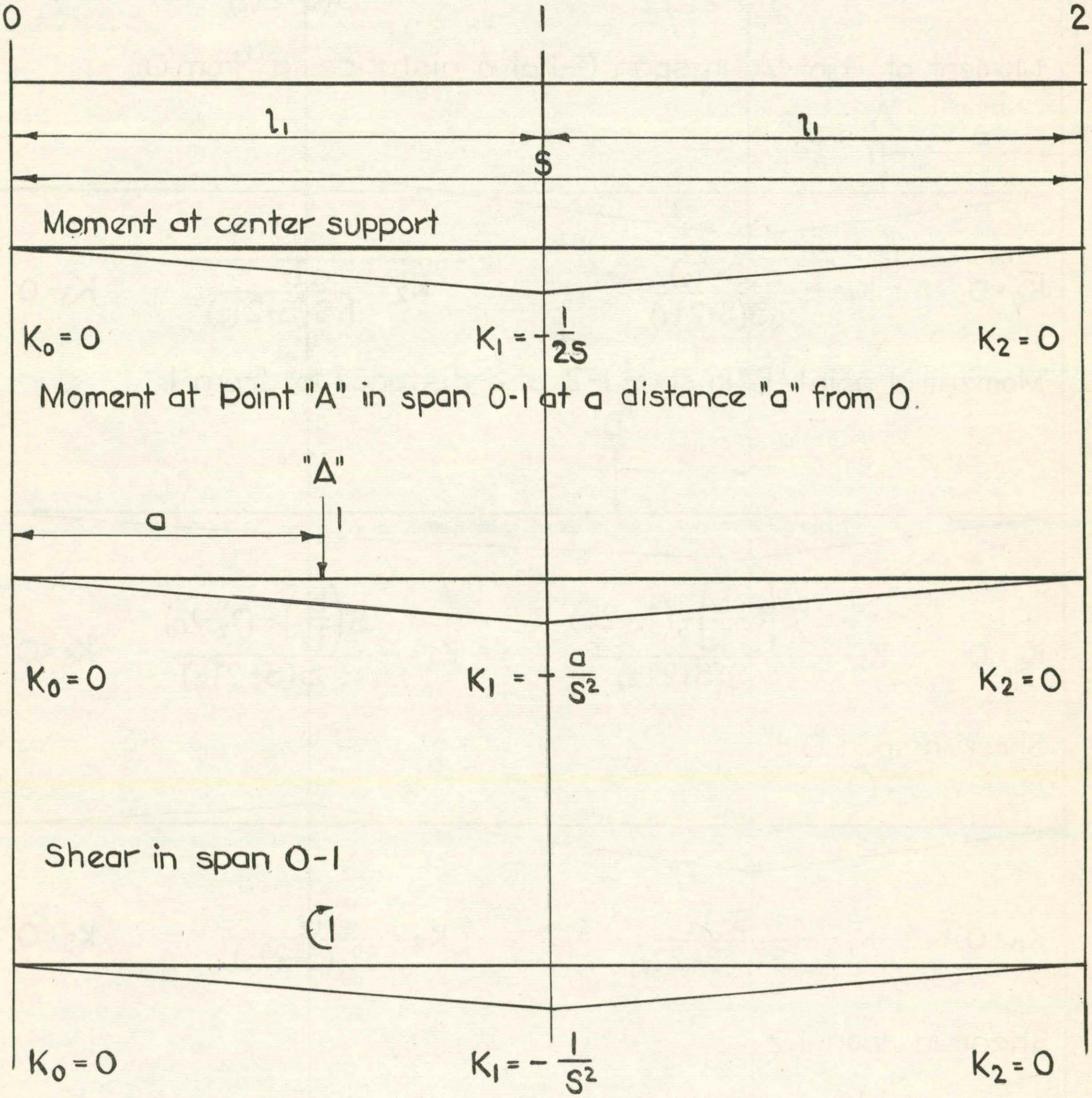
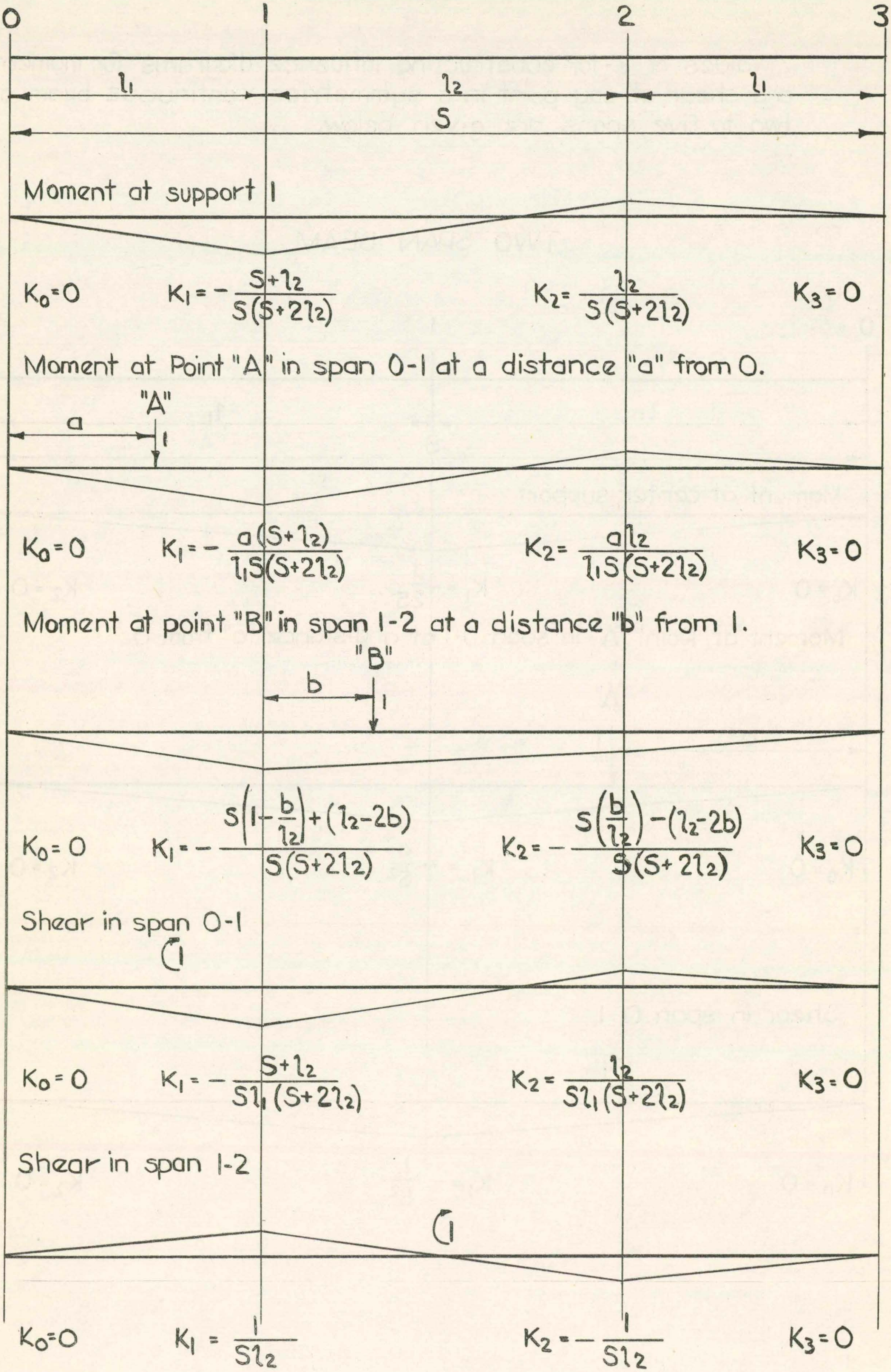


FIGURE 20

THREE SPAN BEAM



Moment at support 1

$K_0 = 0$ $\quad K_1 = -\frac{S+l_2}{S(S+2l_2)}$ $\quad K_2 = \frac{l_2}{S(S+2l_2)}$ $\quad K_3 = 0$

Moment at Point "A" in span 0-1 at a distance "a" from 0.

$K_0 = 0$ $\quad K_1 = -\frac{a(S+l_2)}{l_1 S(S+2l_2)}$ $\quad K_2 = \frac{a l_2}{l_1 S(S+2l_2)}$ $\quad K_3 = 0$

Moment at point "B" in span 1-2 at a distance "b" from 1.

$K_0 = 0$ $\quad K_1 = -\frac{S\left(1-\frac{b}{l_2}\right)+(l_2-2b)}{S(S+2l_2)}$ $\quad K_2 = -\frac{S\left(\frac{b}{l_2}\right)-(l_2-2b)}{S(S+2l_2)}$ $\quad K_3 = 0$

Shear in span 0-1

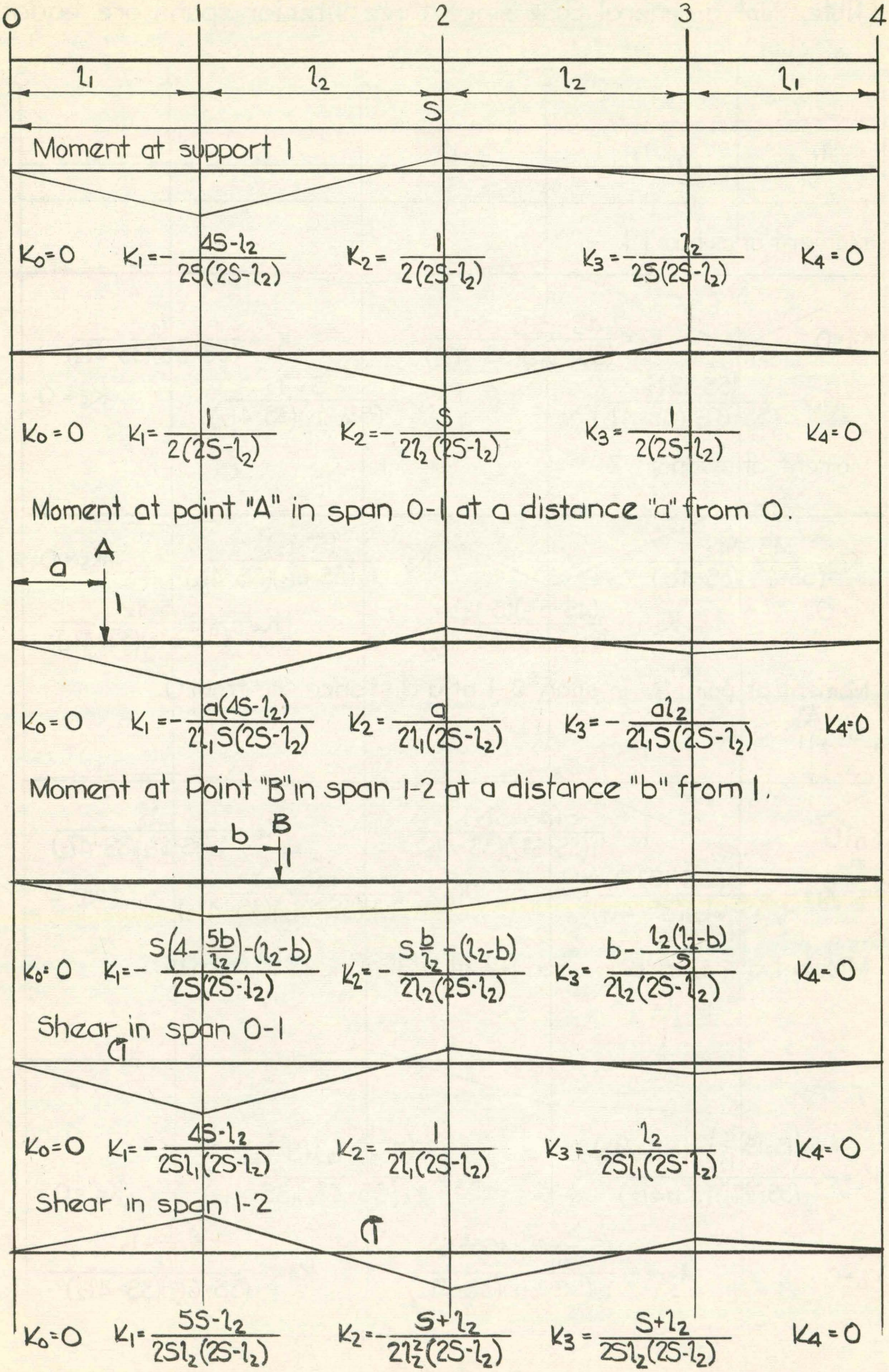
$K_0 = 0$ $\quad K_1 = -\frac{S+l_2}{S l_1 (S+2l_2)}$ $\quad K_2 = \frac{l_2}{S l_1 (S+2l_2)}$ $\quad K_3 = 0$

Shear in span 1-2

$K_0 = 0$ $\quad K_1 = \frac{1}{S l_2}$ $\quad K_2 = -\frac{1}{S l_2}$ $\quad K_3 = 0$

FIGURE 21

FOUR SPAN BEAM



Moment at support 1

$K_0=0$ $K_1=-\frac{4S-l_2}{2S(2S-l_2)}$ $K_2=\frac{1}{2(2S-l_2)}$ $K_3=-\frac{l_2}{2S(2S-l_2)}$ $K_4=0$

$K_0=0$ $K_1=\frac{1}{2(2S-l_2)}$ $K_2=-\frac{S}{2l_2(2S-l_2)}$ $K_3=\frac{1}{2(2S-l_2)}$ $K_4=0$

Moment at point "A" in span 0-1 at a distance "a" from 0.

$K_0=0$ $K_1=-\frac{a(4S-l_2)}{2l_1S(2S-l_2)}$ $K_2=\frac{a}{2l_1(2S-l_2)}$ $K_3=-\frac{al_2}{2l_1S(2S-l_2)}$ $K_4=0$

Moment at Point "B" in span 1-2 at a distance "b" from 1.

$K_0=0$ $K_1=-\frac{S\left(4-\frac{5b}{l_2}\right)-(l_2-b)}{2S(2S-l_2)}$ $K_2=-\frac{S\frac{b}{l_2}-(l_2-b)}{2l_2(2S-l_2)}$ $K_3=\frac{b-\frac{l_2(l_2-b)}{S}}{2l_2(2S-l_2)}$ $K_4=0$

Shear in span 0-1

$K_0=0$ $K_1=-\frac{4S-l_2}{2Sl_1(2S-l_2)}$ $K_2=\frac{1}{2l_1(2S-l_2)}$ $K_3=-\frac{l_2}{2Sl_1(2S-l_2)}$ $K_4=0$

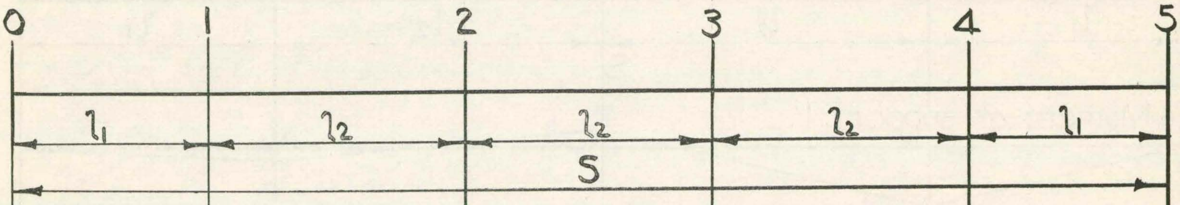
Shear in span 1-2

$K_0=0$ $K_1=\frac{5S-l_2}{2Sl_2(2S-l_2)}$ $K_2=-\frac{S+l_2}{2l_2^2(2S-l_2)}$ $K_3=\frac{S+l_2}{2Sl_2(2S-l_2)}$ $K_4=0$

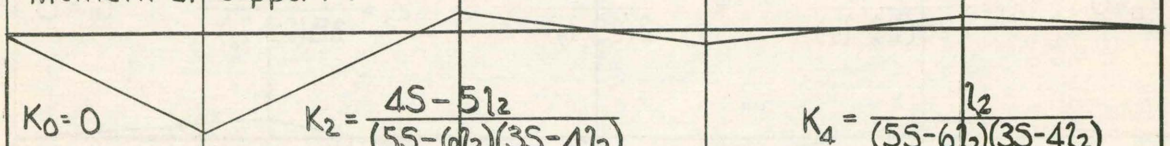
FIGURE 22

FIVE SPAN BEAM

(Note: Not a general case since three interior spans are equal.)



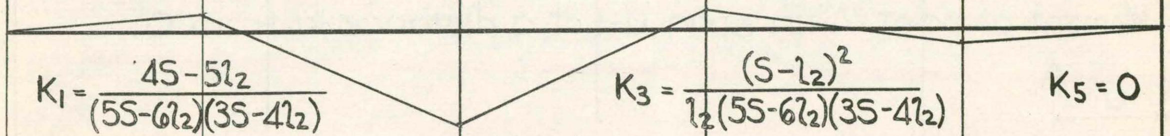
Moment at support 1



$K_0 = 0$ $\quad K_2 = \frac{4S-5l_2}{(5S-6l_2)(3S-4l_2)}$ $\quad K_4 = \frac{l_2}{(5S-6l_2)(3S-4l_2)}$

$K_1 = -\frac{15S-19l_2}{(5S-6l_2)(3S-4l_2)}$ $\quad K_3 = -\frac{S-l_2}{(5S-6l_2)(3S-4l_2)}$ $\quad K_5 = 0$

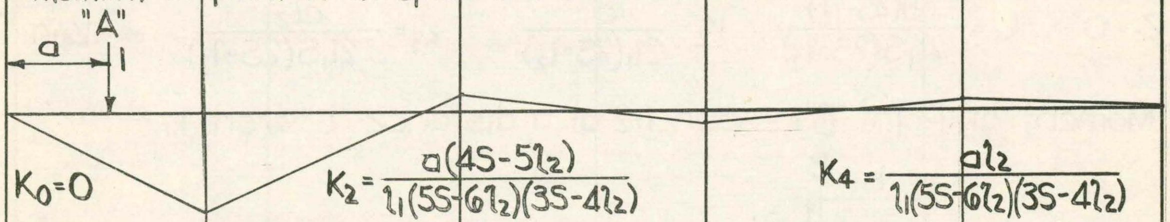
Moment at support 2



$K_1 = \frac{4S-5l_2}{(5S-6l_2)(3S-4l_2)}$ $\quad K_3 = \frac{(S-l_2)^2}{l_2(5S-6l_2)(3S-4l_2)}$ $\quad K_5 = 0$

$K_0 = 0$ $\quad K_2 = -\frac{(4S-5l_2)(S-l_2)}{l_2(5S-6l_2)(3S-4l_2)}$ $\quad K_4 = -\frac{S-l_2}{(5S-6l_2)(3S-4l_2)}$

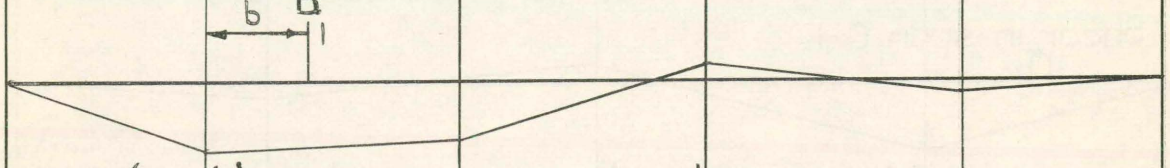
Moment at point "A" in span 0-1 at a distance "a" from 0.



$K_0 = 0$ $\quad K_2 = \frac{a(4S-5l_2)}{l_1(5S-6l_2)(3S-4l_2)}$ $\quad K_4 = \frac{a l_2}{l_1(5S-6l_2)(3S-4l_2)}$

$K_1 = -\frac{a(15S-19l_2)}{l_1(5S-6l_2)(3S-4l_2)}$ $\quad K_3 = -\frac{a(S-l_2)}{l_1(5S-6l_2)(3S-4l_2)}$ $\quad K_5 = 0$

Moment at point "B" in span 1-2 at a distance "b" from 1.



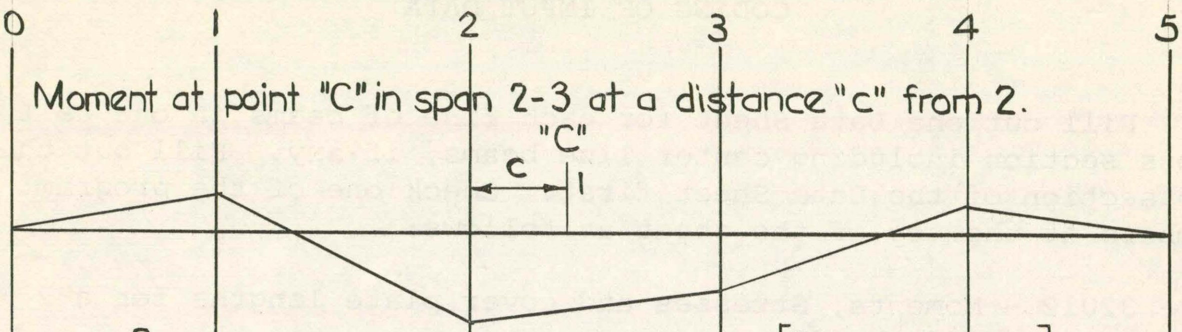
$K_1 = -\frac{S\left(15-19\frac{b}{l_2}\right)-(19l_2-24b)}{(5S-6l_2)(3S-4l_2)}$ $\quad K_3 = \frac{\left(S\frac{b}{l_2}-l_2\right)(S-l_2)}{l_2(5S-6l_2)(3S-4l_2)}$ $\quad K_5 = 0$

$K_0 = 0$ $\quad K_2 = -\frac{\left(S\frac{b}{l_2}-l_2\right)(4S-5l_2)}{l_2(5S-6l_2)(3S-4l_2)}$ $\quad K_4 = -\frac{S\frac{b}{l_2}-l_2}{(5S-6l_2)(3S-4l_2)}$

FIGURE 23

FIVE SPAN BEAM (continued)

Moment at point "C" in span 2-3 at a distance "c" from 2.



$$K_1 = \frac{\frac{S}{l_2}(4l_2-5c)-(5l_2-6c)}{(5S-6l_2)(3S-4l_2)}$$

$$K_3 = -\frac{(S-l_2)\left[\frac{S}{l_2}(5c-l_2)-(6c-l_2)\right]}{l_2(5S-6l_2)(3S-4l_2)}$$

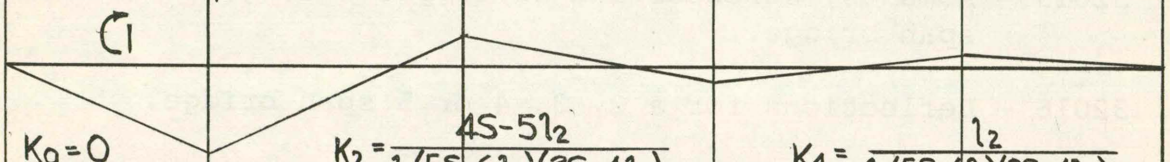
$K_5=0$

$K_0=0$

$$K_2 = -\frac{(S-l_2)\left[\frac{S}{l_2}(4l_2-5c)-(5l_2-6c)\right]}{l_2(5S-6l_2)(3S-4l_2)}$$

$$K_4 = \frac{\frac{S}{l_2}(5c-l_2)-(6c-l_2)}{(5S-6l_2)(3S-4l_2)}$$

Shear in span 0-1



$K_0=0$

$$K_2 = \frac{4S-5l_2}{l_1(5S-6l_2)(3S-4l_2)}$$

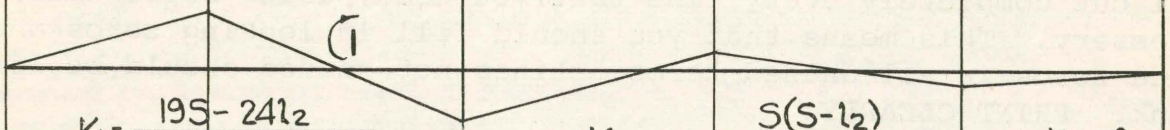
$$K_4 = \frac{l_2}{l_1(5S-6l_2)(3S-4l_2)}$$

$$K_1 = -\frac{15S-19l_2}{l_1(5S-6l_2)(3S-4l_2)}$$

$$K_3 = -\frac{S-l_2}{l_1(5S-6l_2)(3S-4l_2)}$$

$K_5=0$

Shear in span 1-2



$$K_1 = \frac{19S-24l_2}{l_2(5S-6l_2)(3S-4l_2)}$$

$$K_3 = \frac{S(S-l_2)}{l_2^2(5S-6l_2)(3S-4l_2)}$$

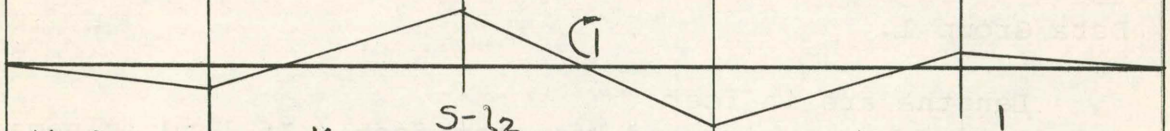
$K_5=0$

$K_0=0$

$$K_2 = -\frac{S(4S-5l_2)}{l_2^2(5S-6l_2)(3S-4l_2)}$$

$$K_4 = -\frac{S}{l_2(5S-6l_2)(3S-4l_2)}$$

Shear in span 2-3



$K_0=0$

$$K_2 = \frac{S-l_2}{l_2^2(3S-4l_2)}$$

$$K_4 = \frac{1}{l_2(3S-4l_2)}$$

$$K_1 = -\frac{1}{l_2(3S-4l_2)}$$

$$K_3 = -\frac{S-l_2}{l_2^2(3S-4l_2)}$$

$K_5=0$

FIGURE 23

CODING OF INPUT DATA

Fill out one Data Sheet for each line of beams in one half cross section including center line beams, if any. Fill out the top section of the Data Sheet first. Check one of the program numbers at the top of the sheet as follows:

32012 - Moments, Stresses and cover plate lengths for a 2 span bridge.

32013 - Moments, Stresses and cover plate lengths for a 3 span bridge.

32014 - Moments, Stresses and cover plate lengths for a 4 span bridge.

32015 - Moments, Stresses and cover plate lengths for a 5 span bridge.

32016 - Deflections for a 2, 3, 4 or 5 span bridge.

32017 - Shears and Reactions for a 2, 3, 4 or 5 span bridge.

For the Moment and Stress Programs, fill out data groups I and II. For the Deflection Program fill out data groups I, II, III and IV. For the Shear and Reaction Program, fill out data groups I and V. Fill out completely every line that you need, using zeros where necessary. This means that you should fill in leading zeros and place zeros in all unused terms. Lines not needed should be left blank. PRINT CLEARLY.

When using the Moment and Stress Program, several sections may be tried by using a different run number for each different section. It takes only a little longer to try 2 or more sections than 1.

Data Group I.

Lengths are in feet.
Loads are in kips and kips per foot. If load is negative, put minus sign over low order digit.
Moment increase is in the form .xxx
In column 71, put an 8 for H20 Loading only or a 9 for H20 and H20-S16 Loading.

Data Group II.

Fill out only the lines needed. Refer to point number list.
Areas are in square inches.
Dimensions are in inches.
For Positive Moment Sections use cover plate-1 if a cover plate is used. Put zeros in cover plate-2.
For negative moment use both cover plates or only cover plate-1.

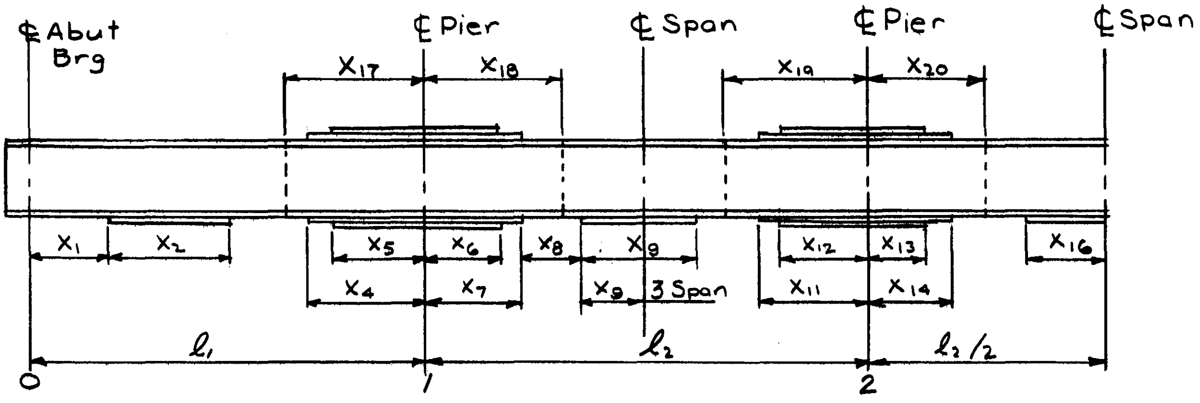
H is the distance in inches from the bottom of the beam to the bottom of the slab. For negative sections, put the depth of the beam in H.

Data Group III.

Fill out only the lines needed-refer to point number list.
Moments are in foot-kips.

Data Group IV.

Place zeros in areas that do not apply; for example, if there is no positive moment cover plate in span 0-1, place zeros in x1 and x2, or if there is only one cover plate at pier one place zeros in x5 and x6. Under item "No. BMS." put the total number of lines of beams in bridge. Give x's in feet and tenths. FWS is weight per beam in kips/ft. of future wearing surface.



COVER PLATE AND SPLICE POINT DATA FOR DEFLECTION PROGRAM

Data Group V.

Areas are in square inches.
Dimensions are in inches.
Shear lug resisting value is in pounds.
Moments are in foot kips.

Explanation of Point Numbers
I-Beam Bridge Design Programs

00	Input card for Moment computation
01	Negative Moment Pier 1
02	Negative Moment Pier 2
03	Positive Moment End Span
04	Positive Moment Interior Span
05	Positive Moment Center Span (5 span only)
09	Input for Shear
49	Input for Deflections
50	Abutment Reaction
51	Pier 1 Reaction
52	Pier 2 Reaction
59	Shears
61	Stress at Pier 1
62	Stress at Pier 2
63	Stress in End Span
64	Stress in Interior Span
65	Stress in Center Span (5 span only)
81	Pier 1 Section Properties
82	Pier 2 Section Properties
83	End Span Section Properties
84	Interior Span Section Properties
85	Center Span Section Properties (5 span only)
98	Cover Plate Lengths & Theor. Splice Points
99	Deflections

DATA SHEET FOR ELECTRONIC COMPUTATION OF I-BEAM BRIDGES

To: Computing Center ______________ Date ______________ Date Results Desired

Return To ______________ Name ______________ Department ______________ Phone

______________ County ______________ Design No. ______________ Budget Code

☐ 32012 2 - Span
☐ 32013 3 - Span
☐ 32014 4 - Span
☐ 32015 5 - Span
☐ 32016 Deflections
☐ 32017 Shear & React

I	BM. No.	Point No.	County	Design No.	Run	Length of End Span x xxx.x xx	Length of Int. Span xx xx.x x	Length of Bridge x x x x.x x	Dead Load 1 xx.x x x x	Dead Load 2 x x.x x x x		Uniform Live Load x x.x x x x		Conc. Live Load For Mom x x.x x x x		Truck Wheel xx.x x x x	8 9	For H20 H20-S16	Pier 1 Increase	Pier 2 Increase
C.C.	1	2 3	4 5	6 7 8 9	10	11 12 13 14 15 16	17 18 19 20 21 22	23 24 25 26 27 28	29 30 31 32 33 34	35 36 37 38 39 40	41 42 43 44	45 46 47 48 49 50	51 52 53 54	55 56 57 58 59 60	61 62 63 64	65 66 67 68 69 70	71	72 73 74	75 76 77	78 79 80
		00									0 000		0000		0 0 0 0			0 0 0		

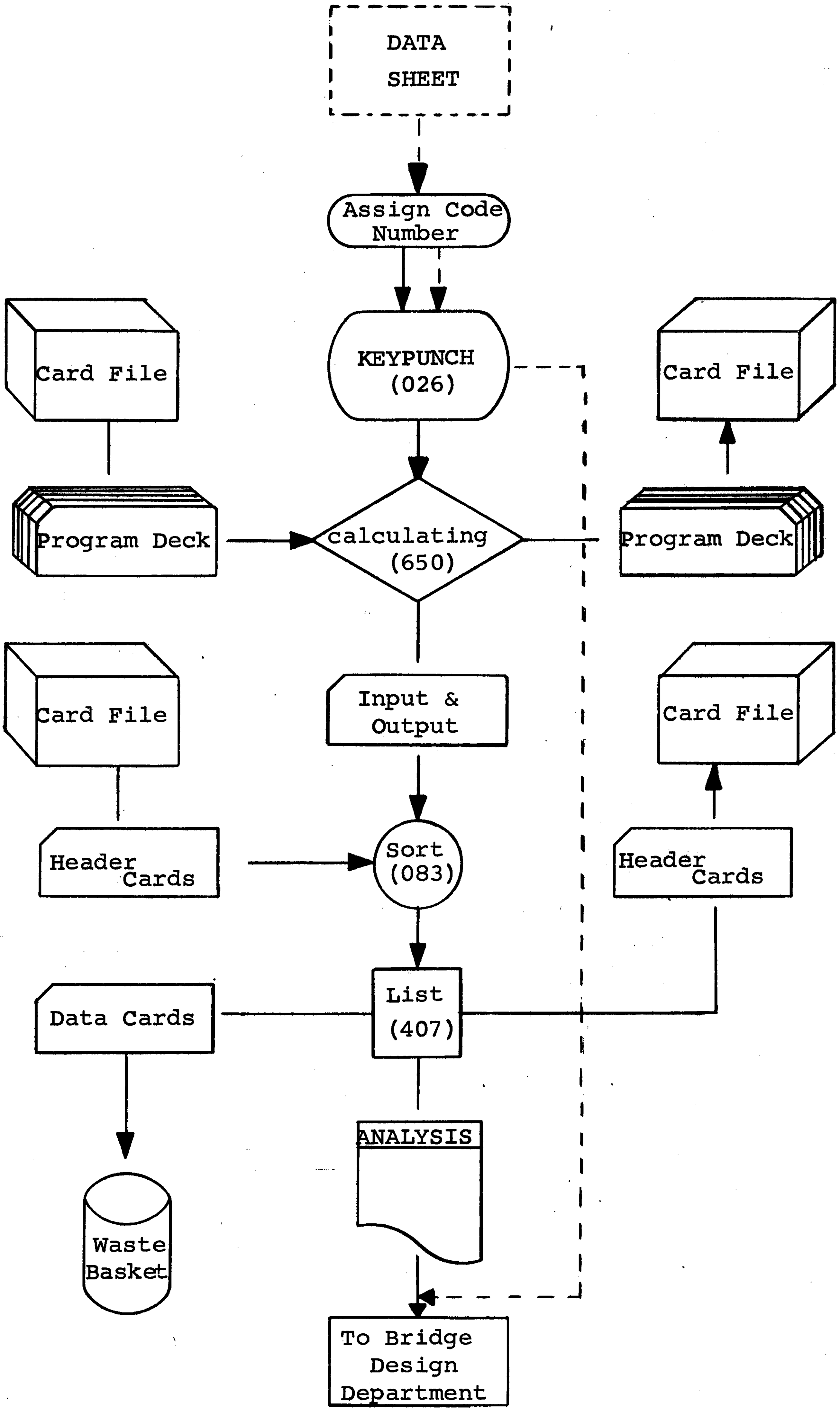
II						Beam Area x xxxx.x x	Beam Depth xx xx.x x	Beam I x x x x x.x	Conc. Width xxx.x x x	Conc. Depth xxx.xxx		N.	Cover Plate - 1 (Inner) Width xx.x x x	Cover Plate - 1 (Inner) Thickness xx.xxx	Cover Plate - 2 (Outer) Width xx.x xx	Cover Plate - 2 (Outer) Thickness xx.x x x		H xx.x x
		81									0—0						0—0	
		82									0—0						0—0	
		83									0—0						0—0	
		84									0—0						0—0	
		85									0—0						0—0	

III							Dead Load 2 Moment xx x xxx	
		01				0—0		0—0
		02				0—0		0—0

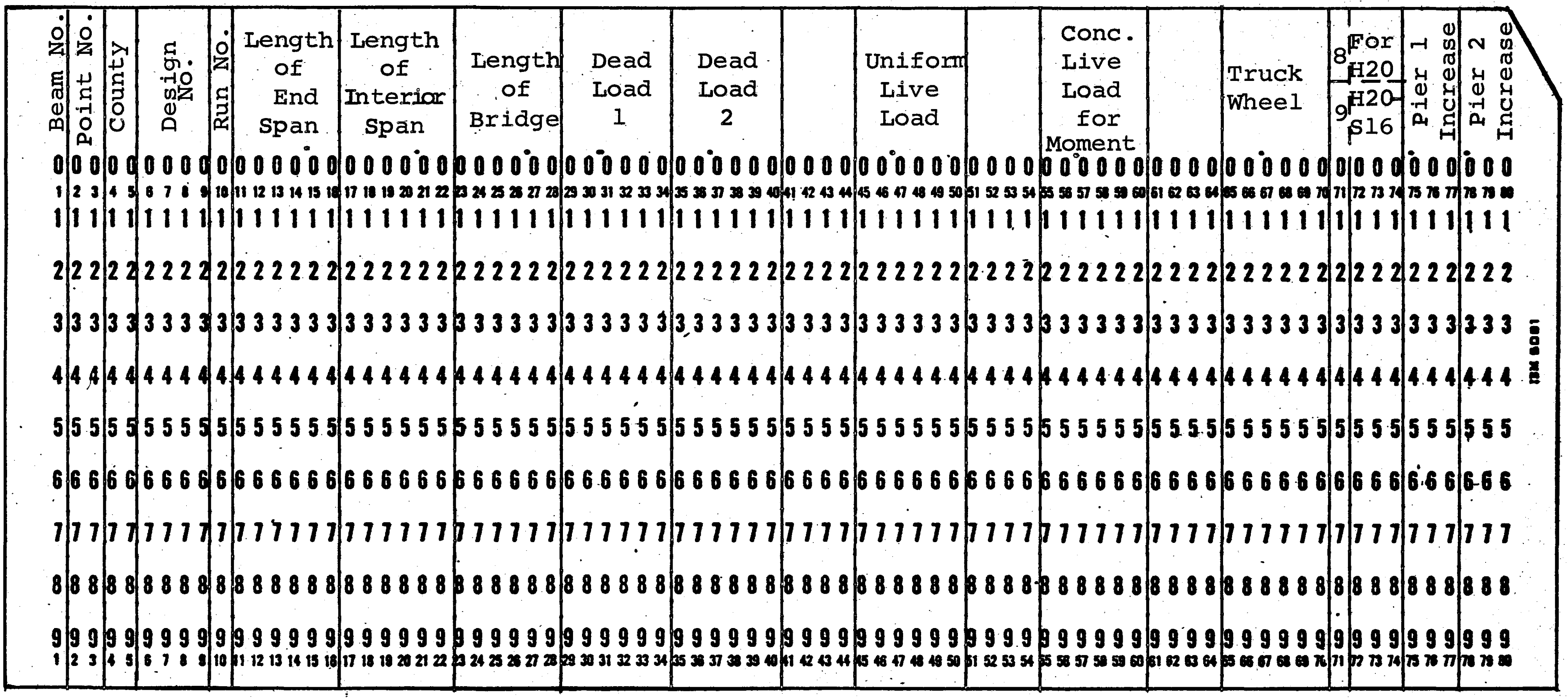
IV						X_1 x x.x	X_2 x xx	X_4 x x.x	X_5 x x.x	X_6 x x.x	X_7 x x.x	X_8 x x.x	X_9 x x.x	X_{11} x x.x	X_{12} x x.x	No. Bms		X_{13} xx.x		X_{14} x x.x		X_{16} xx.x		X_{17} x x.x		X_{18} x x x		X_{19} x x.x		X_{20} x x.x	FWS x.x xxx
		49															0		00		00		0 0		00		0 0		0 0		

V						Beam Area x x x x.xx	Beam Depth x xxx x.xx	Beam I xxxxxx.x	Conc. Width xx x.x xx	Conc. Depth xx x.xxx		N		DL - 1 Moment Pier 1 x xx x.xx		DL - 1 Moment Pier 2 xx x x.x x	H x x.xx	Shear Lug xxx x xx
		09									0—0		0000		0000			

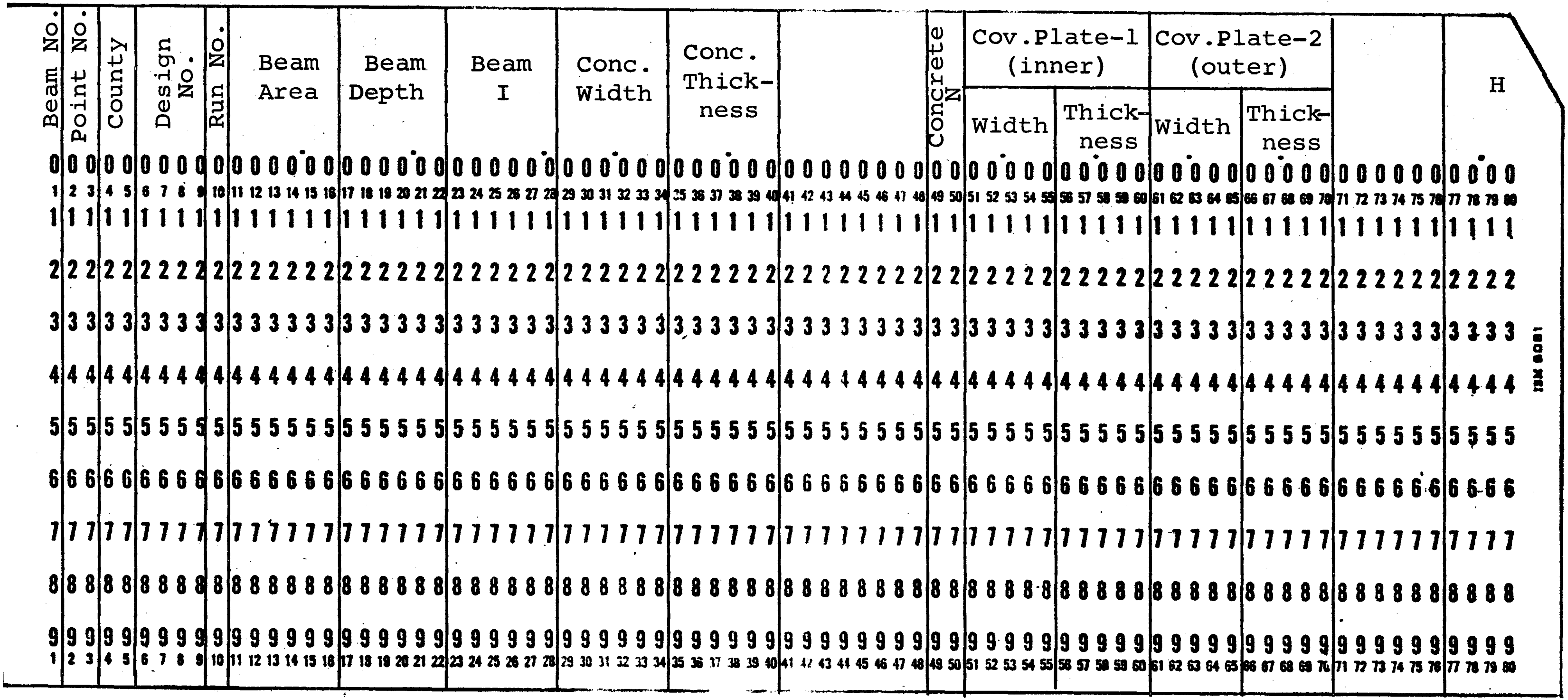
GENERAL FLOW CHART



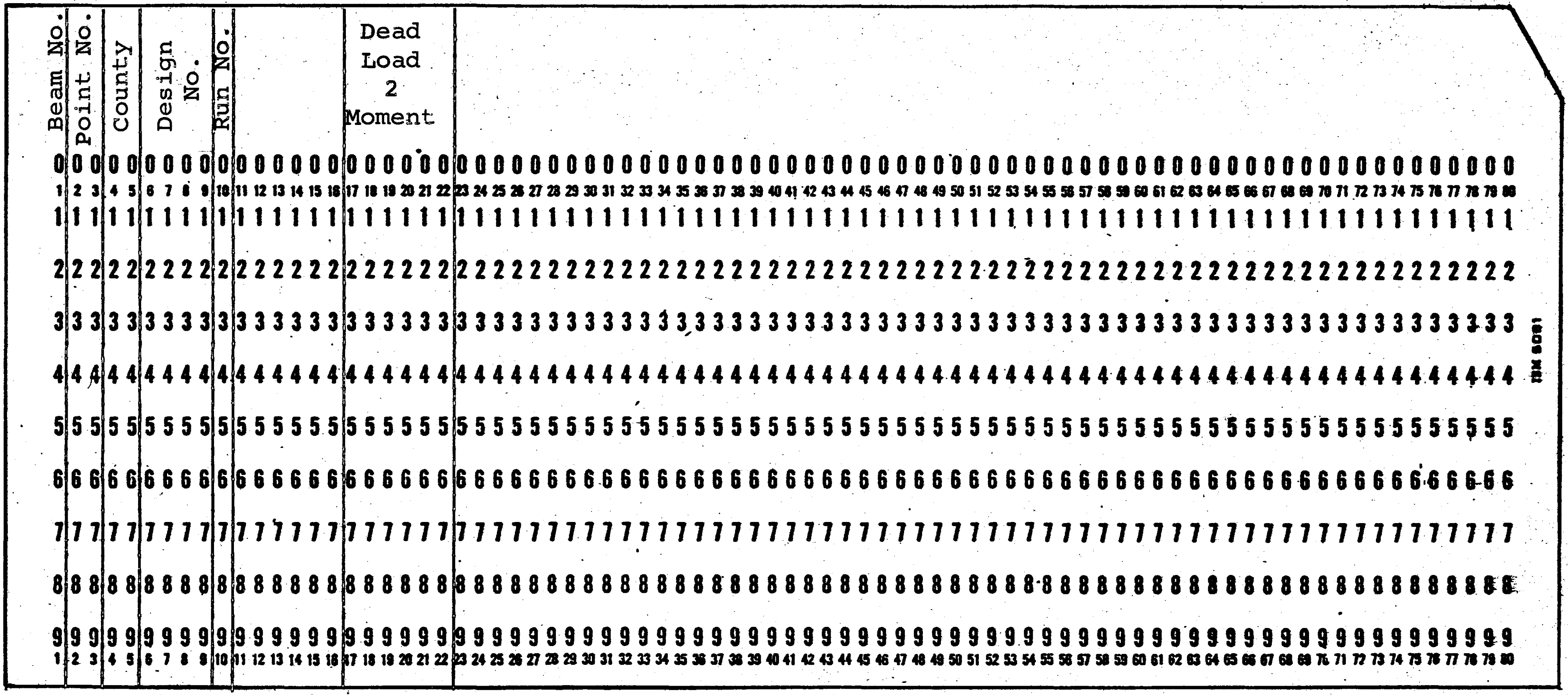
INPUT FOR MOMENT COMPUTATION - DATA GROUP I



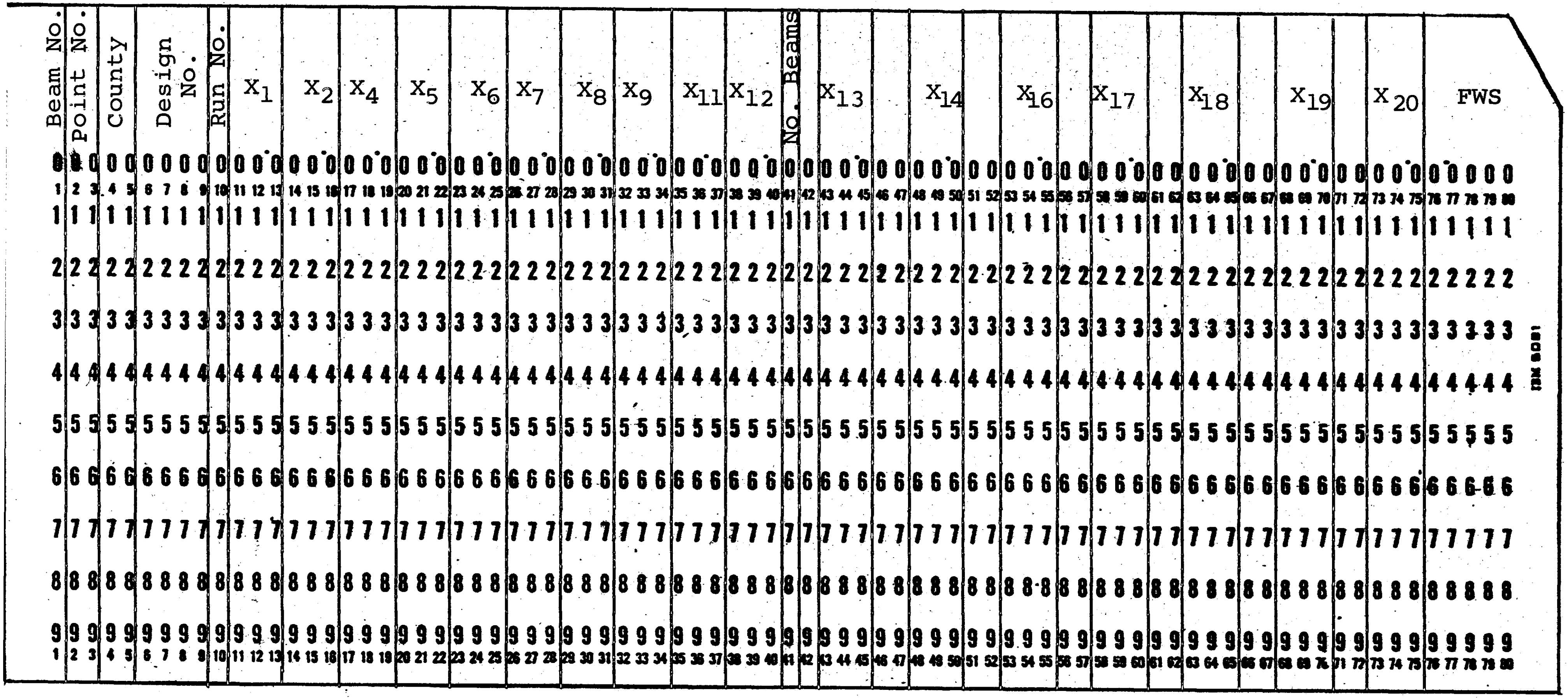
INPUT - SECTION PROPERTIES - DATA GROUP II



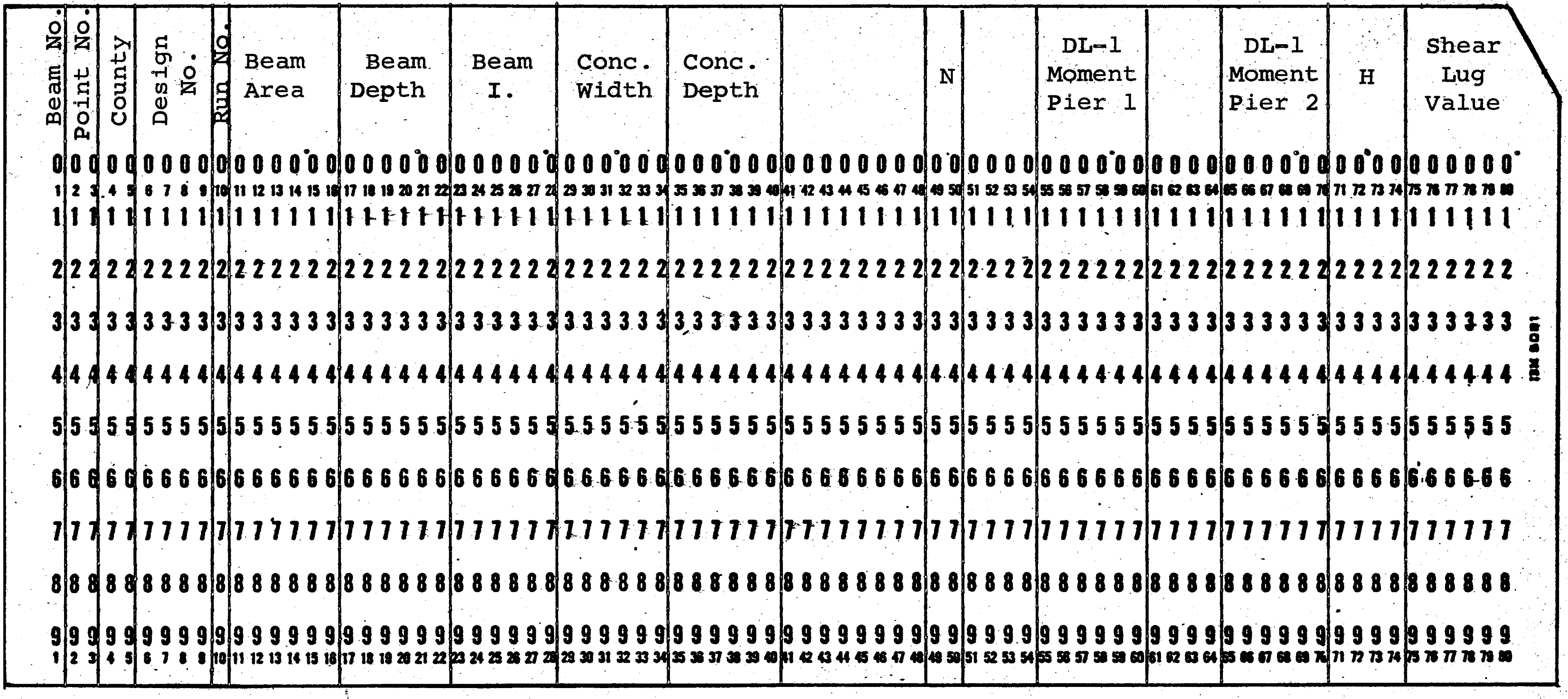
INPUT - NEGATIVE MOMENT - DEAD LOAD 2 - DATA GROUP III



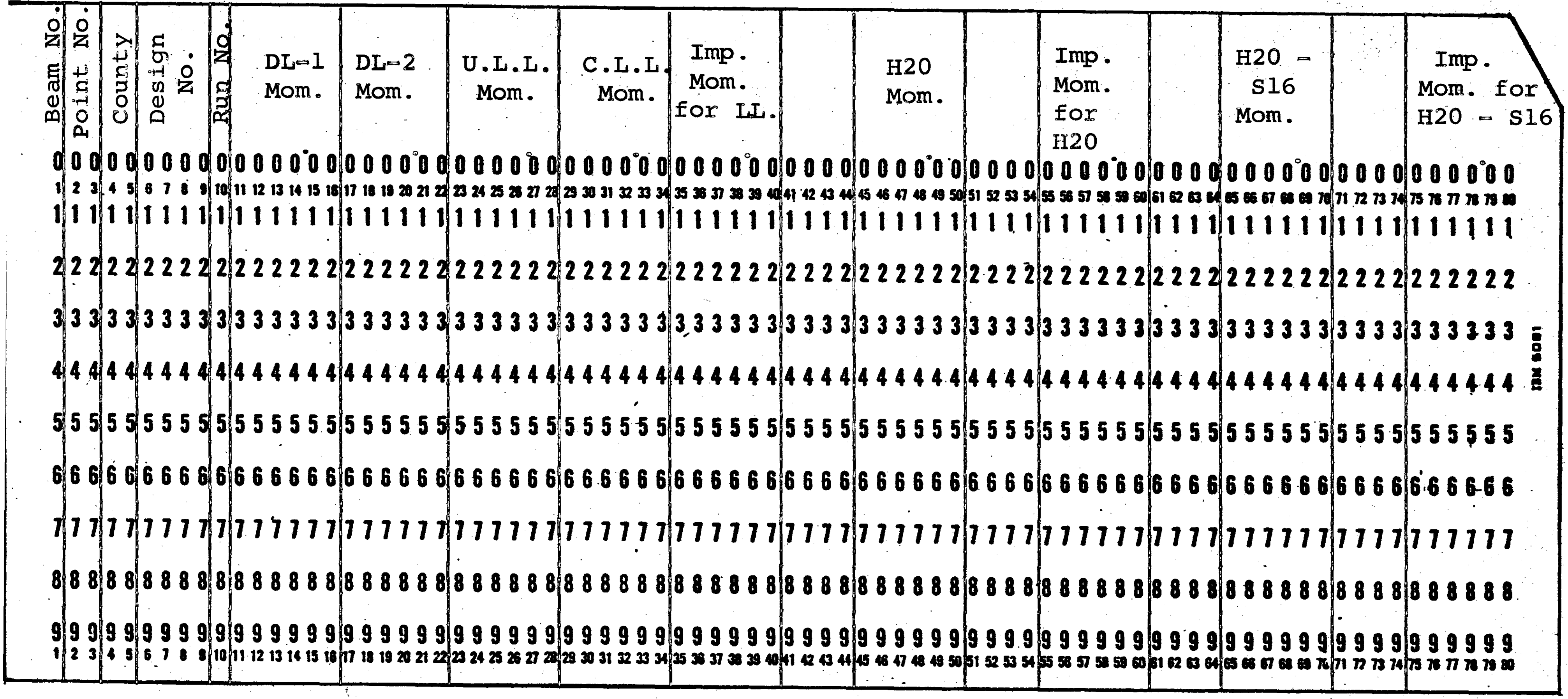
INPUT FOR DEFLECTIONS - DATA GROUP IV



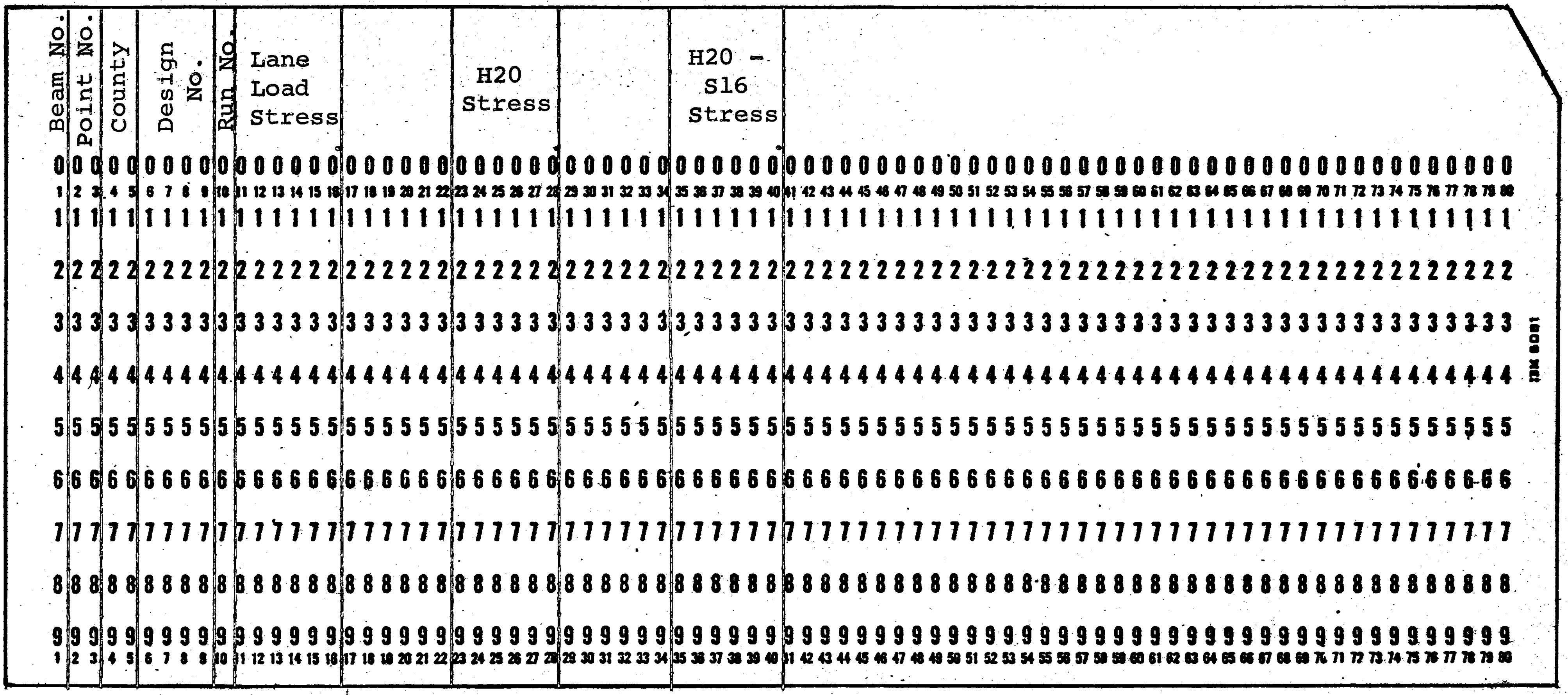
INPUT FOR SHEAR - DATA GROUP V



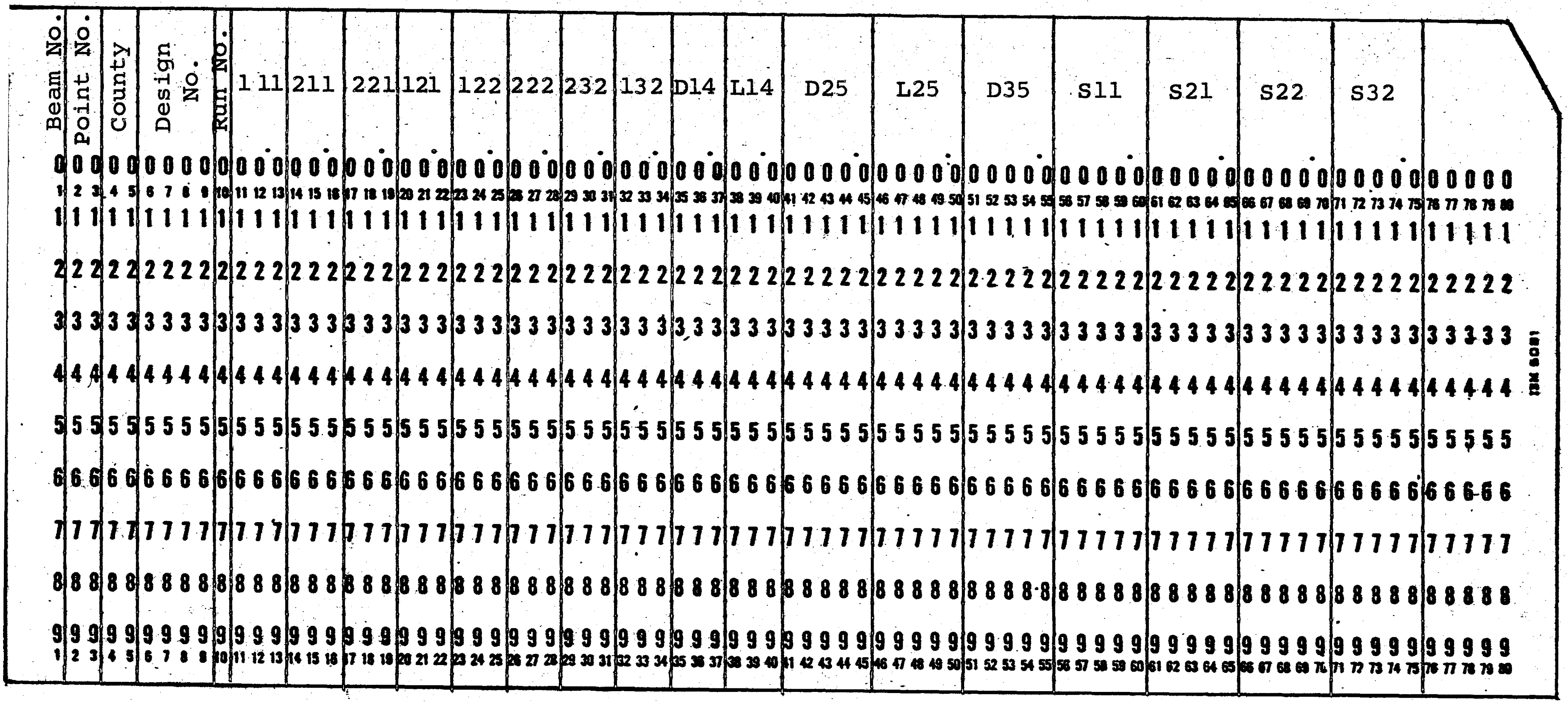
OUTPUT - MAXIMUM MOMENTS



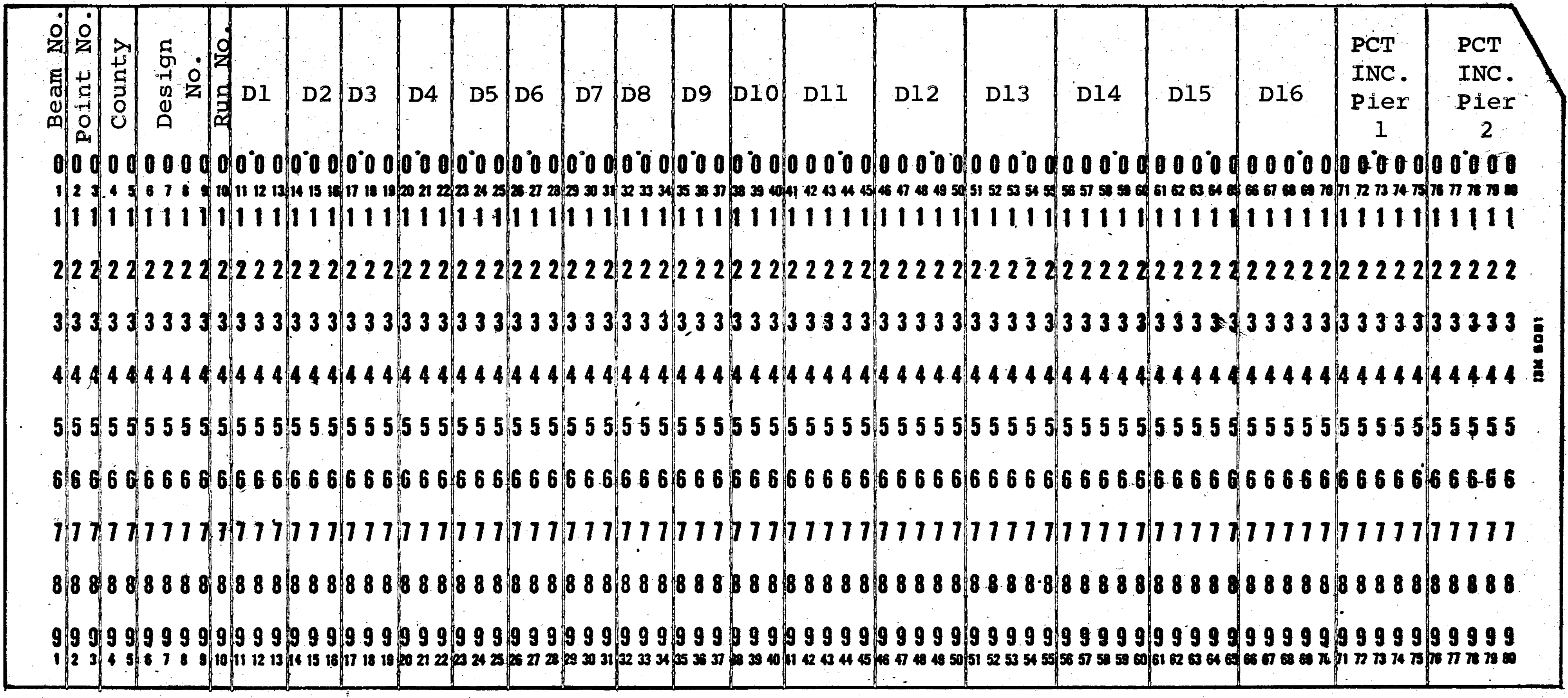
OUTPUT - MAXIMUM STRESSES



OUTPUT - COVER PLATE LENGTHS & THEORETICAL SPLICE POINTS



OUTPUT - DEFLECTIONS

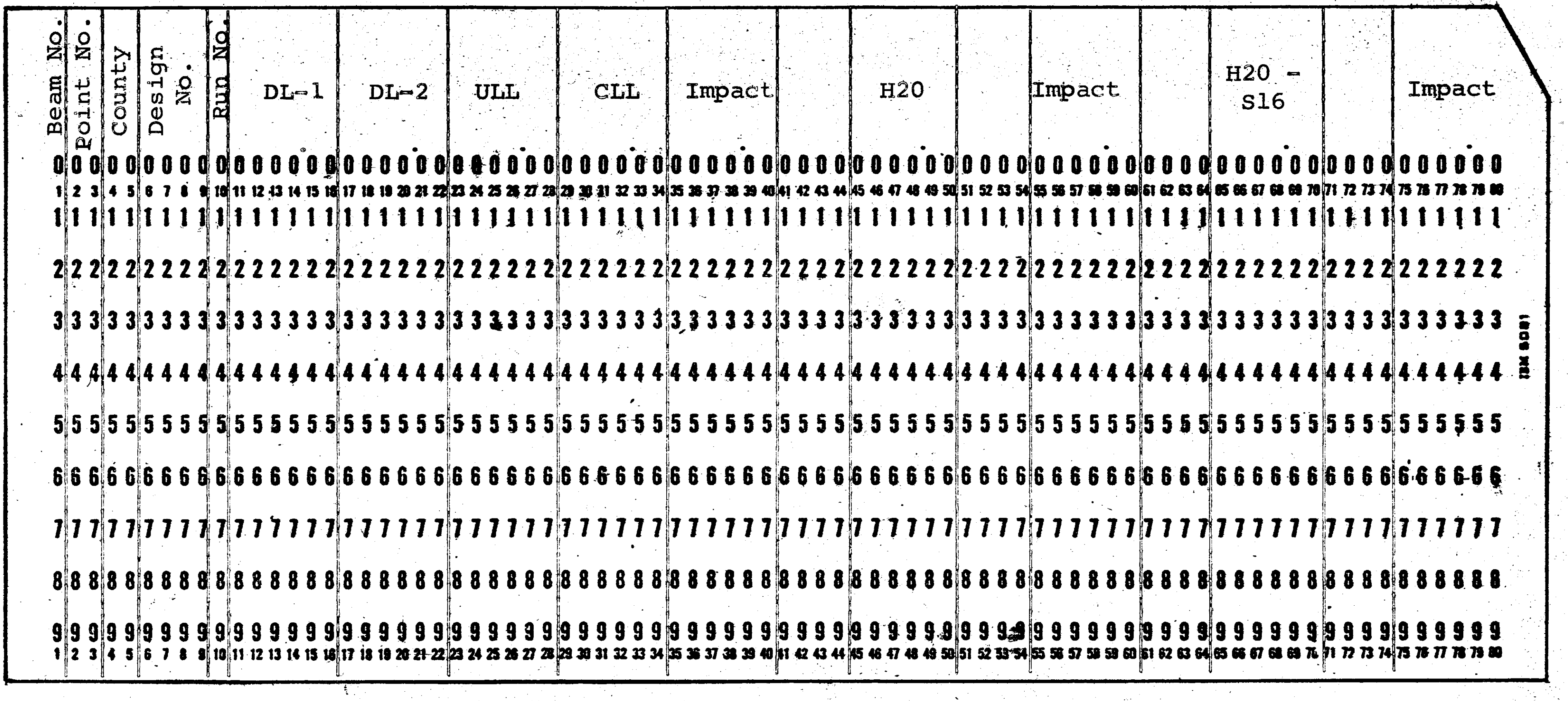


OUTPUT - SHEARS

Beam No.	Point No.	County	Design No.	Run No.	Spacing Factor		Shear at Abut. +	Shear at 0.4 Pt. EndSpan +	Shear at 0.4 Pt. End Span −	Shear at Left Side Pier 1 −	Shear at Right Side Pier 1 +	Shear at 0.5 Pt. Int. Span +	Shear at 0.5 Pt. Int. Span −	Shear at Left Side Pier 2 −	Shear at Right Side Pier 2 +	Shear at ℄ Ctr. Span +
0	0 0	0 0	0 0 0 0	0	0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0
1	2 3	4 5	6 7 8 9	10	11 12 13 14 15 16	17 18 19 20 21 22 23 24 25 26 27 28	29 30 31 32 33 34	35 36 37 38 39 40	41 42 43 44 45	46 47 48 49 50	51 52 53 54 55	56 57 58 59 60	61 62 63 64 65	66 67 68 69 70	71 72 73 74 75	76 77 78 79 80
1	1 1	1 1	1 1 1 1	1	1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1
2	2 2	2 2	2 2 2 2	2	2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2	2 2 2 2 2
3	3 3	3 3	3 3 3 3	3	3 3 3 3 3 3	3 3 3 3 3 3 3 3 3 3 3 3	3 3 3 3 3 3	3 3 3 3 3 3	3 3 3 3 3	3 3 3 3 3	3 3 3 3 3	3 3 3 3 3	3 3 3 3 3	3 3 3 3 3	3 3 3 3 3	3 3 3 3 3
4	4 4	4 4	4 4 4 4	4	4 4 4 4 4 4	4 4 4 4 4 4 4 4 4 4 4 4	4 4 4 4 4 4	4 4 4 4 4 4	4 4 4 4 4	4 4 4 4 4	4 4 4 4 4	4 4 4 4 4	4 4 4 4 4	4 4 4 4 4	4 4 4 4 4	4 4 4 4 4
5	5 5	5 5	5 5 5 5	5	5 5 5 5 5 5	5 5 5 5 5 5 5 5 5 5 5 5	5 5 5 5 5 5	5 5 5 5 5 5	5 5 5 5 5	5 5 5 5 5	5 5 5 5 5	5 5 5 5 5	5 5 5 5 5	5 5 5 5 5	5 5 5 5 5	5 5 5 5 5
6	6 6	6 6	6 6 6 6	6	6 6 6 6 6 6	6 6 6 6 6 6 6 6 6 6 6 6	6 6 6 6 6 6	6 6 6 6 6 6	6 6 6 6 6	6 6 6 6 6	6 6 6 6 6	6 6 6 6 6	6 6 6 6 6	6 6 6 6 6	6 6 6 6 6	6 6 6 6 6
7	7 7	7 7	7 7 7 7	7	7 7 7 7 7 7	7 7 7 7 7 7 7 7 7 7 7 7	7 7 7 7 7 7	7 7 7 7 7 7	7 7 7 7 7	7 7 7 7 7	7 7 7 7 7	7 7 7 7 7	7 7 7 7 7	7 7 7 7 7	7 7 7 7 7	7 7 7 7 7
8	8 8	8 8	8 8 8 8	8	8 8 8 8 8 8	8 8 8 8 8 8 8 8 8 8 8 8	8 8 8 8 8 8	8 8 8 8 8 8	8 8 8 8 8	8 8 8 8 8	8 8 8 8 8	8 8 8 8 8	8 8 8 8 8	8 8 8 8 8	8 8 8 8 8	8 8 8 8 8
9	9 9	9 9	9 9 9 9	9	9 9 9 9 9 9	9 9 9 9 9 9 9 9 9 9 9 9	9 9 9 9 9 9	9 9 9 9 9 9	9 9 9 9 9	9 9 9 9 9	9 9 9 9 9	9 9 9 9 9	9 9 9 9 9	9 9 9 9 9	9 9 9 9 9	9 9 9 9 9
1	2 3	4 5	6 7 8 9	10	11 12 13 14 15 16	17 18 19 20 21 22 23 24 25 26 27 28	29 30 31 32 33 34	35 36 37 38 39 40	41 42 43 44 45	46 47 48 49 50	51 52 53 54 55	56 57 58 59 60	61 62 63 64 65	66 67 68 69 70	71 72 73 74 75	76 77 78 79 80

IBM 5081

OUTPUT - REACTIONS



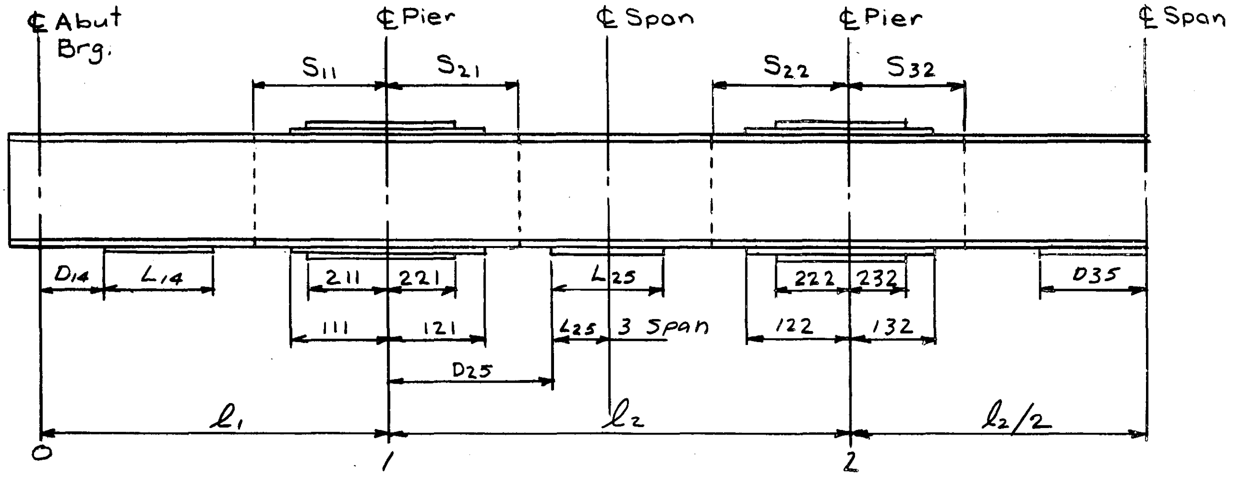
Keypunch Instructions

1. Program Card - All Numeric
2. Punch card as indicated. All columns must be punched. Punch zeros where necessary. Punch an x overpunch when there is a minus sign over a number.
3. Leave cards in the order indicated on the data sheet.
4. Take cards to 650 operator.

Equipment Instructions

1. Sorting: All input and output cards are sorted with the header cards on cc 1, 3 and 2.
2. Listing: Cards are listed on the 407 as shown in the sample listings.

Output



LOCATION OF COVER PLATES & SPLICE POINTS ON OUTPUT FORM

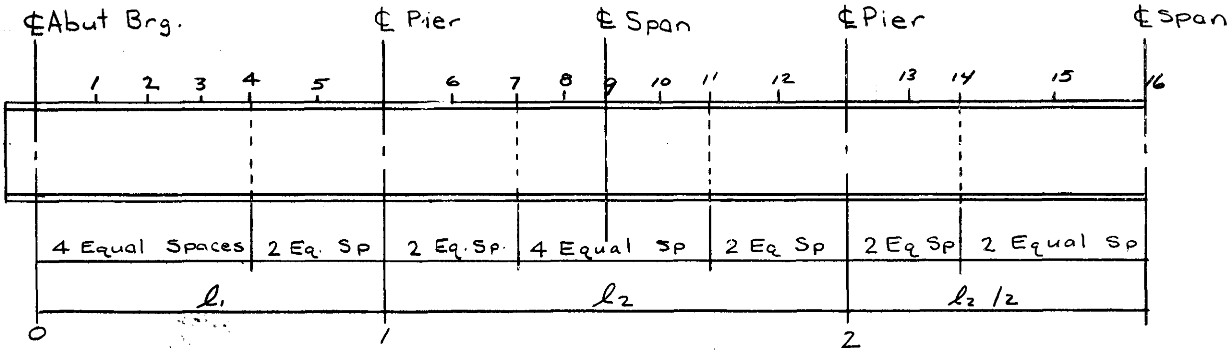
Explanation of 3 digit number describing negative moment Cover Plates --

left digit - cover plate number
center digit - span number
right digit - pier number

D25 is measured from pier 1 and is not given for 3 span bridges.

Theoretical splice points are absolute.

* * * * * * *



LOCATION OF DEFLECTIONS SHOWN ON OUTPUT FORM

If there is no splice in span 0-1 then deflections will be given for quarter points of span 0-1 and Nos. 4 and 5 on output form will be zero or blank.

```
BM PT CO DESN R     L 1      L 2        S    DL 1     DL 2          ULL          CLL        WHEEL    INCREASE
BM PT CO DESN R    X.XX     X.XX     X.XX  X.XXXX   X.XXXX       X.XXXX       X.XXXX       X.XXXX    .XXX.XXX
 1 00 77 0156 1    6650     8500    30300    7150     5350         3210          903       160000  9000145120
 2 00 77 0156 1    6650     8500    30300   10850      950         5250         1476       262000  9000145120

BM PT CO DESN R    DL 1     DL 2      ULL     CLL      IMP     H TRUCK          IMP    HS TRUCK          IMP
BM PT CO DESN R    X.XX     X.XX     X.XX    X.XX     X.XX        X.XX         X.XX        X.XX         X.XX
 1 01 77 0156 1   47231    30865    21922   12308     8523
 2 01 77 0156 1   71672     5481    35854   20118    13937
 1 02 77 0156 1   49222    32884    24261   13003     8869
 2 02 77 0156 1   74693     5839    39678   21254    14502
 1 03 77 0156 1   19188    16104    14929   12452     7146       25120         6556       37168         9701
 2 03 77 0156 1   28961     2852    24541   20428    11737       41134        10736       61151        15960
 1 04 77 0156 1   16347    16443    17309   13012     7216       26320         6264       39344         9364
 2 04 77 0156 1   24807     2920    28310   21269    11800       43099        10258       64452        15340

BM PT CO DESN R    LANE             H TRK            HS TR
BM PT CO DESN R      XX                XX               XX
 1 61 77 0156 1   17946
 2 61 77 0156 1   17883
 1 62 77 0156 1   17453
 2 62 77 0156 1   17406
 1 63 77 0156 1   15208             14700            17678
 2 63 77 0156 1   14838             14207            17888
 1 64 77 0156 1   15082             14111            17272
 2 64 77 0156 1   15144             13920            17947

BM PT CO DESN R    BM A     BM D     BM I  CONC W   CONC T        N  CP1 W CP1 T CP2 W CP2 T          H
BM PT CO DESN R    X.XX     X.XX      X.X   X.XXX    X.XXX          X.XXX X.XXX X.XXX X.XXX        X.XX
 1 81 77 0156 1    3826     3310    66990                        10 10000 00750  9000 00625        3310
 2 81 77 0156 1    4416     3584    90121                        10 11000 00750 10000 00625        3584
 1 82 77 0156 1    3826     3310    66990                        10 10000 00875  9000 00750        3310
 2 82 77 0156 1    4416     3584    90121                        10 11000 00875 10000 00750        3584
 1 83 77 0156 1    3826     3310    66990   59875     7062       10  4000 00375                    3391
 2 83 77 0156 1    4416     3584    90121   84750     7062       10  6000 005                      3665
 1 84 77 0156 1    3826     3310    66990   59875     7062       10  4000 00375                    3391
 2 84 77 0156 1    4416     3584    90121   84750     7062       10  6000 00375                    3665

BM PT CO DESN R 111 211 221 121 122 222 232 132 D14 L14  D25   L25  D35  S11  S21  S22  S32
BM PT CO DESN R X.X X.X X.X X.X X.X X.X X.X X.X X.X X.X  X.X   X.X  X.X  X.X  X.X  X.X  X.X
 1 98 77 0156 1 137 082  77 125 142 081         118 285  276 00294       188  192 00200
 2 98 77 0156 1 155 090  80 136 158 085         108 314  260 00329       197  205 00211
```

Explanation of Listing of Input & Output Data for Sample Problem (Program No. 32014)

General for all Items -

BM - Number assigned to each beam of a given bridge

PT - Point number (refer to Explanation of Point Numbers, p. 38)

CO - Number of County

DESN - Design Number

R - Run number - identifies various trials using different sets of data for same bridge

xx.xx - Indicates decimal point position

Item 1 - Input Data - See Input for Moment Computation - Data Group I, p. 41

Item 2 - Output Data - moments in ft-kips at specified point numbers due to loads indicated in heading

Item 3 - Output Data - stresses in psi. Truck load stresses are not given at piers (points 61 & 62)

Item 4 - Input Data - See Input - Section Properties - Data Group II, p. 42

Item 5 - Output Data - theoretical cover plate cutoffs and theoretical splice points. See p. 53 for interpretation.

Listings for programs 32012, 32013, 32015 are similar except for greater or lesser number of points given.

```
BM PT CO DESN R     L 1      L 2        S     DL 1     DL 2          ULL          CLL         WHEEL     INCREASE
BM PT CO DESN R    X.XX     X.XX     X.XX  X.XXXX   X.XXXX       X.XXXX       X.XXXX        X.XXXX     .XXX.XXX
 1 00 77 0156 1    6650     8500    30300     7150     5350         3210          903        160000   9000145120
 2 00 77 0156 1    6650     8500    30300    10850      950         5250         1476        262000   9000145120

BM PT CO DESN R             DL 2
BM PT CO DESN R             X.XX
 1 01 77 0156 1            30865
 2 01 77 0156 1             5481
 1 02 77 0156 1            32884
 2 02 77 0156 1             5839

BM PT CO DESN R  X1   X2   X4   X5   X6   X7   X8   X9  X11  X12 N X13    X14    X16    X17    X18    X19    X20    FWS
BM PT CO DESN R X.X  X.X  X.X  X.X  X.X  X.X  X.X  X.X  X.X  X.X X X.X    X.X    X.X    X.X    X.X    X.X    X.X  .XXXX
 1 49 77 0156 1 105  310  150  095   90  135  130  315  155  095  400                       2    200  00200           690
 2 49 77 0156 1  95  340  165  100   90  150  100  350  170  095  400                       2    200  00200          1880

BM PT CO DESN R    BM A     BM D     BM I   CONC W   CONC T               N  CP1 W  CP1 T  CP2 W  CP2 T               H
BM PT CO DESN R    X.XX     X.XX      X.X    X.XXX    X.XXX                  X.XXX  X.XXX  X.XXX  X.XXX            X.XX
 1 81 77 0156 1    3826     3310    66990                                10  10000  00750   9000  00625            3310
 2 81 77 0156 1    4416     3584    90121                                10  11000  00750  10000  00625            3584
 1 82 77 0156 1    3826     3310    66990                                10  10000  00875   9000  00750            3310
 2 82 77 0156 1    4416     3584    90121                                10  11000  00875  10000  00750            3584
 1 83 77 0156 1    3826     3310    66990    59875     7062              10   4000  00375                          3391
 2 83 77 0156 1    4416     3584    90121    84750     7062              10   6000  005                            3665
 1 84 77 0156 1    3826     3310    66990    59875     7062              10   4000  00375                          3391
 2 84 77 0156 1    4416     3584    90121    84750     7062              10   6000  00375                          3665

BM PT CO DESN R  D1   D2   D3   D4   D5   D6   D7   D8   D9  D10    D11    D12    D13    D14    D15    D16  1 PCT  INC 2
BM PT CO DESN R .XX  .XX  .XX  .XX  .XX  .XX  .XX  .XX  .XX  .XX    .XX    .XX    .XX    .XX    .XX    .XX   .XXX   .XXX
   99 77 0156 1  38  058   53  030   10  009   29  053   62  052     28  00008                                139  00110
```

Explanation of Listing of Input & Output Data for Sample Problem (Program No. 32016)

General for all Items - see p. 54B

Item 1 - see p. 54B

Item 2 - Input Data - see Input - Negative Moment - Dead Load 2 - Data Group III, p. 43

Item 3 - Input Data - see Input for Deflections - Data Group IV, p. 44

Item 4 - Input Data - see Input - Section Properties - Data Group II, p. 42

Item 5 - Output Data - deflections at quarter points between splices. See p. 53 for interpretation.

Listings for 2, 3 and 5 span bridges are similar except for greater or lesser number of deflections given.

```
BM PT CO DESN R    L 1     L 2       S    DL 1    DL 2        ULL          CLL         WHEEL    INCREASE
BM PT CO DESN R   X.XX    X.XX    X.XX  X.XXXX  X.XXXX     X.XXXX       X.XXXX        X.XXXX    .XXX.XXX
 1 00 77 0156 1   6650    8500   30300    7150    5350       3210          903        160000  9000145120
 2 00 77 0156 1   6650    8500   30300   10850     950       5250        1476         262000  9000145120

BM PT CO DESN R   BM A    BM D    BM I  CONC W  CONC T 8OR9     N         M P1          M P2     H   LUG
BM PT CO DESN R   X.XX    X.XX     X.X   X.XXX   X.XXX                     X.XX          X.XX X.XX    XX
 1 09 77 0156 1   3826    3310   66990   59875    7062         10         47231         49222 33910 48400
 2 09 77 0156 1   4416    3584   90121   84750    7062         10         71672         74693 36650 48400

BM PT CO DESN R   DL 1    DL 2     ULL     CLL     IMP      H TRUCK         IMP    HS TRUCK          IMP
BM PT CO DESN R   X.XX    X.XX    X.XX    X.XX    X.XX         X.XX        X.XX        X.XX         X.XX
 1 50 77 0156 1   1667    1315     992    1304     599         1904         497        2992          781
 2 50 77 0156 1   2530     234    1622    2131     980         3118         814        4899         1279
 1 51 77 0156 1   6103    4495    2930    1304    1054         1984         494        3504          872
 2 51 77 0156 1   9261     798    4793    2131    1724         3249         8 9        5738         1429
 1 52 77 0156 1   6125    4592    3076    1304    1042         1984         472        3520          838
 2 52 77 0156 1   9294     816    5030    2131    1704         3249         773        5764         1372

BM PT CO DESN R  SPFAC                          ABUT   O.4PT  O.4PT PIER1 PIER1 O.5PT O.5PT PIER2 PIER2 O.5PT
BM PT CO DESN R     XX                          X.XX    X.XX   X.XX  X.XX  X.XX  X.XX  X.XX  X.XX  X.XX  X.
 1 59 77 0156 1   1805                          5088    1647   1520 06300  6369 017 1  1666 06357
 2 59 77 0156 1   1870                          6412    2855   2332 07041  7141 02817  2697 07057
```

Explanation of Listing of Input & Output Data for Sample Problem (Program No. 32017)

General for all Items - see p. 54B

Item 1 - see p. 54B

Item 2 - Input Data - See Input Data for Shear - Data Group V, p. 45

Item 3 - Output Data - Maximum reactions in kips at specified point numbers due to loads indicated in heading (refer to Explanation of Point Numbers, p. 38)

Item 4 - Output Data -
SPFAC - factor to be divided by shear at given points to find shear lug spacing in inches.

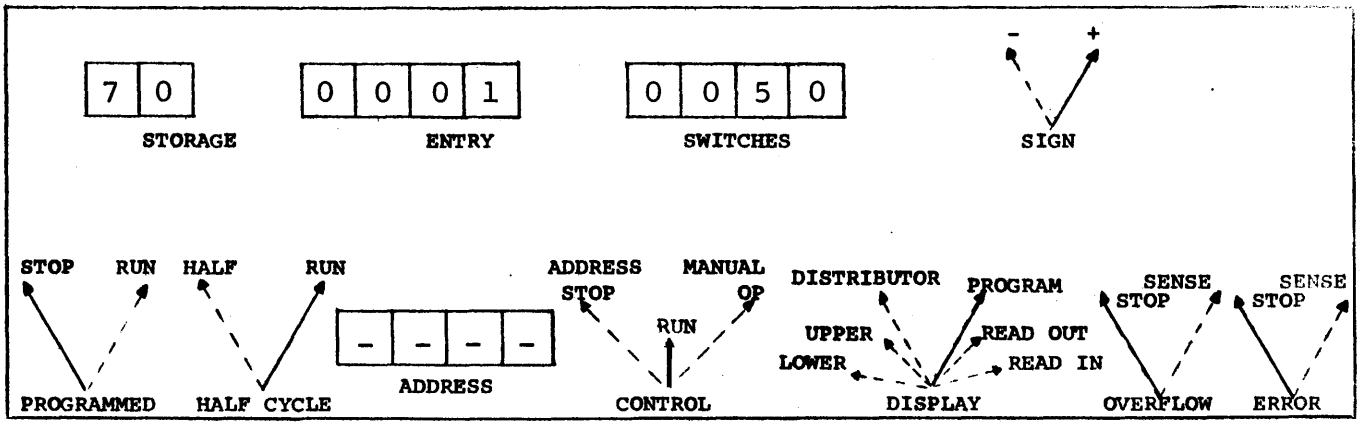
Other items are maximum shears at points indicated in headings. Signs of shears alternate from plus to minus by pairs starting with plus for abutment and 1st 0.4 point value.

Listings for 2, 3 and 5 span bridges are similar except for greater or lesser number of points given.

32012, 32013
32014
Program No. 32015
Page 1 of 2

7 Per Card Deck

650 PROGRAM LOADING INSTRUCTIONS

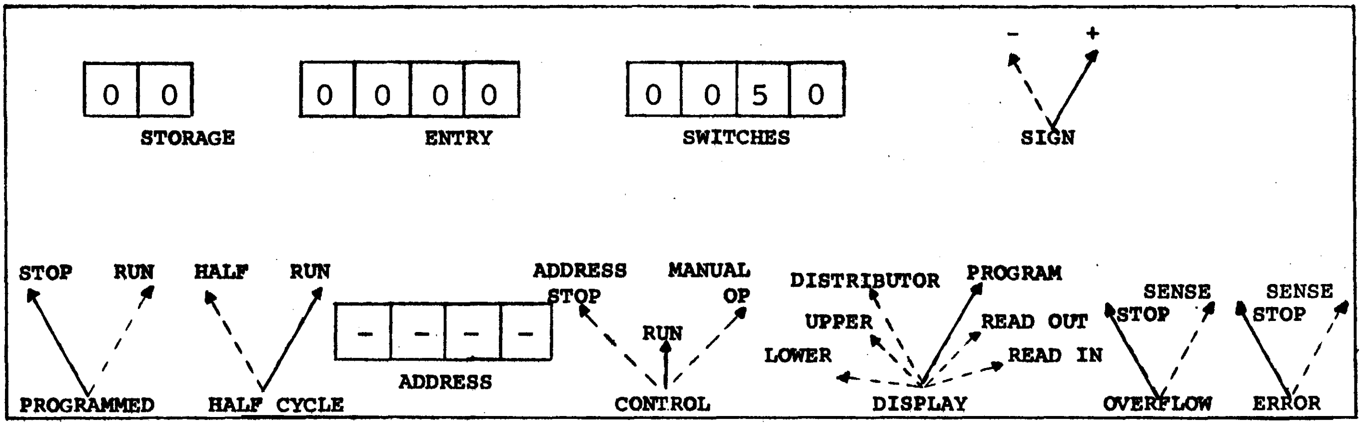


1. Initial Console Setting as shown above.
2. Starting Procedure: Computer Reset, Program Start.
3. Special Instructions: Place data cards behind the program deck push END OF FILE after last card goes in.

To restart or run another bridge, see below.

Sort header cards with input and output on cols. 1, 3, 2. List on 407 board No. 7 SW. 1 on. Save header cards. Use wide paper.

650 PROGRAM OPERATING INSTRUCTIONS



1. Console Setting Shown Above.
2. Starting Procedure: Computer Reset, Program Start
   Punch Feed 5081
   Control Panels No. 2
3. Special Instructions:

32012, 32013
32014
Program No. 32015
Page 2 of 2

OPERATING INSTRUCTIONS, cont'd

Other Instructions and Remarks:

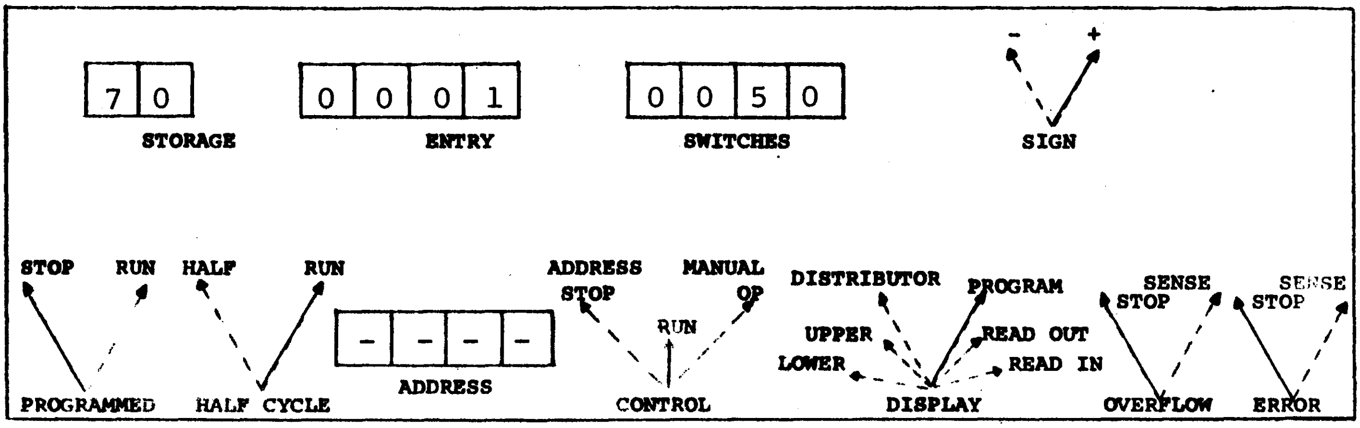
Program Stops and Required Action:

Stop D-Address	Message-Explanation-Action
0001	Type 00 (cc 2-3) not first. Arrange cards as shown
	on the data sheet (cc 1-10)
0002	Different Beam No. (cc 1) in one group of data.
	Arrange cards as shown on the data sheet. Only one
	beam to a data sheet.
0003	Section 1 card (81 in cc 2-3) Not second. Arrange
	cards as shown on data sheet.
0004	County No., Design No. and Run No. (cc 4-10) not in
	agreement with other cards from the same data sheet.
	Check cards with data sheet.
0005	Section 2 not 3rd card (See Stop 0003)
0006	Section 3 not 4th card (See Stop 0003)
0007	Section 4 not 5th card (See Stop 0003)
0008	Wrong Length of Bridge. Length of 2 end spans plus
	length of "x" interior spans does not equal length
	of bridge. Inform designer. x = 0 for 2 span
	1 for 3 span
	2 for 4 span
	3 for 5 span
0009	Section 5 not 6th card (See Stop 0003)

Program No. 32016
Page 1 **of** 2

7 Per Card Deck

650 PROGRAM LOADING INSTRUCTIONS

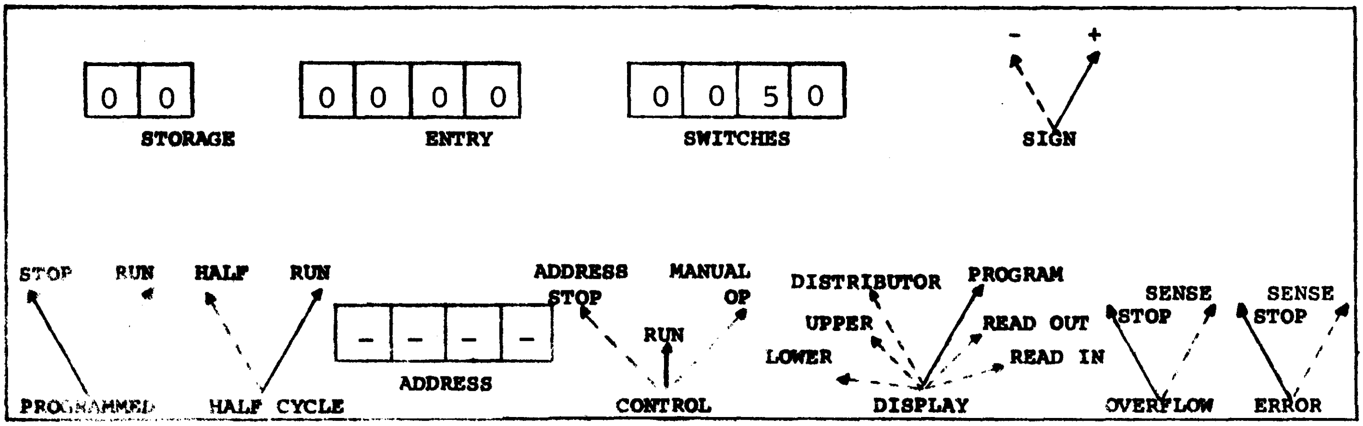


1. Initial Console Setting as shown above.
2. Starting Procedure: Computer Reset, Program Start.
3. Special Instructions: Place data cards behind the program deck. Push END OF FILE after last card goes in.

   To restart or run another bridge, see below.

   Sort header cards with input and output on cols. 1, 3, 2. List on 407, board No. 7 SW. 1 on. Save header cards. Use wide paper.

650 PROGRAM OPERATING INSTRUCTIONS



1. Console Setting Shown Above.
2. Starting Procedure: Computer Reset, Program Start
   Punch Feed 5081
   Control Panels No. 2
3. Special Instructions:

OPERATING INSTRUCTIONS, cont'd

Program No. 32016
Page 2 of 2

Other Instructions and Remarks:

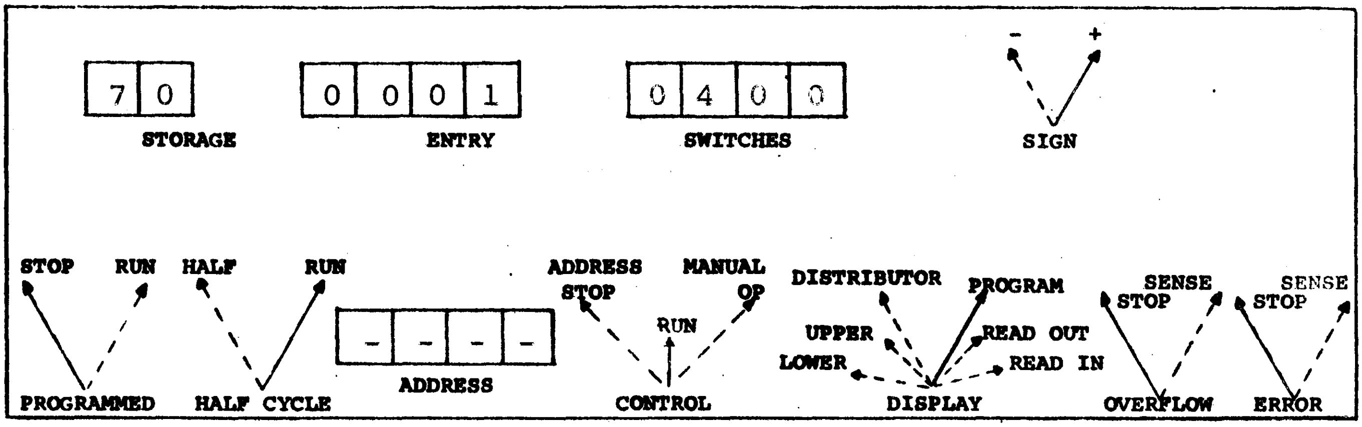
Program Stops and Required Action:

Stop D-Address	Message-Explanation-Action
0001	Beam No. not in agreement with other beam numbers
0004	
0007	
0010	on one data sheet (cc 1).
0002	Point No. (cc 2-3) not in order or wrong. Check
0005	
0009	
0012	data sheet.
0003	Wrong length of Bridge. Length of 2 end spans plus
	length of "x" interior spans does not equal the
	length of bridge. Inform designer. x = 0 for 2 span
	1 for 3 span
	2 for 4 span
	3 for 5 span
0006	cc 4-10 not in agreement with other cards on this
0008	
0011	data sheet

Program No. 32017
Page 1 of 2

7 Per Card Deck

650 PROGRAM LOADING INSTRUCTIONS

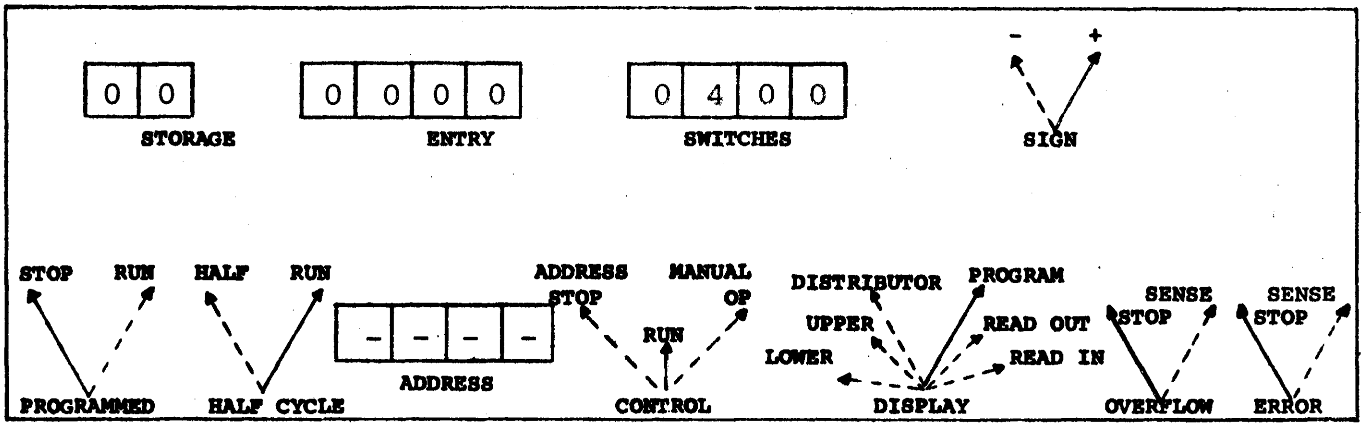

STORAGE 7 0
ENTRY 0 0 0 1
SWITCHES 0 4 0 0
ADDRESS - - - -

1. Initial Console Setting as shown above.
2. Starting Procedure: Computer Reset, Program Start.
3. Special Instructions: Place data cards behind the program deck. Push END OF FILE after last card goes in.

   To restart or run another bridge, see below.

   Sort header cards with input and output on cols. 1, 3, 2. List on 407 board, Board No. 7, SW. 1 on. Save header cards. Use wide paper.

650 PROGRAM OPERATING INSTRUCTIONS


STORAGE 0 0
ENTRY 0 0 0 0
SWITCHES 0 4 0 0
ADDRESS - - - -

1. Console Setting Shown Above.
2. Starting Procedure: Computer Reset, Program Start
   Punch Feed 5081
   Control Panels No. 2
3. Special Instructions:

OPERATING INSTRUCTIONS, cont'd

Program No. 32017
Page 2 of 2

Other Instructions and Remarks:

Program Stops and Required Action:

Stop D-Address	Message-Explanation-Action
0001	Type 00 (cc 2-3) not first. Arrange cards as shown on the data sheet cc 1-10.
0002	Different Beam No. (cc 1) in one group of data. Arrange cards as shown on the data sheet.
0003	Second card does not have 09 in cc 2-3. Arrange cards as shown on data sheets.
0004	County No., Design No. and Run No. (cc 4-10) not in agreement with the other cards from the same data sheet. Check cards with data sheet.
0005	Not a 2, 3, 4 or 5 span bridge.

533 Board Wiring List

READ C and PUNCH C

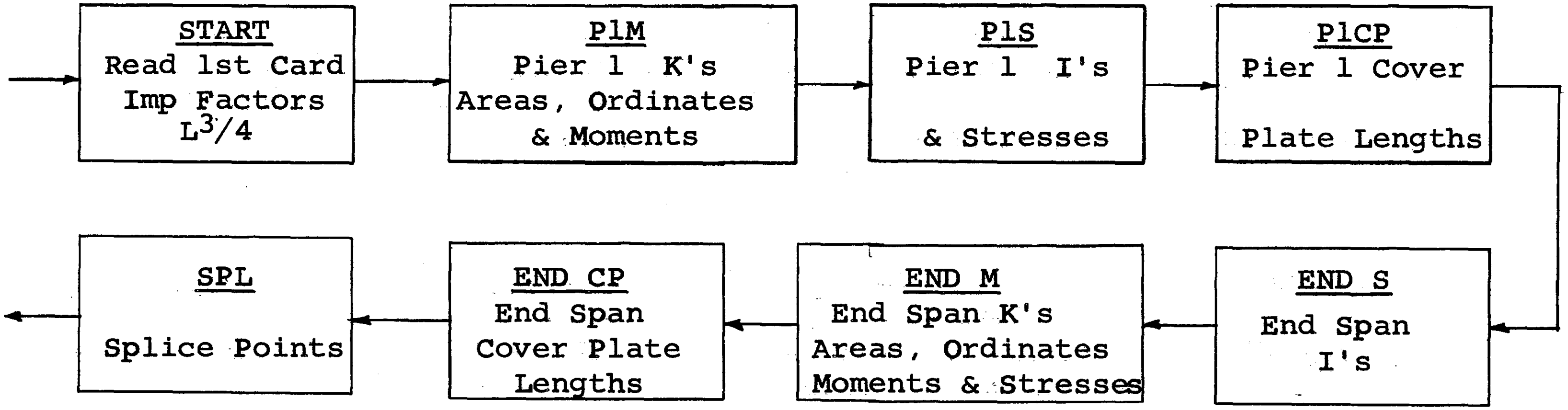
cc	1-10	to	Word 1	Pos	10-1
cc	11-16	to	Word 2	Pos	6-1
cc	17-22	to	Word 3	Pos	6-1
cc	23-28	to	Word 4	Pos	6-1
cc	29-34	to	Word 5	Pos	6-1
cc	35-40	to	Word 6	Pos	6-1
cc	41-50	to	Word 7	Pos	10-1
cc	51-60	to	Word 8	Pos	10-1
cc	61-70	to	Word 9	Pos	10-1
cc	71-80	to	Word 10	Pos	10-1

Plug RSU & PSU

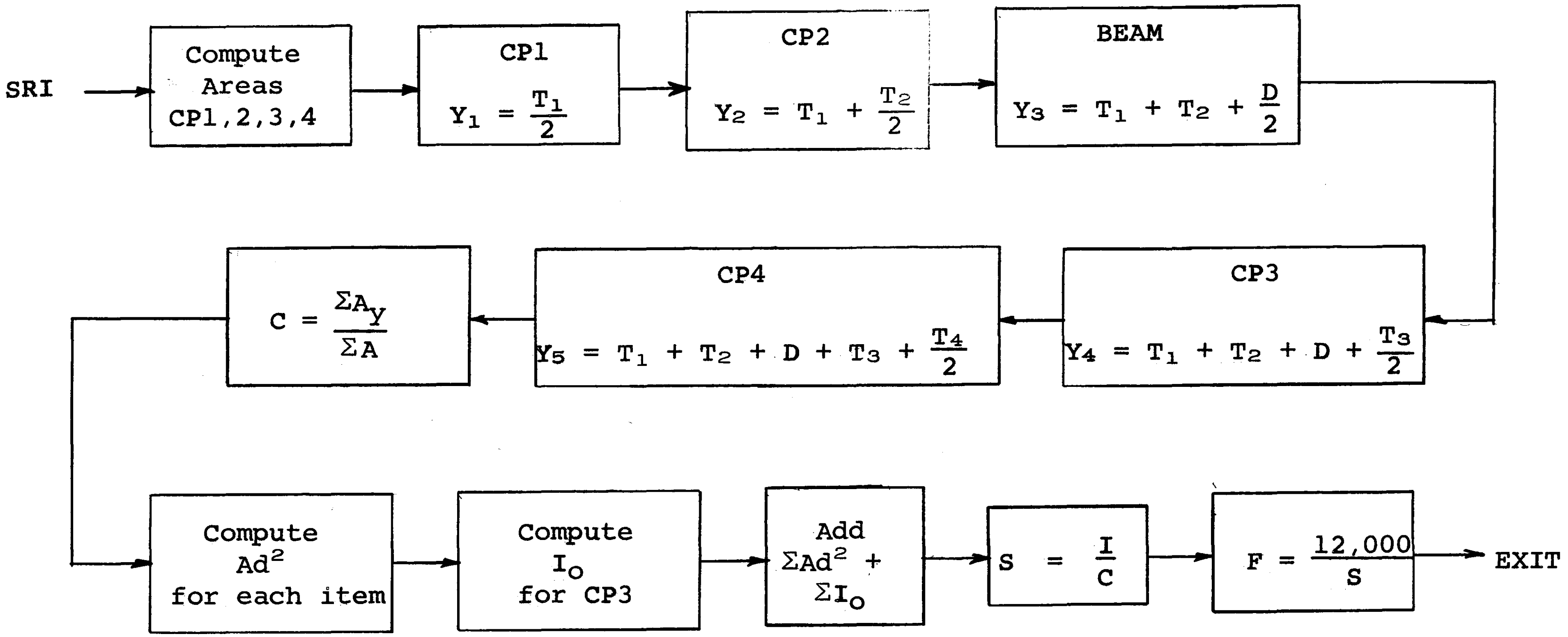
Word size emitter:
10 to Read C word 1, 7, 8, 9 & 10
6 to Read C word 2, 3, 4, 5 & 6

First Read Col 1 to Load

GENERAL FLOW DIAGRAM (2 SPAN)



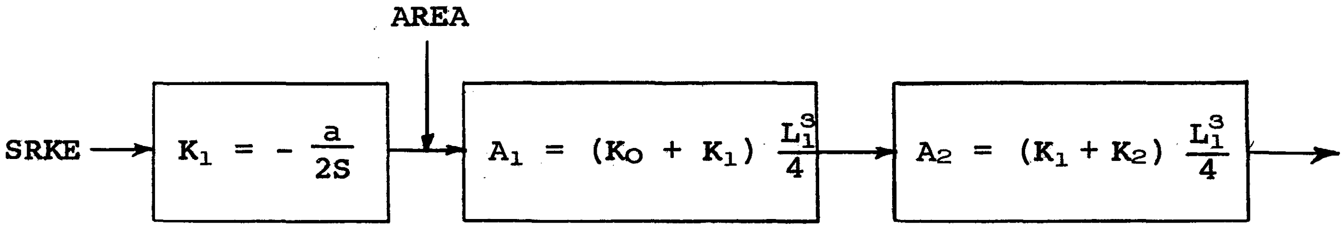
I SUB ROUTINE



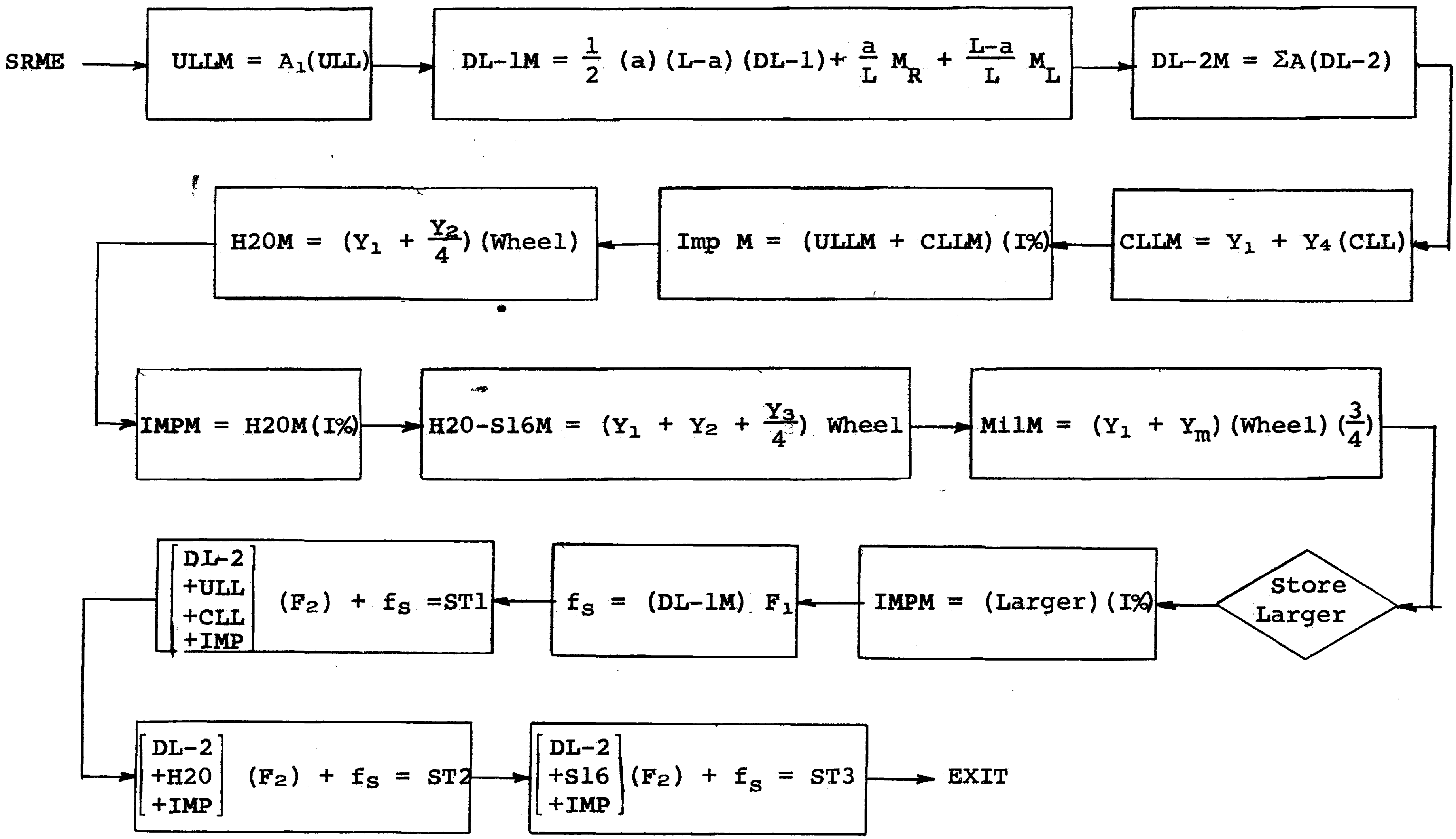
Note: Set CP1W CP1T
CP2W CP2T
CP3W CP3T
CP4W CP4T
EXIT Instruction in Distributor

END SPAN K FACTORS

Sub Routine SRKE
Sub Routine AREA



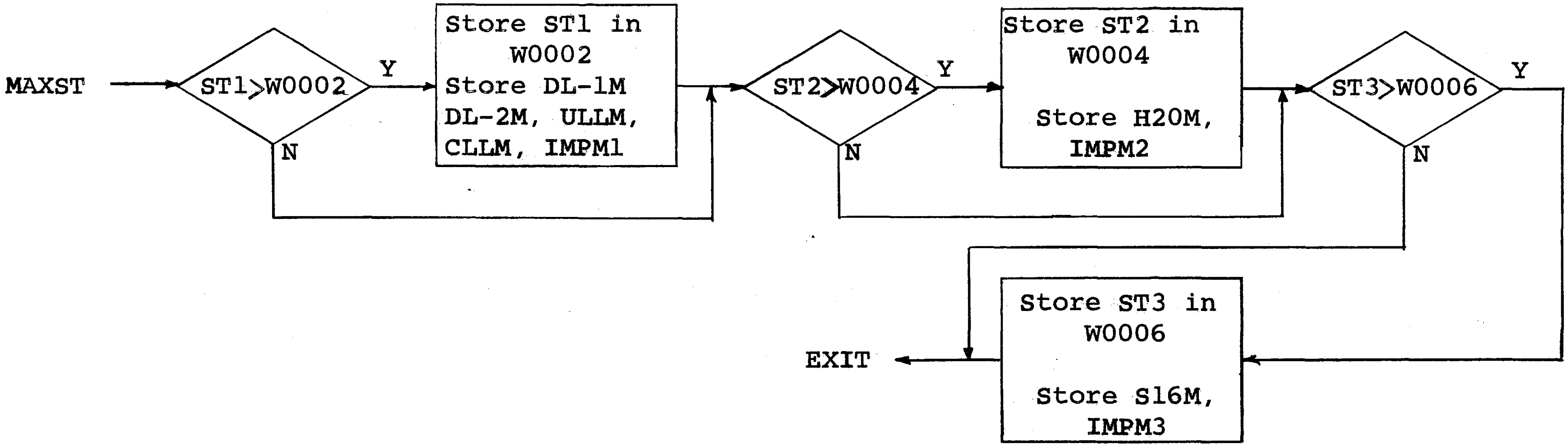
MOMENT SUB ROUTINE



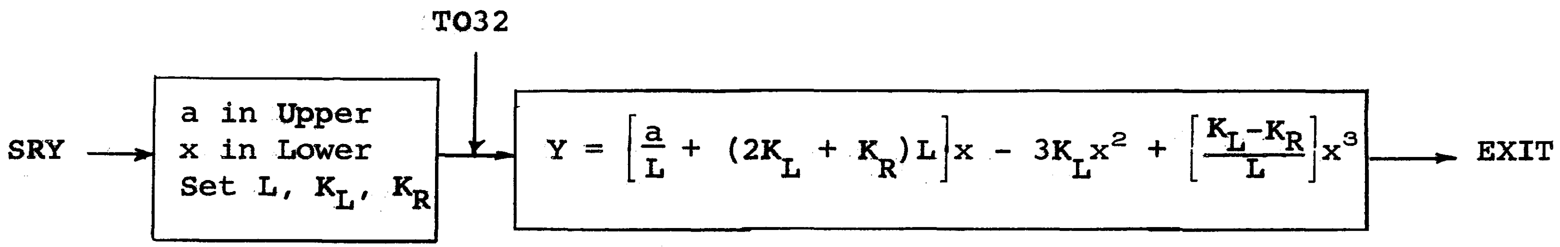
Note: M_R in Lower
M_L in Upper
Exit in Dist.

Fix A, L, IMP, Y_4

MAXIMUM STRESS SUB ROUTINE

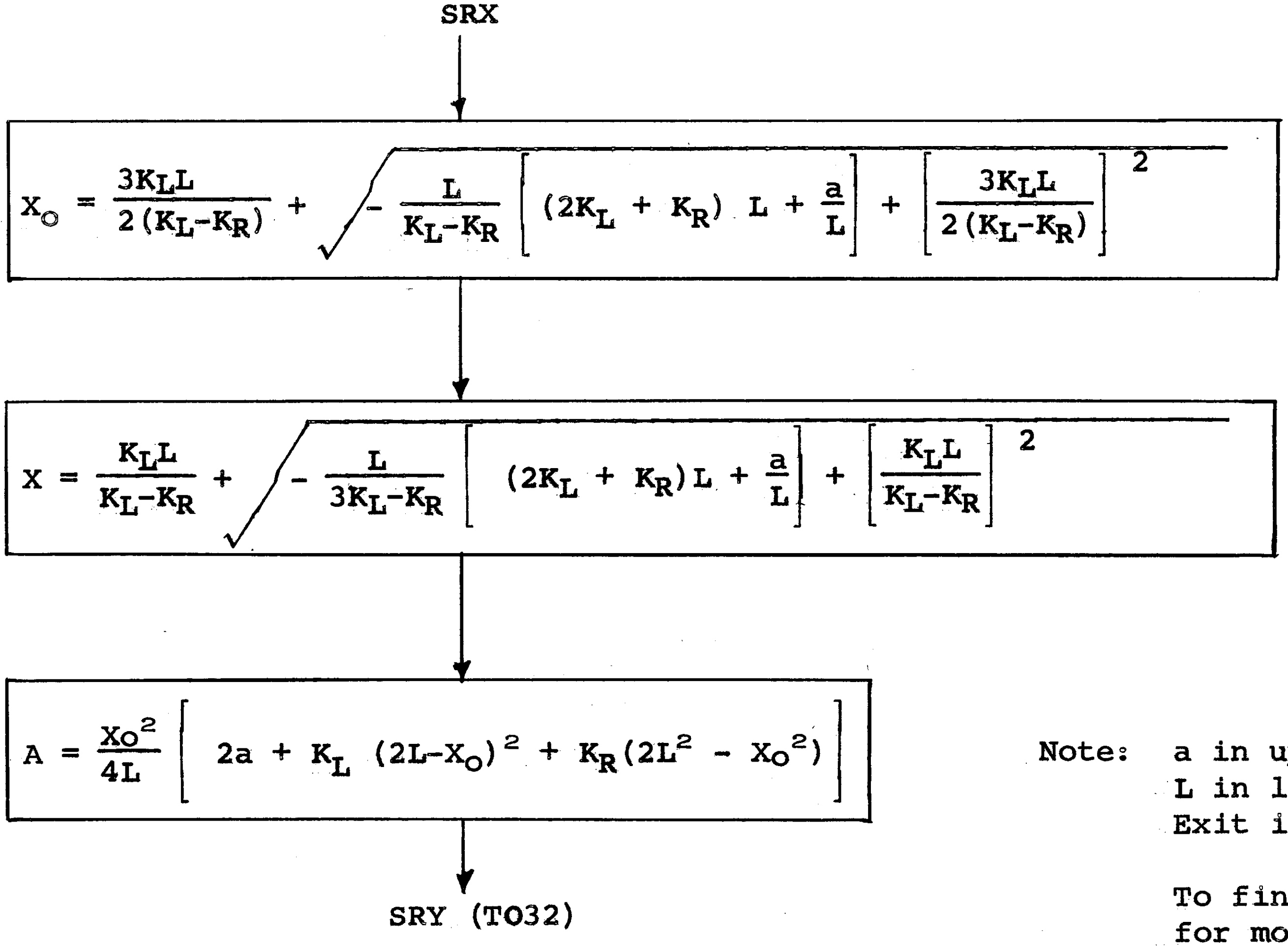


Y SUB ROUTINE



Note: When the first term of the equation contains L-a instead of a, substitute L-a for a. When the equation does not contain the first term, make a equal to 0.

X SUB ROUTINE



$$X_o = \frac{3K_L L}{2(K_L-K_R)} + \sqrt{-\frac{L}{K_L-K_R}\left[(2K_L + K_R)\ L + \frac{a}{L}\right] + \left[\frac{3K_L L}{2(K_L-K_R)}\right]^2}$$

$$X = \frac{K_L L}{K_L-K_R} + \sqrt{-\frac{L}{3K_L-K_R}\left[(2K_L + K_R)L + \frac{a}{L}\right] + \left[\frac{K_L L}{K_L-K_R}\right]^2}$$

$$A = \frac{Xo^2}{4L}\left[2a + K_L\ (2L-X_o)^2 + K_R(2L^2 - Xo^2)\right]$$

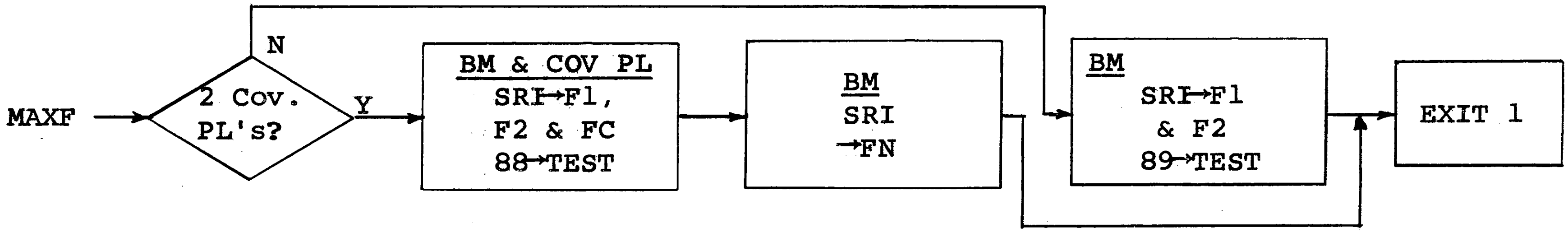
Note: a in upper
L in lower
Exit in Distributor

To find X max only
for moment at the pier
put 0 in a

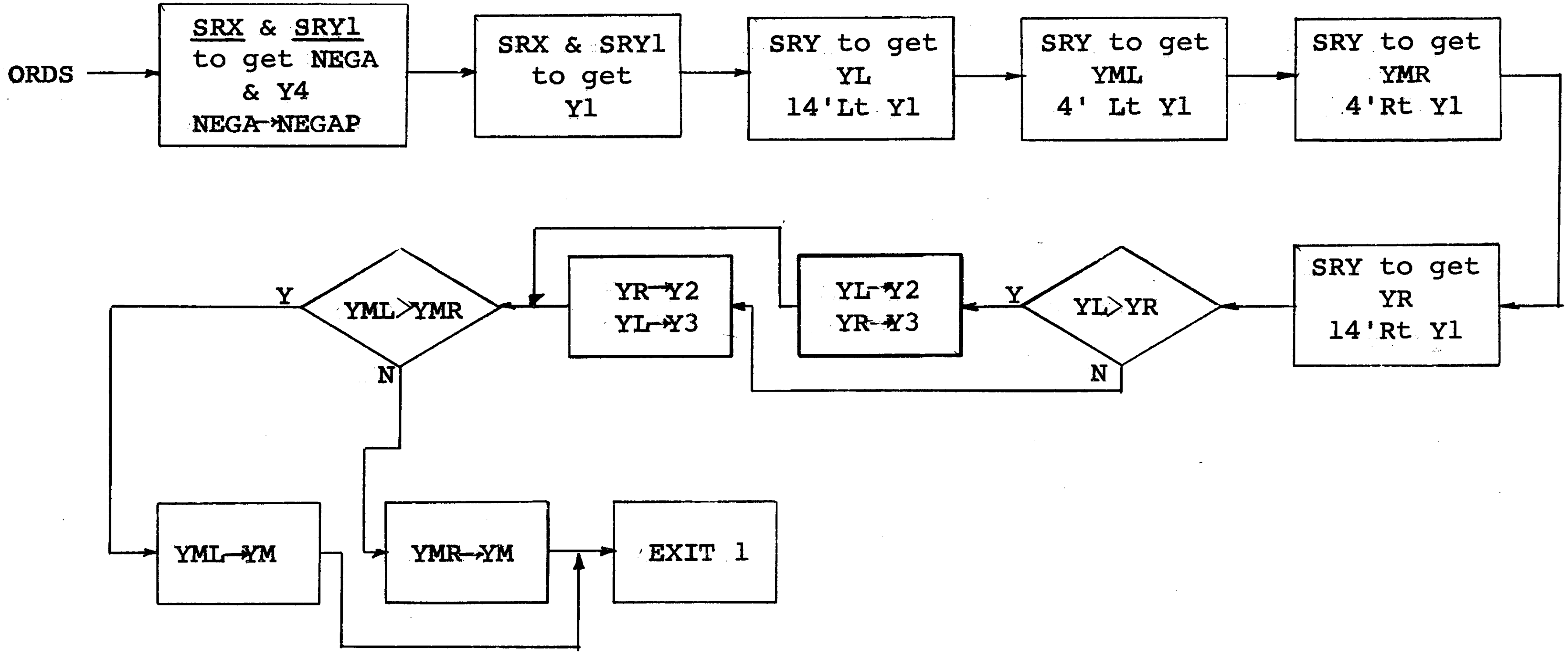
Partial Area is in NEGA

Y is in lower (from SRY)

MAXF Exit 1 in distrib.

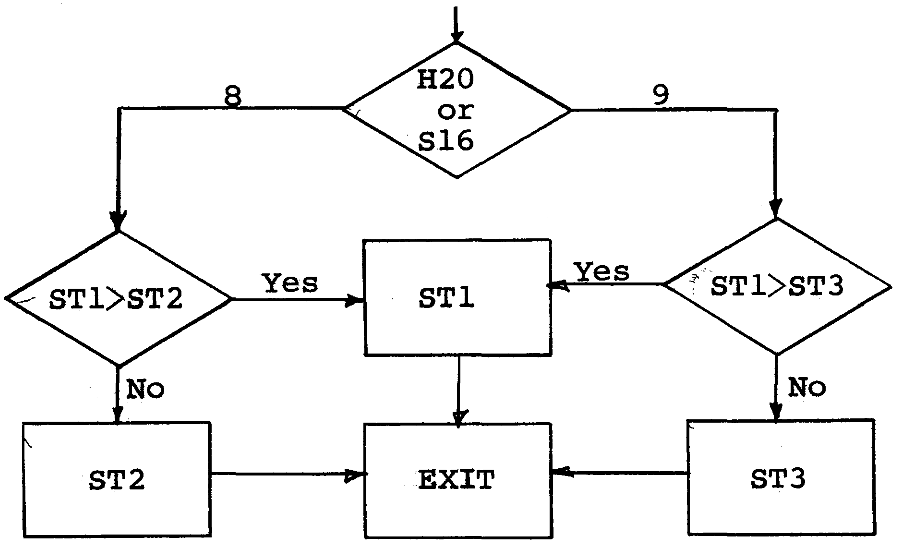


ORDS Exit 1 in distrib.

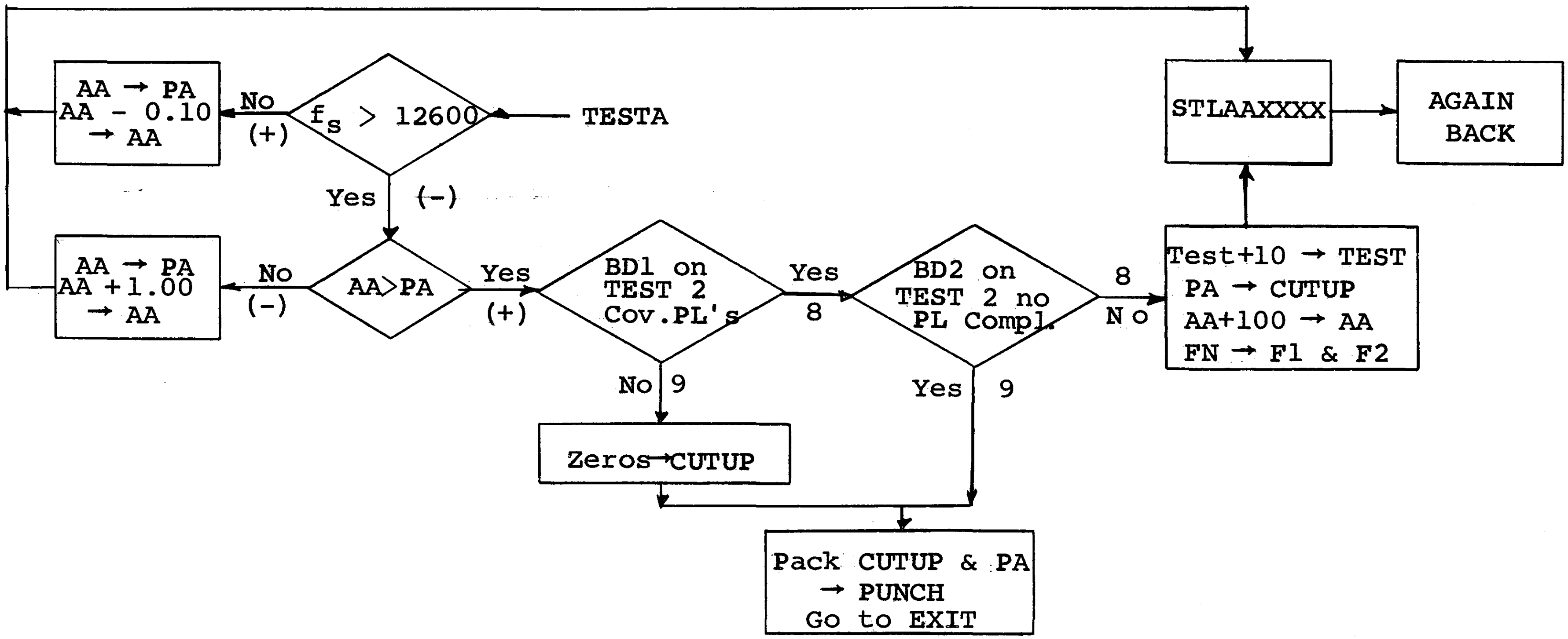


Note: Fix KL, KR, KNEX, A, L & L1 (adjacent L)

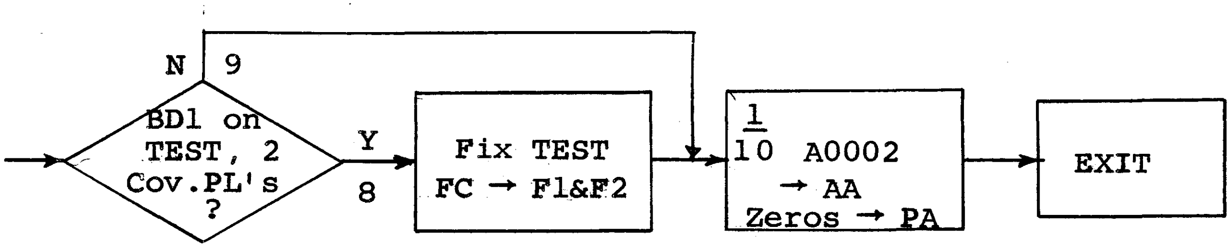
TOPST Exit in distributor



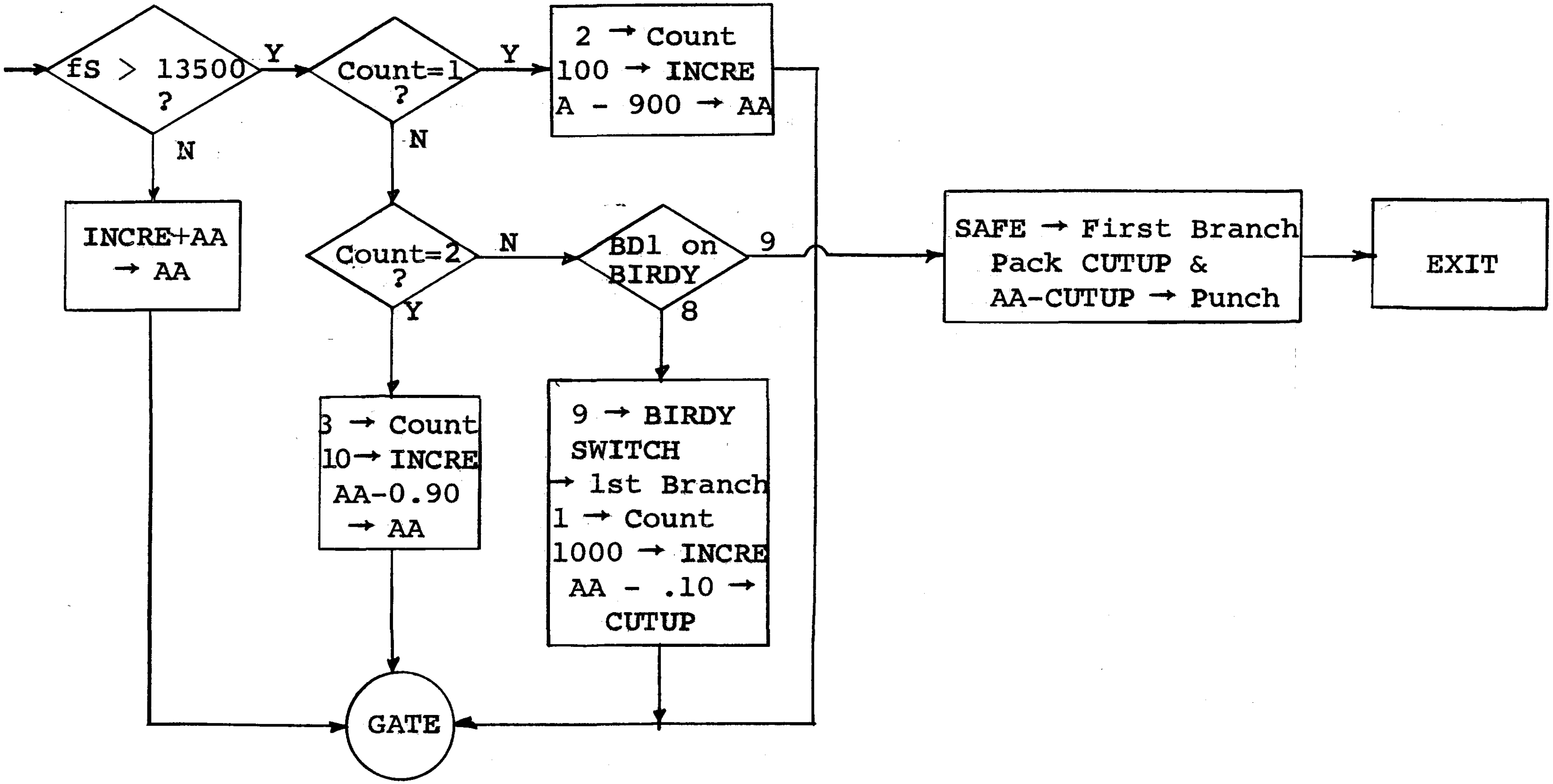
TESTA Exit in distributor. Max Stress in lower

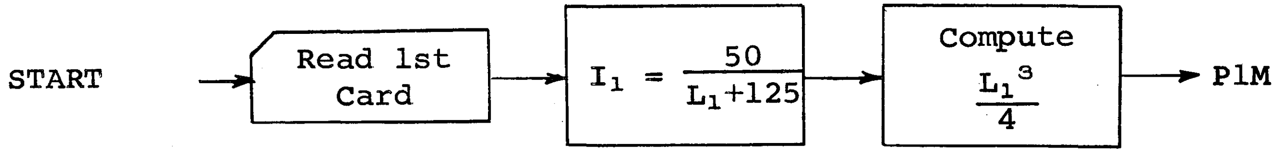


CYCLE   Exit in distrib.

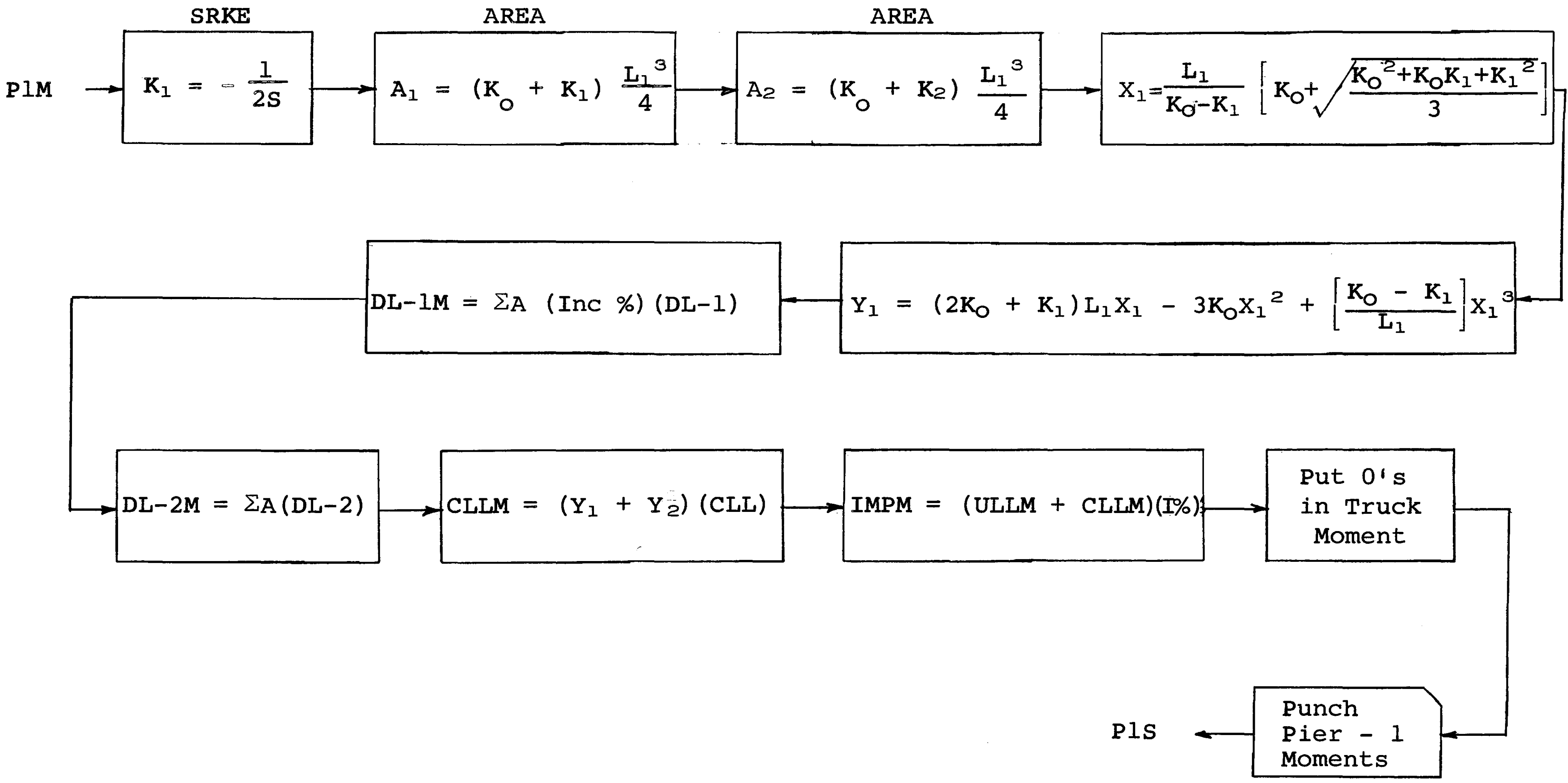


TEST B   1 → COUNT, 1000 → INCRE → AA, 8 → BIRDY   MAXST in lower, EXIT → distrib.

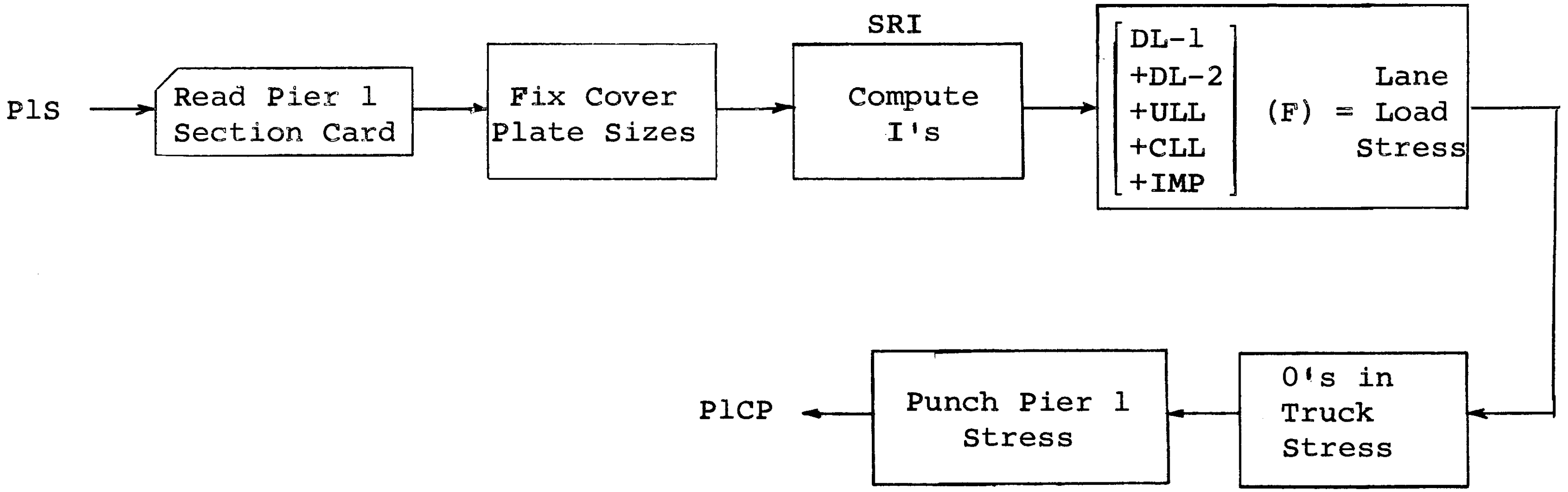



START
Read 1st Card
$I_1 = \frac{50}{L_1+125}$
Compute $\frac{L_1^3}{4}$
P1M

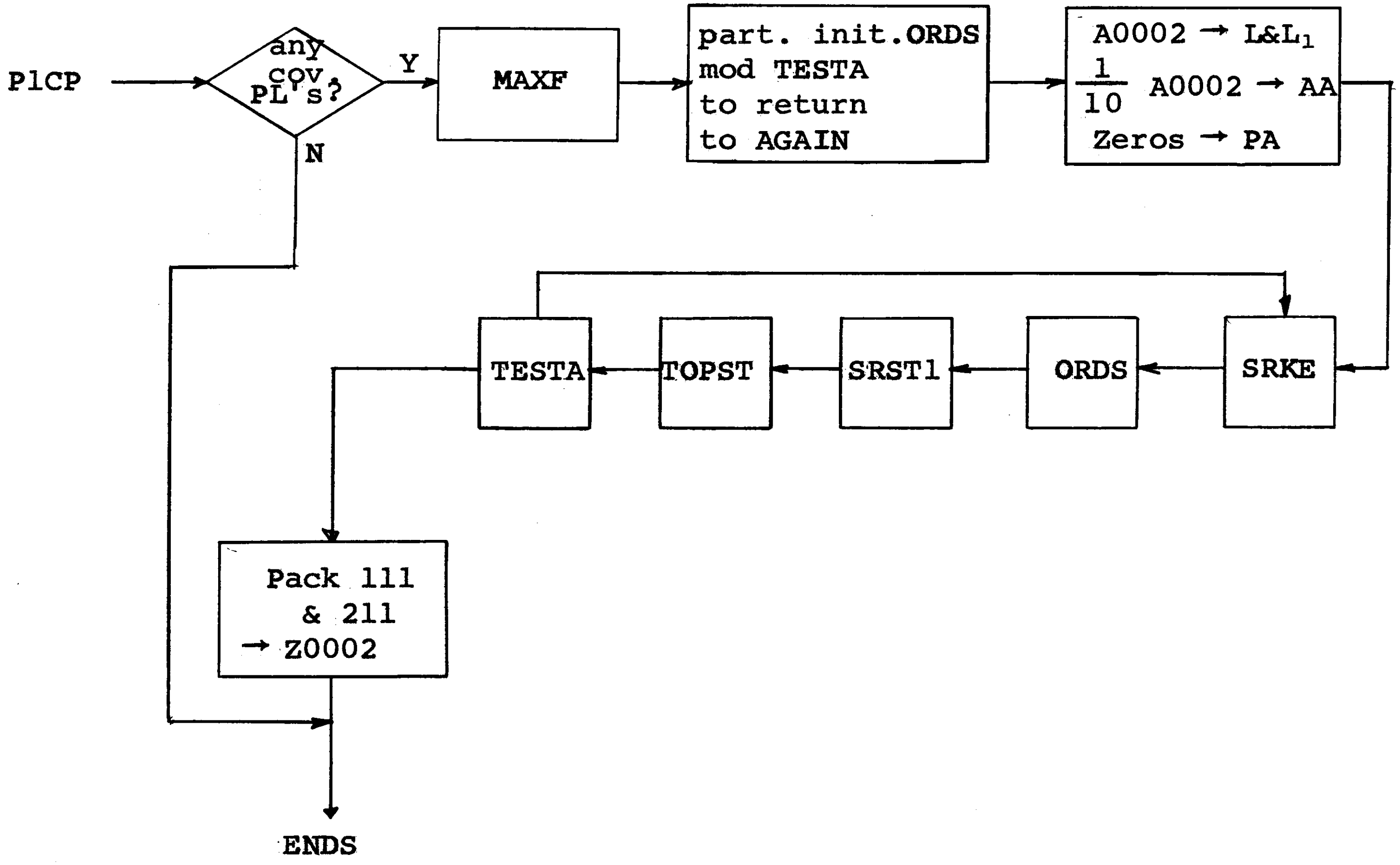
PIER 1 MOMENTS



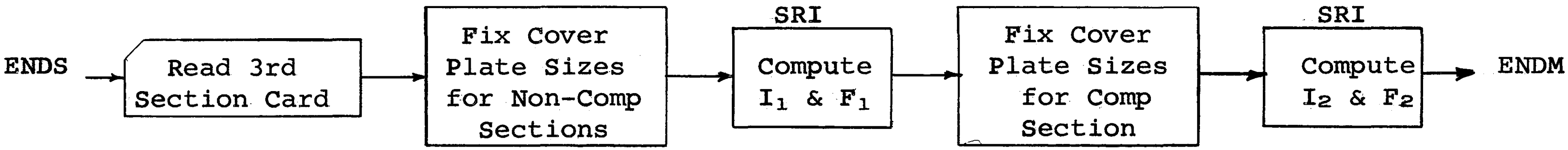
PIER 1 STRESS



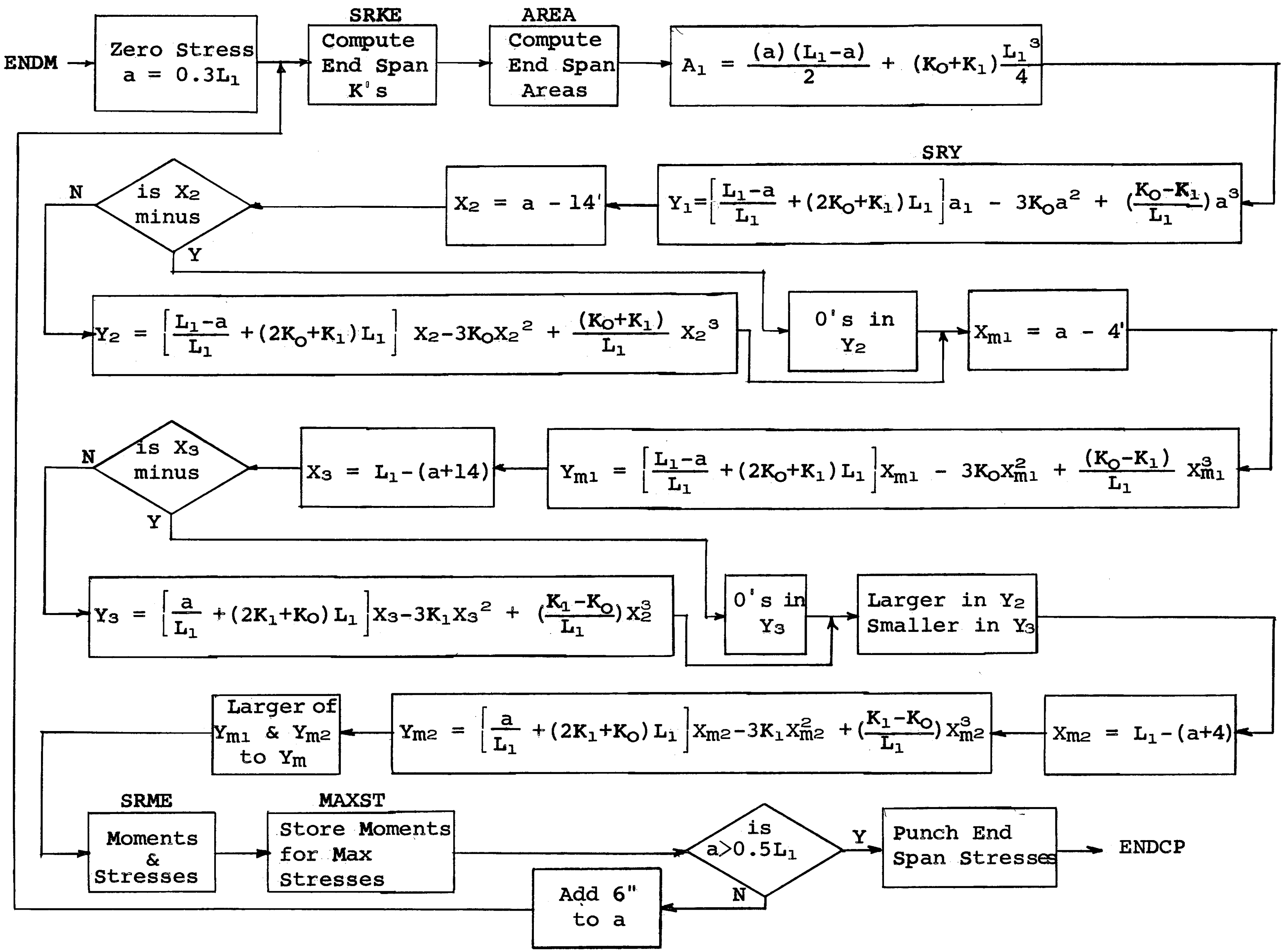
PIER 1 COVER PLATE LENGTHS



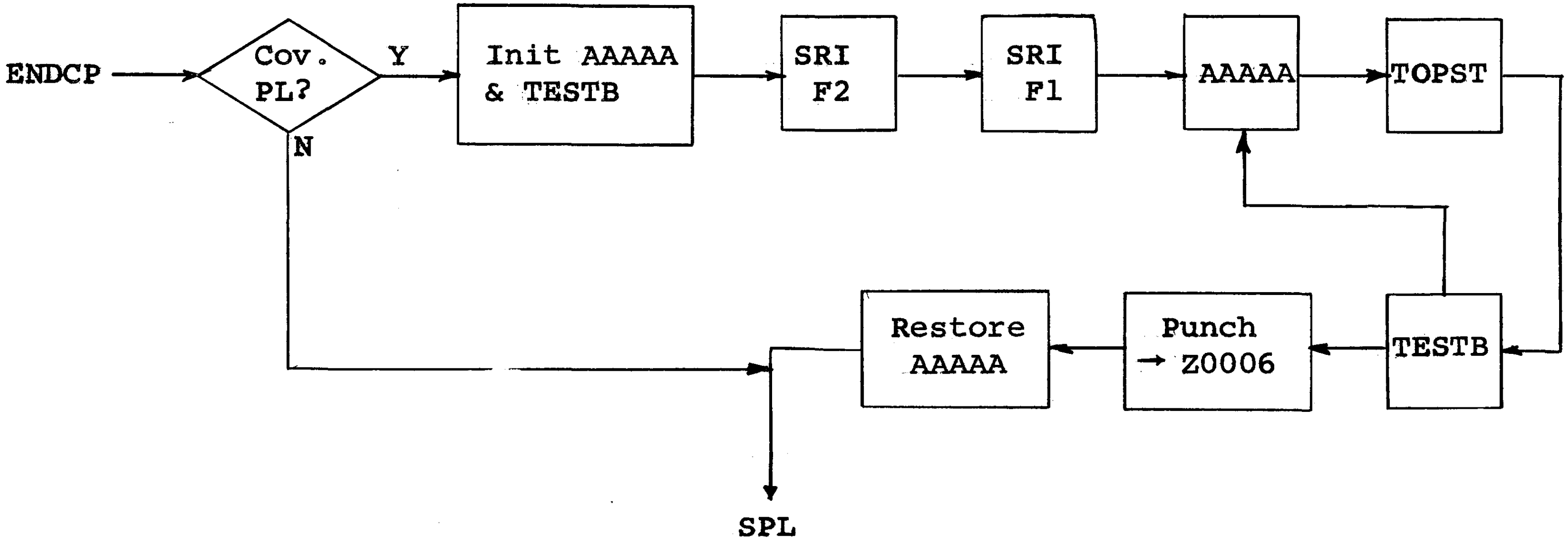
END SPAN SECTION PROPERTIES



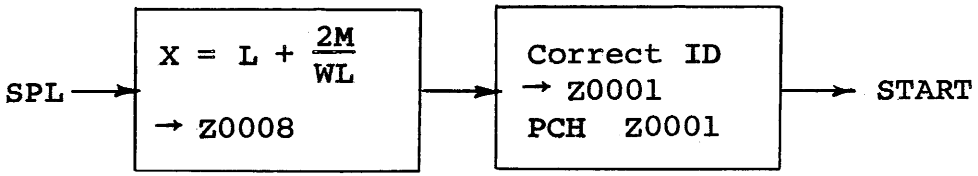
END SPAN MOMENTS



END SPAN COVER PLATE LENGTHS



SPLICE POINTS



WORD LAYOUT FORM

650 MAGNETIC-DRUM DATA-PROCESSING MACHINE

PROGRAM NO. 32012

A0001	A0002	A0003	A0004	A0005	A0006	A0007	A0008	A0009	A0010
BEAM Point No. County Design No. Run	Length of End Span	Zeros	Length of Bridge	Dead Load-1	Dead Load-2	Uniform Live Load	Conc. Live Load for Moment	Truck Wheel	0 — 0 8 H20 9 H20-S16 Pier-1 Incr. 0 — 0

B0001	B0002	B0003	B0004	B0005	B0006	B0007	B0008	B0009	B0010
BEAM Point No. County Design No. Run	Beam Area	Beam Depth	Beam I	Concrete Width	Concrete Thickness	N	Width Thickness Cover Plate-1	Width Thickness Cover Plate-2	H

P0001	P0002	P0003	P0004	P0005	P0006	P0007	P0008	P0009	P0010
BEAM Point No. County Design No. Run	DL-1 Moment Lane Stress	DL-2 Moment 0———0	ULL Moment 0———0	CLL Moment 0———0	Imp. Moment 0———0	H20 Moment 0———0	Imp. Moment 0———0	H20-S16 Moment 0———0	Imp. Moment 0———0

W0001	W0002	W0003	W0004	W0005	W0006	W0007	W0008	W0009	W0010
BEAM Point No. County Design No. Run	Lane Stress		H20 Stress		H20 S16 Stress				

X0001	X0002	X0003	X0004	X0005	X0006	X0007	X0008	X0009	X0010
BEAM Point No. County Design No. Run	DL-1 Moment	DL-2 Moment	ULL Moment	CLL Moment	Imp Moment				

Z0001	Z0002	Z0003	Z0004	Z0005	Z0006	Z0007	Z0008	Z0009	Z0010
BEAM Point No. County Design No. Run	111 211				D14 L14		S11		

SYMBOL TABLE 32012

SYMBOL	LOCATION	DESCRIPTION
01	0108	CONSTANT
03	0258	CONSTANT
10	0900	CONSTANT
100	0850	CONSTANT
1000	0174	CONSTANT
12	0082	CONSTANT
125	1060	CONSTANT
126HU	0659	CONSTANT
135HU	0709	CONSTANT
14	0124	CONSTANT
15	1400	CONSTANT
19	1450	CONSTANT
2	0226	CONSTANT
24	1500	CONSTANT
25	0148	CONSTANT
3	0096	CONSTANT
4	0192	CONSTANT
4HUN	0694	CONSTANT
5	0074	CONSTANT
5BILL	0363	CONSTANT
6	1300	CONSTANT
61	0158	CONSTANT
63	0308	CONSTANT
75	0090	CONSTANT
8	1050	CONSTANT
800	0224	CONSTANT
81	0386	CONSTANT
83	0486	CONSTANT
88	0154	CONSTANT
89	0548	CONSTANT
9	1350	CONSTANT
90	0394	CONSTANT
900	0344	CONSTANT
98	0380	CONSTANT
A	0510	Distance to point of influence line for sub routine xx.xx
A1	0147	AREA under the influence line for Span 0-1 xxxx.xx
A2	0205	AREA under the influence line for Span 1-2 xxxx.xx
AA	0086	Working Storage for A xx.xx
AAAAA	1689	TRANSFER Control
AGAIN	1347	Start of Pier 1 Cov. PL loop
AREA	0142	Start of Area Sub Routine
BIRDY	0960	Storage for 8's or 9's for BDn branch instructions

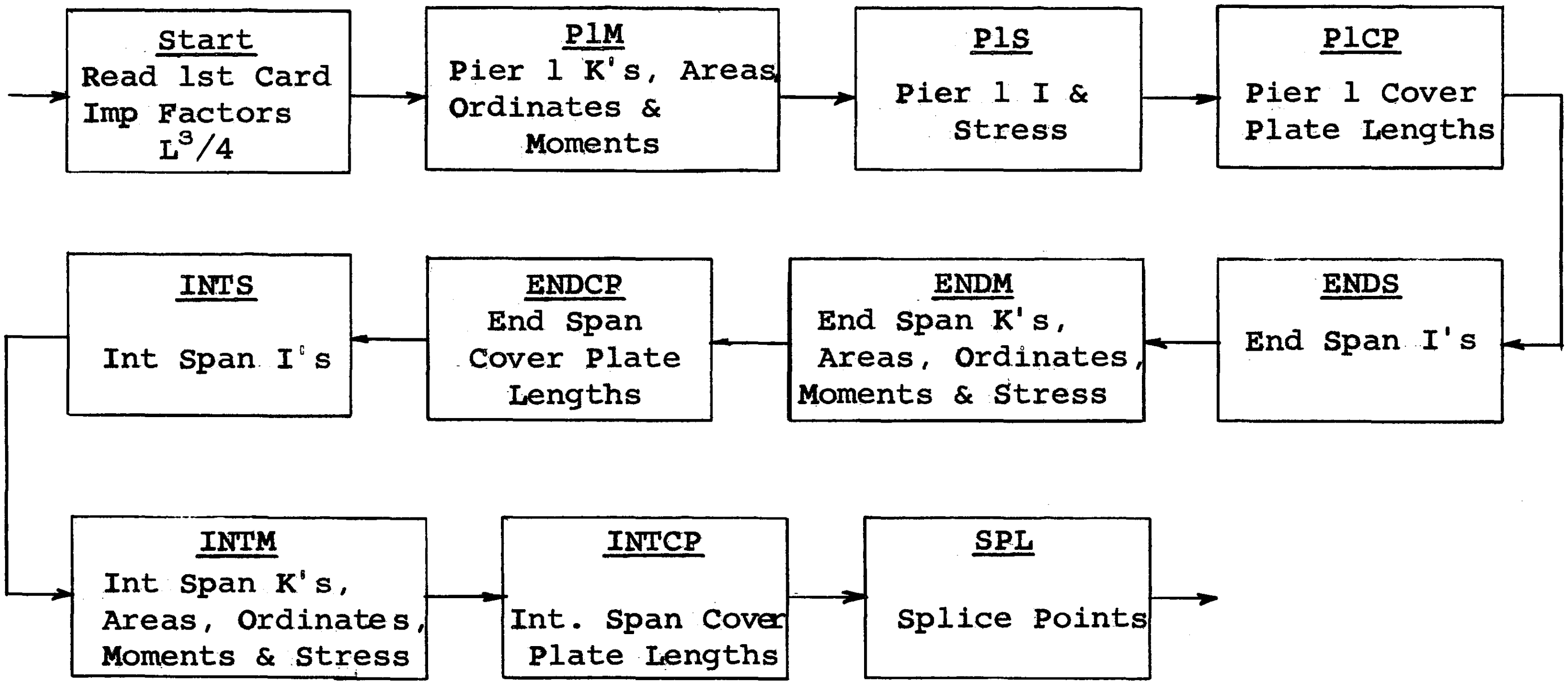
SYMBOL	LOCATION	DESCRIPTION
BMNO	0616	BEAM Number x
CLLM	0595	Concentrated Live Load Moment xxxx.xx
COUNT	0220	Control for modification of Positive Mom. Cover Plate Loop
CP1A	0103	Cover Plate 1 Area xx.xx
CP1T	0066	Cover Plate 1 Thickness xx.xxx
CP1W	0059	Cover Plate 1 Width xx.xxx
CP2A	0153	Cover Plate 2 Area xx.xx
CP2T	0116	Cover Plate 2 Thickness xx.xxx
CP2W	0109	Cover Plate 2 Width xx.xxx
CP3A	0203	Cover Plate 3 Area xx.xx
CP3T	0166	Cover Plate 3 Thickness xx.xxx
CP3W	0159	Cover Plate 3 Width xx.xxx
CP4A	0253	Cover Plate 4 Area xx.xx
CP4T	0216	Cover Plate 4 Thickness xx.xxx
CP4W	0209	Cover Plate 4 Width xx.xxx
CUTUP	0274	Storage of intermediate results for pier cover plate cutoffs xx.xx
DESN	1193	Design Number xxxxxxx
DL1M	0915	Dead Load 1 Moment xxxx.xx
DL2M	0643	Dead Load 2 Moment xxxx.xx
ENDCP	1377	Start of End Span Cover Plate Computation
ENDM	1345	Start of End Span Moment Computation
ENDS	1167	Start of End Span Section Properties Computation
EXIT	0053	Storage of Exit Instruction for Sub Routines
EXIT1	0407	Storage of Exit Instruction for Sub Routines
EXIT2	0803	Storage of Exit Instruction for Sub Routines
EXITA	0280	Instruction to modify ENDM for use in ENDCP
F1	0072	Mom. of Inertia factor for computing Dead Load 1 stress xx.xx
F2	0242	Mom. of Inertia factor for computing Dead Load 2 stress xx.xx
FC	0498	Current mom. of inertia factor xx.xx
FIFTY	0058	CONSTANT
FN	0971	Next mom. of inertia factor xx.xx
GATE	0999	Variable exit from sub routine TESTB
H20M	0695	H20 Moment xxxx.xx
IMP	0550	Percent of Impact .xxx
IMPM1	0535	Lane Load Impact Moment xxxx.xx
IMPM2	0635	H20 Impact Moment xxxx.xx
IMPM3	0829	H20-S16 Impact Moment xxxx.xx
INC1	0444	Increase factor for influence line areas for Dead Load 1 x.xxx

SYMBOL	LOCATION	DESCRIPTION
INCRE	0294	Increase in trial distance for location of cov. PL cutoff x.xx
K1	0389	Pier 1 K factor .xxxxxxx
KL	0513	Left K factor used in sub routines .xxxxxxx
KR	0176	Right K factor used in sub routines .xxxxxxx
L	0078	Length of span used in sub routines xxx.xx
L134	0104	$L_1^3/4$ xxxxxx.xx
MAXF	0650	Start of sub routine to determine F1 & F2
MAXST	0600	Start of sub routine to determine maximum stress
MDFY1	0472	Instruction to modify TESTA
MDFY5	1673	Instruction to modify TESTB
NEGA	0765	Negative Area of influence lines
NEGAP	0266	Negative Area of influence line for partially loaded span
ONE	0128	CONSTANT
ONEM	0434	CONSTANT
ORDS	0700	Start of sub routine to compute influence line ordinates
P1CP	1277	Start of Pier 1 Cover Plate Computation
P1M	0907	Start of Pier 1 Moment Computation
P1S	1177	Start of Pier 1 Section Properties Computation
PA	0244	Previous distance A xx.xx
PCHEM	0944	Punch End Span Moments
PUNCH	1289	Storage for packed cover plate lengths in sub routine TESTB
S16M	0845	H20-S16 Moment xxxx.xx
SAFE	1623	Storage for original instr. in sub routine SRME which is modified for other sub rout.
SAVE	0596	Storage for L - A xx.xx
SKIP1	1317	Synonymous to Transfer instruction T012
SPL	1367	Start of Splice Point Computation
SQRT	0150	Start of Square Root Sub Routine
SRI	0100	Start of Moment of Inertia Sub Routine
SRKE	0200	Start of End Span K-factor Sub Routine
SRME	0450	Start of End Span moment sub routine
SRSET	1000	Start of sub routine to initialize TESTB and get F1 & F2
SRST1	0500	Start of moment sub routine for cover plate cutoffs
SRX	0350	Start of distance sub routine
SRY	0300	Start of Ordinate Computation Sub Routine
ST1	0989	Lane Load Stress xxxxx
ST2	1089	H20 Stress xxxxx
ST3	1139	H20-S16 Stress xxxxx
START	0050	Start of Program
STOP1	1287	STOP

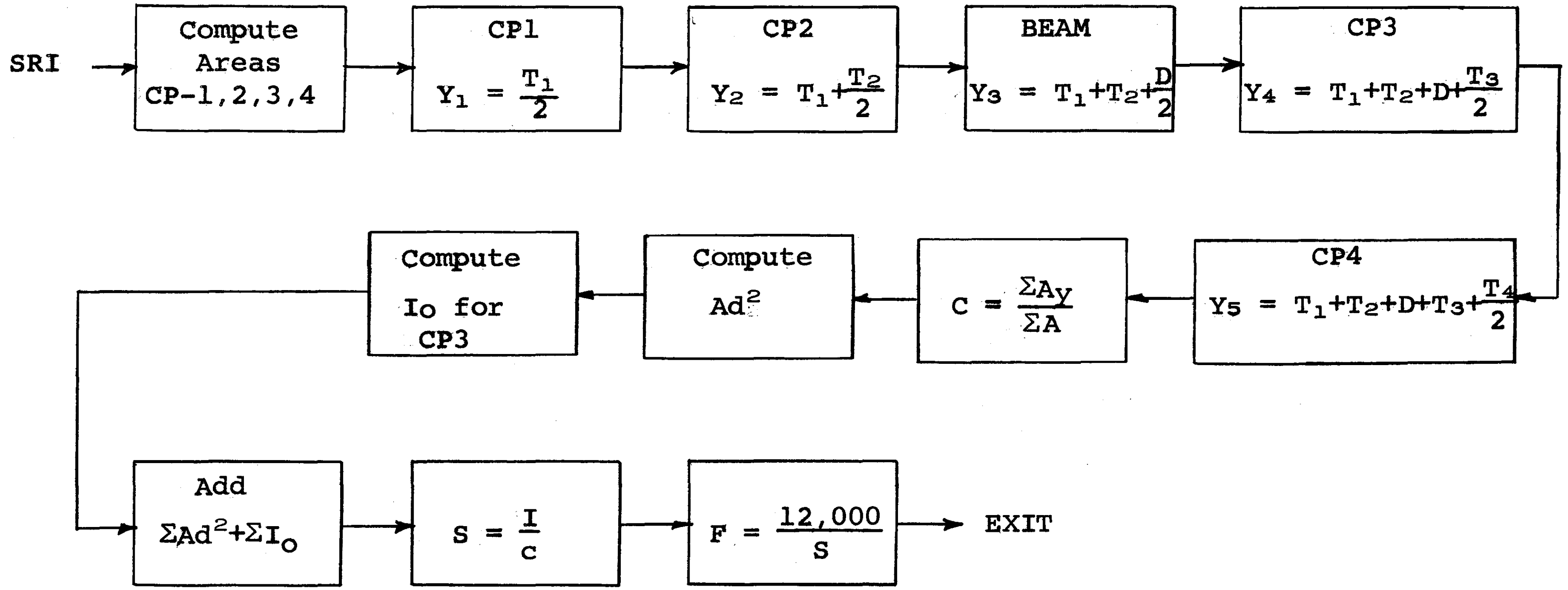
SYMBOL	LOCATION	DESCRIPTION
STOP2	0925	STOP
STOP3	1195	STOP
STOP4	1100	STOP
STOP6	1295	STOP
STOP8	0362	STOP
SUMAY	0085	Summation of Area times the distance from the centroid xx.xx
SWTCH	0825	Instruction to reverse branch instruction TO65
TEMP1	0057	Temporary Storage
TEMP2	0131	Temporary Storage
TEMP3	0188	Temporary Storage
TEMP4	0076	Temporary Storage
TEMP5	0126	Temporary Storage
TEMP6	0061	Temporary Storage
TEST	0960	Equivalent to BIRDY
TESTA	0800	Beginning of sub routine to control transfer for cov. PL cutoff at Pier 1
TESTB	0950	Beginning of sub routine to control transfer for cov. PL cutoff in Span 0-1
TO1	0343	Transfer Control
TO10	0214	Transfer Control
TO12	1317	Transfer Control
TO2	0285	Transfer Control
TO3	0301	Transfer Control
TO30	0136	Transfer Control
TO31	0538	Transfer Control
TO32	0070	Transfer Control
TO33	1253	Transfer Control
TO34	1059	Transfer Control
TO4	0052	Transfer Control
TO5	1733	Transfer Control
TO50	0817	Transfer Control
TO51	0168	Transfer Control
TO53	1015	Transfer Control
TO54	0849	Transfer Control
TO55	0268	Transfer Control
TO56	0847	Transfer Control
TO57	0366	Transfer Control
TO58	0152	Transfer Control
TO59	0655	Transfer Control
TO6	0644	Transfer Control
TO60	0318	Transfer Control
TO62	1187	Transfer Control
TO63	1237	Transfer Control
TO64	0270	Transfer Control
TO65	1213	Transfer Control
TO66	0416	Transfer Control

SYMBOL	LOCATION	DESCRIPTION
TO67	0727	Transfer Control
TO68	1017	Transfer Control
TO69	0194	Transfer Control
TO7	1933	Transfer Control
TO8	0744	Transfer Control
TO9	1199	Transfer Control
TOPST	0750	Beginning of sub routine to pick largest stress of Lane, H or HS truck load
ULLM	0593	Uniform Live Load Moment xxxx.xx
VAULT	0919	Storage location for branch instr. TO65 while modified by SWTCH
X	0267	Distance to required Ordinate xx.xx
XO	0347	Distance to Zero Ordinate xx.xx
Y1	0599	Maximum ordinate xx.xx
Y2	0341	Second Truck Ordinate or adjacent span ordinate for Pier Moment xx.xx
Y3	0441	Third Truck ordinate xx.xx
Y4	0556	Span 2 ordinate for cover plate lengths xx.xx
YM	0606	Military Load Ordinate xx.xx

GENERAL FLOW DIAGRAM (3 SPAN)



I - SUB ROUTINE

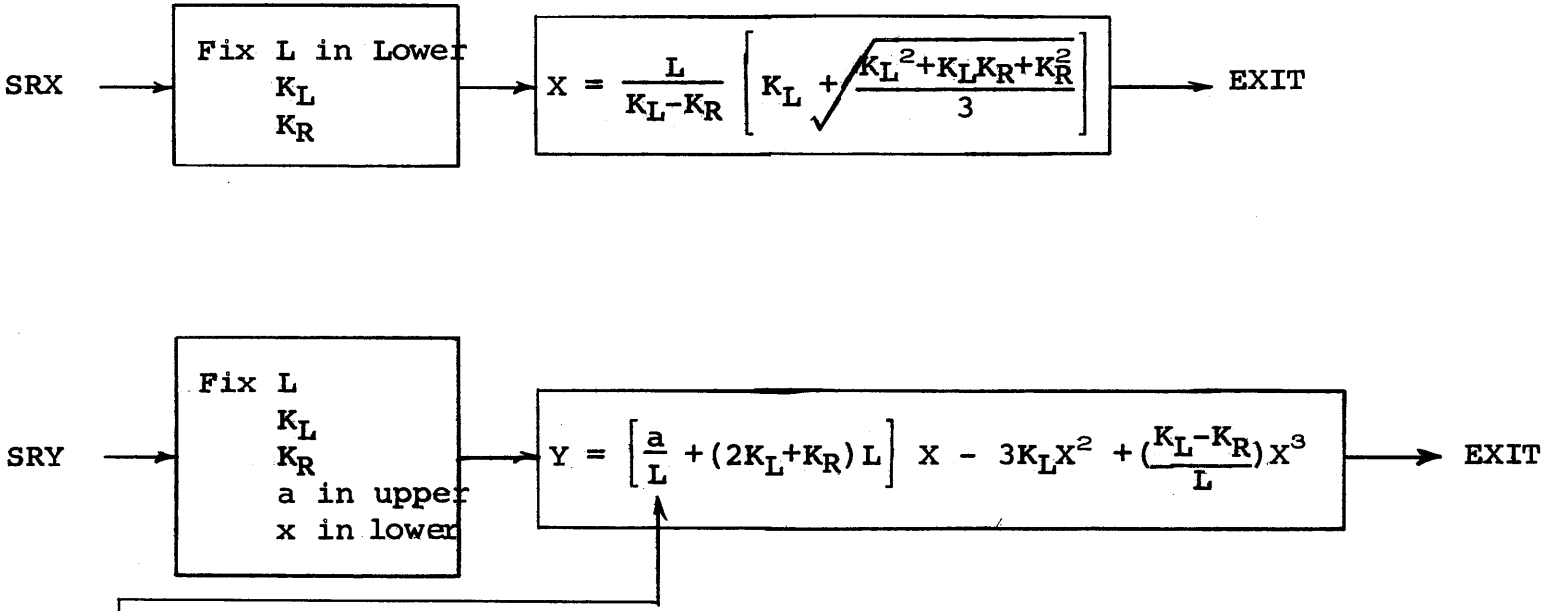


Note: Set

CP1W	CP1T
CP2W	CP2T
CP3W	CP3T
CP4W	CP4T

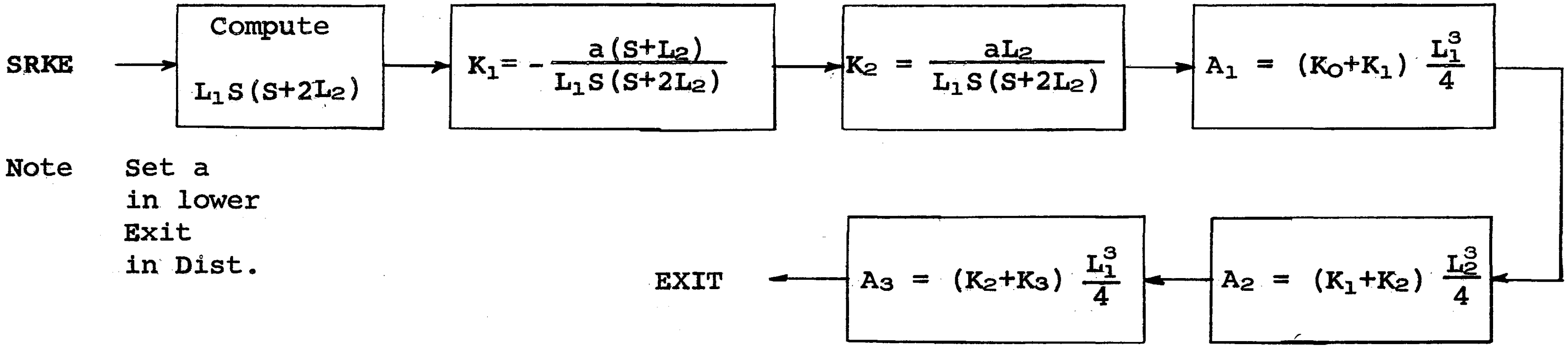
Exit inst.
in Dist.

SUB ROUTINES



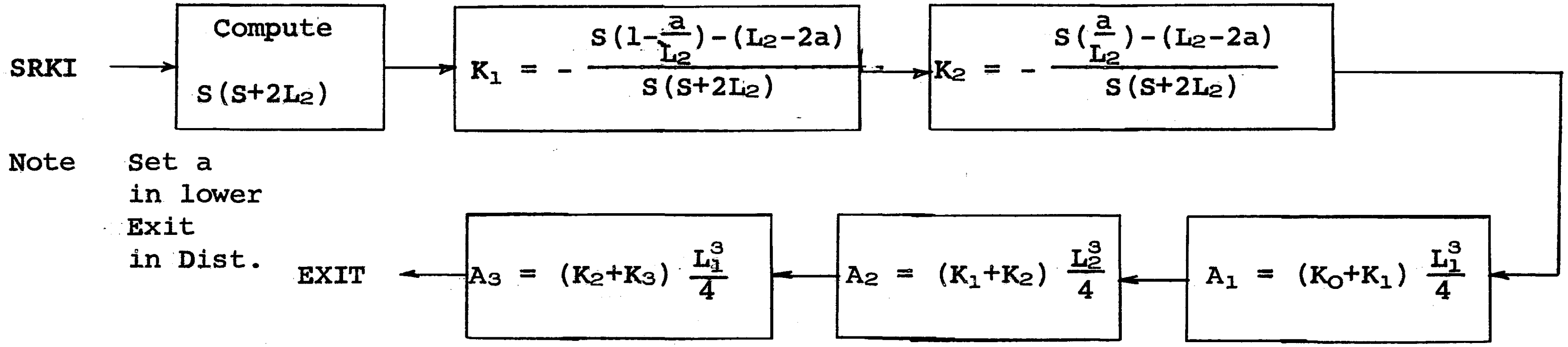
Note: Where the first term contains L-a instead of a, substitute L-a for a. Where the first term is to be omitted make a equal to 0.

END SPAN K-FACTORS
Sub Routine SRKE



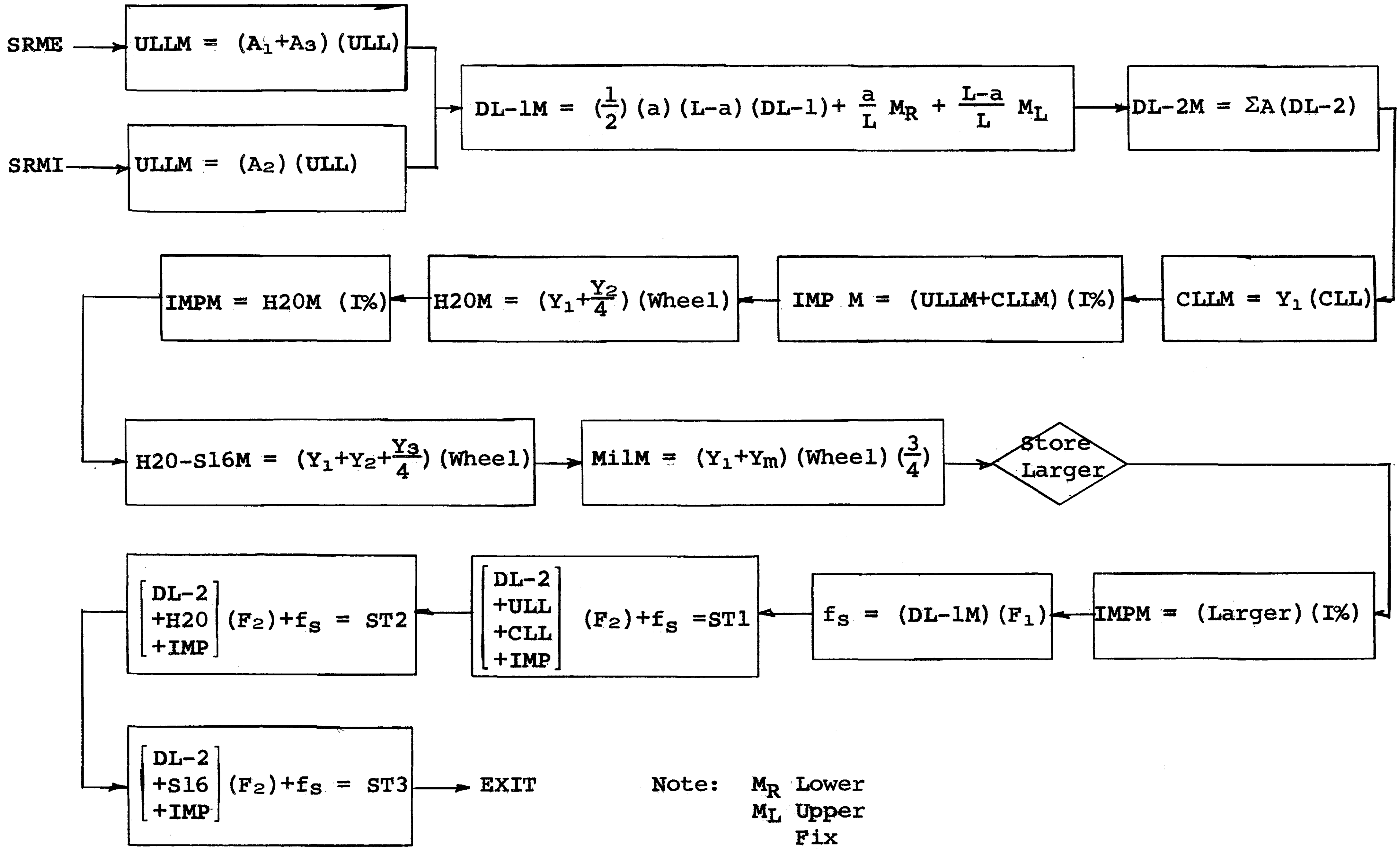
Note Set a
in lower
Exit
in Dist.

INT SPAN K-FACTORS
Sub Routine SRKI



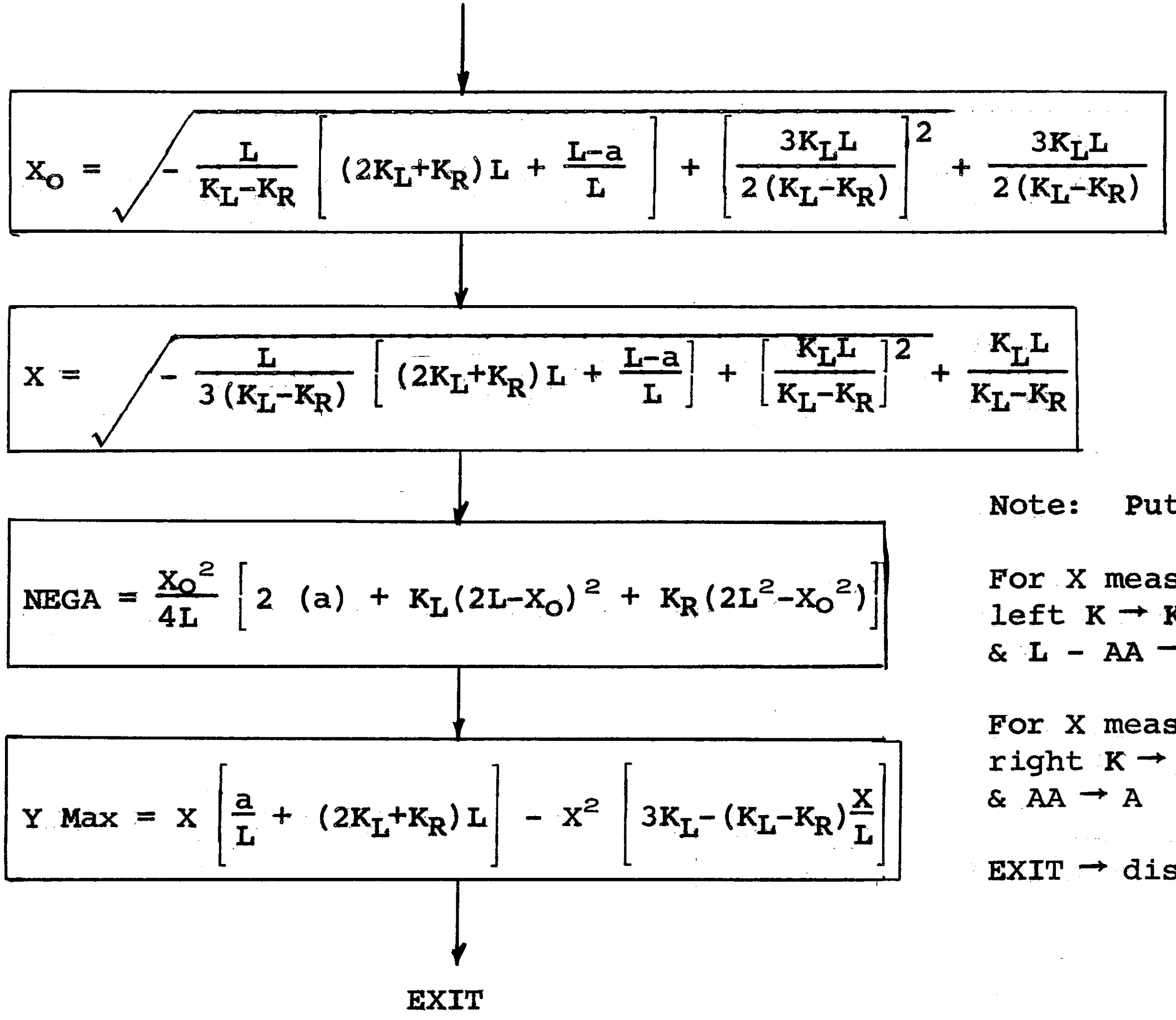
Note Set a
in lower
Exit
in Dist.

MOMENT SUB ROUTINE



Note: M_R Lower
M_L Upper
Fix
A
L
IMP

SRXAY - To find neg. area & max. neg. ord. for partial loads



$$X_o = \sqrt{-\frac{L}{K_L-K_R}\left[(2K_L+K_R)L + \frac{L-a}{L}\right] + \left[\frac{3K_L L}{2(K_L-K_R)}\right]^2} + \frac{3K_L L}{2(K_L-K_R)}$$

$$X = \sqrt{-\frac{L}{3(K_L-K_R)}\left[(2K_L+K_R)L + \frac{L-a}{L}\right] + \left[\frac{K_L L}{K_L-K_R}\right]^2} + \frac{K_L L}{K_L-K_R}$$

$$NEGA = \frac{X_o^2}{4L}\left[2\ (a) + K_L(2L-X_o)^2 + K_R(2L^2-X_o^2)\right]$$

$$Y\ Max = X\left[\frac{a}{L} + (2K_L+K_R)L\right] - X^2\left[3K_L-(K_L-K_R)\frac{X}{L}\right]$$

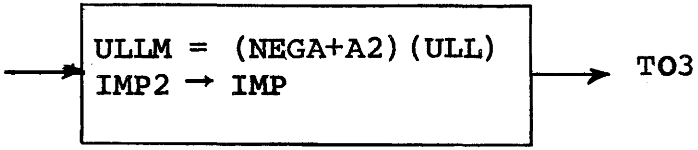
Note: Put A0002 or A0003 → L

For X measured from left, put left K → K_L, right K → K_R & L - AA → A

For X measured from right, put right K → K_L, left K → K_R & AA → A

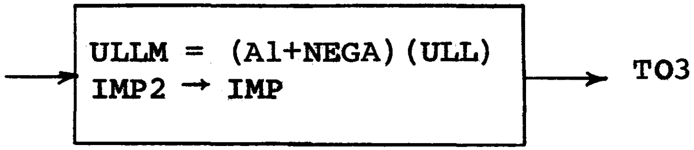
EXIT → distributor

SRST1



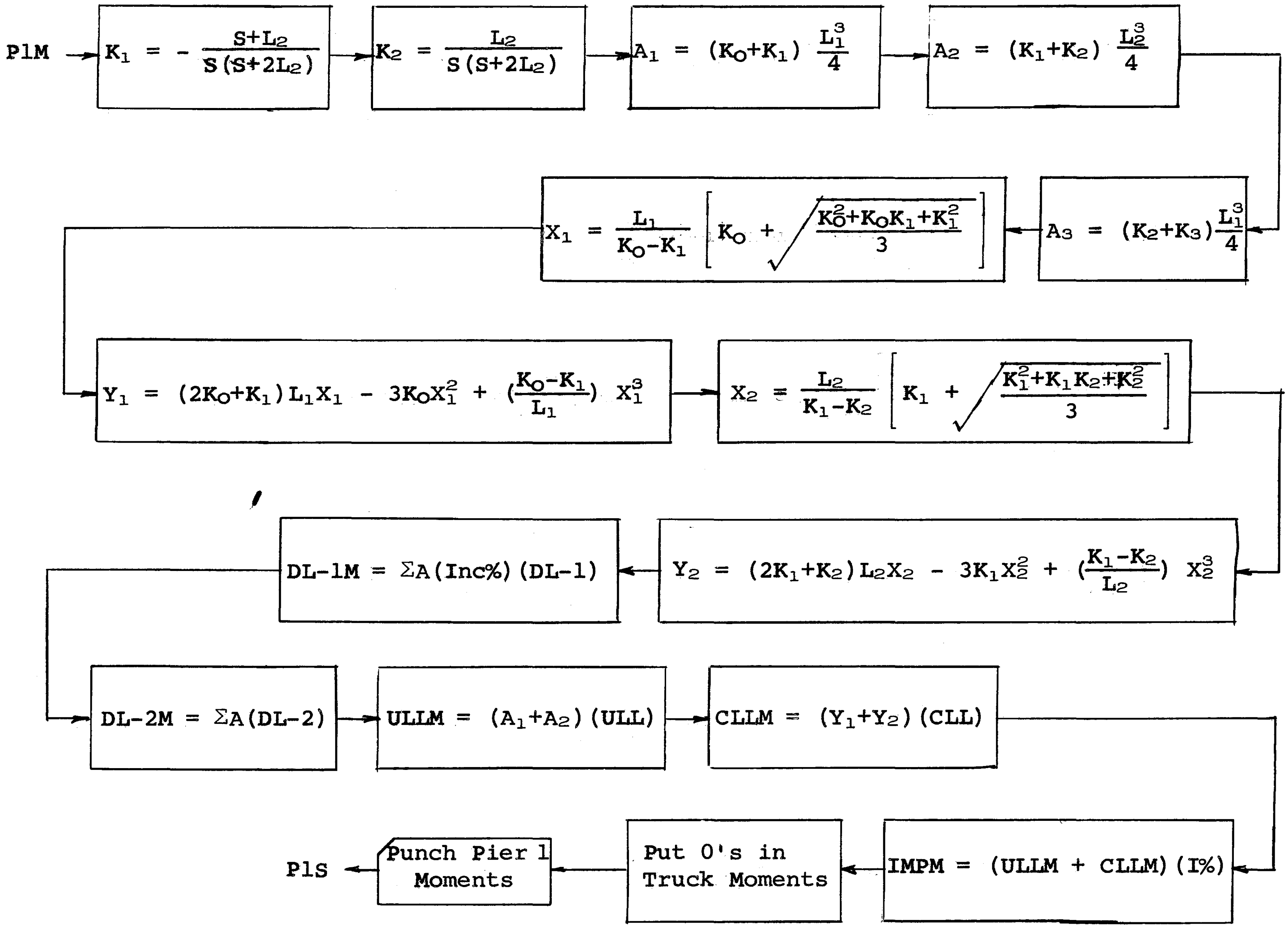
Note: AA → A A0002 → L
X0002 → Lower

SRST2

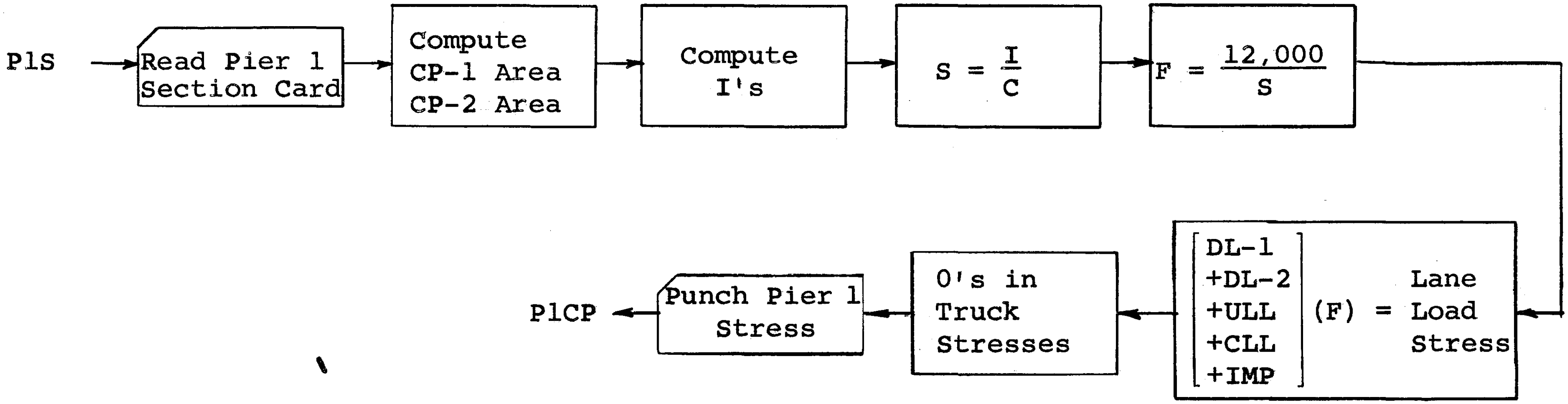


Note: AA → A A0003 → L
X0002 → Upper Y0002 → Lower

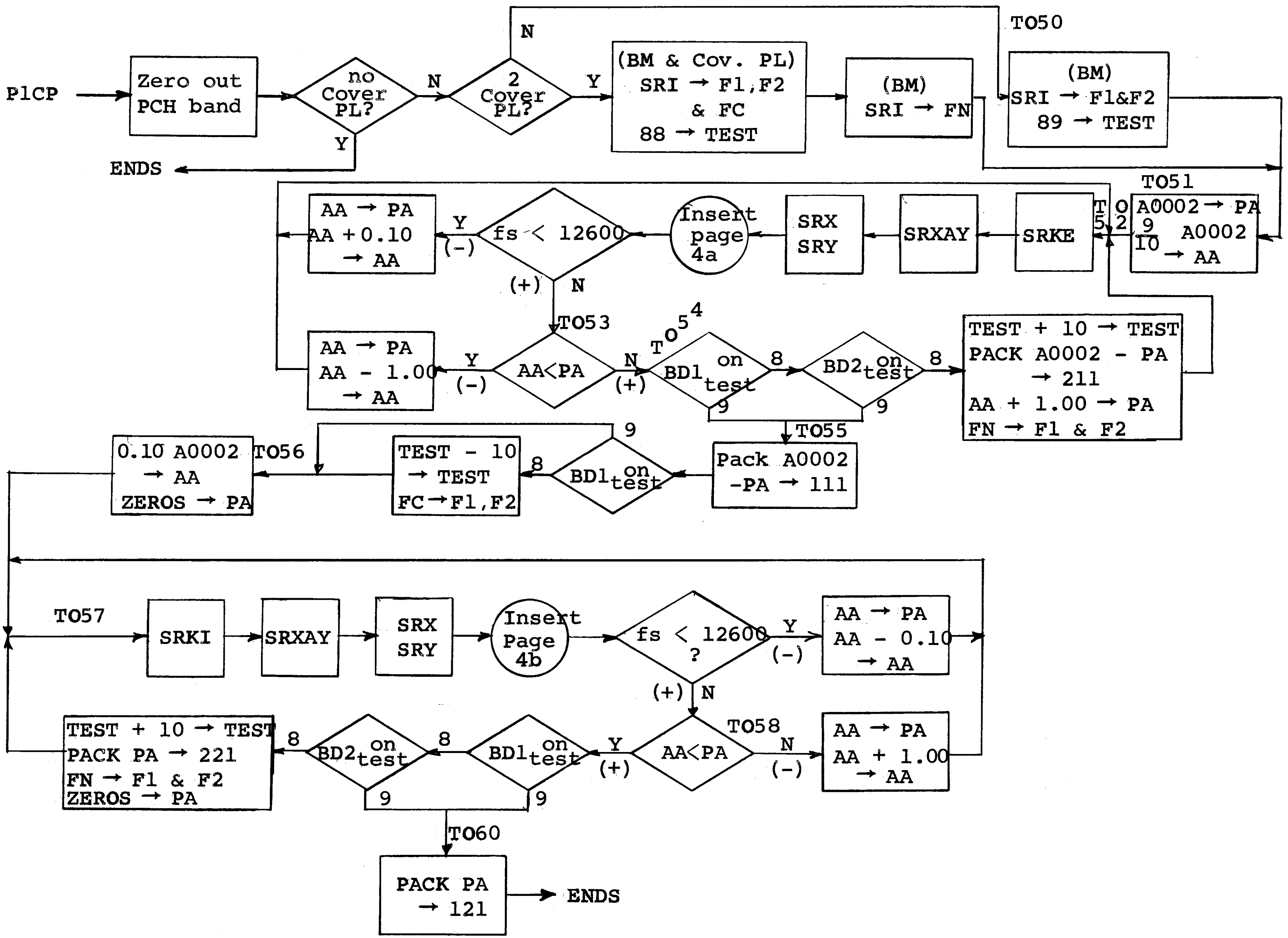
PIER 1 MOMENTS



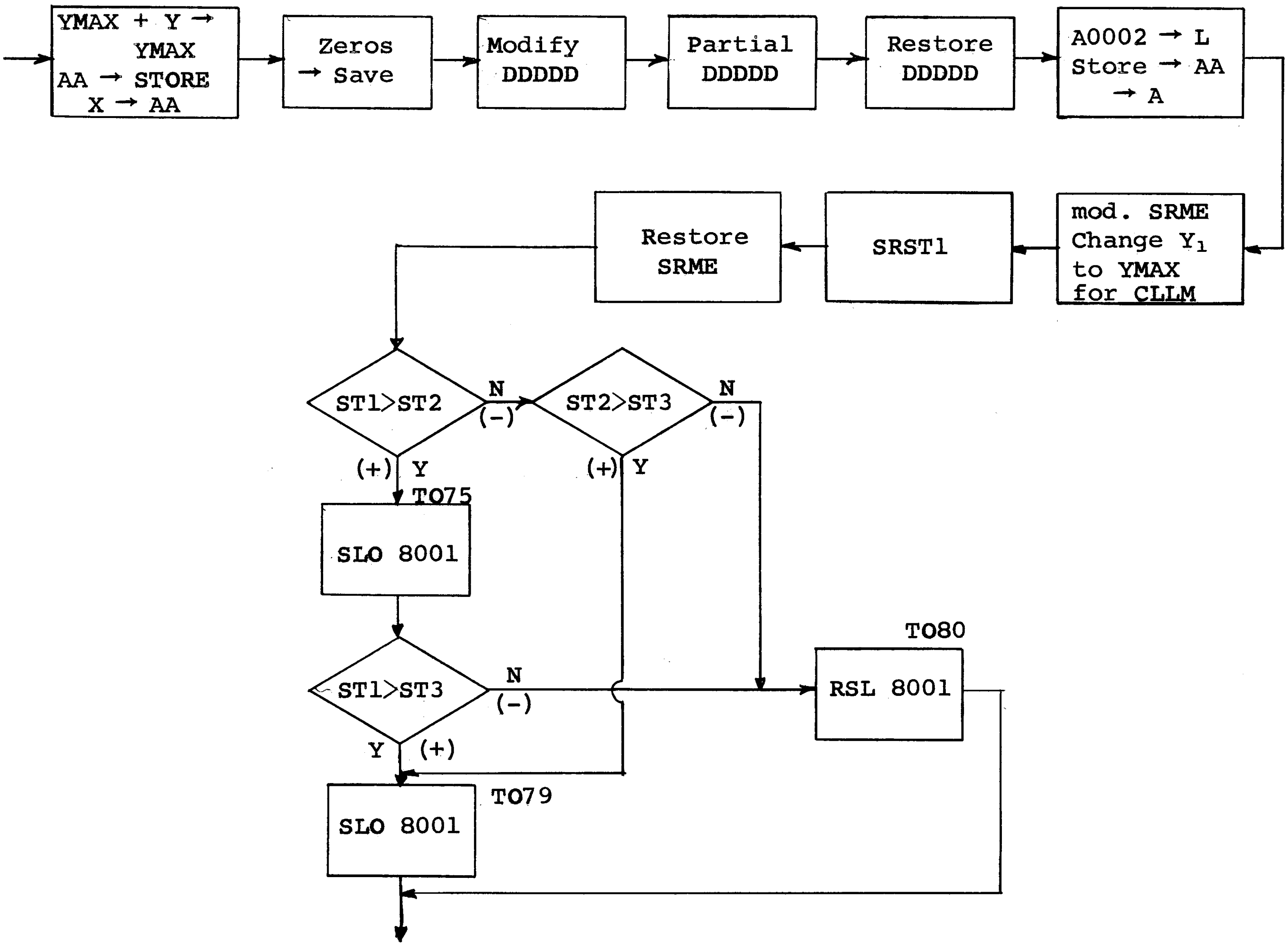
PIER 1 STRESS



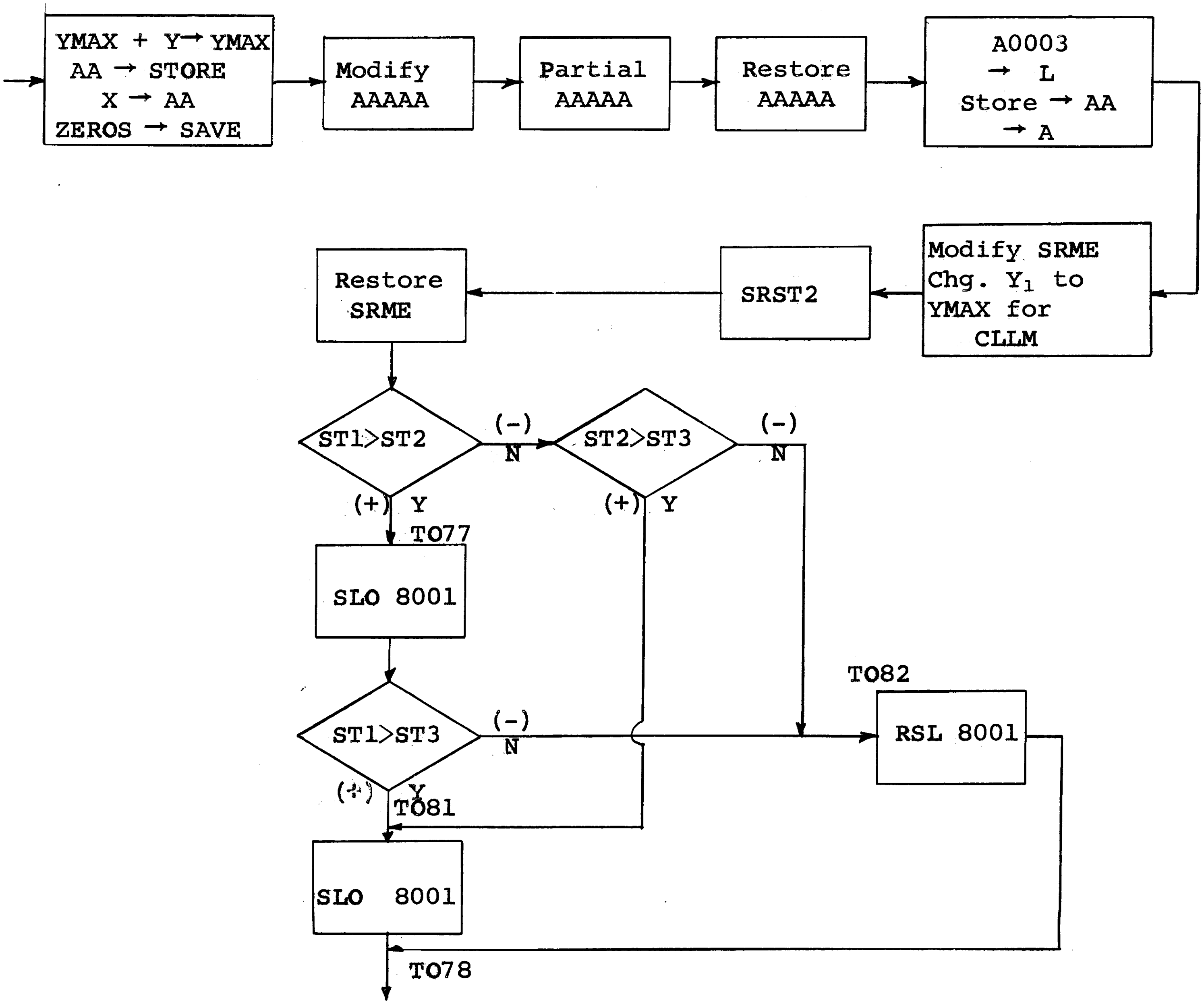
PIER 1 COVER PLATE LENGTHS



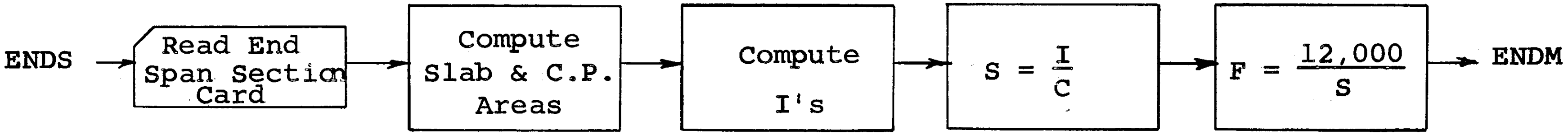
PAGE 4a


YMAX + Y → YMAX
AA → STORE
X → AA
Zeros → Save
Modify DDDDD
Partial DDDDD
Restore DDDDD
A0002 → L
Store → AA → A
mod. SRME Change Y_1 to YMAX for CLLM
SRST1
Restore SRME
ST1>ST2
N (-)
(+) Y
TO75
SLO 8001
ST2>ST3
N (-)
(+) Y
ST1>ST3
N (-)
Y (+)
TO80
RSL 8001
TO79
SLO 8001

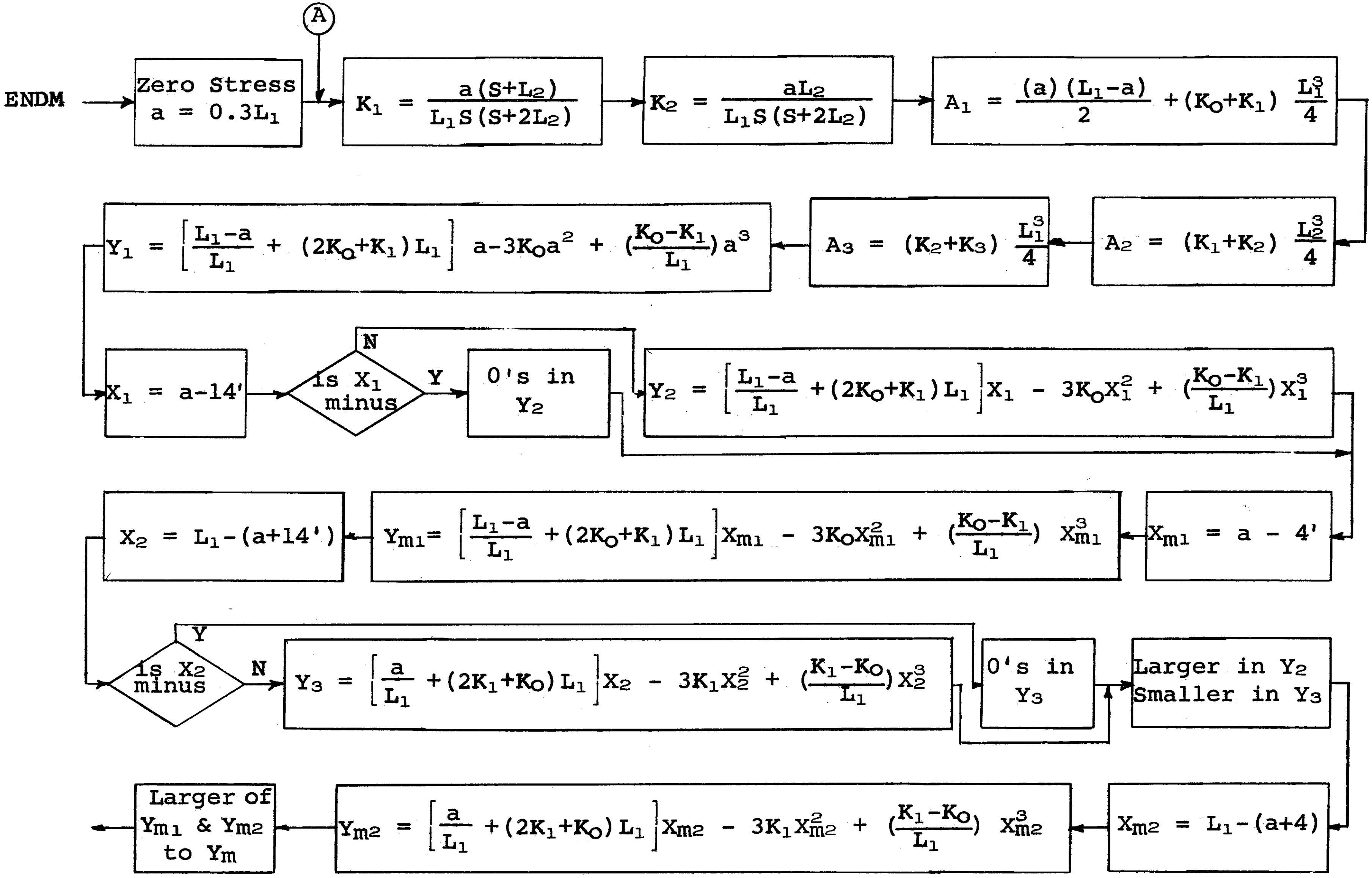
PAGE 4b


YMAX + Y→ YMAX
AA → STORE
X → AA
ZEROS → SAVE
Modify AAAAA
Partial AAAAA
Restore AAAAA
A0003
→ L
Store → AA
→ A
Modify SRME
Chg. Y_1 to
YMAX for
CLLM
SRST2
Restore SRME
ST1>ST2
(-)
N
(+)
Y
TO77
ST2>ST3
(-)
N
(+)
Y
SLO 8001
ST1>ST3
(-)
N
(+)
Y
TO81
TO82
RSL 8001
SLO 8001
TO78

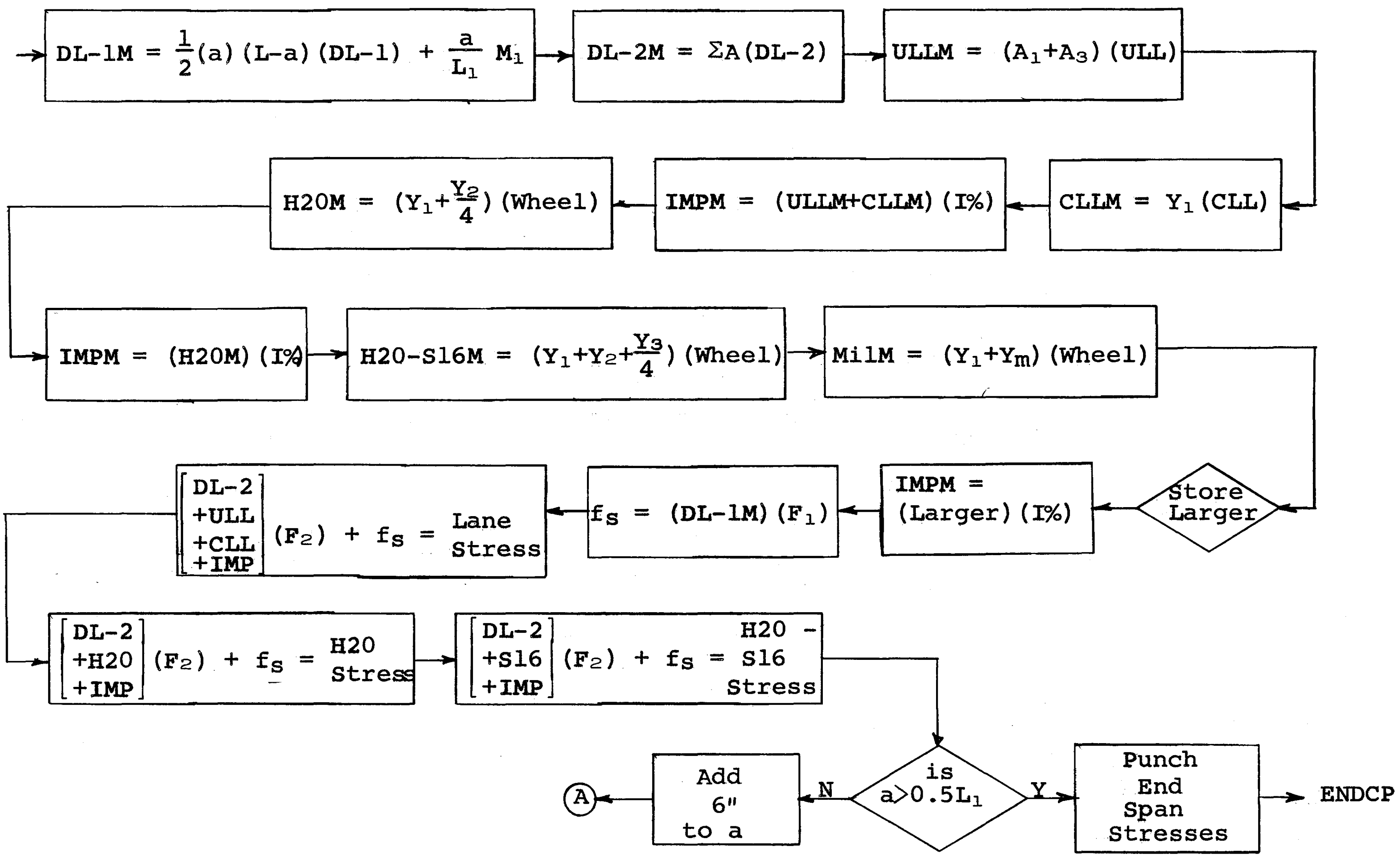
END SPAN SECTION PROPERTIES



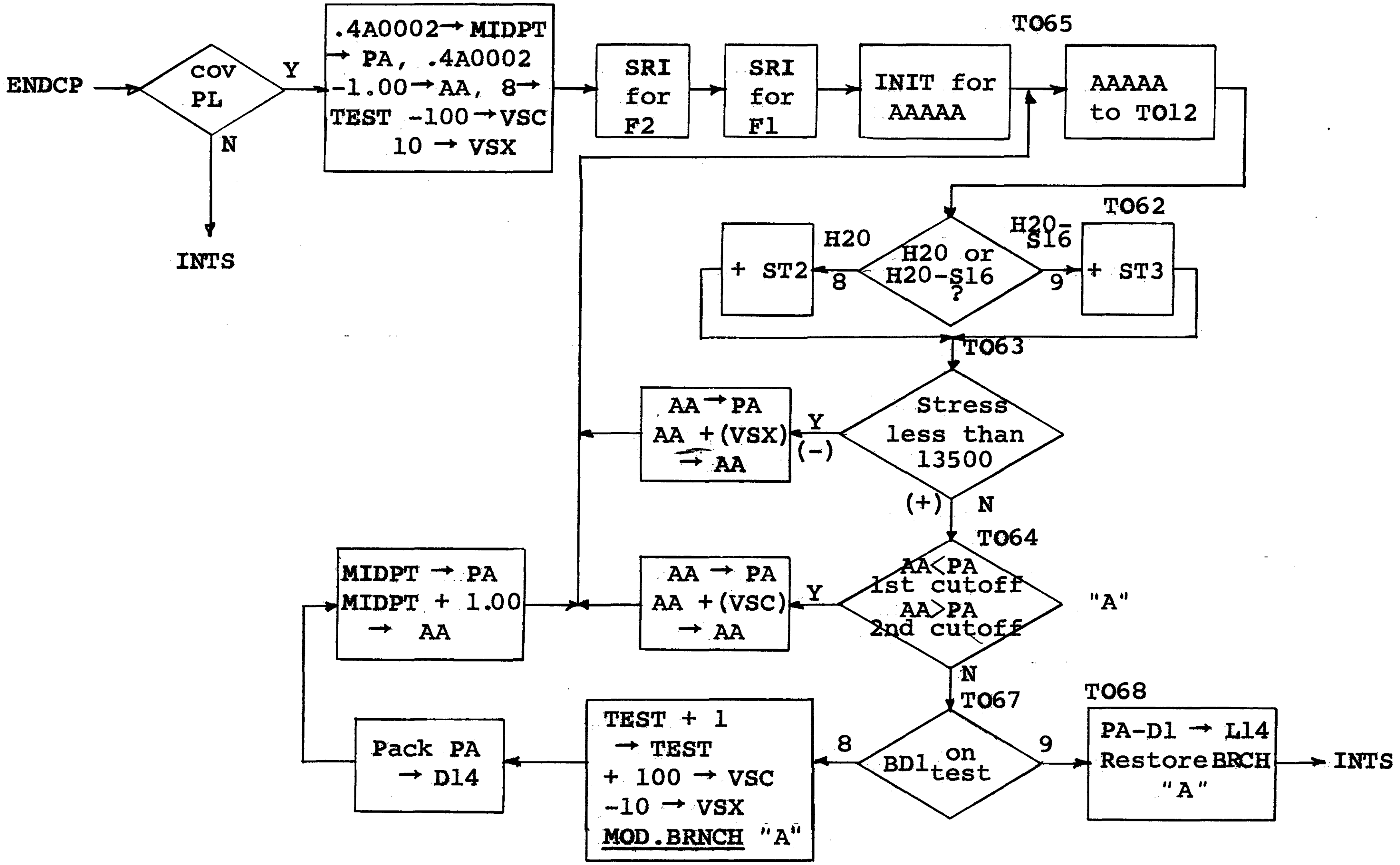
END SPAN MOMENTS AND STRESSES



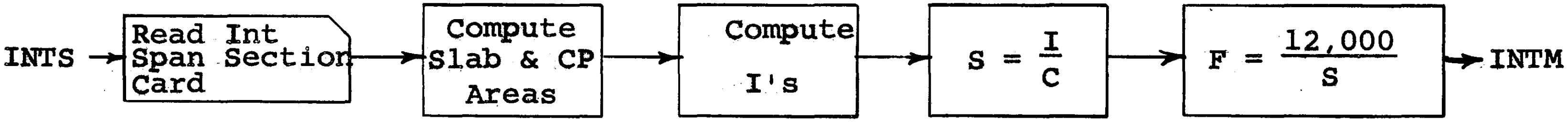
END SPAN MOMENTS AND STRESSES (Cont.)



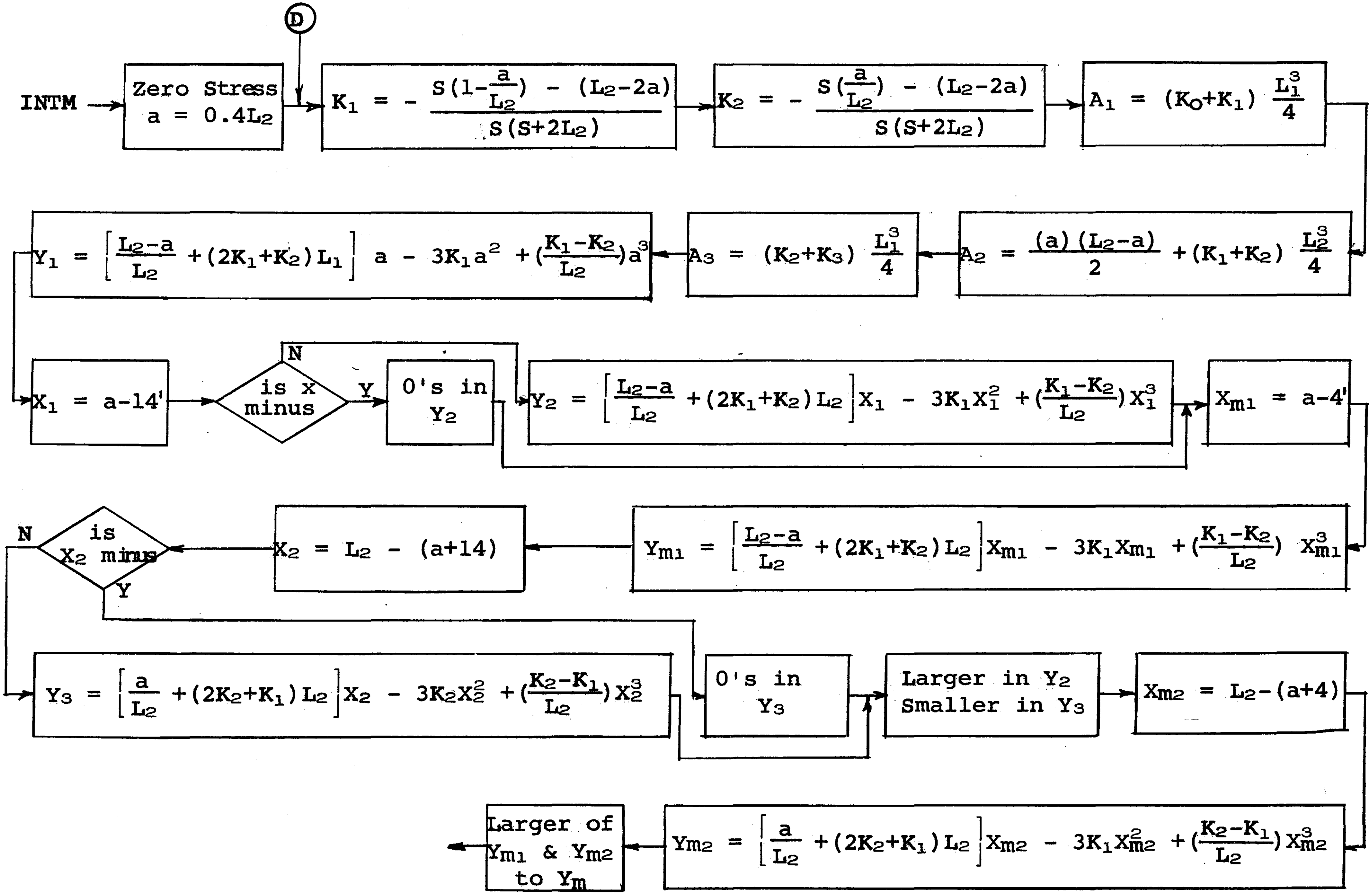
END COVER PLATE LENGTHS



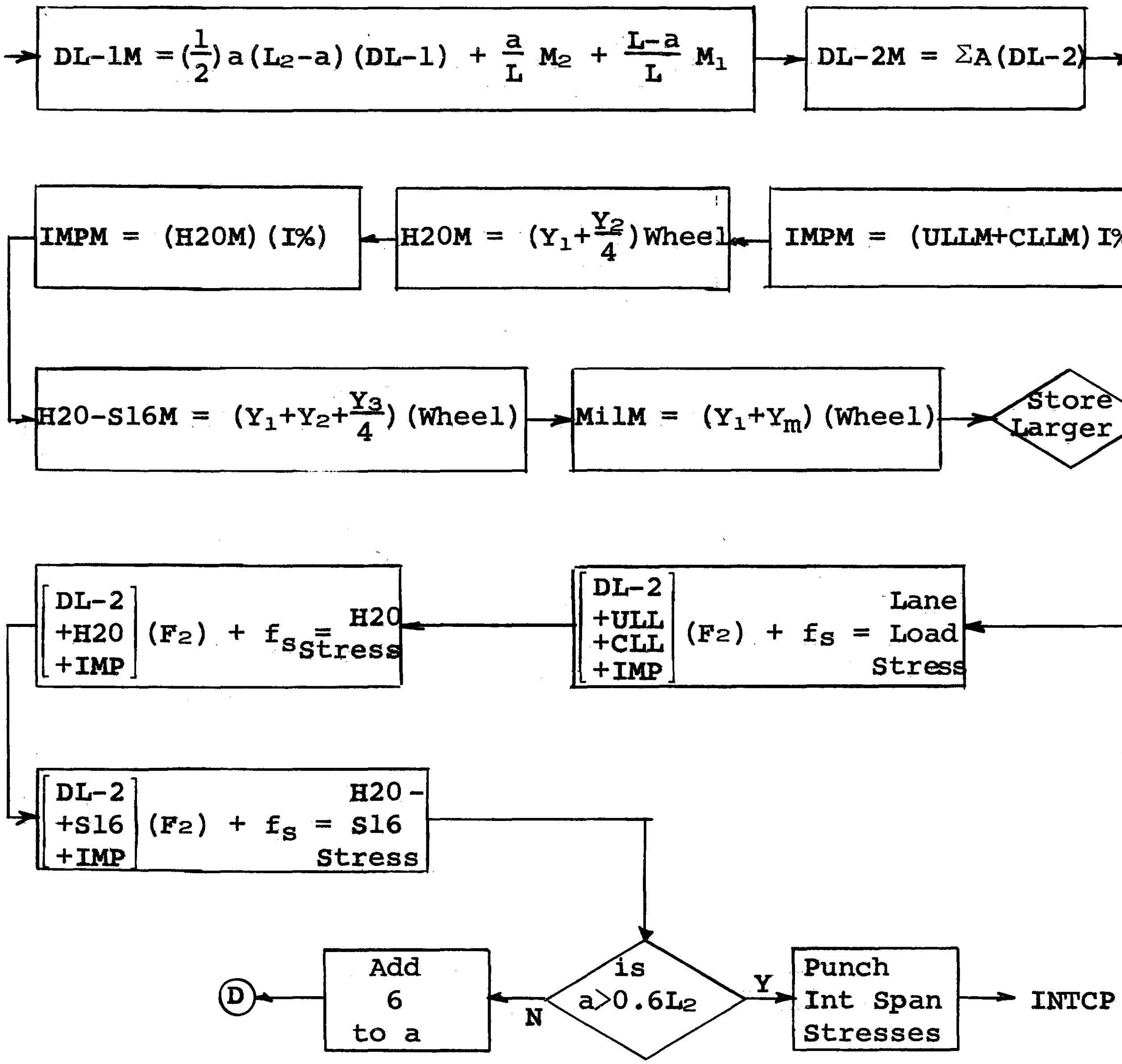
INTERIOR SPAN SECTION PROPERTIES



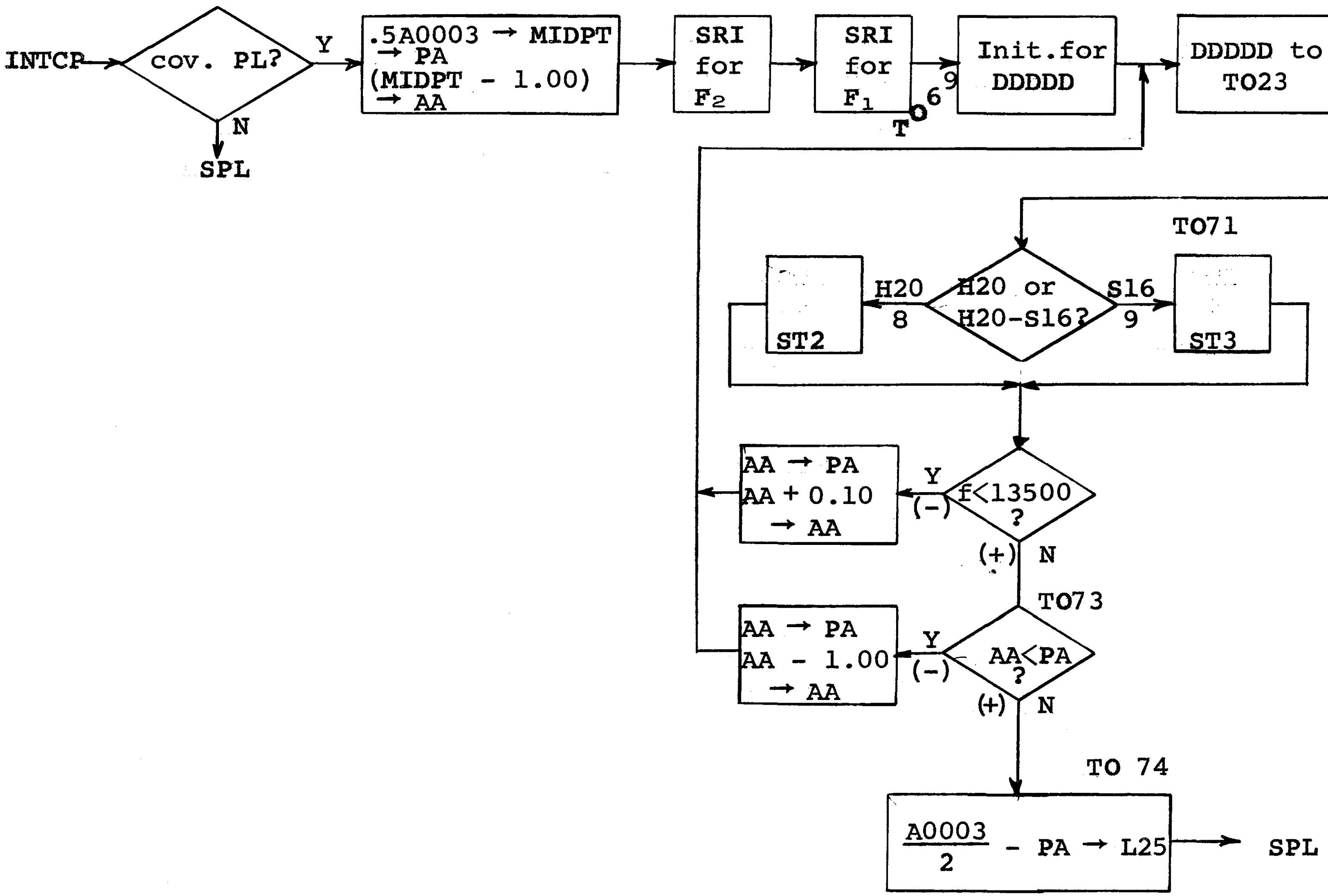
INTERIOR SPAN MOMENTS AND STRESSES



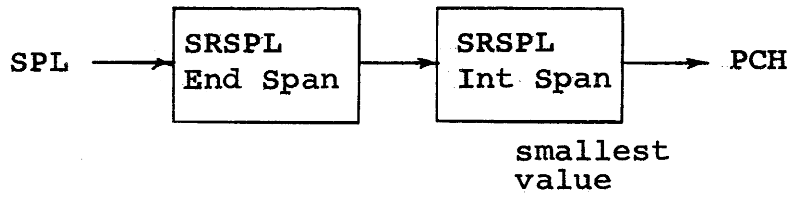
INTERIOR SPAN MOMENTS AND STRESSES (Cont.)



INTERIOR COVER PLATE LENGTHS



SPLICE POINTS



SRSPL

$$\boxed{X = \pm\sqrt{\frac{2M_L}{W} + \left[\frac{M_L-M_R}{WL} - \frac{L}{2}\right]^2} - \left[\frac{M_L-M_R}{WL} - \frac{L}{2}\right]}$$

Note: Fix L & W
M_L upper
M_R lower

WORD LAYOUT FORM

650 MAGNETIC-DRUM DATA-PROCESSING MACHINE

PROGRAM NO. 32013

A0001	A0002	A0003	A0004	A0005	A0006	A0007	A0008	A0009	A0010
BEAM Point No County Design No Run	Length of End Span	Length of Int Span	Length of Bridge	Dead Load-1	Dead Load-2	Uniform Live Load	Conc. Live Load for Moment	Truck Wheel	0—0 8 H20 9 H20-S16 Pier-1 Incre. 0—0

B0001	B0002	B0003	B0004	B0005	B0006	B0007	B0008	B0009	B0010
BEAM Point No County Design No Run	Beam Area	Beam Depth	Beam I	Concrete Width	Concrete Thickness	N	Width Thickness Cover Plate-1	Width Thickness Cover Plate-2	H

P0001	P0002	P0003	P0004	P0005	P0006	P0007	P0008	P0009	P0010
BEAM Point No County Design No Run	DL-1 Moment Lane Stress	DL-2 Moment 0—0	ULL Moment 0—0	CLL Moment 0—0	Imp Moment 0—0	H20 Moment 0—0	Imp Moment 0—0	H20-S16 Moment 0—0	Imp Moment 0—0

W0001	W0002	W0003	W0004	W0005	W0006	W0007	W0008	W0009	W0010
BEAM Point No County Design No Run	Lane Stress		H20 Stress		H20-S16 Stress				

X0001	X0002	X0003	X0004	X0005	X0006	X0007	X0008	X0009	X0010
BEAM Point No County Design No Run	DL-1 Moment	DL-2 Moment	ULL Moment	CLL Moment	Imp Moment				

Z0001	Z0002	Z0003	Z0004	Z0005	Z0006	Z0007	Z0008	Z0009	Z0010
BEAM Point No County Design No Run	111 211	221 121			D14 L14	D25 L25	S11	S21	

SYMBOL TABLE 32013

SYMBOL	LOCATION	DESCRIPTION
01	0158	CONSTANT
02	1650	CONSTANT
03	0708	CONSTANT
04	1810	CONSTANT
10	1217	CONSTANT
100	0072	CONSTANT
12	0082	CONSTANT
125	1060	CONSTANT
126HU	0956	CONSTANT
135HU	1096	CONSTANT
14	0304	CONSTANT
15	0246	CONSTANT
2	0174	CONSTANT
25	0148	CONSTANT
3	0388	CONSTANT
4	0224	CONSTANT
4HUN	0354	CONSTANT
5	0074	CONSTANT
5BILL	0363	CONSTANT
6	1252	CONSTANT
61	0208	CONSTANT
62	1700	CONSTANT
63	0758	CONSTANT
75	0090	CONSTANT
8	1603	CONSTANT
81	0136	CONSTANT
82	1600	CONSTANT
83	0436	CONSTANT
84	1238	CONSTANT
88	0104	CONSTANT
89	0348	CONSTANT
9	0366	CONSTANT
98	0592	CONSTANT
A	0610	Distance to point of influence line for sub routine xx.xx
A1	0677	AREA under the influence line for Span 0-1 xxxx.xx
A2	0727	AREA under the influence line for Span 1-2 xxxx.xx
A3	0777	AREA under the influence line for Span 2-3 xxxx.xx
AA	0747	Working Storage for A xx.xx
AAAAA	1200	TRANSFER Control
AREA	0130	Start of Area Sub Routine
BMNO	0266	BEAM Number x
BYPAS	1935	Instruction to modify SRME for use in P1CP

SYMBOL	LOCATION	DESCRIPTION
CLLM	0645	Concentrated Live Load Moment xxxx.xx
CP1A	0103	Cover Plate 1 Area xx.xx
CP1T	0066	Cover Plate 1 Thickness xx.xxx
CP1W	0059	Cover Plate 1 Width xx.xxx
CP2A	0153	Cover Plate 2 Area xx.xx
CP2T	0116	Cover Plate 2 Thickness xx.xxx
CP2W	0109	Cover Plate 2 Width xx.xxx
CP3A	0203	Cover Plate 3 Area xx.xx
CP3T	0166	Cover Plate 3 Thickness xx.xxx
CP3W	0159	Cover Plate 3 Width xx.xxx
CP4A	0253	Cover Plate 4 Area xx.xx
CP4T	0216	Cover Plate 4 Thickness xx.xxx
CP4W	0209	Cover Plate 4 Width xx.xxx
DDDDD	1350	Transfer Control
DESN	0943	Design Number xxxxxxx
DL1M	0589	Dead Load 1 Moment xxxx.xx
DL2M	0493	Dead Load 2 Moment xxxx.xx
ENDCP	0828	Start of End Span Cover Plate Computation
ENDM	1695	Start of End Span Moment Computation
ENDS	1143	Start of End Span Section Properties Computation
EXIT	0053	Storage of Exit Instruction for Sub Routines
EXIT1	0407	Storage of Exit Instruction for Sub Routines
EXITA	1038	Instruction to modify ENDM for use in ENDCP
EXITB	1735	Instruction to modify INTM for use in P1CP
EXITD	1191	Instruction to modify INTM for use in INTCP
EXITE	0386	Instruction to modify ENDM for use in P1CP
F1	0196	Mom. of Inertia factor for comp. Dead Load 1 stress xx.xx
F2	0192	Mom. of Inertia factor for comp. Dead Load 2 stress xx.xx
FC	0298	Current mom. of inertia factor xx.xx
FIFTY	0058	CONSTANT
FN	0128	Next mom. of inertia factor xx.xx
H20M	0745	H20 Moment xxxx.xx
IMP	0500	Percent of Impact for sub routines .xxx
IMP1	1731	Percent of Impact for End Span .xxx
IMP2	1473	Percent of Impact for Pier 1 .xxx
UMP3	1931	Percent of Impact for Interior Span .xxx
IMPM1	0585	Lane Load Impact Moment xxxx.xx
IMPM2	0685	H20 Impact Moment xxxx.xx
IMPM3	0779	H20-S16 Impact Moment xxxx.xx
INC1	0446	Increase factor for influence line areas for Dead Load 1 x.xxx

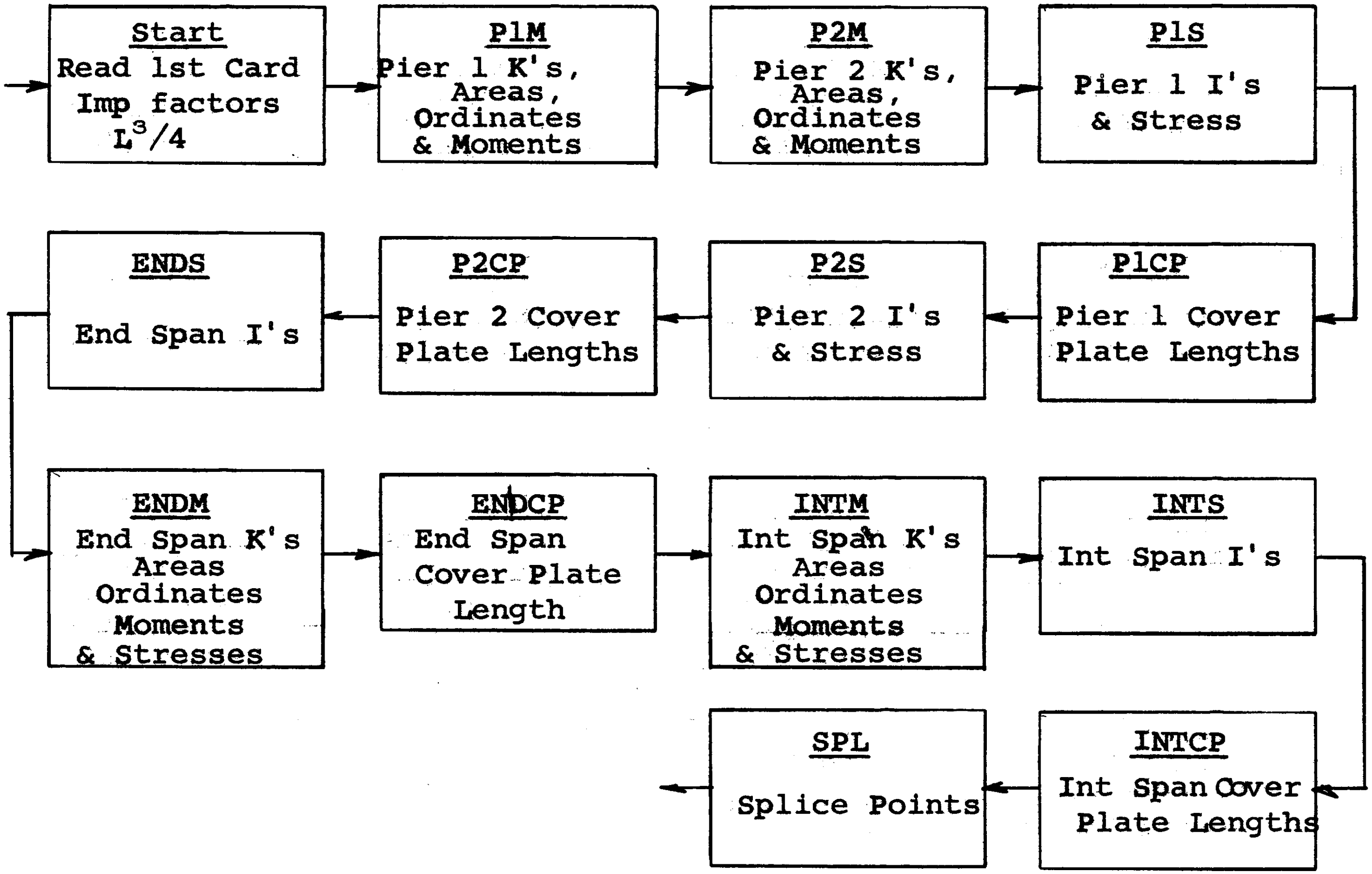
SYMBOL	LOCATION	DESCRIPTION
INC2	0496	Increase factor for influence line areas for Dead Load 1 x.xxx (not used)
INTCP	1378	Start of Interior Span Cover Plate Computation
INTM	1945	Start of Interior Span Moment Computation
INTS	1569	Start of Interior Span Section Properties Computation
K1	0577	Pier 1 K factor .xxxxxxx
K2	0627	Pier 2 K factor .xxxxxxx
KL	0267	Left K factor used in sub routines .xxxxxxx
KR	0124	Right K factor used in sub routines .xxxxxxx
L	0511	Length of span used in sub routines xxx.xx
L134	0284	$L_1^3/4$ xxxxxx.xx
L234	0334	$L_2^3/4$ xxxxxx.xx
MIDPT	1355	Location of beginning point for determination of pos. mom. cover plate cutoffs
ML	0860	Left moment used in sub routines xxxx.xx
MMM	0068	CONSTANT
MR	0617	Right moment used in sub routines xxxx.xx
NEGA	0647	Negative Area of influence lines
ONE	0774	CONSTANT
ONEM	0086	CONSTANT
P1CP	0078	Start of Pier 1 Cover Plate Computation
P1M	1687	Start of Pier 1 Moment Computation
P1S	1727	Start of Pier 1 Section Properties Computation
PA	1410	Previous distance A xx.xx
PCHEM	0554	Punch End Span Moments
PCHIM	1855	Punch Interior Span Moments
S16M	0895	H20-S16 Moment xxxx.xx
SAFE	0278	Storage for original instr. in sub routine SRME which is modified for other sub rout.
SAVE	0154	Storage for L - A xx.xx
SPL	1822	Start of Splice Point Computation
SQRT	0150	Start of Square Root Sub routine
SRI	0100	Start of Moment of Inertia Sub routine
SRKE	0300	Start of End Span K-factor Sub routine
SRKI	0350	Start of Interior Span K-factor Sub routine
SRME	0400	Start of End Span Moment Sub routine
SRMI	0450	Start of Interior Span Moment Sub routine
SRSPL	1550	Start of theoretical splice point sub routine
SRST1	0650	Start of moment sub routine for cover plate cutoffs
SRST2	0700	Start of sub routine for moments in interior span for cover plate cutoffs.

SYMBOL	LOCATION	DESCRIPTION
SRX	0200	Start of distance sub routine
SRXAY	0550	Start of maximum influence line areas and ordinates with partial span loading sub routine
SRY	0250	Start of Ordinate Computation Sub routine
ST1	0739	Lane Load Stress xxxxx
ST2	0839	H20 Stress xxxxx
ST3	0889	H20-S16 Stress xxxxx
START	0050	Start of Program
STOP1	1587	STOP
STOP2	0675	STOP
STOP3	1395	STOP
STOP4	0750	STOP
STOP5	0062	STOP
STOP6	1645	STOP
STOP7	1197	STOP
STORE	1103	Temporary instruction or data storage
SUMAY	0085	Summation of Area times the distance from the centroid xx.xx
SWTCH	1009	Instruction to reverse branch instruction TO65
TEMP1	0057	Temporary Storage
TEMP2	0131	Temporary Storage
TEMP3	0188	Temporary Storage
TEMP4	0076	Temporary Storage
TEMP5	0126	Temporary Storage
TEMP6	0061	Temporary Storage
TEST	0412	Storage for 8's or 9's for BDn branch instructions
TO1	0343	Transfer Control
TO10	1973	Transfer Control
TO11	1047	Transfer Control
TO12	1933	Transfer Control
TO13	1097	Transfer Control
TO14	0426	Transfer Control
TO15	1147	Transfer Control
TO16	1914	Transfer Control
TO17	0294	Transfer Control
TO18	1560	Transfer Control
TO19	0344	Transfer Control
TO2	0285	Transfer Control
TO20	1400	Transfer Control
TO21	0572	Transfer Control
TO22	1297	Transfer Control
TO23	1236	Transfer Control
TO24	1347	Transfer Control
TO25	0925	Transfer Control
TO26	0748	Transfer Control

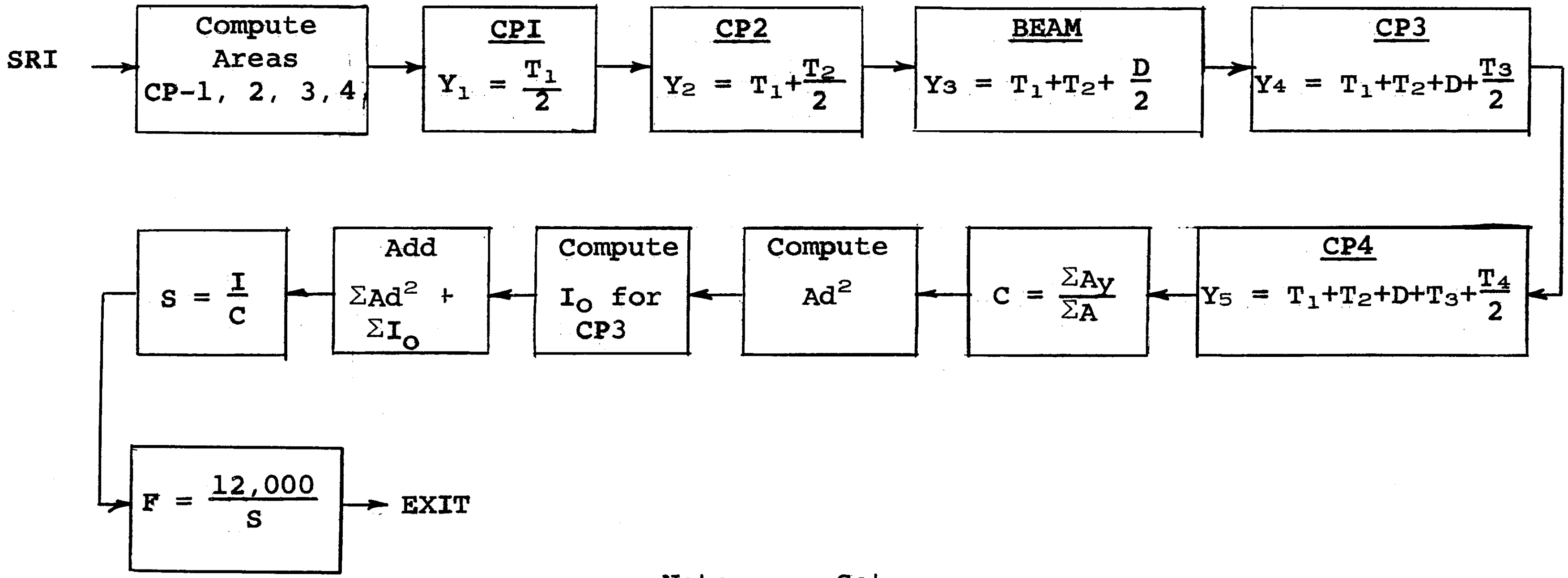
SYMBOL	LOCATION	DESCRIPTION
TO3	0931	Transfer Control
TO30	0146	Transfer Control
TO31	0553	Transfer Control
TO32	0416	Transfer Control
TO33	1367	Transfer Control
TO34	0449	Transfer Control
TO35	0753	Transfer Control
TO4	0052	Transfer Control
TO5	1214	Transfer Control
TO50	1167	Transfer Control
TO51	0832	Transfer Control
TO52	0800	Transfer Control
TO53	1565	Transfer Control
TO54	1269	Transfer Control
TO55	0722	Transfer Control
TO56	0922	Transfer Control
TO57	1000	Transfer Control
TO58	1965	Transfer Control
TO59	0955	Transfer Control
TO6	0144	Transfer Control
TO60	1172	Transfer Control
TO61	1300	Transfer Control
TO62	0724	Transfer Control
TO63	1843	Transfer Control
TO64	1405	Transfer Control
TO65	1499	Transfer Control
TO66	0602	Transfer Control
TO67	1170	Transfer Control
TO68	1572	Transfer Control
TO69	1749	Transfer Control
TO7	1211	Transfer Control
TO70	1500	Transfer Control
TO71	1478	Transfer Control
TO72	0594	Transfer Control
TO73	1556	Transfer Control
TO74	1520	Transfer Control
TO75	0797	Transfer Control
TO76	1203	Transfer Control
TO77	0897	Transfer Control
TO78	1403	Transfer Control
TO79	0847	Transfer Control
TO8	0194	Transfer Control
TO80	0646	Transfer Control
TO81	0947	Transfer Control
TO82	0746	Transfer Control
TO9	1449	Transfer Control
ULLM	0393	Uniform Live Load Moment xxxx.xx
VSC	1284	Location of 100 with variable sign

SYMBOL	LOCATION	DESCRIPTION
VSX	0674	Location of 10 with variable sign
W	0644	Dead Load 1 plus Dead Load 2
X	0317	Distance to required Ordinate xx.xx
X0	0935	Distance to Zero Ordinate xx.xx
Y1	0399	Maximum ordinate xx.xx
Y2	0341	Second Truck Ordinate or Span 2 Ordinate for Pier Moment xx.xx
Y3	0441	Third Truck ordinate xx.xx
YM	0151	Military Ordinate xx.xx
YMAX	1179	Maximum influence line ordinate with span partially loaded

GENERAL FLOW DIAGRAM (4 Span)



I-SUB ROUTINE



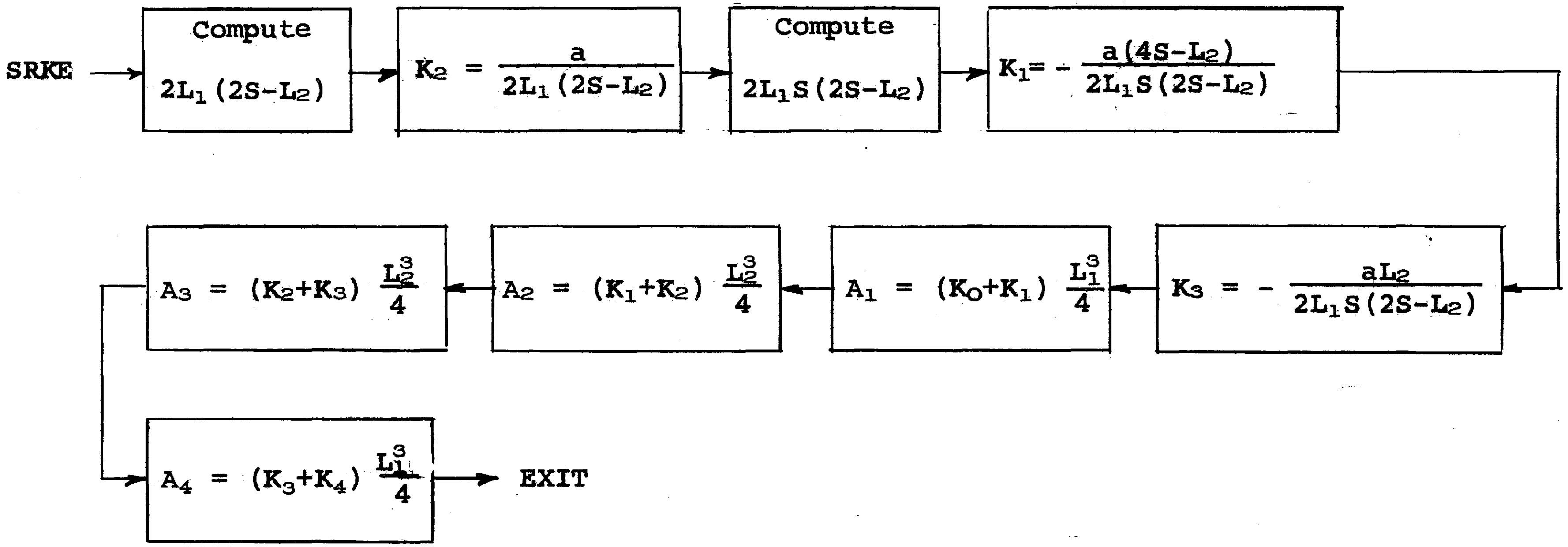
Note: Set

CP1W CP1T
CP2W CP2T
CP3W CP3T
CP4W CP4T

Exit Inst.
in Dist.

END SPAN K-FACTORS

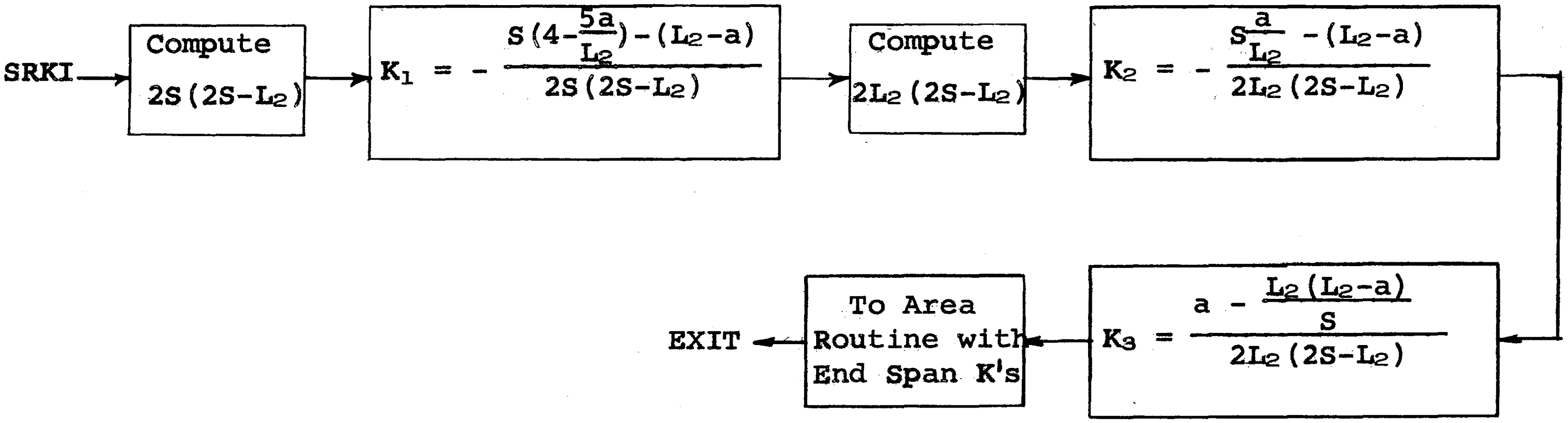
Sub Routine SRKE



Note: Set a in lower
Exit inst. in Dist.

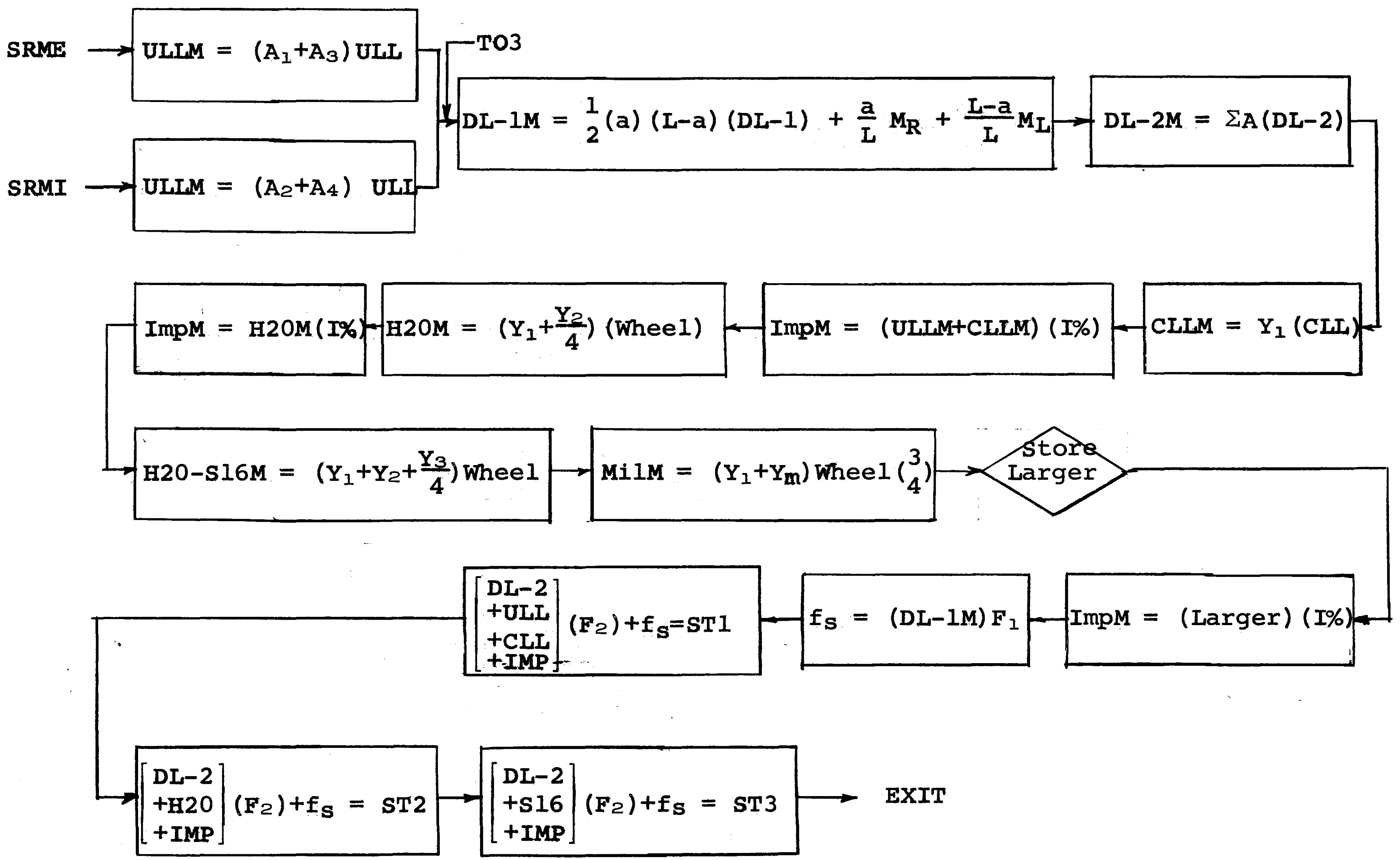
INT SPAN K-FACTORS

Sub Routine SRKI



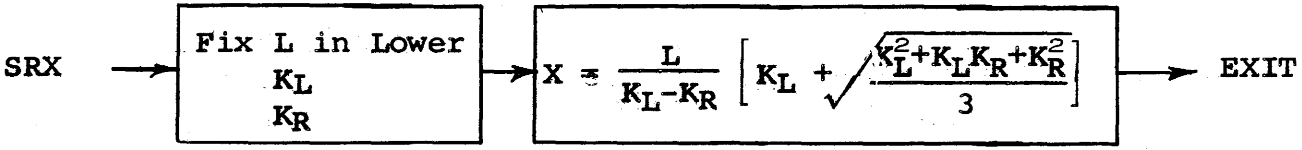
Note: Set a in lower
Exit Inst. in Dist.

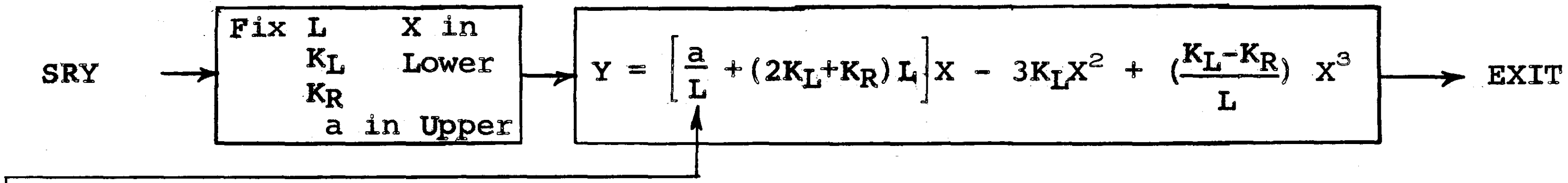
MOMENT SUB ROUTINE



Note: Fix M_R Lower
M_L
A
L
IMP

SUB ROUTINES

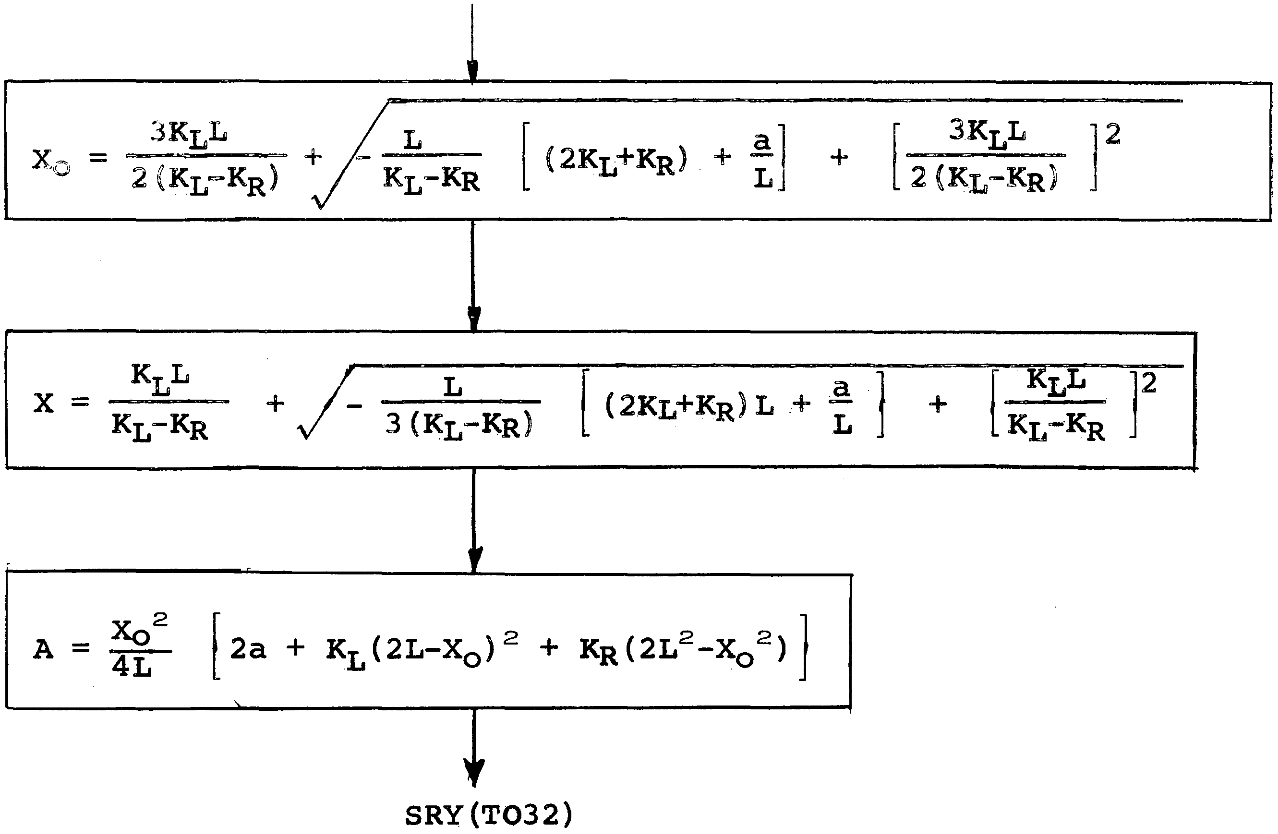




Note: Where the first term contains L-a instead of a, substitute L-a for a.

Where the equation does not contain the first term, put a=0.

SUB ROUTINE SRX



$$X_o = \frac{3K_L L}{2(K_L - K_R)} + \sqrt{-\frac{L}{K_L - K_R}\left[(2K_L + K_R) + \frac{a}{L}\right] + \left[\frac{3K_L L}{2(K_L - K_R)}\right]^2}$$

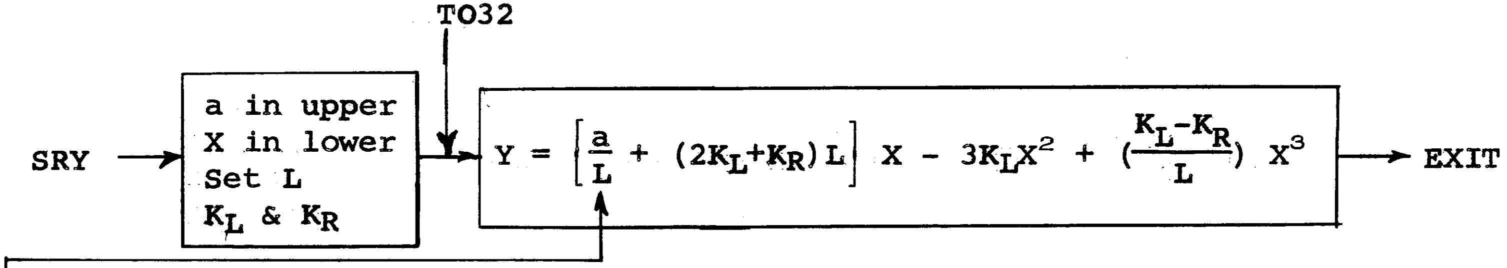
$$X = \frac{K_L L}{K_L - K_R} + \sqrt{-\frac{L}{3(K_L - K_R)}\left[(2K_L + K_R)L + \frac{a}{L}\right] + \left[\frac{K_L L}{K_L - K_R}\right]^2}$$

$$A = \frac{X_o^2}{4L}\left[2a + K_L(2L - X_o)^2 + K_R(2L^2 - X_o^2)\right]$$

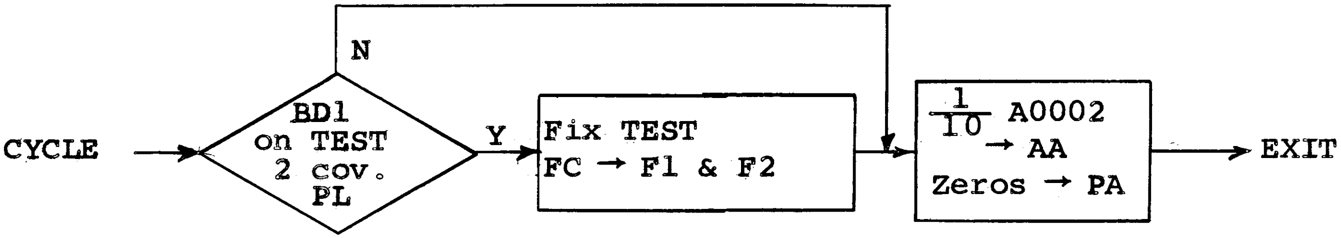
Note: Exit in Distributor
a in upper, L in lower

To find X only for moment
at pier put 0 in "a"
Partial A is in NEGA

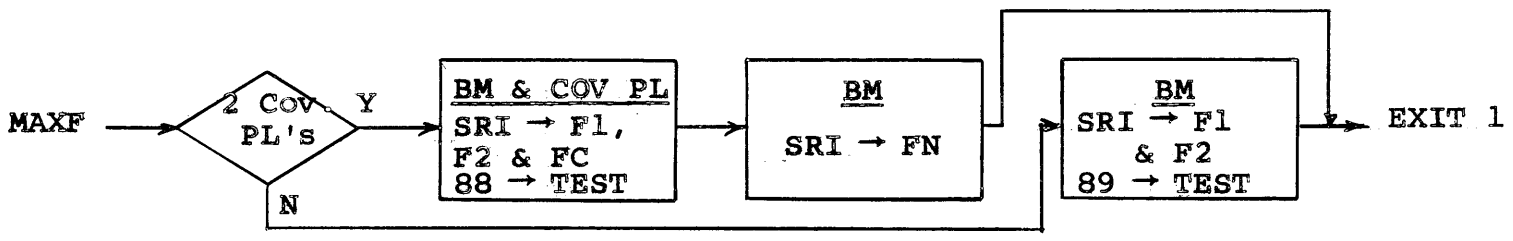
SUB ROUTINE SRY



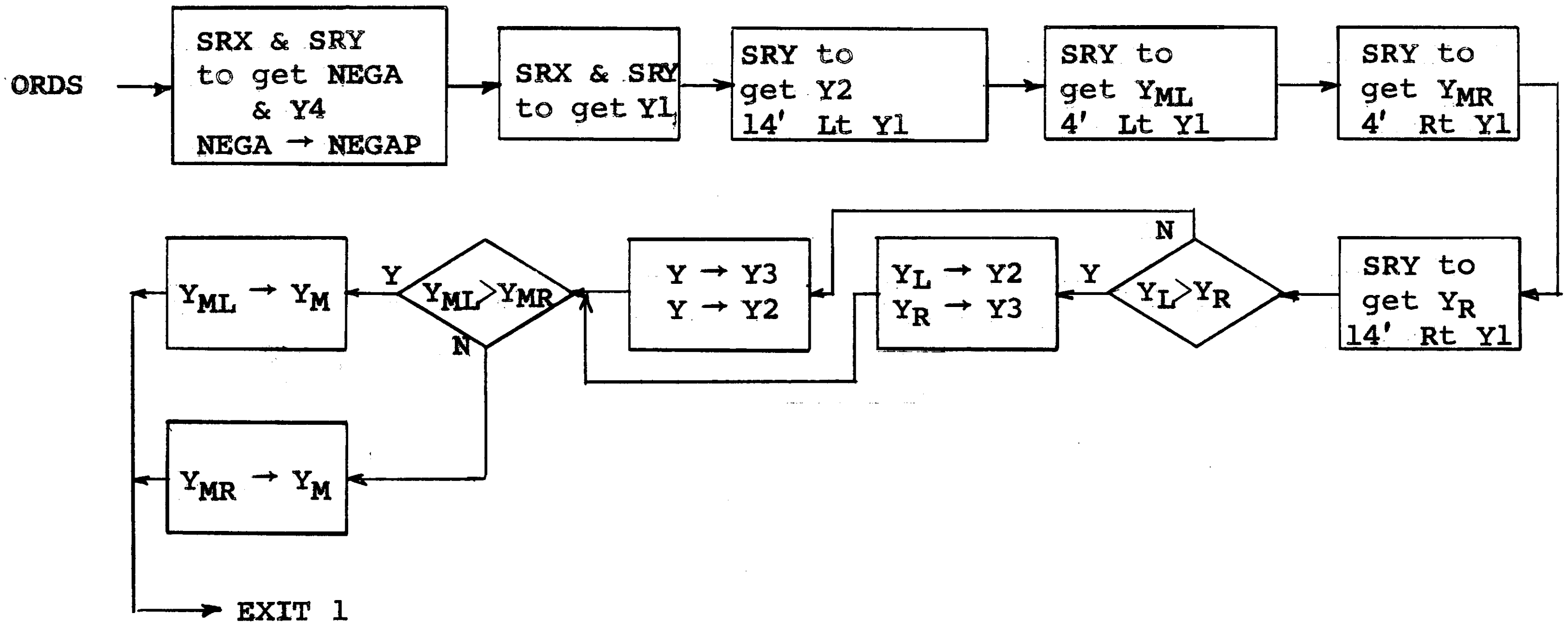
Note: When the first term of the equation contains L-a instead of a, substitute L-a for a. When the equation does not contain the first term, set a equal to zero.



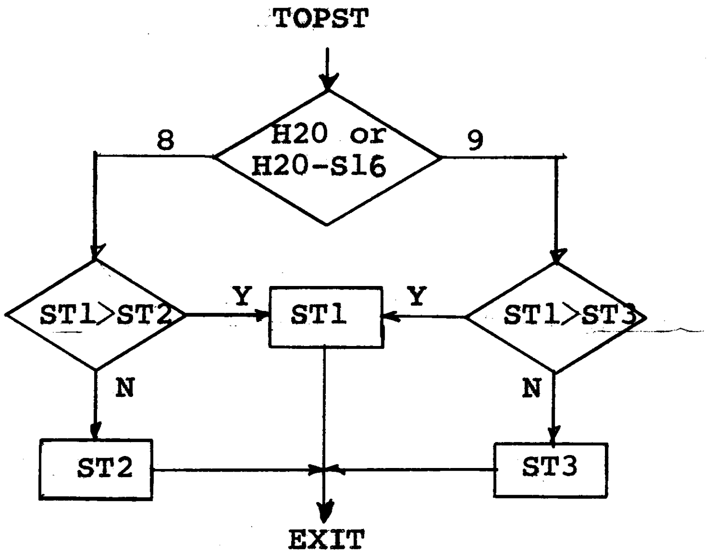
Note: EXIT in distributor



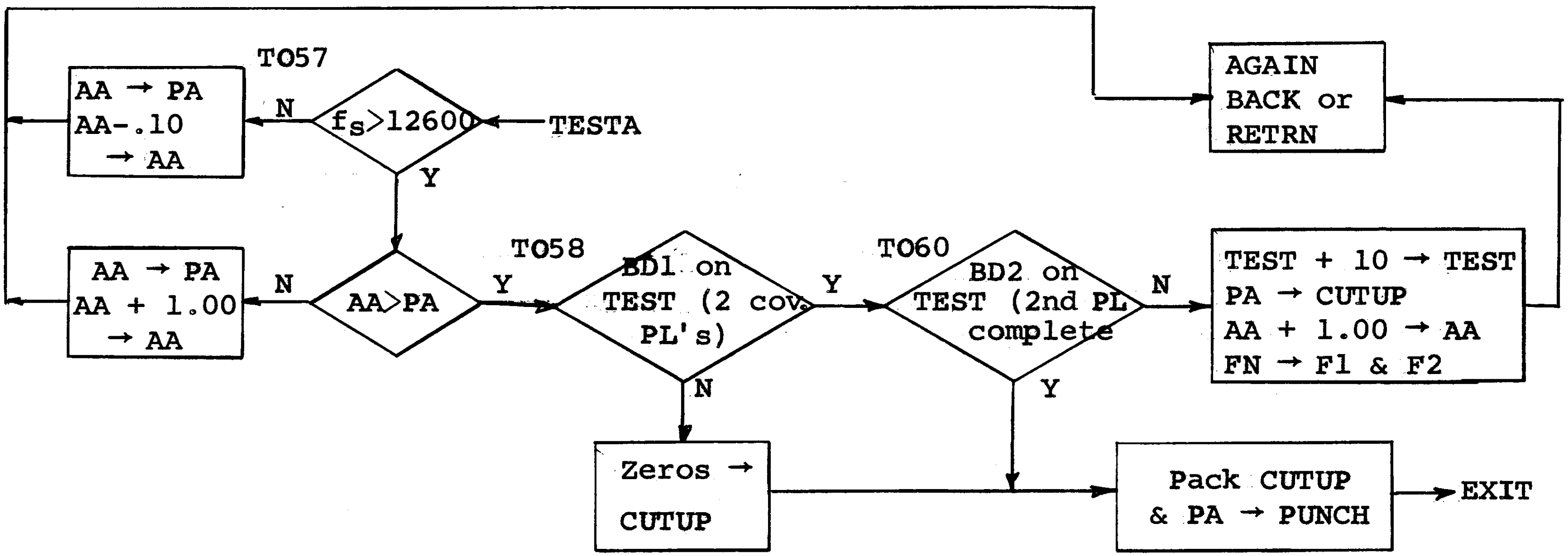
Note: EXIT 1 in distributor



Note: Fix adjacent L → L1, K_L, K_R, KNEX & A
EXIT 1 in Distributor

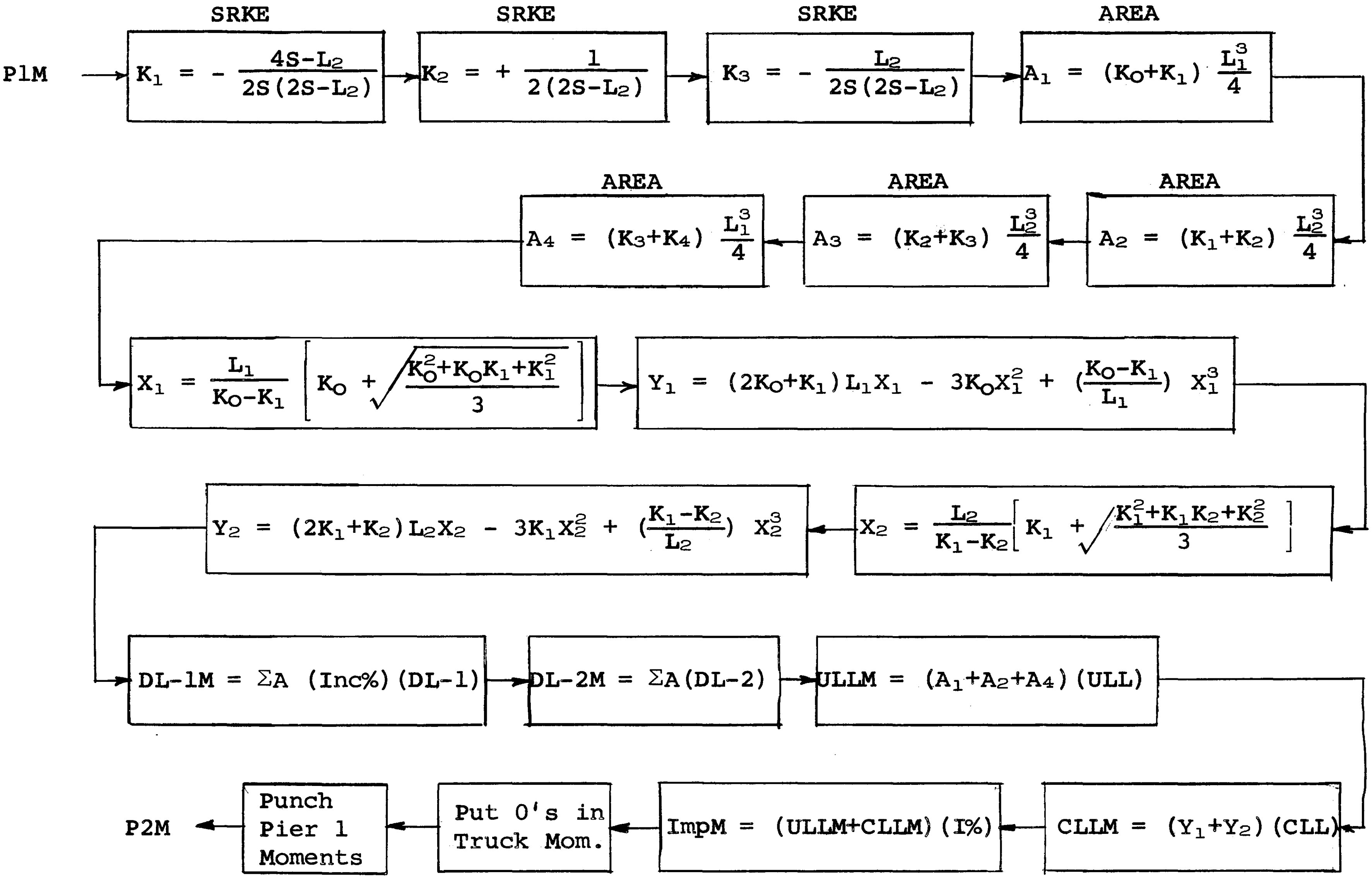


Note: EXIT in distributor
works for pos. or neg. stresses
leaves max stress in lower

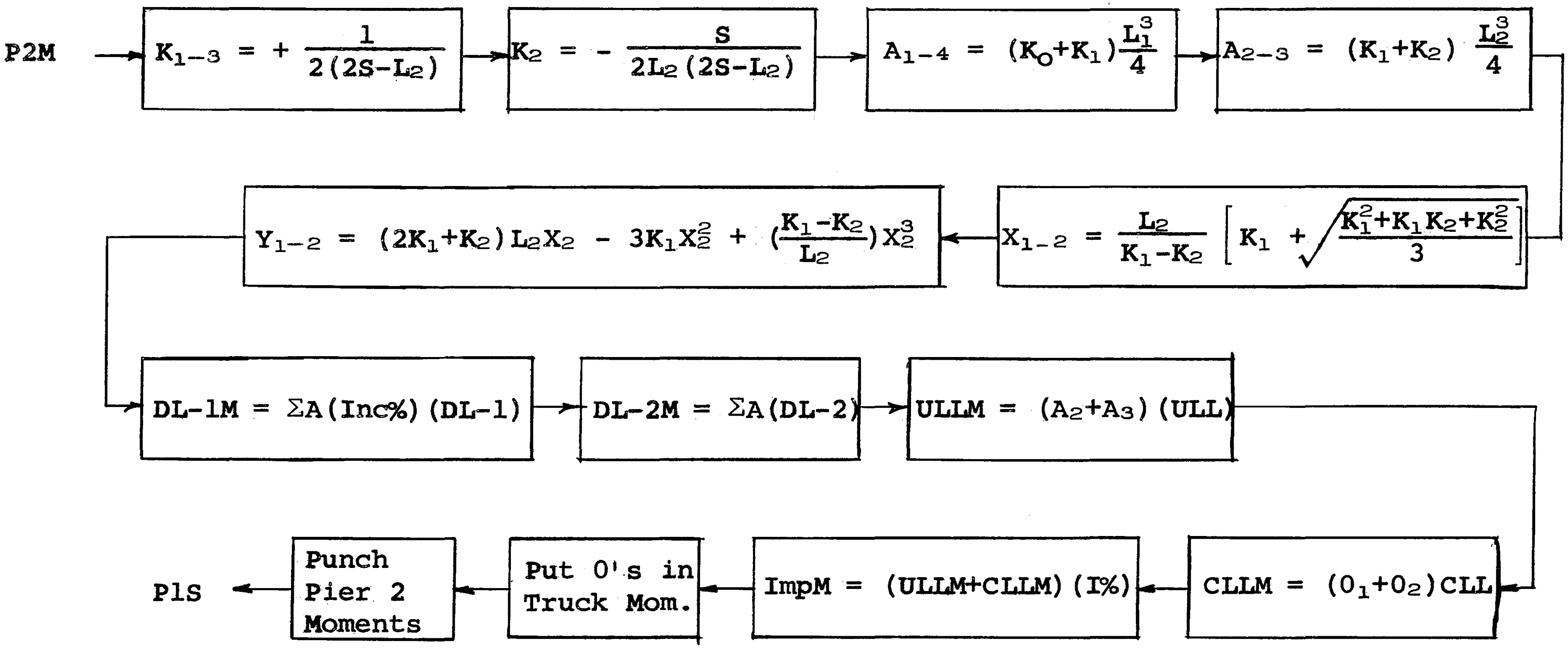


Note: EXIT in distributor
MAXST in lower

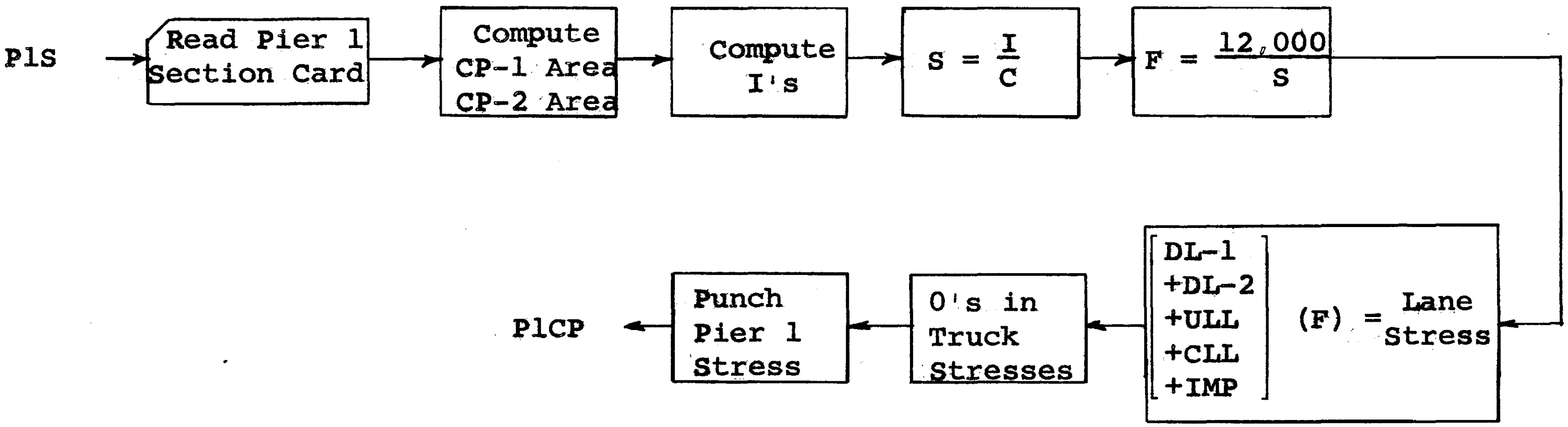
PIER 1 MOMENTS



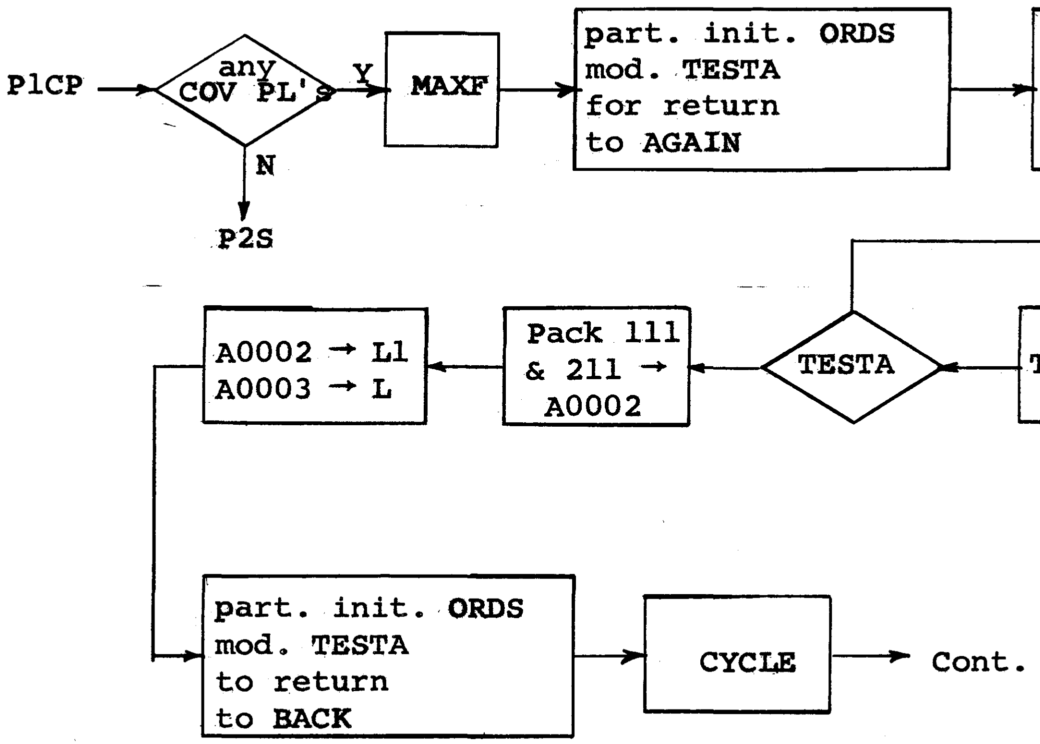
PIER 2 MOMENTS



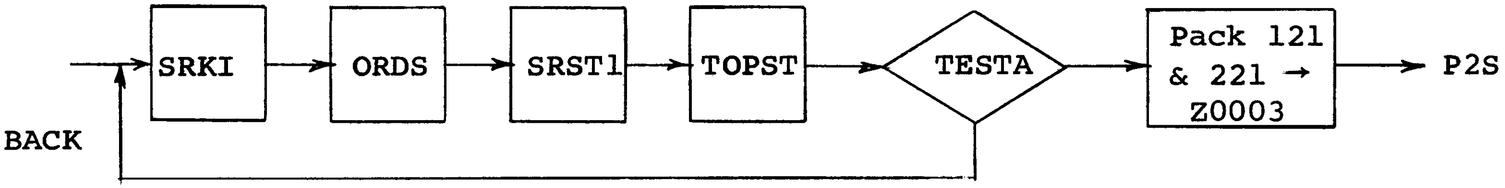
PIER 1 STRESS



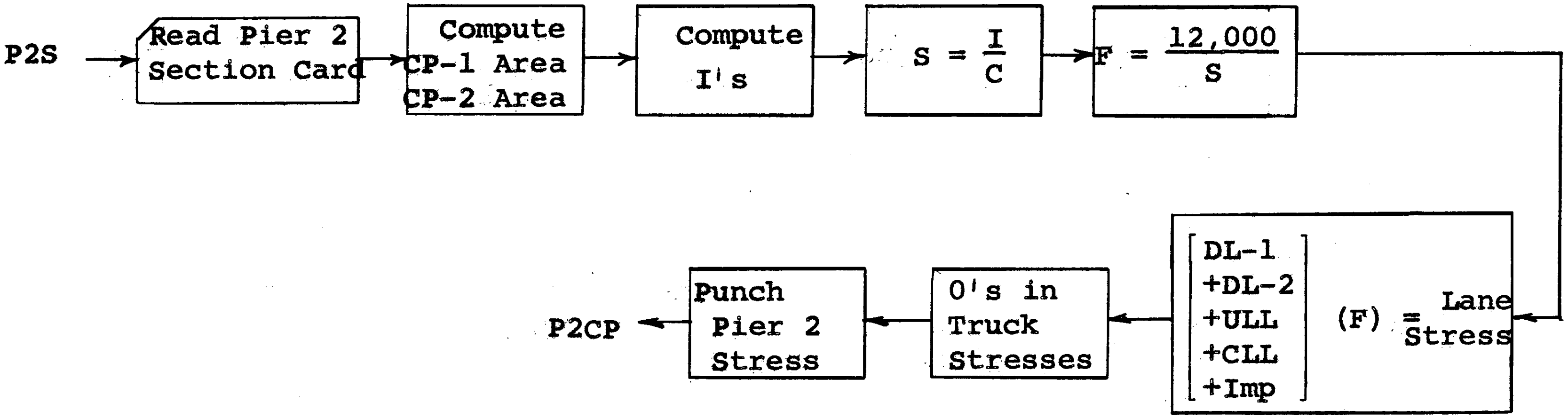
PIER 1 COVER PLATE LENGTHS



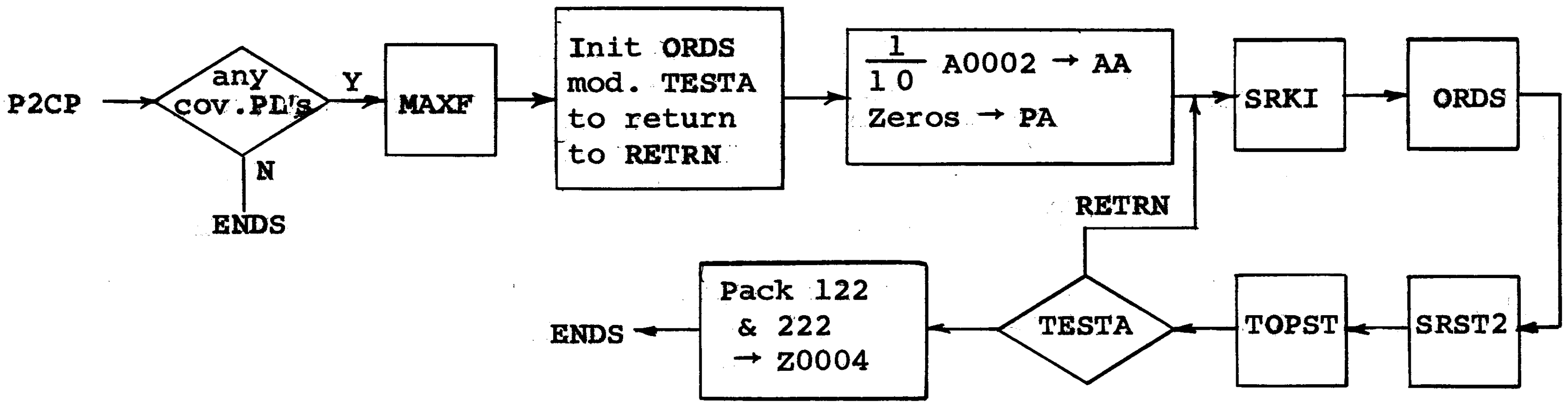
P1CP Continued



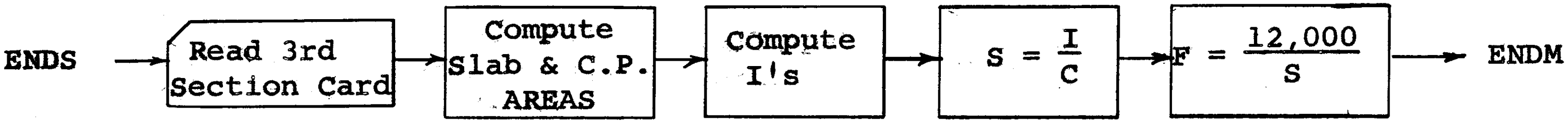
PIER 2 STRESS



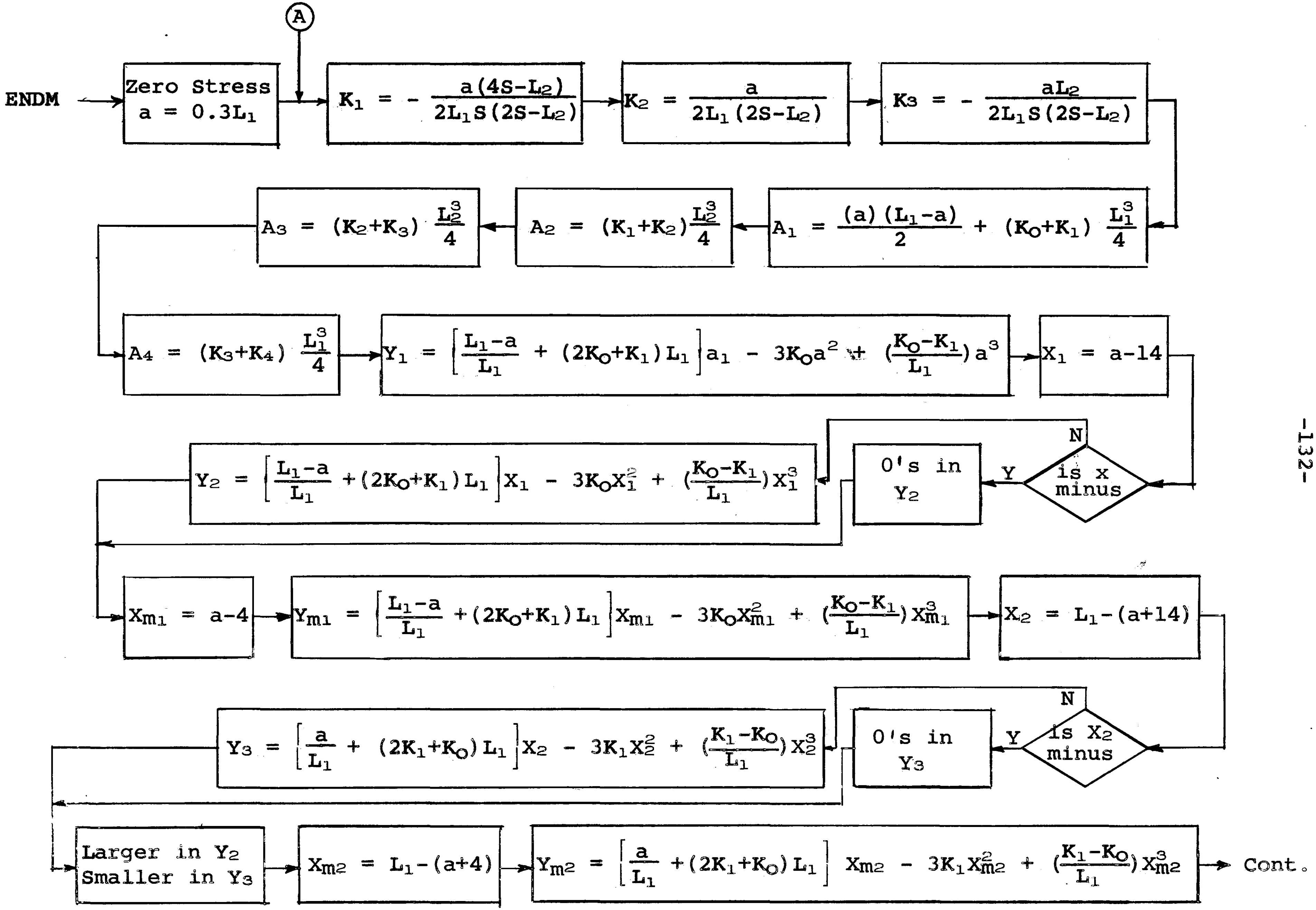
PIER 2 COVER PLATE LENGTHS



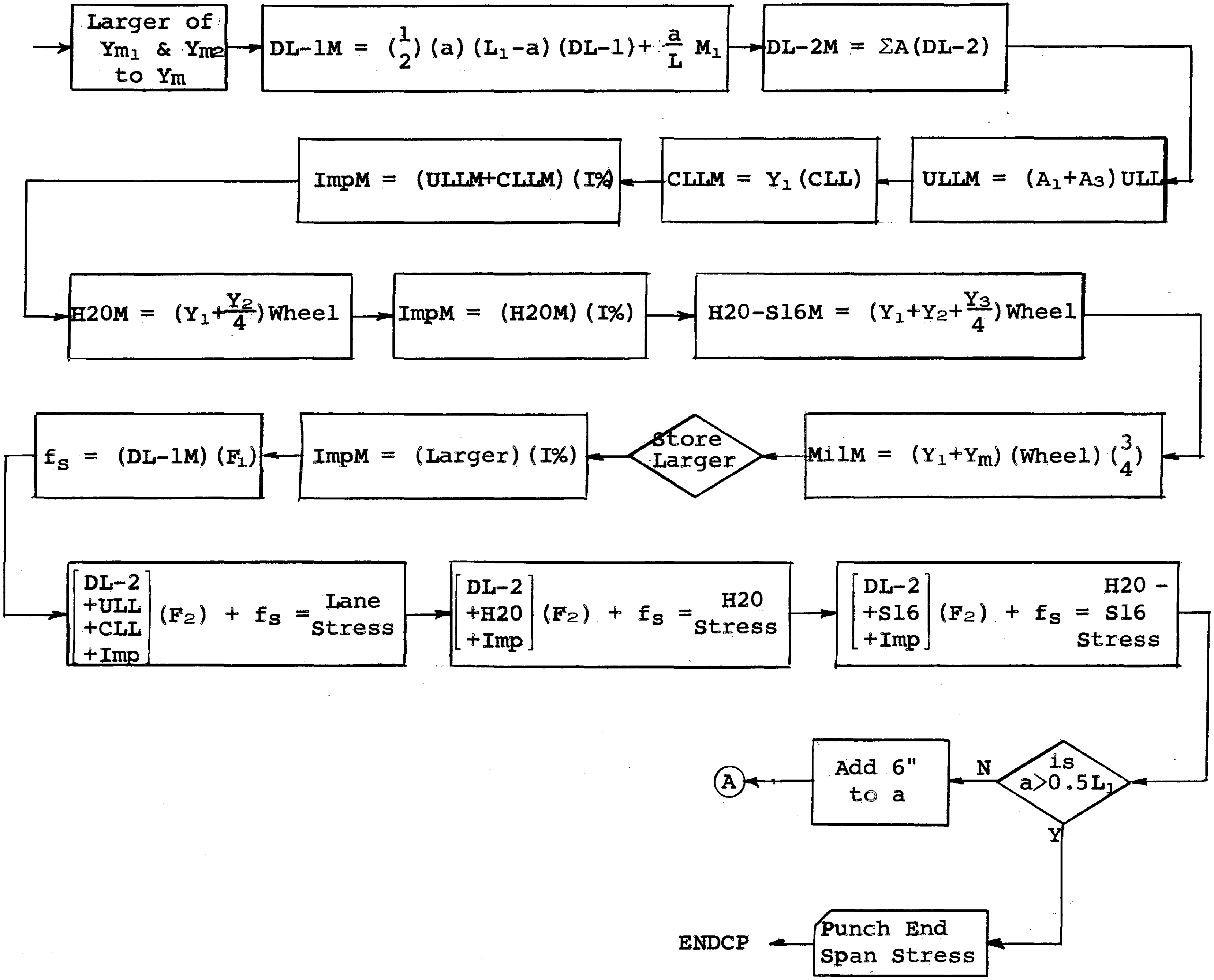
END SPAN SECTION PROPERTIES



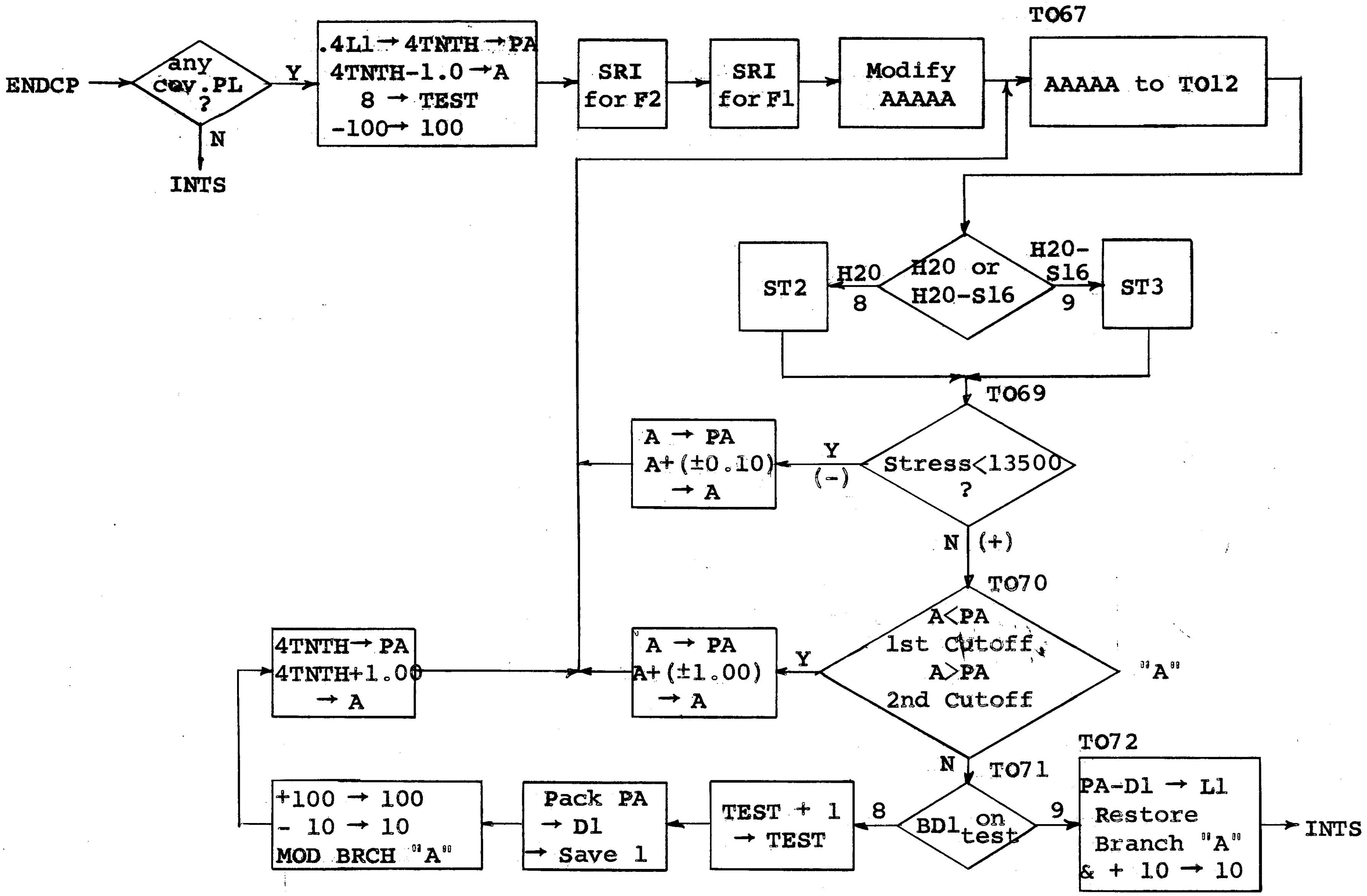
END SPAN MOMENTS AND STRESSES



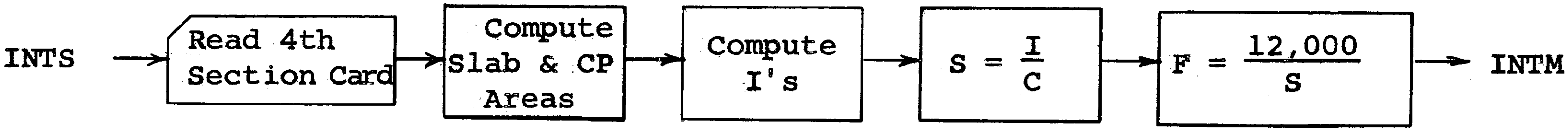
ENDM Continued



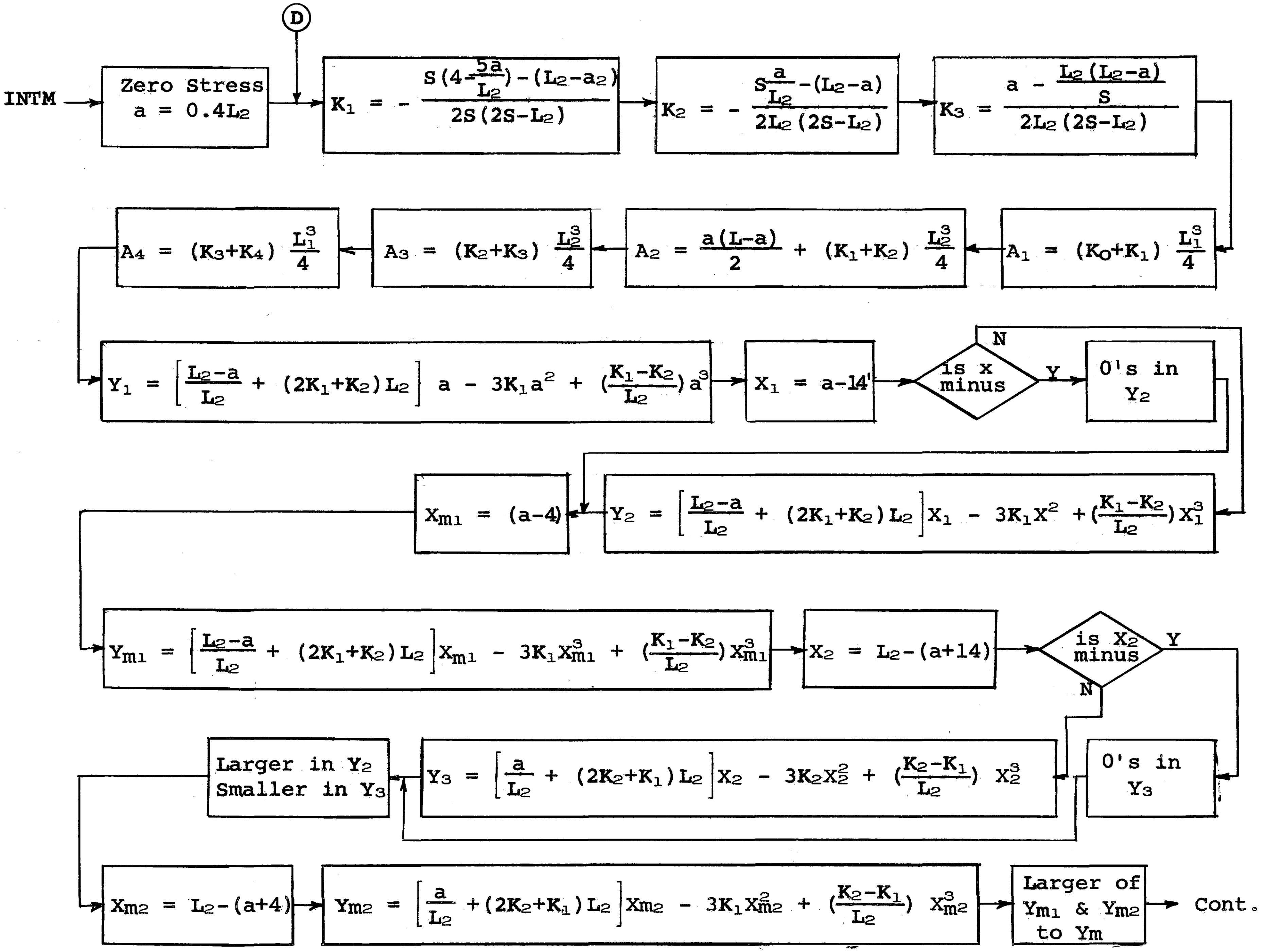
END COVER PLATE LENGTHS



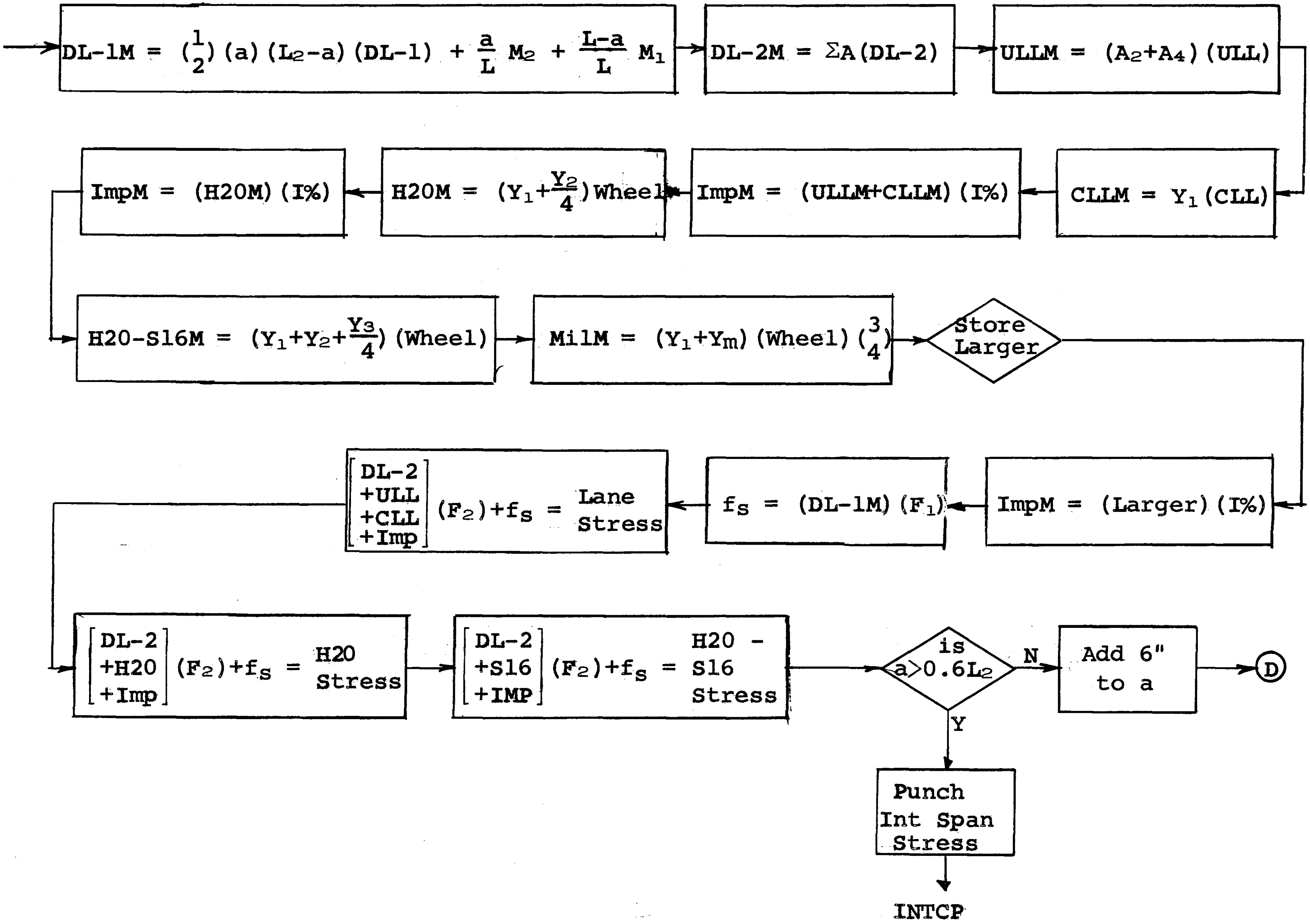
INTERIOR SPAN SECTION PROPERTIES



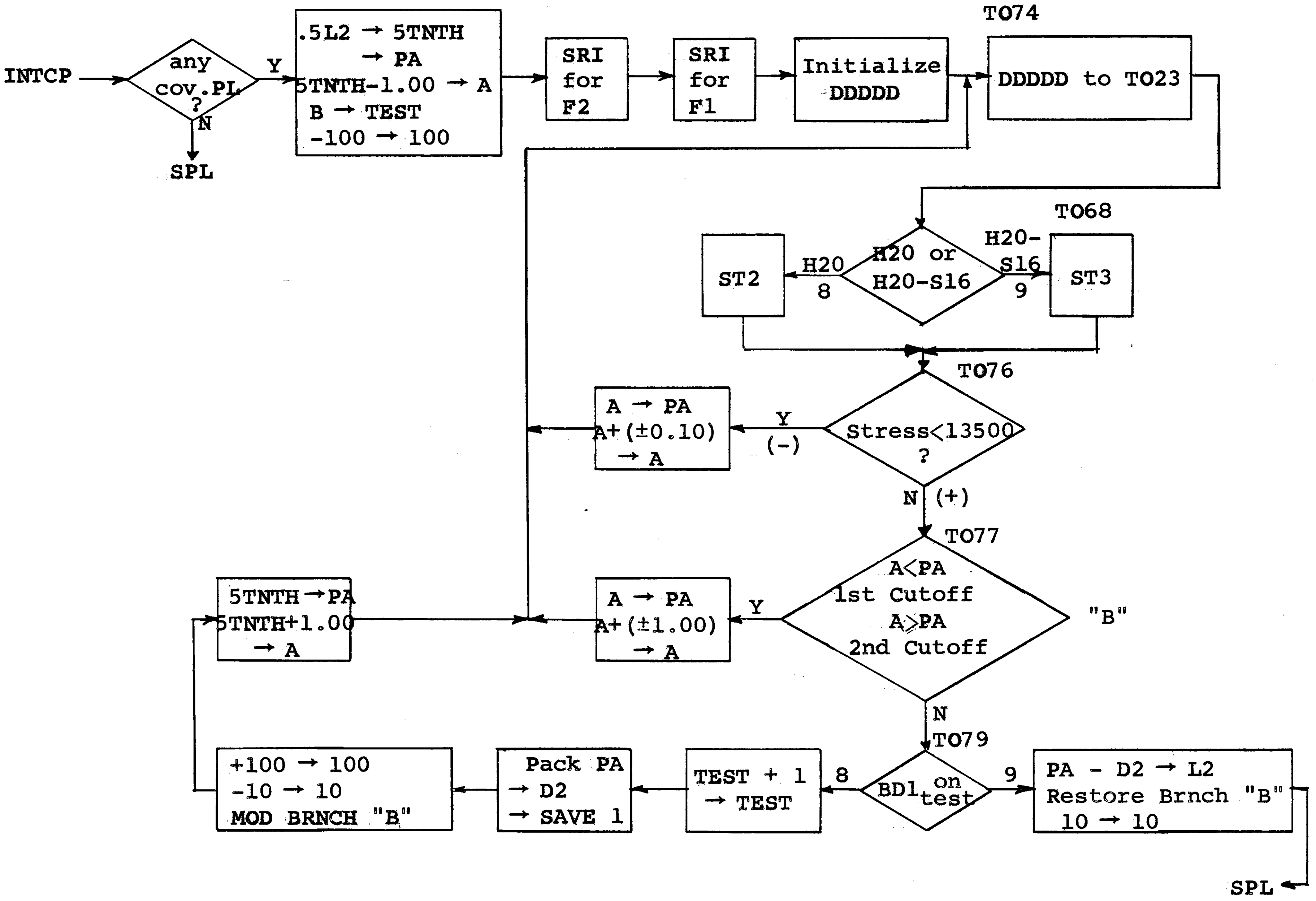
INTERIOR SPAN MOMENTS AND STRESSES



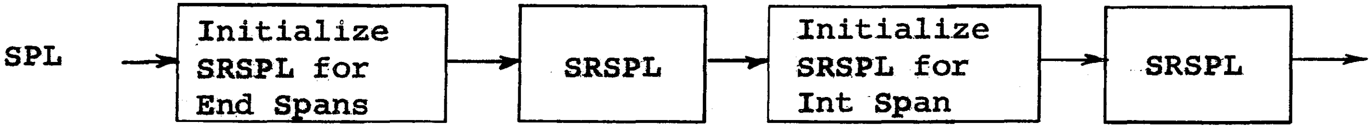
INTM Continued



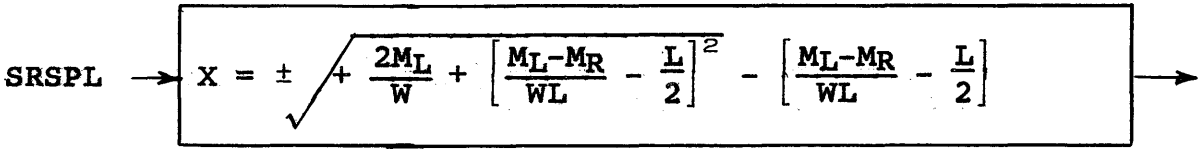
INTERIOR SPAN COVER PLATE LENGTHS



SPLICE POINTS



Fix W & L put M_L in upper M_R in lower



$$X = \pm \sqrt{+\frac{2M_L}{W} + \left[\frac{M_L-M_R}{WL} - \frac{L}{2}\right]^2} - \left[\frac{M_L-M_R}{WL} - \frac{L}{2}\right]$$

WORD LAYOUT FORM

650 MAGNETIC-DRUM DATA-PROCESSING MACHINE

PROGRAM NO. 32014

A0001	A0002	A0003	A0004	A0005	A0006	A0007	A0008	A0009	A0010
BEAM Point No County Design No Run	Length of End Span	Length of Int Span	Length of Bridge	Dead Load-1	Dead Load-2	Uniform Live Load	Conc. Live Load for Moment	Truck Wheel	0—0 8 H20 9 H20-S16 Pier-1 Incre. Pier-2 Incre.

B0001	B0002	B0003	B0004	B0005	B0006	B0007	B0008	B0009	B0010
BEAM Point No County Design No Run	Beam Area	Beam Depth	Beam I	Concrete Width	Concrete Thickness	N	Width Thickness Cover Plate-1	Width Thickness Cover Plate-2	H

P0001	P0002	P0003	P0004	P0005	P0006	P0007	P0008	P0009	P0010
BEAM Point No County Design No Run	DL-1 Moment Lane Stress	DL-2 Moment 0——0	ULL Moment 0——0	CLL Moment 0——0	Imp Moment 0——0	H20 Moment 0——0	Imp Moment 0——0	H20-S16 Moment 0——0	Imp Moment 0——0

W0001	W0002	W0003	W0004	W0005	W0006	W0007	W0008	W0009	W0010
BEAM Point No County Design No Run	Lane Stress		H20 Stress		H20-S16 Stress				

X0001	X0002	X0003	X0004	X0005	X0006	X0007	X0008	X0009	X0010
Y0001	Y0002	Y0003	Y0004	Y0005	Y0006	Y0007	Y0008	Y0009	Y0010
BEAM Point No County Design No Run	DL-1 Moment	DL-2 Moment	ULL Moment	CLL Moment	Imp Moment				

Z0001	Z0002	Z0003	Z0004	Z0005	Z0006	Z0007	Z0008	Z0009	Z0010
BEAM Point No County Design No Run	111 211	221 121	122 222		D14 L14	D25 L25	S11	S21 S22	

SYMBOL TABLE 32014

SYMBOL	LOCATION	DESCRIPTION
01	0308	CONSTANT
02	0358	CONSTANT
03	0908	CONSTANT
04	1558	CONSTANT
10	1285	CONSTANT
100	0474	CONSTANT
1000	1327	CONSTANT
12	0082	CONSTANT
125	1110	CONSTANT
126HU	1509	CONSTANT
135HU	0846	CONSTANT
14	0326	CONSTANT
15	1350	CONSTANT
2	0226	CONSTANT
24	1400	CONSTANT
25	0162	CONSTANT
3	0246	CONSTANT
4	0212	CONSTANT
4HUN	0072	CONSTANT
4TNTH	1197	Location of 0.4 length of end span xx.xx
5	0074	CONSTANT
5BILL	0363	CONSTANT
5TNTH	1855	Location of 0.5 length of interior span xx.xx
6	1100	CONSTANT
61	0408	CONSTANT
62	0658	CONSTANT
63	0958	CONSTANT
64	1608	CONSTANT
75	0090	CONSTANT
800	1377	CONSTANT
81	0086	CONSTANT
82	1537	CONSTANT
83	1687	CONSTANT
84	1491	CONSTANT
88	0168	CONSTANT
89	0512	CONSTANT
9	1300	CONSTANT
90	1450	CONSTANT
A	0511	Distance to point of influence line for sub routine xx.xx
A1	0627	AREA under the influence line for Span 0-1 xxxx.xx
A2	0677	AREA under the influence line for Span 1-2 xxxx.xx

SYMBOL	LOCATION	DESCRIPTION
A3	0727	AREA under the influence line for Span 2-3 xxxx.xx
A4	0777	AREA under the influence line for Span 3-4 xxxx.xx
AA	1261	Working Storage for A xx.xx
AAAAA	0814	Transfer Control
AGAIN	1421	First instruction of first loop in P1CP
AREA	0180	Start of Area Sub routine
BACK	1437	First instruction of second loop in P1CP
BMNO	0416	Beam Number x
CLLM	0395	Concentrated Live Load Moment xxxx.xx
CP1A	0103	Cover Plate 1 Area xx.xx
CP1T	0066	Cover Plate 1 Thickness xx.xxx
CP1W	0059	Cover Plate 1 Width xx.xxx
CP2A	0153	Cover Plate 2 Area xx.xx
CP2T	0116	Cover Plate 2 Thickness xx.xxx
CP2W	0109	Cover Plate 2 Width xx.xxx
CP3A	0203	Cover Plate 3 Area xx.xx
CP3T	0166	Cover Plate 3 Thickness xx.xxx
CP3W	0159	Cover Plate 3 Width xx.xxx
CP4A	0253	Cover Plate 4 Area xx.xx
CP4T	0216	Cover Plate 4 Thickness xx.xxx
CP4W	0209	Cover Plate 4 Width xx.xxx
CUTUP	0388	Storage for first cover plate cutoff as determined in TESTA
CYCLE	0800	Start of sub routine to partially initialize second loop in P1CP
DDDDD	1364	Transfer Control
DESN	1093	Design Number xxxxxxx
DL1M	0589	Dead Load 1 Moment xxxx.xx
DL2M	0593	Dead Load 2 Moment xxxx.xx
ENDCP	1028	Start of End Span Cover Plate Computation
ENDM	1660	Start of End Span Moment Computation
ENDS	1817	Start of End Span Section Properties Computation
EXIT	0053	Storage of Exit Instruction for Sub routines
EXIT1	0407	Storage of Exit Instruction for Sub routines
EXIT2	1053	Storage of Exit Instruction for Sub routines
EXITA	1861	Instruction to modify ENDM for use in ENDCP
EXITD	1814	Instruction to modify INTM for use in INTCP

SYMBOL	LOCATION	DESCRIPTION
F1	0196	Mom. of Inertia factor for Comp. Dead Load 1 stress xx.xx
F2	0756	Mom. of Inertia factor for comp. Dead Load 2 stress xx.xx
FC	0362	Current mom. of inertia factor xx.xx
FIFTY	0058	CONSTANT
FN	0971	Next mom. of inertia factor xx.xx
H20M	0495	H20 Moment xxxx.xx
IMP	0765	Percent of Impact for sub routines .xxx
IMP1	0732	Percent of Impact for End Span .xxx
IMP2	0609	Percent of Impact for Pier 1 .xxx
IMP3	0659	Percent of Impact for Interior Span and Pier 2 .xxx
IMPM1	0449	Lane Load Impact Moment xxxx.xx
IMPM2	0549	H20 Impact Moment xxxx.xx
IMPM3	0529	H20-S16 Impact Moment xxxx.xx
INC1	0094	Increase factor for infl. line areas for Dead Load 1 at Pier 1 x.xxx
INC2	0144	Increase factor for infl. line areas for Dead Load 1 at Pier 2 x.xxx
INTCP	1728	Start of Interior span cover plate computation
INTM	1762	Start of Interior span moment computation
INTS	0770	Start of Interior span section properties computation
K1	0527	Pier 1 K factor .xxxxxxx
K2	0477	Pier 2 K factor .xxxxxxx
K3	0577	Pier 3 K factor .xxxxxxx
KL	0763	Left K factor used in sub routines .xxxxxxx
KNEX	1277	K factor at far end of adjacent span used in ORDS .xxxxxxx
KR	0176	Right K factor used in sub routines .xxxxxxx
L	0349	Length of span used in sub routines xxx.xx
L1	1019	Length of adjacent span used in ORDS xx.xx
L134	0134	$L_1^3/4$ xxxxxx.xx
L234	0184	$L_2^3/4$ xxxxxx.xx
MAXF	0650	Start of sub routine to find mom. of inertia factors for beam and beam with one cover plate
MDFY1	0372	Instruction to modify TESTA to return to AGAIN

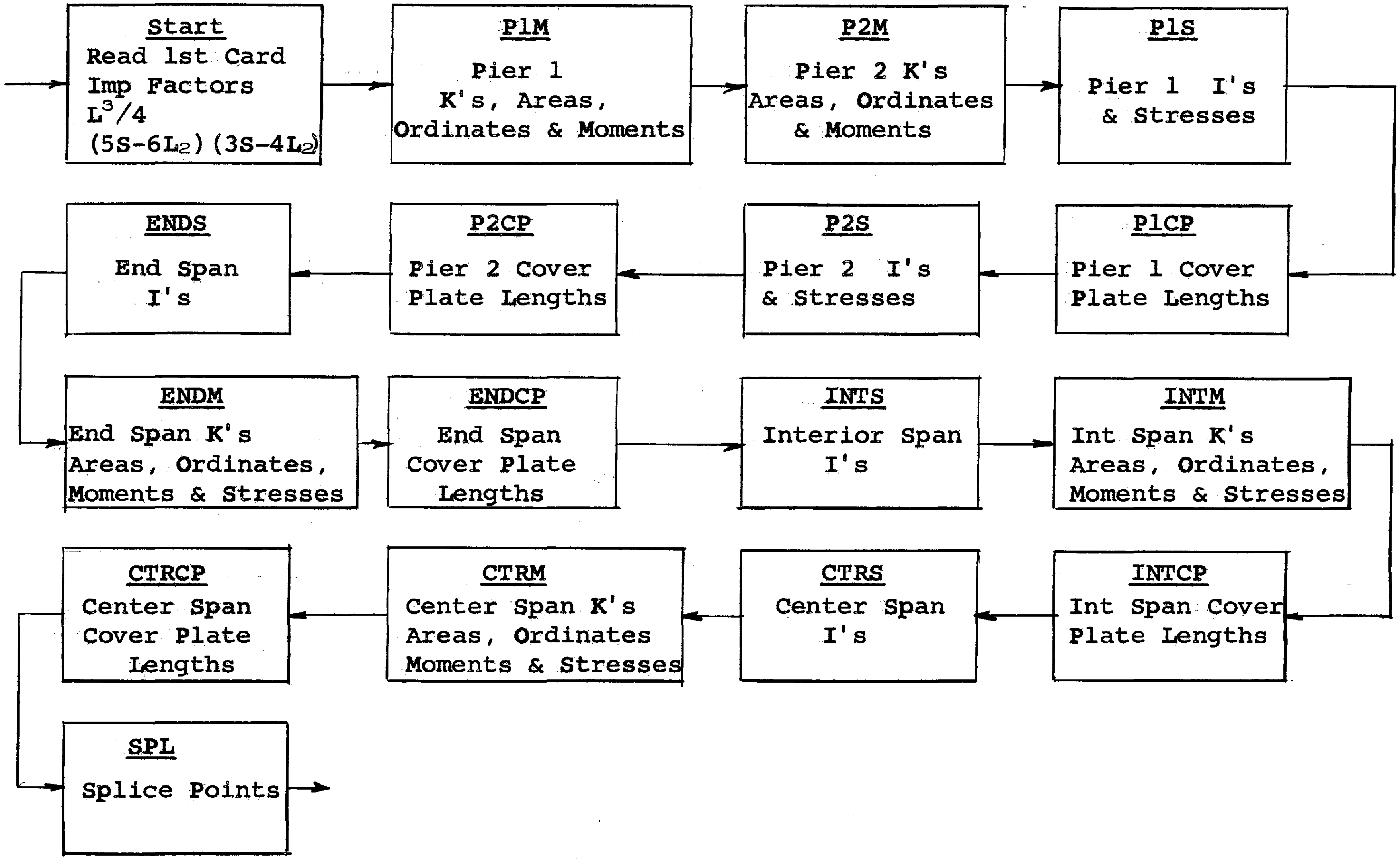
SYMBOL	LOCATION	DESCRIPTION
MDFY2	1205	Instruction to modify TESTA to return to BACK
MDFY3	0572	Instruction to modify TESTA to return to RETRN
MDFY4	1561	Instruction to modify TO3A to reverse branch instruction
ML	0710	Left moment used in sub routines xxxx.xx
MR	0617	Right moment used in sub routines xxxx.xx
NEGA	1087	Negative area of influence lines
NEGAP	0871	Sum of negative influence line areas used in SRST1 & SRST2 xxx.xx
ONE	1250	CONSTANT
ONEM	1535	CONSTANT
ORDS	0700	Start of sub routine to compute maximum influence line ordinates in P1CP & P2CP
P1CP	0478	Start of Pier 1 Cover Plate Computation
P1M	1237	Start of Pier 1 Moment Computation
P1S	0378	Start of Pier 1 Section Properties Computation
P2CP	0578	Start of Pier 2 Cover Plate Computation
P2M	0228	Start of Pier 2 Moment Computation
P2S	1767	Start of Pier 2 Section Properties Computation
PA	0318	Previous distance A xx.xx
PCHEM	1871	Punch End Span Moments
PCHIM	1272	Punch Interior Span Moments
PUNCH	1103	Location of packed cover plate lengths in TESTA
RETRN	1621	First instruction of loop in P2CP
S16M	0595	H20-S16 Moment xxxx.xx
SAFE	1005	Storage for original instr. in sub routine SRME which is modified for use in other sub routines
SAVE	0570	Storage for L - A xx.xx
SAVE2	1328	Temporary storage for PA
SPL	1120	Start of Splice Point Computation
SQRT	0150	Start of Square Root Sub routine
SRI	0100	Start of Moment of Inertia sub routine
SRKE	0200	Start of End Span K-factor sub routine
SRKI	0250	Start of Interior span K-factor sub routine
SRME	0400	Start of End Span moment sub routine
SRMI	0450	Start of Interior Span moment sub routine

SYMBOL	LOCATION	DESCRIPTION
SRSPL	1200	Start of theoretical splice point sub routine
SRST1	0300	Start of moment sub routine for cover plate cutoffs
SRST2	0350	Start of sub routine for moments in interior span for cover plate cutoffs
SRX	0550	Start of distance sub routine
SRY	0500	Start of Ordinate Computation sub routine
ST1	0739	Lane Load Stress xxxxx
ST2	0839	H20 Stress xxxxx
ST3	0939	H20-S16 Stress xxxxx
START	0050	Start of Program
STOP1	1137	STOP
STOP2	0925	STOP
STOP3	0695	STOP
STOP4	0900	STOP
STOP5	0845	STOP
STOP6	0945	STOP
STOP7	1349	STOP
STOP8	0612	STOP
SUMAY	0085	Summation of Area times the distance from the centroid xx.xx
TEMP1	0057	Temporary Storage
TEMP2	0131	Temporary Storage
TEMP3	0188	Temporary Storage
TEMP4	0076	Temporary Storage
TEMP5	0126	Temporary Storage
TEMP6	0061	Temporary Storage
TEST	0124	Storage for 8's or 9's for BDn branch instructions
TESTA	0850	Beginning of sub routine to control transfer for cover plate cutoff
TO1	0343	Transfer Control
TO10	0964	Transfer Control
TO11	1047	Transfer Control
TO12	0886	Transfer Control
TO13	1097	Transfer Control
TO15	1147	Transfer Control
TO16	0342	Transfer Control
TO17	1308	Transfer Control
TO18	0392	Transfer Control
TO19	1408	Transfer Control
TO2	0285	Transfer Control
TO20	1518	Transfer Control
TO21	1718	Transfer Control

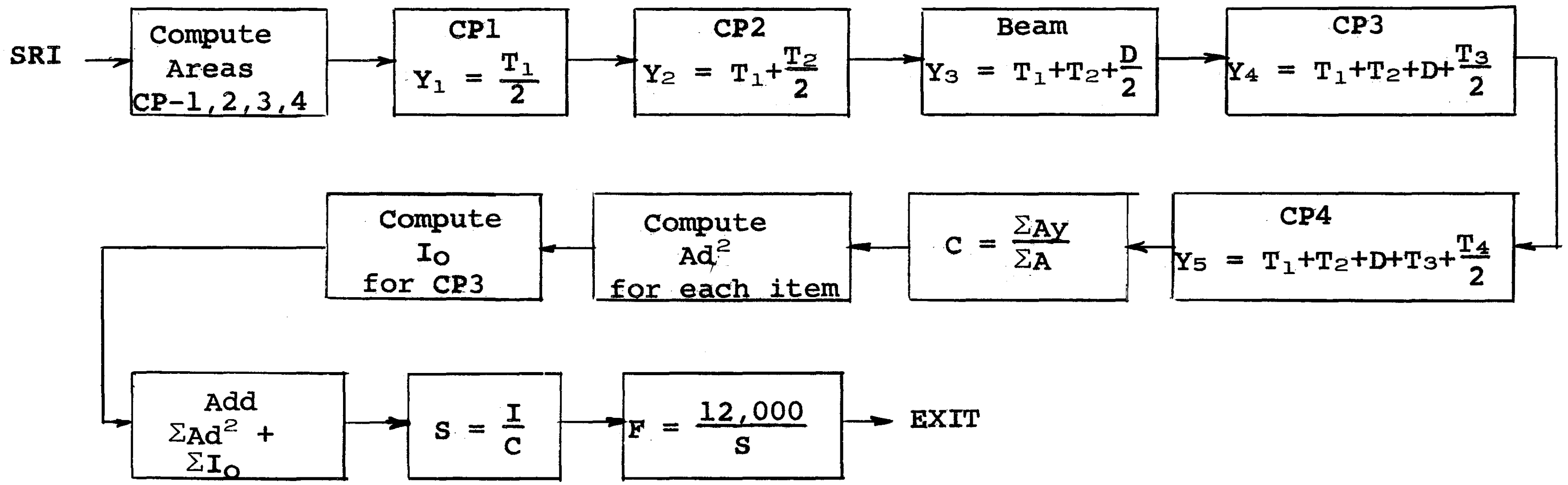
SYMBOL	LOCATION	DESCRIPTION
TO22	1347	Transfer Control
TO23	1738	Transfer Control
TO24	1397	Transfer Control
TO26	1447	Transfer Control
TO3	1031	Transfer Control
TO32	0122	Transfer Control
TO3A	0649	Transfer Control
TO4	0152	Transfer Control
TO4A	0753	Transfer Control
TO5	0240	Transfer Control
TO50	1267	Transfer Control
TO51	0218	Transfer Control
TO53	1515	Transfer Control
TO54	1013	Transfer Control
TO55	0268	Transfer Control
TO56	0747	Transfer Control
TO57	0366	Transfer Control
TO58	1477	Transfer Control
TO59	0929	Transfer Control
TO6	0758	Transfer Control
TO60	0632	Transfer Control
TO61	0484	Transfer Control
TO67	0591	Transfer Control
TO674	1299	Transfer Control
TO684	1341	Transfer Control
TO69	1593	Transfer Control
TO69A	0208	Transfer Control
TO7	0290	Transfer Control
TO70	1605	Transfer Control
TO71	1228	Transfer Control
TO72	1391	Transfer Control
TO73	0718	Transfer Control
TO74	1499	Transfer Control
TO75	1202	Transfer Control
TO76	1893	Transfer Control
TO77	1356	Transfer Control
TO78	1420	Transfer Control
TO79	1590	Transfer Control
TO8	0808	Transfer Control
TO80	1145	Transfer Control
TO9	0914	Transfer Control
TO98	0440	Transfer Control
TO99	1000	Transfer Control
TOPST	0750	Start of sub routine to find greatest value of ST1, ST2 & ST3

SYMBOL	LOCATION	DESCRIPTION
ULLM	0493	Uniform Live Load Moment xxxx.xx
W	1925	Dead Load 1 plus Dead Load 2
X	0419	Distance to required ordinate xx.xx
XO	0597	Distance to zero ordinate xx.xx
Y1	0399	Maximum ordinate xx.xx
Y2	0455	Second Truck Ordinate or Span 2 ordinate for Pier Moment xx.xx
Y3	0505	Third Truck ordinate xx.xx
Y4	0606	Maximum ordinate in adjacent span for second concentrated live load used in P1CP & P2CP xx.xx
YM	0656	Military Ordinate xx.xx

GENERAL FLOW DIAGRAM (5 Span)



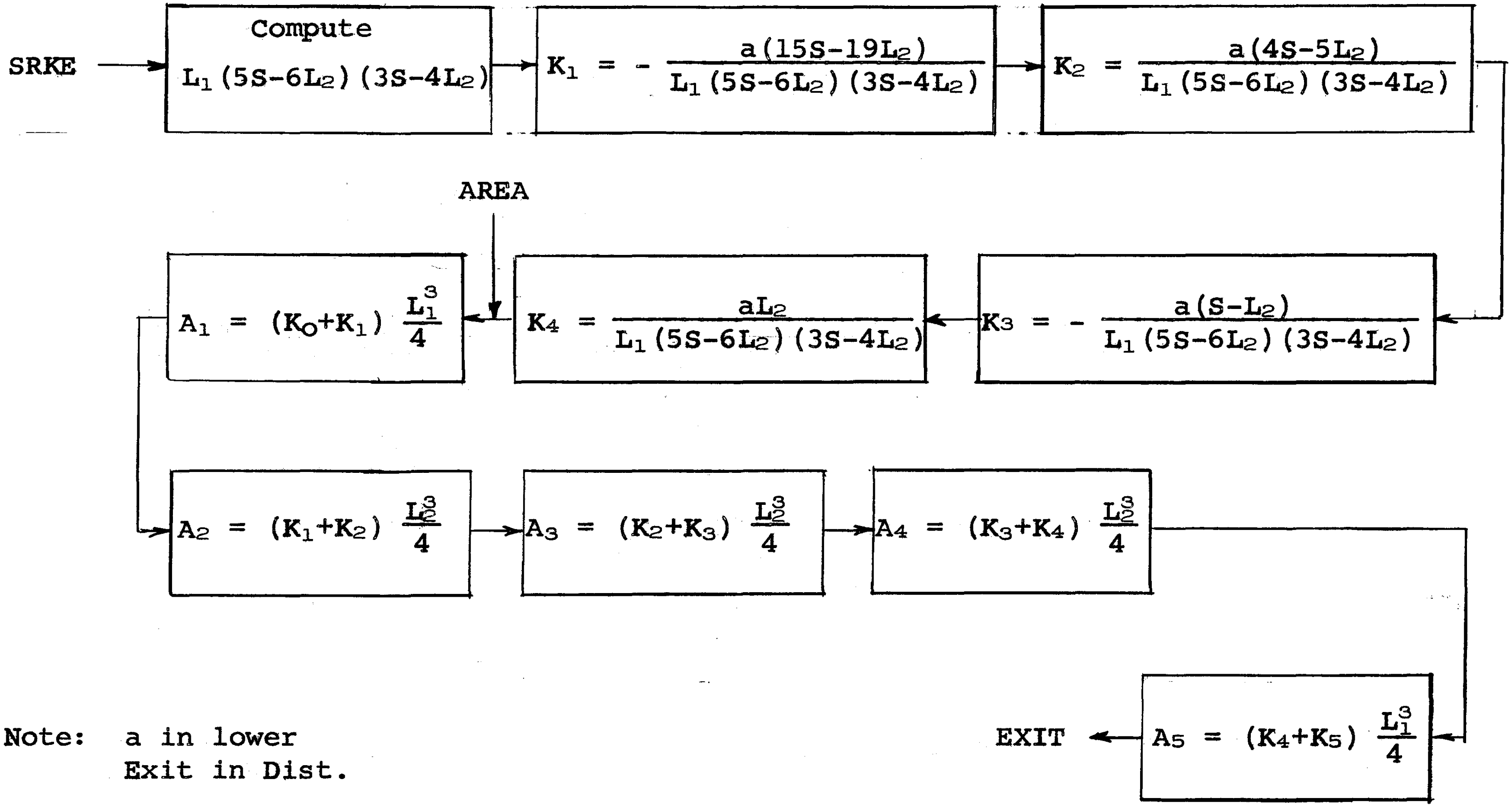
I SUB ROUTINE



Note: Set CP1W CP1T
CP2W CP2T
CP3W CP3T
CP4W CP4T
Exit instruction
in Dist.

END SPAN K FACTORS

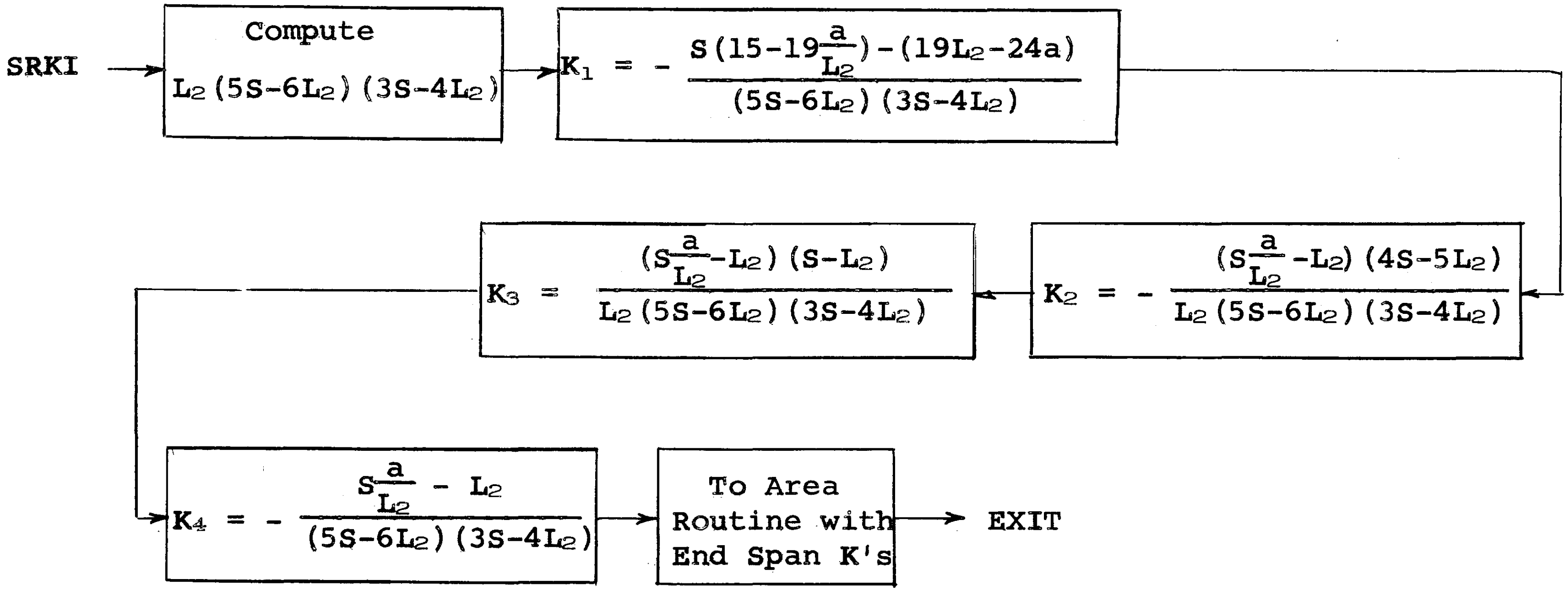
Sub Routine SRKE
Area Sub Routine



Note: a in lower
Exit in Dist.

INTERIOR SPAN K FACTORS

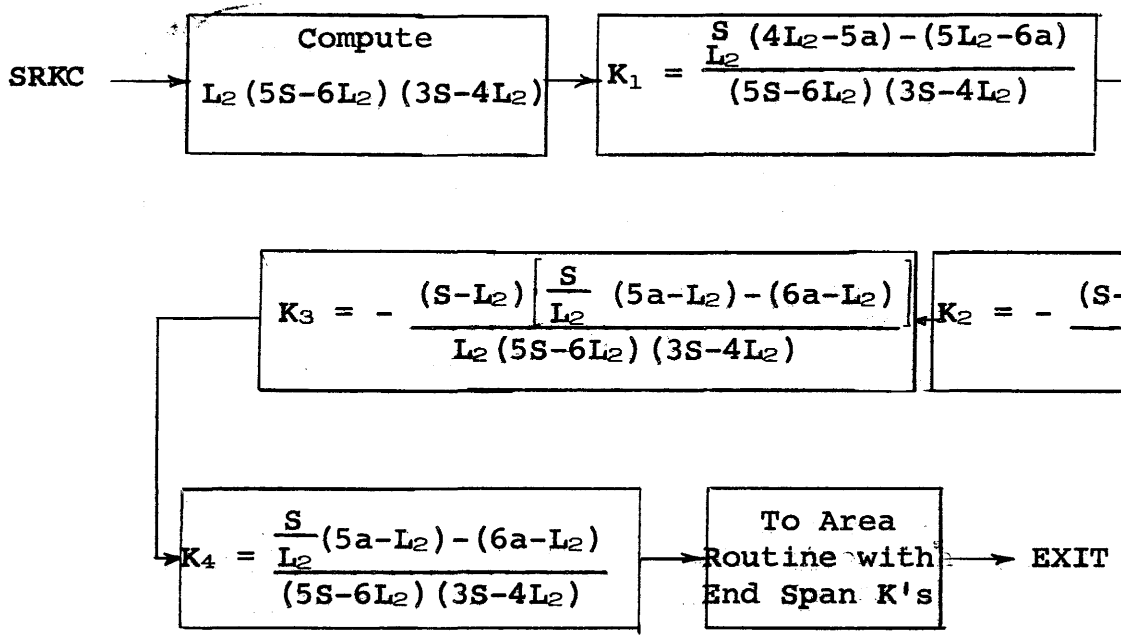
Sub Routine SRKI



Note: a in lower
Exit in Dist.

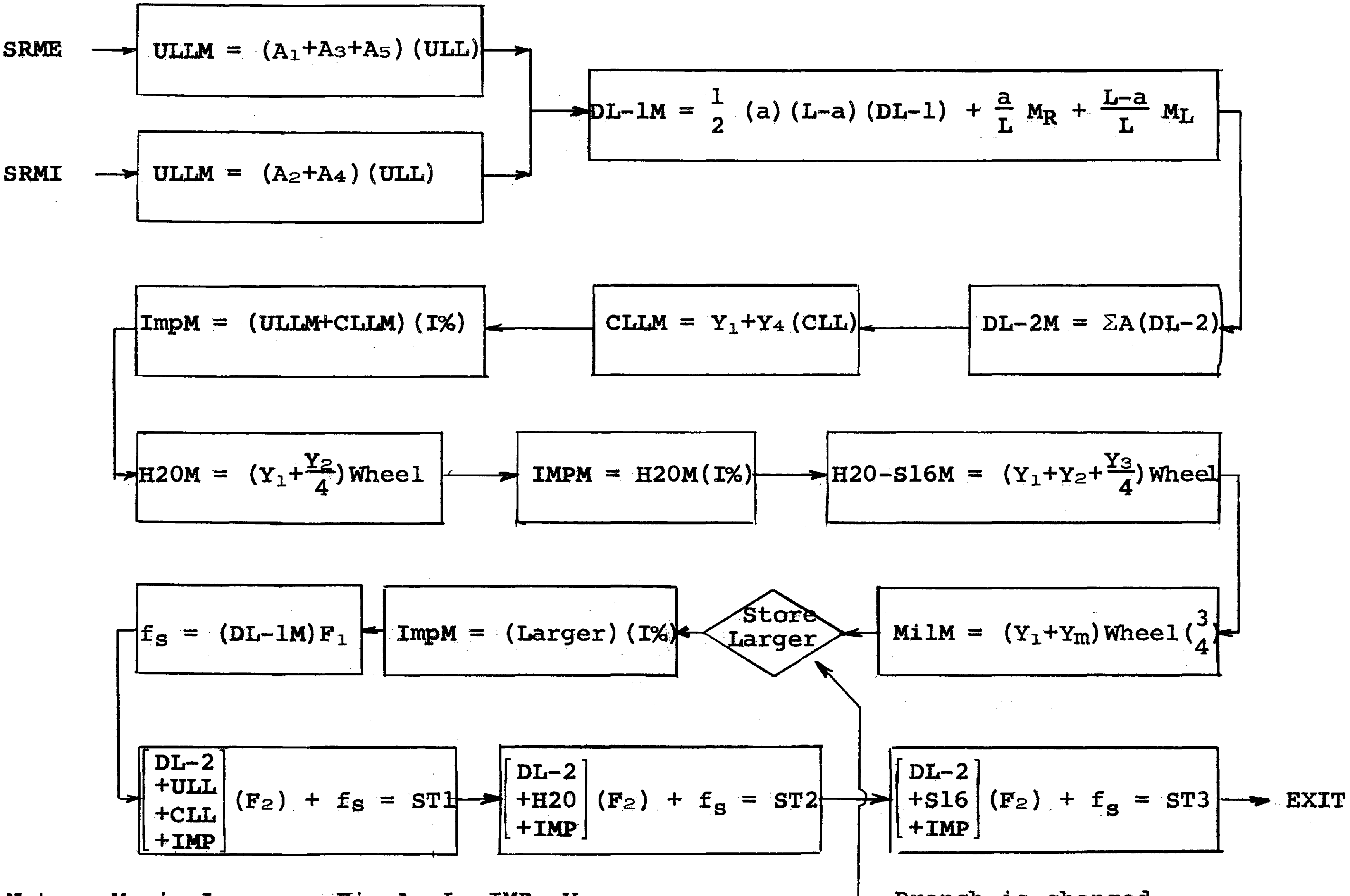
CENTER SPAN K FACTORS

Sub Routine SRKC



Note: a in lower
Exit in Dist.

MOMENT SUB ROUTINE

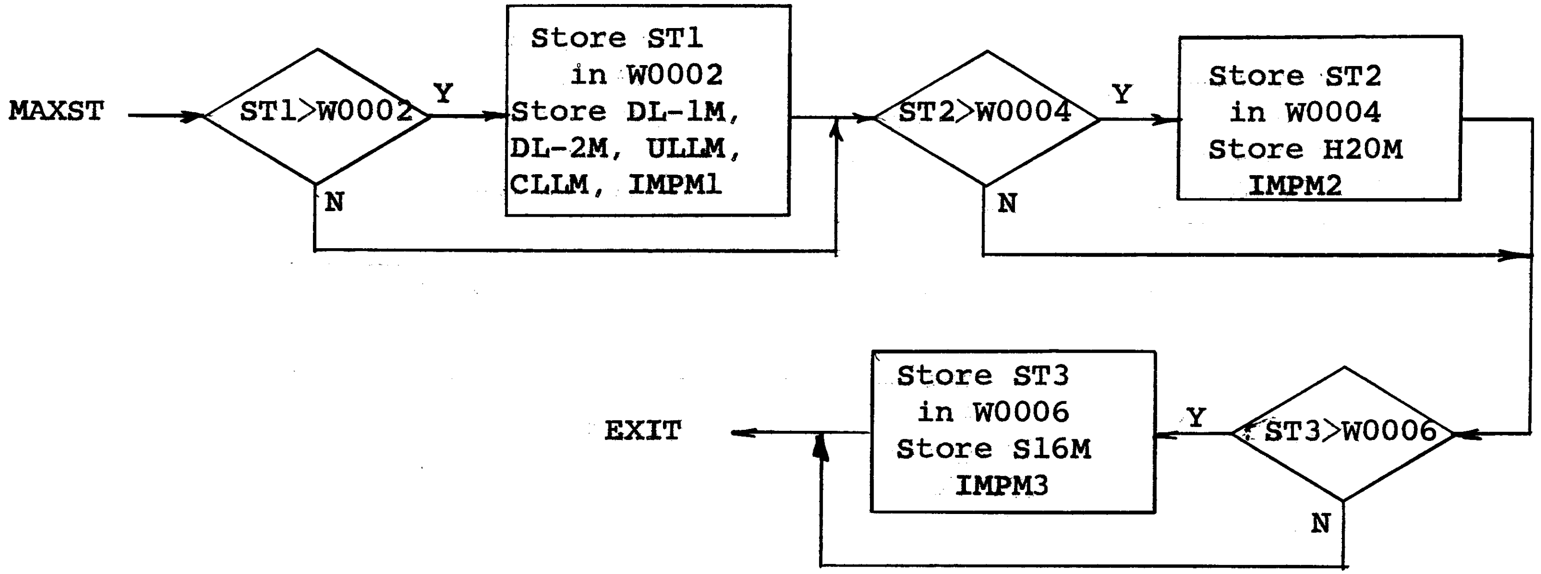


Branch is changed
for cover plate
routines

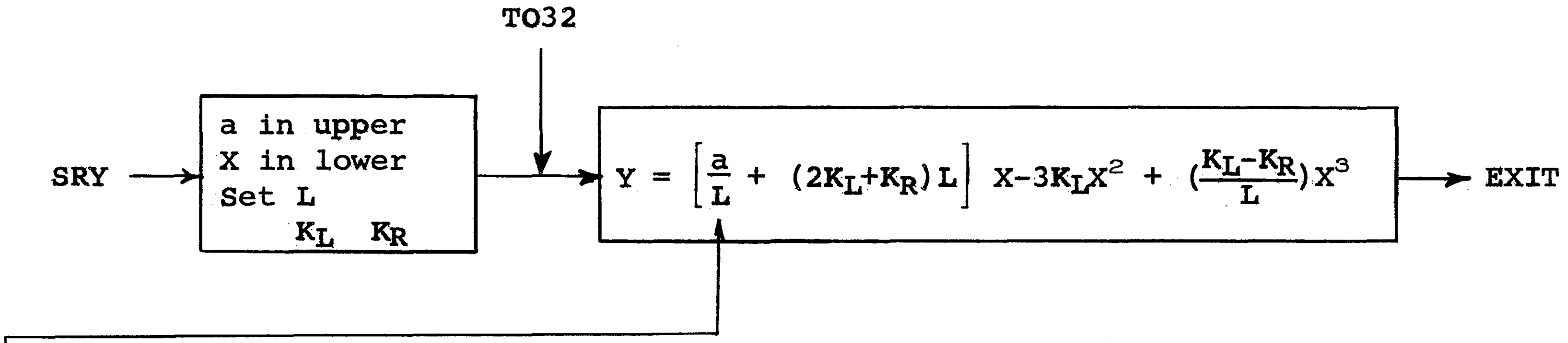
Note: M_R in Lower
M_L in Upper
Exit in Dist.

Fix A, L, IMP, Y_4

MAXIMUM STRESS SUB ROUTINE

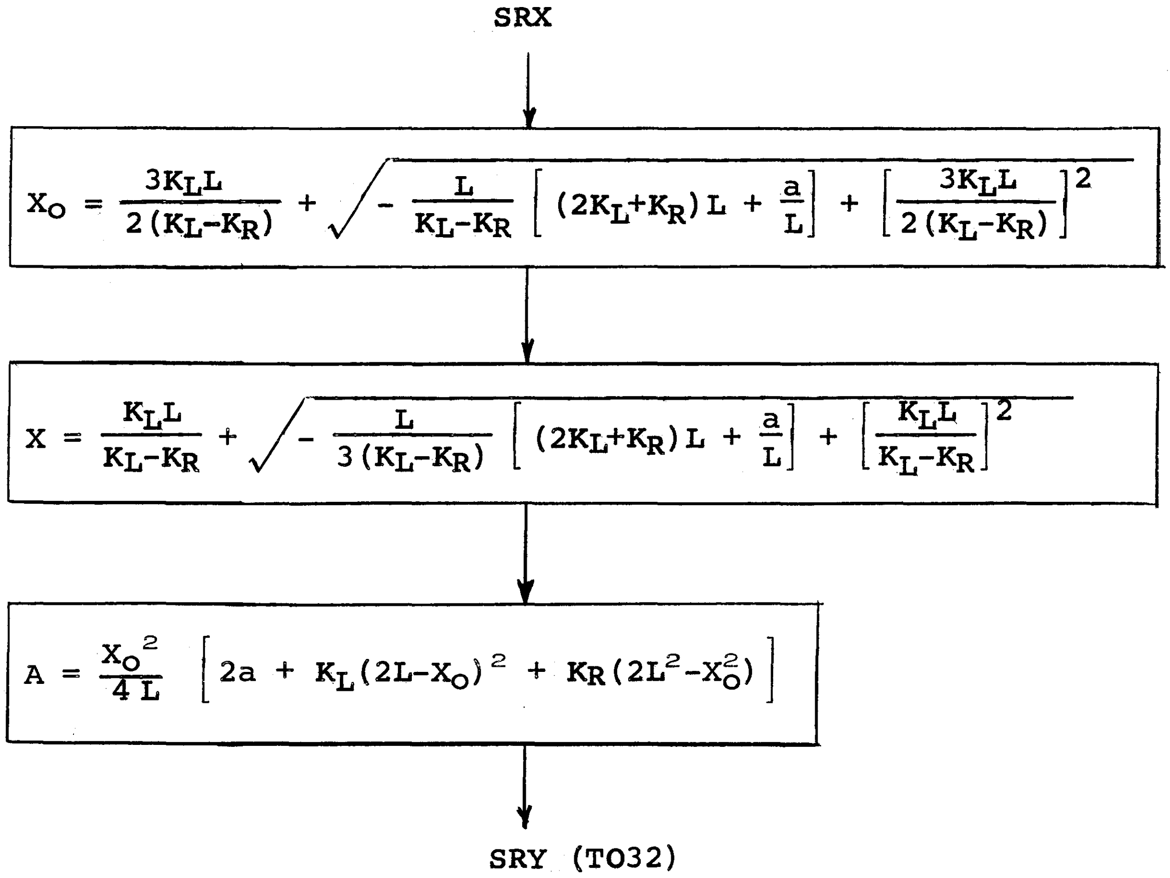


SUB ROUTINE SRY



Note: When the first term of the equation contains L-a instead of a, substitute L-a for a. When the equation does not contain the first term, make a equal to zero.

SUB ROUTINE SRX



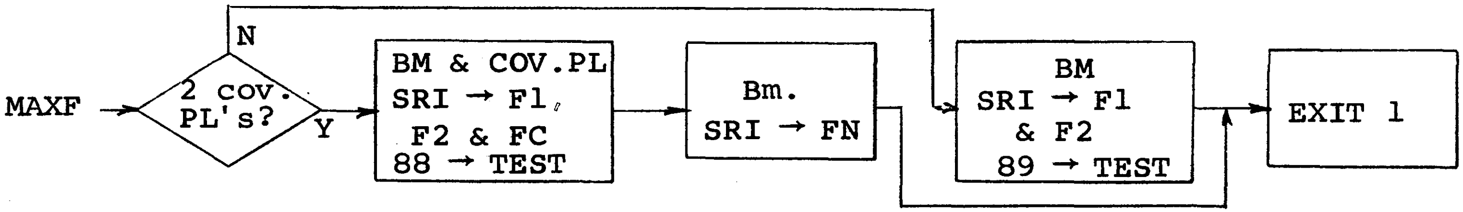
$$X_o = \frac{3K_L L}{2(K_L-K_R)} + \sqrt{- \frac{L}{K_L-K_R}\left[(2K_L+K_R)L + \frac{a}{L}\right] + \left[\frac{3K_L L}{2(K_L-K_R)}\right]^2}$$

$$X = \frac{K_L L}{K_L-K_R} + \sqrt{- \frac{L}{3(K_L-K_R)}\left[(2K_L+K_R)L + \frac{a}{L}\right] + \left[\frac{K_L L}{K_L-K_R}\right]^2}$$

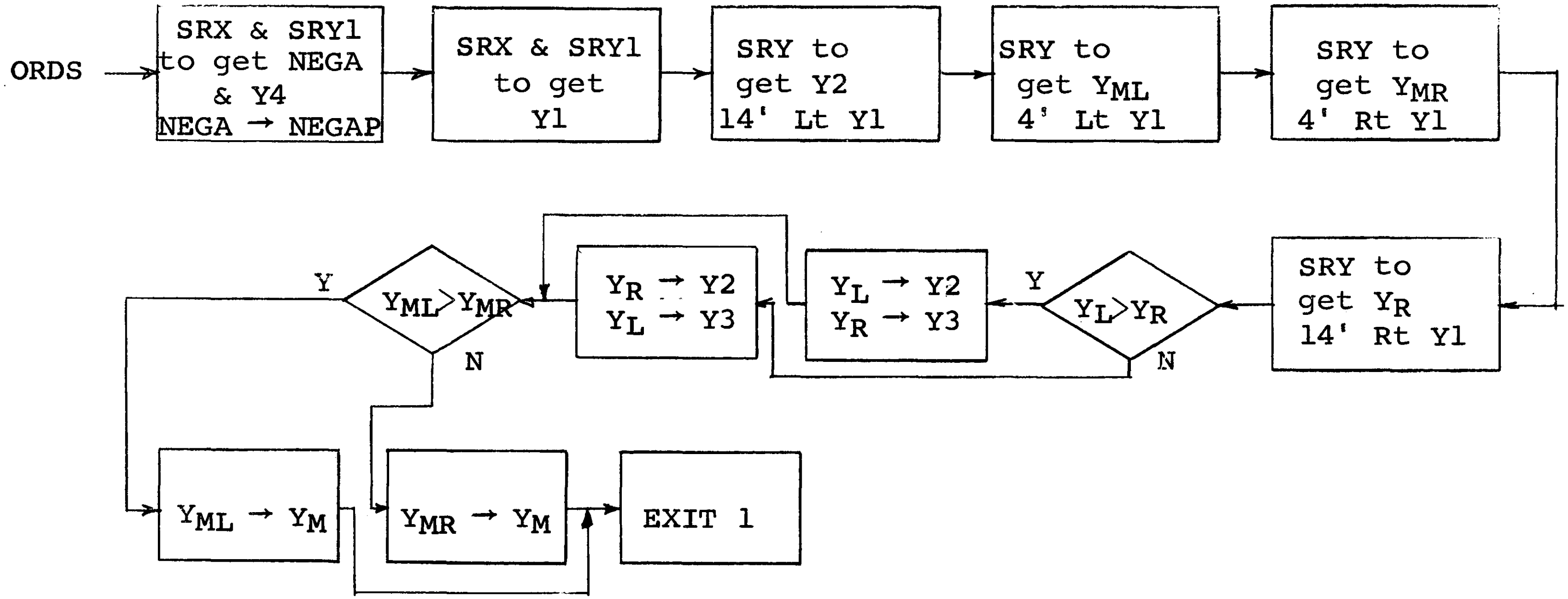
$$A = \frac{X_o{}^2}{4\,L}\left[2a + K_L(2L-X_o)^2 + K_R(2L^2-X_o^2)\right]$$

Note: Exit in Distributor
a in upper
L in lower

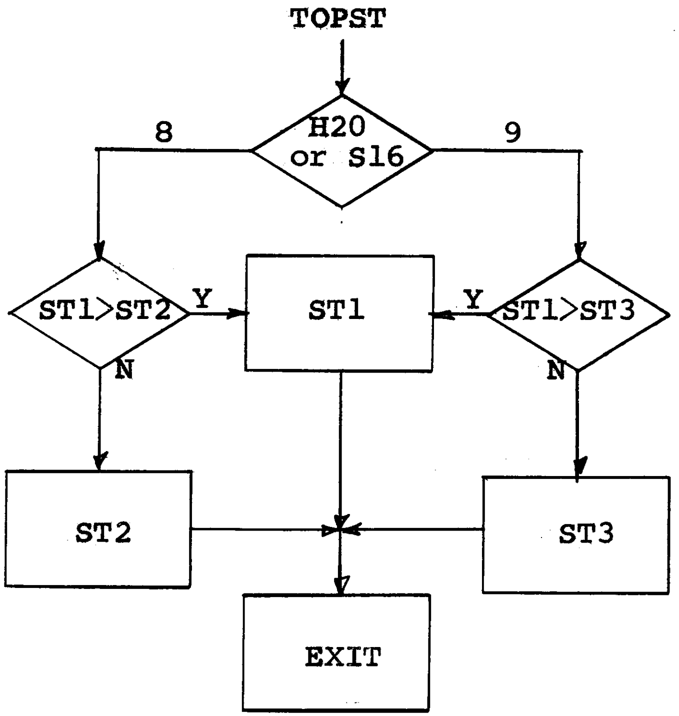
To find Xmax only for moment at the
pier put 0 in A
Partial A is in NEGA



Note: Exit 1 in distributor

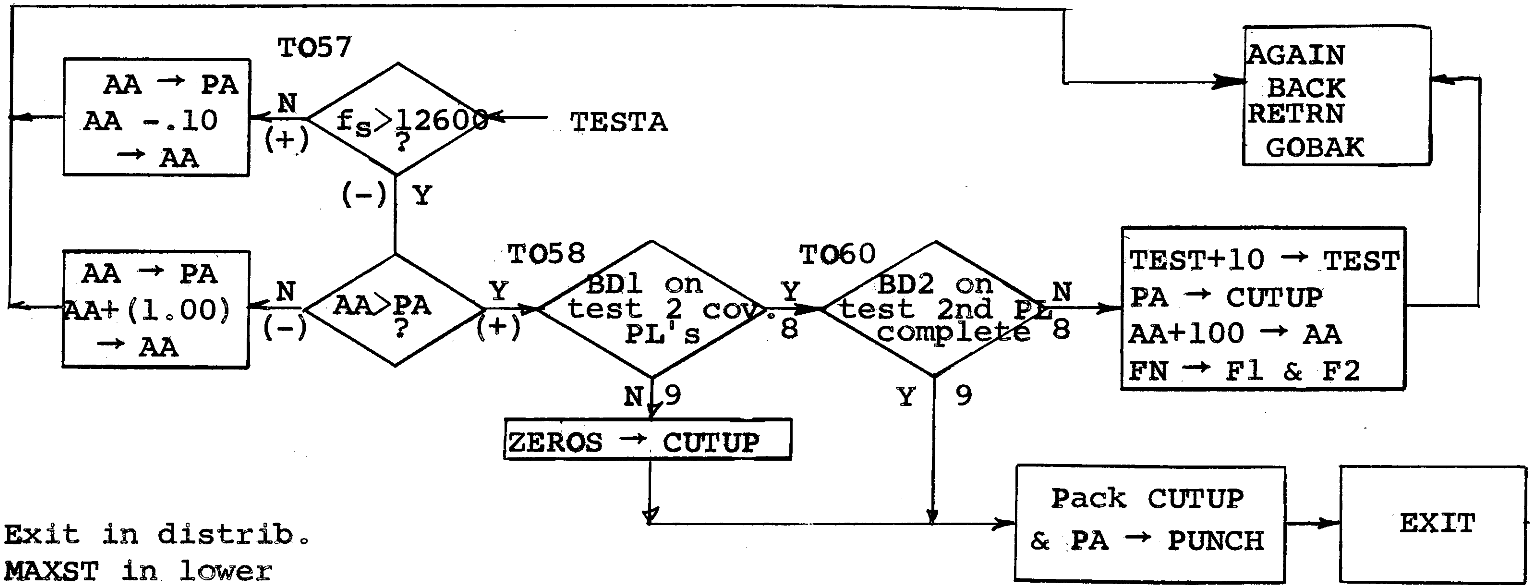


Note: Fix adjacent L, L1, K_L, K_R, KNEX & A
Exit 1 in Distributor
Store SUM of neg. areas in NEGAP



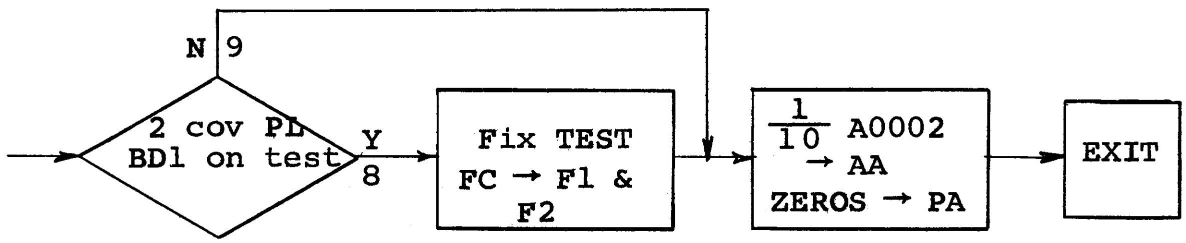
Note: Exit in distrib. works for pos. or neg. stresses.

Leave max ST in Lower



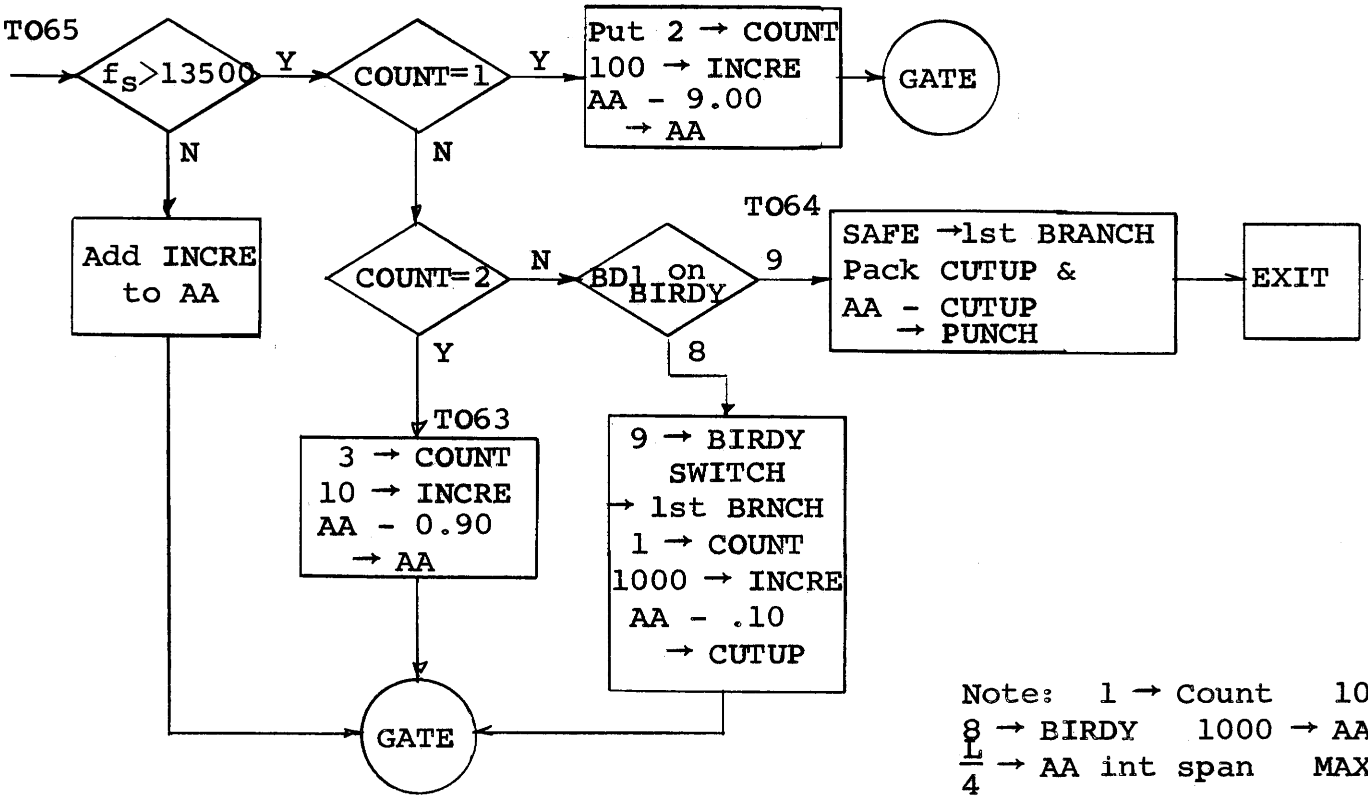
Note: Exit in distrib.
MAXST in lower

CYCLE

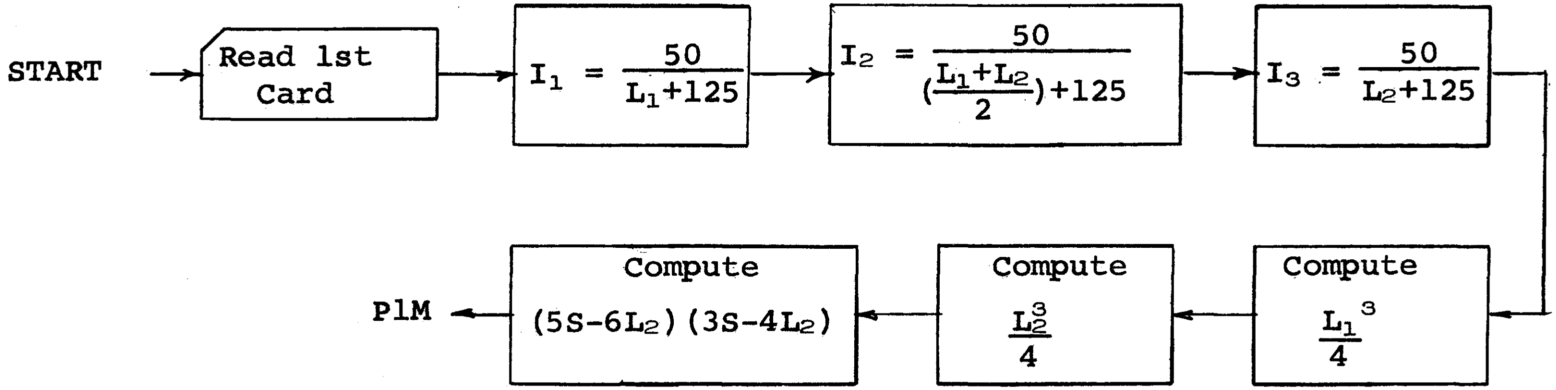


Note: Exit in
distrib.

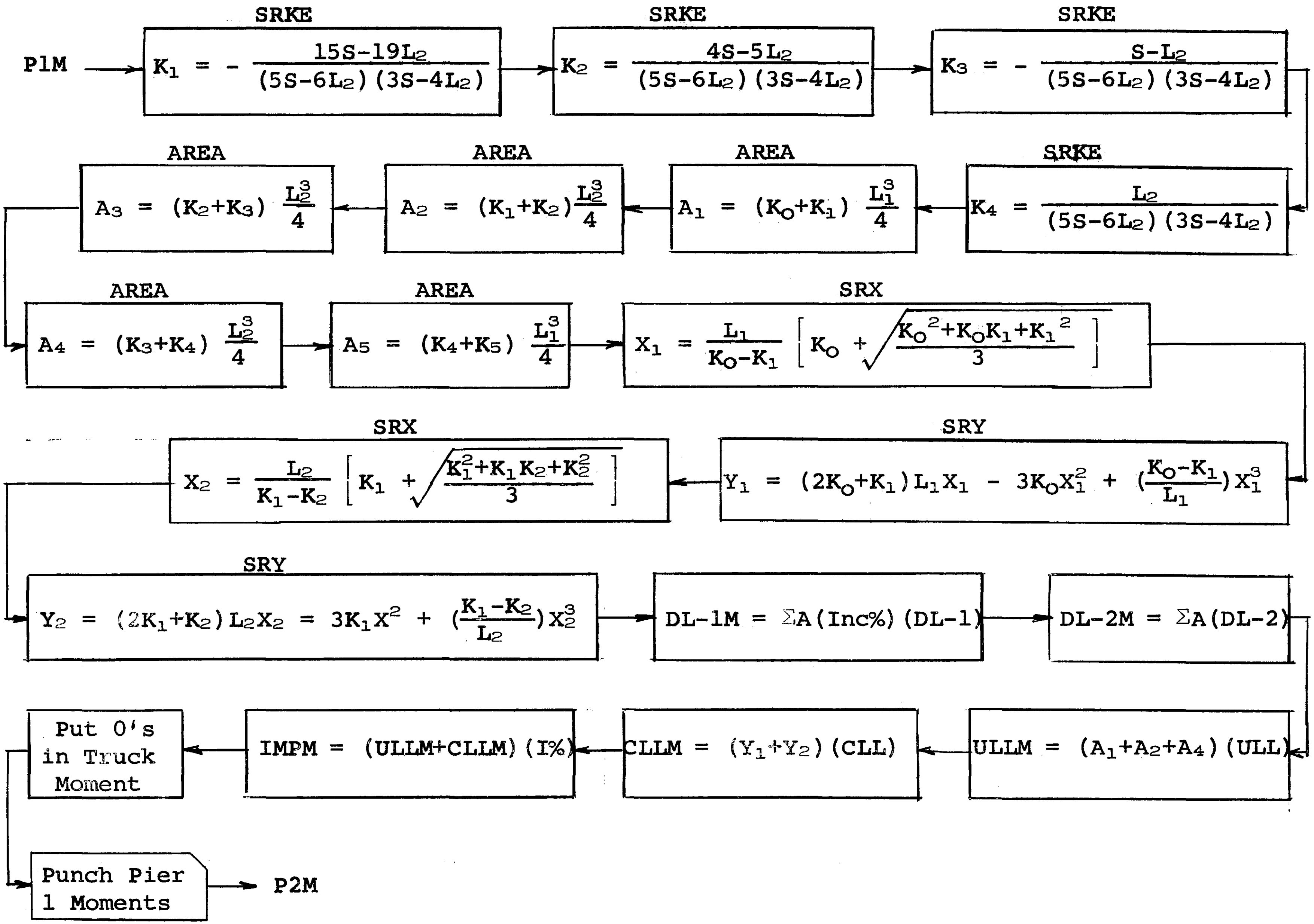
TEST B



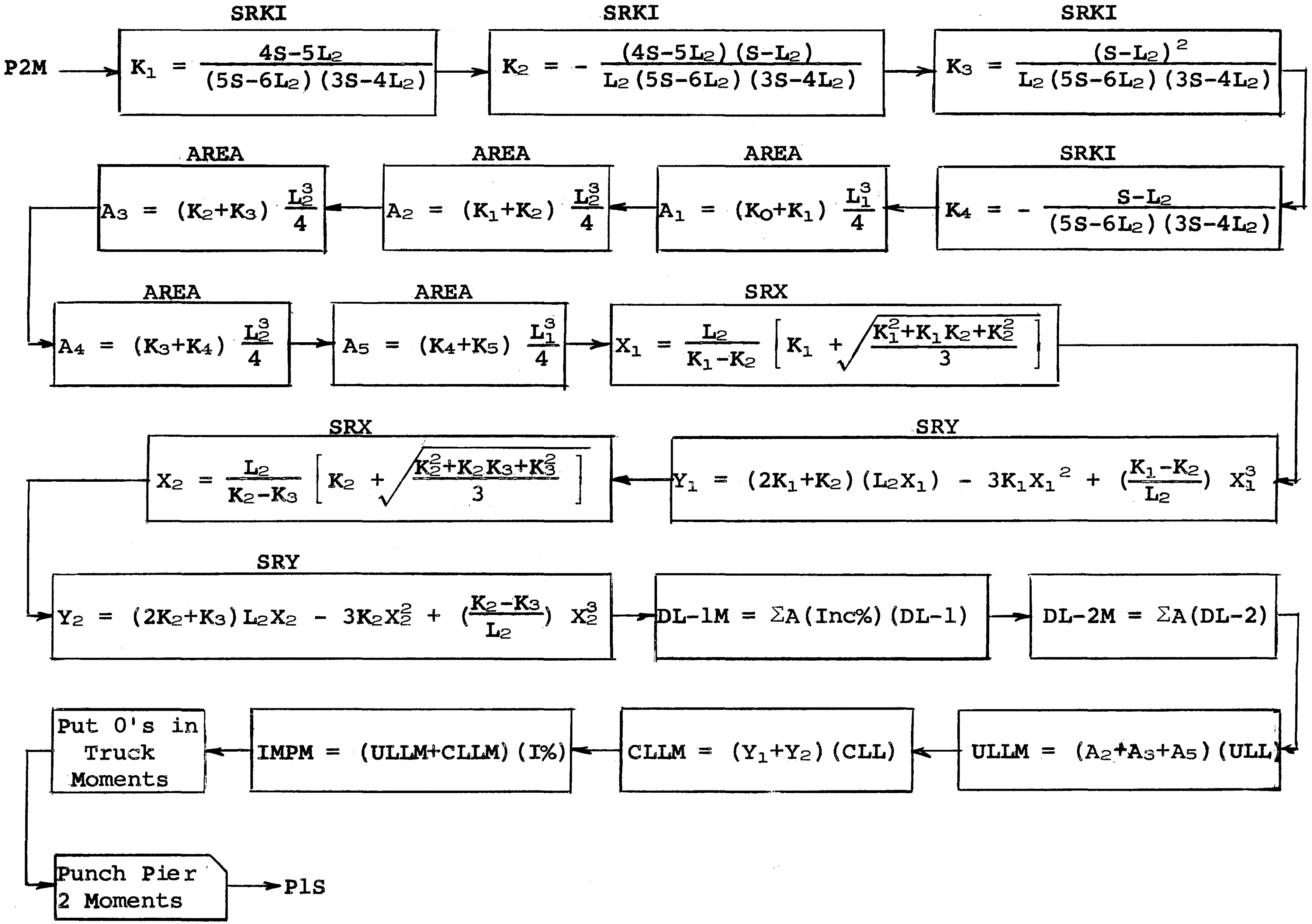
Note: 1 → Count   1000 → INCRE
8 → BIRDY   1000 → AA   end span
$\frac{L}{4}$ → AA int span   MAXST in lower
EXIT in distrib   MOD. GATE to
return to AAAAA, BBBBB or CCCCC


START
Read 1st Card
$I_1 = \frac{50}{L_1+125}$
$I_2 = \frac{50}{(\frac{L_1+L_2}{2})+125}$
$I_3 = \frac{50}{L_2+125}$
Compute $\frac{L_1}{4}^3$
Compute $\frac{L_2^3}{4}$
Compute $(5S-6L_2)(3S-4L_2)$
P1M

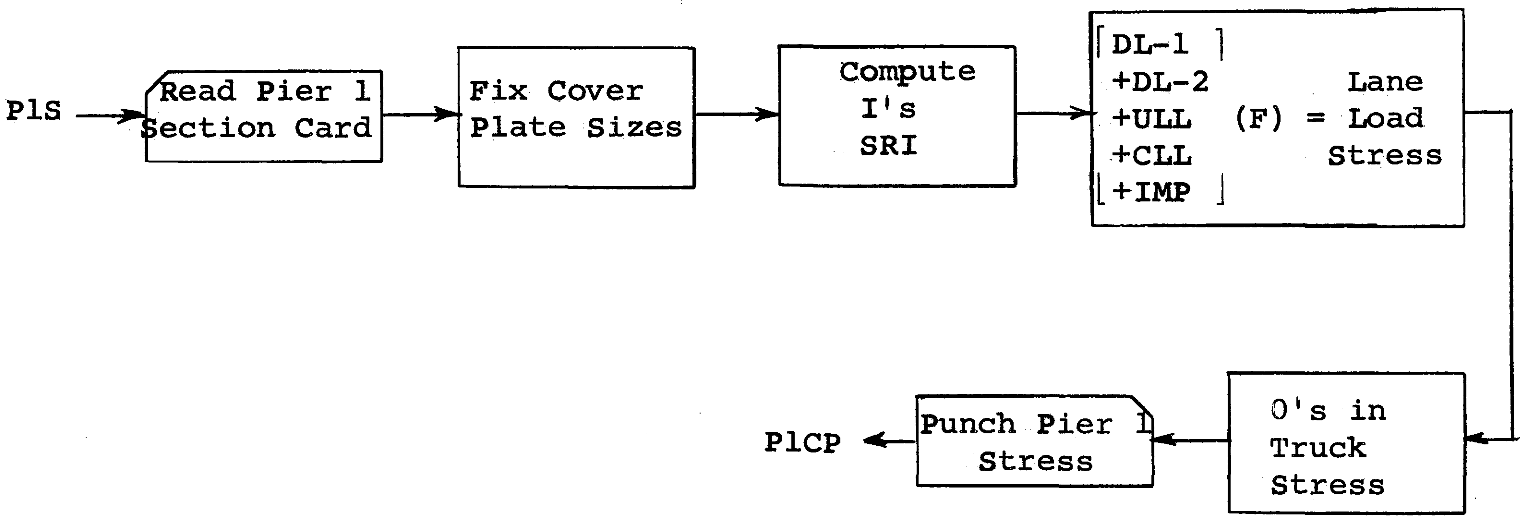
PIER 1 MOMENTS



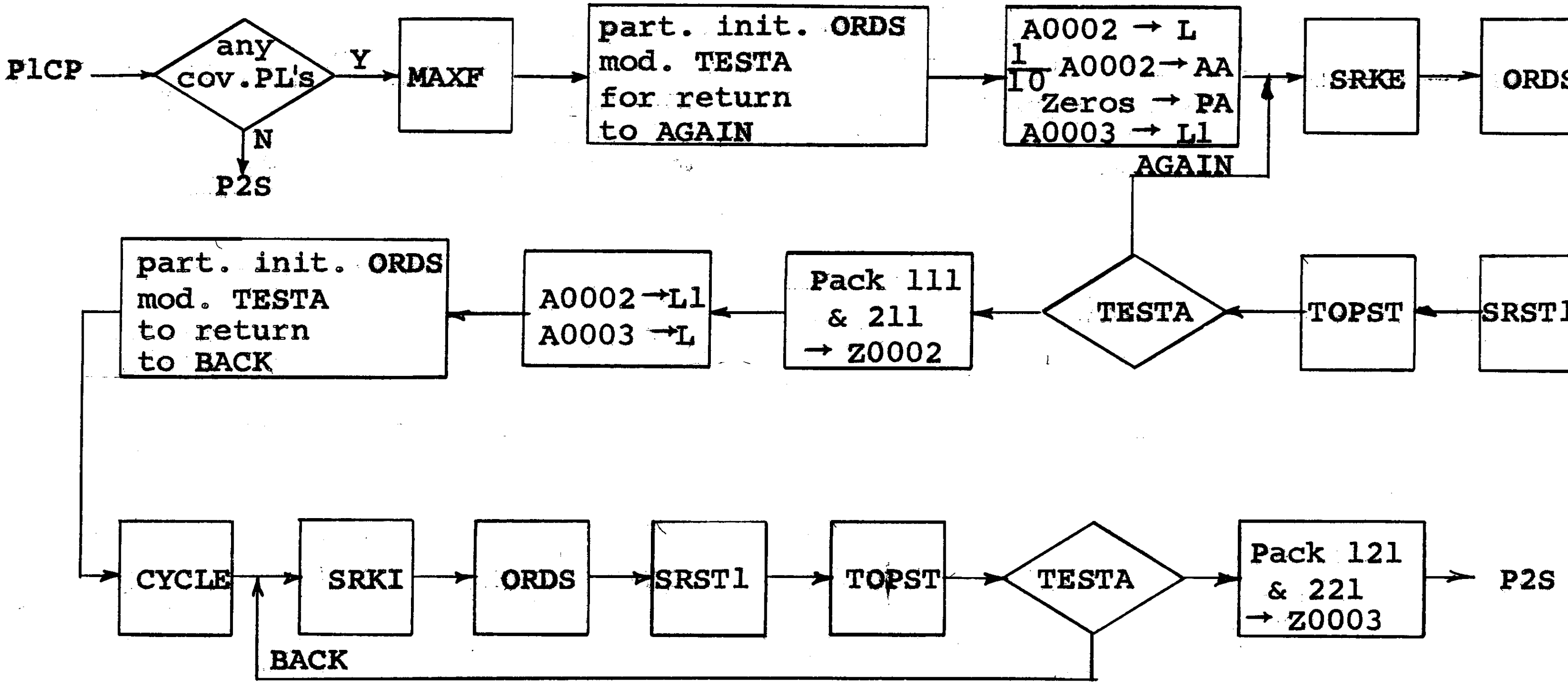
PIER 2 MOMENTS



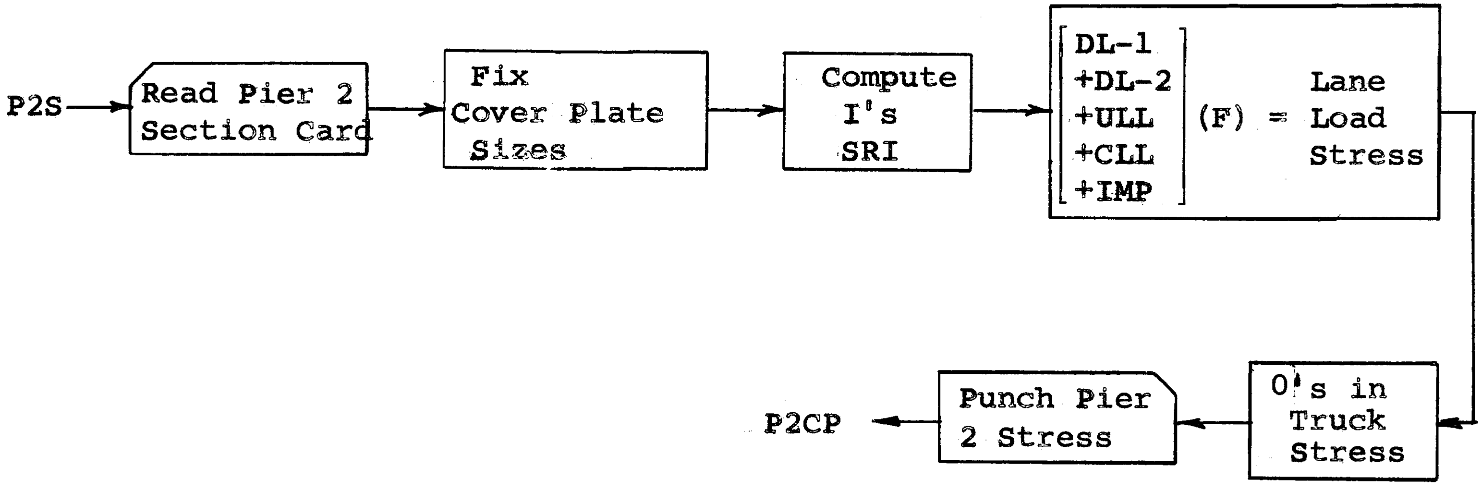
PIER 1 STRESS



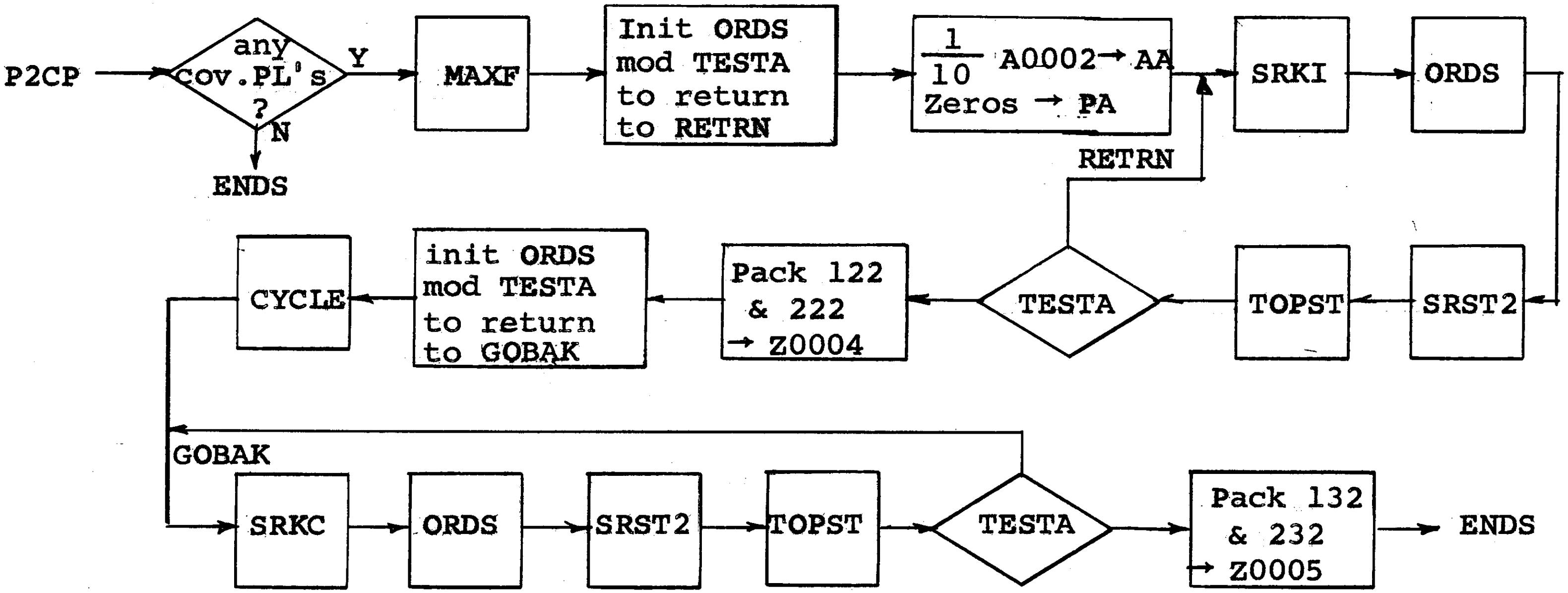
PIER 1 COVER PLATE LENGTHS



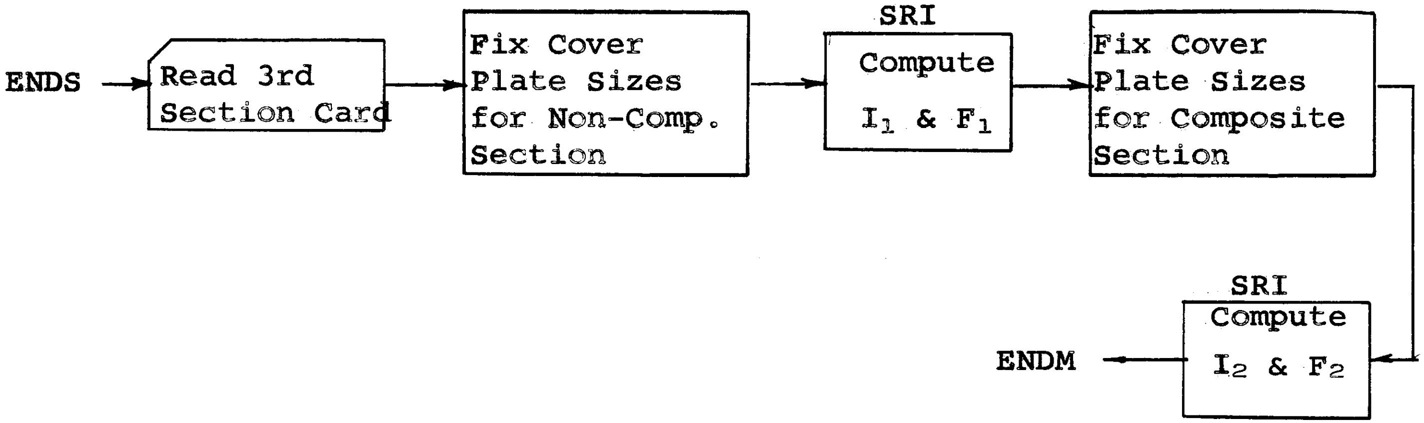
PIER 2 STRESS



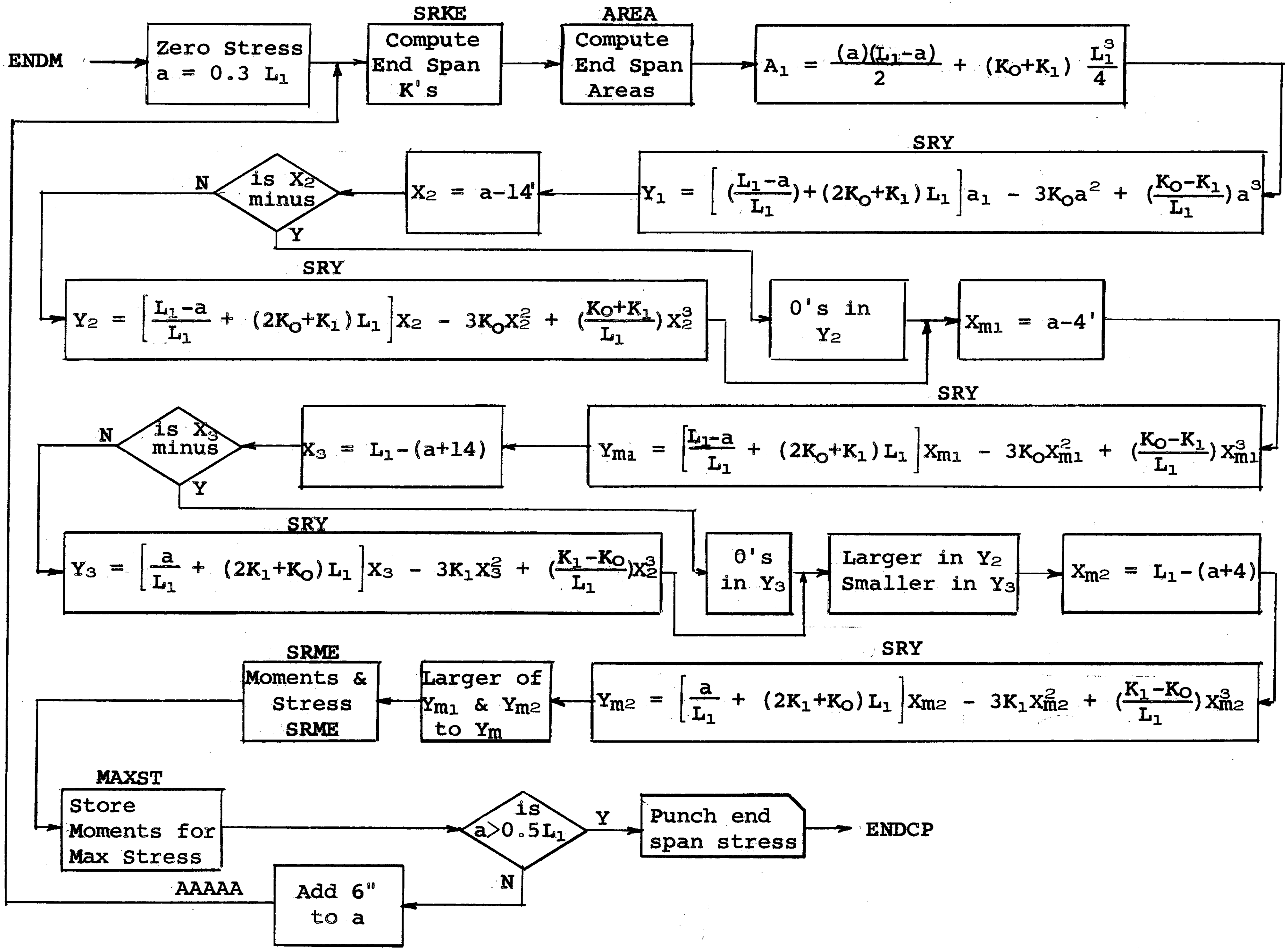
PIER 2 COVER PLATE LENGTHS



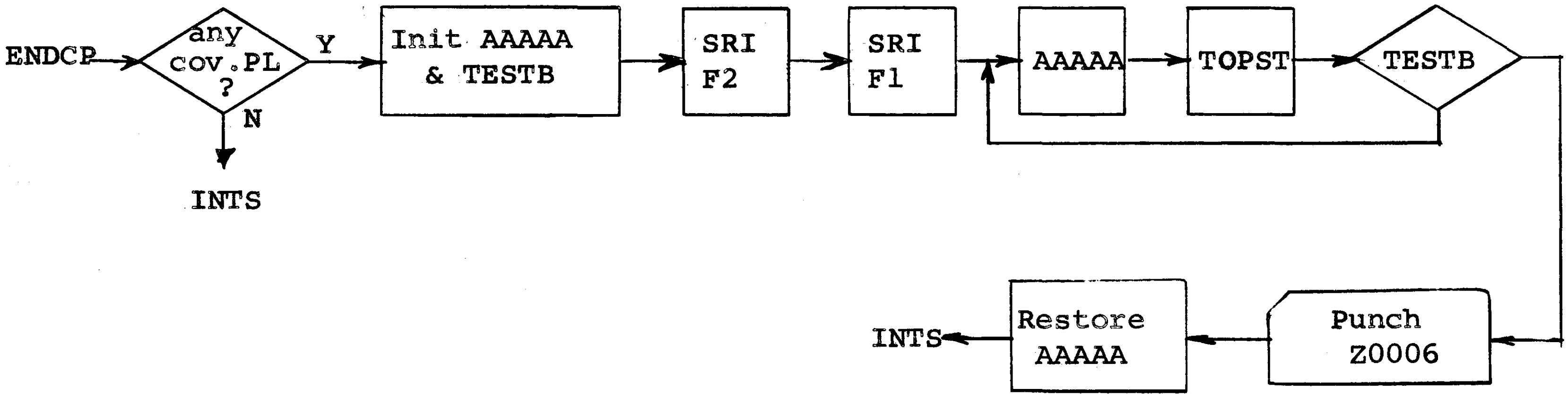
END SPAN SECTION PROPERTIES



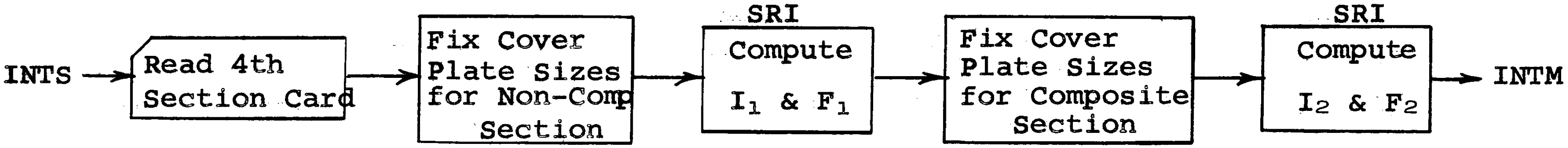
END SPAN MOMENTS



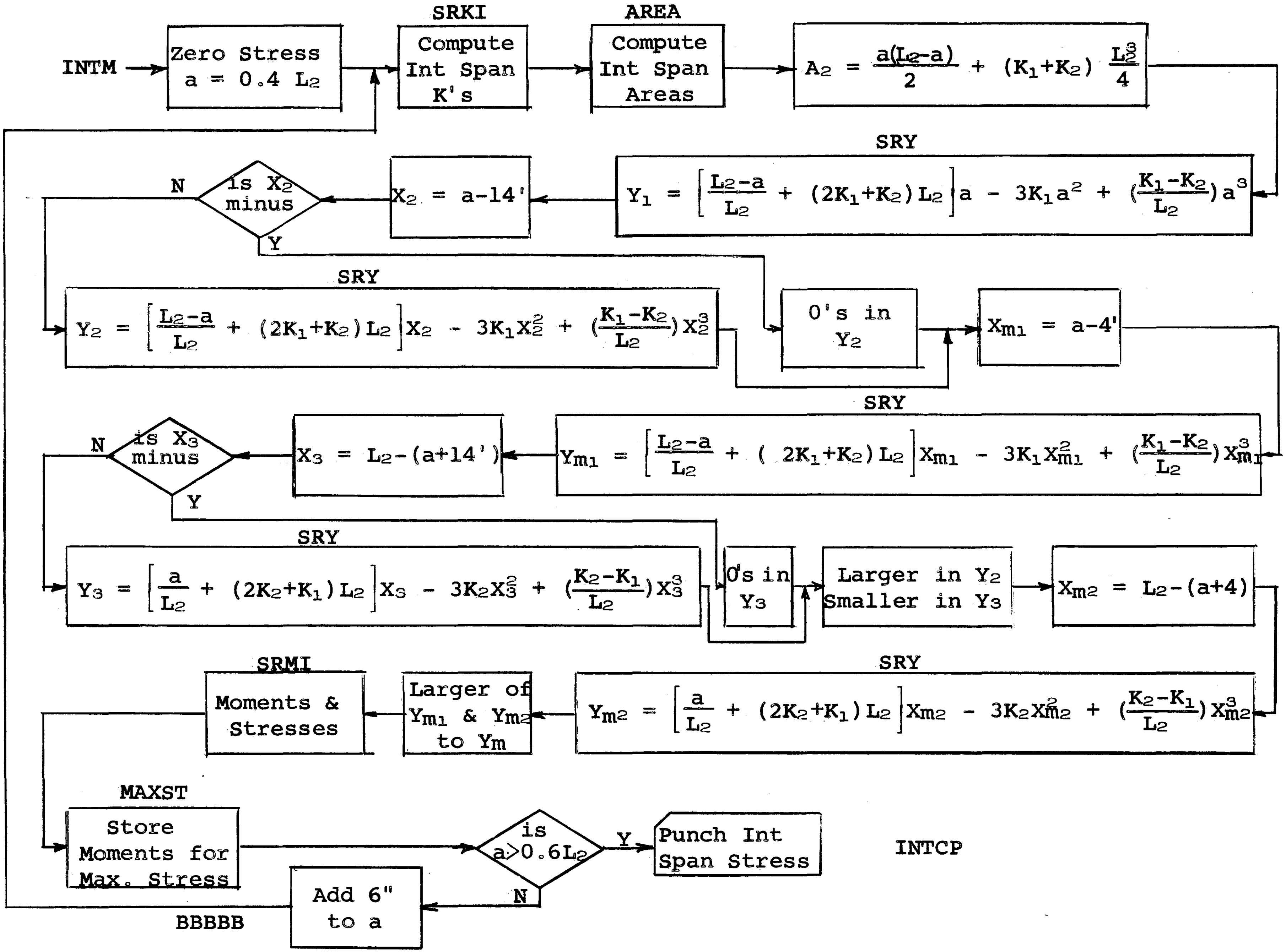
END SPAN COVER PLATE LENGTHS



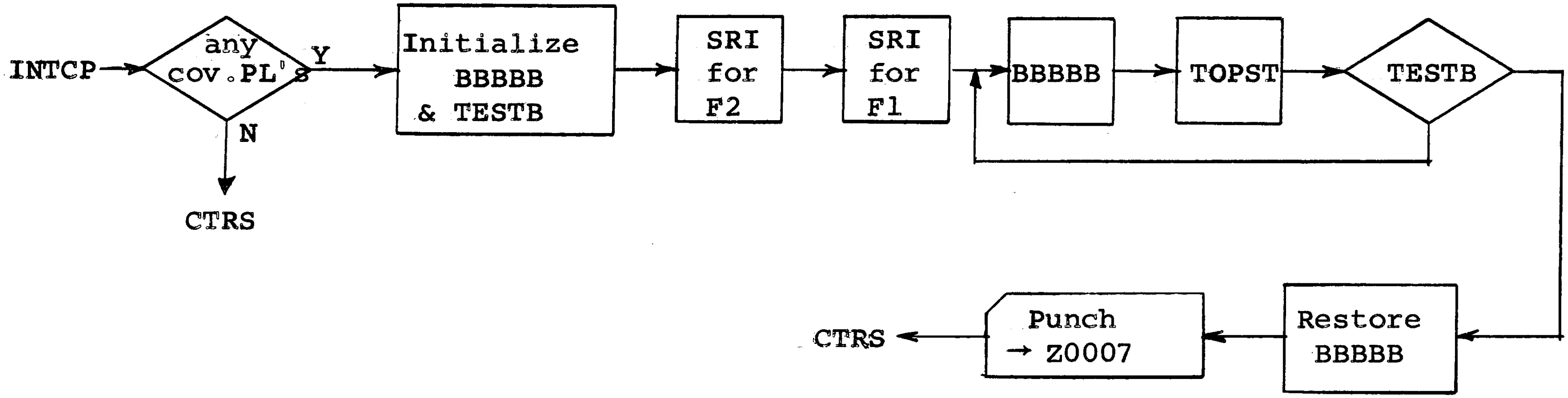
INTERIOR SECTION PROPERTIES



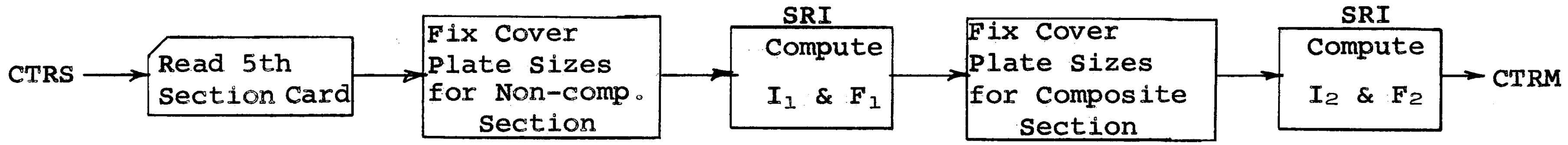
INTERIOR SPAN MOMENTS



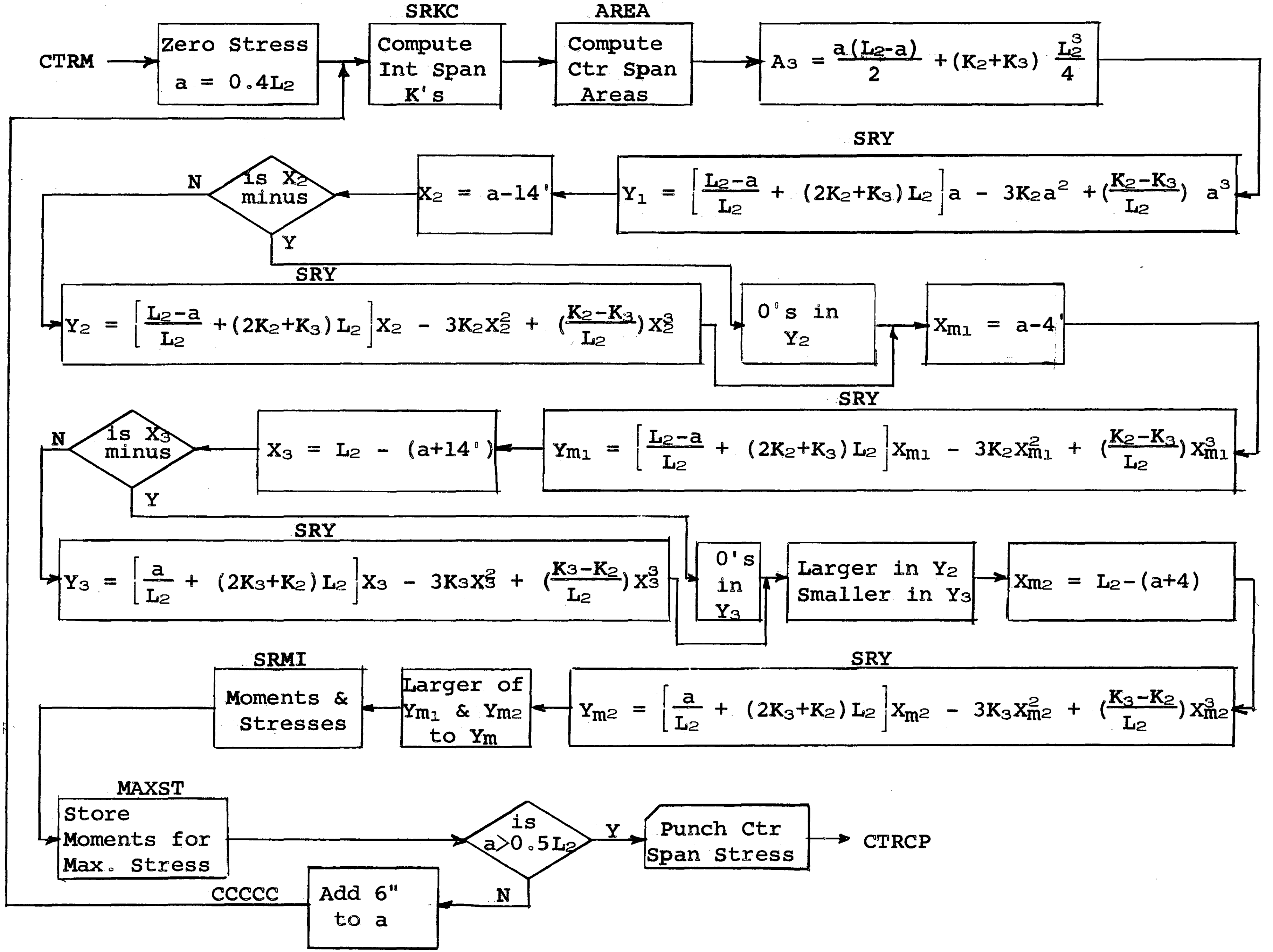
INTERIOR SPAN COVER PLATE LENGTHS



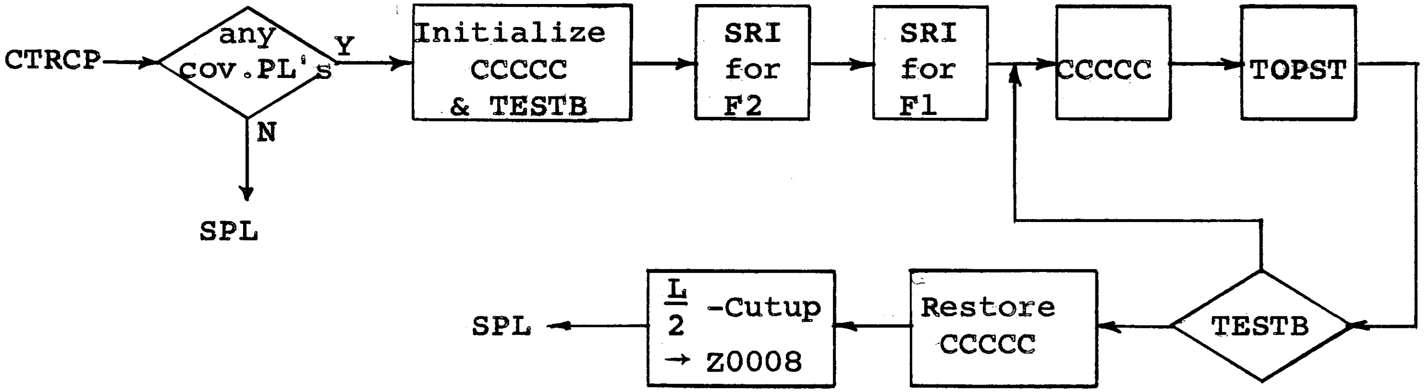
CENTER SPAN SECTION PROPERTIES



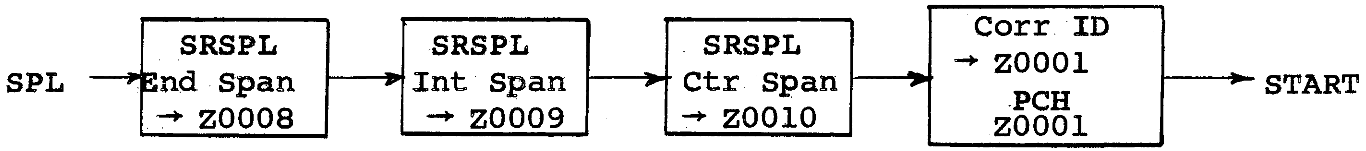
CENTER SPAN MOMENTS



CENTER SPAN COVER PLATE LENGTHS



SPLICE POINTS



SRSPL

$$\boxed{X = \pm \sqrt{\frac{2M_L}{W} + \left[\frac{M_L - M_R}{WL} - \frac{L}{2}\right]^2} - \left[\frac{M_L - M_R}{WL} - \frac{L}{2}\right]}$$

Note: Fix L & W
M_L → Upper
M_R → Lower

WORD LAYOUT FORM

650 MAGNETIC-DRUM DATA-PROCESSING MACHINE

PROGRAM NO. 32015

A0001	A0002	A0003	A0004	A0005	A0006	A0007	A0008	A0009	A0010
BEAM Point No County Design No Run	Length of End Span	Length of Int Span	Length of Bridge	Dead Load-1	Dead Load-2	Uniform Live Load	Conc. Live Load for Moment	Truck Wheel	0—0 8 H20 9 H20-S16 Pier-1 Incre. Pier-2 Incre.

B0001	B0002	B0003	B0004	B0005	B0006	B0007	B0008	B0009	B0010
BEAM Point No County Design No Run	Beam Area	Beam Depth	Beam I	Concrete Width	Concrete Thickness	N	Width Thick-ness Cover Plate-1	Width Thick-ness Cover Plate-2	H

P0001	P0002	P0003	P0004	P0005	P0006	P0007	P0008	P0009	P0010
BEAM Point No County Design No Run	DL-1 Moment Lane Stress	DL-2 Moment 0——0	ULL Moment 0——0	CLL Moment 0——0	Imp Moment 0——0	H20 Moment 0——0	Imp Moment 0——0	H20-S16 Moment 0——0	Imp Moment 0——0

W0001	W0002	W0003	W0004	W0005	W0006	W0007	W0008	W0009	W0010
BEAM Point No County Design No Run	Lane Stress		H20 Stress		H20-S16 Stress				

X0001 X0002 X0003 X0004 X0005 X0006 X0007 X0008 X0009 X0010

Y0001	Y0002	Y0003	Y0004	Y0005	Y0006	Y0007	Y0008	Y0009	Y0010
BEAM Point No County Design No Run	DL-1 Moment	DL-2 Moment	ULL Moment	CLL Moment	Imp Moment				

Z0001	Z0002	Z0003	Z0004	Z0005	Z0006	Z0007	Z0008	Z0009	Z0010
BEAM Point No County Design No Run	111 211	221 121	122 222	232 132	D14 L14	D25 L25	D35 S11	S21 S22	S32

SYMBOL TABLE 32015

SYMBOL	LOCATION	DESCRIPTION
01	0658	CONSTANT
02	0858	CONSTANT
03	1558	CONSTANT
04	1812	CONSTANT
05	0976	CONSTANT
10	0624	CONSTANT
100	1210	CONSTANT
1000	0336	CONSTANT
12	0082	CONSTANT
125	1311	CONSTANT
126HU	0909	CONSTANT
135HU	1059	CONSTANT
14	1477	CONSTANT
15	0687	CONSTANT
19	0463	CONSTANT
2	0226	CONSTANT
24	0513	CONSTANT
25	0650	CONSTANT
3	0096	CONSTANT
4	0737	CONSTANT
4HUN	0704	CONSTANT
5	0074	CONSTANT
5BILL	0363	CONSTANT
6	1687	CONSTANT
61	0908	CONSTANT
62	1108	CONSTANT
63	1608	CONSTANT
64	1862	CONSTANT
65	1026	CONSTANT
75	0190	CONSTANT
8	1310	CONSTANT
800	1577	CONSTANT
81	1839	CONSTANT
82	1941	CONSTANT
83	0244	CONSTANT
84	1095	CONSTANT
85	1295	CONSTANT
88	0856	CONSTANT
89	0900	CONSTANT
9	1700	CONSTANT
90	0254	CONSTANT
900	0204	CONSTANT
98	1650	CONSTANT
A	0511	Distance to point of influence line for sub routine xx.xx

SYMBOL	LOCATION	DESCRIPTION
A1	0677	AREA under the influence line for Span 0-1 xxxx.xx
A2	0727	AREA under the influence line for Span 1-2 xxxx.xx
A3	0777	AREA under the influence line for Span 2-3 xxxx.xx
A4	0827	AREA under the influence line for Span 3-4 xxxx.xx
A5	0877	AREA under the influence line for Span 4-5 xxx.xx
AA	0546	Working storage for A xx.xx
AAAAA	1649	TRANSFER Control
AGAIN	1008	Start of Pier 1, Span 0-1 Cov. PL loop
AREA	0230	Start of Area Sub routine
BACK	1721	Start of Pier 1, Span 1-2 Cov. PL loop
BBBBB	1849	TRANSFER Control
BIRDY	0162	Storage for 8's or 9's for BDn branch instructions
BMNO	0616	Beam Number x
CCCCC	1550	TRANSFER Control
CLLM	0595	Concentrated Live Load Moment xxxx.xx
COUNT	0320	Control for modification of positive mom. Cover plate loop
CP1A	0103	Cover Plate 1 Area xx.xx
CP1T	0066	Cover Plate 1 Thickness xx.xxx
CP1W	0059	Cover Plate 1 Width xx.xxx
CP2A	0153	Cover Plate 2 Area xx.xx
CP2T	0116	Cover Plate 2 Thickness xx.xxx
CP2W	0109	Cover Plate 2 Width xx.xxx
CP3A	0203	Cover Plate 3 Area xx.xx
CP3T	0166	Cover Plate 3 Thickness xx.xxx
CP3W	0159	Cover Plate 3 Width xx.xxx
CP4A	0253	Cover Plate 4 Area xx.xx
CP4T	0216	Cover Plate 4 Thickness xx.xxx
CP4W	0209	Cover Plate 4 Width xx.xxx
CTRCP	1678	Start of Center span cover plate computation
CTRM	1398	Start of Center span moment computation
CTRS	1070	Start of Center span section properties computation
CUTUP	0276	Storage of intermediate results for pier cover plate cutoffs xx.xx
CYCLE	1100	Start of sub routine to initialize cover plate loops
DESN	1593	Design Number xxxxxxx
DL1M	1339	Dead Load 1 Moment xxxx.xx
DL2M	0993	Dead Load 2 Moment xxxx.xx
ENDCP	1278	Start of End Span Cover Plate Computation

SYMBOL	LOCATION	DESCRIPTION
ENDM	0748	Start of End Span Moment Computation
ENDS	1919	Start of End Span Section Properties Computation
EXIT	0053	Storage of Exit Instruction for Sub routines
EXIT1	0407	Storage of Exit Instruction for Sub routines
EXIT2	0953	Storage of Exit Instruction for Sub routines
EXITA	1658	Instruction to modify AAAAA for use in ENDCP
EXITB	1912	Instruction to modify BBBBB for use in INTCP
EXITC	1226	Instruction to modify CCCCC for use in CTRCP
F1	0246	Mom. of Inertia factor for comp. Dead Load 1 stress xx.xx
F2	0094	Mom. of Inertia factor for comp. Dead Load 2 stress xx.xx
FC	0850	Current mom. of inertia factor xx.xx
FIFTY	0058	CONSTANT
FN	1221	Next mom. of inertia factor xx.xx
GATE	1109	Variable exit from sub routine TESTB
GOBAK	1971	Start of Pier 2, Span 2-3 Cover PL loop
H20M	0645	H20 Moment xxxx.xx
IMP	0600	Percent of Impact for sub routines .xxx
IMP1	1083	Percent of Impact for End Span .xxx
IMP2	1159	Percent of Impact for Pier 1 .xxx
IMP3	1209	Percent of Impact for Interior Span & Pier 2 .xxx
IMPM1	1037	Lane Load Impact Moment xxxx.xx
IMPM2	1137	H20 Impact Moment xxxx.xx
IMPM3	1279	H20-S16 Impact Moment xxxx.xx
INC1	0846	Increase factor for infl. line areas for Dead Load 1 x.xxx
INC2	0896	Increase factor for infl. line areas for Dead Load 1 x.xxx
INCRE	0154	Increase of trial distance for loc. of Cover PL cutoff x.xx
INTCP	1528	Start of Interior Span cover plate computation
INTM	1048	Start of Interior span moment computation
INTS	0870	Start of Interior span section properties computation
K1	0477	Pier 1 K factor .xxxxxxx
K2	0527	Pier 2 K factor .xxxxxxx
K3	0577	Pier 3 K factor .xxxxxxx
K4	0627	Pier 4 K factor .xxxxxxx
KL	0763	Left K factor used in sub routines .xxxxxxx
KNEX	1271	Location of K for Cov. PL length determination in adjacent span .xxxxxxx

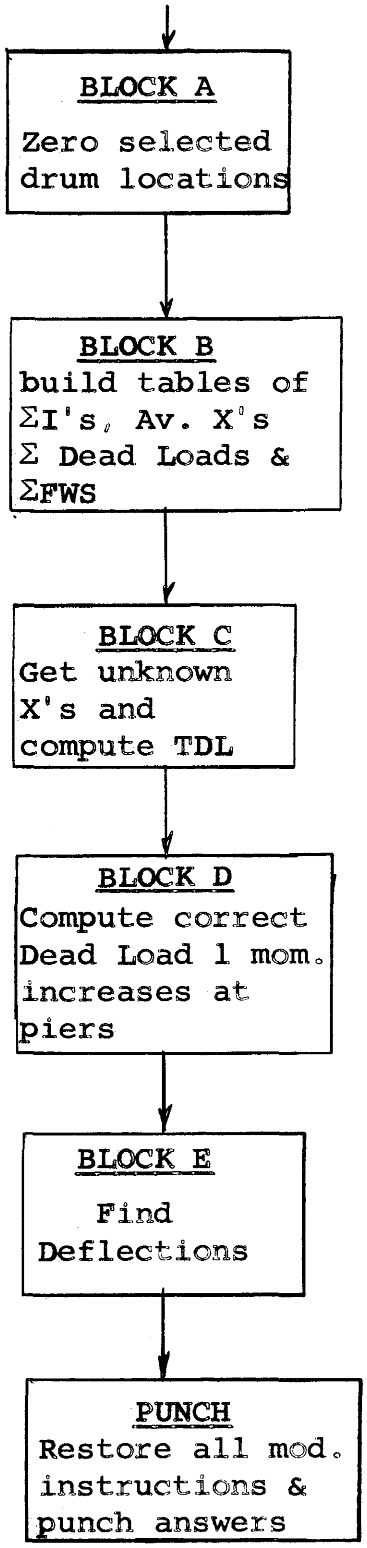
SYMBOL	LOCATION	DESCRIPTION
KR	0176	Right K factor used in sub routines .xxxxxxx
L	0078	Length of span used in sub routines xxx.xx
L1	0969	Location of length of end span xxx.xx
L134	0234	$L_1^3/4$ xxxxxx.xx
L234	0284	$L_2^3/4$ xxxxxx.xx
MAXF	0800	Start of sub routine to determine F1 & F2
MAXST	0700	Start of sub routine to determine maximum stress
MDFY1	1174	Instruction to modify TESTA to return to AGAIN
MDFY2	1989	Instruction to modify TESTA to return to BACK
MDFY3	1374	Instruction to modify TESTA to return to RETRN
MDFY4	0194	Instruction to modify TESTA to return to GOBAK
MDFY5	0802	Instruction to modify TESTB to return to AAAAA
MDFY6	1652	Instruction to modify TESTB to return to BBBBB
MDFY7	1944	Instruction to modify TESTB to return to CCCCC
ML	0960	Left moment used in sub routines xxxx.xx
MR	1417	Right moment used in sub routines xxxx.xx
NEGA	0659	Negative Area of influence lines
NEGAP	1315	Negative Area of influence line for partially loaded span
ONE	0128	CONSTANT
ONEM	0336	CONSTANT
ORDS	0950	Start of sub routine to compute influence line ordinates
P1CP	0728	Start of Pier 1 Cover Plate Computation
P1M	1713	Start of Pier 1 Moment Computation
P1S	0628	Start of Pier 1 Section Properties Computation
P2CP	0978	Start of Pier 2 Cover Plate Computation
P2M	0428	Start of Pier 2 Moment Computation
P2S	1669	Start of Pier 2 Section Properties Computation
PA	0104	Previous distance A
PCHCM	1570	Punch Center Span Moments
PCHEM	1455	Punch End Span Moments
PCHIM	1606	Punch Interior Span Moments
PUNCH	1543	Storage for packed cover plate lengths in sub routine TESTB
RETRN	1208	Start of Pier 2, Span 1-2 Cover PL loop
S16M	0695	H20-S16 Moment xxxx.xx

SYMBOL	LOCATION	DESCRIPTION
SAFE	0752	Storage for original instr. in sub routine SRME which is modified for other sub rout.
SAVE	0820	Storage for L - A xx.xx
SKIP1	0494	Equivalent to TO12
SKIP2	1245	Equivalent to TO22
SKIP3	1520	Equivalent to TO42
SPL	1126	Start of Splice Point Computation
SQRT	0150	Start of Square Root Sub routine
SRI	0100	Start of Moment of Inertia Sub routine
SRKC	0300	Start of Center Span K factor sub routine
SRKE	0200	Start of End Span K factor sub routine
SRKI	0250	Start of Interior Span K factor sub routine
SRME	0500	Start of End Span moment sub routine
SRMI	0550	Start of Interior Span moment sub routine
SRSET	1350	Start of sub routine to initialize TESTB and get F1 and F2
SRSPL	0750	Start of theoretical splice point sub rout.
SRST1	1250	Start of moment sub routine for cover plate cutoffs
SRST2	1300	Start of sub routine for moments of interior span for cover plate cutoffs
SRX	0400	Start of distance sub routine
SRY	0350	Start of Ordinate Computation Sub routine
ST1	1439	Lane Load Stress xxxxx
ST2	1489	H20 Stress xxxxx
ST3	1539	H20-S16 Stress xxxxx
START	0050	Start of Program
STOP1	1537	STOP
STOP2	1025	STOP
STOP3	1897	STOP
STOP4	1400	STOP
STOP5	1399	STOP
STOP6	1403	STOP
STOP7	1603	STOP
STOP8	0612	STOP
STOP9	1803	STOP
SUMAY	0085	Summation of Area times the distance from the centroid xx.xx
SWTCH	0825	Instruction to reverse branch instruction TO65
TEMP1	0057	Temporary Storage
TEMP2	0131	Temporary Storage
TEMP3	0188	Temporary Storage
TEMP4	0076	Temporary Storage
TEMP5	0126	Temporary Storage
TEMP6	0061	Temporary Storage
TERM1	0510	$(5S-6L_2)(3S-4L_2)$ xxxxxx.

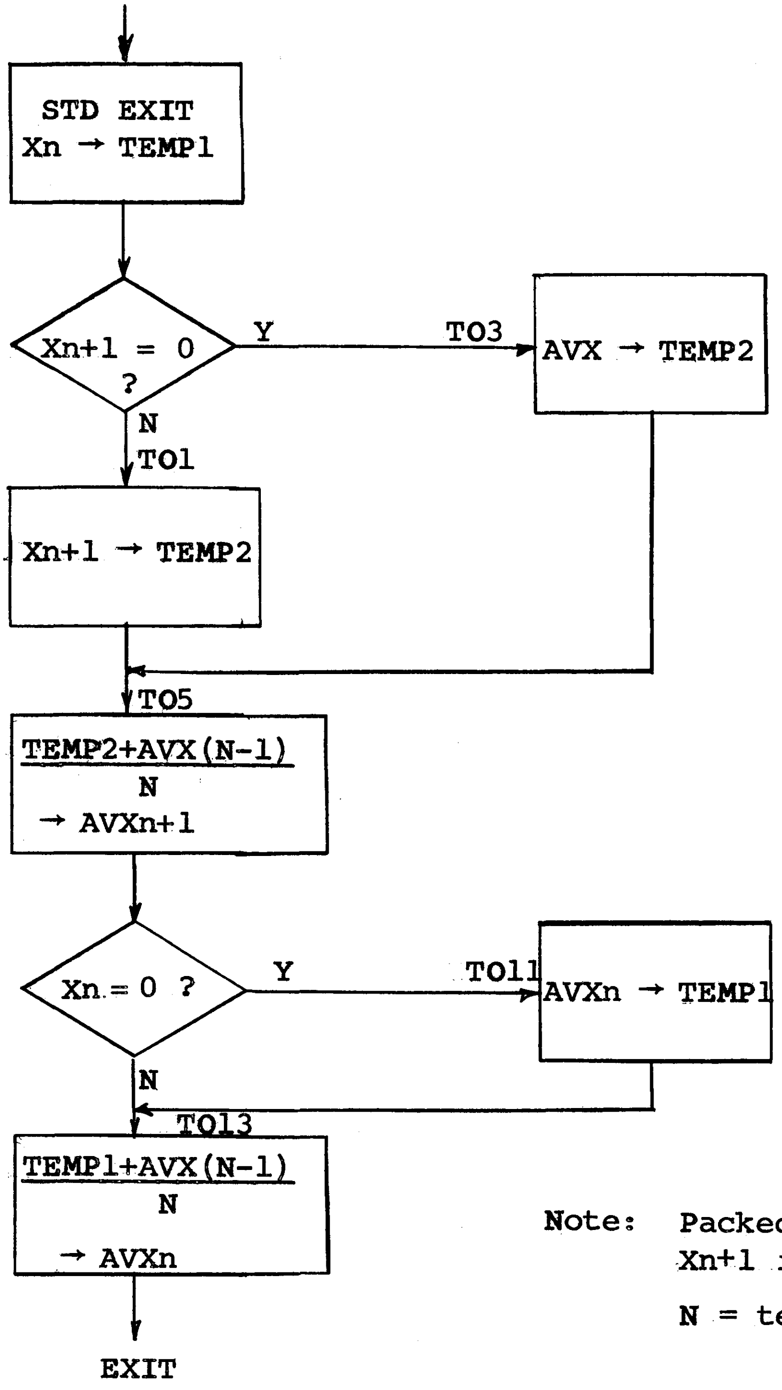
SYMBOL	LOCATION	DESCRIPTION
TEST	0162	Equivalent to BIRDY
TESTA	1150	Beginning of sub routine to control transfer for Cover PL cutoff
TESTB	1200	Beginning of sub routine to control transfer for Cover PL cutoff
TO1	0343	Transfer Control
TO10	1064	Transfer Control
TO12	0494	Transfer Control
TO16	1146	Transfer Control
TO17	1196	Transfer Control
TO18	1246	Transfer Control
TO19	1296	Transfer Control
TO2	0285	Transfer Control
TO20	1402	Transfer Control
TO21	1716	Transfer Control
TO22	1245	Transfer Control
TO3	0582	Transfer Control
TO30	0086	Transfer Control
TO31	0388	Transfer Control
TO32	0072	Transfer Control
TO36	1498	Transfer Control
TO37	1396	Transfer Control
TO38	1598	Transfer Control
TO39	1446	Transfer Control
TO4	0052	Transfer Control
TO40	1254	Transfer Control
TO41	0776	Transfer Control
TO42	1520	Transfer Control
TO5	0344	Transfer Control
TO50	1517	Transfer Control
TO51	0068	Transfer Control
TO53	1365	Transfer Control
TO54	0401	Transfer Control
TO55	0574	Transfer Control
TO56	1447	Transfer Control
TO57	0366	Transfer Control
TO58	0362	Transfer Control
TO59	1465	Transfer Control
TO6	0996	Transfer Control
TO60	0270	Transfer Control
TO61	0272	Transfer Control
TO62	1437	Transfer Control
TO63	1487	Transfer Control
TO64	0372	Transfer Control
TO65	1463	Transfer Control
TO66	0416	Transfer Control
TO67	1429	Transfer Control

SYMBOL	LOCATION	DESCRIPTION
T068	1767	Transfer Control
T069	0496	Transfer Control
T07	0444	Transfer Control
T08	1046	Transfer Control
T09	0502	Transfer Control
TOPST	1050	Beginning of sub routine to pick largest stress of Lane, H or HS truck load
ULLM	0893	Uniform Live Load Moment
VAULT	1069	Storage location for branch instr. T065 while modified by SWTCH
W	0342	Dead Load 1 plus Dead Load 2 xx.xxxx
X	0469	Distance to required Ordinate xx.xx
X0	0497	Distance to Zero Ordinate xx.xx
Y1	0649	Maximum ordinate xx.xx
Y2	1043	Second Truck Ordinate or Span 2 Ordinate for Pier Moment xx.xx
Y3	1093	Third Truck Ordinate xx.xx
Y4	0656	Span 2 Ordinate for Cover plate lengths xx.xx
YM	0706	Military Ordinate xx.xx

GENERAL FLOW DIAGRAM (Deflections)



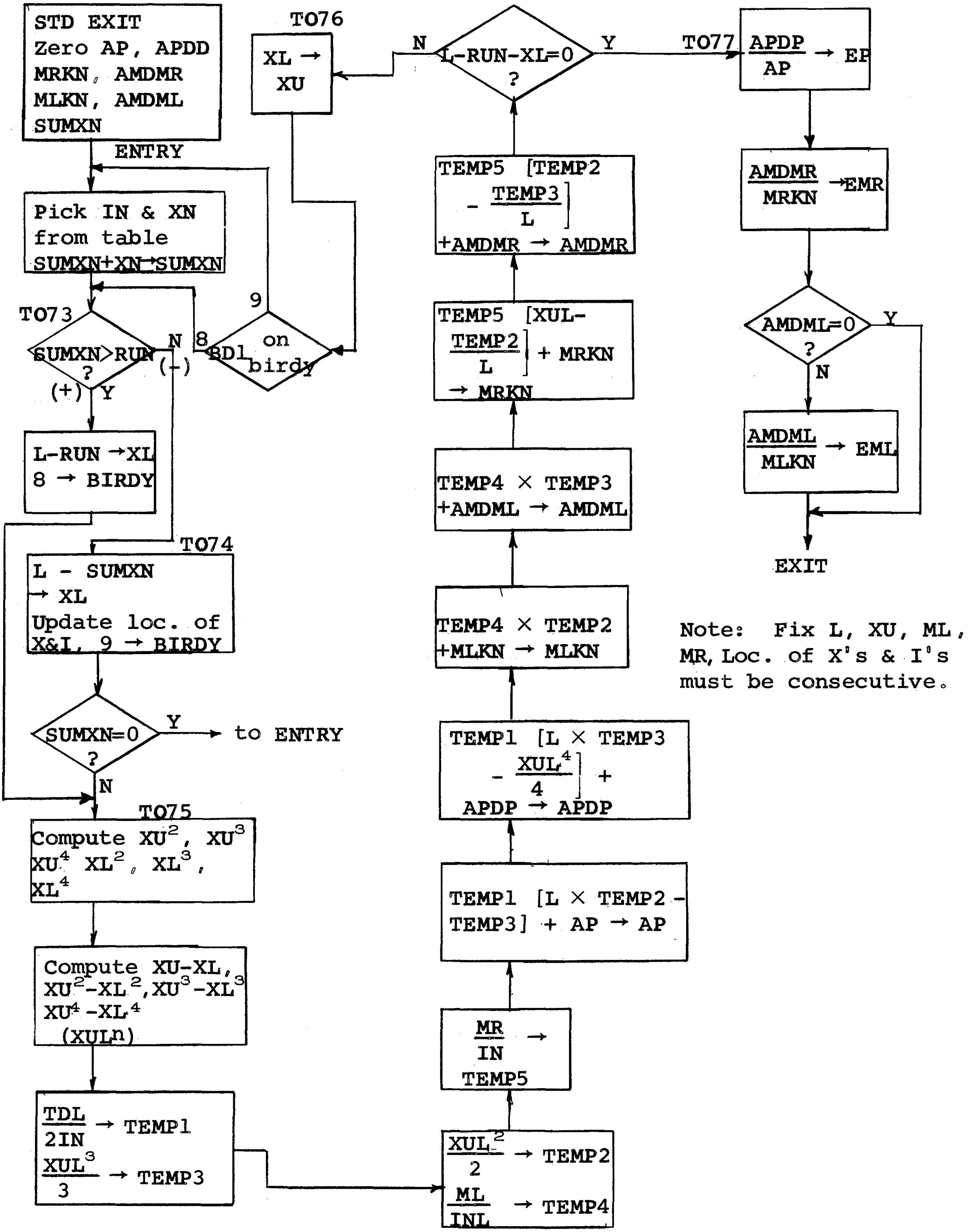
SUBROUTINE - SRA



Note: Packed Xn in upper &
Xn+1 in lower.

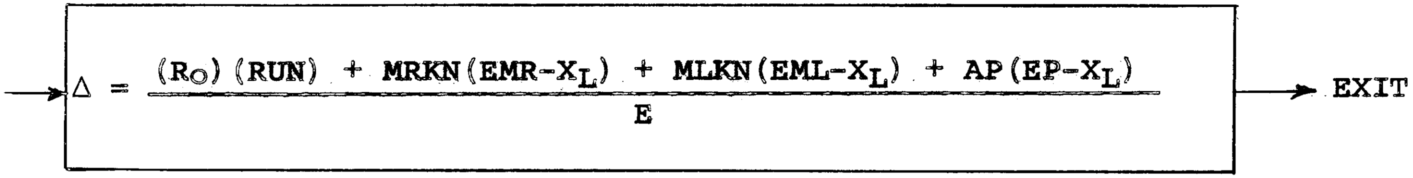
N = temporary beam count.

SUBROUTINE SUBRB



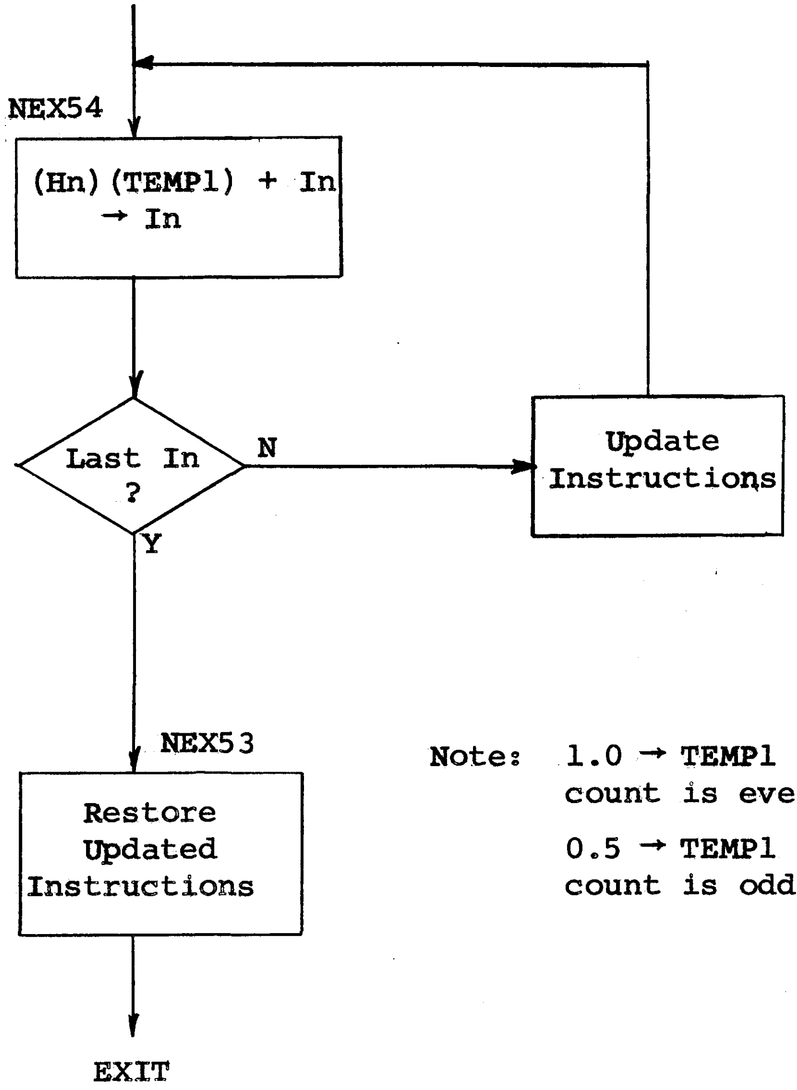
Note: Fix L, XU, ML, MR, Loc. of X's & I's must be consecutive.

SUBROUTINE SUBRC



$$\Delta = \frac{(R_O)(RUN) + MRKN(EMR-X_L) + MLKN(EML-X_L) + AP(EP-X_L)}{E}$$

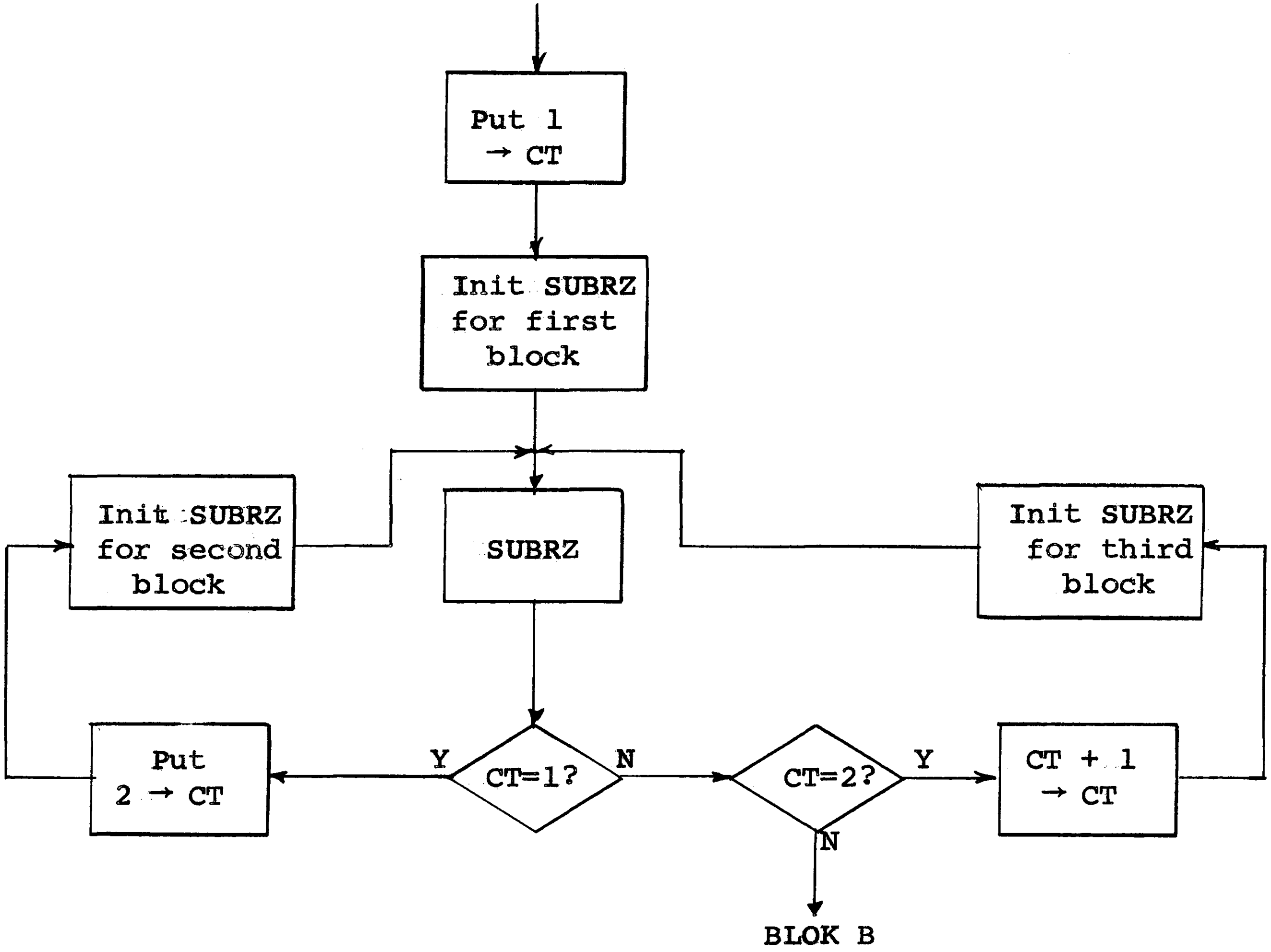
SUBROUTINE - SUBRE



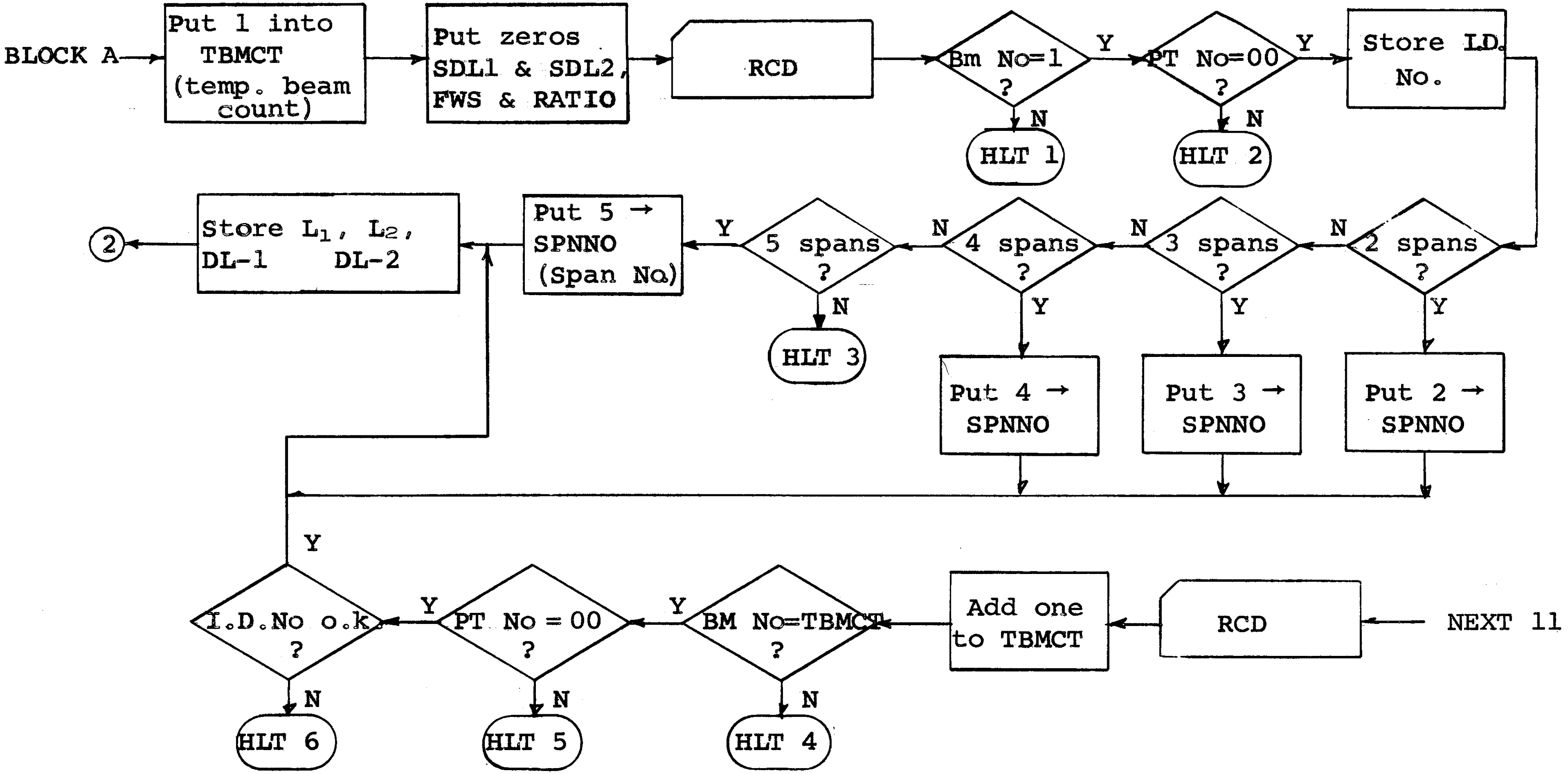
Note: 1.0 → TEMP1 if beam count is even.

0.5 → TEMP1 if beam count is odd.

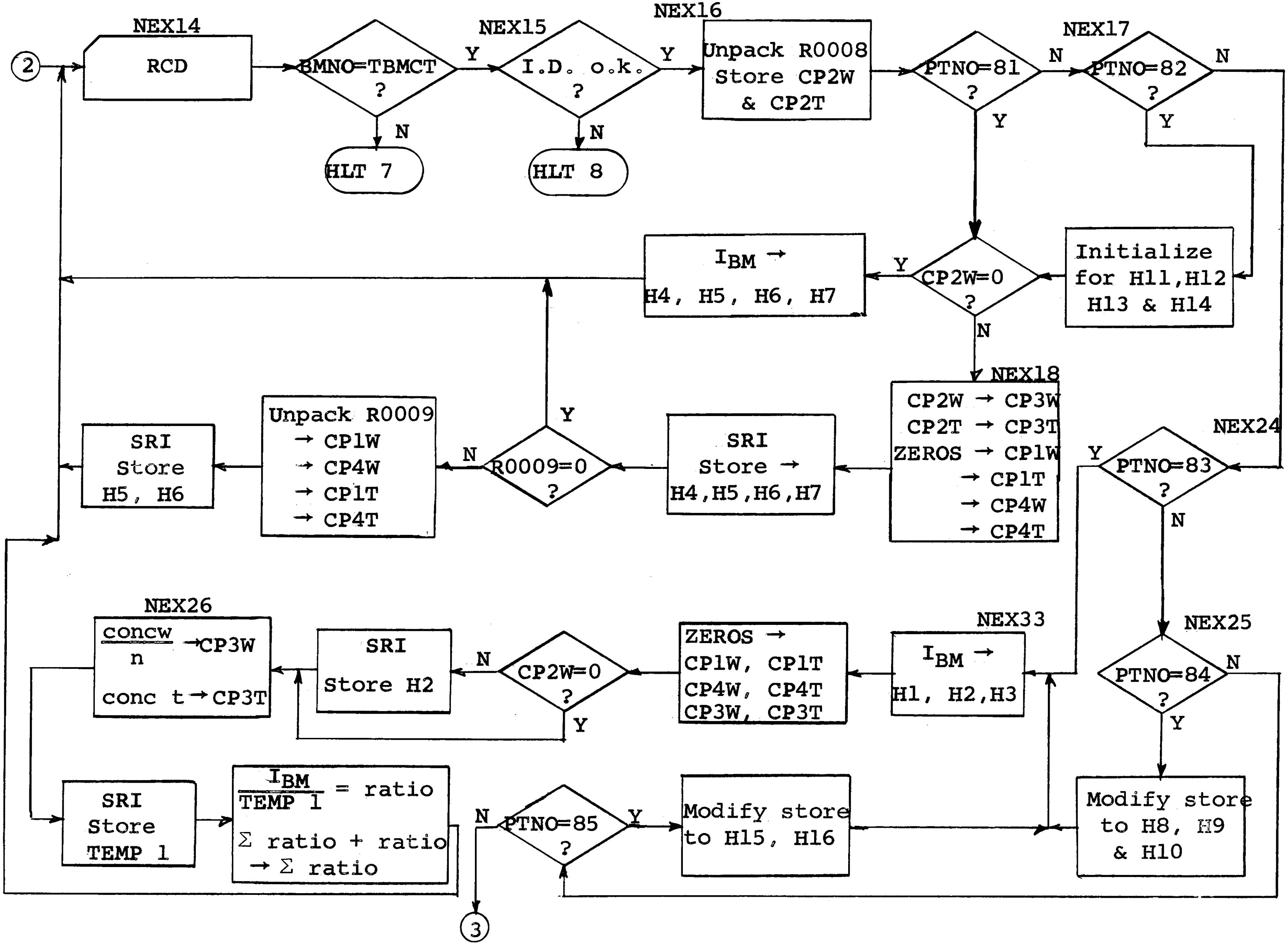
BLOCK A


Put 1
→ CT
Init SUBRZ
for first
block
Init SUBRZ
for second
block
SUBRZ
Init SUBRZ
for third
block
Put
2 → CT
Y
CT=1?
N
CT=2?
Y
N
CT + 1
→ CT
BLOK B

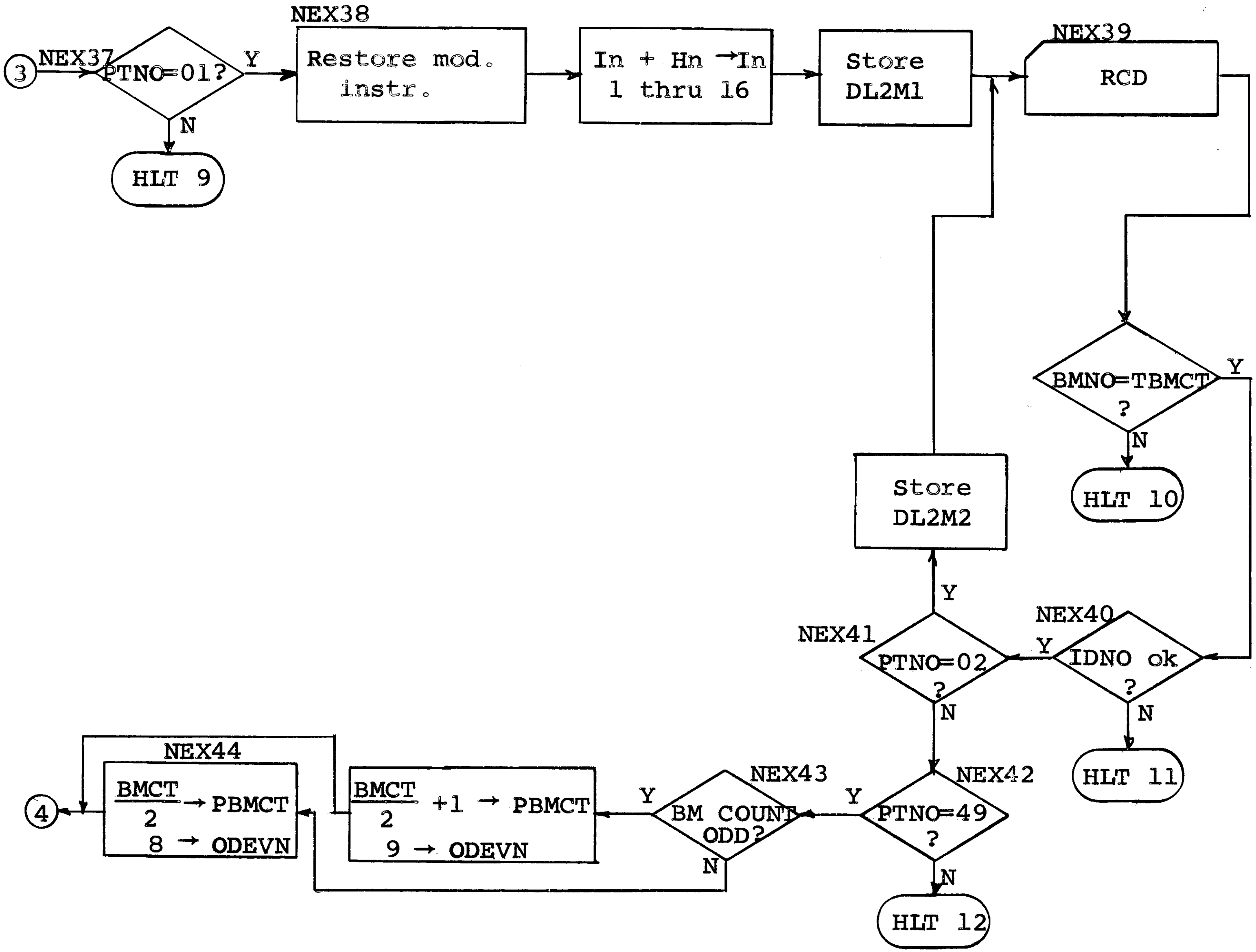
BLOCK B


BLOCK A
Put 1 into TBMCT (temp. beam count)
Put zeros SDL1 & SDL2, FWS & RATIO
RCD
Bm No=1 ?
Y
N
HLT 1
PT No=00 ?
Y
N
HLT 2
Store I.D. No.
2 spans ?
N
Y
Put 2 → SPNNO
3 spans ?
N
Y
Put 3 → SPNNO
4 spans ?
N
Y
Put 4 → SPNNO
5 spans ?
Y
N
HLT 3
Put 5 → SPNNO (Span No.)
Store L1, L2, DL-1 DL-2
2
NEXT 11
RCD
Add one to TBMCT
BM No=TBMCT ?
Y
N
HLT 4
PT No = 00 ?
Y
N
HLT 5
I.D.No o.k. ?
Y
N
HLT 6

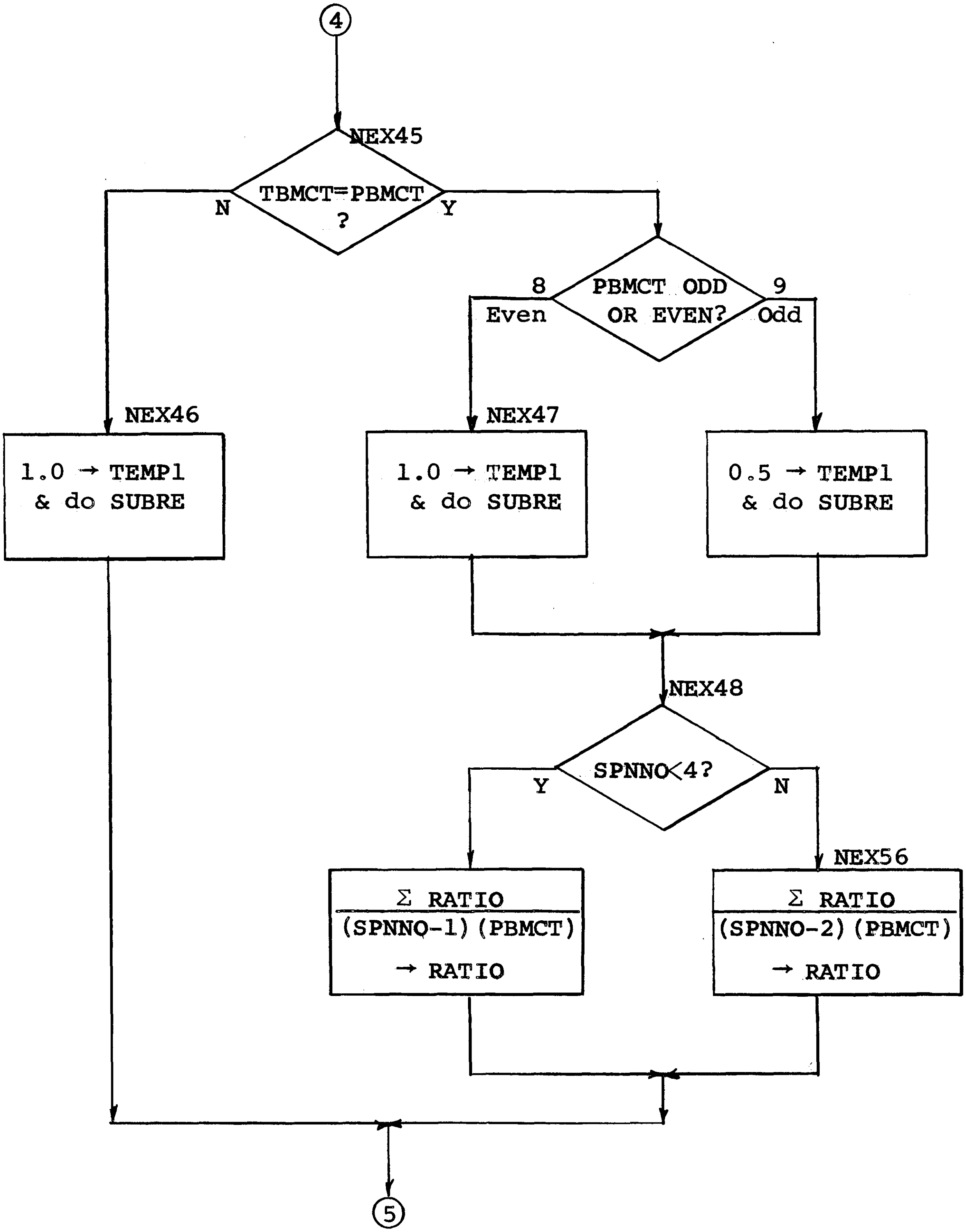
BLOCK B (Continued)



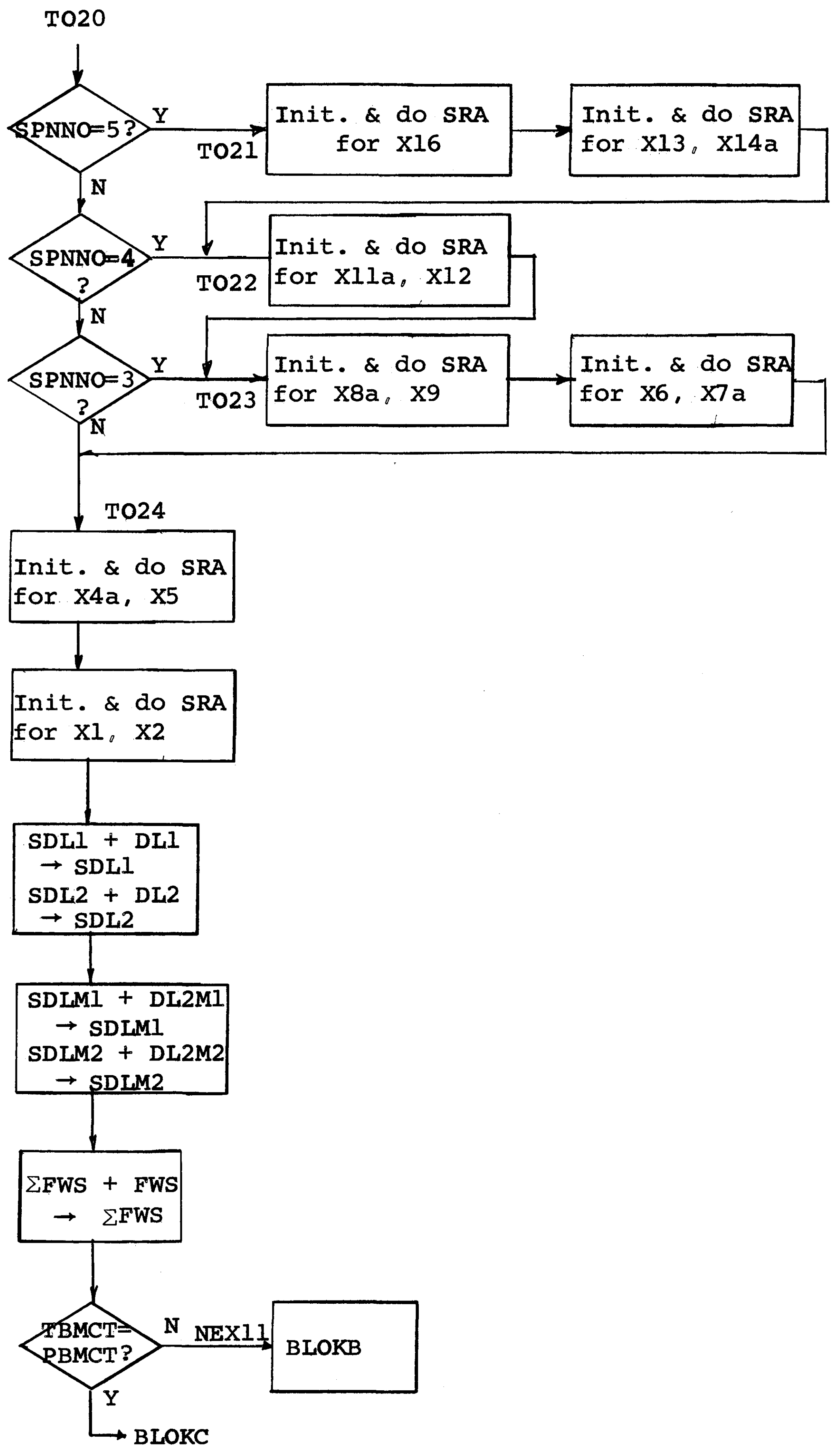
BLOCK B (Continued)



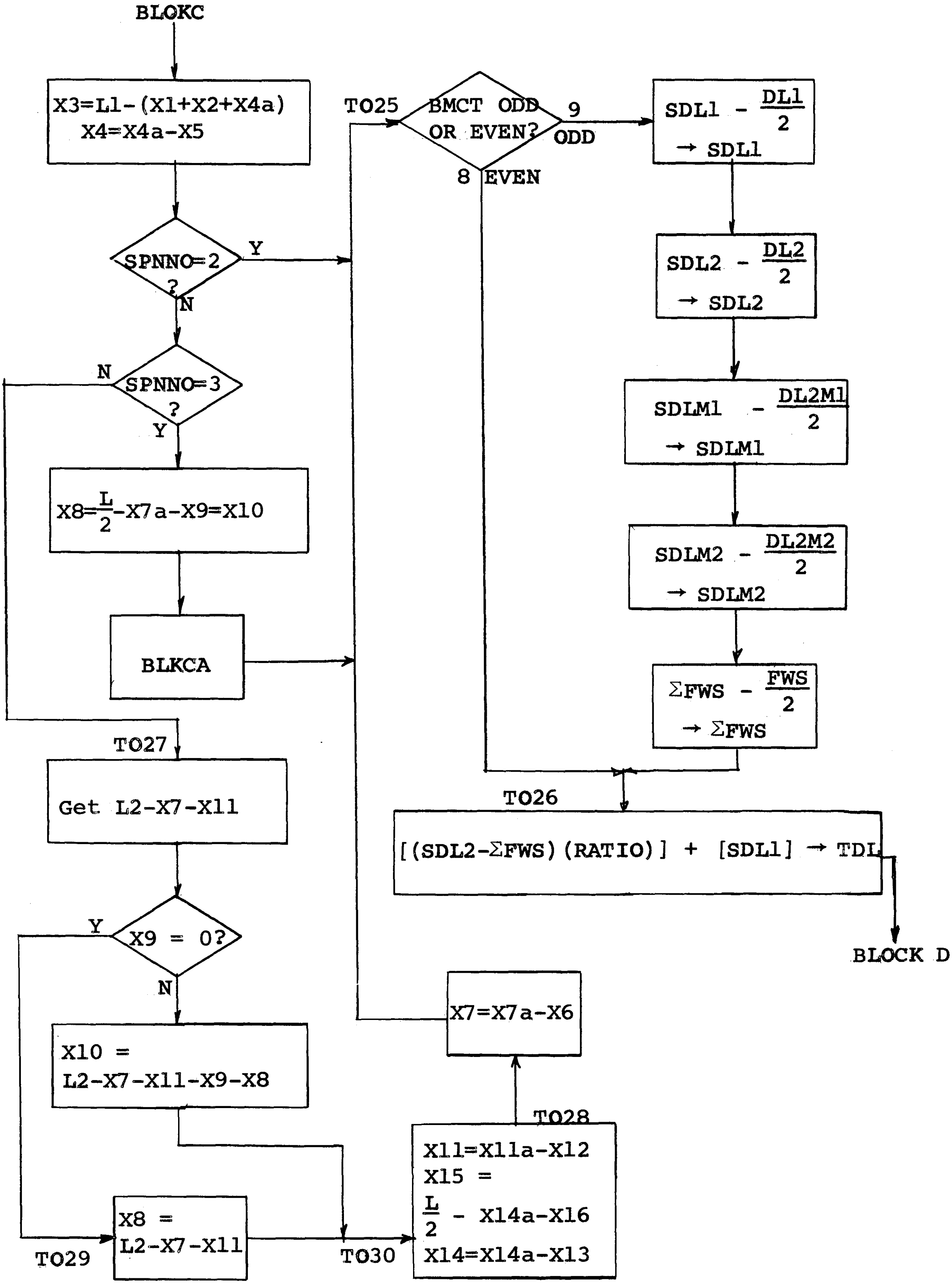
BLOCK B (Continued)



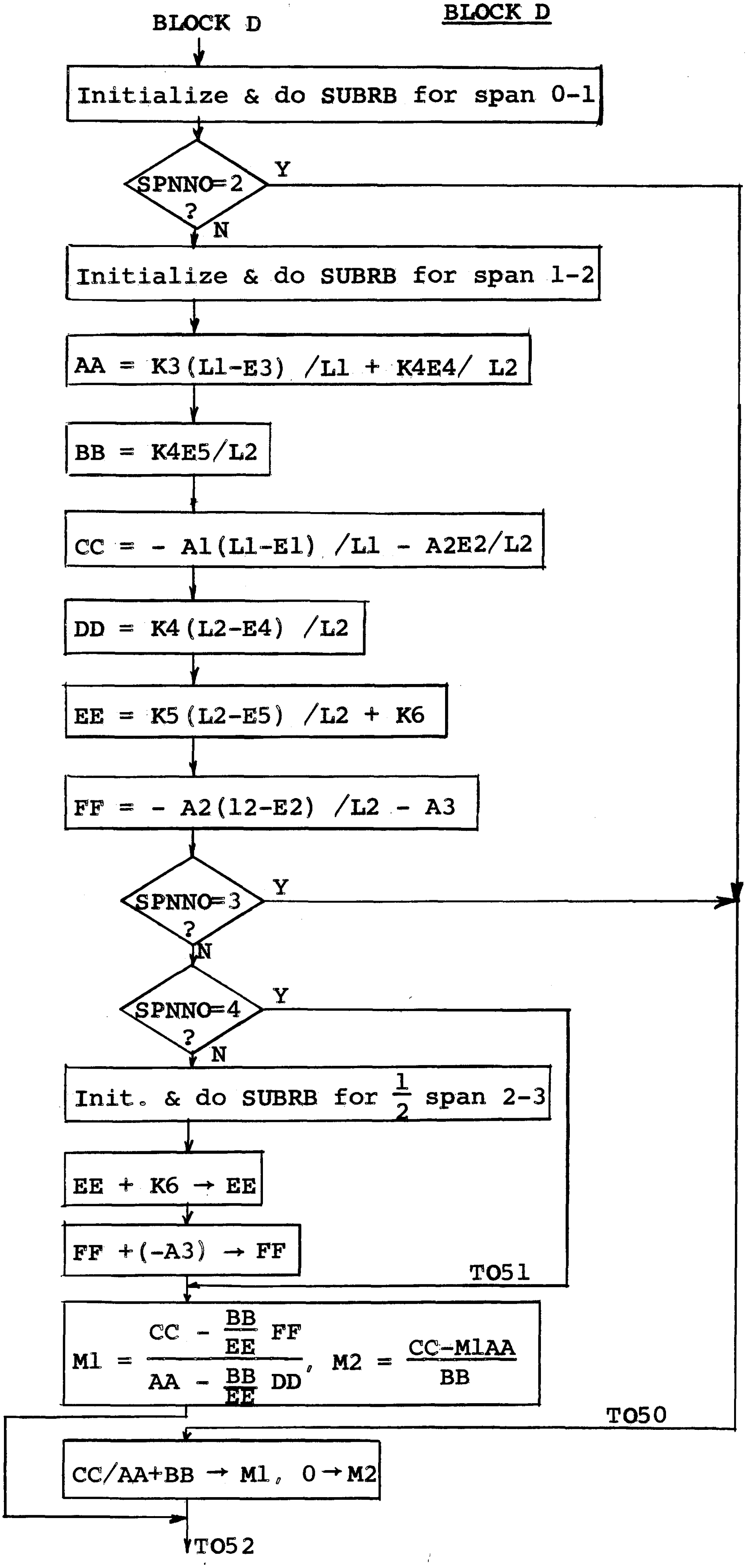
BLOCK B (Continued)



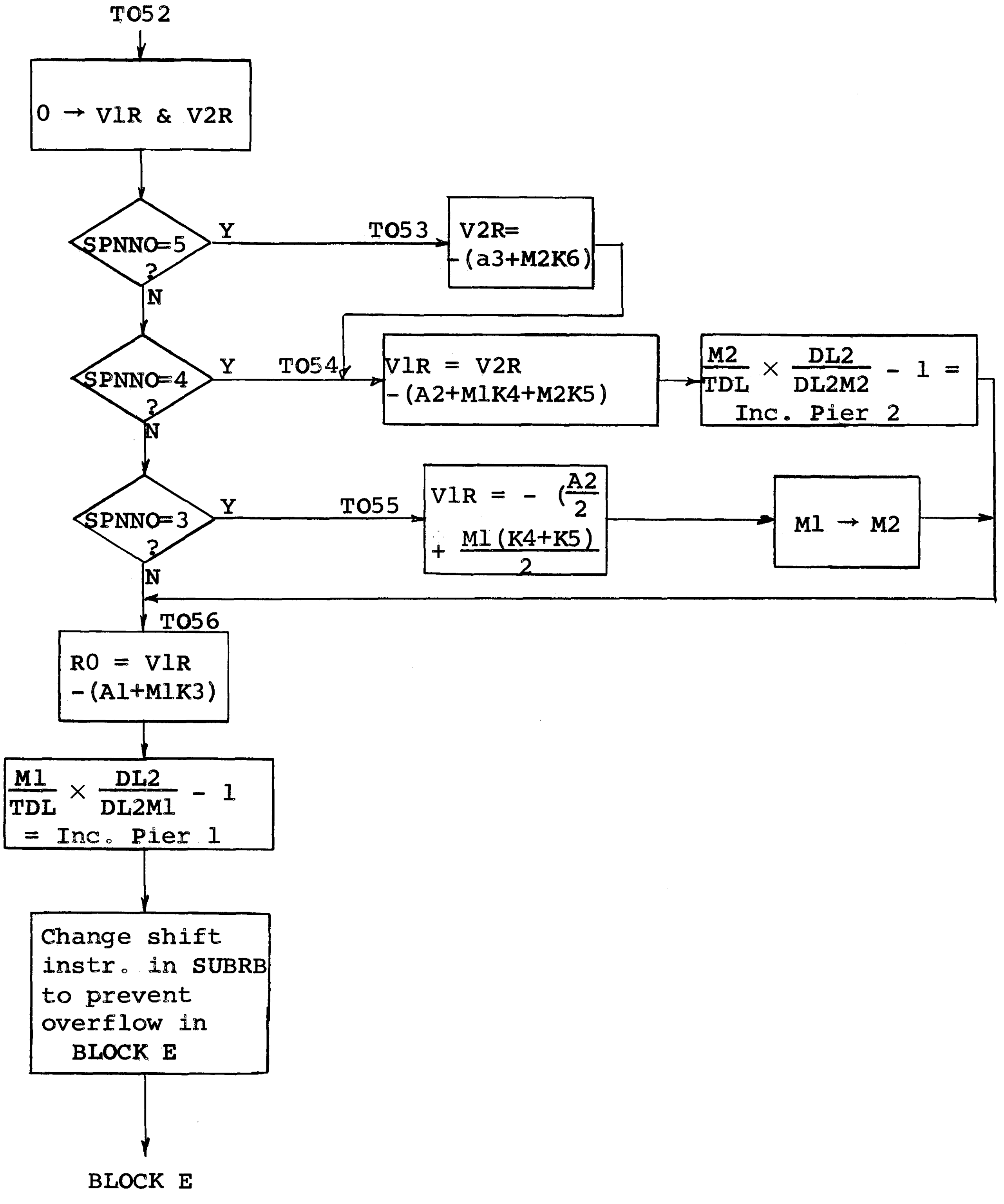
BLOCK C


BLOKC
X3=L1-(X1+X2+X4a)
X4=X4a-X5
SPNNO=2
?
Y
N
SPNNO=3
?
N
Y
X8=L/2-X7a-X9=X10
BLKCA
TO27
Get L2-X7-X11
X9 = 0?
Y
N
X10 =
L2-X7-X11-X9-X8
X8 =
L2-X7-X11
TO29
TO30
X11=X11a-X12
X15 =
L/2 - X14a-X16
X14=X14a-X13
TO28
X7=X7a-X6
TO25
BMCT ODD
OR EVEN?
9
ODD
8
EVEN
SDL1 - DL1/2
→ SDL1
SDL2 - DL2/2
→ SDL2
SDLM1 - DL2M1/2
→ SDLM1
SDLM2 - DL2M2/2
→ SDLM2
ΣFWS - FWS/2
→ ΣFWS
TO26
[(SDL2-ΣFWS)(RATIO)] + [SDL1] → TDL
BLOCK D

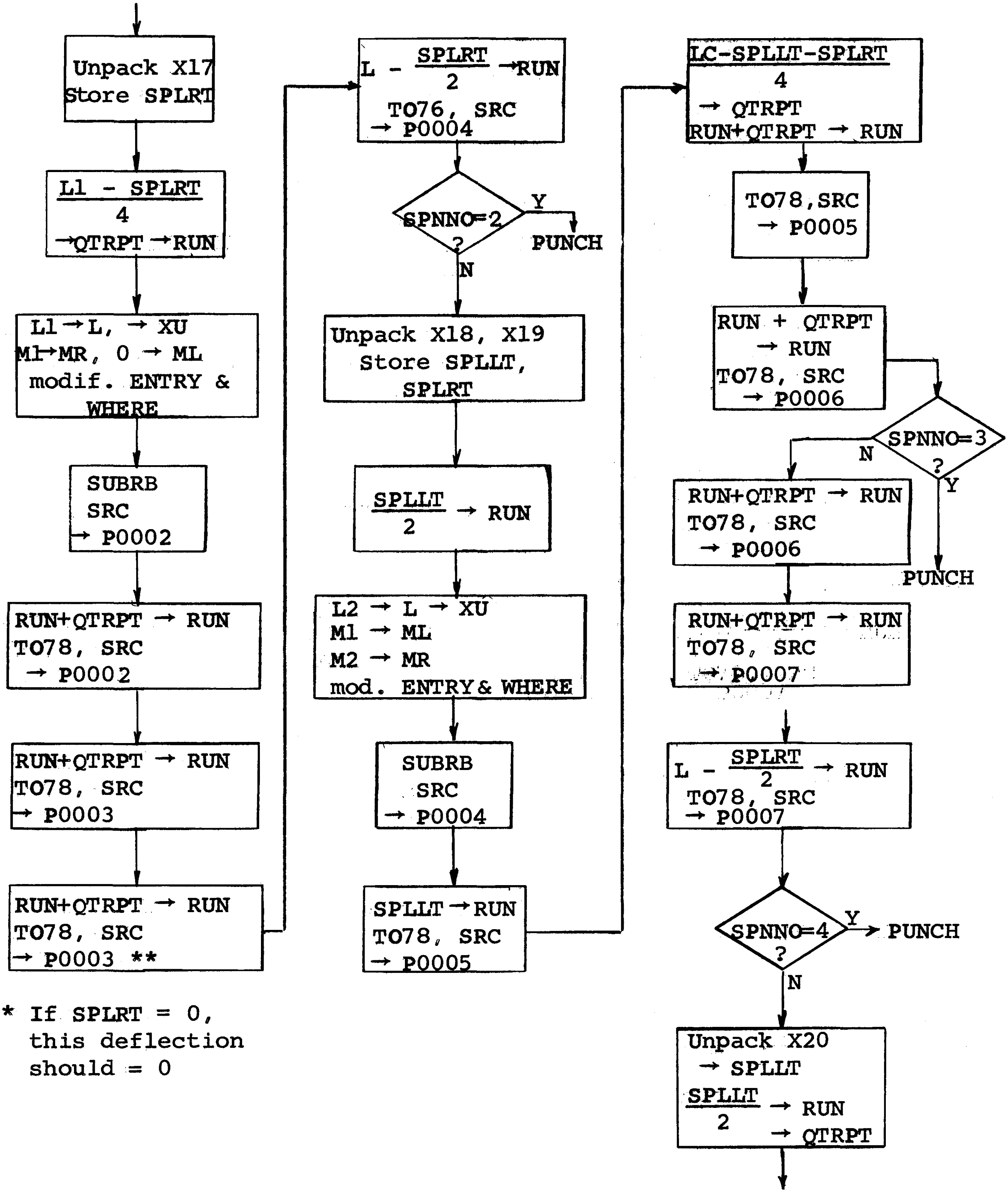
BLOCK D


BLOCK D
Initialize & do SUBRB for span 0-1
SPNNO=2 ?
Y
N
Initialize & do SUBRB for span 1-2
AA = K3(L1-E3) /L1 + K4E4/ L2
BB = K4E5/L2
CC = - A1(L1-E1) /L1 - A2E2/L2
DD = K4(L2-E4) /L2
EE = K5(L2-E5) /L2 + K6
FF = - A2(12-E2) /L2 - A3
SPNNO=3 ?
Y
N
SPNNO=4 ?
Y
N
Init. & do SUBRB for 1/2 span 2-3
EE + K6 → EE
FF +(-A3) → FF
TO51
M1 = (CC - (BB/EE) FF) / (AA - (BB/EE) DD), M2 = (CC-M1AA)/BB
TO50
CC/AA+BB → M1, 0 → M2
TO52

BLOCK D (Continued)



BLOCK E



** If SPLRT = 0,
this deflection
should = 0

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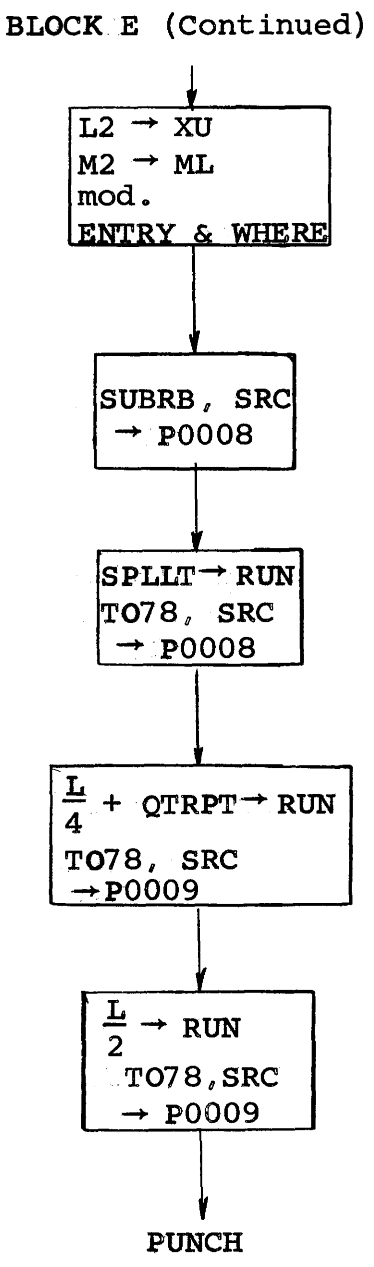
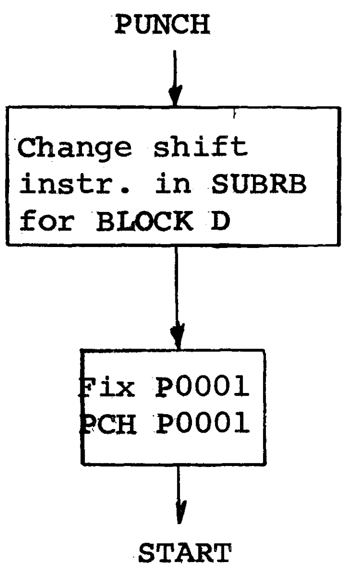

BLOCK E (Continued)
L2 → XU
M2 → ML
mod.
ENTRY & WHERE
SUBRB, SRC
→ P0008
SPLLT → RUN
T078, SRC
→ P0008
$\frac{L}{4}$ + QTRPT → RUN
T078, SRC
→ P0009
$\frac{L}{2}$ → RUN
T078, SRC
→ P0009
PUNCH


PUNCH
Change shift
instr. in SUBRB
for BLOCK D
Fix P0001
PCH P0001
START

WORD LAYOUT FORM

650 MAGNETIC-DRUM DATA-PROCESSING MACHINE

PROGRAM NO. 32016

R0001	R0002	R0003	R0004	R0005	R0006	R0007	R0008	R0009	R0010
BEAM Point No County Design No Run	Length of End Span	Length of Int Span	Length of Bridge	Dead Load-1	Dead Load-2	Uniform Live Load	Conc. Live Load for Moment	Truck Wheel	0-0 8 H20 9 H20-S16 Pier 1 Incre. Pier 2 Incre.

R0001	R0002	R0003	R0004	R0005	R0006	R0007	R0008	R0009	R0010
BEAM Point No County Design No Run	Beam Area	Beam Depth	Beam I	Concrete Width	Concrete Thickness	N	Width Thick-ness Cover Plate-1	Width Thick-ness Cover Plate-2	H

R0001	R0002	R0003	R0004	R0005	R0006	R0007	R0008	R0009	R0010
BEAM Point No County Design No Run		Dead Load-2 Moment							

R0001	R0002	R0003	R0004	R0005	R0006	R0007	R0008	R0009	R0010
BEAM Point No County Design No Run	X_1 X_2	X_4 X_5	X_6 X_7	X_8 X_9	X_{11} X_{12}	No. Bms. X_{13} X_{14}	X_{16} X_{17}	X_{18} X_{19}	X_{20} FWS

P0001	P0002	P0003	P0004	P0005	P0006	P0007	P0008	P0009	P0010
BEAM Point No County Design No Run	D1 D2	D3 D4	D5 D6	D7 D8	D9 D10	D11 D12	D13 D14	D15 D16	Corr. Pier 1 Incre Corr. Pier 2 Incre

SYMBOL TABLE 32016

SYMBOL	LOCATION	DESCRIPTION
10	1307	CONSTANT
10M	0076	CONSTANT
12	0182	CONSTANT
12CUB	0120	CONSTANT
16	1551	CONSTANT
1851D	1601	CONSTANT
1868D	0466	CONSTANT
1875D	0767	CONSTANT
1882D	0817	CONSTANT
1883D	0524	CONSTANT
1901D	0516	CONSTANT
1904D	1215	CONSTANT
1906D	1373	CONSTANT
1908D	1267	CONSTANT
1911D	1217	CONSTANT
1913D	0591	CONSTANT
1916D	0286	CONSTANT
1918D	1062	CONSTANT
1933D	0574	CONSTANT
1951D	0566	CONSTANT
1986D	0624	CONSTANT
2	0138	CONSTANT
3	0084	CONSTANT
4	0070	CONSTANT
40M	1264	CONSTANT
47	0472	CONSTANT
5	0474	CONSTANT
6	1651	CONSTANT
60M	1164	CONSTANT
8	0086	CONSTANT
81	0236	CONSTANT
84	0867	CONSTANT
9	0135	CONSTANT
99	1938	CONSTANT
A1	1135	Positive M/I load span 0-1
A2	1335	Positive M/I load span 1-2
A3	0920	Positive M/I load span 2-3
AA	1153	Intermediate result for solution of simultaneous equations
AMDML	1966	Moment about right hinge of M/I load due to M in real beam at right hinge as found in SRA

SYMBOL	LOCATION	DESCRIPTION
AMDMR	1964	Moment about right hinge of M/I load due to M in real beam at left hinge as found in SRA
AP	1961	Positive M/I load as found in SRA
APDP	1962	Moment of AP about right hinge as found by SRA
BB	1861	Intermediate result for solution of simultaneous equations
BIRDY	0092	Location of 8's and 9's for BDn branch instructions
BLOKA	0050	Beginning instruction for Block A
BLOKB	0112	Beginning instruction for Block B
BLOKC	1475	Beginning instruction for Block C
BLOKD	1272	Beginning instruction for Block D
BLOKE	1318	Beginning instruction for Block E
CC	1203	Intermediate result for solution of simultaneous equations
CP1A	0403	Cover Plate 1 Area
CP1T	0266	Cover Plate 1 Thickness
CP1W	0509	Cover Plate 1 Width
CP2A	0453	Cover Plate 2 Area
CP2T	0316	Cover Plate 2 Thickness
CP2W	0559	Cover Plate 2 Width
CP3A	0503	Cover Plate 3 Area
CP3T	0366	Cover Plate 3 Thickness
CP3W	0609	Cover Plate 3 Width
CP4A	0553	Cover Plate 4 Area
CP4T	0416	Cover Plate 4 Thickness
CP4W	0659	Cover Plate 4 Width
DD	1253	Intermediate result for solution of simultaneous equations
DL1	0561	Dead Load 1
DL1M1	0358	Not Used
DL1M2	0408	Not Used
DL2	0262	Dead Load 2
DL2M1	0811	Moment at Pier 1 due to Dead Load 2
DL2M2	0961	Moment at Pier 2 due to Dead Load 2
E	0154	CONSTANT
EE	1155	Intermediate result for solution of simultaneous equations
ENTRY	0069	First instruction of loop in SUBRB
EP	0881	Distance from right hinge to c.g. of positive M/I load as found in SRA
EXIT	0053	Storage for exit instructions for sub routines

SYMBOL	LOCATION	DESCRIPTION
EXIT1	0172	Instruction to control exit from SRI
EXIT2	0222	Instruction to control exit from SRI
EXIT3	0272	Instruction to control exit from SRI
EXIT4	0322	Instruction to control exit from SRI
EXIT5	1521	Instruction to control exit from SRI
EXIT6	0422	Instruction to control exit from SRI
EXIT7	1017	Instruction to control exit from sub routine beginning at NEX54
EXIT8	1117	Instruction to control exit from sub routine beginning at NEX54
FF	1205	Intermediate result for solution of simultaneous equations
FWS	1972	Future wearing surface
HASH	0078	Symbol for D-address to be modified in SKA
IDNO	1481	Location of identification numbers for data cards
IN	0224	Moment of inertia of cover plate (if any) and beam at a distance XN from left hinge or support
K3	0336	M/I load in span 0-1 for M1=1
K4	0888	M/I load in span 1-2 for M1=1
K5	0386	M/I load in span 1-2 for M2=1
K6	1775	½ M/I load in span 2-3 for M2 & M3 = 1
L	0132	Length of span used in sub routines
L1	0258	Length of end span
L2	0959	Length of interior span
LOLIM	0232	Instruction which defines lower limit of block of drum locations to be zeroed in SUBRZ
M1	0983	Combined moment in ½ beams in bridge at Pier 1 due to DL1 & DL2
M2	1033	Combined moment in ½ beams in bridge at Pier 2 due to DL1 & DL2
MDFY1	0052	Instruction to replace ENTRY
MDFY2	1625	Instruction to replace WHERE
MDFY3	0720	Instruction to replace ENTRY
MDFY4	1675	Instruction to replace WHERE
MDFY5	0480	Instruction to replace ENTRY
MDFY6	1725	Instruction to replace WHERE
ML	0146	Moment in real beam at left hinge used in SUBRB
MLKN	1965	Total M/I load in span due to ML
MR	0259	Moment in real beam at right hinge used in SUBRB

SYMBOL	LOCATION	DESCRIPTION
MRKN	1963	Total M/I load in span due to MR
NEX10	0647	Transfer Control
NEX11	0450	Transfer Control
NEX12	0606	Transfer Control
NEX13	0218	Transfer Control
NEX14	1115	Transfer Control
NEX15	0656	Transfer Control
NEX16	0839	Transfer Control
NEX17	1145	Transfer Control
NEX18	0616	Transfer Control
NEX19	0500	Transfer Control
NEX20	0550	Transfer Control
NEX21	0716	Transfer Control
NEX22	0600	Transfer Control
NEX23	0650	Transfer Control
NEX24	1763	Transfer Control
NEX25	0314	Transfer Control
NEX26	1569	Transfer Control
NEX27	0700	Transfer Control
NEX32	0464	Transfer Control
NEX33	0364	Transfer Control
NEX34	1157	Transfer Control
NEX35	1471	Transfer Control
NEX36	0372	Transfer Control
NEX37	0564	Transfer Control
NEX38	0276	Transfer Control
NEX39	0664	Transfer Control
NEX40	0706	Transfer Control
NEX41	0889	Transfer Control
NEX42	0318	Transfer Control
NEX43	0482	Transfer Control
NEX44	0204	Transfer Control
NEX45	0246	Transfer Control
NEX46	0254	Transfer Control
NEX47	0899	Transfer Control
NEX48	0750	Transfer Control
NEX49	0522	Transfer Control
NEX50	0756	Transfer Control
NEX51	0989	Transfer Control
NEX52	1323	Transfer Control
NEX53	1039	Transfer Control
NEX54	0170	Transfer Control
NEX56	0679	Transfer Control
NEX57	1609	Transfer Control

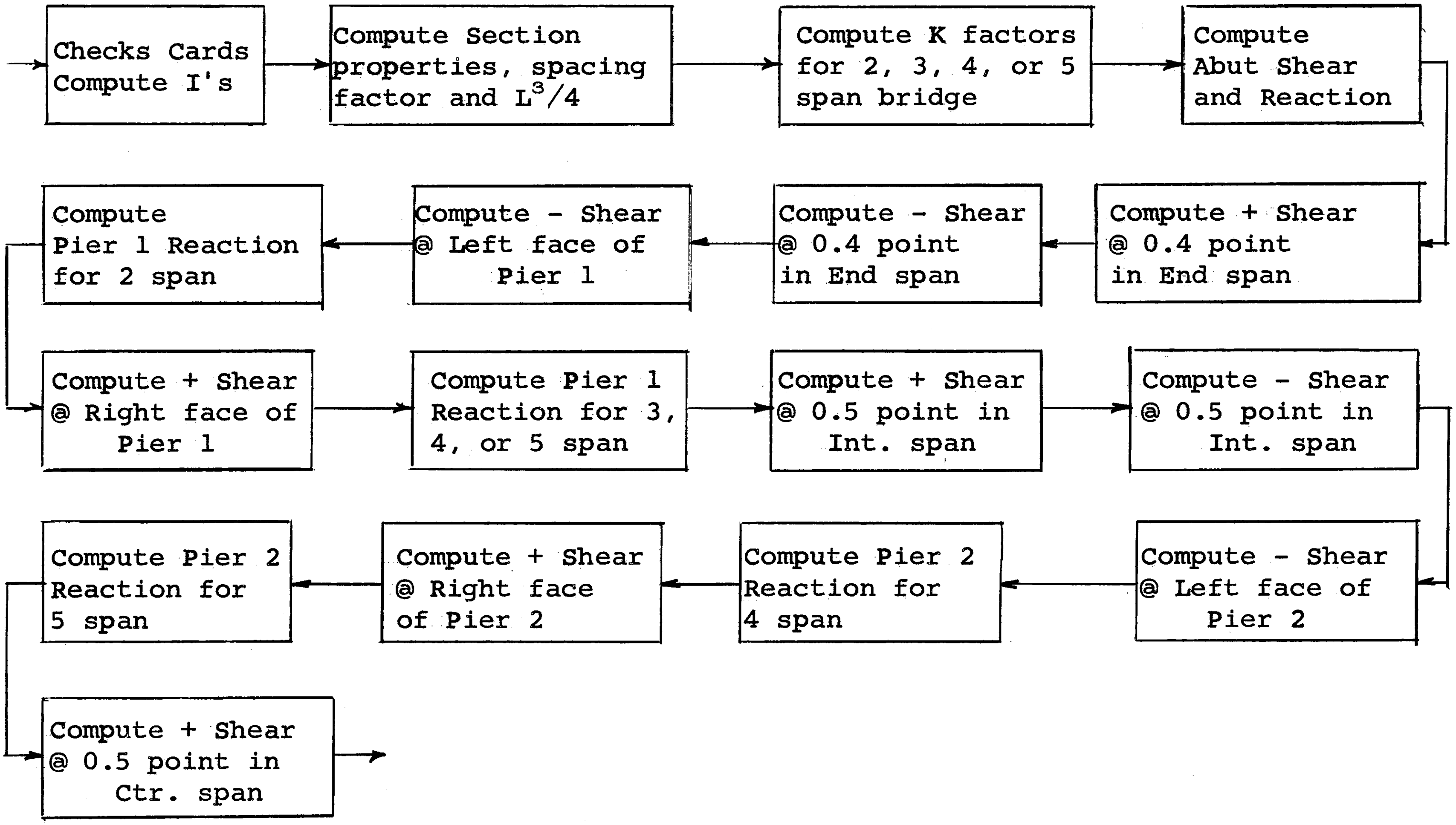
SYMBOL	LOCATION	DESCRIPTION
NEXT1	0350	Transfer Control
NEXT2	0400	Transfer Control
NEXT3	0062	Transfer Control
NEXT4	0164	Transfer Control
NEXT5	0126	Transfer Control
NEXT6	0162	Transfer Control
NEXT7	0110	Transfer Control
NEXT8	0160	Transfer Control
NEXT9	0461	Transfer Control
NXT52	0330	Instruction to modify NEX52
ODEVN	0643	Location of 8 for even number or 9 for odd number of beams in bridge
ONE	0054	CONSTANT
PBMCT	0814	Location of number of beams in bridge
PUNCH	0947	Beginning instruction of block to restore modified instructions and punch answers
QTRPT	1743	One forth distance between splice points
RO	0211	Reaction in conjugate beam at left support
RATIO	1971	Average ratio of I of bare beam to I of composite section in positive moment areas for all beams in bridge
RUN	0274	Distance over which total area of M/I diagram is to be integrated and accumulated
SDL1	1967	Sum of DL1 on ½ beams in bridge
SDL2	1968	Sum of DL2 on ½ beams in bridge
SDLM1	1969	Sum of DL2 moments on ½ beams in bridge at Pier 1
SDLM2	1970	Sum of DL2 moments on ½ beams in bridge at Pier 2
SHFT1	0351	Shift instruction in SUBRB which is modified for use in Block E
SHFT2	0463	Shift instruction in SUBRB which is modified for use in Block E
SOME	0124	Symbol for D-address to be modified in SRA
SPLLT	0988	Distance from left support to left splice point
SPLRT	0858	Distance from right support to right splice point
SPNNO	0144	Number of spans in bridge

SYMBOL	LOCATION	DESCRIPTION
SRA	0100	Location of first instruction of sub routine SRA (SRA used to build tables of distances and I's for bridge)
SRC	0250	First instruction of sub routine to find actual deflections in bridge
SRI	0300	First instruction of sub routine to find moment or inertia of beam with one or two pairs of cover plates
SUBRB	0150	First instruction of sub routine to find total M/I load in a given span
SUBRZ	0529	First instruction of sub routine to store zeros in a preselected block of drum locations
SUMAY	0635	First moment of area of beams and cover plates about their c.g.
SUMXN	0068	Current sum of distances XN from left support or hinge
TBMCT	0096	Temporary beam count
TDL	0169	Total dead load of one half bridge
TEMP1	0060	Temporary storage of data
TEMP2	0090	Temporary storage of data
TEMP3	0155	Temporary storage of data
TEMP4	0103	Temporary storage of data
TEMP5	0345	Temporary storage of data
TEMP6	0435	Temporary storage of data
TO1	0074	Transfer Control
TO10	0174	Transfer Control
TO11	0125	Transfer Control
TO12	0181	Transfer Control
TO13	0113	Transfer Control
TO14	0109	Transfer Control
TO15	0149	Transfer Control
TO16	0107	Transfer Control
TO2	0085	Transfer Control
TO20	0999	Transfer Control
TO21	0583	Transfer Control
TO22	1064	Transfer Control
TO23	1114	Transfer Control
TO24	1162	Transfer Control
TO25	0697	Transfer Control
TO26	1249	Transfer Control
TO27	1615	Transfer Control
TO28	1567	Transfer Control

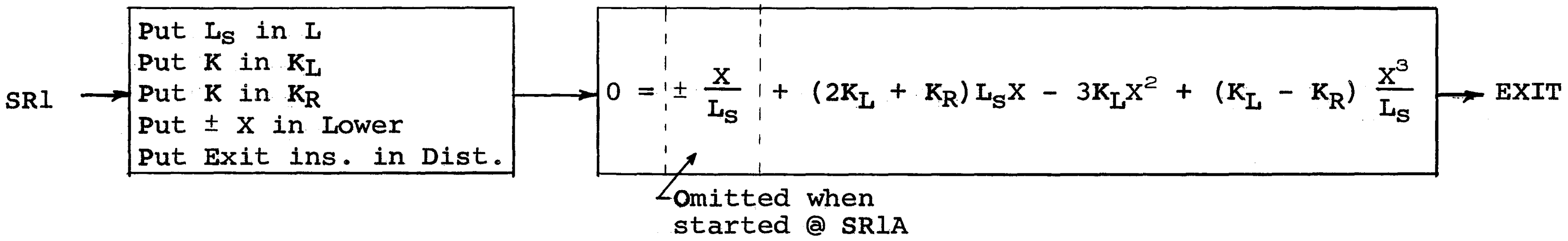
SYMBOL	LOCATION	DESCRIPTION
TO29	0520	Transfer Control
TO3	0075	Transfer Control
TO30	1166	Transfer Control
TO4	0081	Transfer Control
TO5	0093	Transfer Control
TO50	0747	Transfer Control
TO51	1472	Transfer Control
TO52	0486	Transfer Control
TO53	1083	Transfer Control
TO54	1524	Transfer Control
TO55	1574	Transfer Control
TO56	1822	Transfer Control
TO6	0059	Transfer Control
TO7	0099	Transfer Control
TO70	0221	Transfer Control
TO71	0055	Transfer Control
TO72	0061	Transfer Control
TO73	0271	Transfer Control
TO74	0082	Transfer Control
TO75	0129	Transfer Control
TO76	0200	Transfer Control
TO77	0401	Transfer Control
TO78	1333	Transfer Control
TO79	0342	Transfer Control
TO8	0057	Transfer Control
TO9	0131	Transfer Control
UPLIM	0291	Instruction which defines upper limit of block of drum locations to be zeroed in SUBRZ
V1R	0140	Shear in conjugate beam to right of hinge 1
V2R	0496	Shear in conjugate beam to right of hinge 2
WHERE	0077	Location of instruction in SUBRB which is modified to give location of current IN
XL	0142	Lower limit of integral to find area of M/I diagram
XL2	0127	XL^2
XL3	0133	XL^3
XL4	0175	XL^4
XN	0058	Current distance along beam in which I remains constant to be added to SUMXN
XU	0381	Upper limit of integral to find area of M/I diagram

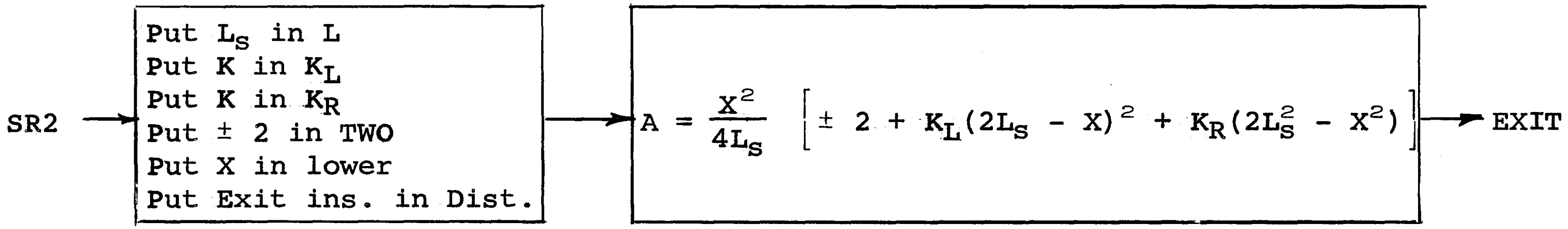
SYMBOL	LOCATION	DESCRIPTION
XU2	0177	XU^2
XU3	0371	XU^3
XU4	0363	XU^4
XUL	0251	XU-XL
XUL2	0177	XU^2-XL^2
XUL3	0371	XU^3-XL^3
XUL4	0363	XU^4-XL^4
ZEROS	0122	CONSTANT

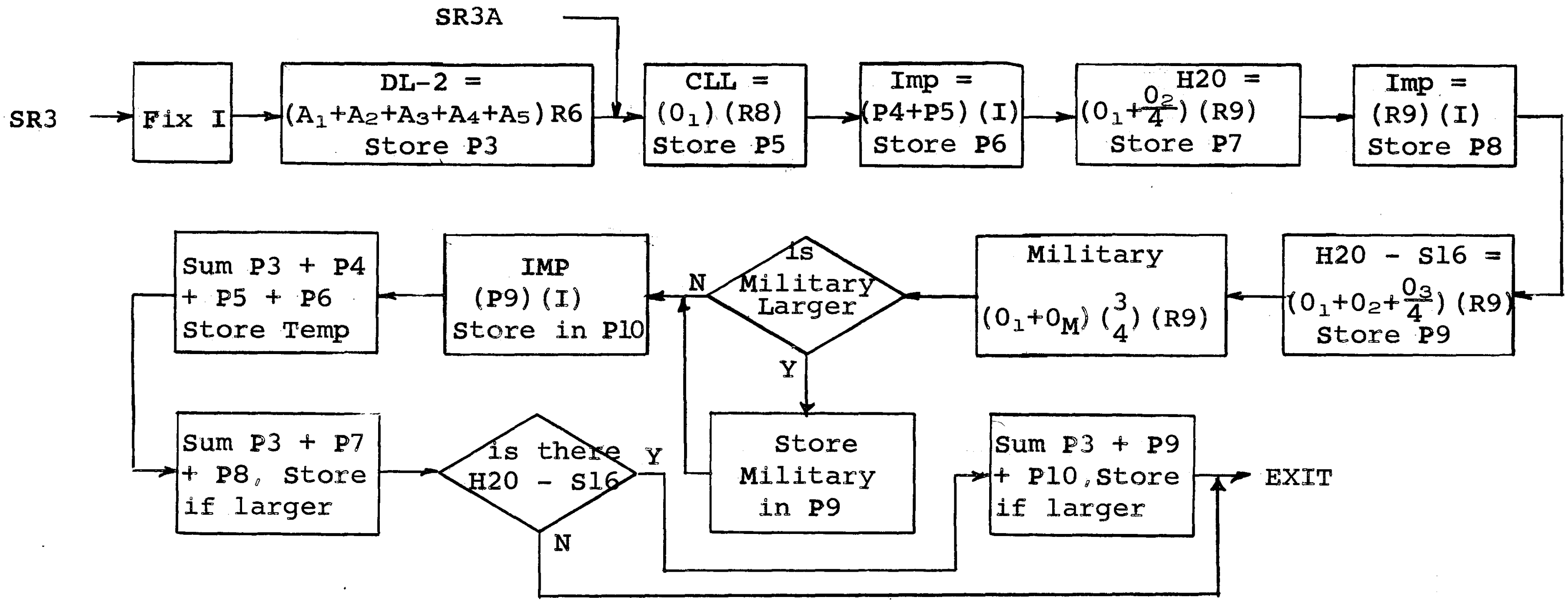
GENERAL FLOW DIAGRAM (SHEAR AND REACTIONS)



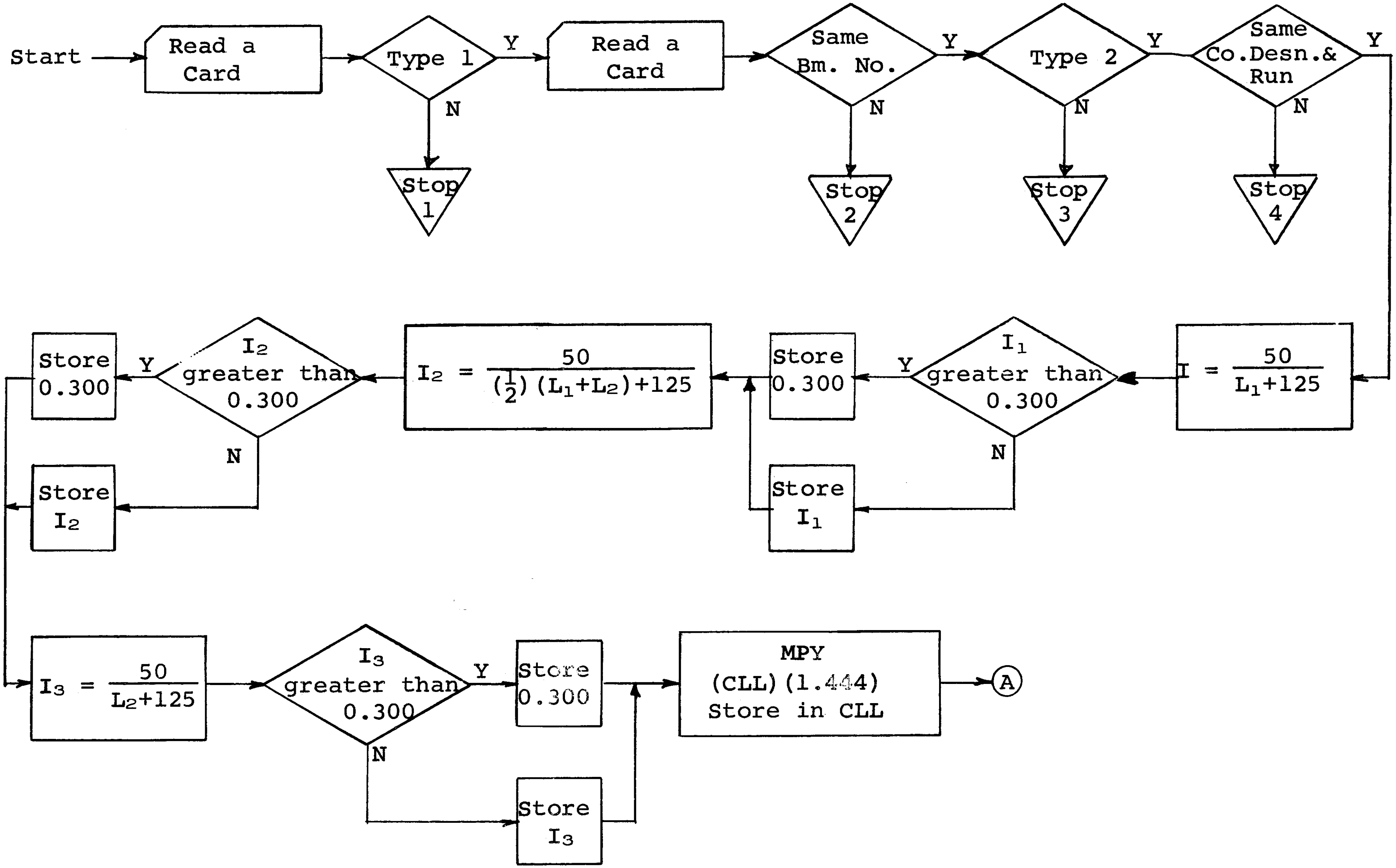
SUB ROUTINES



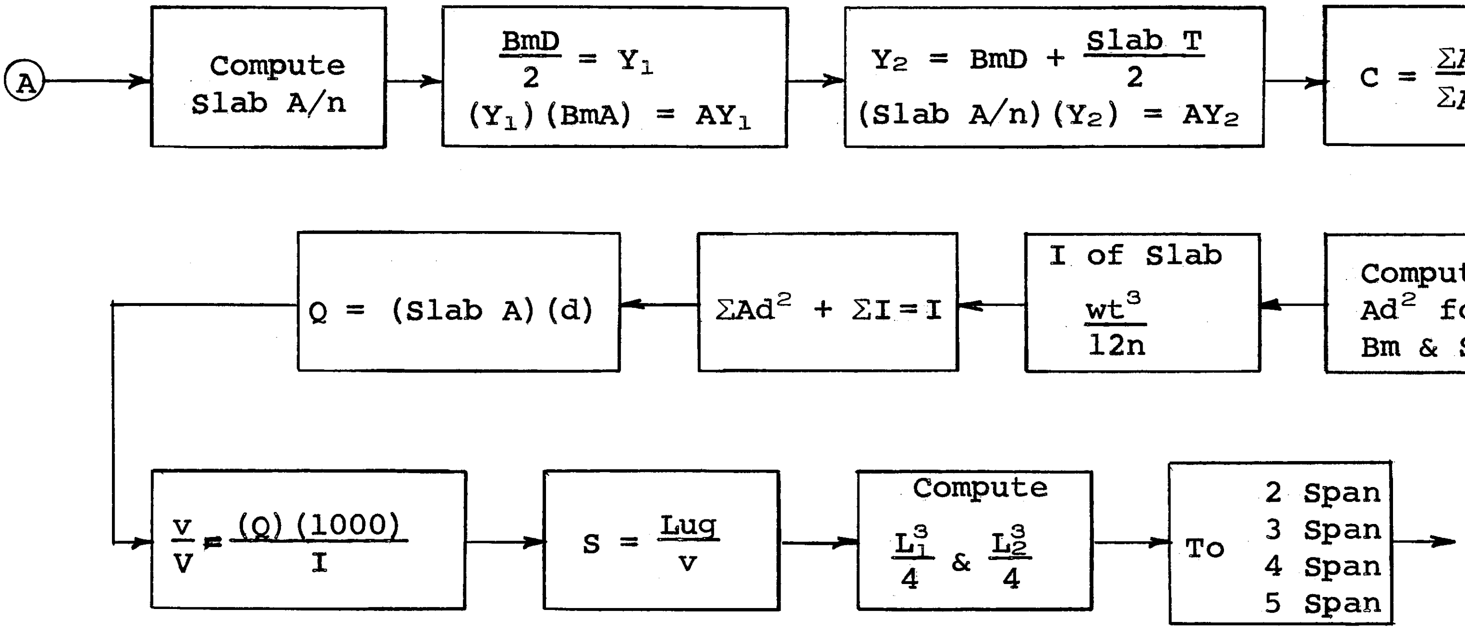




BLOCK START


Start
Read a Card
Type 1
Y
N
Stop 1
Read a Card
Same Bm. No.
Y
N
Stop 2
Type 2
Y
N
Stop 3
Same Co.Desn.& Run
Y
N
Stop 4
$I = \frac{50}{L_1+125}$
I_1 greater than 0.300
Y
N
Store 0.300
Store I_1
$I_2 = \frac{50}{(\frac{1}{2})(L_1+L_2)+125}$
I_2 greater than 0.300
Y
N
Store 0.300
Store I_2
$I_3 = \frac{50}{L_2+125}$
I_3 greater than 0.300
Y
N
Store 0.300
Store I_3
MPY (CLL)(1.444) Store in CLL
A

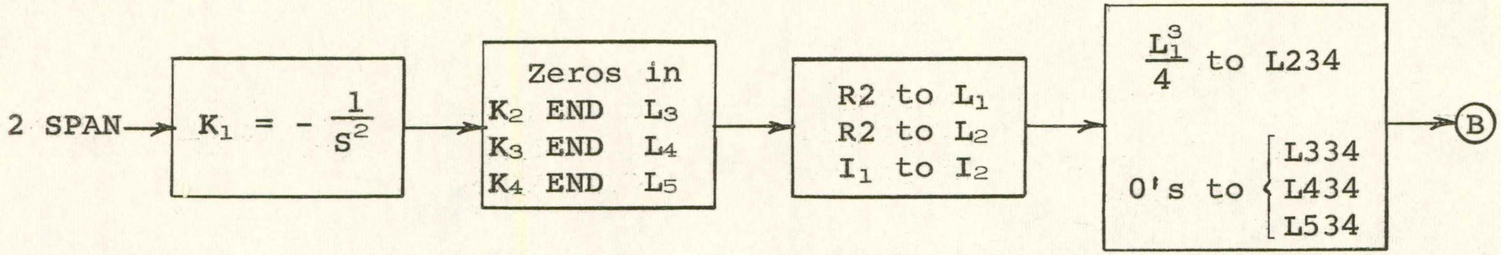
BLOCK A



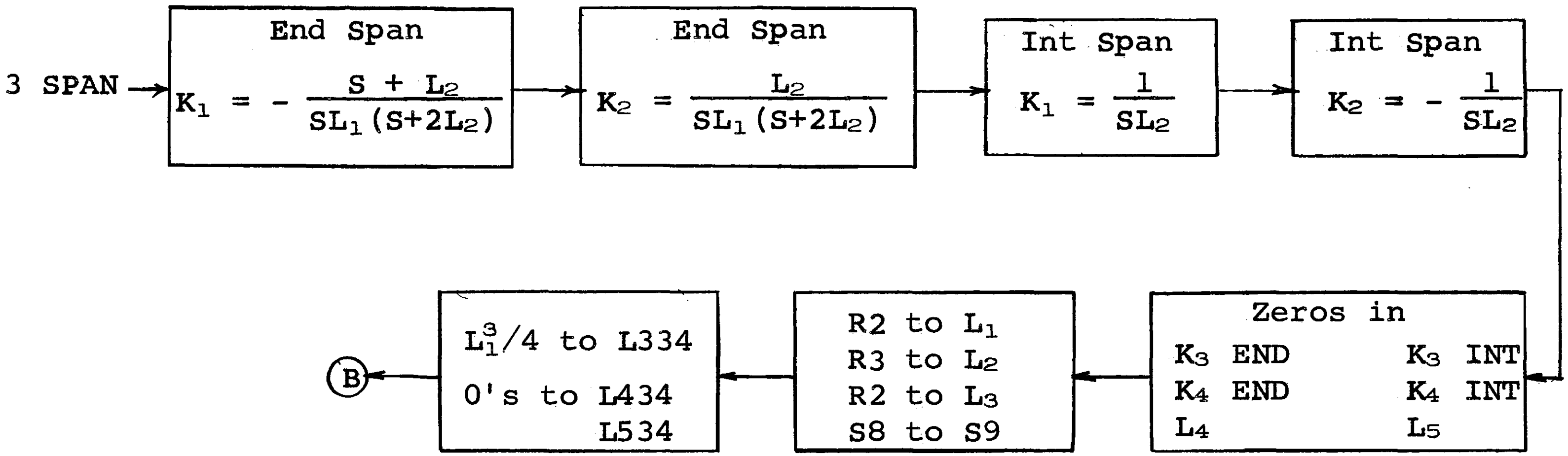
Actual shear lug spacing = $\frac{S}{V}$

S = spacing factor
V = vertical shear

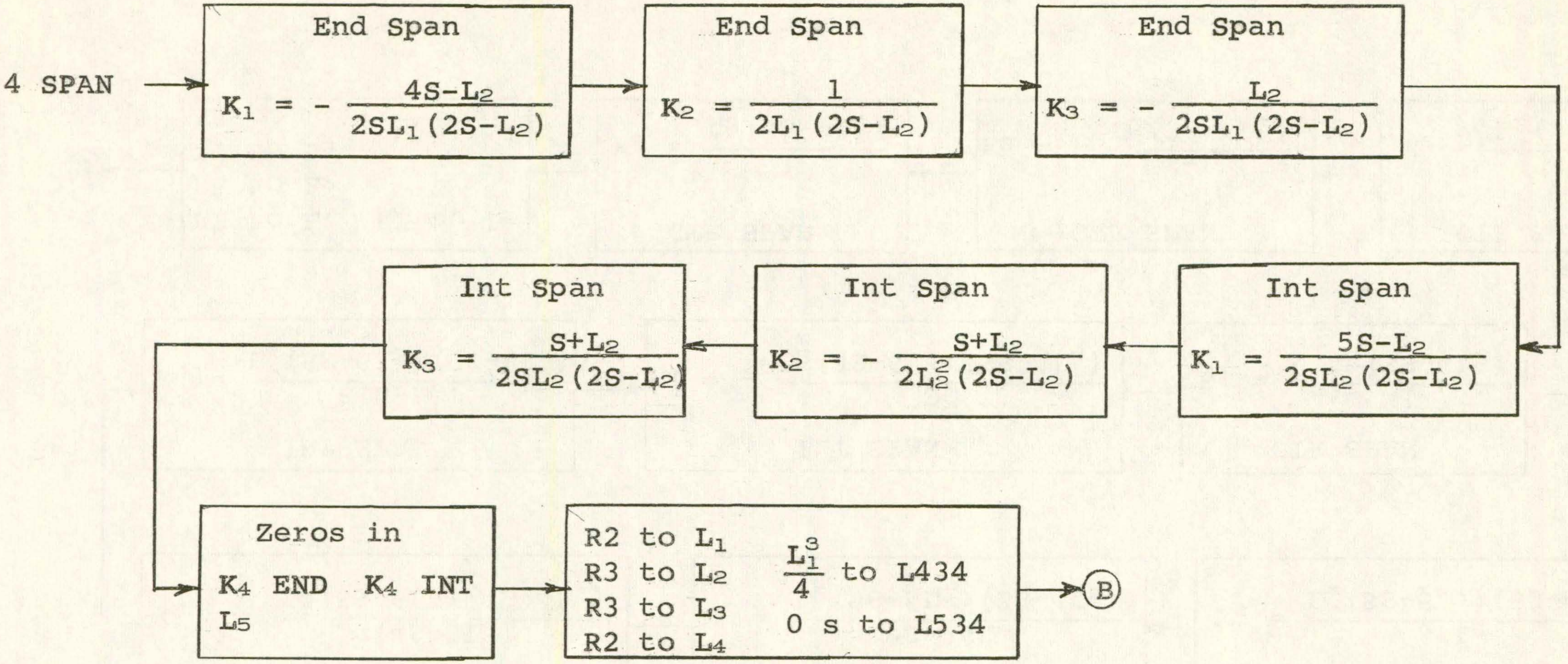
BLOCK 2 SPAN


2 SPAN
$K_1 = -\frac{1}{S^2}$
Zeros in
K_2 END L_3
K_3 END L_4
K_4 END L_5
R2 to L_1
R2 to L_2
I_1 to I_2
$\frac{L_1^3}{4}$ to L234
0's to L334 L434 L534
B

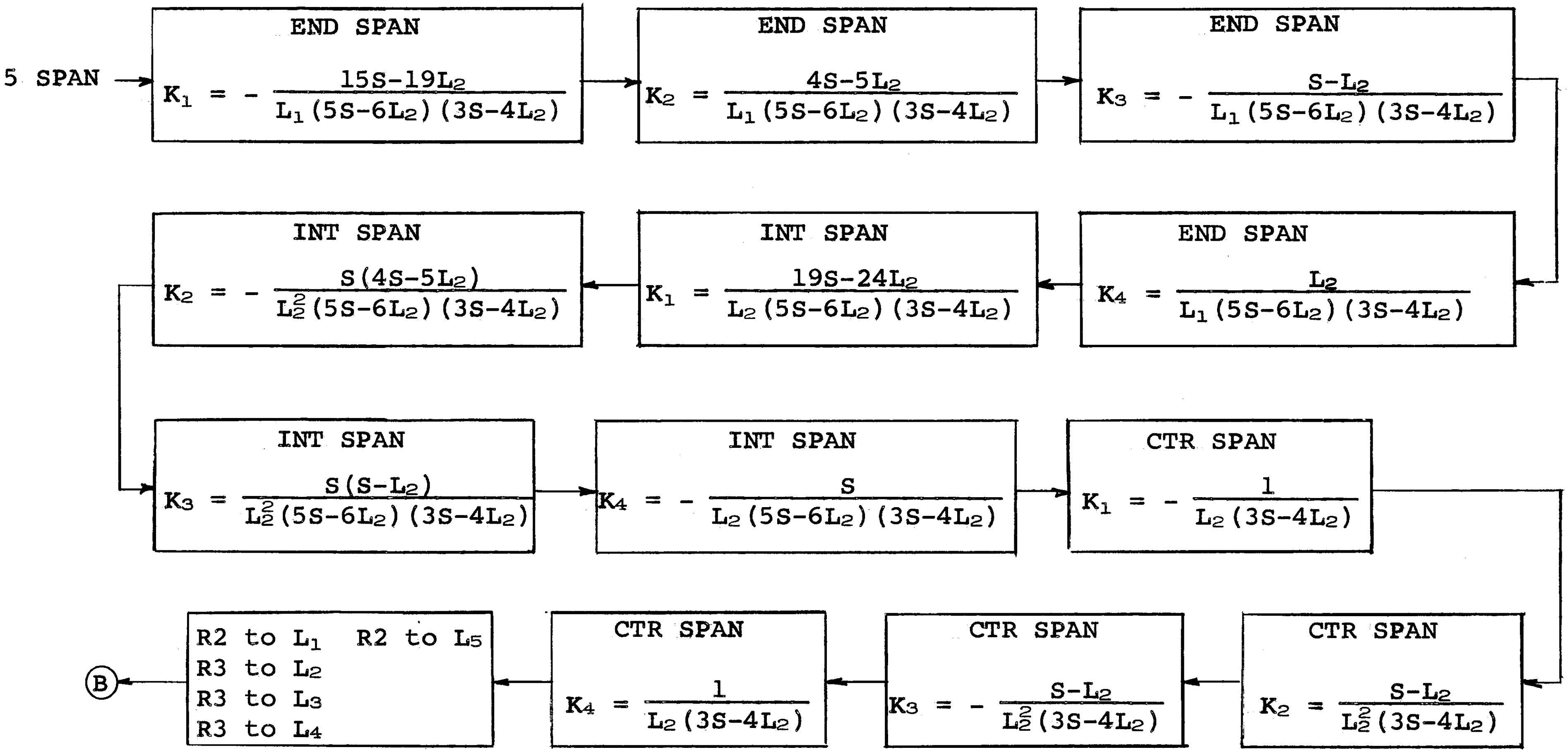
BLOCK 3 SPAN


3 SPAN
End Span
$K_1 = -\frac{S + L_2}{SL_1(S+2L_2)}$
End Span
$K_2 = \frac{L_2}{SL_1(S+2L_2)}$
Int Span
$K_1 = \frac{1}{SL_2}$
Int Span
$K_2 = -\frac{1}{SL_2}$
Zeros in
K_3 END
K_4 END
L_4
K_3 INT
K_4 INT
L_5
R2 to L_1
R3 to L_2
R2 to L_3
S8 to S9
$L_1^3/4$ to L334
0's to L434
L534
B

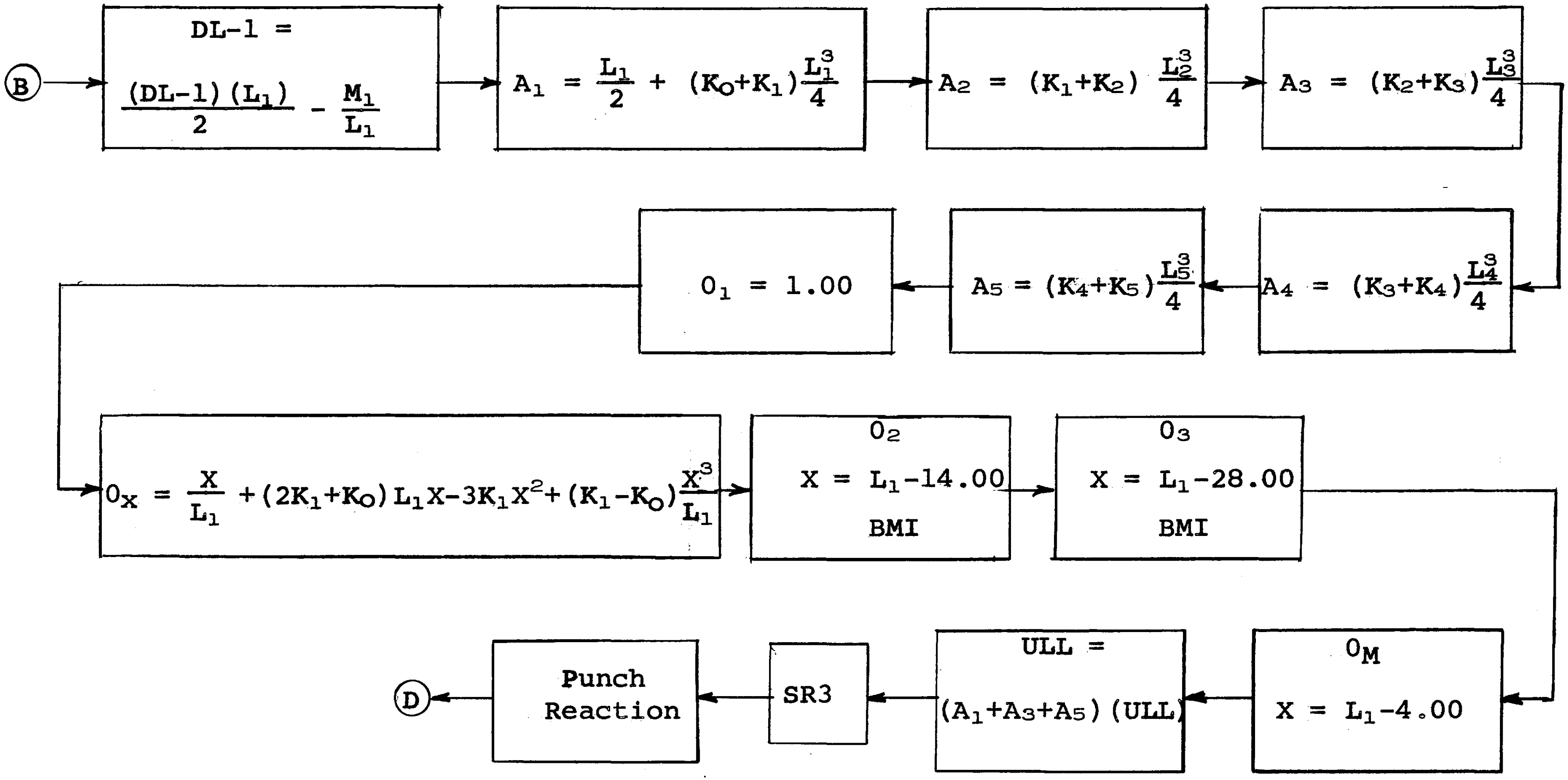
BLOCK 4 SPAN


4 SPAN
End Span
$K_1 = -\frac{4S-L_2}{2SL_1(2S-L_2)}$
End Span
$K_2 = \frac{1}{2L_1(2S-L_2)}$
End Span
$K_3 = -\frac{L_2}{2SL_1(2S-L_2)}$
Int Span
$K_1 = \frac{5S-L_2}{2SL_2(2S-L_2)}$
Int Span
$K_2 = -\frac{S+L_2}{2L_2^2(2S-L_2)}$
Int Span
$K_3 = \frac{S+L_2}{2SL_2(2S-L_2)}$
Zeros in
K_4 END K_4 INT
L_5
R2 to L_1
R3 to L_2
R3 to L_3
R2 to L_4
$\frac{L_1^3}{4}$ to L434
0 s to L534
B

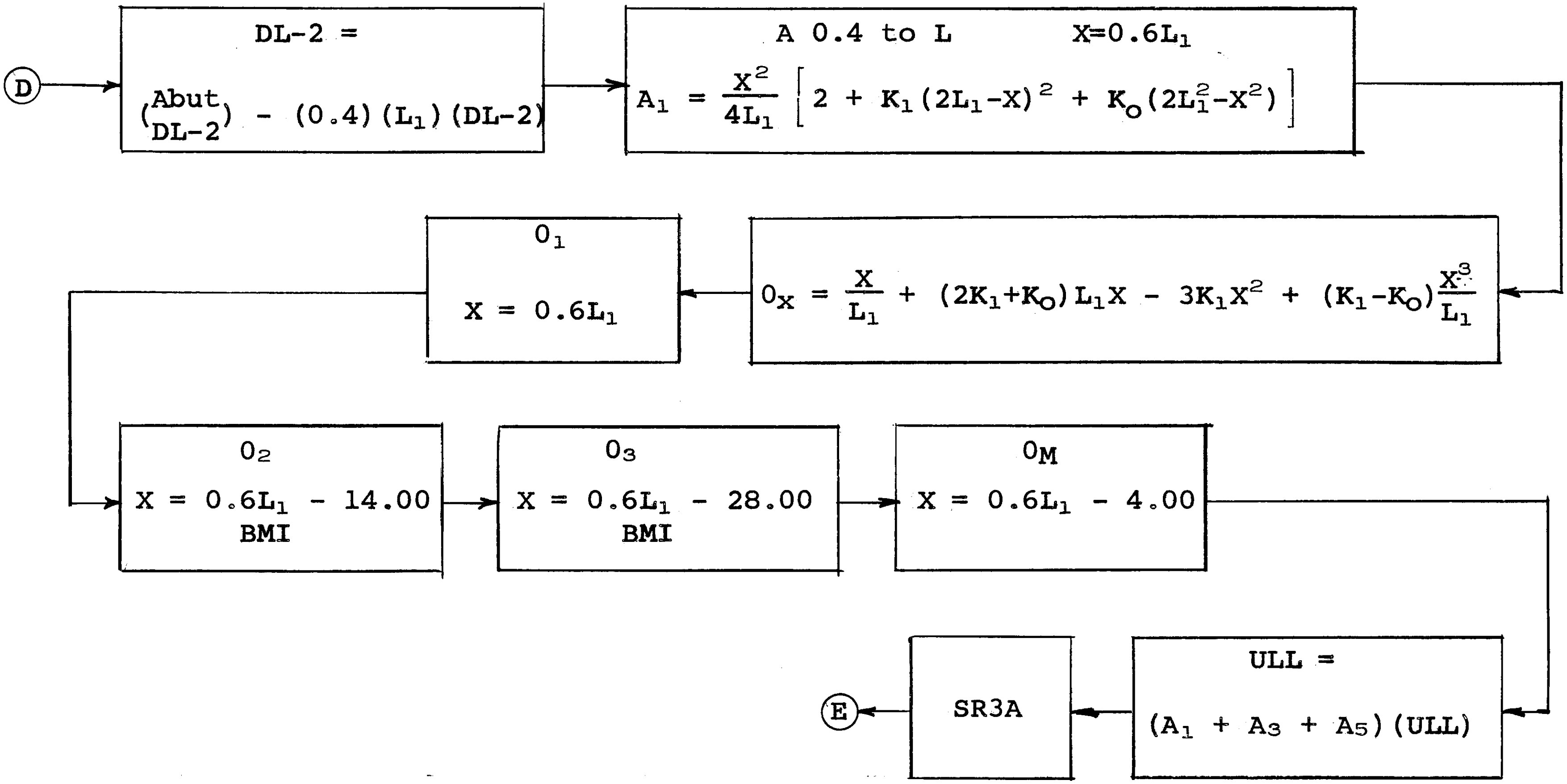
BLOCK 5 SPAN


5 SPAN
END SPAN
$K_1 = - \frac{15S-19L_2}{L_1(5S-6L_2)(3S-4L_2)}$
END SPAN
$K_2 = \frac{4S-5L_2}{L_1(5S-6L_2)(3S-4L_2)}$
END SPAN
$K_3 = - \frac{S-L_2}{L_1(5S-6L_2)(3S-4L_2)}$
END SPAN
$K_4 = \frac{L_2}{L_1(5S-6L_2)(3S-4L_2)}$
INT SPAN
$K_1 = \frac{19S-24L_2}{L_2(5S-6L_2)(3S-4L_2)}$
INT SPAN
$K_2 = - \frac{S(4S-5L_2)}{L_2^2(5S-6L_2)(3S-4L_2)}$
INT SPAN
$K_3 = \frac{S(S-L_2)}{L_2^2(5S-6L_2)(3S-4L_2)}$
INT SPAN
$K_4 = - \frac{S}{L_2(5S-6L_2)(3S-4L_2)}$
CTR SPAN
$K_1 = - \frac{1}{L_2(3S-4L_2)}$
CTR SPAN
$K_2 = \frac{S-L_2}{L_2^2(3S-4L_2)}$
CTR SPAN
$K_3 = - \frac{S-L_2}{L_2^2(3S-4L_2)}$
CTR SPAN
$K_4 = \frac{1}{L_2(3S-4L_2)}$
R2 to L_1 R2 to L_5
R3 to L_2
R3 to L_3
R3 to L_4
B

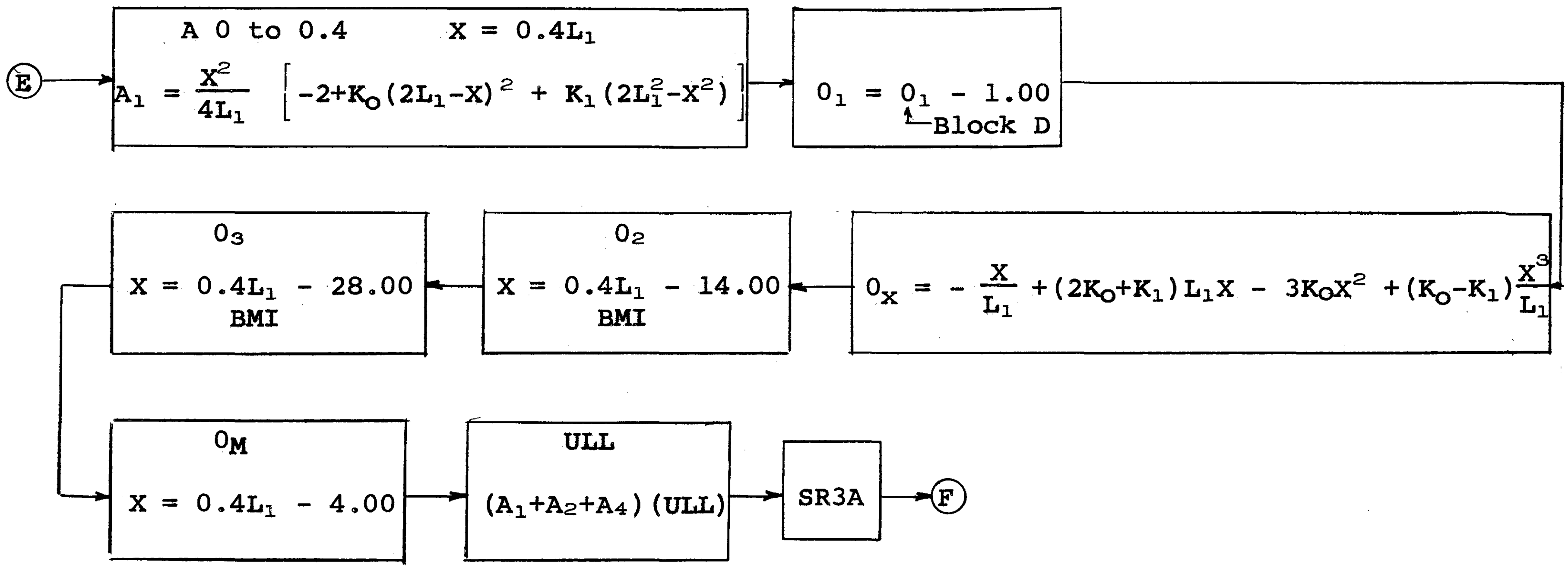
BLOCK B **ABUT REACTIONS & SHEAR**



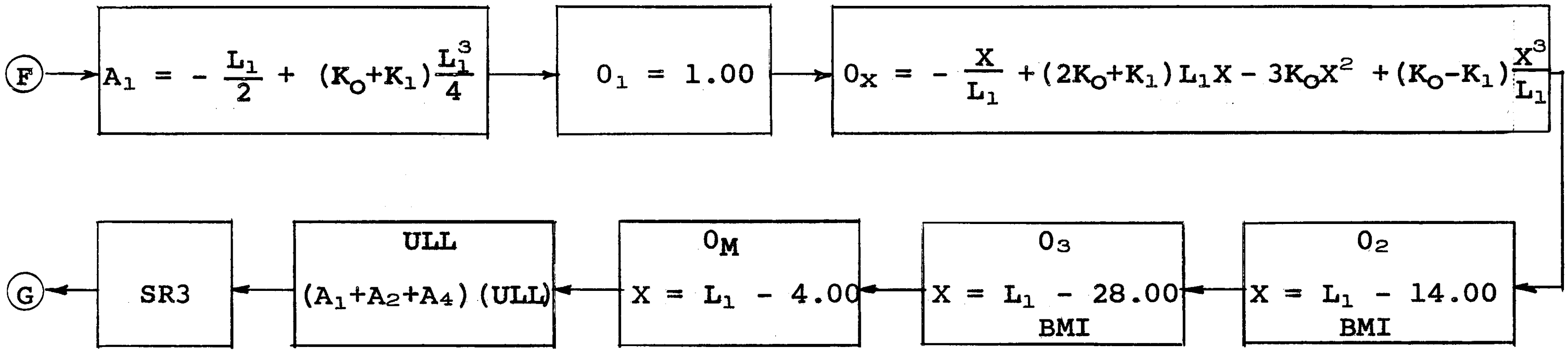
BLOCK D **SHEAR @ 0.4 PT IN END SPAN (+)**



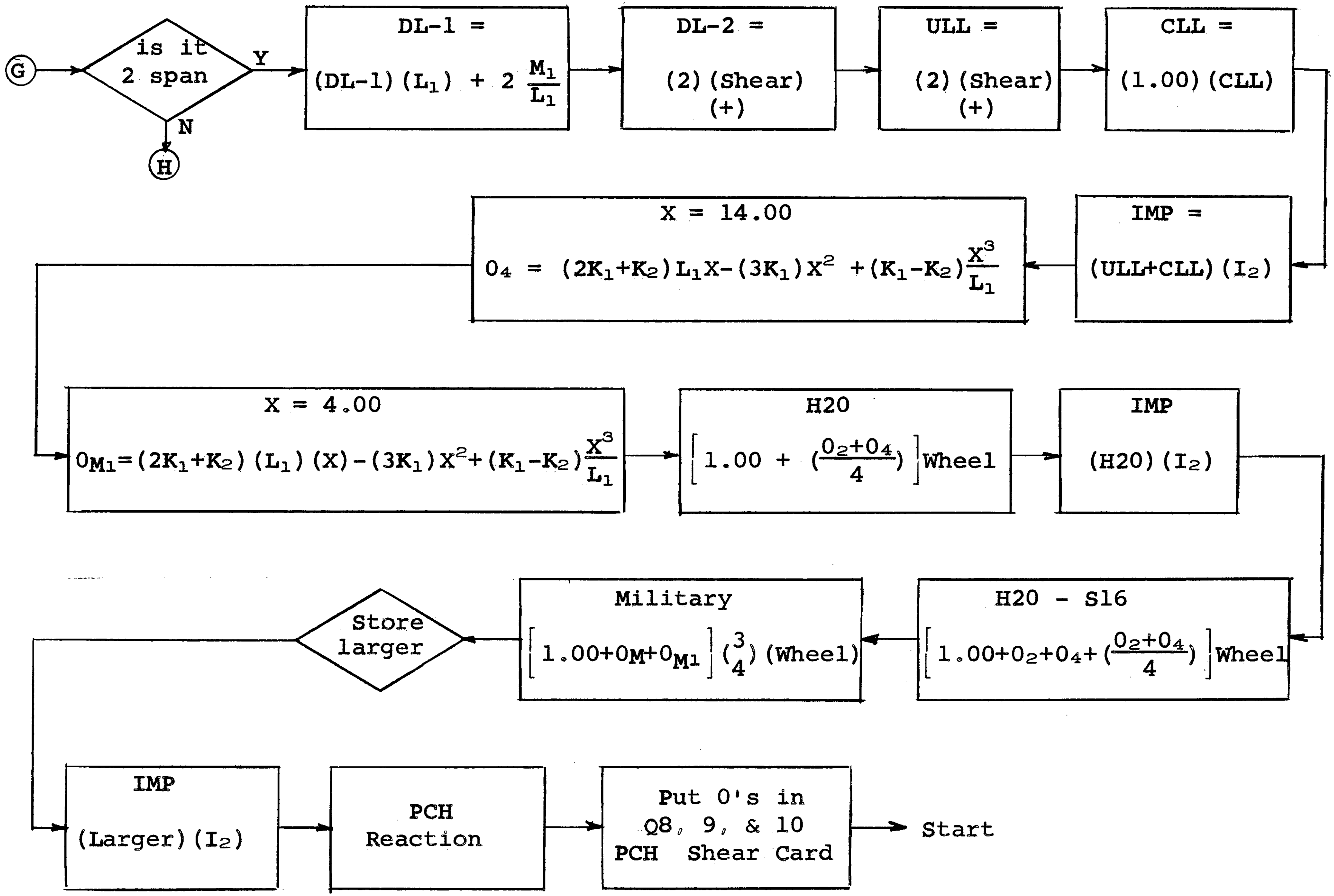
BLOCK E SHEAR @ 0.4 PT IN END SPAN (-)



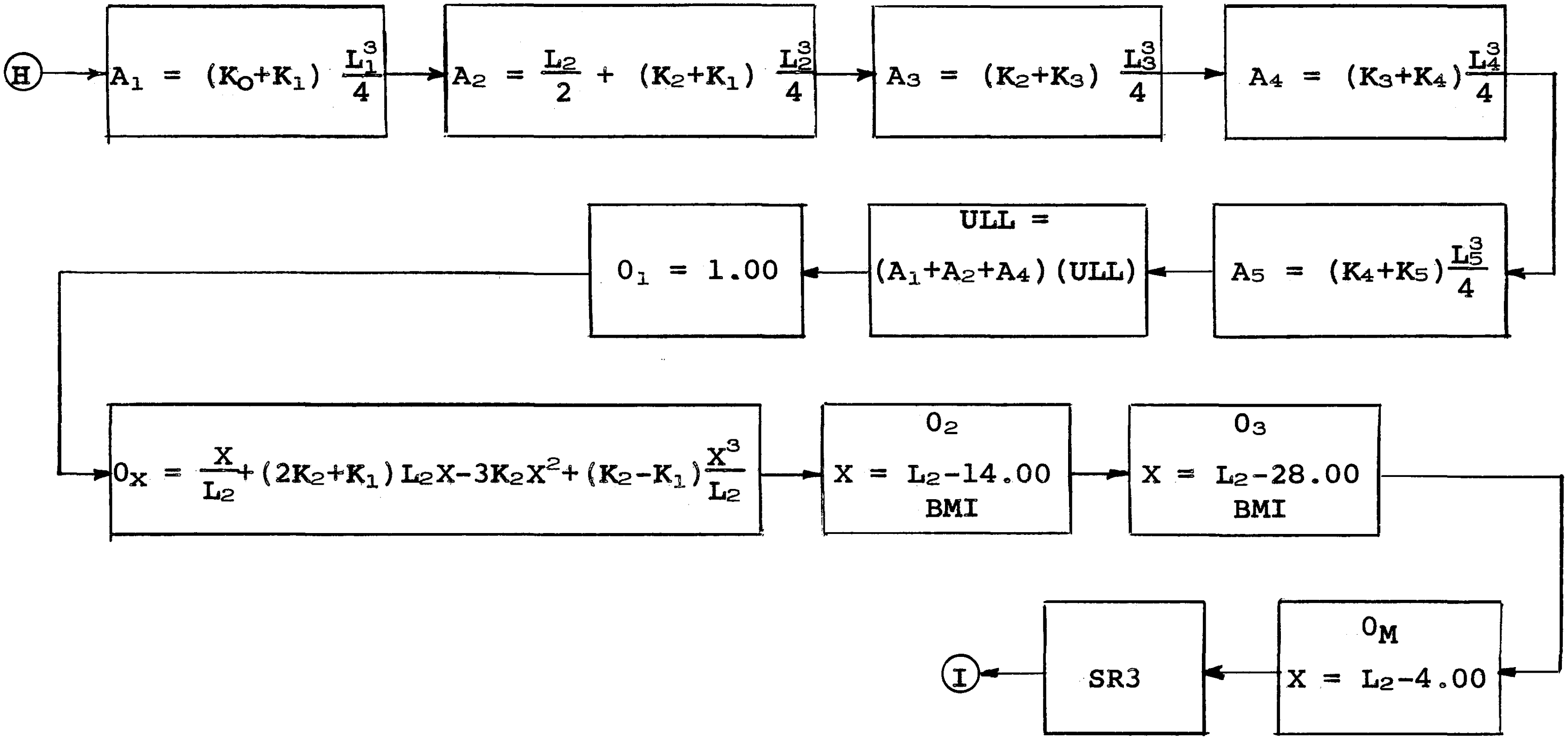
BLOCK F   SHEAR @ LEFT FACE OF PIER 1 (-)



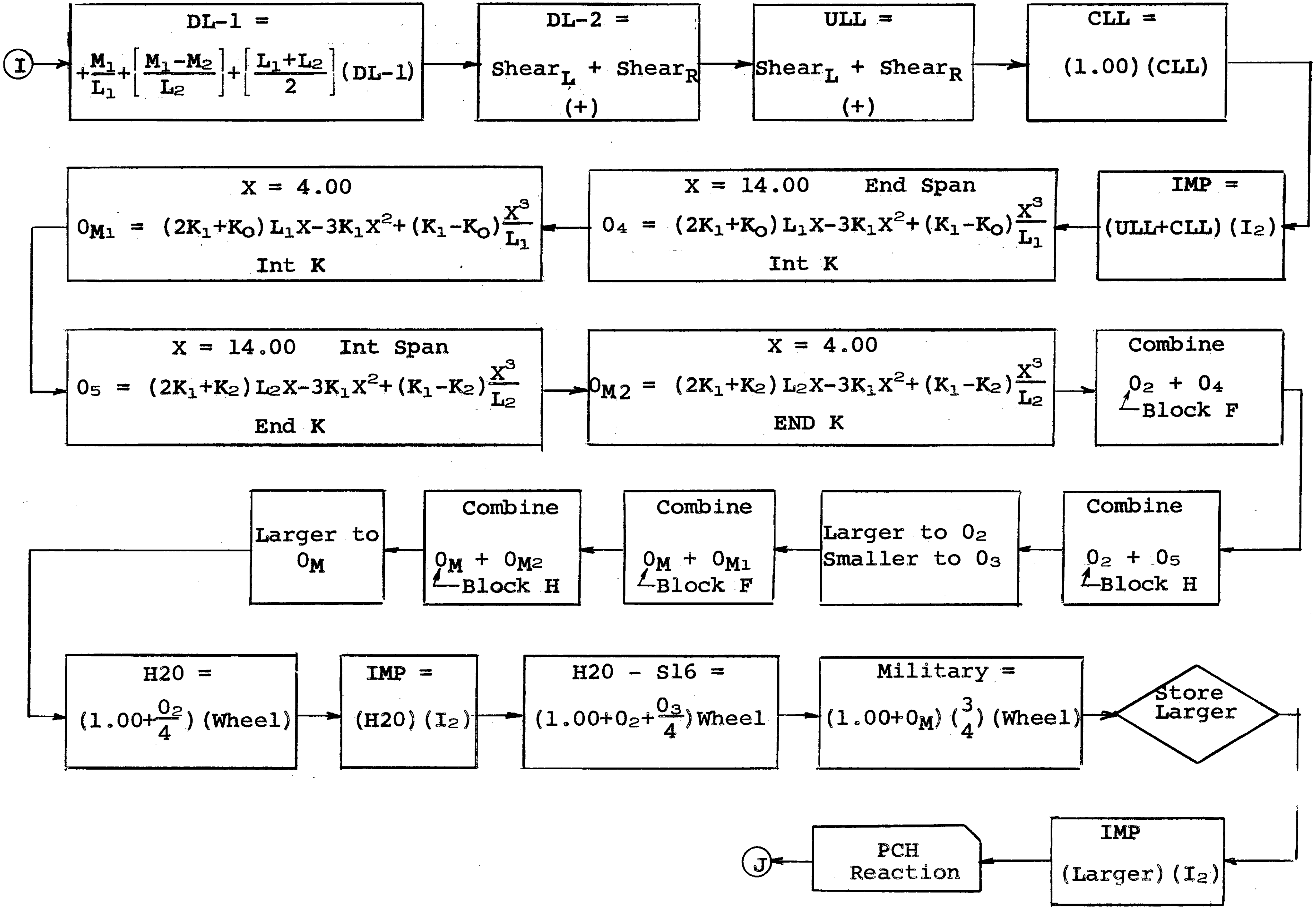
BLOCK G **PIER 2 REACTION**



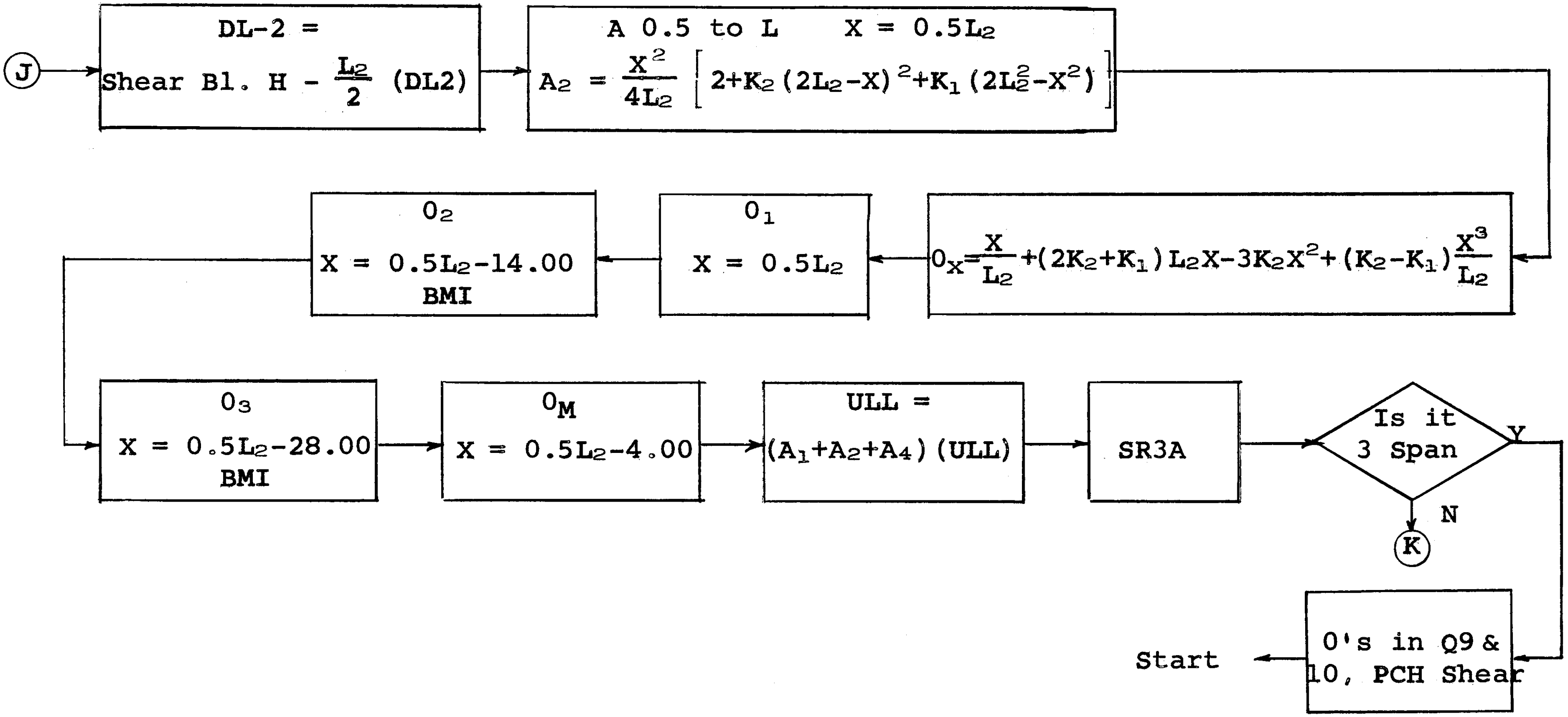
BLOCK H **SHEAR @ RIGHT FACE OF PIER 1 (+)**



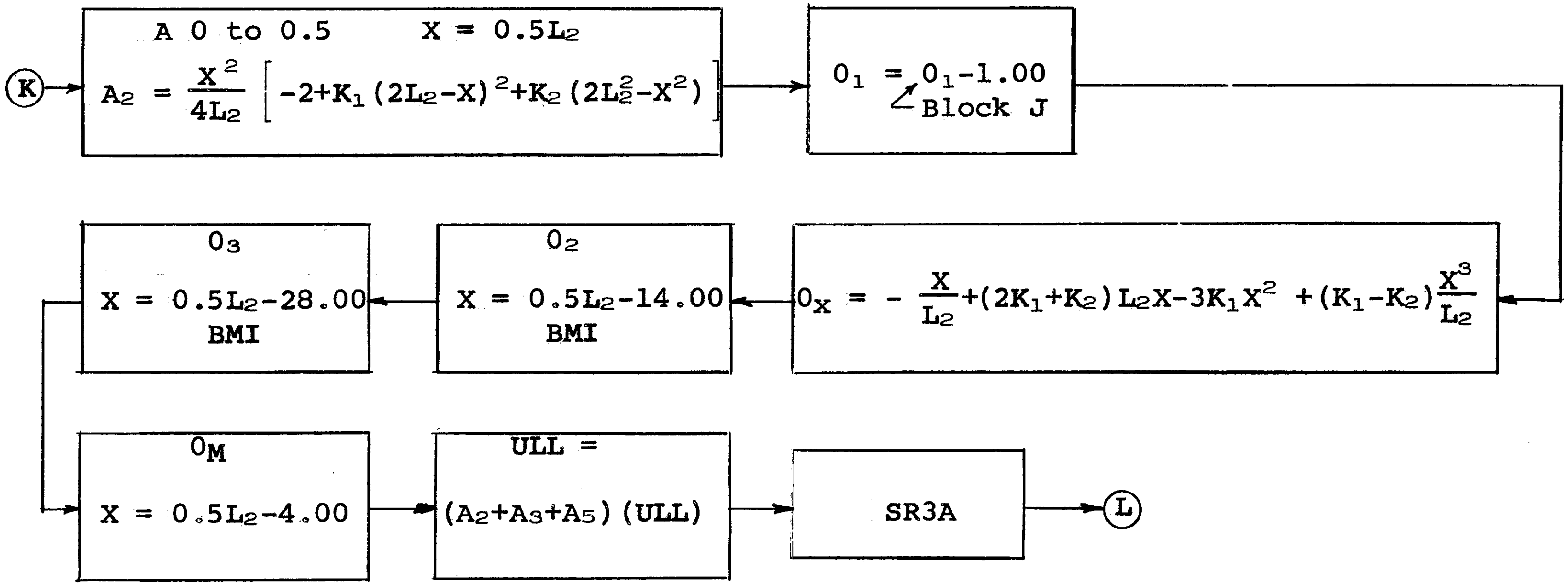
BLOCK I PIER 1 REACTION (3, 4 & 5 Span)



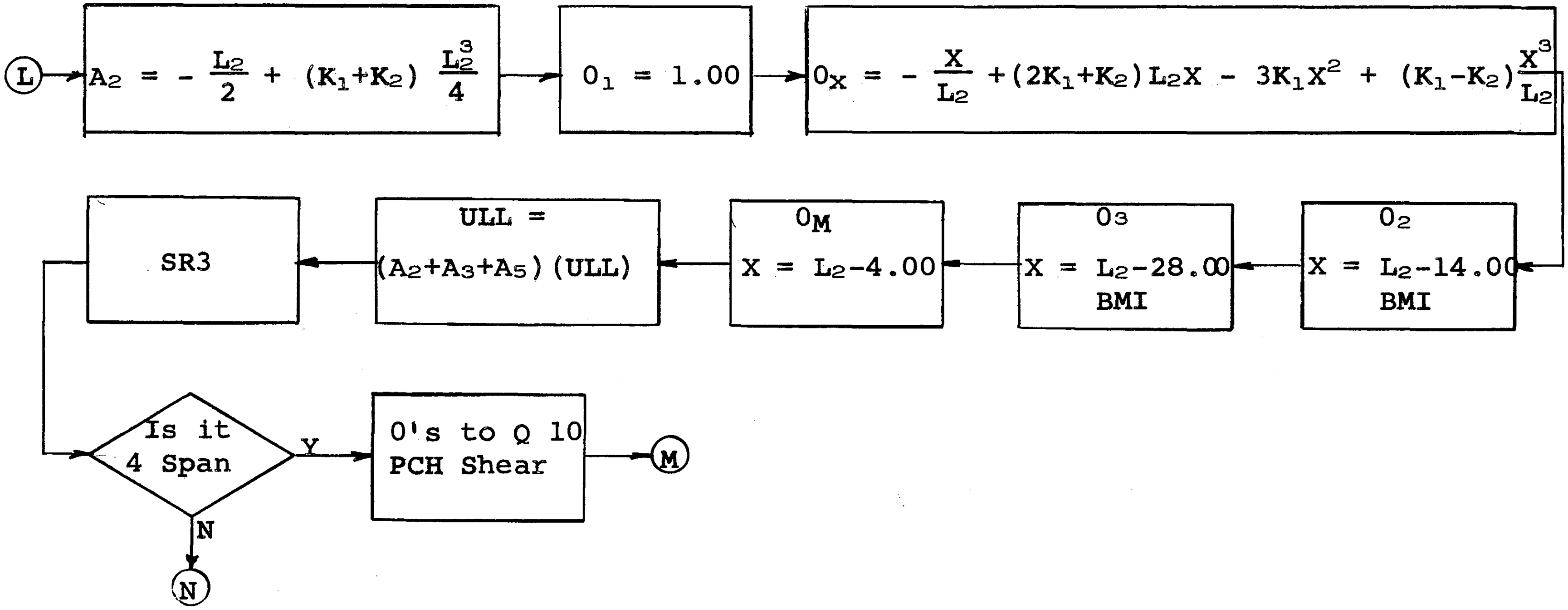
BLOCK J SHEAR @ 0.5 PT IN INT SPAN (+)



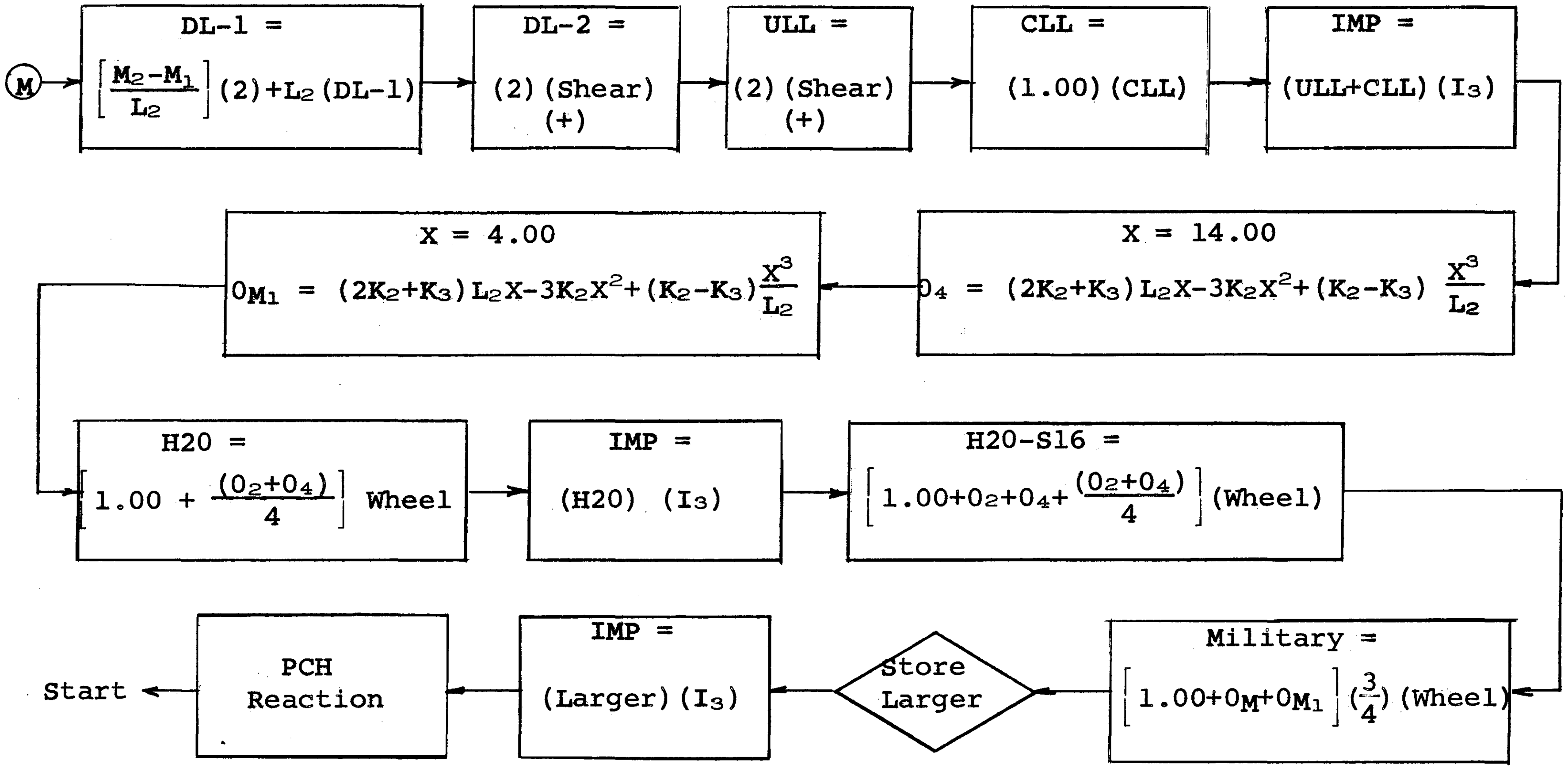
BLOCK K **SHEAR @ 0.5 PT IN INT SPAN (-)**



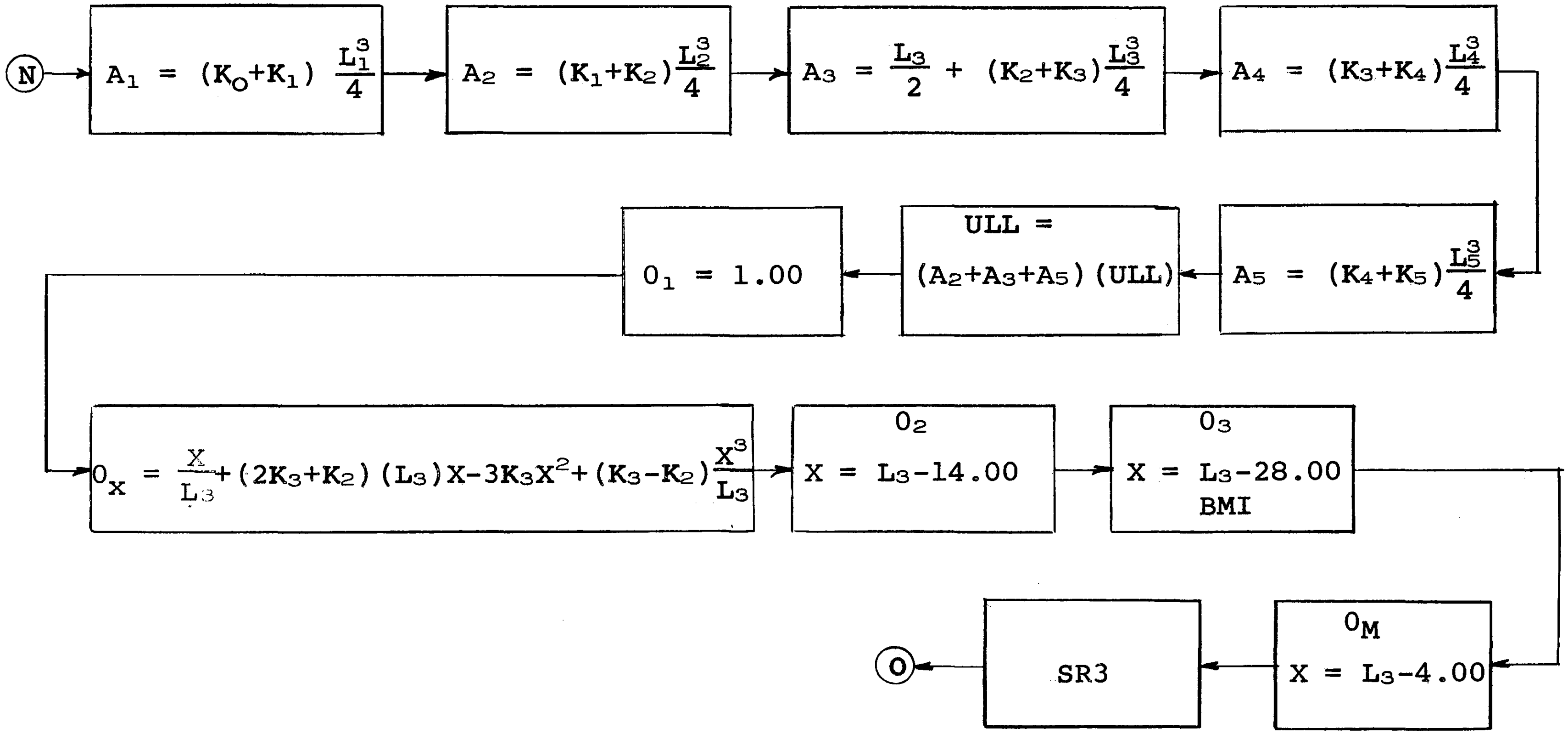
BLOCK L SHEAR @ LEFT FACE OF PIER 2 (-)



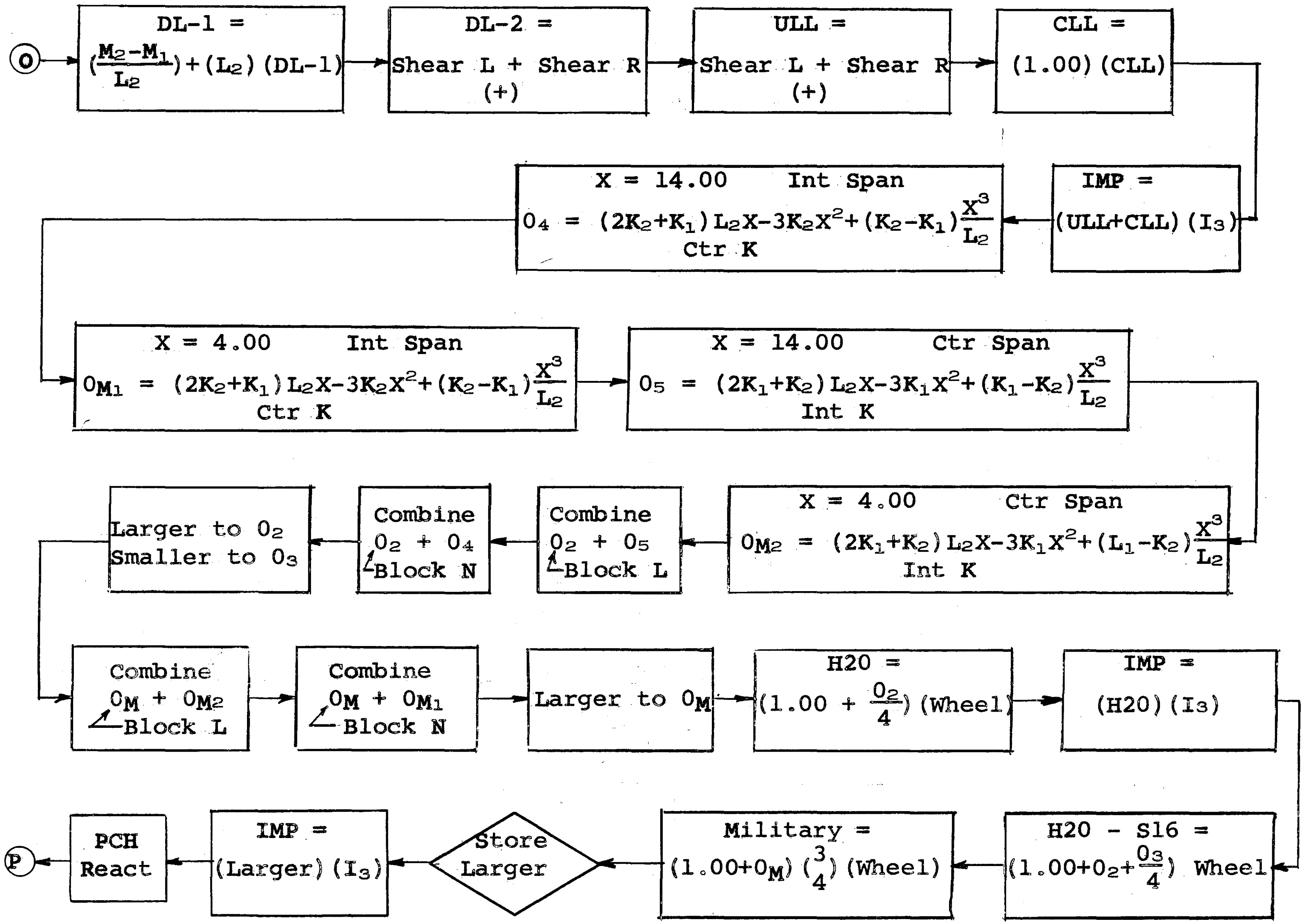
BLOCK M **PIER 2 REACTION (4 SPAN)**



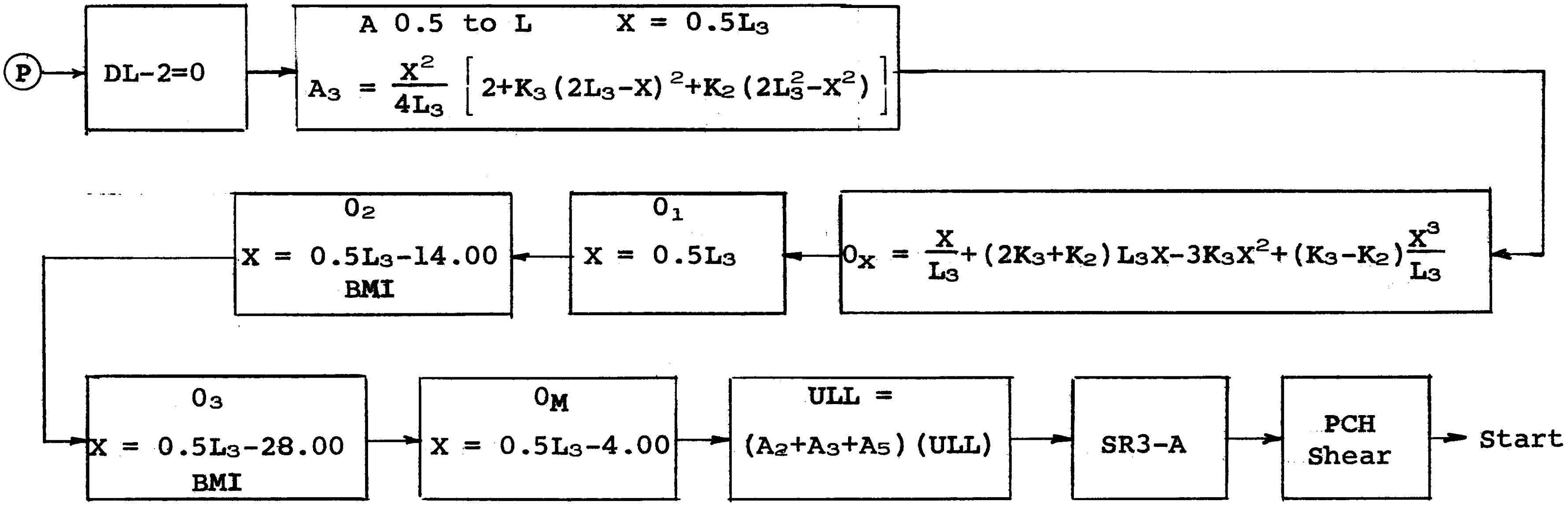
BLOCK N **SHEAR @ RT FACE OF PIER 2 (+) 5 SPAN**



BLOCK O **PIER 2 REACTION (5 SPAN)**



BLOCK P **SHEAR @ 0.5 PT CTR SPAN (+)**



WORD LAYOUT FORM

650 MAGNETIC-DRUM DATA-PROCESSING MACHINE

PROGRAM NO. 32017

P0001	P0002	P0003	P0004	P0005	P0006	P0007	P0008	P0009	P0010
Point No County Design No Run	DL-1 Reaction	DL-2 Reaction	ULL Reaction	CLL Reaction	Imp Reaction	H20 Reaction	Imp Reaction	H20-S16 Reaction	Imp Reaction

Q0001	Q0002	Q0003	Q0004	Q0005	Q0006	Q0007	Q0008	Q0009	Q0010
Point No County Design No Run	Spacing Factor			Shear @ Abut (+)	Shear @ 0.4 Pt End Span (+)	Shear @ 0.4 Pt End Span (-) Shear @ Lt.Side Pier 1 (-)	Shear @ Rt.Side Pier 1 (+) Shear @ 0.5 Pt Int Span (+)	Shear @ 0.5 Pt Int Span (-) Shear @ Lt.Side Pier 2 (-)	Shear @ Rt.Side Pier 2 (+) Shear @ ℄ Ctr Span (+)

R0001	R0002	R0003	R0004	R0005	R0006	R0007	R0008	R0009	R0010
Point No County Design No Run	Length of End Span	Length of Int Span	Length of Bridge	Dead Load-1	Dead Load-2	Uniform Live Load	Conc. Live Load for Moment	Truck Wheel	0 - 0 8 H20 9 H20-S16 Pier 1 Incre. Pier 2 Incre.

S0001	S0002	S0003	S0004	S0005	S0006	S0007	S0008	S0009	S0010
Point No County Design No Run	Beam Area	Beam Depth	Beam I	Concrete Width	Concrete Thickness	N	DL-1 Moment Pier-1	DL-1 Moment Pier-2	H Shear Lug Strength

WORD LAYOUT FORM

650 MAGNETIC-DRUM DATA-PROCESSING MACHINE

PROGRAM NO. 32017

P0001	P0002	P0003	P0004	P0005	P0006	P0007	P0008	P0009	P0010
BEAM Point No County Design No Run	DL-1 Reaction	DL-2 Reaction	ULL Reaction	CLL Reaction	Imp Reaction	H20 Reaction	Imp Reaction	H20-S16 Reaction	Imp Reaction

Q0001	Q0002	Q0003	Q0004	Q0005	Q0006	Q0007	Q0008	Q0009	Q0010
BEAM Point No County Design No Run	Spacing Factor			Shear @ Abut (+)	Shear @ 0.4 Pt End Span (+)	Shear @ 0.4 Pt End Span (-) Shear @ Lt.Side Pier 1 (-)	Shear @ Rt.Side Pier 1 (+) Shear @ 0.5 Pt Int Span (+)	Shear @ 0.5 Pt Int Span (-) Shear @ Lt.Side Pier 2 (-)	Shear @ Rt.Side Pier 2 (+) Shear @ ℄ Ctr Span (+)

R0001	R0002	R0003	R0004	R0005	R0006	R0007	R0008	R0009	R0010
BEAM Point No County Design No Run	Length of End Span	Length of Int Span	Length of Bridge	Dead Load-1	Dead Load-2	Uniform Live Load	Conc. Live Load for Moment	Truck Wheel	0 - 0 8 H20 9 H20-S16 Pier 1 Incre. Pier 2 Incre.

S0001	S0002	S0003	S0004	S0005	S0006	S0007	S0008	S0009	S0010
BEAM Point No County Design No Run	Beam Area	Beam Depth	Beam I	Concrete Width	Concrete Thickness	N	DL-1 Moment Pier-1	DL-1 Moment Pier-2	H Shear Lug Strength

SYMBOL TABLE 32017

SYMBOL	LOCATION	DESCRIPTION
2PART	0104	Transfer Control in SRI
2SPAN	0463	2 Span K Factors
3SPAN	0911	3 Span K Factors
4SPAN	0221	4 Span K Factors
5SPAN	0781	5 Span K Factors
A1	0113	Influence Area in Span 0-1 xxxx.xx
A2	0070	Influence Area in Span 1-2 xxxx.xx
A3	0078	Influence Area in Span 2-3 xxxx.xx
A4	0086	Influence Area in Span 3-4 xxxx.xx
A5	0094	Influence Area in Span 4-5 xxxx.xx
AAAAA	0496	Transfer Control
BBBBB	0546	Transfer Control
BLOKA	0661	Start of Block A
BLOKB	0550	Start of Block B
BLOKD	0630	Start of Block D
BLOKE	1400	Start of Block E
BLOKF	0686	Start of Block F
BLOKG	0836	Start of Block G
BLOKH	0362	Start of Block H
BLOKI	0240	Start of Block I
BLOKJ	1327	Start of Block J
BLOKK	0662	Start of Block K
BLOKL	1138	Start of Block L
BLOKM	1627	Start of Block M
BLOKN	0762	Start of Block N
BLOKO	1190	Start of Block O
BLOKP	1827	Start of Block P
CCCCC	0596	Transfer Control
DDDDD	0646	Transfer Control
DL2	1086	Dead Load 2 Shear xxxx.xx
DL2A	1386	Dead Load 2 Shear Alternate xxxx.xx
EEEEE	0696	Transfer Control
EXIT	0057	Storage for Exit Instruction for Sub routines
H	0180	Distance from Bottom of Beam to Bottom of Slab xx.xx
HLT1	0273	STOP
HLT2	0359	STOP
HLT3	0279	STOP
HLT4	0368	STOP
HLT5	0230	STOP
I	0088	Impact Factor for Sub routines .xxx
I1	0132	Impact Factor for End Span .xxx
I2	0182	Impact Factor for Pier 1 .xxx
I3	0232	Impact Factor for Int Span .xxx
INS1	0644	Storage for Exit Instructions

SYMBOL	LOCATION	DESCRIPTION
INS10	0486	Storage for Exit Instructions
INS11	1489	Storage for Exit Instructions
INS12	1251	Storage for Exit Instructions
INS13	1301	Storage for Exit Instructions
INS14	0382	Storage for Exit Instructions
INS15	0636	Storage for Exit Instructions
INS16	0102	Storage for Exit Instructions
INS17	1351	Storage for Exit Instructions
INS18	0924	Storage for Exit Instructions
INS19	1044	Storage for Exit Instructions
INS2	1101	Storage for Exit Instructions
INS20	1094	Storage for Exit Instructions
INS21	1024	Storage for Exit Instructions
INS22	1144	Storage for Exit Instructions
INS23	1801	Storage for Exit Instructions
INS24	1124	Storage for Exit Instructions
INS25	1805	Storage for Exit Instructions
INS26	0795	Storage for Exit Instructions
INS27	1224	Storage for Exit Instructions
INS28	0845	Storage for Exit Instructions
INS29	1374	Storage for Exit Instructions
INS3	0774	Storage for Exit Instructions
INS30	0246	Storage for Exit Instructions
INS31	0222	Storage for Exit Instructions
INS32	0903	Storage for Exit Instructions
INS33	0953	Storage for Exit Instructions
INS34	1474	Storage for Exit Instructions
INS35	1095	Storage for Exit Instructions
INS36	0396	Storage for Exit Instructions
INS37	1003	Storage for Exit Instructions
INS38	1053	Storage for Exit Instructions
INS39	0682	Storage for Exit Instructions
INS4	0744	Storage for Exit Instructions
INS40	1687	Storage for Exit Instructions
INS41	1556	Storage for Exit Instructions
INS42	1103	Storage for Exit Instructions
INS43	0732	Storage for Exit Instructions
INS44	1837	Storage for Exit Instructions
INS45	1345	Storage for Exit Instructions
INS46	0826	Storage for Exit Instructions
INS47	1445	Storage for Exit Instructions
INS48	1803	Storage for Exit Instructions
INS49	1076	Storage for Exit Instructions
INS5	0638	Storage for Exit Instructions
INS50	1008	Storage for Exit Instructions
INS51	1545	Storage for Exit Instructions
INS52	1226	Storage for Exit Instructions

SYMBOL	LOCATION	DESCRIPTION
INS53	1595	Storage for Exit Instructions
INS54	1326	Storage for Exit Instructions
INS55	1160	Storage for Exit Instructions
INS56	1426	Storage for Exit Instructions
INS57	1310	Storage for Exit Instructions
INS58	1410	Storage for Exit Instructions
INS59	1476	Storage for Exit Instructions
INS6	0172	Storage for Exit Instructions
INS60	1840	Storage for Exit Instructions
INS7	1151	Storage for Exit Instructions
INS8	1201	Storage for Exit Instructions
INS9	0824	Storage for Exit Instructions
K1CTR	0955	K Factor at Pier 1 for Center Span .xxxxxxx
K1END	0271	K Factor at Pier 1 for End Span .xxxxxxx
K1INT	0881	K Factor at Pier 1 for Interior Span .xxxxxxx
K2CTR	1013	K Factor at Pier 2 for Center Span .xxxxxxx
K2END	0153	K Factor at Pier 2 for End Span .xxxxxxx
K2INT	0497	K Factor at Pier 2 for Interior Span .xxxxxxx
K3CTR	0829	K Factor at Pier 3 for Center Span .xxxxxxx
K3END	0609	K Factor at Pier 3 for End Span .xxxxxxx
K3INT	0421	K Factor at Pier 3 for Interior Span .xxxxxxx
K4CTR	1189	K Factor at Pier 4 for Center Span .xxxxxxx
K4END	0915	K Factor at Pier 4 for End Span .xxxxxxx
K4INT	0477	K Factor at Pier 4 for Interior Span .xxxxxxx
KL	0071	Left K Factor for Sub routines .xxxxxxx
KON1	0121	Constant
KON10	0558	Constant
KON11	0862	Constant
KON12	0508	Constant
KON13	0120	Constant
KON14	0310	Constant
KON15	0307	Constant
KON16	0170	Constant
KON17	0066	Constant
KON18	0414	Constant
KON19	0857	Constant
KON2	0138	Constant
KON20	0447	Constant
KON21	1507	Constant
KON22	0647	Constant
KON23	1607	Constant
KON24	1835	Constant

SYMBOL	LOCATION	DESCRIPTION
KON25	0253	Constant
KON26	0090	Constant
KON3	1610	Constant
KON4	0278	Constant
KON5	0360	Constant
KON6	0900	Constant
KON7	0386	Constant
KON8	0216	Constant
KON9	0458	Constant
KR	0084	Right K Factor for Sub routines .xxxxxxx
L	0080	Length of Span for Sub routines xx.xx
L1	0108	Length of Span 0-1 xx.xx
L134	0791	$L_1^3/4$
L2	0464	Length of Span 1-2 xx.xx
L234	0841	$L_2^3/4$
L3	0321	Length of Span 2-3 xx.xx
L334	0397	$L_3^3/4$
L4	0377	Length of Span 3-4 xx.xx
L434	0103	$L_4^3/4$
L5	0583	Length of Span 4-5 xx.xx
L534	0347	$L_5^3/4$
TO1	0809	Transfer Control
NEX1	0142	Transfer Control
NEX10	0228	Transfer Control
NEX11	0935	Transfer Control
NEX12	0062	Transfer Control
NEX13	0410	Transfer Control
NEX14	0220	Transfer Control
NEX15	0242	Transfer Control
NEX16	0806	Transfer Control
NEX17	0799	Transfer Control
NEX18	0752	Transfer Control
NEX19	1193	Transfer Control
NEX20	1693	Transfer Control
NEX21	1062	Transfer Control
NEX22	1758	Transfer Control
NEX23	1149	Transfer Control
NEX24	1444	Transfer Control
NEX3	0058	Transfer Control
NEX5	0318	Transfer Control
NEX6	0128	Transfer Control
NEX7	0735	Transfer Control
NEX8	0178	Transfer Control
NEX9	0835	Transfer Control
NEXT	0054	Transfer Control
NEXT1	0395	Transfer Control

SYMBOL	LOCATION	DESCRIPTION
NEXT2	0445	Transfer Control
NEXT3	0495	Transfer Control
NEXT4	0545	Transfer Control
NEXT5	0595	Transfer Control
NEXT6	0745	Transfer Control
NEXT7	0296	Transfer Control
NEXT8	0346	Transfer Control
NEXT9	0446	Transfer Control
01	0485	Influence Line Ordinate xx.xx
02	0096	Influence Line Ordinate xx.xx
02A	0152	Influence Line Ordinate xx.xx
03	0146	Influence Line Ordinate xx.xx
04	1254	Influence Line Ordinate xx.xx
05	0756	Influence Line Ordinate xx.xx
0M	0092	Influence Line Ordinate xx.xx
0M1	1501	Influence Line Ordinate xx.xx
0M2	0702	Influence Line Ordinate xx.xx
0MA	0098	Influence Line Ordinate xx.xx
OUT1	0950	I-Address of Exit Instruction
OUT11	1450	I-Address of Exit Instruction
OUT12	1500	I-Address of Exit Instruction
OUT13	1550	I-Address of Exit Instruction
OUT14	1600	I-Address of Exit Instruction
OUT15	1650	I-Address of Exit Instruction
OUT16	1700	I-Address of Exit Instruction
OUT17	1750	I-Address of Exit Instruction
OUT18	1800	I-Address of Exit Instruction
OUT19	1850	I-Address of Exit Instruction
OUT2	1000	I-Address of Exit Instruction
OUT20	1900	I-Address of Exit Instruction
OUT21	1950	I-Address of Exit Instruction
OUT22	1751	I-Address of Exit Instruction
OUT23	0202	I-Address of Exit Instruction
OUT24	0252	I-Address of Exit Instruction
OUT25	0302	I-Address of Exit Instruction
OUT26	0402	I-Address of Exit Instruction
OUT27	0452	I-Address of Exit Instruction
OUT28	0502	I-Address of Exit Instruction
OUT29	0552	I-Address of Exit Instruction
OUT3	1050	I-Address of Exit Instruction
OUT30	1002	I-Address of Exit Instruction
OUT31	1052	I-Address of Exit Instruction
OUT32	1102	I-Address of Exit Instruction
OUT33	1152	I-Address of Exit Instruction
OUT34	1202	I-Address of Exit Instruction
OUT35	1252	I-Address of Exit Instruction

SYMBOL	LOCATION	DESCRIPTION
OUT36	1352	I-Address of Exit Instruction
OUT37	1402	I-Address of Exit Instruction
OUT38	1452	I-Address of Exit Instruction
OUT39	1502	I-Address of Exit Instruction
OUT4	1100	I-Address of Exit Instruction
OUT40	1552	I-Address of Exit Instruction
OUT41	1702	I-Address of Exit Instruction
OUT42	1752	I-Address of Exit Instruction
OUT43	1802	I-Address of Exit Instruction
OUT44	1153	I-Address of Exit Instruction
OUT45	1303	I-Address of Exit Instruction
OUT46	1353	I-Address of Exit Instruction
OUT47	1753	I-Address of Exit Instruction
OUT48	1604	I-Address of Exit Instruction
OUT49	1654	I-Address of Exit Instruction
OUT5	1150	I-Address of Exit Instruction
OUT50	1704	I-Address of Exit Instruction
OUT51	1158	I-Address of Exit Instruction
OUT52	1208	I-Address of Exit Instruction
OUT53	1308	I-Address of Exit Instruction
OUT54	1358	I-Address of Exit Instruction
OUT55	1210	I-Address of Exit Instruction
OUT56	1260	I-Address of Exit Instruction
OUT57	1360	I-Address of Exit Instruction
OUT58	1460	I-Address of Exit Instruction
OUT59	1510	I-Address of Exit Instruction
OUT6	1200	I-Address of Exit Instruction
OUT60	1560	I-Address of Exit Instruction
OUT7	1250	I-Address of Exit Instruction
OUT8	1300	I-Address of Exit Instruction
OUT9	1350	I-Address of Exit Instruction
PART2	0082	Transfer Control
SR1	0050	Start of Ordinate Sub routine
SR1A	0100	Start of Ordinate Sub routine
SR2	0150	Start of Area Sub routine
SR3	0200	Start of Shear Sub routine
SR3A	0250	Start of Shear Sub routine
START	0400	Start of Program
TEMP1	0051	Temporary Storage
TEMP2	0061	Temporary Storage
TEMP3	0111	Temporary Storage
TEMP4	1035	Temporary Storage
TEMP5	0196	Temporary Storage
TEMP6	0469	Temporary Storage
TEMP7	0741	Temporary Storage
TEMP8	0299	Temporary Storage
TWO	0268	Storage for Constant
ULL	1136	Uniform Live Load Storage xxxx.xx
X	0065	Storage for X for sub routines xx.xx