FOREWORD

Volume II of the Index to Users Projects has been published to provide a source for immediate reference and an easy and efficient method for the reader to maintain an up to date index to all Users Projects produced since Number 399. Periodically, abstracts for new projects will be forwarded under separate cover and these should be added to the last numbered project included in this Index.

Volume I of the Index to Users Projects includes abstracts of all projects from Number 1 to Number 399 and is available upon request.

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A B S T R A C T
USERS' PROJECT NO. 400

Class 1

Card Input Program for Machine Language Commands

ORIGINATOR: Wayne O. Daigh, Director of Computer Applications

ADDRESS: Wyoming Highway Department, Cheyenne, Wyoming

MODE: Machine Language, CA-2

DATE: December 9, 1959

PURPOSE: To provide a rapid and accurate means for the preparation of machine language programs.

METHOD: Hollerith cards are keypunched and verified direct from programmers' code sheets.

INPUT: Card format is arranged for input using CA-2 test control panel, eliminating the necessity of an additional control panel. Input may consist of (1) commands, (2) single precision hex fractions or integers and (3) single precision decimal fractions which are converted to hex fractions during read-in.

OUTPUT: When each block of commands are read and stored within the computer, type is gated and the desired check sum of the block is typed by the operator. A balance constant is computed and stored in a location specified by the operator. The tape is then punched using condensed format.

A B S T R A C T
USERS' PROJECT NO. 401
Class 1

POGO Service Routine (Revised)

ORIGINATOR: Wayne O. Daigh, Director of Computer Applications

ADDRESS: Wyoming Highway Department, Cheyenne, Wyoming

MODE: G-15, Single Precision

DATE: December 23, 1959

PURPOSE: To provide means for CA-2 control, magnetic tape input and output, extraction, precession, line copy and line 19 typeout.

METHOD: Original POGO compiler and input routine are used to compile the preliminary tape. Sub-routines in the service routine accomplish the necessary operations.

The program retains nearly all of the advantages of the original routine and has many advantages over the original routine, such as, typeout simultaneous with computation, CA-2 input and output, magnetic tape input and output, extraction and precession. A disadvantage of the routine is that no trace operations are available.

Programmer should be familiar with original program before any attempt is made at programming with the service routine.

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Programmer should be familiar with original program before any attempt is made at programming with the service routine.

Abstract of Users Project No. 402

FIT OF A FIFTH DEGREE POLYNOMIAL TO SIX GIVEN POINTS

For Bendix G 15-D Computer
Intercom 1000 D.P.

CLASS I

Canadian Pratt & Whitney Aircraft Company, Limited
P.O. Box 10
Longueuil, P.Q., Canada

December 1959.

Given a set of six points defined by their X and Y coordinates a polynomial of the form:

$$Y = A+BX^2 + CX^3 + DX^4 + FX^5$$

will be fitted. Up to five sets of points can be processed per run.

In order to check the accuracy of the fit, the values of Y will be recomputed using the coefficients and printed out along with the inputted values of X and Y.

As a further check on the smoothness of the fit, intermediate values of X and the corresponding values of Y will be computed and printed.

Running time is approximately 2 minutes per set, exclusive of input.

The main point of interest is that the values of X need not be equidistant.

Abstract of User's Project No. 403

"SEARCH FOR BLANK MAGNETIC TAPE" ROUTINE

for Bendix G15D Computer
Class 1

Canadian Pratt & Whitney Aircraft Company, Limited
P.O. Box 10,
Longueuil, P.Q., Canada.
January 1960

Because of the fact that the G15D MTA-2 magnetic tape accessory will not write new information on top of old, it is fairly often necessary at the beginning of a program to position the tape read-write head ahead of a blank portion of tape. This is the purpose of this routine.

Although it was designed as an Intercom 1000SP sub-routine, since it is completely independent of Intercom, it can also be used in conjunction with a machine language problem; the program description includes the method of using the routine in this mode.

The search time depends on the length of non-blank tape to be traversed. If the head is originally positioned ahead of blank tape, the time of search is approximately one minute.

Positioning of the various tape units (1 to 4) is accomplished by different sub-routine entry locations.

. . . .

Title: Data Input Routine

Originator: Scientific Design Company, Inc.

Address: 2 Park Avenue, New York 16, New York

Mode: Machine Language (S. P.)

Equipment: Bendix G-15D
Off-line Flexowriter

Date: December 14, 1959

This routine is designed to convert to binary and store into specified locations with given scaling a variable length list of numbers. Each number to be put in consists of both a fractional and integral part and is stored as such in the machine, in contrast to the now available conversion routines which allow only integral or fractional decimal input. A complete discussion of the method and a detailed example are included in the write-up.

A tape is punched on the off-line flexowriter in accordance with the procedure outlined in the write-up. This tape can then be proff read and rid of errors, thereby eliminating costly machine correction. Also, data input time is greatly reduced, increasing program efficiency. To put in a list of thirty numbers takes less than one minute.

This routine can be used as a general purpose data input subroutine.

SCIENTIFIC DESIGN COMPANY, INC.

Abstract of Users' Project No. 405
Class 1

Title: Simpson's Rule for Numerical Integration

Originator: Scientific Design Company, Inc.

Address: 2 Park Avenue, New York 16, New York

Mode: Machine Language (S. P.)
Equipment: G-15D
Date: December 14, 1959

This routine will calculate the numerical value of the definite interval of a function, y = f (x), in a given closed interval $[x_o, x_{2m}]$ when the value of y is known for at least three evenly spaced values of x in the interval. The equation used to evaluate the integral is

$$\int_{x_o}^{x_{2m}} ydx = \frac{h}{3}(y_o + 4y_1 + 2y_2 + 4y_3 + \ldots + 4y_{2m-1} + y_{2m})$$

with error approximately $\frac{m\ y^{(4)} h^5}{90}$

where $y^{(4)}$ is the value of the fourth derivative of the function at some point in the given interval.

The values for $y_o, \ldots, y_{2m}$ are scaled down by that factor, k, which makes the largest of the y i's (i = 0, . . ., 2_m) less than unity in absolute falue. After scaling the y i's are stored, as binary fractions, sequentially into line 10, beginning in location 00. The maximum number of y_i's is 107, or the maximum number of subdivisions of the closed interval $[x_o, x_{2m}]$ is 2m = 106.

The value h $= \Delta x$ must also be made less than one, say by some factor L, and placed into $1D_I$ prior to execution of the routine.

The value 2m+1 is placed into AR and then control is transferred to the subroutine.

The resultant value of the integral appears in MQ_o as

$$\frac{\int_{x_o}^{x_{am}} f(x) dx}{KL\ 10^3}$$

The time for data input and computation, as well as the accuracy, varies directly with the number of subdivisions of the interval $[x_o, x_{2m}]$.

Abstract of Users Project No. 406
Class 2

Title: PARC ANALYSIS

Originator: Scientific Design Company, Inc.
Address: 2 Park Avenue, New York 16, New York
Mode: Intercom 1000 (D.P.)
Date: December 1, 1959

The function of the PARC ANALYSIS program is to approximate the linear relationship between an independent variable x_i and a dependent variable y_j, such that the residual error sum of squares about the estimated regression line is at a minimum. Given a sample of n independent variables ($1 \leq n \leq 20$) and the corresponding values of m dependent variables ($1 \leq m \leq 10$), of N observations each ($3 \leq N < \infty$), the following linear relationship is computed:

$$y_j = b_0 + b_i x_i$$

for each sampling of x_i with each sampling of y_j. The error sum of squares (SSE), the regression sum of squares due to x_i ($SS(x_i)$), the mean sum of squares (MSS), the value of the F ratio (F_i), and its significance level are also computed. This program does not permit a varying number of observations between the variables nor does it compute a multiple linear regression analysis. Furthermore, it does not give any relationship between the independent variables nor between the dependent variables.

The values of the independent variables and the dependent variables are arranged in columns of N observations each in the following manner:

obs.	x_1	x_2	x_3	..	..	x_n	y_1	y_2	..	y_m
1	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..
3	..	..	..	..	..	..	..	..	..	..
.	..	..	..	..	..	..	..	..	..	..
N	..	..	..	..	..	..	..	..	..	..

The values of F needed to test the significance level of the F_i ratio are found in the F table included in the program description.

The output includes the Total Corrected Sum of Squares (TSS) for each dependent variable and the associated degrees of freedom, as well as, the regression coefficients and analysis of variance table for each x_i and y_j. A complete output format may be found in the description of the program. The input data is prepared on tape and requires on the average, five minutes per observation depending on the number of variables and the speed of the operator. However, this tape can also used in the LEAST SQUARES MULTIPLE LINEAR REGRESSION ANALYSIS program, the TWO VARIABLE QUADRATIC REGRESSION ANALYSIS program, and the THREE VARIABLE QUADRATIC REGRESSION ANALYSIS program prepared by the author, if further analysis is desired. There is also a program to convert a flexiwriter prepared tape which will eliminate considerable machine time. The input also contains fourteen variable type-in instructions. The computations require 3.5 seconds for each variable per observation. The output requires 25 seconds for each independent variable per dependent variable. Therefore, for n independent variables and m dependent variables, the total time excluding input is: $3.5\,(n + m) \cdot N + 25(n \cdot m)$ seconds.

SCIENTIFIC DESIGN COMPANY INC. Design·Construction
PRODUCT AND PROCESS DEVELOPMENT · PLANT DESIGN AND CONSTRUCTION
TWO PARK AVENUE, NEW YORK 16, N. Y. · EIGHT EIGHTY BERGEN AVENUE, JERSEY CITY 6, N. J.

ADDRESS REPLY TO:
New York Office
Phone MU 9-3176
Cable "Sciencomp"

November 8, 1960

Abstract of U.P. #406-A

description of modifications for Users' Project No. 406, Title: 'Parc Analysis'.

This program will now print-out the means of the input data upon completion of reading the data tape the first time through. It will then automatically back-up the data tape to the beginning and start reading in again for the second time.

Respectfully yours,
Scientific Design Co.,Inc.

Louis E. Cabral

LEC/jb

ABSTRACT

USERS PROJECT NO. 407

TITLE:	Structural Analysis and Design of a Reinforced Concrete Sewer
CLASS:	1
VALUE:	8
ORIGINATOR:	City of Chicago, Bureau of Engineering
ADDRESS:	320 N. Clark Street, Chicago 10, Illinois
MODE:	Intercom 103-D
DATE:	December 1959

Knowing the interior width or height of a given shaped sewer section and the depth of earth fill over the crown and selecting the crown, side and invert thickness, the program will compute and type out the moments, thrusts, and shears of twenty segments for three different cases of loading. It will also complete the design by determining the area of steel for both longitudinal and transverse reinforcement, and will type out a suggested table of bar sizes versus proper spacing from which the Engineer may select the reinforcement.

Due to the geometric variations in each of the sewer sections programmed, and to the limited internal storage available, the problem has been divided into three parts as follows:

Part "A" - This part of the program is designed to calculate and store the many dimensions to be used in the analysis part of the problem.

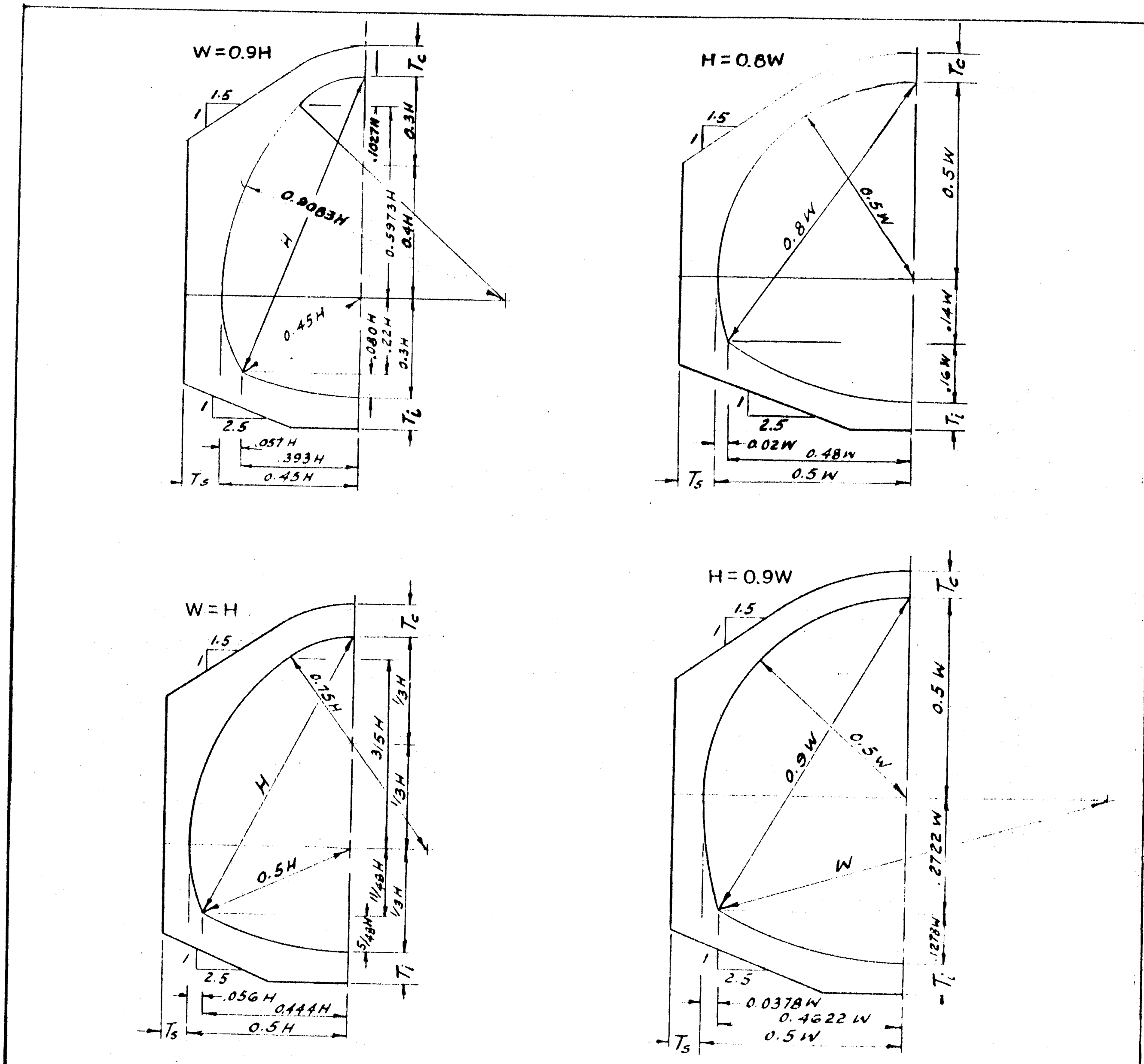
Part "B" - By using the physical dimensions calculated and stored in Part A, this part of the program will compute the Moments, Thrusts, and Shears for the twenty segments for three cases of loading. The procedure followed is as outlined in Portland Cement Association Manual, No. ST. 53. The program is limited to symmetrical shape and loading about the vertical center line of the sewer section.

Part "C" - With the Moments and Thrusts calculated and stored, for the crown, side, and invert, and following the A.C.I. Code for spacing, sizes and allowable stresses, this part of the program will determine the area of reinforcement steel and give a list of spacing versus bar sizes for both transverse and longitudinal reinforcement.

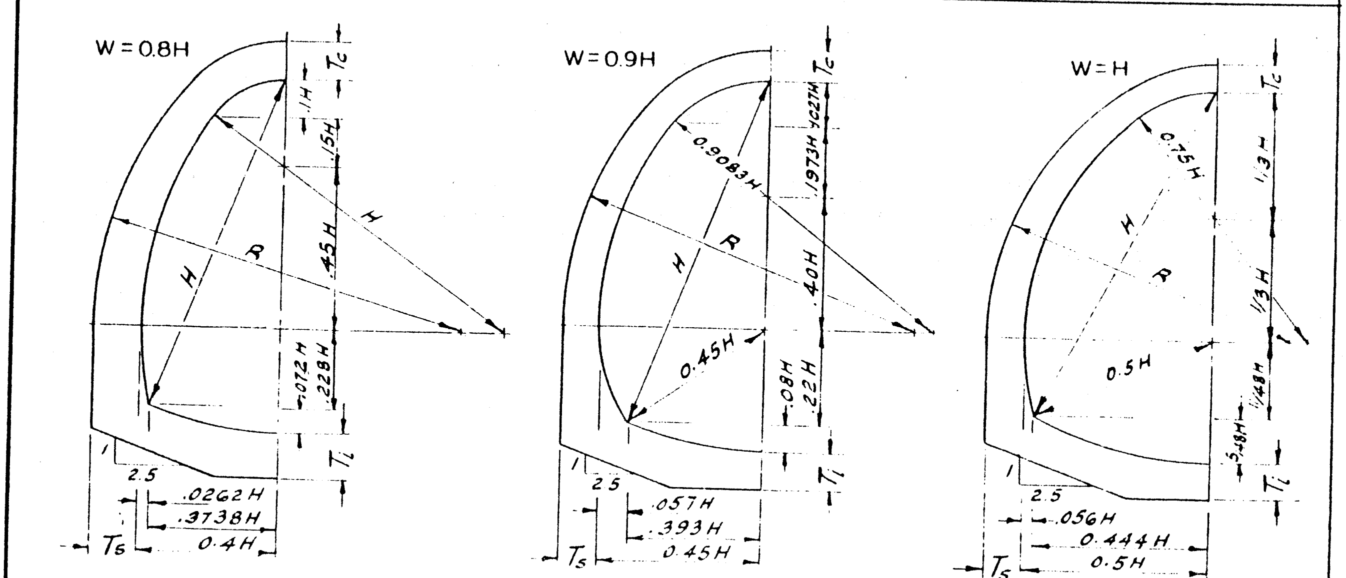
Seven typical sections generally used by the City of Chicago have been analyzed and are shown on Page 3. The Part "A" portion of the program varies for each section, whereas Parts "B" and "C" are the same for any section. However, a separate tape has been prepared for each of the sections.

Data input requires 5 minutes. Calculations and typeouts require 23 minutes. No auxiliary equipment is used.

Copies of the program write-up were distributed at the New York Conference in January 1959. Some corrections and additions have been made to this previous write-up.



OPEN CUT SECTIONS



TUNNEL SECTIONS

SEVEN SECTIONS ANALYZED

LOCKWOOD, KESSLER & BARTLETT, INC.

ENGINEERS • SURVEYORS

ONE AERIAL WAY, SYOSSET, NEW YORK

WELLS 8-0600

USERS' PROJECT NO. 408

ABSTRACT

Title:	General Geometry for Bridge on Circular Curve
Category:	Class 2
Mode:	Intercom 1000 D
Originator:	Lockwood, Kessler & Bartlett, Inc.
Date:	December 21, 1959

Basic information of a straight or circular roadway under and another straight or circular roadway over is known. It is required to compute; off-set distances along center line of bearings, arc lengths on the circular roadway over between center lines of bearings, bearings of radial lines from center lines of bearings to the center of the circular roadway over, horizontal clearances for the circular roadway over, and coordinates of intersections of center line bearings and center line of the roadway over.

It is designed to obtain necessary input data (locations, 1728, 1730, 1732, 1756 - 1799) for the U. P. No. 88, Roadway Elevations for Bridges on Circular Curve.

A problem will be one of four conditions (A, B, C or D), and the output data will be a combination of five parts (I, II, III, IV and V).

Condition	A	Two curves	Parts I, II, III & IV
"	B	Curve over and line	" I & IV
"	C	Line and curve under	" V & III
"	D	Two straight lines	" V

Input data may be located in any one of four quadrants. A maximum number of piers will be four. Computation time: about 7 minutes for Condition A.

Abstract of Users Project No. 409

Class 1

Title:	Interpolation Subroutine
Originator:	Pacific Union College Data Processing Laboratory
Address:	Angwin, California
Mode:	Machine Language (S.P.)
Date:	Dec. 15, 1959

This program performs a four point divided difference interpolation.

Required input is: four values of x, the corresponding four values of y, and the value of $\bar{x}$ for which the interpolation is to be made. For best results, $\bar{x}$ should lie in the interval defined by the four values of x. No two of the four x values may be alike or overflow will result.

Any scaling may be used as long as all the x values have the same scale factor and all the y's have the same scale factor. Output $\bar{y}$ will then have the same scale factor as the input y's.

Running time is 11 drum cycles

Although the input and output for this subroutine are in single precision, all internal computation is done in double precision to preserve accuracy because of the differences involved.

MEISSNER ENGINEERS, INC.

ABSTRACT OF USERS PROJECT NO. 410

TITLE: PRELIMINARY EARTHWORK

ORIGINATOR: MEISSNER ENGINEERS, INC.
300 WEST WASHINGTON STREET
CHICAGO 6, ILLINOIS

CLASS: 2

MODE: INTERCOM 1000S.P.

DATE: DECEMBER 23, 1959

DESCRIPTION: This program slope stake offsets and cut and fill areas and volumes. The program was developed to provide an earthwork computation tool that is easily handled by design engineers and technical assistants.

The required data is easily assimulated; its quantity is maintained at the minimum that will provide useful results.

The offsets at which existing ground elevations are taken are fixed, simplifying the gathering of ground data. The finish template has four points and one predetermined cut and fill slope on each side of the centerline.

The program has been made flexible so that earthwork computations that are suitable for final design may be obtained by proper variation of the design parameters.

The template and/or the ground data offsets may be changed at any station; and the volume accumulations may be omitted between cross-sections.

The program is designed for flexowriter tape input, however, command changes are indicated to permit typewriter input. Computation and type-out time varies with the data and conditions at a particular cross-section, and is between 1.5 and 2.0 minutes per cross-section.

We do not assume or accept responsibility for any errors or misrepresentations that may occur because of this program or its use.

ABSTRACT OF USERS PROJECT NO. 411

Class 2

TITLE: Matrix Multiplication (Smaysie)

ORIGINATOR: Robert J. Smay, Dept. 241-69, Autonetics

ADDRESS: 9150 E. Imperial Hwy., Downey, California

MODE: Daisy

DATE: January 8, 1960

Given the two matrices A and B;

$A = a_{ij}$ and $B = b_{jk}$, where

$i = 1, 2, \ldots l$; $j = 1, 2, \ldots n$; $k = 1, 2, \ldots m$.

and where the first subscript denotes row, and the second subscript denotes column.

Assume that A premultiplies B, i.e. AB = C. The routine will handle up to 15th rank matrices. Zeroes need not be typed into unused locations, and the matrices need not be square, only conformable.

ABSTRACT OF USERS PROJECT NO. 412

CLASS 2

Title: Fixed Point Input Routine

Originator: Butler Manufacturing Company
7400 East 13th Street
Kansas City 26, Missouri

Mode: Machine Language

Date: 29 December, 1959

This program is a service routine for entry or read-out of single precision fixed point data, either in decimal or binary. The program occupies lines 0 thru 4, stores constants in lines 6 thru 9, and addresses words 00-99 of lines 10 and 11. Lines 10 and 11 are referred to as the data lines, and also as lines 100 and 200, respectively. The program may share the drum with PPR, but operates independently of PPR.

It is intended that each user will modify the constants stored in lines 6 thru 9, to effect the scaling desired for each input location. Two pages of the write-up are devoted to instructions to users on how to make this modification. The modification consists of adding or changing four word scaling data groups in lines 6 (for input) and 7 (for output), and in changing T numbers of machine language commands in lines 08 and 09.

The program write-up also contains three pages of operating instructions, 14 pages of flow diagrams which are cross referenced with command locations, 26 pages of listed commands, and 5 pages of sample input and output, including instructions for preparation of punched decimal tape.

Operation Codes Include:

- Clear either data line to 0.
- Read binary paper tape into either data line.
- Punch either data line in binary on paper tape.
- Read punched decimal (flex) paper tape and convert to binary and store in either data line. Tape must be punched in fixed point, not floating point.
- Permit fixed point decimal type-in with slash key as decimal point, with or without verification type-back of each number after it is typed in.
- Type specified range of input locations and contents of each location in fixed point decimal or in hex.
- Accept hex type-in.

Provision is not made for additional operation modes, but users may use supplementary routines or PPR beginning in line 5.

ABSTRACT OF USERS' PROJECT NO. 413

Class II

Title: AROWA WOPPER - 1 (WOPPER)

Originator: U. S. Navy Weather Research Facility
Building R-48
U. S. Naval Air Station
Norfolk 11, Virginia

Mode: Machine Language

Date: 8 December 1959

The Wopper program is a service routine designed originally to differ from the Standard Program Preparation Routine (Applications Section Project No. 30) in the following particulars:

A. Within the Wopper main program, permit the entry of instruction codes, standard commands, sexadecimal numbers, and decimal numbers previously punched on paper tape with a flexowriter (or with minor alterations, punched on cards with an off-line card punch).

B. Within the Wopper main program, permit verification of continuity of a series of commands so entered (i.e. semi-automatic lister).

C. Provide for the immediate, controlled execution by the Wopper program of standard commands of the operator's choosing. This makes available to the programmer the full flexibility of machine language commands for program preparation.

D. Provide a few other devices useful in program preparation, for example, the convenient forcing of desired checksums for blocks of data punched on tape.

ABSTRACT OF USERS PROJECT NO. 413A

CLASS I

Title: AROWA WOPPER - II (WOPPER)

Originator: U. S. Navy Weather Research Facility
Building R-48
U. S. Naval Air Station
Norfolk 11, Virginia

Mode: Machine Language

Date: 11 June, 1960

The purpose of the main program of Wopper is to provide:

A. Conversion and insertion into long line memory: sexadecimal numbers, decimal integers and fractions, and standard commands, from input via typewriter or previously punched Flexowriter tape.

B. Input and output via any auxiliary unit operating through line 19.

C. Type-out of memory content as sexadecimal numbers or standard commands.

D. Semi-automatic listing, with removal of all breakpoints if desired.

E. Copy or addition of block portions of long memory lines.

F. Output of program tapes with identifying checksums.

Single line auxiliary routines serve the following purposes:

G. Debugging- saving, inspection, correction, and restoration of the short line and register memory generated by a subject program.

H. Listing of "empty" locations of a program line; and copying into such empty locations a series of commands written in a second line using only locations which are empty in the first line.

I. Punching a loader which automatically loads program lines whose checksums index the program number and the memory line to which they belong.

USERS' ABSTRACT NO. 414

Simple Traverse

Intercom 1000 D. P.

This program computes curve data utilizing the coordinates of the beginning and ending points, the coordinates of the points of intersection of the curves, curve radii, beginning stationing and curve number, and calculates alignment stationing, curve data and bearings.

Abstract of Users' Project No. 415
Paper Tape Input Read-In and Conversion Routine
For Bendix G15D Computer (M/L Single Precision)
Class I

Canadian Pratt & Whitney Aircraft Company, Limited.
P.O. Box 10,
Longueuil, P.Q., Canada
January 1960

When a program requires a large amount of imputs each with different input scale factor, the conversion and scaling of the input can be an important and tedious part of the program.

Given the number of values to be read-in, their scale factors, and the location where the first value is to be stored, this routine will read the input from paper tape, convert it to binary, scale it and store it in consecutive memory locations; when word U7 of a channel is passed, the next channel is used starting at word 00. The scale factor for each input is originally stored in the same locations where the input will eventually be stored.

The routine occupies long lines 02 and 04 and uses short lines 21 and 22.

. . . .

ABSTRACT

Users' Project No. 416

Decimal to Binary (Integer or Fraction) Tape Conversion Routine

The Decimal to Binary (Integer or Fraction), Conversion Routine provides a self-loading program for the conversion of off-line prepared decimal data tapes to either binary integer or binary fraction tapes. A number, $\pm$xxxDDDD, where the x's may be identification, etc., and the D's are the decimal number (considered as an integer) is scaled 10^{-4} in fraction conversion and scaled 2^{-28} in integer conversion decimal data, and converted values occupy the same positions in input and output tapes, respectively.

ABSTRACT TO USERS' PROJECT NO. 417

Four-Revolution Decimal to Binary Integer Tape Conversion Routine

The Four-revolution Decimal to Binary Integer Conversion Routine provides a self-loading program for the conversion of off-line prepared decimal data tapes to binary integer tapes. A number, ±xxxDDDD, where the x's may be identification, etc., and the D's are the decimal number (considered as an integer) is scaled 2^{-28}. Decimal data and converted values occupy the same positions in input and output tapes. As conversions are made during read-in; execution time, exclusive of read, precess, and punch, is four revolutions.

ABSTRACT TO USERS' PROJECT NO. 418

Title: Inertial Properties of Rolls

Originator: E. I. duPont de Nemours & Co., Inc.
Address: 101 Beech Street, Wilmington 98, Delaware
Mode: G-15D
Date: January 1960

This program in Intercom 103-D will calculate the following properties of a cylindrical roll composed of a number of concentric cylinders of the same density: Weight, center of gravity location, the polar moment of inertia about the axis of symmetry, and the difference between the two principal mass moments of inertia about the center of gravity.

ABSTRACT TO USERS' PROJECT NO. 419

Title: EDITED FLOATING-POINT OUTPUT

Originator: E. I. duPont deNemours & Co., Inc.
Address: 101 Beech Street, Wilmington 98, Delaware
Mode: G-15D
Date: January, 1960

This routine will perform the following output operation. Given a floating-point number in the Daisy 201 system, round it to any number of digits (from 3 to 12) and type it out in the form:

± D.DDDDDDD	± DD
(Value)	(Exponent)

USERS' PROJECT #420
Abstract:

Heat Transfer Problem for the DA-1

A method of setting up the DA-1 to represent a transient state one dimensional heat flow problem is presented. It is based on finite difference equations of heat flow as applied to slabs or cylinders (heat source inside). An example is given (both type in and solution) for a graphite pipe insulated with glass wool and carrying a high temperature fluid. Constant thermal properties are used but non-linear properties can be easily incorporated as explained in the project.

Abstract of Users Project No. 421
Class 2

Title: LEAST SQUARES MULTIPLE LINEAR REGRESSION ANALYSIS and CORRELATION COEFFICIENTS

Originator: Scientific Design Company, Inc.
Address: 2 Park Avenue, New York 16, New York
Mode: Intercom 1000 (D.P.)
Date: December 1, 1959

Given a sampling of n independent variables x_i $(2 \leq n \leq 9)$ of N observations each $(n + 1 < N < \infty)$, the LEAST SQUARES MULTIPLE LINEAR REGRESSION ANALYSIS and CORRELATION COEFFICIENTS program evaluates the correlation coefficients $r_{ik} = \Sigma(x_i-x_i)(x_k-x_k)/\sqrt{\Sigma(x_i-x_i)^2 \; \Sigma(x_k-x_k)^2}$ summed over N observations $(1 \leq i \leq n,\ 2 \leq k \leq n-1)$. The program also requires a sampling of m dependent variables y_j $(1 \leq m \leq 5)$ with a corresponding number of observations to approximate by the least squares method, a multiple linear relationship of each dependent variable y_j with all independent variables $(x_1, \ldots, \ldots, x_n)$ of the following form:

$$y_j = b_o + \sum_{i=1}^{n} b_i x_i$$

An analysis of variance table is also computed for each dependent variable giving the regression sum of squares due to each independent variable after the preceeding variable or variables have been removed (SS (x_i)). The F_i ratio, the significance level for each independent variable as well as the error sum of squares (SSE), the residual degrees of freedom, the error mean sum of squares (MSS), and the total corrected sum of squares (TSS) for each dependent variable are also included in the table. A sample format is included in the program description. This Program does not evaluate the correlation coefficients of the dependent variables nor of the independent variables with the dependent variables.

The dependent and independent variables are arranged in columns of N observations each in the following manner.

obs.	x_1	x_2	x_3	..	..	x_n	y_1	y_2	..	y_m
1	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..
.	..	..	..	..	..	..	..	..	..	..
N	..	..	..	..	..	..	..	..	..	..

An input tape is prepared one row of observations at a time requiring, on the average, five minutes per observation depending on the number of variables and the speed of the operator. However, if this analysis was proceded by a PARC ANALYSIS program (prepared by the author), the Parc Analysis input tape may be utilized by means of a rearrangement subroutine within this program. This tape may also be used in any subsequent least squares programs prepared by the author. There is also a flexowriter prepared tape conversion routine which eliminates considerable machine time. The value of F needed to test the significance level of each F_j may be found on the F table included in the program description. There are eighteen variable constant or type-in instructions. For n independent variables, m dependent variables, the computations require $(4.25n + 2.85m) \cdot N$ seconds. The output requires $8(\sum_{1}^{n} k + n - 2)$ seconds for the correlation coefficients and $14\,(n + 2) \cdot m$ seconds for the regression coefficients and the analysis of variance table.

SCIENTIFIC DESIGN COMPANY INC. *Design·Construction*
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November 8, 1960

Abstract of U.P. #421-A

description of modifications for Users' Project No. 421, Title: 'Least Squares Multiple Linear Regression Analysis and Correlation Coefficients'.

This program will now print-out the means of the input data upon completion of reading the data tape the first time through. It will then automatically back-up the data tape to the beginning and start reading in again for the second time.

Respectfully yours,
Scientific Design Co.,Inc.

Louis E. Cabral

LEC/jb

ABSTRACT OF USERS PROJECT 422

TITLE: TAPE READER

CLASS: I

PREPARED BY: M. R. ROHR
REPAUNO PROCESS LABORATORY
EXPLOSIVES DEPARTMENT
E. I. DU PONT de NEMOURS & COMPANY, INC.

MODE: MACHINE LANGUAGE SUBROUTINE FOR 1000D

DATE: JANUARY, 1960

Many programs such as regression analysis and data reduction require large volumes of data input. Single precision input may be adequate with double precision calculations required. Off-line tape preparation with a Monroe Add Punch minimizes the work associated with data preparation because zero digits are all automatically punched on tape. The format of the tape is 7 digits sign, tab (with reload characters where appropriate). The program will read 7 digit floating or fixed point decimal numbers. Convert the numbers to INC 1000 language and store the converted double precision numbers in consecutive locations in the intercom memory. The locations for storage do not have to start at zero. The program will also read short INC 1000 data tapes into memory in locations which may start at an even location, not necessarily zero.

WILSON & COMPANY ENGINEERS

(Program Abstract)

Users' Project No. 423

STANDARD STEP METHOD OF BACKWATER COMPUTATIONS

The program computes the water-surface curve by the step method. Changes in channel dimensions, and obstructions in the channel are handled by the program. Mannings formula is used and type-out is arranged in tabular form. A trial and error method of computation is used between the trial water surface and the final water surface until they agree within 0.1 foot. The program is written in Intercom 1000 D.P. Running time varies according to the number of obstructions in the channel and the number of stations. No special consideration is given to curved channels.

ABSTRACT

Users' Project #424

TITLE: Geodetic Positions from Plane Coordinates and Vice Versa for the State of Illinois

BY: State of Illinois, Division of Highways, Bureau of Research and Planning

EQUIPMENT AND MODE OF OPERATION: Bendix G-15D, Intercom 1000-D

PROBLEM STATEMENT: Given the plane coordinates of a point determine the geodetic position of the point; or given the geodetic position of a point determine the plane coordinates. The coordinate grid is based on the Transverse Mercator Projection as established for the State of Illinois.

ACKNOWLEDGMENTS: Much of the logic and most of the equations used in this program were taken from a similar program developed for the State of Arizona by the U. S. Army Engineer District, Los Angeles, Corps of Engineers.

INPUT DATA:

I. For computation of geodetic position
   a. Zone involved (east or west)
   b. x and y coordinates of the point

II. For computation of plane coordinates
   a. Zone involved (east or west)
   b. Latitude of point
   c. Longitude of point

OUTPUT DATA:

I. The latitude and longitude of the point and the convergence angle between the central meridian and the meridian through the point at the point.

II. The x and y coordinates of the point and the convergence angle between the central meridian and the meridian through the point at the point.

LIMITATIONS: The values of the constants used are for the State of Illinois as given in Special Publication No. 303 of the U. S. Department of Commerce. The program in its present form applies only to the State of Illinois.

December 28, 1959

ABSTRACT TO USERS' PROJECT #425

Documentation Routine for Intercom 107 (107-006)

This program will document the contents of any series of locations in intercom 107, whether orders or numbers. A vacant location will be interpreted as a zero. There is one chance in 4096 that a number will be interpreted as a store order.

With intercom 107 in the machine in Interpreter mode, Tape #107-006 should be read in with "p" key, and Compute switch then returned to GO.* The effect of this tape is to validate the "8" code. Tape to be documented may be read in prior to or after reading in #107-006.

To document the contents of any set of locations, type abc8 tab s, where abc is the location of the first item to be listed. Contents of this and subsequent locations will be typed out in order. The speed of listing will be output limited. To interrupt documentation, throw Compute switch to Break Point while next to last item is being typed; and, when machine stops, then switch to "GO".

As all other Interpreter instructions remain valid, documentation may be followed immediately by execution of the program. However, execution of other instructions may destroy the documentation routine. (Code 9, for reading tape, will not destroy it). For this reason, an inadvertent use of code 8, after obeying other instructions, will give unpredictable results.

* A continuous bell ring will denote a tape-reading error.

ABSTRACT

USERS' PROJECT NO. 426

TITLE:	Highway Horizontal Alinement
CLASS:	2
VALUE:	5
ORIGINATOR:	Midwest Computer Service, Inc., Decatur, Illinois, and Clark, Daily and Dietz, Urbana, Illinois
LANGUAGE:	Intercom 1000 DP
DATE:	October 1, 1959

The program calculates circular curve data, spiral data, stationing of main points (forward and backward for some points), azimuths of the basic traverse, lengths of the basic traverse, coordinates of the main points, and coordinates of the center of radius of each circular curve of an open traverse consisting of tangents, circular curves and transition spirals. The number of courses or P.I.'s has no practical limit.

Input is via the flexowriter subroutine in groups of five (5) word blocks plus the normal "Z" stop read code. The program reads the initial data, computes the first tangent segment and then enters a read data-compute cycle until a zero D or R value (Degree of curvature or radius) is detected; the computer halts and will read more data for another problem by toggling the compute switch to center position then to compute position.

The input for the first block of flexowriter tape consists of the coordinates of the beginning point, the coordinates of the first P.I., or the azimuth of the first course and minus the length of the first course, and the station of the first point.

The following input blocks consist of coordinates of the next P.I. or the deflection angle and tangent length, the degree of curvature or minus the radius (zero for stop), the length of the first spiral, and the length of the second spiral (zero for no spiral).

The program is limited to one circular curve at each P.I. This circular curve may be connected to the tangents with spirals.

The program incorporates two safety features. The first applies only when spirals are involved; it checks the magnitude of the sum of the spiral angles against the total deflection available if this sum is larger than the deflection angle the computer halts after typing a 1 and the angular overlap in degrees.

The other checks for overlap of the curve (circular or spiraled) from one P.I. upon the curve (circular or spiraled) from its adjacent P.I.; If overlap occurs the computer halts after typing 2 and the overlap in feet.

Often times a correction in foot per foot of length must be considered when working with a coordinate system based on an elevation other than ground elevation. The program is coded for this situation. The correction rate in foot per foot is input. If this rate is not zero the input coordinates must be true coordinates and if lengths of oourses are input, they should be ground-elevation lengths.

Abstract of Users Project No. 427

Class 2

Title: CONTINUOUS BEAM DESIGN

Originator: Clark, Daily & Dietz, Consulting Engineers
Address: 211 N. Race St., Urbana, Illinois
Mode: Intercom 103D
Date: June 1, 1959

The program will design a four-span continuous rolled beam bridge in accordance with the 1953 or 1957 A.A.S.H.O. Specifications using any of three specified loading conditions. Influence lines are computed using a modification of Users' Project No. 24. The interior beam is designed on the basis of the maximum positive moment. The fascia beam moments are computed and a check is made to determine whether or not the interior beam is satisfactory for the fascia beams. The program will determine whether or not cover plates are needed at the supports and will design the cover plate thicknesses and lengths. If the computed relative moments of inertia do not agree fairly closely with the input values the program will recycle and repeat this same procedure based on new influence lines. One recycling operation will normally be sufficient to produce a satisfactory design. Finally influence lines for moment and reaction are typed out.

Input consists of four span lengths, beam spacing, slab thickness, allowable stress, relative moments of inertia and load factors. An Input Data tape has been prepared for a sample problem and may contain many values common to a specific problem.

The output format is designed for 8 in. x 11 in. sheets. The complete beam and cover plate design will be typed out on one sheet. Each recycling operation will take one additional sheet. Three additional sheets are required for three sets of influence ordinates.

The influence ordinates for moment at the interior supports are calculated by computing deflections by the conjugate beam method and applying Maxwell's Reciprocal Theorem as described in Users' Project No. 24. From these ordinates others are computed by statics. The moments are calculated in accordance with the 1953 or 1957 A.A.S.H.O. Specifications. The cover plate cutoff distances are determined by a straight line interpolation between the maximum negative moments at interior supports and at 0.2L away from each interior support.

Data input requires about 5 minutes. The first page of typeout consisting of the beam and cover plate design and each additional recycle requires from 20 to 30 minutes. The typeout of the three sets of influence ordinates takes about 15 to 20 minutes.

ABSTRACT

USER'S PROJECT NO. 428

TITLE: Right of Way Geometry with Areas

CLASS: 2

VALUE: 10

ORIGINATOR: Midwest Computer Service, Inc., Decatur, Illinois
Warren & Van Praag, Inc., Consulting Engineers, Decatur, Illinois

LANGUAGE: Intercom 1000 (double precision)

EQUIPMENT: Bendix G-15D Flexowriter

DATE:

This program will solve fifteen of the different problems found in computing right of ways. Each of these problems is given a case number. A highway centerline or a transit line is used as a base line for computations. Nine cases are provided for the parts of a right of way for which the centerline is straight and six cases are provided for the parts of a right of way for which the centerline lies on the arc of a circle. For all of the cases except one, the program computes data about a straight right of way side. In addition, for ten different cases the program computes data for a right of way side along the arc of a circle. The case number for a right of way side is determined by the input data provided by the user. The program proceeds clockwise around a right of way parcel, and the case number for each side is selected by the user as required. Input is punched on tape by the Flexowriter in floating point notation. Output is in fixed point notation.

For a straight right of way side, the following is printed out:

1. Initial right of way station plus the accumulated distances along the right of way boundary whether it is curved or straight.
2. Length of the right of way side.
3. Azimuth of the right of way side.
4. Offset and centerline station of the computed point on the right of way boundary.
5. Coordinates of the computed point on the right of way boundary.

For a right of way side along the arc of a circle, the following is printed out:

1. Initial right of way station plus the accumulated distances along the right of way boundary.
2. Radius of the right of way side.
3. Delta angle of curved centerline. If centerline is straight program prints out zero.
4. Length of the chord of the right of way side.
5. Azimuth of the chord of the right of way side.
6. Offset and centerline station of the computed point on the right of way boundary.
7. Coordinates of the computed point on the right of way boundary.

For Case 9 the program prints out the following:

1. Azimuth of new centerline tangent.
2. Offset relative to the new centerline tangent of the point on the right of way last computed.
3. Centerline station relative to the new centerline tangent of the point on the right of way last computed.

In addition to the above outputs, the area of the entire parcel is printed out in square feet and in acres after the computations for the parcel have been completed.

The following tables outline the input data required for each case and the type of right of way side each case will compute.

TABLE I

CASE NO.	INPUT INFORMATION REQUIRED TO SPECIFY NEXT R.O.W. SIDE	SHAPE OF RIGHT OF WAY SIDE COMPUTED
	(Straight Centerline)	
1	Offset and centerline station of a point on R.O.W. and if the R.O.W. side is curved, radius of curve is also required	Straight or Curved
2	Coordinates of point on the R.O.W. and, if the R.O.W. side is curved, radius of the curve is also required.	Straight or Curved
* 3	Coordinates and bearings (or azimuths) for two straight lines intersecting at a point on the R.O.W. and, if the R.O.W. side is curved, radius of curve is also required.	Straight or Curved
(Z) * 4	Coordinates and bearing (or azimuth) for a straight line intersecting a circle on the R.O.W., radius of the circle and coordinates of the center of the circle and if the R.O.W. side is curved, radius of the curve is also required.	Straight or Curved

TABLE I (Continued)

CASE NO.	INPUT INFORMATION REQUIRED TO SPECIFY NEXT R.O.W. SIDE	SHAPE OF RIGHT OF WAY SIDE COMPUTED
	(Straight Centerline)	
5	Return to preselected point. No information required if R.O.W. side is straight, but if the R.O.W. side is curved, radius of the curve is also required.	Straight or Curved
6	Bearing (or azimuth) of the R.O.W. side and centerline station of the point on R.O.W.	Straight only
7	Bearing (or azimuth) of the R.O.W. side and offset of the point on R.O.W.	Straight only
8	Bearing (or azimuth) and length of the R.O.W. side.	Straight only
9	Centerline station at the point of intersection of two centerline tangents and azimuth of the second of these two tangents.	(See Section H, Par. C of this part)

(Z) For some conditions, it is not necessary to enter the coordinates of the center of the circle.

TABLE II

CASE NO.	INPUT INFORMATION REQUIRED TO SPECIFY NEXT R.O.W.SIDE	SHAPE OF RIGHT OF WAY SIDE COMPUTED
	(Curved Centerline)	
21	Offset and centerline station of a point on the R.O.W. and radius of the centerline, and, if curved and non-concentric with the centerline, radius of the R.O.W. side is also required.	Straight or Curved
22	Coordinates of a point on the R.O.W. and radius of the centerline, and, if curved and non-concentric with the centerline, radius of the R.O.W. side is also required.	Straight or Curved

TABLE II (Continued)

CASE NO.	INPUT INFORMATION REQUIRED TO SPECIFY NEXT R.O.W.SIDE	SHAPE OF RIGHT OF WAY SIDE COMPUTED
	(Curved Centerline)	
* 23	Coordinates and bearing (or azimuths) for two straight lines intersecting at a point on the R.O.W. and radius of the centerline, and if curved and non-concentric with the centerline, radius of the R.O.W. side is also required.	Straight or Curved
* (=) 24	Coordinates and bearing (or azimuth) for a straight line intersecting a circle at a point on the R.O.W., coordinates of the center of the circle, radius of the circle, and radius of the centerline, and, if curved and non-concentric with the centerline, radius of the R.O.W. side is also required.	Straight or Curved
25	Returns to preselected point on the R.O.W. Radius of the centerline, and, if curved and non-concentric with the centerline, radius of R.O.W. is also required.	Straight or Curved
26	Bearing (or azimuth) of the R.O.W. side, centerline station of a point on the R.O.W. side and radius of the centerline.	Straight only

* If in cases 23 and 24 the coordinates for one of the straight lines are those of the point last computed, they are not needed as input data.

(=) If in case 24 the coordinates of the center of the intersected circle are the same as the coordinates of the center of the centerline circle, they are not needed as input data.

The program uses the Square Root, Arctangent, Sine and Cosine, and Flexowriter Input subroutines.

It requires from forty to sixty seconds of computations and print out for each side of right of way parcel. The four intersection cases take the longest.

Abstract of Users' Project No. 429

Title:	CARD INPUT FOR U.P. 21
Class:	2
Mode:	Machine Language
Auxiliary Equipment:	IBM 026, Card Punch Bendix CA-IB, Punched Card Coupler
Originator:	Tippetts-Abbett-McCarthy-Stratton
Date:	February 15, 1960

This program enables Users' Project No. 21 (Illinois Earthwork Program), Supplement No. 4 to accept data normally supplied by a "ground line tape" directly from punched IBM cards. The data cards are read from an IBM 026 Card Punch coupled to the computer with a CA-IB.

Except for modification of "ground line" data input and a few other limitations specified below, this program operates in exactly the same manner, and with the same limitations as U.P. 21, Sup. No. 4. The program will properly handle variable superelevation rates, omission of earthwork volumes and equation of stations.

In order to simplify data input and to conform to accuracies obtainable from photogrammetric methods, we have limited the range and precision of horizontal and vertical measurements which may be entered as data as follows:

Elevations	+0.1 to 999.9 ft.
Offsets	-0 to 999. ft.
Station Numbers	0+00. to 9999+9.9.
Ground points per cross section	4 to 50

TEXTILE RESEARCH INSTITUTE

PRINCETON, NEW JERSEY

Title: Matrix Preparation Program

Users Project No.: 430

Class: 1

Mode: Intercom 1000 Double Precision

Date: January 25, 1960

Originator: W. P. Virgin
Textile Research Institute

USERS' PROJECT NO. 430

ABSTRACT

The Matrix Preparation Program (MPP) is designed as an aid in the preparation of data tapes for use with MAP 29. Certain statistical design matrices contain columns whose elements are products of the corresponding elements in other columns. This program will perform the multiplications and contains sections for manipulating columns.

Input is either from punched tape or through the key board, fixed point. A maximum of nine matrix columns can be stored at one time. Each column may have up to 28 rows.

The program contains a machine language subroutine which modifies

Abstract of Users' Project No. 430
Title: Matrix Preparation Program
Class: 1
Page Two

Intercom. Since certain of these modifications differ for different issues of Intercom, it is essential that the May 1959 issue be used, Intercom D (3121959).

ABSTRACT

Users' Project No. 431

PPROMPT

(Program Preparation Routine On Magnetic Program Tape)

This program incorporates into PPR the speed and versatility of magnetic tape to facilitate code checking and provide for greater computer efficiency. In addition, the magnetic tape service routines included in the PPROMPT package make magnetic tape handling a simple process.

PPROMPT is contained in two files on magnetic tape. PPR and its auxiliary routines are in the first file; an auxiliary control routine and the magnetic tape service routines are in the second file.

The program uses lines 05 and 14 through 19 for storage, operation, and input-output. Lines 11, 12, and 13, formerly used by PPR and its auxiliary routines, have been made available to the programmer.

This project requires Users' Project No. 153, Magnetic Tape Search Routine, for initially locating and loading PPROMPT from the Magnetic Tape. Hence, U. P. No. 153 is made part of and included with this project.

AURORA GASOLINE COMPANY - DETROIT, MICHIGAN

Linear Programming Routines for Bendix G-15

USERS' PROJECT NO. 432

Abstract

Linear Programming has proved to be a very useful tool for the investigation and solution of many economic problems in the petroleum and other industries. Gasoline blending was one of the first applications for linear programming in the petroleum industry. Since then, linear programming has been applied to an ever widening range of industrial problems. This report summarizes the Aurora Gasoline Company's efforts in writing a linear programming package for the Bendix G-15. The programs are petroleum orientated, but the theory is general and the programs can be used to solve a wide variety of problems.

The linear programming package consists of a series of related programs designed to handle a large variety of situations that may arise during the course of solution to a linear programming problem. The programs are divided into three classes, each class occupying one magazine. The first magazine (magazine A) is called "Input-Output Routines for the Linear Program". The second magazine (magazine B) contains "Service Routines for the Linear Program". The third magazine is the "Linear Program" proper.

Maximum problem size is restricted by:

1. $2(M+N) + (N+1)(M+1) \leq 1726$
2. $M+N \leq 107$

   where M = number of equations not including profit function,

   and N = number of non-basis variables not including right hand side of the equations (does not include positive slack and artificial variables).

Running time for optimization of a linear program depends on M, N, density of the matrix (number of non-zero elements), and the number of iterations. For a typical gasoline blending problem with 28 equations and 27 unknowns, 34 iterations were required for solution. This problem ran approximately 39 minutes.

The routines in this package include programs for:

1. Various modes of data input (cards through a CA-1 coupler, tape prepared by the computer, and the typewriter).
2. Listing of input data by the typewriter.
3. Arbitrary profit function changes.
4. Dual algorithm for handling negative numbers on the right hand side.
5. Simplex algorithm for normal situations with positive right hand side.
6. A program to allow the starting of the problem with any initial basis. This program is considered expecially important since it can possibly lead to the solution of problems with poor round-off characteristics. It is also a complete matrix inversion program and can handle matrices up to 38x38.

Output of the program consists of a complete listing of the matrix and/or:

1. Variables in the basis; their value and the range over which their profit function coefficients can vary without destroying the optimality of the solution, and

2. Variables not in the final solution, their shadow prices and range of feasibility.

Abstract for User's Project No. 433

Class 1

Title: INPUT/OUTPUT ROUTINES UTILIZING THE ALPHANUMERIC TYPEWRITER

Orginator: The Dow Chemical Company, Pittsburg, California

Mode: Machine Language

Date: January 18, 1960

Two separate programs are included. The first permits alphanumeric information to be typed onto reports either prior to or upon the completion of the numeric calculations without modifying the existing non-alphanumeric program. Punched paper tapes are prepared containing the necessary headings, etc. A second section controls the type-out of these tapes.

The second program is intended to be used with Intercom 1000 D and 1000 S. The first section permits the storage of alphanumeric information in consecutive memory location starting in CH WD. (Lines 05, 19 and locations u0 - u7 are excluded.) A total of 108 words may be stored (391 characters) for a given CH WD. The address of the last location used is typed out after the data has been stored. Slight modification will permit the echo of the input alphanumeric data but will use an additional line of memory.

The companion tape for output operates as a subroutine with either Intercom 1000 D or 1000 S. The two command calling sequence in the 1000 D program

```
u 70 CH WD
  08 LL 01
```

permits the alphanumeric data starting in CH WD to be typed out. (LL is the channel in which this subroutine is stored.) The 1000 S calling sequence uses the word base of index register w instead of u to identify the initial ouput location.

J. E. GREINER COMPANY
CONSULTING ENGINEERS
BALTIMORE, MARYLAND

ABSTRACT OF ARCH CULVERT HYDRAULICS

Users' Project No. 434 Program Class 2

Equipment Required: Basic G-15D
Mode: Intercom 1000 S.P. (500)

This Arch Culvert Hydraulics Program computes the various hydraulic properties (area of flow, hydraulic radius, velocity of flow, velocity head, total energy head, and friction slope) for a given flow through an open or closed arch culvert of predetermined shape at various depths.

Required input data is the flow, Manning's N, culvert width, one optional dimension for a closed arch, an open-or-closed culvert code, and the depth limits and depth increment to be studied.

The program computes the critical depth if the critical depth is below the upper depth limit specified by the designer.

ABSTRACT OF USERS' PROJECT NO. 435
CLASS 2

TITLE: Basic Statistics (MTA-3 Input)

ORIGINATOR: D. F. Akeley

ADDRESS: Pioneering Research
Experimental Station
E. I. du Pont de Nemours & Co., Inc.
Wilmington 98, Delaware

MODE: G-15 Machine Language

DATE: 15 February 1960

Fixed-point numbers are recorded on magnetic tape by use of an MTA-4 accessory. This program causes the computer to read the magnetic tape and type back the following results:

Identification Code

N	the number of data
$\bar{X}$	their average
σ	their standard deviation
CV	their coefficient of variation
$(CL)_{99}$	their 99% confidence limit
$(CL)_{95}$	their 95% confidence limit
$(CL)_{90}$	their 90% confidence limit

$$\bar{X} = \Sigma X_i / N$$

$$\sigma = \sqrt{\frac{\Sigma X_i^2 - (\Sigma X_i)^2/N}{N-1}}$$

$$CV = 100\sigma/\bar{X}$$

$$CL = \sigma t/\sqrt{N}$$

ABSTRACT OF USERS' PROJECT NO. 436
CLASS 2

TITLE: Basic Statistics (Type Input)

ORIGINATOR: D. F. Akeley

ADDRESS: Pioneering Research
Experimental Station
E. I. du Pont de Nemours & Co., Inc.
Wilmington 98, Delaware

MODE: G-15 Machine Language

DATE: 15 February 1960

Fixed-point numbers are entered via the typewriter, each input terminated by (Tab) S. Up to 255 separate data may be handled, the restriction being that their sum (scaled 103) must not exceed the capacity of a single precision computer word. The operator may select 0, 1, 2, or 3 digits after the decimal point for input purposes, but internally all numbers are scaled 103. Input is terminated by typing Z (Tab) S.

Output is on a single line and is, in order:

N	the number of data
$\bar{X}$	their average
σ	their standard deviation
CV	their coefficient of variation
$(CL)_{99}$	their 99% confidence limit
$(CL)_{95}$	their 95% confidence limit
$(CL)_{90}$	their 90% confidence limit

$$\bar{X} = \sum X_1/N$$

$$\sigma = \sqrt{\frac{\sum X_1^2 - (\quad _1)^2/N}{N-1}}$$

$$CV = \frac{100\sigma}{X}$$

$$CL = \sigma t/\sqrt{N}$$

Abstract of Bendix
Users Project No: 437
Class : 2

Title: SOLUTION OF SIMULTANEOUS ORDINARY DIFFERENTIAL EQUATIONS
Originator: National Research Council of Canada, Ottawa
Mode: Intercom 1000 Double Precision
Date: February 23, 1960
Problem: Solve the set of N simultaneous, first order, ordinary differential equations for $y_i(x)$

$$\frac{dy_i}{dx} = f_i\ (x, y_1, y_2, \ldots y_N) \quad 1 \leq i \leq N$$

with initial conditions

$$y_i(x_o) = y_{i,0}$$

Limitations: $N \leq 20$

Abstract: The Runge-Kutta-Gill method is used to compute $y_i(x_o + nh)$, $n = 0, 1, 2 \ldots$ over the range $x_o \leq x \leq x_{max}$. The operator must enter x_o, x_{max} and the step width h, as well as a program to compute and store hf_i.

Answers are typed out at intervals specified by the operator and in a format somewhat under his control.

Execution Time:

10 N seconds per step plus four times the time to evaluate hf_i.

Storage Locations Used:
The program occupies essentially 1360 to 1599. The operator's program to compute hf_i will start at 1000.

Abstract of Bendix
Users Project No,: 438
Class : 2

Title: Bessel Functions $J_o(x)$, $J_1(x)$, $Y_o(x)$, $Y_1(x)$

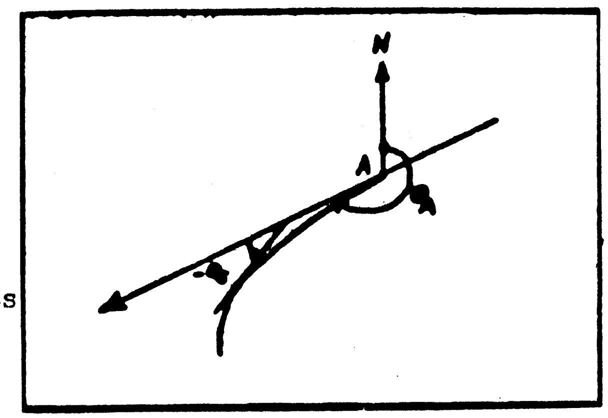
Originator: National Research Council of Canada
Mode: Intercom 1000 Double Precision
Date: 21 February, 1960
Problem: Given a real argument x, compute the Bessel functions of first and second kind, zero and first order, i.e. $J_o(x)$, $J_1(x)$, $Y_o(x)$, $Y_1(x)$.

Method: Polynomial expansion. Same as User's Projects 107 and 108.
Accuracy: Between seven and ten digits.
Execution Time: Approximately 10 seconds.
Storage Locations Use: 0900 to 1499, except for 1242 to 1299.
Disclaimer:

No responsibility is assumed by National Research Council of Canada for any errors or misrepresentations that may occur as the result of using this program. No responsibility is assumed by the Bendix Computer Division for the correct reproduction of this program.

Title: STATION & OFFSET DISTANCE TO A POINT
Class: 2
Mode: Intercom 1000 D. P. (5-1-59)
Originator: Vogt, Ivers, Seaman & Associates
Date:

This program determines the station radially opposite a given point and computes the offset distance from the alignment station to this point. The alignment may consist of tangent, spiral, and circular curve. However, the second tangent of a complete curve is not included in the program.



Input Data:

a) Station A
b) Coordinates of A
c) Azimuth of approaching tangent
d) Spiral angle
e) Length of spiral
f) Radius of circle if no spiral
g) Coordinates of one to twenty-one points

Output:
a) Station radially opposite the point
b) Coordinates of main line at this station
c) Radial offset distance
d) Azimuth of the tangent to the curve at the station opposite the point

Abstract of Users' Project No. 440

Title: Highway Transition Curves

Class: 2

Mode: Intercom 1000 Double Precision

Originator: Parsons, Brinckerhoff, Quade & Douglas

Program Scope:

Given a minimum of data for a central curve with up to five standard transition curves symmetrically placed on each side, this program will compute all curve elements and coordinates normally required.

Input consists of the actual or relative P.I. coordinates and tangent bearings; radius for the central curve; radius, central angle and arc length for each transition curve. The output from the program is:

1. Stations and coordinates of the PC, all PCC's, and the PT.

2. The total tangent distance from PC or PT to PI.

3. R, Δ, L, T, and E for the central curve.

4. Center coordinates of each curve.

Program Limitations:

The curve system (central curve and transition curves either side) must be symmetrical about the central axis (line joining the PI and the center of the central curve).

Method of Solution:

Standard formulas for finding curve elements and solving triangles are used in the solution on one side of the central curve. The symmetry of the layout is taken advantage of in finding the data for curves on the other side of the central curve.

Operating Time:

Time varies with the number of curves on either side of the central curve; a typical problem with four curves on each side requires fifteen minutes for type-in computation and type-out. No auxiliary equipment is required.

Title: Fixed Arch and Sewer Section Analysis

Class: 2

Mode: Intercom 1000 Single Precision

Originator: Parsons, Brinckerhoff, Quade & Douglas

This program is a modified version of U.P. 18 and follows basically the same method of solution described for that project.

Program Scope

The program can be used to analyze both open structures such as fixed arches, single span rigid frames, etc., and closed structures such as tunnel sections, sewer sections, etc.

The final results from the program are the internal reactions at up to five designated points along the axis of the structure due to an external system of loads. The program can also find the internal reactions at the same points caused by the dead load of the structure itself.

As a preliminary step in obtaining the final results the program first computes influence values for the axial points. Program options provide for computing:

A) Influence values due to a unit vertical load.

B) Influence values due to a unit horizontal load.

C) Both A) and B).

The influence values are punched out and preserved on paper tape. They also may be typed out for examination by the designer to determine the critical locations for moving loads. These influence values are then multiplied by as many different loading systems as desired to produce the actual forces and moments acting at the axial points.

Program Limitations

1. The structure may not be subdivided into more than 43 segments.

2. The reinforcing steel must be symmetrically placed and each segment must be symmetrical.

3. Open structures may be unsymmetrical and have unsymmetrical external loadings, but closed structures must be symmetrical about the Y axis and have only symmetrical external loadings.

4. Each external load must be applied at the centroid of a segment.

Abstract of Users' Project No. 442

Title: Distribution Primary Radial Circuit Calculations for Voltage Drop, Fault Current, Loss

Class: 1

Mode: G-15D, Intercom 1000 S

Originator: John A. Salin
Ebasco Services Inc.

This program solves for the voltage drop, loss and fault current-calculations for a radial electric distribution circuit.

The program is written for wye connected circuits and is not suitable for fault current calculations for delta connected circuits. However, it can be used for voltage drop calculations for delta circuits, through a data manipulation on input.

To speed up operation it is possible to bypass some of the output so that initial trial runs may be sped up over the final runs.

USERS' PROJECT NO. 443

ABSTRACT

When a volume of printed output is required the CA-2 coupler and IBM 402 line printer can be used to advantage. This is an Intercom 1000 S subroutine which will cause printing of nine Intercom numbers per line, in standard format except that the sign follows, rather than preceeding, the associated number. The standard G-15 number track has been used with no apparent difficulty.

(Class I)

LOCKWOOD, KESSLER & BARTLETT, INC.

ENGINEERS • SURVEYORS

ONE AERIAL WAY, SYOSSET, NEW YORK

WELLS 8-0600

USERS' PROJECT NO. 444

ABSTRACT

Title:	Area by Traverse
Category:	Class 2
Mode:	Intercom 1000 D (.3121959)
Originator:	Lockwood, Kessler & Bartlett, Inc.
Date:	Feb 23, 1960

The x and y coordinates of initial point, and the bearing and distance of each course of a closed or open traverse are given. It is required to compute; (1) The x and y coordinates of each course, the x and y errors of closure, and the area of the closed traverse, or (2) the x and y coordinates of each course, the closing bearing and distance, and the area of the open traverse.

A closed or open traverse up to 45 courses for flex input and 46 courses for type input may be located in any one of four quadrants. Accuracy of output data will be 0.0001 ft, 0.01", and 0.0001 sq ft and 0.0001 acre, for the distance, bearing, and area, respectively.

Computation time: 12 sec/ course plus 35 sec for each traverse.

Scientific Computers, INCORPORATED

1315 4TH STREET S. E., MINNEAPOLIS 14, MINNESOTA • FE 1-7927

Abstract of the Users' Project No. 445

Title: INTERCOM 500X DOCUMENTER
Class: 1
Mode: Intercom 500X, Single Precision
Originator: Scientific Computers, Inc.
1315 Fourth Street S. E.
Minneapolis 14, Minnesota
Date: March 1, 1960

This program will list programs written in Intercom 500X starting at location 00 up to location 99 of any order of channels defined by the input.

Number of the blocks of tape to be read in and channel numbers in order they appear are required as input.

Output format is made so that the command locations and intercom commands can be typed out on a standard intercom coding sheet. There is a break point halt following each 25 command type-out so that the coding sheet can be replaced with a new one.

Subroutines used: Index register utilization subroutine for Intercom 500X. (Revised Feb. 19, 1960.)

Abstract of Users Project No. 446

Class 2

Title: CURVED ALIGNMENT GEOMETRY

Originator: Richardson, Gordon and Assocaites
Address: 3 Gateway Center, Pittsburgh 22, Pennsylvania
Mode: Intercom 1000 Double Precision
Date: March 17, 1960

Given a starting station, north and east coordinates of the starting station direction azimuths and distances between P.I.'s and radii at all P.I.'s of the alignment traverse, this program will compute the horizontal curve data, including: central angle, arc length and tangent length; coordinates of: P.I., radius center, P.C. and P.T., and stations of P.C. and P.T. This program will also compute the coordinates and radial azimuth, on center line, at any desired incremented or random station if given the station increment desired and/or the random stations. The program will also accommodate station equations on the alignment traverse.

The output format is shown in the write-up. The output can be typed or punched on tape. If tape is punched the output can then be used to solve subsequent problems as may be desired.

Standard equations for horizontal alignment are used in the mathematical method.

Computational and output time varies depending on the length of the problem. The program will handle up to 13 lines in the alignment traverse, 50 random stations and two station equations per run.

Abstract of Users Project No. 447

Class 2

Title: THREE CENTER CURVE

Originator: Richardson, Gordon and Associates
Address: 3 Gateway Center, Pittsburgh 22, Pennsylvania
Mode: Intercom 1000 Double Precision
Date: March 17, 1960

This program will handle three basic three center curve problems. Input that is required of all three cases is as follows: north and east coordinates of the main tangent P.I., direction azimuths of the alignment and offsets (if any) to subtangents. Case one will handle the problem where properties of the three curves are known, namely: length of left curve, length of right curve, and the radii of all three curves. Case two will handle the problem of replacing spiral transitions with curved alignment such that the curve will approximate the spiral alignment - given the length of super elevation transition left and right (spiral lengths) and the radius of the center curve. Case three will handle the problem of widening the roadway on curve - given the length of widening transition left and right, radius of the center curve and the widening offsets left and right. The program can also be used for two centered and single center curves by zeroing out non-applicable input.

The output format is shown in the write-up but basically the program computes: main tangent lengths, subtangent lengths, curve data (arc lengths, tangent lengths and central angles) for all three curves and the coordinates of all control points (P.I.'s, P.C., P.cc.'s, P.T. and radius centers.)

The mathematical method is described in the write-up.

Computational and output time is approximately 2½ minutes. The program is limited to one curve per run.

Abstract of Users Project No. 448

Class 2

Title: EARTHWORK TABULATION

Originator: Richardson, Gordon and Associates
Address: 3 Gateway Center, Pittsburgh 22, Pennsylvania
Mode: Intercom 1000 Double Precision
Date: March 17, 1960

This program was developed to tabulate earthwork volumes with given stations and their respective cut and fill areas. The method of computation (volume runout taken into account) and the output format conform with the requirements of the Pennsylvania Department of Highways. The volume runout characteristic may be ignored or, by entering the proper indicator, may be taken into account. This program will also accommodate a scale factor, a cut factor (swelling), a fill factor (shrinkage), starting cut and/or fill volumes and an unlimited number of stations equations. A subtotal may be obtained at any desired station by entering the proper indicator.

Input is basiclly prepared on tape and the output format is shown in the write-up.

The average end area method with volume runout (if desired) is used in the Mathematical development.

Computational and output time runs approximately 1/2 minute per station.

ABSTRACT
USERS PROJECT NO. 449

TITLE: Hydraulic Computations for Sewer Design Using Hydrograph or Rational Method

CLASS: 1

ORIGINATOR: City of Chicago, Bureau of Engineering

ADDRESS: 320 N. Clark Street, Chicago 10, Illinois

MODE: Intercom 1000 S.P.

DATE: March 1960

This Program is adaptable to either one of two methods for determining the runoff rate, namely: "Hydrograph Method" or "Rational Method." A separate Program Tape is available for each method.

The data required as input and the information obtained as output are given below:

INPUT

1. Actual diameter of pipe in feet for each reach, (used only for analysis of an existing sewer).
2. Total number of different types of surfaces directly tributary to each reach.
3. Time of concentration (T_c) for Rational Method or time of travel (T_r) for Hydrograph Method at the upstream end of the system.
4. Length of each reach in feet.
5. Runoff coefficient (C) or imperviousness (I_p) for each surface area.
6. Area in acres for each surface.
7. Total number of reaches.
8. Upstream elevation of the desired hydraulic grade line.
9. Slope of the desired hydraulic grade line for each reach.

OUTPUT

1. Flow in cubic feet per second in each reach.
2. Velocity of flow in feet per second.
3. Diameter of circular pipe in feet (design only).
4. Invert elevations for each reach (design only).
5. Cost in dollars for each reach and its summation, (design only).

Abstract of Users Project No. 450
Class 2

Title: COMPOSITE PLATE GIRDER DESIGN

Originator: Tippetts-Abbett-McCarthy-Stratton
Address : 375 Park Avenue, New York 22, N.Y.
Mode : INTERCOM 1000 S.P.
Date : March 15, 1960

Given the detailed dimensions, allowable stresses and loadings, this program designs a symmetrical, simple span, interior or fascia, welded composite plate girder according to AASHO 1957 Specifications. The live load may be either standard AASHO or a special loading as described in the write-up. Web depth and thickness and flange widths are not variable along the span.

The girder is designed by means of the standard formulas for moment and shear in a composite beam making use of a series of incrementation and decrementation loops. The program is so written that either theoretical thicknesses of top and bottom flange plates may be determined at (a) specified cut-off points, (b) all tenth points along the span, or theoretical cut-off points may be determined at which the bottom plate thickness can be reduced to a specified ratio of its maximum value at mid-span.

The program will not design a riveted composite plate girder. Girders must be parallel and the web depth constant.

Input consists of span and spacing of girders (also overhang if fascia girder); steel web depth, flange widths and minimum thicknesses at support; concrete deck dimensions; elastic moduli and allowable stresses in bending and shear; loading details and shear connector capacity; cut-off options.

Output consists of steel web thickness; steel top and bottom flange thicknesses at mid-span and cut-off or tenth-points, with accompanying moments and stresses; shears, web stiffner and shear connector spacings and horizontal shear stresses for weld design at junction of web and flange plates; reaction data; dead load cambers and live load deflection ratio; concrete and steel quantities.

Operating time varies from about 30 minutes for a girder designed with two cut-off points in the half-span to about 50 minutes for one with all tenth-point computations. Running time is also dependent upon the proximity of the trial flange plate thickness at mid-span to the final design thickness.

Off-line preparation of input data by flexowriter is possible but, for the small amount input data required, little time is saved.

ABSTRACT OF USERS' PROJECT NO. 451

TITLE:	AROWA FLITOWRITER-1 (Flitowriter)
MODE:	Machine Language
ORIGINATOR:	US Navy Weather Research Facility Building R-48 Naval Air Station Norfolk 11, Virginia
DATE:	29 February 1960 Class 1

This routine, which is an appendix to Flit (UP No. 378), permits the programmer to prepare a machine language tape of his program on off-line equipment, specifically a Friden Flexowriter of a type designed to be compatible with the G-15 computer. This tape may contain (modified) standard decimal commands and sexadecimal constants. Decimal constants cannot be entered by this routine.

Standard commands are punched on the Flexowriter in the following format:

LL	tab	P.TT.NN.C.SS.DD	tab	LL	tab	P.TT.NN.C.SS.DD	carriage return
/LL	tab	P.TT.NN.C.SS.DD	tab	LL	tab	P.TT.NN.C.SS.DD	carriage return
/LL	tab	P.TT.NN.C.SS.DD	tab	LL	tab	P.TT.NN.C.SS.DD	carriage return

etc.

The prefix P must always be typed at the Flexowriter, and has the value u, v, w, or x depending on whether the command is immediate or deferred, and whether it is to be inserted only if LL contains zero, or is to be inserted regardless of the prior content of LL.

Sexadecimal constants are punched at the Flexowriter in the following format:

LL	tab	F.HHHHHHH	tab	LL	tab	F.HHHHHHH	carriage return
/LL	tab	F.HHHHHHH	tab	LL	tab	F.HHHHHHH	carriage return

etc.

The prefix F must always be typed at the Flexowriter, and has the value y or z, depending on whether the constant is to be inserted only if LL contains zero, or is to be inserted regardless of the prior content of LL.

Though shown separately here, commands and sexadecimal numbers may be intermixed in any order. Note that a reload code or slash (/) must follow each pair of entries. Not more than 54 entries, or 27 pairs of entries, may be entered on a single block of Flexowriter tape.

Flitowriter makes use of constants and subroutines borrowed from Flit, so that the latter must be stored in memory when Flitowriter is in use. The assembled program can be either punched out, or transferred to any line in memory. No auxiliary equipment is needed other than the Flexowriter.

USERS' PROJECT NO. 452

ABSTRACT

Reinforced Concrete Pipe Design

(Intercom 1000 - Single Precision)

This program computes the circumferential steel area and perimeter required in reinforced concrete pipe conforming to the American Water Works Association Standards for reinforced concrete water pipe--steel cylinder type, not prestressed (AWWA C300-57) and reinforced concrete water pipe-noncylinder type, not prestressed (AWWA C302-57). The design procedure is based upon the Olander theory of load distribution outlined in "Stress Analysis of Concrete Pipe", H. C. Olander, Engineering Monograph No. 6, United States Department of the Interior, Bureau of Reclamation, October 1950, and "Example 8, Rectangular Section, combined bending and axial load (Tension)", Reinforced Concrete Design Handbook, American Concrete Institute, Second Edition, 1955, page 9.

A B S T R A C T

USERS' PROJECT NO. 453

Class 1

INTERCOM DP CARD INPUT AND CARD LOADING ROUTINE

ORIGINATOR: Wayne O. Daigh, Director of Computer Applications

ADDRESS: Wyoming Highway Department, Cheyenne, Wyoming

MODE: Double Precision

EQUIPMENT AFFECTED: G-15, CA-2

DATE: February 29, 1960

PURPOSE: To provide a rapid and accurate means for the preparation of intercom commands and preparation of punched tapes.

METHOD: Hollerith cards are keypunched and verified direct from programmers' code sheets.

INPUT: Card format is arranged for input using CA-2 test control panel, eliminating the necessity of an additional control panel.

OUTPUT: Routine prepares loader with which program may be loaded using only enable p, then turning compute switch to GO. Control is then returned to intercom.

A B S T R A C T

USERS' PROJECT NO. 454

Class 1

CA-2 Data Output Conversion Subroutine

ORIGINATOR: Wayne O. Daigh, Director of Computer Applications

ADDRESS: Wyoming Highway Department, Cheyenne, Wyoming

MODE: Machine Language, Single Precision, Subroutine

DATE: January 20, 1960

PURPOSE: To provide a means of zero printing from alphabetic type bars on IBM 402 or 403

METHOD: Binary coded decimal data is converted for 6 bit format control. Significant zero digits are replaced with "alphabetic" zeros.

INPUT: $\pm$ Binary coded decimal in AR.

OUTPUT: Absolute value in PN_1 and PN_0. Routine will not retain sign.

Abstract of Users Project No. 455
Class 1

Title: AREA INTEGRATION ROUTINE

Originator:	Bucyrus-Erie Company
Address:	South Milwaukee, Wisconsin
Mode:	Machine Language
Date:	December 4, 1959

The Area Integration Routine (hereafter referred to as AIR) is a single precision, fixed point, basic machine language program for the Bendix G-15D Digital Computer. No accessories for the computer are required. The input consists of a series of point descriptions which describe the perimeter of some plane figure. The perimeter may be composed of any combination of straight lines and arcs of circles. The output is as follows:

(a) The location of the centroid of the given figure.
(b) The moments of inertia, section moduli, and the radii of gyration of the given figure about lines parallel to the x and y axes and through the centroid of the given figure.
(c) The polar moment of inertia of the given figure about the centroid.
(d) The area of the given figure.

An intermediate output also gives the following information:
(a) The area of the given figure.
(b) The first moments of the given figure about the x and y axes.
(c) The second moments (inertia) of the given figure about the x and y axes.

Both input and output are through the typewriter. The program can integrate any figure or combination of figures which can be contained in a square area one thousand units by one thousand units. There are provisions for placing holes which are bounded by any combination of straight lines and arcs of circles in any of the given figures.

USERS' PROJECT NO. 456

ABSTRACT

FOURIER COEFFICIENTS (IMPROVED PROGRAM)

Acknowledgement is made to H. Briar of the Dow Chemical Company, Williamsbrug, Va., Users' Project #314, for the original idea for this program.

However, it was found that by using Simpson's method of integration, and certain other minor changes, it was possible to greatly increase the accuracy of the program, and at the same time increase the speed.

Data input consists of not more than 181 values of f(θ), valued at evenly spaced points over the θ axis. Output consists of the Fourier coefficients of a series approximating the original data. Time required is five minutes per pair of coefficients for 181 values of f(θ), one minute for 37 values of f(θ).

Prepared by
R. L. Watson
Bendix Radio Division
Baltimore 4, Md.

U. P. #457
ABSTRACT

RIGID FRAME ANALYSIS

This program calculates moments and reaction under any combination of uniform and concentrated load conditions for spans, cantilevers and columns of a structure, a single story at a time.

The program has a limitation of a minimum of 2 spans and a maximum of 18 spans with cantilevers on both right and left ends. Each member may have different dimensions and loadings. Story heights above and below remain fixed throughout the computation, but the column above may be omitted at any or all joints and a small non influenceing column dimensions may be entered for "column below" entries if no column is present. Each span may have multiple loadings, the only restriction being 40 load conditions for entire problem under analysis.

Input required consists of the breadth and depth of beams and columns, span length, height of story above and below, a "cantilever left" signal, live and dead loads and a signal to indicate whether the load on the span is concentrated or uniform, and a signal to indicate the last load on each span. Also the number of spans involved.

Output consists of maximum moments on cantilevers if there are any; maximum moment; reaction for max. mom.; dead load reactions; live load reactions at both ends; also max. and min. center moment. Max. and min. column moments for column above and column below complete the output.

The method is a three cycle application of Hardy-Cross moment distribution utilizing six different loading schemes to produce the requested moments and reactions.

Time requirements depend on the number of spans involved.

2 - 3 span input and output - 15 minutes
6 spans input and output - 50 minutes
12 spans input and output - 1 hour, 15 minutes

This entire program has been rewritten in POGO and for any problem over 4 spans we recommend the POGO version which is at least twice as fast.

Abstract for Users' Project No. 458

Title: DATA DISTRIBUTION ROUTINE

Class: 1

Mode: Intercom 1000 D (3121959)

Originator: W. P. Virgin and Hedy Knauer, Textile Research Institute

Date: March , 1960

The Data Distribution Routine is a program for determining the frequency distribution of data. The data must be on punched tape which has been prepared by Intercom 1000 D.

The program requires a type-in of the lowest and highest class marks, C_1 and C_2 respectively; the half-increment $\Delta C/2$*, and the number d of digits to be typed out for the class marks after the decimal point. C_2 must be chosen so that $C_2 = C_1 + p\Delta C$, where p is an integer less than or equal to 49. (p+1) is the number of classes. In other words, the maximum number of classes into which the data may be divided is 50.

The number n of tape blocks to be entered is typed into the program. In order to speed up the counting and searching process, n can be entered as positive or negative number. If n is positive, a switch is set so that zeros are counted as data words, whereas a negative sign sets a switch so that zeros are disregarded. Each block of tape is then read in and the number of data words in each class counted:

$$C_1 + (2\mu - 1)\Delta C \leq X < C_1 + (2\mu + 1)\Delta C \quad \text{where}$$

$\mu = 0, 1, \ldots, p$. Data words such that $X < C_1 - \Delta C/2$ or $X \geq C_2 + \Delta C/2$ are typed out. When all data tape blocks have been read in and searched, the program halts, ready for a new instruction. This may be an instruction to read tape or to go to the output section. The output section types out for each class: classmark, frequency, cummulative frequency, relative frequency, and cummulative relative frequency, the latter two rounded off in the fourth digit after the decimal point. After this information has been typed, the program computes and types: mean value, variance, standard deviation, and coefficient of variation (this one rounded off in the second digit after the decimal point). These statistics are computed from the original data, not from the grouped data.

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*One could think of programming this in such a way that ΔC is typed in and divided by 2 in order to obtain $\Delta C/2$. However this division gives only an approximation of $\Delta C/2$, whereas in this program the exact value of $\Delta C/2$ is needed. Therefore $\Delta C/2$ is typed in and multiplied by 2 in order to get ΔC.

Abstract 459
Users' Project

Class 2

Title: Capacity and Brake Horsepower Calculation for Large Compressor

Originator: Darrell Morrow

Address: Texas Gas Transmission Corporation, Owensboro, Kentucky

Mode: Machine Language (Auto Point 24 Subroutines)

Date: February 15, 1960

Summary:

This program will calculate and tabulate the Brake Horsepower and Capacity for a given size compressor engine under given suction and discharge pressures and clearance volumes. The information gained from this program can be used to design compressor cylinders, but it is primarily intended to be used in the preparation of loading curves for a large compressor engine. This program should be used for only single stage engines with compression ratios of 2.2:1 or less.

The following formulae were used in this program.

$$BHP/M^2 = A(R^B - 1) + C$$
$$R = P_d/P_s$$
$$Ev = D - Cl(R^E - 1) - FR$$
$$Z = 1.0034 - 1.6221 \times 10^{-4} P_s$$
$$Q_1 = (P_{disp})(P_s)(E_v)(.9584 \times 10^{-6})$$
$$Q_2 = Q/Z$$
$$BHP = (BHP/M^2)(Q_1)$$

BHP/M^2 = Brake Horsepower per million cubic feet of gas pumped @ 60°F, 15.025 psia.
P_d = Discharge Pressure, psia
P_s = Suction Pressure, psia
Cl = Per cent Clearance
Z = Supercompressibility
Q_1 = Capacity of Engine, uncorrected
Q_2 = Capacity of Engine, corrected for supercompressibility
E_v = Volumetric Efficiency
P_{disp} = Piston Displacement of the engine, ft^3/minute
R = Compression Ratio
BHP = Brake Horsepower @ 60°F, 15.025 psia

ABSTRACT OF USERS' PROJECT NO. 460

CLASS 1

Title: Real & Complex Roots of Polynomial Equations

Originator: K. Ellenberger
North American

Address: 12214 Lakewood Blvd.
Downey, California

Date: November 5, 1959

This program solves for the real and complex roots of polynomial equations by means of both Newton's and Bairston's Iteration procedures. The degree of polynomial cannot be greater than 30.

The program requires a G-15, CA-2, card reader and 402 printer. The routine uses the Intercard Interpreter and Intercard Log Package.

ABSTRACT OF USERS' PROJECT NO. 461
CLASS 1

Title: Determinant Expansion & Polynomial Root Extraction Program

Originator: T. Miller
K. Ellenberger
North American

Address: 12214 Lakewood Blvd.
Downey, California

Date: November 17, 1959

This program requires a G-15, CA-2, Card Reader, Line Printer and three Magnetic Tape Units and the system must be set up for Intercard.

This program has two main parts: the first will reduce the order of the determinant; the second will expand up to a tenth order determinant with polynomial elements of degree three or less.

Abstract of Users' Project No. 462
Class I

Title: Bending & Shear Mode Calculations by Frequency Choice Method

Originator: North American

Address: 12214 Lackewood Blvd.
Downey, California

Date:

This program requires a G-15, CA-2, Card Reader, Line Printer and one Magnetic Tape Unit. It computes the period of vibration of a variable inertia beam taking into consideration the shear and bending flexibilities. The beam is idealized into a searies of concentrated masses at finite points. It is assumed that no energy is lost from the vibrating system and that all points on the beam move in phase.

ABSTRACT TO USERS' PROJECT NO. 463

This material balance is a cumulative Schilthuis type of balance. The balance was designed primarily to provide 1) a means for analyzing reservoir behavior as a function of known production history and 2) a "report form" processor of predicted results gained by other means.

The balance may in addition be used for performance predictions where production can be specified. Such is the case in a closed undersaturated reservoir.

Six program entries are provided as follows:

Entry A. Water influx as a function of given pressure and production data is calculated. In a closed system this calculation indicates the quantity of water injection required to balance withdrawals at specified pressures.

Entry B. Entry B output is the amount of gas injection (at standard surface conditions) required to balance withdrawals at given pressures in a closed system or in a system where aquifer behavior is defined by external means.

Entry C. An average pressure is calculated at which the oil zone and gas cap will exist simultaneously as a result of specified withdrawals. This calculation is useful where a single average measured pressure must be specified each time period for analog simulation.

Entry D. A value for in-place oil at each time period is calculated as a function of measured pressures and productions. In-place free gas must be specified.

Entry E. Cumulative relative reservoir energies - solution gas, gas cap gas, and water drive indices - are calculated for each time period.

Entry F. The output consists of oil and gas volume factors at input oil zone and gas cap pressures.

A maximum of 32 data points may be entered. Calculations may be initiated at any time period (1 through 32) and halted at any period (2 through 32). An automatic halt is provided for in the event an end calculation period is not specified. If the initial calculation period is other than 1 or 2, the first line of output only will indicate meaningless water influx or gas injection rates. All other output factors are independent of the initial calculation period.

EQUATIONS AND NOMENCLAUTRE

The form of the material balance is as follows:

$$NB_{oi} + GB'_{gi} = (N-N_{pj})\ B_{oj} + (N-N_{pj})\ (R_{si}-R_{sj})\ B_{gj}$$

Original Hydrocarbon Volume = Remaining Oil + Released Solution Bas

$$-\ (G_{pj} - N_{pj}\ R_{si})\ B_{gj} + (G-G'_{pj})\ B'_{gj} + G''_{Ij}\ B''_{gj}$$

− Produced Free Gas + Gas Cap Volume

$$-W_{pj} + W_{Ij} + NB_{oi}C_e \quad P_j + W_{ej}$$

Net Water Production + Formation Expansion + Water Influx

Where:

$$C_e = \frac{C_w S_w}{1-S_w} + \frac{C_r}{1-S_w}$$

Note: Formation expansion is accounted for only in the oil zone.

and

$$P_j = P_i - P_j$$

Subscripts:

i = initial time
j = jth time

Superscripts:

' refers to gas cap gas
" refers to injected gas

Abbreviations:

CF - Cubic feet
M - Thousand
Psi- Pounds per square inch
RB - Reservoir barrels
STB- Stock tank barrels
D - Days

All other symbols conform to AIME standard symbols.

Cylindrical Shell Analysis Simplified by Beam Method

By

Portland Cement Association

October 1959

Abstract

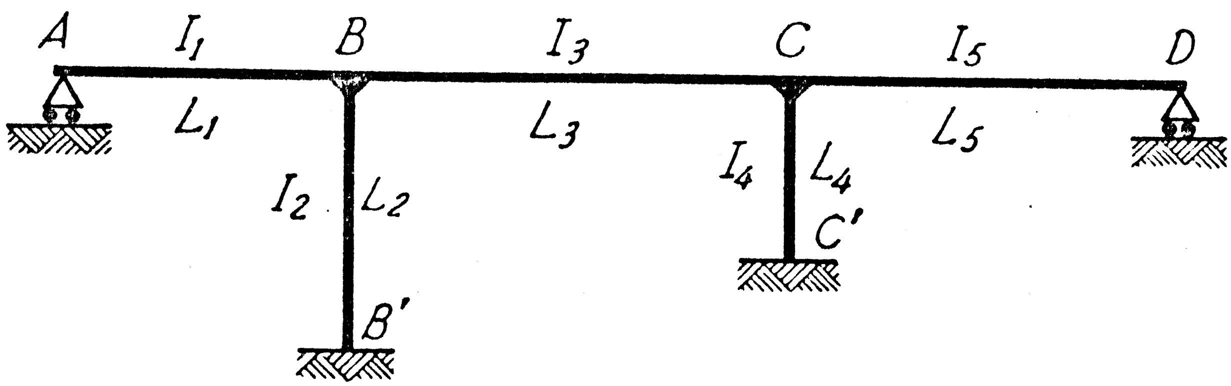
USERS' PROJECT NO. 464

This family of five programs can be supplied unit loads and dimensions to produce tables of internal forces in simple span cylindrical shells with r/ℓ smaller than 0.60. The programs will also solve for actual forces in individual designs which do not fit the tables already developed. A set of tables for the most useful parameters are included in the Appendix. Edge beams or unsymmetrical loadings are not included.

Internal forces in an individual design are computed in about three minutes. Intercom 1000D interpretative system is used.

Abstract of Users Project No. 465
Class 2

The General Condition



Title: 3 SPAN FRAME WITH 2 INTEGRAL COLUMNS

Originator: Palmer & Baker Engineers, Inc.
Address: P. O. Box 346, Mobile, Alabama
Mode: Intercom 1000S
Date: November 11, 1959

The program is coded for the Bendix G-15D Computer in Intercom 1000 Single Precision. A subroutine for Solution of Simultaneous Equations is included.

The structure analyzed is a three-span structure with two integral, fixed-base columns. The exterior supports are assumed to be free to translate horizontally. All members are assumed to be prismatic.

The input consists of the moments of inertia, which may be relative, and the lengths of all the members.

The program will compute the influence ordinates for all joint moments, shears and intermediate moments and summate the area under each influence line for each span. The machine time required is 1 3/4 hours, including input and output.

Slope Deflection Equations and Equations of Statics are solved simultaneously for each load position.

Abstract of Users Project No. 466

Class 2

Title: RAMP GEOMETRICS PACKAGE - "RAMPAGE"

Mode: Intercom 1000D (August, 1958)
Originator: Palmer & Baker Engineers, Inc.
Address: P. O. Box 346, Mobile, Alabama
Date: January 1, 1960

The geometric features of a ramp connecting two roadways are computed and typed out in columnar form. A number of different types of ramps are handled and are described separately herein. The basic roadway conditions prevail for all ramp types. Roadways may be straight or curved in either direction, and may be tapered at ramp terminal points.

Input information of bearings, coordinates and distances establishes the relative locations of the roadways and the ramp. Either radius or degree of curve may be entered for all curves, and bearings are entered as degrees, minutes and seconds. An autoloader and an automatic correction routine make it unnecessary for the operator to address the program at any time.

Output gives curve data for each ramp curve, coordinates of all curve control points, stationing of the ramp, roadway equation stations and bearings of ramp tangent lines. All output values are rounded, and angular values are expressed as degrees, minutes and seconds.

Only those types of ramps shown may be computed, and the sketch of the applicable ramp type must be oriented with a drawing of the problem. No elevations or spirals are considered.

The method of solution makes use of standard curve formulae (arc definition), oblique and right triangle solution, coordinate projection, trigonometric identities, inverse traverse and compound and reversed curve formulae.

Auxiliary equipment used: none

Subroutines used: square root; sin, cos; arc tan; fraction selector

Computation time: approximately eight minutes

ABSTRACT

USERS' PROJECT NO. 467

Title : Executive Game

Equipment Affected : G-15D, & Intercom 1000 D.P.

Prepared By : Pacific Union College
Angwin, California

The Executive Game simulates the operations of a multi-firm, single product manufacturing industry. The players act as top management officials of the several firms. They control their firms by making quarterly budgetary decisions. Using these decisions the computer prepares operating statements giving the condition of each firm. The relative well-being of each firm is based both on competition and on certain fixed standards. The details are given in the Instructions for Players.

Computation time is about 7.5n +6 seconds where n is the number of firms. Input time is about 40 sec/firm and output time is about 70 sec/firm.

The game was developed by the Graduate School of Business Administration, UCLA, where it is known as the UCLA Executive Game #2.

Abstract of User's Proj. 468

Class 1

Title: A POGO Service Routine

Mode: POGO

Originator: J. J. Longbottom
Ellerbe & Co. - St. Paul, Minnesota

Date: April 1960

This routine is designed as a service routine to handle the usual operations encountered in input preparation in conjunction with a Pogo coded program.

Since there is no convenient input mode in Pogo, it is necessary to provide every Pogo program with some type of input facility. Every input program essentially does nothing but store data in the proper location, therefore, this rather flexible routine was written to be used with all Pogo programs.

In essence, the routine provides the following:

1. Numeric typed input with verification stored anywhere in Channels 12 - 18.
2. Listing of stored data.
3. Read in of computer punched tape.
4. Read in of flexowriter punched tape.
5. Punch tape.
6. Read in to line 6, one channel of program tape, and a jump to location 600 to commence regular program. (All Ellerbe Pogo programs are self loading except for line 6). This eliminates need of the Pogo loader and the manual compute instruction.

The routine is loaded with P-go, after Pogo Magazine #3 has been read in. Each of the input/output operations is selected by a one word packed signal as follows:

9CHWDwd:

Enters data into channel designated by CH, starting with Word WD and ending with Word wd.

8000000:

Reads one channel of program tape and jumps to location 0600.

THEORETICAL CHEMISTRY LABORATORY
(FORMERLY U.W. NAVAL RESEARCH LABORATORY)
UNIVERSITY OF WISCONSIN
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MADISON 5, WISCONSIN

TELEPHONES:
ALPINE 5-4224 OR
ALPINE 5-3311 EXT. 3548

ABSTRACT OF USERS' PROJECT NO. 469

Title: Index Register Utilization, Sense Switch and Punch-Type Subroutines

Class: 1

Mode: Intercom 1000 D. P.

Originator: Stuart E. Lovell, University of Wisconsin Theoretical Chemistry Laboratory

Date: 15 April 1960

Index Register Utilization: This allows programmer to use index register values as floating point numbers and to set index registers from floating point numbers.

Sense Switch: This makes available three sense switches (one on an unmodified machine) to the Intercom 1000 D. P. programmer.

Punch-Type: Converts Intercom 1000 D. P. commands 30, 32, 33, 34 and 38 from type to punch commands and back again. This provides for more flexible format in Flexowriter output.

Note: All three of these subroutines are coded into the same channel, and may be added to the Appendix I subroutine magazine.

MEISSNER ENGINEERS, INC.

ABSTRACT OF USERS PROJECT NO. 470

TITLE: OFFSET ALIGNMENT INTERSECTIONS

ORIGINATOR: MEISSNER ENGINEERS, INC.
300 WEST WASHINGTON STREET
CHICAGO 6, ILLINOIS

CLASS: 2

MODE: INTERCOM 1000D.P.

DATE: JANUARY 8, 1960

DESCRIPTION: This program computes the coordinates and station of the intersection of two lines, and the Δ-angle from the P.C.'s to the intersection.

The program operates for any combination of tangents and/or circles.

The lines may be main alignments, or lines at some constant offset to the main alignments.

The program uses either arc, or 100 Ft. chord definition of curve.

Six (6) items of data define each alignment:

- N. Coordinate at a point on the alignment,
- E. Coordinate at a point on the alignment,
- Azimuth or Bearing at that point,
- Station at that point,
- Offset from centerline to line of intersection,
- Radius or Degree of Curve at Circular alignments.

A straight line may be defined by the coordinates of two points. All input data is typed out during computation.

Data may be input from Flex tape or from the typewriter.

Users' Project No. 471

ABSTRACT

TRAPEZOIDAL CHANNEL DESIGN

Class 1

This program allows the computation of the required end area, depth of flow, velocity, slope hydraulic radius, wetted perimeter and bottom width, in even feet, of a trapezoidal channel to carry a given quantity of water. Input data consists of the "Q" discharge in cfs; design v; sideslopes; channel roughness coefficient; aspect ration, or ratio of bottom width to depth of flow; and optionally the slope required to suit a field condition if known. In the latter data item, a 0 is entered if the slope is unknown or immaterial. Type-in is accomplished on the same form as type-out, and provision is made for successive problems by manipulating the Compute switch for breakpoint operation. Should the input data be such that no solution is possible within the given parameters the computer will eject the the data input sheet. Slope is computed using Mannings Formula. Program is written in Intercom 1000D, dated May 1, 1959, an Enable p loader reads in the tape and allows the type-in of each piece of data, after all data locations are entered the computer automatically begins computation without further commands. Operation and loading instructions are listed on the data input sheet, a blank copy of which is attached with the program to allow local reproduction that will suit the type-out format of the program.

Department of Highways
County of Cook
130 N. Wells Street
Chicago 6, Illinois

Abstract of Users Project No. 472

Class 1

Title: PULSE HEIGHT ANALYSER TAPE READER SUBROUTINE

Originator: McMaster University
Address: Hamilton, Ontario, Canada
Mode: Machine Language (S.P.)
Date: March 4, 1960

The Nuclear Data Pulse Height Analyser is a 256 channel instrument with a maximum count capacity of 99,999 per channel. Data output from this instrument is paper tape punched in four blocks of 64 channels. Punch out is in binary coded decimal. In order to minimize punching time each group of 4 channels is punched as 20 consecutive decimal integers with no channel identification or separation. Each such group of 20 digits is followed by a "reload" code punch and the next 20 digits from the next 4 channels. The "reload" code is replaced with a "stop" code and a tape leader after channels 63, 127, 191 and 255.

This subroutine will read the tape prepared by the pulse height analyser, separate the counts from individual channels, convert the data to standard floating point binary form and store it. The subroutine may be executed by means of commands 0808U3 or 0208U3 and will read four blocks (256 channels) of data from the pulse height analyser tape. It will store the data in intercom addresses 1000 to 1255 inclusive.

This subroutine uses 105 words of a storage line. Loader 2 of Intercom 500 will not accept subroutines extending past word 99. The routine has, therefore, been written to include the conversion constants of line 08 (words U0 and U1) of Intercom 500 so that it may be attached to the basic package ahead of loader 2 and read in automatically to line 08 by means of appropriate changes in loader 1.

If desired, the subroutine may be stored in any other available memory line leaving line 08 free for the selective print subroutine. To obtain a copy of this subroutine, punch line 08 on tape immediately after loading Intercom 500. (390800) This tape may then be read into any desired line (55CH00) and entry made by 08CHU3 or 02CHU3. Note, however, that in this case the index register in line CH must not be used.

It should be noted that execution of this subroutine destroys the contents of the A Register and the Index Register Accumulator.

Abstract of Users Project No. 473
Class 2

Title: HYDROLOGIC MASS CURVE ANALYSIS

Originator: Tippetts-Abbett-McCarthy-Stratton
Address: 375 Park Avenue, New York 22, New York
Mode: Intercom 1000 S.P.
Date: May 1, 1960

1. DESCRIPTION

This program was written to determine the volume of storage required in a reservoir to meet certain predetermined demands. Based upon historical records of mean monthly inflow, the program will compute the reservoir storage capacity required to satisfy a given monthly demand rate which may vary from month to month. The historical record may cover a period of from two to seventy-five years, complete for each month of each year. The program will operate for any consistent set of inflow data in either English or metric units of volume per second.

The program is primarily one of the data processing type whereby inflow and outflow for each month are compared until a period of drawdown is reached. Deficiencies and surpluses are then accumulated until a balance is reached. The acculated deficiency equals a storage requirement. The maximum storage requirement is stored for output. Evaporation and seepage losses are not considered by the program but may be estimated and added to the demand rates, either on the first run or on a succeeding run after maximum requirement has been computed. The program was written either for input from tape prepared on a Flexowriter or by manual entry from typewriter.

2. INPUT

Input consists of the following data:

a. Numerical values identifying the data to be processed by blocks, dates and system (English or Metric).

b. Mean monthly inflow data for each month of the total number of years of record available.

c. Mean monthly demand rates for 12 consecutive months.

3. OUTPUT

The output typeout consists of the required volume of the reservoir in units compatible with the input, the date (month and year) drawdown begins and ends, and the required time for replenishment in months.

4. OPERATING TIME

Operating time is approximately a straight line variation depending upon the years of record processed, the last year taking slightly more than any other year. The average computation time for one year is three minutes.

Abstract of Users Project No: 474
Class : 1

TITLE: INTERRUPTION AND DUMP OF INTERCOM 1000 DP PROGRAM

ORIGINATOR: National Research Council of Canada, Ottawa
Mode: Machine Language
Date: May 4, 1960.

ABSTRACT: With an Intercom 1000 DP program running on the G.15, arrange to interrupt the program and dump on magnetic tape using MTSR. On reloading, the program will carry on automatically from the point of Interruption. Intercom and the interpretive memory will have been restored to their original conditions. The Intercom referred to is that of A. Sect.Project No. 83, or check sum .3121959.

EQUIPMENT AFFECTED:
G.15D, 1 MTA-2

STORAGE LOCATIONS USED:
Lines 05, 19 and unused locations in Intercom 1000.

DISCLAIMER:

No responsibility is assumed by National Research Council of Canada for any errors or misrepresentations that may occur as the result of using this program. No responsibility is assumed by the Bendix Computer Division for the correct reproduction of this program.

ABSTRACT OF USERS PROJECT NO. 475

Class 1

TITLE: SORTING AND TABULATING REPRODUCTION CHARGES

ORIGINATOR: Reynolds, Smith & Hills
Architects & Engineers

ADDRESS: 227 Park Street, Jacksonville, Florida

MODE: Machine Language (S.P.)

DATE: May 15, 1960

This program accepts typed-in data from charge slips accumulated by the reproduction department for various sizes and types of blue printing, etc. Input from each charge slip is in the form:

A (tab) B (tab) C (tab) D (tab) E
A = Any 1 to 7 digit job number
B = Number of drawings to be printed
C = Number of prints required of each
D = Size code refering to a standard list of print sizes
E = Cost of work (typed by computer)

As the cost is being typed it is also being accumulated in memory in a list of up to 108 job numbers which are arranged in numeric order. Only job numbers which are entered are placed in the list. Input may be in random order of job number and the number of slips processed is unlimited. After 108 different job numbers have been placed in the list, subsequent new job numbers will not be accumulated or added to the list. However the typed output will be flagged to notify the operator of this condition.

After the data from all charge slips is entered a tabulation of total charges in ascending order of job number is typed. Next, two blocks of tape are punched containing the same data.

The output tapes from several runs of the program (up to 8) are processed to obtain a consolidated tabulation in numeric order. In this way the first part of the program may be operated for short periods as a fill-in job on the computer. The second part will combine the results of these runs to give a monthly report as required by the accounting department.

An interesting feature is that the time required for the sorting of job numbers requires only 1 to 14 drum cycles for each charge. Thus the program is completly input-output limited. The sorting routine may be easily lifted out of this program for use as a subroutine.

This program is written for the alphanumeric typewriter. However instructions are given for easily modifying to numeric output only.

Abstract of Users' Project # 476

Title: Multiple Intersections of Circles and Lines.

Class: 1

Mode: Intercom 1000D

Originator: Cook County Highway Department.

Date: 3 May, 1960

This program will give the solution of up to 18 different line and circle intersection problems. The line is defined by the coordinates of a point on the line and the azimuth of the line. The circle is given by the coordinates of the center and the radius. It is written in Intercom 1000D and contains an automatic P loader and data entry program. The data entry part of the program provides for entry of successive problems, requiring entry only of those items that are changed from the preceding problem, and providing for correction of the last item entered. There is also provision for placing different problems or groups of problems on separate sheets of paper if continous paper, 8 1/2" by 11", is used.

The typeout includes the original data, the two points of intersection, the distance from these points to the point given on the line, and the azimuth from the center of the circle to these points. A special typeout indicates those cases that have no real solutions. The angle typeouts are coded in "Lincoln Form" as one number; i.e. DD.MMSS SSSSS.

The running time is about one minute per problem.

ABSTRACT OF USERS PROJECT NUMBER: 477
CLASS:
TITLE: 6 ALPHANUMERIC ROUTINES
ORIGINATOR: POMONA COLLEGE
ADDRESS: CLAREMONT, CALIFORNIA
DATE: APRIL 1960

THIS PROJECT CONTAINS THE SIX FOLLOWING ROUTINES:

1. AN ALPHANUMERIC DEMONSTRATION ROUTINE.

2. A ROUTINE FOR STORING ALPHABETIC MATERIAL ON MAGNETIC TAPE. THIS IS TO BE USED WITH THE MAGNETIC TAPE SERVICE ROUTINE. (SEE APPLICATIONS SECTION: PROJECT NUMBER 61)

3. 4. 5. ROUTINES FOR ENABLING ALPHABETIC CHARACTERS TO BE TYPED OUT USING INTERCOMS 1000 DOUBLE PRECISION, 1000 SINGLE PRECISION, AND 500X.

6. A ROUTINE FOR ENABLING A FULL ALPHANUMERIC STATEMENT TO BE TYPED OUT USING INTERCOM 500X.

TITLE: 12 x 12 DETERMINANT EVALUATION

ORIGINATOR: National Research Council of Canada.
DATE: May 10, 1960
MODE: Intercom 1000 Single Precision

ABSTRACT:
The program computes the determinant of any matrix up to size 12 x 12. The method is reduction to upper triangular form.

INPUT: Enter matrix of coefficients as follows.

0700	0800	......	1806
0701	0801		.
0702	0802		.
.	.		.
.	.		.
.	.		.
0711	0811	.....	1811

Set word limit 4 and channel limit 4 to (N-1).

DISCLAIMER:
No responsibility is assumed by National Research Council of Canada for any errors or misrepresentations that may occur as the result of using this program. No responsibility is assumed by the Bendix Computer Division for the correct reproduction of this program.

Abstract of Users' Project No. 479

FIXED AND FLOATING POINT OUTPUT ROUTINE

For Bendix G-15D Computer

M/L Single Precision

Class 1

Canadian Pratt & Whitney Aircraft Company, Limited,

P. O. Box 10, Longueuil, P.Q. Canada.

March 1960

The purpose of this routine is to provide a flexible and convenient means of output from the computer, and to relieve the coder as much as possible from the binary to decimal conversion, output format coding, and page format control tasks.

Entries are available for output of fixed point tabulating numbers, floating point data, or format control. Output is available off line on magnetic tape #3 or on line on the typewriter, or on punched paper tape. The routine is designed for maximum buffering; a complete line of output consisting of one to seven words can be printed, punched, or written on magnetic tape while computing proceeds.

The routine occupies lines 02, 05 and 06, and uses short line locations 21:01 03, 20:01 03, and 22:03.

BLL/jas
May 16, 1960

Abstract of Users Project No. 480
Class 2

Title: 2^n FACTORIAL DESIGN EXPERIMENT

Originator: Scientific De .gn Company, Inc.
Address: 2 Park Avenue New York 16, New York
Mode: Intercom 1000 (S.P.)
Date: December 1, 1 59

Given a designed experiment of n factors ($2 \leq n \leq 7$) with r replicates ($1 \leq r \leq 100$) at two levels each, the function of the 2^n FACTORIAL DESIGN EXPERIMENT program is to compute the main and interaction effects, their respective sum of squares, and the total corrected sum of squares (TSS). The experimenter assigns two levels for each factor and carries out r trials with each of the possible combinations of the levels of the factors. The results or responses of these trials are then arranged in a standard order with the replicates of each treatment combination being grouped together. Given three factors A, B, and C with respective levels (1), a, (1), b, (1), c, the standard order for A is (1), a. To introduce a second factor B, the level b is mutiplied by the preceding sequence of two to give a sequence of four, (1), a, b, ab. The level c of a third factor C is then mutiplied by the sequence of four giving a sequer of eight, (1), a, b, ab, c, ac, bc, abc. The extension to more factors is obvious. Thus, ab denotes a low level of C and a high level of A and B, whereas c denotes a high level for C and a low level for A and B.

Using these responses in standard order, with all replicates grouped together, the program computes the main and interaction effects, their respective sum of squares as well as the total corrected sum of squares. The Main Effect for each factor is the average change in response produced by a change in the level of the factor, whereas the Interaction Effect is the result when the effect of one factor is different at different levels of another. The program sums the replicates, if any, and performs a series of two operations on the summed responses which are regarded as sets of two. These operations of summing and differencing introduced by Yates are carried out n times and are explained in the program description. The effects and their respective sum of squares are then rearranged in groups of main effects, two factor interaction effects, three factor interaction effects, etc. A complete output format is found in the description of the program.

The operating time of this program for n factors and r replicates is shown in the following table:

Input:	$3 \cdot 2^n$ seconds
Calculations:	$1.4(n \cdot 2^n)$ seconds
Output:	$2^2 .11n$ seconds

A complete description of the principles involved in factorial experiments may be found in DESIGN andANALYSIS of INDUSTRIAL EXPERIMENTS, ed. Owen L. Davies, New York, Hafner Publishing Company, 1956.

ABSTRACT
USERS' PROJECT NO. [illegible]
CLASS 1

HEXY - HEX DEBUGGER

ORIGINATOR	WESTERN ELECTRIC CO., INC.
ADDRESS	P.O. BOX 900, PRINCETON, N.J.
MODE	MACHINE LANGUAGE, G15D
DATE	17 MAY 1960
PURPOSE	TO AID IN THE DEBUGGING OF DIRECT MACHINE LANGUAGE PROGRAMS. IT ALLOWS INTERROGATION OF THE MEMORY, INSERTION OF INFORMATION INTO THE MEMORY, AND ALSO MAKES AVAILABLE SPECIAL TECHNIQUES FOR INTERROGATION OF THE TWO-WORD REGISTERS.
INPUT	ALL ENTRIES INTO THE COMPUTER MUST BE HEXADECIMAL NUMBERS, INCLUDING MLTT, WHERE ML IS THE MEMORY LINE, AND TT IS THE WORD LOCATION.
MEMORY ALLOCATION	THIS ROUTINE USES ONLY LINE 19. ALL OTHER MEMORY IS EITHER UNCHANGED OR PRESERVED AND RESTORED UPON EXITING FROM THE ROUTINE. THIS FEATURE MAKES THIS ROUTINE VERY GOOD FOR DEBUGGING.

Abstract of Users Project No. 482

Title:	CROSS-CORRELATION FUNCTION
Class:	1
Originator:	Calif. Inst. of Tech.-Seismology Lab.
Mode:	Pogo
Date:	May 4, 1960

The cross-correlation function of two time series, X_s and Y_r is calculated from the formula:

$$f(p) = \sum_{s=1}^{[n, m-p]} X_s \cdot Y_{s+p} \qquad p \geq 0$$

$$f(p) = \sum_{r=1}^{[m, n+p]} X_{r-p} \cdot Y_r \qquad p > 0$$

$$\begin{cases} X_s \ (X_1, \ldots\ldots, X_n) \\ Y_r \ (Y_1, \ldots\ldots, Y_m) \end{cases}$$

where $[a, b]$ denotes the smaller of the two numbers a and b.

Abstract of Users Project No. 483

Title:	RAYLEIGH WAVE DISPERSION - 20 LAYERS
Class:	1
Originator:	Calif. Inst. of Tech. -Seismology Lab.
Mode:	Intercom 1000D
Date:	May 4, 1960

The matrix iteration method of Haskell (Bull. Seismol. Soc. Amer., 43, pp. 17-34) is used to compute the period, group velocity and ratio of surface horizontal to vertical particle motion for specified phase velocity of Rayleigh waves. A maximum of 19 layers lying on a solid half-space may be used. A surface liquid layer may also be included.

An automatic modified version of this program with a time-saving of approximately 1/3 will be available shortly.

Abstract of Users Project N. 484

Title: LOVE WAVE DISPERSION - 40 LAYERS

Class: 1

Originator: Calif. Inst. of Tech. -Seismology Lab.

Mode: Intercom 1000D

Date: May 4, 1960

Haskell's matrix iteration method (Bull. Seismol. Soc. Amer., 43, 17-34) is used for the computation of the period, group velocity, and specified phase velocity of love waves. In addition a second program on the tape can be used to compute the above quantities and the horizontal displacement ratio of layer interfaces to the free surfaces. A maximum of 39 solid layers lying on a solid half-space may be used.

Abstract of Users Project No. 485

Class 1

TITLE: ALPHANUMERIC INPUT/OUTPUT ROUTINE

ORIGINATOR: E. I. du Pont de Nemours & Co., Inc.
Eastern Laboratory, Gibbstown, New Jersey

MODE: Machine Language Subroutine for Intercom 500 or Intercom 1000 D.P. and Alphanumeric Typewriter.

DATE: June 7, 1960

The project consists of one sub-routine each for Intercom 1000 D.P. and Intercom 500. The two routines differ in coding but are identical in operation. For either Intercom system, the routine may be stored in words 00-99 of any line of the interpretive memory.

Alphanumeric input or output is executed by means of a sequence of two Intercom commands which may occur consecutively in a program or may be entered consecutively at the typewriter. If the routine is stored in Line CH, the first command is 02CH00, which patches Intercom to permit interpretation of the second command, which will remove the patch. The second command has the form:

K 00 CHWD Permit input of alphanumeric information at address CHWD, as modified by the contents of index register K.

K 01 CHWD Type out alphanumeric information beginning at address CHWD, as modified by the contents of index register K.

The input routine types the beginning address and prepares for alphanumeric input. Line 19 is continuously monitored during input and a bell rings at each reload to indicate the four words have been stored in memory. At the end of input, the last address used is typed out.

The output routine re-assembles the information in Line 19 and types it out. If the length of the alphanumeric item is more than enough to fill Line 19, the typeout is started and the computer continues to fill Line 19 while the typeout is in progress. Thus an item to be typed is not limited to one line of memory.

Provision is made for correcting errors in alphanumeric information which do not involve changing the number of characters, such as typing or spelling errors, without re-typing the entire item.

Abstract of Users' Project # 486

Title: Intersection of Two Lines -- Multiple Input

Class: 1

Mode: Intercom 1000D

Originator: Cook County Highway Department.

Date: 16 May, 1960

This program will give the solution of up to 15 different intersection of two line problems. Each line is defined by the coordinates of a point on the line and the azimuth of the line. It is written in 1000D and contains an automatic P loader and data entry program. The data entry part of the program provides for entry of successive problems, requiring entry only of those items that are changed from the preceding problem, and providing for correction of the last item entered. There is also provision for placing different problems or groups of problems on separate sheets of paper if continous paper, 8 1/2" by 11", is used.

The output gives the complete geometry of the triangle formed by the two given points and the intersection. This consists of the coordinates, the lengths, and the azimuths in systemmatic order. Those problems with no solution, that is two parallel lines, have the indeterminate items in this format filled by 77.7's as a code. The angle typeouts are coded in "Lincoln Form" as one number; i. e. DD.MMSS SSSS.

The running time is about one minute per problem.

ABSTRACT OF USERS PROJECT NO. 487

Class 1

Title: Subroutine for conversion of floating point data from single to double precision.

Originator: M. Mack, Philips Laboratories, Irvington-on-Hudson New York

Mode: Machine language subroutine for use with Intercom 1000D

Date: 3/2/60

This subroutine converts two floating point single precision numbers with the Intercom 1000S or 500X format into corresponding double precision numbers suitable for input to the Intercom 1000D system. Input consists of two single precision numbers in the "A" register (21.00-01) and output is two double precision numbers in words 00-01 and 02-03 of line 19. The subroutine is executed by an 08 op code and time required is approx. three drum cycles.

OPTICAL DESIGN DEPARTMENT

Program Abstract

User's Project No. 488

Title: Meridional Raytrace with Astigmatism, RT-3.

Class: 2

Equipment and Mode of Operation: G-15D, (Flexowriter optional).

Originator: Optical Design Department, A.&O. Div., Eastman Kodak Co.

Program Description: The program will trace paraxial and meridional rays through a system of spherical or plane surfaces. The astigmatic foci may be calculated for any meridional ray at the discretion of the operator.

Input Data:

Lens data: Number of surfaces, surface curvatures, refractive indices of elements and surface separations.

Ray data: Two quantities must be given to define each ray. There are two options:

1) Height of ray in vertex plane of first surface and slope angle of ray in degrees.
2) Normal distance from first surface vertex onto ray and sine of ray slope.

Output:

3 options: One, three or six quantities per surface with closing data in image plane.

Limitations:

Maximum number of surfaces = 26
Maximum refractive index < 8.0
Maximum linear distance < 10.0
Maximum surface curvature < 10.0 (i.e. minimum radius > 0.1)

Operating times:

Meridional ray without astigmatism: 1.6 sec/surface.
Meridional ray with astigmatism: 2 sec/surface.
Note: with output of 3 or 6 quantities per surface the operating speed is limited by the typewriter speed.

DESIGNER	ASSIGN.
COMPUTER	
DRAWING BY	DATE

AO 778

USERS' PROJECT NO. 489
ORIGINATOR: STANLEY ENGINEERING COMPANY
PROGRAM TITLE: BUILDING HEAT LOSS PROGRAM

CLASS: 2
MODE: 1000-S

PART I - ABSTRACT

A. This program, given the temperature differences, coefficients and dimensions for a room, will compute heating and ventilating requirements for that room. Infiltration air volumes and heat losses are computed by either or both the crack and air change methods. Ventilation air volumes and heating requirements are computed by any or all of the following methods: Cfm per sq. ft. of area, Cfm per person, and air changes per hour. A summary for all the rooms in a building is also provided.

B. Input for each room is:

1. Room number.
2. Transmission: surface dimensions, temperature differences and coefficients, edge length and coefficient.
3. Temperature difference outside air to inside air for ventilation and infiltration.
4. Infiltration: air changes per hour and/or crack length and coefficient.
5. Ventilation: (a) Air changes per hour, and/or
   (b) Number of people and Cfm per person, and/or
   (c) Cfm per sq. ft. of area.
6. Room dimensions for volume.

C. Output for each room is typed on one line as follows:

1. Room number.
2. Transmission: heat loss (including edge loss).
3. Infiltration: air volumes by crack and air change methods.
4. Total of transmission plus each infiltration heat loss.
5. Ventilation: (a) Air change method - room volume, Cfm required and heat loss;
   (b) Occupancy method - Cfm required and heat loss;
   (c) Area method - room area, Cfm required and heat loss.

D. The items in C. above are totaled and typed for the building summary. The total transmission loss is added to the largest of the ventilation losses and typed.

E. Limitations: Number of rooms unlimited; 13 transmission surfaces per room; 12 cubes per room (for volume computation); flexowriter input (can easily be converted for typewriter input). The transmission and volume data may be in different combinations; i.e., 8 volumes and 16 transmission surfaces.

F. Operating time: Approximately 80 seconds for average room.

MEISSNER ENGINEERS, INC.

ABSTRACT OF USERS PROJECT NO. 490

TITLE: GRID NORTH AZIMUTH OF A LINE FROM POLARIS OBSERVATIONS

ORIGINATOR: MEISSNER ENGINEERS, INC.
300 WEST WASHINGTON STREET
CHICAGO 6, ILLINOIS

CLASS: 2

MODE: DAISY

DATE: JUNE 7, 1960

DESCRIPTION: This program computes the Grid North Azimuth of a line when given the position of polaris, the mapping angle (Lambert or T. Mercator), the place and time of observation, and the vernier readings of a transit in a prescribed sequence.

A B S T R A C T

Users' Project # 491

Title:	MAchine LAnguage BAR Summarizer (MALABAR)
Originator:	Enelco Limited
Address:	164 Eglinton Ave. East, Toronto 12, Ontario.
Mode:	G15D Machine Language
Date:	June 1960

This routine accepts a flexowriter tape prepared in the form:

DDDD.ODD	TAB	DD-DD.DDD	CR
Quantity Bar size		Ft. Inches	

OR

DDDD.ODD	TAB	DD.DDDDD	CR
as above		Ft. & Decimals	

and sorts into the following form:

Bar #	Quantity	Length	Weight
2			
3			
.			
.			
.			
11			
			Weight

Machine time is about 2 minutes for 50 items and output takes about 30 seconds. Flexowriter tape for 50 items can be prepared in 20-30 minutes. Operator can usually transpose directly from bar schedules.

Abstract of Users' Project No. 492
Class 2

Title: ARITHMETIC INTEGRATION OF RESTRICTED ORIFICE SURGE TANK

Originator: Tippetts-Abbett-McCarthy-Stratton
375 Park Avenue
New York, N. Y.

Mode: Machine Language

Date: June 15, 1960

This program performs the arithmetic integration required to determine the height of surge and check the stability of a restricted orifice surge tank of predetermined dimensions.

Given:

a. The reservoir elevation.
b. Initial "steady state" flow through the turbine and conduit.
c. Closure (or opening) characteristics of the turbine gates.
d. Length, cross-sectional area, and friction, entrance and bend losses of the conduit.
e. Cross-sectional area of the surge tank.
f. Cross-sectional area and efficiency of the restricted orifice.

The program will tabulate the following values at a one second time interval for the period during gate closure (or opening); and at a five second interval, and whenever a maximum or minimum water surface elevation occurs in the surge tank, for the remainder of the computation.

a. Elapsed time.
b. Flow in the conduit.
c. Flow through the turbine in conformance with c. above.
d. Water surface elevation in the surge tank.
e. The head differential producing flow through the restricted orifice.
f. The piezometric head in the conduit below the restricted orifice.
g. The velocity in the conduit.

The program will operate in either English or Metric units. Forty-five seconds are required to tabulate five seconds of output data.

LEDEX INC.

Formerly G. H. Leland Inc.

123 Webster Street · Dayton 2, Ohio

TWX DY 169

BAldwin 4-9891

ABSTRACT OF USERS PROJECT NO. 493

CLASS One

TITLE: Intercom X-500 Lister
ORIGINATOR: Ledex Inc.
ADDRESS: 123 Webster Street
Dayton 2, Ohio
MODE: Machine Language
DATE: June 15, 1960

This program will list all Intercom X-500 commands stored in any channel of the computer's memory (09-18).

Input is the starting location of the channel to be listed (four or three digits). The program will come to halt in order to replace the paper. It will also halt after 26 commands (standard form) have been listed.

The loader includes instruction information for alphanumeric typewriters.

The listing is of the form:

.LLLL .K .cccc (.0900 .4 .1325) and the speed is 17 lines per minute.

PROGRAM BY George Papaiconomou

Abstract of Users' Project No. 494
Class 1

Title: SIMPLE PROGRAM QUESTIONING ROUTINE (SPQR)

Originator: University of Delaware
Address: Box 239, Newark, Delaware
Mode: Machine Language
Date: June 27,1960

For greater convenience in debugging operations the Simple Program Preparation Routine (Applications Section Project No. 57) has been modified as follows:
(1) two entry points have been provided to make operation independent of the state of the "Test" flipflop CQ at the point reached in the program being debugged and, if CQ is set when SPQR is entered, the location-of-next-command information stored in 00.u7 by M is appropriately modified so that the correct branch is taken on return to the program;
(2) any non-standard AR format composed of no more than 9 format characters is saved and can be readily restored before return; and
(3) removal of an existing breakpoint or insertion of a new one are effected by the same simple procedure.

Changes (1) and (2) are one-shot preliminaries and do not encroach on non-erasable memory. Change (3) is made at the expense of the bell which warns of storage in a location already occupied.

Operation is essentially the same as for Applications Section Project No. 57.

Users' Project No. 495
Class: 2

Title: Orthogonal Polynomial Curve Fitting

Originator: Bendix-Pacific
Bendix Corp., North Hollywood, Calif.
Mode: Intercom 1000 DP
Date: June 3, 1960

Problem: Fit n equally spaced points to a polynomial

Range: Degree $1 \leq m \leq 5$
Points $m + 1 \leq n \leq 50$

Abstract: The operator enters n, x_1, x_n, the n points, and the desired degree. The coefficients of the polynomial are typed out in both fixed point and floating point form. An error routine then types out the x's, the given ordinates, the computed ordinates, and the deviation from the given ordinate. The computed midpoints between the given points are also typed out for reference.

Storage locations used: All available memory is used, except locations 1736 thru 1749 incl.

Disclaimer

Abstract of Users Project No: 496
Class: 1

TITLE: EVALUATION OF A DEFINITE INTEGRAL

ORIGINATOR: National Research Council of Canada.
DATE: May 17, 1960
MODE: Intercom 1000 Double Precision (.3121959)

ABSTRACT:

The program computes the integral of a function between given limits using a Gaussian Two-Point Formula.

INPUT: Enter a subroutine to compute the function f(x), the lower and upper limits of integration x_o and x_1, and n (even) the number of intervals desired.

DISCLAIMER:

Abstract of Users' Project No. 497
Class 2

Title: GEOMETRY PROGRAM WITH FILING OPTION

Originator: Reynolds, Smith and Hills
Address: 227 Park Street, Jacksonville 1, Florida
Mode: Machine Language
Date: May 9, 1960

This program was written to encompass problems which involve the geometry of straight lines. These problems are frequently encountered in solving subdivision layouts and bridge and roadway problems.

An additional feature, which has proved very useful in carrying out many sets of computation within a single large problem is the formation of a file. The file is essentially stored locations for sets of coordinates and bearings which is saved on tape for future use. These filed quantities may be used many times in the computations by referring to a code number which will identify the set of coordinates or the bearing and draw them from the file for use.

The program will compute an infinite number of traverse courses in which no unknown distances or bearings occur. When an unknown appears in one of the traverse courses, coordinates to the point of the first unknown course are computed and typed out, the latitudes and departures are then calculated and summed for the remaining known courses but are not typed out. The unknowns are then computed and now, since all traverse courses are known, a type out of the traverse continues. If a traverse contains unknown distances or bearings, a maximum of 34 courses may be entered after the first course containing an unknown. The maximum number of unknowns per problem is two.

Input is in the form of a data tape prepared on a flexowriter. The data tape contains a reference number, which is compared with the reference number of the file in memory, a traverse number for identification of the problem, starting coordinates or a code number if the starting coordinates are in the file, and distances and bearings which represent the traverse courses. Unknown quantities or quantities drawn from the file are flagged. Input to the interpreter program is via type in of numeric codes.

The output has the optional feature of alphanumeric or straight numeric type out, the option being determined by the position of the punch switch. Problems containing all known traverse courses or unknown courses are printed in the following way. After the identifying reference number and traverse number are typed, the starting coordinates are typed. Then the distance, bearing, and bearing code of a traverse course is typed. The next line of output is the x coordinate, y coordinate, and station code. The continuation of courses followed by the coordinates which are computed from the traverse courses, are printed until the end of the problem is reached.

ABSTRACT OF USERS PROJECT NO. 497

Auxiliary Routine No. 1

Class 2

TITLE Geometry Program With Filing Option
Auxiliary Routine: Horizontal Curve Data Program

ORIGINATOR: Reynolds, Smith and Hills

ADDRESS: 227 Park Street, Jacksonville 1, Florida

MODE: Machine Language

DATE: September 12, 1960

This routine is designed to augment the basic geometry program in situations where circular curves are to be inserted at PI's of traverse lines. This routine and the basic program of intersection of straight lines and curves may be used alternately to work out horizontal alignment of interchange ramps where certain controls, such as specific radius and arc length, must be provided. Provisions are also made to subdivide arcs into specific parts, thus providing the information required in laying out lot dimensions around curves for land survey plats. In all cases complete curve data is provided.

This curve program uses the reference file which has been established by the main geometry program. Bearings and coordinates placed in the file are used by referring to their identifying code numbers.

Input data to the program is via tape prepared on an offline Flexowriter. Two types of data may be entered. The first type describes the curve; the two bearings of the tangents, the radius of the curve, and the coordinates of the center of the curve (Sta._0) or the coordinates of the intersection of the tangents (P.I. Station). The program computes the deflection angle of the curve, the tangent distance, the arc and chord lengths subtending the angle, and the unknown coordinates (Sta._0 or P.I. Station). Alphanumeric output is optional.

The second type of data, which is optional, subdivides the curve into parts; the input data are the desired fractional arcs or the corresponding chord lengths and codes for filing of the station coordinates.

The program computes the arc or chord length, whichever is unknown, the angle of the arc, and the coordinates at the terminal of the arc and chord.

A curve problem is calculated and printed with alphanumeric headings in 40 seconds. The number of curve problems is unlimited but the number of subdivisions is limited as follows. The number of subdivisions before the one unknown arc or chord is unlimited, but once the unknown is listed as input, the remaining number of arcs or chords may not exceed 18.

Abstract of Users Project No. 498

Class 1

Title: Spherical Bessel Function, $j_n(t)$, subroutine.

Originator: McMaster University (Theoretical Physics Group).

Address: Hamilton, Ontario.

Mode: Intercom 1000 (S.P.)

Date: July 19, 1960.

With t in the accumulator and the $\begin{matrix}\cos\\ \sin\end{matrix}\Big)$ - subroutine in Ch. 15, $j_n(t)$ may be calculated by reading this subroutine into Channel 17.

The order 28170n in position ADDR of the main program will put $j_n(t)$ into position 1790, (for n = 1, 2, 3, 4, 5) -. The program will then be returned to position ADDR+1.

This subroutine occupies all of Ch. 17.

Definition: $j\ (t) = (\frac{\pi}{2t})^{\frac{1}{2}} J_n+1\ (t)$

where J is an ordinary Bessel function.

$j_0(t) = \frac{\sin t}{t}$; $j_1(t) = \frac{\sin t}{t} - \frac{\cos t}{t}$; etc.

Abstract of Users Project No. 499

Class 1

Title: Spherical Hankel Function, $h_n^{(1)}(t)$ subroutine.

Originator: McMaster University (Theoretical Physics Group).

Address: Hamilton, Ontario.

Mode: Intercom 1000 (S.P.)

Date: July 19, 1960.

With t in the accumulator and the exponential subroutine in Ch. 16, $h_n^{(1)}$ (it) may be calculated by reading this subroutine into Channel 18.

The order 28180n in position ADDR of the main program will put $h_n^{(1)}$ (t) into position 1890, (for n = 1, 2, 3, 4, 5) -. The program will then be returned to position ADDR+1. This subroutine occupies all of Ch. 18.

Definition:

$$h_n^{(1)}(t) = j_n(t) + in(t)$$

$$h_o^{(1)}(it) = -\frac{1}{t} e^{-t}$$

$$h_1^{(1)}(it) = i\left(\frac{1}{t} + \frac{1}{t^2}\right) e^{-t}$$

etc.

LOCKWOOD, KESSLER & BARTLETT, INC.

ENGINEERS • SURVEYORS

ONE AERIAL WAY, SYOSSET, NEW YORK

WELLS 8-0600

USERS' PROJECT NO. 500

ABSTRACT

Title: Station and Offset
Category: Class 2
Mode: Intercom 1000 DP (. 3121959)
Originator: Lockwood, Kessler & Bartlett, Inc.
Date: July 29, 1960

The program consists of two independent parts.

Part I Station and Offset Along a Base Line

The coordinates x and y of the starting point on a base line, the station number of the point, and the bearing of the line are known. Determine; the station number along the base line and the perpendicular distance from the base line to a point of known coordinates.

Computation time; 5 seconds per point. A maximum of 22 points per solution can be entered as either typed or Flexowriter tape input.

Part II Station and Offset Along a Circular Curve

The coordinates x and y of the center of a circle, and the coordinates and the station number of the starting point on the circle are given. Compute; the station number along the curve, the radial distance from the curve to a point of known coordinates, and the bearing of the radial line.

Computation time; 9 seconds per point without bearing and 23 seconds per point with bearing. A maximum of 22 points per solution can be entered as either typed or Flexowriter tape input.

Input data for both Parts I and II may be located in any one of four quadrants.

Abstract of Uses Project no. 501

Title: Complete Elliptic Integrals of First and Third Kind.

Class: 1

Mode: Intercom 1000 D

Originator: Seismology Laboratory
California Institute of Technology.

Date: 7-21-1960

A method developed by Professor Morgan Ward is used for the computation of complete elliptic integrals of the first and third kinds. The computation takes approximately thirty seconds.

TITLE: CO-ORDINATE CONVERSION SUBROUTINE

ORIGINATOR: National Research Council of Canada

DATE: May 16, 1960

MODE: Intercom 1000 Double Precision (.3121959)

ABSTRACT: The program converts $x + i y$ to $Re^{i\theta}$

and $Re^{i\theta}$ to $x + i y$

The subroutine is self-contained. The entry command is 0 26 Addr. and the return is with 0 16 0000.

INPUT (RANGE): x, y - any

R, θ - any

OUTPUT (RANGE): x, y, R - any
θ - 0-360° (0 - 2π radians)

DISCLAIMER: No responsibility is assumed by the National Research Council of Canada for any errors or misrepresentations that may occur as the result of using this program. No responsibility is assumed by the Bendix Computer Division for the correct reproduction of this program.

Abstract of Users Project No.: 503

Class: 1

TITLE: SUBROUTINE TO CALCULATE HYPERBOLIC FUNCTIONS WITH COMPLEX ARGUMENTS

ORIGINATOR: National Research Council of Canada

DATE: May 16, 1960

MODE: Intercom 1000 Double Precision (.3121959)

ABSTRACT: The subroutine will calculate sinh X, cosh X, and tanh X in Cartesian and Polar form.

where X = a + ib, or, = (1+i)a, or = a

The 28 and 26 commands are used in the program.

SUBROUTINES: USED: $\sqrt{X}$, e^X, sine-cosine X, arctan X and coordinate conversion subroutine (U.P.502)

MEMORY: LOCATIONS: 1500 - 1599 and subroutine storage

DISCLAIMER: No responsibility is assumed by the National Research Council of Canada for any errors or misrepresentations that may occur as the result of using this program. No responsibility is assumed by the Bendix Division for the correct reproduction of this program.

TITLE: 2 x 2 Complex Matrix Program

ORIGINATOR: National Research Council of Canada, Ottawa

MODE: Intercom 1000-D (.3121959)

DATE: 1 March 1960

ABSTRACT: The program is a general program which will work with 2 x 2 matrices with complex elements. It is suited to solving problems in

(a) Electrical circuits and analogues

(b) Heat conduction in slabs (periodic and transient)

(c) Optics (thin films)

The program consists of 26 micro-programs which manipulate matrices in a specified manner. The computer is operated as a desk calculator in that micro-programs are initiated by typing a starting command. There is temporary or working storage for two matrices and permanent storage for one matrix.

The 26 commands available fall under the general headings:

- enter matrices
- multiply, invert, add, subtract matrices
- calculate special transmission matrices containing hyperbolic functions of the form $\frac{R}{X}$ sinh X where X is complex
- move matrices in memory
- evaluate determinants of matrices
- type out matrices

cont'd

ANALYSIS OF FIXED AND HINGED CIRCULAR ARCHES OF CONSTANT CROSS-SECTION

by

Portland Cement Association

May 1960

Part I

Abstract

This program computes the moment, tangential thrust, and normal shear at nine points in a fixed or hinged circular arch of constant cross-section. Forces caused by dead load and uniform live load are computed. The unsymmetrical loading condition is automatically computed for dead load over the whole arch plus uniform live load on the left half of the arch. Because of the sensitive nature of arch computations, double precision arithmetic was essential. The results of this program may be used for single arch analysis or the fixed end moments and horizontal thrust may be used as basic data for a moment-distribution or slope-deflection technique to solve a multiple bay arch bent. This type of structure is normally used for supports for cylindrical shell roofs. An arch bent analysis is planned as a sequel to this program.

Computation and output time for this Intercom 1000 D program is approximately 3 minutes per arch. The sin-cos subroutine is used from channel 18.

Abstract of Users Project No. 506

Off-Line Tape to Tape Version of Intercard Single Precision

Class: 1

In order to provide more complete time usage of the Bendix G-15D computer and keep the operating costs at a minimum, the Intercard Off-Line System has been developed. In this system all input-output is via magnetic tapes, therby eliminating the necessity of the IBM component and the CA-2 for executing jobs. Because the assembly process is 100% input-output, it is not provided for in the off-line system.

Due to the use of magnetic tape input-output, the off-line system is in three parts: the Input Translator to prepare the input tape, the monitor to provide off-line program execution, and the Output Translator to process the output tape. These notes provide a general description of the entire system and detailed instructions for its use.

MEISSNER ENGINEERS, INC.

ABSTRACT OF USER'S PROJECT NO. 507

TITLE: SPIRALED WAY-ALIGNMENT II

ORIGINATOR: MEISSNER ENGINEERS, INC.
300 WEST WASHINGTON STREET
CHICAGO 6, ILLINOIS

CLASS: 2

MODE: INTERCOM 1000 D.P.

DATE: JULY 27, 1960

DESCRIPTION: This program is a complete revision of U.P. 242. Given a beginning station and its coordinates, and the P.I. coordinates, radius or degree of curve, and spiral lengths, the program computes complete alignment and curve data for an alignment of up to seven P.I.'s. Coordinates of detail stations, or of incremented stations are also computed.

SPECIFICATIONS:
TYPEWRITER INPUT
FIXED-POINT OUTPUT, VARIABLE FORMAT
BARNETT'S SPIRAL
ARC OR 100-FT CHORD DEFINITION OF CURVE
ALL INPUT INCLUDED IN TYPE-OUT.

Abstract of Users Project No. 508
Class 2

Title: ISOTHERMAL FLASH VAPORIZATION

Originator: The Ohio Oil Company, Refining Division
Address: Robinson, Illinois
Mode: Intercom 1000
Date: July 27, 1960

Given a mixture of light hydrocarbons of known composition and a set of vapor liquid equilibrium constants at the system temperature and pressure, this program is designed to compute the amount and composition of the vapor and liquid from an isothermal flash vaporization.

Input consists of the mol fraction of each component in the mixture and the equilibrium constant associated with each componet up to a maximum of 24 components.

The program first determines if the mixture is between the bubble and dew points for the given set of conditions and if the sum of the mol fraction is equal to 1.00. If these conditions are satisfied, the program proceeds to compute the amount and composition of vapor and liquid using an iterative method. At each iteration, the value of Sigma X_i is typed out to indicate the rate of convergence.

Computer time, including type in of data and type out of results, required to run the sample problem containing five components is approximately eight minutes and required thirty-three iterations.

Abstract of Users' Project No. 509
Class 1

Title: Multiple Correlation Coefficients

Originator: Pacific Union College, Data Processing Laboratory
Address: Box 32, Angwin, California
Mode: Intercom 500X
Date: July 11, 1960

Given a set of data consisting of N values of each of n variates ($3 \leq N \leq 3199$; $2 \leq n \leq 35$), this program calculates and types out the correlation coefficient matrix.

This program is similar to Users' Project No. 285; however, considerable savings of time have been effected by the use of Intercom 500X, rather than Intercom 1000. A problem with 260 values of each of 21 variates would require about 30 hours with the previous program, but only about 9-1/2 hours with this program. Similar savings are made on any size program.

Input is on paper tape, and consists of the values of the variates. In addition, N and n are typed in at the start of the computation.

The output is a triangular matrix consisting of the coefficients of correlation between each of the variates.

Computation time for 10 values of the variates ranges from 45 seconds (for 2 variates) to 43 minutes (for 30 variates) and beyond. In addition, 30 seconds are required for initializing at the start of each problem.

ABSTRACT OF USERS PROJECT NO. 510

Title: Solution of the Elastic Buckling Load of Parallel Chord Trusses with Outstanding Compression Chords.

Type: Civil Engineering

Class: 1

Mode: Intercom 1000 (D)

Originator: Queen's University Computing Centre

Date: 15th July 1960

This program gives an approximate solution, using the energy method, for the elastic stability out of their plane of trusses with outstanding compression chords, the tension chord being held in position. The truss is considered as a whole, account being taken of the flexural and torsional rigidities of all the members and of partial restraint of the tension chord against twisting. The solution is derived for a truss in which the compression chord is of uniform section carrying a uniform thrust.

USERS' PROJECT NO. 510-1A

ABSTRACT

"The General Solution of the Buckling Load of Parallel Chord Trusses with Outstanding Compression Chords"

This programme gives the solution for the stability out of their plane of trusses with outstanding compression chords.

The programme is based on the analysis of an elastically supported beam-column and may be used for trusses with up to and including ten panel lengths in the compression chord.

The tangent modulus (or reduced modulus) of elasticity is introduced for stresses exceeding the proportional limit but less than the yield point and this is calculated on the assumption that the column curve in the inelastic range is assumed to be a parabola.

This is a more comprehensive development of the programme previously issued as Users' Project No. 510.

USERS' PROJECT NO. 511

Abstract

It is convenient to enter programs into the computer and to start computing automatically with the minimum amount of operator control.

This program has been written to enable Intercom 500 (X) and 1000 (D) programs to be read into the computer and computations commenced with a 'p - GO" operation.

ABSTRACT OF USERS' PROJECT NO. 512

Title: Solution of the Eigenvalue Problem: $y'' + (-K^2 + f(x))y = 0$

Type: Mathematical

Equipment Affected: Bendix G-15D, Intercom 1000 (D)

Class: 1

Originator: Queen's University Computing Centre

Date: 22 June 1960

This program solves the eigenvalue problem
$y'' + (-K^2 + f(x)) y = 0$

within the limits $y(0)=0$ and $y(\infty)=0$ giving K^2, $y(x)$ and
The routine requires $f(x)$ to have a definite asymptotic behaviour
namely $f(x) \rightarrow 0$ as $x \rightarrow \infty$ and $f(x) \rightarrow K - \frac{e(e+1)}{x^2}$ as $x \rightarrow 0$.

Abstract Users Project No. 513

TITLE: Distance-Azimuth

CLASS: 1

MODE: Intercom 1000 DP

ORIGINATOR: Seismological Laboratory
California Institute of Technology

DATE: 7-29-60

SUBROUTINES: All subroutines used are included in program tape.

This program calculates cistances and azimuths from a single point to a maximum of 49 other points. The points are designated by their respective latitudes and longitudes.

An auxiliary program calculates distances and azimuths from as many as 49 points to a single point.

Abstract of Users Project No. 514

TITLE: Least Squares Straight Line Fit.

CLASS: 1

MODE: Intercom 1000 DP

ORIGINATOR: Seismological Laboratory
California Institute of Technology

DATE: 7-29-60

SUBROUTINES: All Subroutines used included in program tape.

Legendre's principle of least square error is used to fit a straight line to a set of data points. The intercept and slope of the line and their standard deviations are calculated as well as the inverse slope.

An auxiliary program is included which allows the use of weighted data.

Abstract of Users Project No. 515

Title: Two Dimensional Gravity

Class: 1

Mode: Intercom 1000 S.P.

Originator: Seisomology Laboratory
California Institute of Technology

Date: August 11, 1960

The vertical component of gravitational attraction of a 2- dimensional n-sided palygon is computed from the line integral $2G\rho\oint z\,d\Theta$ where G is the universal gravitational constant and ρ the surface density.

Users' Project No. 516

ABSTRACT OF USERS PROJECT NUMBER CLASS I

TITLE: LOader Preparation (X-500)

ORIGINATOR: Geo. Papaiconomou

ADDRESS: Ledex Inc.
123 Webster Street
Dayton 2, Ohio

MODE: Machine Language (Subroutine Form)

DATE: August 9, 1960

This program will punch a loader for any intercom X-500 program. It operates from line 05 and does not interfere with the intercom it's self.

Input consists of two digits-tab-indicating the line which the loader is to load each block read.

Output is punched tape-loader-which will load the channels in the order typed in the input and then return control to intercom.

This loader is self destroyed and does not require any of the intercom memory.

The execution time is limited by the input and output time only.

ABSTRACT

Users' Project No. 517

Type: Subroutine in machine language for Intercom 1000 DP

Equipment: G-15D

Execution: Line 19

Entry: Line 16 word 61

Exit: Return command in 16:60

Scaling: Double precision floating point output

Data Output: Sum of n random numbers in 21:00 - 01

Data Input: When loading this subroutine type, as a command, a 7-digit odd number a b c d e f g into location 16:88 in the form a d e f g b c.

Execution Time: 65 revolutions for n = 12

Storage: Line 16 words 60 - 90, 93, 95, 97

Check Sum: .vylvz3u

If $X_1, \ldots, X_n$ are independent random variables with the same distribution, the Central Limit Theorem says that $X_1 + \ldots + X_n$ has a distribution which is approximately normal and the degree of approximation improves as n increases. In the case where the X_i have a uniform distribution over an interval, the distribution of $X_1 + \ldots + X_n$ can be expressed explicitly {Mathematical Methods of Statistics, by Cramer} and it is found that a relatively small n gives a good approximation to the normal distribution. Since random variables with a uniform distribution are readily simulated on a computer and random variables with a normal distribution are desirable in many simulation programs, advantage can be taken of the Central Limit Theorem. The necessity of extensive table storage and searching in the computer is eliminated.

A program for the simulation of a random variable X with uniform distribution in the interval 0 to 1 was written according to the methods described in Report #855 of the Ballistic Research Laboratories, Aberdeen Proving Grounds, Maryland. The method used has been examined by several tests for randomness and has been found to perform very well.

ABSTRACT

Users' Project No. 517

Type: Subroutine in machine language for Intercom 1000 DP

Equipment: G-15D

Execution: Line 19

Entry: Line 16 word 60

Exit: Return command in 16:86

Scaling: Double precision floating point output

Data Output: Random number in 21:00 - 01

Data Input: When loading this subroutine type, as a command, a 7-digit odd number a b c d e f g into location 16:62 in the form a d e f g b c.

Execution Time: 4 revolutions

Storage: Line 16 words 60 - 74, 76, 81, 86

Check Sum: - .457w385

This program produces sequences of numbers that closely approximate sequences of uniformly distributed random numbers selected from the interval 0 to 1. This method is described in Report #855 of the Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland.

An odd number is multiplied by an odd power of 5. Here the choice is $K = 5^{11}$, which written in sexadecimal notation is 2y90yxx. An odd seven digit sexadecimal number r_o, is the multiplicand. After multiplication has taken place, the least significant half of the result, which is the random number desired, is transferred to the accumulator {21:00 - 01} as a floating point number and a return to Intercom 1000 DP follows.

An r_o value is provided in the routine, but if a different beginning value of r_o is desired, the instructions are given in the above Data Input information. Successive entries to the routine cause r_o to be replaced, such that the results may be regarded as stochastically independent. If one wishes to change the channel location of this subroutine, instructions via intercom commands are available from the author.

Title: OPUS #1 (Overall Pier - Unlimited Shape)
Class: 2
Mode: Machine Language
Originator: Vogt, Ivers, Seaman & Associates
Date: August, 1960

This program computes frame moments and reactions given dimensions and loading conditions. No practical limitations are placed on either the dimensions or the loading possibilities.

The program is written in Machine Language, fixed point, single precision. The Modulus of Elasticity is an input item to provide for concrete or metal structures. The analysis methods used are as follows:

(a) Column Analogy - for determining fixed end moments, stiffness factors and carry-over factors.
(b) Moment Distribution - for determining the theoretical joint moments.
(c) For Continuous Footing - the moment of inertia of the footing is an input.
(d) For Isolated Footings - the soil stiffness is an input item and by the use of this number the base can be fixed, hinged or have any intermediate degree of fixity. Each base may have a different fixity.
(e) Sidesway corrections are applied in all solutions.

General Configuration

The number of columns may vary from 2 to 6. Column heights within a frame may vary. Span lengths may vary. Cap girder may cantilever at either or both ends. Footings may be isolated or continuous.

Column Details

If the program is to compute information at each section, column cross-sections may be circular or rectangular and all faces of rectangular columns may be tapered. Column taper will always be straight.

If the column shape is not covered by these conditions, the input data includes the moment of inertia and the weight at 8 sections.

Cap Girder Details

Cap girders may be prismatic, haunched, or irregular. For symmetrically haunched pier caps, three input factors are required. (See Fig. 1).

α = Length of haunch divided by span length
j = Tangent of haunch angle
B = Power to which the term in the equation must be raised.

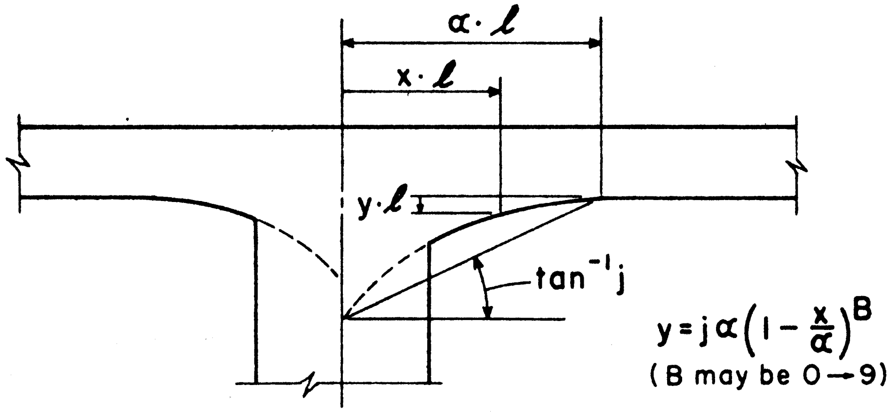

FIG. 1

For symmetrically haunched caps, the program will determine the depth of cap at 8 sections in each span. This information is used to compute fixed end moments, and carry-over and distribution factors. For irregular pier caps, the input data includes moment of inertia and weight at 8 sections in each span: When the program determines the cantilever weight and centroid, the cantilever will be straight. For haunched cantilevers, input includes the weight and centroid.

Loading Details

There may be 33 positions of vertical concentrated loads. These load positions are referenced to the centerline of the first column. During one input operation the following types of loads may be applied with a maximum total input of 100 loads.

1. Temperature rise or drop.
2. Shrinkage (as an equivalent temperature drop)
3. Horizontal loads positioned at the centerline of the pier cap.
4. Concentrated loads for superstructure dead load
5. Sets of concentrated loads for combinations of live loads.
6. Dead load of cap girder.
7. Any number of additional or unusual loads may be applied to the structure by entering the fixed end moments for these loads.

Output

Frame moments and reactions for each member at each joint are typed out for each loading condition. This output can also be punched on tape.

G-22.3702

J. E. GREINER COMPANY
Consulting Engineers
Baltimore, Maryland

ABSTRACT

Users Project No. 519

Program Class 2

J. E. Greiner Traffic Assignment Program.

Machine-language program using basic G-15D computer.

Requires off-line tape punch or programmed flexowriter simulator to prepare data tapes.

This program will assign traffic from a 1,000 by 1,000 zone grid to an expressway 1,000 miles in length having 80 interchanges. An assignment formula is used, having been developed for this program and being compatable with practices of the Bureau of Public Roads, more closely approximating the curves recommended by the A.A.S.H.O., and, on certain tests, being within seven per cent of the assignment obtained from standards of the State of California.

Program output consists of an assignment for each traffic movement together with the data used to obtain the assignment and a summary of interchange turning movements by quadrants, total traffic on each section of the expressway, and vehicle-mile accumulations required for benefit ratio analyses.

On expressway studies of 15 interchanges or less the program will process approximately six traffic movements per minute.

Prepared by: J.E. Greiner Co.

Date: August 24, 1960

Abstract of Users Project No. 520

Class 2

Title:	B.F.GOODRICH MULTIPLE CORRELATION PROGRAM for the Bendix G-15 Computer
Type:	General
Originator:	B.F.Goodrich Chemical Company, Development Center
Address:	Avon Lake, Ohio
Mode:	Intercom 1000 D.P., Modified MAP-29 and Machine Language
Equipment Affected:	G-15, Optional Use of One MTA-2, Optional Use of Off-Line Tape Punching Equipment
Date:	July 1, 1960

Description:

Tabulated data which describe the behavior of a process usually can be separated into two groups consisting of independent and dependent variables. Independent variables (X) are usually factors which have an effect on a measured or observed dependent variable (Y). One product of this program is the computation of b constants (multiple regression coefficients) for an empirical equation which represents a Y variable as a function of the X variables.

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 \cdots b_nX_n$$

Other computational results useful in evaluating the interrelations which exist among the variables are as follows:

1. Number of experiments processed by the program.

2. Degrees of freedom = no. of experiments - no. of variables.

3. Average of each variable.

4. Standard deviation of each variable (how much it varied).

5. Simple correlation coefficients (how well each pair of variables line up ignoring variations in the other variables).

6. Multiple correlation coefficient (how much variation in each of the dependent variables can be explained by the independent variables considered).

7. Simple regression coefficients (the "best" slope of the plot of dependent variable vs. each independent variable).

8. Multiple regression coefficients (rate of change in the dependent variable for a unit change in each independent variable, eliminating effects of the other independent variables).

9. Intercept.

10. Standard error of estimate (how accurately the dependent variable can be predicted from the independent variables).

11. Standard deviation of each multiple regression coefficient (how accurately each multiple regression is known).

12. F-test (how well the data fit the determined empirical equation).

13. T test (how significant each independent variable is).

14. Predicts each dependent variable based on the determined empirical equation. Computes the difference between the dependent variable which was actually measured and the predicted value based on the empirical equation.

The program is divided into three parts: Part I covers items 1 to 5; Part II covers items 6 to 13; and Part III covers item 14. Matrix data and other information are punched at the end of Part I and serve as input to Part II. Likewise, Part II punches a tape which serves as input to Part III. A matrix shrinker program is included which is used to delete interfering variables from the tape punched by Part I. A lister routine is also included to document the matrix and other data punched both by Parts I and II.

Capacity:

The program has capacity for a total of 21 X and Y variables and a maximum of eight Y variables. When the maximum of eight Y variables is being considered, a maximum of 13 X variables can be handled. Also, when only one Y variable is present, a maximum of 20 X variables can be handled. The program has a special routine which will handle one X and one Y variable for simple two-way curve fitting problems.

Data Handling:

All arithmetic operations are performed with double-precision floating point numbers. There is, therefore, no limit to the number of rows which can be handled. The only limit in this regard is that the sum of the product of any two input variables not exceed an approximate value of 1×10^{38}. Data may be read from tape prepared off-line, binary paper tape punched by the machine, or magnetic tape. Space is reserved in the program for possible insertion of a card input routine.

Data may be rearranged or modified immediately after read in. Transformed data remain in memory and are processed directly rather than punched on paper tape for re-entry at a later time. Arithmetic operations may be performed on input data such as addition, subtraction, reciprocal, division, and multiplication. Data may also be transformed to log or exponential (base 10 or e), and square root. All typed output is in fixed point form.

Part I is usually the most time consuming portion of the program. A feature has been included in the program whereby a number of Part I programs and data may be recorded on magnetic tape and run automatically in sequence by an executive routine.

The time required to process 40 rows of data each consisting of 21 variables is about $3\frac{1}{2}$ hours for all three parts of the program. The program is designed to offer a good balance among flexibility, ease of operation, capacity, and speed.

Program Applications:

Some uses of this program are:

A. Multiple Regression Analysis

B. Simple or Multi-Dimensional Curve Fitting

C. Development of Digital Process Simulation Equations

D. Evaluation of Different Experimental Strategies

E. Sales Forecasting

F. Determining Optimum Process Conditions

Abstract of Users Project No. 521

Class 2

Title:	MASS SPECTROMETER PROGRAMS for the Bendix G-15 Computer
Type:	General
Originator:	B.F.Goodrich Chemical Company, Development Center
Address:	Avon Lake, Ohio
Mode:	Intercom 1000 D.P., Modified MAP-29 and Machine Language
Equipment Affected:	G-15, Optional Use of One MTA-2
Date:	May 9, 1960

Description:

The programs included in this project are used to generate data and a program for computing the composition of samples analyzed with a mass spectrometer for systems containing up to 29 components. This project consists of the following programs:

1. Matrix Algebra Program (modified MAP-29)
2. Program compiler for paper tape operations
3. Program compiler for magnetic tape operations
4. Magnetic tape master routine
5. Matrix lister

For computations using the magnetic tape unit, both data and programs for many different analyses can be recorded on magnetic tape and run automatically with a minimum of operator participation.

Although considerably less automatic, a paper-tape-only method is included in this project for installations without a magnetic tape accessory. In either case the computational results are the same.

Input data may be entered directly through the computer typewriter or from tape prepared off-line.

All arithmetic computations are performed using floating point double precision numbers.

What the Program Does:

The initial input data required to develop the mass spectrometer program and data tapes for a particular system are cracking pattern coefficients, molecular weight and sensitivity for each component.

The method involves the solution of n simultaneous equations as follows:

$$
\begin{array}{ccc}
x_1 a_{11} \cdots x_n a_{1n} & = & m_1 \\
\vdots & & \vdots \\
x_1 a_{n1} \cdots x_n a_{nn} & = & m_n
\end{array}
$$

where: x_1 = divisions of base peak contributed by component 1

a_{11} = cracking pattern coefficient of component 1 at the first mass charge value

m_1 = peak height of mixture peaks at the first mass charge value

Solution of the equations above is obtained by multiplying peak height of mixture peaks (m) by the inverse of the cracking pattern coefficient matrix to obtain the divisions of base peak (x) for each component. Partial pressure of a component is obtained by dividing divisions of base peak by component sensitivity and is used to compute mole and weight percents.

The program compiler routine assembles an Intercom program which controls computation and type out of the final analytical results. The compiler will permit deletion of up to seven specified interfering components (such as air and water) from the analysis. The compiled program and the inverse matrix tapes comprise the mass spectrometer "package" for a particular system.

For routine analyses, multiple sets of m's are processed by the mass spectrometer routines and the "package" program to obtain the final analytical results.

The matrix lister program will read tapes prepared for or by the matrix algebra routine and list the data in adjacent columns in either floating point or fixed point form. This program is used to document the input matrix, inverse matrix, molecular weights and sensitivities.

The magnetic tape master routine provides complete control of magnetic tape operations. It is used for recording input data, inverse matrices and programs on magnetic tape. Other provisions of the routine permit data retrieval and correction.

Limitations:

The capacity of the matrix algebra inversion routine limits the number of components to 29. However, when using the compiled magnetic tape program, space for 50 components is available by sacrificing the component deletion feature. The inverse matrix for systems larger than 29 components may be obtained using matrix partition or a different routine.

A maximum of 99 sets of m data can be handled automatically by either compiled program.

Operating Times:

The time required to produce a mass spectrometer "package" program for a 29 component system is about $3\frac{1}{2}$ hours, excluding data preparation time. For routine analyses, the computing time per analysis is 18 minutes for the magnetic tape program and 11 minutes for the paper tape program.

Abstract of Users' Project No. 522
Class 1

Title: LATENT HEAT AND VAPOR PRESSURE CALCULATION (OTHMER METHOD)
Originator: The Standard Oil Company (Ohio)
Address: 1762 B Guildhall Building, Cleveland 15, Ohio
Mode: Intercom 500x
Date: July 12, 1960

Given the boiling point, critical temperature and pressure, molecular weight of up to ten components and from one to ten temperatures at which information is desired, this program produces corresponding latent heats (in BTU/mol and BTU/lb) and vapor pressures.

This program is written to handle each item concurrently for which the preceding information is available (e.g. - pure hydorcarbons). The Othmer Method of caluclation is employed wherein water is used as a reference compound.

Input temperatures are in degrees fahrenheit and pressures are absolute.

The output format is shown in the writeup. The first typeout is the initial temperature considered. The next two numbers are latent heats in BTU/mol and BTU/lb respectively. Finally, vapor pressure is printed. This sequence is then repeated for all other temperatures specified and then again for any other components. If an item falls beyond the table limits, only the temperature is typed at this point. The upper bound of these tables is the critical temperature and the lower limit is exceded when the reduced temperature is ≤ 0.42.

Data input time is variable with five to fifty single precision numbers being typed. Calculation time for the sample problem (ten components, ten temperatures) was twenty-one minutes with thirty-eight of the one hundred combinations falling outside the critical limits. No auxiliary equipment is needed.

$\text{Log}_{10}A$ and 10^A are the subroutines incorporated.

Abstract of Users' Project No. 523

FLOATING POINT NUMBER CONVERSION SUBROUTINE: INTERCOM 1000 DP TO INTERCOM 500 X

This subroutine for Intercom 500 will convert an Intercom 1000 double precision floating point number to an Intercom 500 floating point number.

Abstract of Users' Project No. 524

PA-3 DATA POINTER SUBROUTINE FOR INTERCOM 500 X

This subroutine for Intercom 500 enables the programmer to plot symbols for data points on the PA-3 accessory to the G-15.

Abstract of Users' Project No. 525

INTERCOM 500 X FORMATER SUBROUTINE

This subroutine for Intercom 500 enables the programmer to set the number of digits before and after the decimal point for fixed point typeouts. This subroutine may be substituted for the existing Intercom 500 formater subroutine in the Intercom 500 Appendix.

Abstract of Users Project No. 526

Class 1

Title: Intercom 501

Originator: W. F. Carley, Dept. A-852
Douglas Aircraft Company

Address: 3000 Ocean Park Blvd.
Santa Monica, California

Mode: Machine Language

Date: May 16, 1960

This program is a single precision, floating point interpretive routine; an expansion of Intercom 500. The major changes and additions to Intercom 500 are as follows:

I. The operation of OP codes 59, 91, and w3 has been expanded to permit the word portion of the command to contain information to be used by the subroutine.

II. The formater has been expanded to permit selection of the number of digits typed before the decimal point.

III. Loader I has been revised to allow clearing of memory and automatic loading of the arithmetic subroutines during Intercom read-in if the operator so desires.

IV. A routine has been written to type out the contents of any number of consecutive memory locations. Data and commands are each typed in the proper form (data in floating point). This routine does not take any memory space as subroutines do, but operates directly from the Intercom tape.

V. The selective print trace routine has been changed to permit starting and stopping trace operation without taking the computer out of the Automatic mode. The trace is either started or stopped by the Enable action "sclf."

ABSTRACT OF BENDIX
Users Project No: 527
Class : 1

Title: POLYNOMIAL CURVE FITTING BY LEAST SQUARES
Originator: National Research Council of Canada, Ottawa
Mode: Intercom 1000 DP (.3121959)
Date: 23 August, 1960

Abstract: The program uses the method of least squares to fit pairs of data (x_i, y_i) with a best polynomial

$$y = \sum_{j=0}^{n} c_j x^j$$

for the range $1 \leq d \leq 50$, $1 \leq n \leq 9$, $n \leq d - 1$
This program occupies essentially 0900-1699 and uses index registers 1-6. The execution time depends on n and d, and is 12 minutes for n = 9 and d = 10.

The program differs from others that are available in the same area as follows

A 60 computes n = 3,4 and 5 and requires 11 equally spaced x_i,
A 90 uses the Tehebyscheff norm and requires an analytic expression for the function to be fitted,
U 118 fits only a fourth degree polynomial to 7 equidistant x_i,
U 331 requires a program to be written to compile the coefficients of the normal equations,
U 376 fits linear and quadratic polynomials plus other forms to the same type of data as this present program.
U 402 fits a fifth degree polynomial to 6 non-equidistant points.

Disclaimer:
No responsibility is assumed by National Research Council of Canada for any errors or misrepresentations that may occur as the result of using this program. No responsibility is assumed by the Bendix Computer Division for the correct reproduction of this program.

Title: SOLUTION OF SIMULTANEOUS ALGEBRAIC EQUATIONS

Originator: National Research Council of Canada.

Date: August 30, 1960.

Mode: Three programs, to be used with
(a) Intercom 1000 DP (.3121959 with 0283 modified as described on page 29 of A.S. Project 83)
(b) Intercom 1000 SP
(c) Intercom 500

Abstract: Each program solves a set of n simultaneous linear algebraic equations using the Gauss-Jordan complete elimination procedure.

Limitations:
$n \leq 12$ with Intercom 1000 SP
$n \leq 10$ with Intercom 1000 DP or Intercom 500

Input: Set index registers (which vary with n) and enter the values of the coefficients and constants in matrix form.

Output: Results are typed out in a column in fixed point form.

Disclaimer:

Abstract of Users' Project No. 529

Class 2

Title: ANALYSIS OF 2^n FACTORIALS

Originator: General Foods Research Center
Address: 555 South Broadway, Tarrytown, New York
Mode: Intercom 500X
Date: August 22, 1960

This program performs the statistical analysis of unreplicated or fractionally replicated 2-series factorials. In the main program, the data are typed in or read from G-15 punched paper tape (punched tape is necessary if $N = 2^n > 64$, or if transformed data are to be analyzed). The main program may be terminated after (1) computing and printing the N orthogonal contrasts, (2) after printing in ranked order the absolute values of the contrasts, (3) after completing a form of an analysis of variance table, (4) after printing the observation, prediction, residual, and residual as a percent of the original observation, or (5) after printing the residuals in ranked order. The program is limited to $8 \leq 2^n \leq 256$.

Any number of sets of data for the same N without having to reread the entire program. Transformations of y to $\sqrt{y}$, log y, and 1/y may be performed automatically.

The start-up phase of the program calls for typed fixed point numbers which define the size of the problem, which transformations, if any, are wanted, the number of sets of data to be analyzed, the form of the input, and the length of the analysis.

The operating time for the program is very dependent on the conditions defined in the start-up phase. The minimum time (punched tape input) for the complete analysis is about 5 minutes for N = 8, 10 min. for N = 16, 17 for N = 32, and 50 for N = 64.

Abstract of Users' Project No. 530

Class 2

Title: PAIRED COMPARISONS ANALYSIS
Originator: General Foods Research Center
Address: 555 South Broadway, Tarrytown, New York
Mode: Intercom 500X
Date: August 18, 1960

This program is based on the Bradley-Terry method of paired comparisons, for as many as 20 samples. All pairs of samples do not have to be compared, and the pairs which are compared do not have to be run equal numbers of times.

The program computes the preference ratings p_i, tests the hypothesis that all p_i are equal, tests the agreement between the observed and the estimated preferences, and prints the pairwise preferences for all pairs. Through a type-in at the beginning of the analysis, the operator can control the length of the analysis.

The input are t^2 values of $a_{ij} \geq 0$. a_{ij} is the number of times sample i was preferred to sample j. The data are typed in.

Total operating time varies, depending on the number of iterations and the value of t. For representative data, the times were 3.5 minutes for t= 3, 6.25 minutes for t = 5, and 24 minutes for t = 10, including time for typed input.

Abstract of Users Project No. 531

Class 1

Title: Harmonic Analysis by Fourier Series

Originator: Mpls. Honeywell,
Address: Florida Aero Div.
Mode: Intercom 1000 Double Precision, Revised as of May 1959
Date:

Given the values of a function in a certail interval this program produces as many of the first twenty-four Fourier coefficients as are desired. A second part of the program computes the function at a given point by means of the Fourier coefficients computed in the first part.

The program works best for curves which have no discontinuities, however this is not necessary.

Details of input and output formats are shown in the write-up. The time of computation varies from less than a half a minute up to eight minutes per pair of Fourier coefficients depending on the number of subintervals taken in the interval $(-\pi, \pi)$

The program does not compute how good a fit the truncated Fourier Series is to the original curve.

Among other uses, this program can be used in determining the frequencies that go to make up a curve.

Wyoming Highway Department
HEADQUARTERS OFFICE
Cheyenne, Wyoming

Abstract of Users Project No. 532
Class 2

Title: VARIABLE MOMENT OF INERTIA BEAM CHARACTERISTICS
Date: September 9, 1960

I. General Information

The program was coded for the Bendix G-15D computer using single precision machine language. No auxiliary or off-line equipment is necessary.

Data type-in time is usually under 5 minutes. Program operating time, including typeouts, is 1 minute 45 seconds.

The program will calculate the stiffness and carry-over factors, and the fixed end moments for a unit load at the tenth points of a span, using as input the moments of inertia at the twentieth points of the span. The method used is the column analogy procedure.

II. Program Notes

The program operates by taking the input values of moment of inertia and computing the area of the analogous column. The assumption used is that the I varies as a straight line between the twentieth points. This assumption is not critical since twenty points have been used for calculation. The next step is to locate the center of gravity of the analogous column. The moment of inertia of the analogous column is next computed about the centroidal axis. To obtain stiffnesses a unit load is placed on the ends of the beam (analogous to a unit rotation) and the stress in the analogous column is calculated for each case. The stresses in the analogous column are equal to the stiffness factors for the beam, based on a constant minimum I value (I_c), E and a length of unity. The computer, in other words, obtains the K factor for the equation shown below:

$$\text{Stiffness} = \frac{KEI_c}{L}, \text{ where } E \text{ and } I_c \text{ are constant and } L \text{ equals unity.}$$

The carry-over factors are then obtained.

The stiffness factors obtained are then adjusted for the span ratio and for the I_c used (to be relative to the stiffness factors for other spans in the structure) and typed out.

The program next procedes to obtain the fixed-end moments for concentrated loads. The fixed end moments are calculated in each case by loading the column at the tenth point (beginning with the first tenth point from the left end) with a unit load. A loading diagram for the analogous column is then obtained by taking the simple beam moment of the load on the analogous column. The loading diagram thus obtained is divided into sections and the moments of the load about the centroid of the analogous column are obtained. Summing up these moments gives the final moments acting on the analogous column due to the loading diagram caused by the unit load. The stress in the analogous column is then obtained and the fixed end moments are calculated, adjusted for the span ratio and typed.

III. Input Notes

Input information consists of I values or I ratios, the span ratio, and an I_c value if desired.

The designer may use either actual moment of inertia values or moment of inertia ratios for input to the program. The operator should enter the values as six digit numbers, scaled indentically.

The span ratio is entered as a seven digit number scaled 10^{-1}.

If the designer wishes to base the stiffness computations on an I_c value which is different from the minimum moment of inertia value of the span (such as for the legs of integral leg structures) he may enter this value as shown on the form and the stiffness factor resulting will be made relative to the chosen I value. If the minimum moment of inertia of the span equals I_c then no value need be entered.

IV. Output Notes

Output consists of the following information in the order listed, which will be typed out by the computer.

1. Area of analogous column.
2. Center of gravity of the analogous column from the left hand end.
3. Moment of Inertia of analogous column about its centroid.
4. Stiffness Factor K_{AB}, "A" being the left hand end and "B" being the right hand end.
5. Stiffness Factor K_{BA}.
6. Carry-over Factor C_{AB}.
7. Carry-over Factor C_{BA}.
8. Fixed End Moments

   The fixed end moments will be typed as follows:

   M_{FAB} and M_{FBA} for the load at the .1 point,
   M_{FAB} and M_{FBA} for the load at the .2 point,
   etc.
   M_{FAB} and M_{FBA} for the load at the .9 point

The information on the analogous column can be used for obtaining other fixed end moments for other loading conditions if the designer desires.

V. Program limitations

The I_c value must fulfill the relationship $\left(\frac{I_c}{I}\right) < 10$. It may be made as small as desired, within limits imposed by the accuracy desired. i.e. $\left(\frac{I_c}{I}\right) =$ 1/1000 or 1/10000 would not give an area of the analogous column large enough to be comparable to the possible magnitude of the error. There are essentially no other limits to the variance of the data entered, except that it is possible to cause overflow to arise by varying the span ratio to too great an extent.

No signs are typed. Signs required for use of the output from this program for other calculations must be assigned by the designer.

Abstract of Users Project No. 533

Class 1

TITLE: Three Factor Analysis of Variance - General.

Originator: R. B. Jackson, American Can Company

Address: 11th Ave. & St. Charles Rd., Maywood, Illinois.

Auxiliary Equipment: None

Mode: Intercom 1000 (single)

Date: May 10, 1960

Given the data from a factorial experiment with three complete factors (without replications) this program will type out the conventional analysis of variance table consisting of Mean Squares and Degrees of Freedom. In addition Total Sum of Squares and Correction Factor are typed out.

The limits of the number of levels of the three factors are, for A: 2 to 8
B: 2 to 10
C: 2 to 6

Disclaimer: No responsibility is assumed by the American Can Company, or by R. B. Jackson for any errors, mistakes or misrepresentations that may occur when using this program; nor is responsibility assumed by Bendix Computer Division for the correct reproduction of this routine.

Abstract of Users Project No. 533-A

Class 1

TITLE: Three Factor Analysis of Variance: General
(With Descriptive Titles Included in Type-Out)

Originator: R. B. Jackson, American Can Company

Address: 11th Ave. & St. Charles Rd., Maywood, Illinois

Auxiliary Equipment: Alpha-numeric typewriter

Mode: Intercom 1000 (Single)

Date: May 10, 1960

Given the data from a factorial experiment with three complete factors (without replications) this program will type out and label the conventional Analysis of Variance table consisting of Source of Variation, Mean Squares, and Degrees of Freedom. In addition Total Sum of Squares and Correction Factor are typed out.

The limits of the number of levels of the three factors are, for A: 2 to 8
for B: 2 to 10
for C: 2 to 5

ABSTRACT

Users'Project - No. 534 Class: 1

Intercom 500 - Modified

The Intercom command k. 65. CH. WD will store the check sum of CH. 00 to CH. WD in 22. 00, and the balancer in 21. 01. Words u0 and ul are considered zero in this command.

The Intercom command 0. 08. 06. 31 will reverse tape one block.

The Intercom commands with operation "02" and "w3" have been eliminated to make room for the above commands.

An Add Punch Input subroutine converts binary coded decimal tape containing up to 100 words of
1) all Intercom 500 commands, or
2) all single precision modified floating numbers, or
3) all double precision modified floating numbers.

The numbers are converted to Intercom 500 floating numbers.

The Bendix floating number is a special case of the modified floating number. The difference being:

a) If the exponent = 0, the previous non zero exponent is assumed. The first word of each tape should contain a non zero exponent.
b) The most significant part of a number may contain zeros. However in double precision numbers, there may be no more than 10 leading zeros.

The advantage of the modified floating numbers is that floating numbers may be entered as fixed point after the entry of one exponent.

	Modified		Bendix
Single	54. 00126+	=	52. 12600+
Precision	00. 00093-	=	51. 93000-
Example	00. 00006+	=	50. 60000+
	52. 00290-	=	50. 29000-

Prepared by: Donald E. Nevel
U. S. Army Snow Ice and Permafrost Research Establishment
1215 Washington Avenue
Wilmette, Illinois

Date: 5 August 1960

ABSTRACT

Class: 1

Users' Project - No. 535

Intercom 1000 D - Modified

The Intercom command k. 65. CH. WD will store the check sum of CH. 00 to CH. WD in 21. 00, and the balancer in 21. 01.

The Intercom command 0. 08. 06. 31 will reverse tape one block.

The Format subroutine will set the number of digits before the decimal as well as the number of digits after the decimal.

The Add Punch Input subroutine converts binary coded decimal tape containing up to 100 words of

1) all Intercom 1000 D commands, or
2) all single precision modified floating numbers, or
3) all double precision modified floating numbers.

The numbers are converted to Intercom 1000 D floating numbers.

The Bendix floating number is a special case of the modified floating number. The difference being:

a) If the exponent = 0, the previous non zero exponent is assumed. The first word of each tape should contain a non zero exponent.
b) The most significant part of the number may contain zeros. However in double precision numbers, there may be no more than 10 leading zeros.

The advantage of the modified floating numbers is that floating numbers may be entered as fixed point after the entry of one exponent.

	Modified		Bendix
Single	54. 00126+	=	52. 12600
Precision	00. 00093-	=	51. 93000-
Example	00. 00006+	=	50. 60000
	52. 00290-	=	50. 29000-

Prepared by: Donald E. Nevel
U. S. Army Snow Ice and Permafrost Research Establishment
1215 Washington Avenue
Wilmette, Illinois

Date: 5 August 1960

Abstract of User's Project No. 536

Class Unrestricted (1)

TITLE: Seven (7) Point Smoothing Program

ORIGINATOR: Brown Engineering Co. Inc.

ADDRESS: P. O. Box 917, Huntsville, Alabama

MODE: Intercom 1000 D. P.

DATE: October 27, 1960

The purpose of this program is to smooth or average data which are undesirably irregular.

Smoothing is accomplished by use of cubic or quadratic (whichever is applicable) seven point smoothing equations. In either case all numbers except the first three and last three are smoothed by the following equation: $Y_3 = \frac{1}{21}(-2Y_0+3Y_1+6Y_2+7Y_3+6Y_4+3Y_5-2Y_6)$ where Y_0= first unsmoothed number, Y_1= second unsmoothed number, Y_2= third unsmoothed number, Y_3= fourth unsmoothed number, Y_4= fifth unsmoothed number, Y_5= sixth unsmoothed number, Y_6= seventh unsmoothed number.

The beginning and ending numbers are smoothed by formulas indicated on the included list. Input data may range from 8 to 300 numbers. Output will be a smoothed value to correspond to each input number. Operating time is approximately 9 seconds for each output number.

ABSTRACT OF USERS' PROJECT NO 537

CLASS 2

TITLE: Three Span Bridge with Moving Loads- Moments by Influence Line.

ORIGINATOR: Ecole Polytechnique

ADDRESS: 2500 Guyard Avenue, Montreal, P.Q.,Canada

MODE: Machine Language (S.P.)

DATE: September 19, 1960.

given the influence line ordinates at every 10% of each span and the position and magnitude of up to 428 point loads, this program will compute the resulting moments for different positions of the load. The distance by which the loads are moved is an input value. The loads may be moved from right to left or left to right or both simultaneously. There is also provisions to include the effect of a constant distributed fixed load on each span. The output sheet is identified alphabetically where an alphanumeric typewriter is available.

Computing time depends on the number of loads and will be approximately 2 sec. per position in the case of three loads (truck) and 1 min. in the case of 120 loads (30 car freight train).

In many cases this same program may be used for a bridge with more or less than three spans.

Users Project No: 538

Class: 1

ABSTRACT

TITLE: The Numerical Calculation of Inverse Laplace Transforms

ORIGINATOR: National Research Council of Canada, Ottawa.

MODE: Intercom 1002-D

DATE: 13 July 1960

PROBLEM: Numerically calculate an inverse Laplace transform given the values of transform at p = 1,2,3,4 --- 10.

ABSTRACT: The program uses a modified form of Salzer's method. The method is described in its original form in J. Maths and Phys, Vol. 37, n2, J.58, and a paper submitted for publication in the same journal describes a modified form of the method and discusses its limitations.

STORAGE: Lines 10, 11, 17 and 18

EXECUTION TIME: 12 to 70 secs per value of the independent variable.

DISCLAIMER: No responsibility is assumed by the National Research Council of Canada, Ottawa, for any errors or misrepresentations that may occur as a result of using this program.

Users Project No: 539

Class: 1

ABSTRACT

TITLE: Harmonic Synthesis

ORIGINATOR: National Research Council of Canada, Ottawa

MODE: Intercom 1000-D

DATE: 26 May 1960

PROBLEM: Evaluate:

$$F(t) = F_{mean} + A_a \sin(awt+\delta a) + A_b \sin(bwt+\delta_b) + ----+ A_p \sin(pwt+\delta_p) \text{ for } t_o \ (\Delta t) \ t_{max}$$

where F_{mean}, w, a, A_a, δ_a --- p, A_p, δ_p, are known.

ABSTRACT: The program will handle up to 15 sinusoidal terms. No limitations are imposed on the values of a,b,c --- p. The values of t and F(t) are also punched on tape using the "Intercom 1000-D Plotter Subroutine" - NRC-8" by D.C. Baxter. (for non-NRC users this can be omitted)

STORAGE LOCATIONS: Lines 10, 11, 13 and 14 plus storage for the plotter subroutine.

EXECUTION TIME: Depends on the number of terms in the series - 13 secs. per point for 3 sinusoidal terms.

Abstract of Users Project No. 540

Class 1.

TITLE — The Smoothing and Tabulation at any Interval of a Function derived from Experimental Data at Random Intervals.

ORIGINATOR — National Research Council of Canada.

DATE — 6 October, 1960

MODE — Intercom 1000 Double Precision. (.3121959)

ABSTRACT — Experimental data of the form x_0, y_0; x_1, y_1; - - - x_n, y_n, where the interval in x may be random, is linearly interpolated to equal intervals in x, followed by a smoothing of the y terms by fitting them to a polynomial of degree 2 or 3 by the method of least squares. The smoothed data are then interpolated to a smaller interval in x, using a polynomial interpolation formula. The increment in x for the linear interpolation and the polynomial interpolation may be chosen by the operator.

THEORETICAL CHEMISTRY LABORATORY
(FORMERLY U.W. NAVAL RESEARCH LABORATORY)
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Abstract of Users' Project No. 541

Class 1

Title: COMPLETE ELLIPTIC INTEGRALS OF FIRST AND SECOND KIND

Originator: S. Lovell
Theoretical Chemistry Laboratory
University of Wisconsin

Mode: Intercom 1,000 (D.P.) Subroutine

Date: 28 September 1960

This subroutine will calculate the complete elliptic integrals of the first and second kind. It is a combination machine language and Intercom subroutine for use in an Intercom 1,000 (D.P.) program. It occupys one complete channel and includes the standard Intercom square-root subroutine which is available to the programmer.

With this subroutine stored in channel CH execution of the command 008CH55 (u2) will replace the argument in the accumulator by its complete elliptic integral of the first (second) kind. Execution time is about 10 seconds and results are correct to at least 9 significant figures.

ABSTRACT OF USERS' PROJECT NO. 542

Title:	Stream Flow Rating Table Program
Class:	2
Mode:	Machine Language
Originator:	California Department of Water Resources P.O. Box 388 Sacramento 2, California
Date:	September 15, 1960

This program develops a table of discharge, in cubic feet per second, for each one-hundredth of a foot of gauge height from an equation of the form

$$Q = C(G-b)^n$$

where C, b, and n are given constants and G is the gage height.

Abstract of Users Project No. 543

Class 2

Title: WIND ANALYSIS OF TALL BUILDINGS

Originator: Scientific Computers, Inc.

Address: 1315 Fourth Street S. E., Minneapolis 14, Minn.

Mode: Intercom 1000 Single Precision

Date: September 30th, 1960

Problem Statement: This program analyzes one through three bay building frames of up to 20 stories, subjected to wind pressure, and computes the moments in each beam and column at their intersections. The vertical shear in the beams is also determined. The Maney - Goldberg modified slope deflection method was used in programming this problem for computer application. The columns at the base of the frame may be of any degree of fixity desired from hinged to fixed.

Input Data:

- I_B - Moment of Inertia of Beam (exact or relative)
- L_1, L_2, L_3, - Span lengths of Bays
- W - Wind force applied to each floor
- I_c - Moment of Inertia of column (exact or relative)
- h - Floor heights
- Sig - Signal for fixity of columns at their base

Output Data: The output includes the moments in each beam and column at their intersections and the vertical shear in the beams.

ANTENNA PROGRAM FOR IMPEDANCE AND VSWR

Users' Project No. 544

Class: 1

ABSTRACT

When the equivalent parallel impedance (resistance and reactance) of a load - transmission line combination is known at a particular frequency the program can be used to:

1. Determine the voltage standing wave ratio (VSWR) corrected to the load.

2. Compute reflection coefficient corrected to the load.

3. Compute the equivalent series per unit resistance and reactance of the load based upon the characteristic impedance (Z_o) of the transmission line.

4. Compute the transmission line loss in DB for the length of line under consideration.

A supplementary program is attached that permits:

1. Computation of the load VSWR of a load-transmission line combination when the VSWR of the combination is known at a particular frequency.

2. Determination of load reflection coefficient versus frequency.

Provisions are made to permit the insertion of 66 sets of frequency-impedance data in the main program and 50 sets of frequency - VSWR data in the supplementary program.

Up to 11 sets of transmission line data can be stored in memory to permit the operator to investigate various load-transmission line combinations.

The program was originally written for the testing of aircraft type antennas but can be used for any load-transmission line combination.

Originator: LeRoy H. Carson
Land-Air Inc.
7444 West Wilson Avenue
Chicago 31, Illinois

Wyoming Highway Department

HEADQUARTERS OFFICE

Cheyenne, Wyoming

Abstract of Users Project No. 545

Class 1

Title: Statistical analysis of Speed Survey

Originator: Wyoming Highway Department

Address: P. O. Box 931; Cheyenne, Wyoming

Mode: Machine Language (SP)

Date: October 1, 1960

Given a field count of vehicles traveling at various speeds, required to compute and /or print out MPH, Vehicles, cumulative total, cumulative % for each 2 MPH bracket from 2 MPH to 100 MPH incl. Further required to compute and print out the arithmetic mean speed, median speed, 85% tile speed and pace.

Data input from punched cards via CA 2∘average one second per study.

Computations and data output average 2 minutes per study.

The program is amenable to modification for CA1 or flexowrite input.

Limitations: Study number: $1 \leqslant$ No. $\leqslant 999$
Speed = 2 mod 2 $\geqslant$ 100 MPH

Enclosed sample input and output.

ABSTRACT OF USERS PROJECT No. 546

Title: Smith Chart Tabulation

Class: 1

Mode: Intercom 1000 (D)

Originator: Queen's University, Kingston, Ontario.

Date: 20th July, 1960.

Abstract

This programme tabulates the Smith Impedance Chart to facilitate microwave impedance measurements where standing wave ratio is greater than 26 db. Reactance and Resistance are tabulated for a chosen range of standing wave ratios and distances along the transmission line.

Abstract of Users' Project No. 547

Class 2

Title: WATER HAMMER IN SIMPLE CONDUITS

Originator: Tippetts-Abbett-McCarthy-Stratton
375 Park Avenue
New York 22, New York

Mode: INTERCOM 500X

Date: October 15, 1960

This program performs the arithmetic integration required to determine the magnitude of water hammer pressure resulting from valve closure in a simple (not branching) conduit.

Given:

a. Initial conduit discharge (Q_o)

b. Initial head on the valve (H_o)

c. Area and length of conduit between reservoir and valve (A_c & L)

d. Wave celerity for the given conduit (a)

e. Valve closure characteristics

The program will compute and tabulate the following quantities at a time interval (Δt) of L/2a. Losses due to friction have little effect upon this computation and are neglected.

a. Elapsed time

b. Increment of water hammer pressure propagated by the closing valve during the time interval Δt

c. Incremental conduit velocity change during the time interval Δt

d. Increment of water hammer pressure at the valve reflected from the reservoir

e. Total instantaneous head at the valve

f. Ratio of instantaneous to initial area of valve opening

g. Instantaneous conduit velocity and discharge

The program will operate in either English or Metric units. Twenty-five seconds are required per line of type out.

Users' Project No.548

ABSTRACT

The integral $\int_{\rho_1}^{\rho_2} p \exp\left\{-\frac{1}{2}\rho^2 - \frac{1}{2}\tau^2\right\} \quad I_0(\rho\tau)\, d\rho$ is computed by using Simpson's rule for numerical integration. This integral is used in the solution of the following problem in Search Theory:

Problem: A target is located at point P with a certain inaccuracy which is specified by the Gaussian circular distribution of standard deviation σ. The target is known to be proceeding along a straight line at speed u knots, but in an unknown direction. t hours after the location was made, the probability that the target is r nautical miles from P is given by $f(r, t)$.

Note: This program is designed to be used as a subroutine in conjunction with a main program.

EASTMAN KODAK COMPANY

APPARATUS AND OPTICAL DIVISION

400 PLYMOUTH AVE. N. ROCHESTER 4, NEW YORK

Program Abstract

Users' Project No. 549

Title:	General Optical Raytrace, RT-4
Class:	2
Equipment and Mode of Operation:	G-15D Machine Language, Flexowriter Optional.
Originator:	Optical Design Department, A & O Div., Eastman Kodak Co.
Program Description:	The program will trace paraxial and general rays (skew or meridional) through an optical system containing aspheric, spherical and/or plane surfaces. This program is a companion to RT-3 (U.P. #488).
Input Data:	
Lens Data:	Number of surfaces, surface curvatures, refractive indices of elements, surface separations and aspheric coefficients.
Ray Data:	Four quantities defining a skew ray; two options for infinite and finite object distances.
Output:	
Paraxial Ray:	Back focus and focal length.
General Ray:	Semi-aperture of the ray at each surface and closing data in image plane.
Limitations:	Maximum number of surfaces = 26 Maximum number of aspheres per system = 5 Maximum refractive index < 8.0 Maximum linear distance < 10.0 Maximum surface curvature < 10.0 (i.e. min. radius > 0.1)
Operating Time:	General ray, spherical surface: 1.8 sec/surface. General ray, aspheric surface: 4 sec/surface.

LOCUST 2-6000

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LINCOLN PLANT, BEVERLY 5-7770

Kodak

September 9, 1959

ABSTRACT OF USERS' PROJECT NO. 550

CLASS 2

Title: VERTICAL ALIGNMENT TEMPLATE PROGRAM

Originator: CHAS. W. COLE & SON
Engineers and Architects

Address: 3600 EAST JEFFERSON BOULEVARD
SOUTH BEND 15, INDIANA

Mode: INTERCOM 1000 (D.P.)

Date: AUGUST 10, 1959

The program will supply data showing pavement centerline, edge pavement, and shoulder elevations in vertical curve, superelevated position or in superelevation transition. The program will handle stations in normal series as chosen by designer and extra plus stations as determined by designer. The program will handle the following applications with some alteration of the Input Data.

(a) Vertical Alignment Showing Profile Line Only

(b) Vertical Alignment Template Interstate

(c) Vertical Alignment Template - Single Pavement

(d) Vertical Alignment Template - Street Pavement, showing Curb and Gutter Elevations

Wyoming Highway Department

HEADQUARTERS OFFICE

Cheyenne, Wyoming

ABSTRACT OF USER'S PROJECT NO 551

CLASS 1

TITLE: STATISTICAL ANALYSIS OF SPEED STUDY BY SELECTED GROUPS OF REPORTING STATIONS

ORIGINATOR: WYOMING HIGHWAY DEPARTMENT

ADDRESS: P. O. Box 931; Cheyenne, Wyoming

MODE: M.L. S.P.

DATE: October 28, 1960

Input: punched cards giving numbers of Vehicles observed traveling at rates of speed 2 mod 2 between 2 MPH and 100 MPH inclusive. Location of punches indicates velocity.

Required: to compute and/or print out MPH, △ Vehicle, cum. total, cum. % for each 2 MPH mod 2 which contains Vehicles, and finally to compute and print out the arithmetic mean speed, median speed, and 85% tile speed.

This program was written to use the same cards punched for use with U.P. 545 - 1, statistical analysis of Speed Survey. Where U.P. 545 - 1 analyzes the stations individually, this program analyzes selected groups of stations; Interstate highway system, State secondary, city streets, etc.

Abstract of Users Project No. 552
Class 2

Title: 3^n FACTORIAL DESIGN EXPERIMENT

Originator: Scientific Design Company, Inc.
Address: 2 Park Avenue, New York 16, New York
Mode: Intercom 1000 (S.P.)
Date: December 1, 1959

The function of the 3^n FACTORIAL DESIGN EXPERIMENT program is to compute the Main Effects (linear and quadratic) and the two factor Interaction Effects, and their respective sums of squares for n quantitative factors at three levels each ($2 \leq n \leq 5$). Each factor may have r replicates at each level ($1 \leq r \leq 100$). After the three levels for each factor has been assigned, all possible treatment combinations are tested r times. The results or responses of these tests are then arranged in a standard order and the replicates of each response are grouped together. If, for example, we have three factors, A, B, and C with respective levels, (1), a_1, a_2, (1), b_1, b_2, (1), c_1, c_2, the standard order for the first factor A would be (1), a_1, a_2. To introduce the second factor B ((1), b_1, b_2,) two more sets of three are formed by multiplying the above sequence by b_1 and b_2, respectively, to produce the following sequence of nine, (1), a_1, a_2, b_1, a_1b_1, a_2b_1, b_2, a_1b_2, a_2b_2. To extend the analysis to another factor C, the levels c_1 and c_2 are multiplied, respectively, by the above sequence of nine to produce a sequence of twenty seven. The extension to four or more factors is obvious. Thus, b_1 denotes the second level of B and the first levels of A and C and $a_1b_1c_2$ denotes the second level of A and B and the third level of C.

Using the responses in the standard order, the program sums the replicates, if any, for each treatment combination, performs a series of three operations on the summed responses, which are regarded as sets of three, and computes these operations n times. These operations, which are equivalent to the sum, slope or linear effect, and curvature or quadratic effect are shown below:

Sum:	$(y_1 + y_2 + y_3)$
Slope:	$(y_3 - y_1)$
Curvature:	$(y_1 - 2y_2 + y_3)$

A complete description of this method introduced by Yates is found in the program description. The Main Effects (linear and quadratic) and the two factor Interaction Effects are then respectively squared and divided by the sum of squares of the coefficients of the responses contributing to the effect. It can be shown this divisor equals $2^m . 3^{n-p} . r$ where m is the order of the interaction, p is the number of linear terms, n is the number of factors examined, and r is the number of replicates. The program also evaluates the Total Corrected Sum of Squares (TSS) and the Error Sum of Squares (SSE). The results are rearranged in groups of Main Effects (linear and quadratic) and two factor Interaction Effects and are typed out. A complete output format is found in the program description.

This program does not evaluate qualitative factors. The input requires $4.r.3^n$ seconds, the calculations require $2n^2 + 3^n(n+1)$ seconds, and the output requires $3^{0.63n}$ minutes. A complete description of the principles involved in factorial experiments may be found in DESIGN and ANALYSIS of INDUSTRIAL EXPERIMENTS, ed. Owen L. Davies, New York, Hafner Publishing Company, 1956.

ABSTRACT OF USERS' PROJECT NO. 553

Class 1

Title: LEAST SQUARES SINE FIT

Originator: J. T. Cheeseman
Address: Corn Products Co.
Argo, Illinois
Made: Intercom 1000 (S.P.)
Date: 11-8-60

This program determines by the method of least squares the constants for the following equation:

$$y = a(\sin x)^n$$

This program also computes the standard deviation of the calculated values from the observed values to show how well the data can be represented by the above equation.

Input consists of pairs of x and y values. The restrictions for this program are: (1) maximum of 50 sets of X and Y values, & (2) all X and Y values must be greater than zero.

Running time is approximately,

T = 10 X (Sets of data) + 10 Seconds.

ABSTRACT OF USERS' PROJECT 554

Title:	AROWA FLEXOPAR - 1 (Flexopar)
Originator:	US Navy Weather Research Facility
Date:	3 November 1960
Mode:	Machine Language

Class I

Flexopar (Flexowriter Program Assembly Routine) is a program designed to make possible the convenient assembly of machine language programs by means of a Friden Flexowriter compatible with G-15 punched tape codes.

Machine language commands are punched on tape at the Flexowriter in the following format:

```
 LL  (tab)  P.TT.NN.C.SS.DD   (tab)   LL  (tab)  P.TT.NN.C.SS.DD  (car rtn)
/LL  (tab)  P.TT.NN.C.SS.DD   (tab)   LL  (tab)  P.TT.NN.C.SS.DD  (car rtn)
                              etc.
```

The prefix P, which must always be typed, has the value u, w, or O, denoting an immediate, deferred, or unspecified prefix, respectively. In the case of the unspecified "O" prefix, Flexopar will assign a prefix to the command and possibly modify TT, after the fashion of PPR, depending on the values of LL, TT, and DD.

Sexadecimal constants, and decimal fractions and integers may also be entered in the following format:

```
LL  (tab)  F.NNNNNNN    (tab)    LL  (tab)  F.NNNNNNN  (car rtn)
                        etc.
```

where the prefix F has the value x, y, or z, to specify that NNNNNNN is a decimal integer, a decimal fraction, or a sexadecimal constant, respectively. This prefix F must always be punched. Note that numbers and commands may be intermixed in any order, eg.

```
LL  (tab)  F.NNNNNNN    (tab)    LL  (tab)  P.TT.NN.C.SS.DD  (car rtn)
                        etc.
```

The foregoing format may be modified by any interchange of tabs and carriage returns, at the fancy of the operator.

In addition to its Flexowriter assembly functions, Flexopar also contains provision for making single entries through the G-15 typewriter, interrogating and listing, forcing checksums, punching tapes, and ordinary input-output functions. Flexopar occupies Lines 05, 14, 15, 16, and 17. Programs are assembled into Line 18. No auxiliary equipment is needed other than the Flexowriter.

ABSTRACT OF USERS' PROJECT 554-1A

Title:	AROWA FLEXOPAR -1A (Flexopar)
Originator:	US Navy Weather Research Facility
Mode:	Machine Language
Date:	28 February 1961

Class I

(This program supersedes UP 554-1, AROWA FLEXOPAR - 1.)

Flexopar is a service routine designed specifically for the convenient assembly of machine language programs prepared initially by means of a Friden Flexowriter. Programs so prepared consist of standard decimal commands, decimal fractions and integers, and sexadecimal numbers. These various items may be punched on tape at a Flexowriter in a format such as the following:

```
 LL  (tab)  P.TT.NN.C.SS.DD   (tab)   LL  (tab)  P.TT.NN.C.SS.DD  (car rtn)
/LL  (tab)  P.TT.NN.C.SS.DD   (tab)   LL  (tab)  x.IIIIIIII       (car rtn)
/LL  (tab)  z.HHHHHHH         (tab)   LL  (tab)  P.TT.NN.C.SS.DD  (car rtn)
/LL  (tab)  P.TT.NN.C.SS.DD   (tab)   LL  (tab)  y.FFFFFFFF       (car rtn)
```

etc.

Note that commands, decimal numbers, and sexadecimal numbers may be intermixed in any desired order.

In the above example, LL is the word-time into which the following item is to be inserted. The prefix P appearing in the commands must always be typed, and has the value u, w, or O, denoting immediate, deferred, or unspecified operation, respectively. In the case of the unspecified "O" prefix, Flexopar will assign a prefix to the command, and possibly modify TT, after the fashion of PPR, depending on the values of LL, TT, and DD.

Decimal integers IIIIIIII and decimal fractions FFFFFFFF consist of eight digits, and are preceded by the flags "x" and "y", respectively, as shown above. Sexadecimal numbers HHHHHHH consist of seven digits, and are preceded by the "z" flag.

In addition to its chief function of program assembly, Flexopar also contains provision for transferring data between long lines, input and output, forcing checksums, interrogating, listing, and making individual insertions through the G-15 typewriter. Provision also exists for the easy correction of errors punched on the Flexowriter tape. This routine is superior to Flexopar - 1 in that the lister has been greatly improved, and decimal numbers may be entered with greater accuracy.

A B S T R A C T

Users' Project #555

Title: Analysis of Multistory Building Frames

Originator: Enelco Limited

Address: 164 Eglinton Avenue East, Toronto 12, Ontario.

Mode: G15D Machine Language

Class: 2

Date: October 19, 1960.

DESCRIPTION:

This program will analyse building frames of less than 100 joints without overlapping. Results are obtained by moment distribution using successive approximation to converge on the final result. Data is prepared off-line by flexowriter and read in under control of the program. The program must be loaded on magazines, Since storage is limited various routines are stored externally and both back and forward reads are employed.

Any degree of base fixity may be handled by inserting appropriate inertia values to imaginary members at the base.

Limitations:

1. The number of joints is limited to 100. All members must be prismatic.

2. The frame may be of any shape providing it has a regular grid, i.e. no offset columns nor any missing columns.

WORTHINGTON CORPORATION
HARRISON, NEW JERSEY

November 11, 1960

Abstract of Users' Project No. 556

Title: Special loader hereafter called 500XN loader for automatic shift from 1000 single or double Precision to 500X

Purpose: During extensive unsupervised work this routine will prove useful to change from 1000 single or double precision to 500X without manual intervention. This permits a greater variety of unattended computation.

Abstract: This routine consists of the basic Intercom 500X package coupled with a new loader which is executed as a subroutine of Intercom 1000 single or double precision. Commands incorporated in this loader allows Intercom 500X to be read in under the control of Intercom 1000 without manual intervention of the G - 15 operator. An additional block of tape is read into channel nine which can consist of an initial command at 0900 followed by any program. The command counter set at 0899 so that computation will begin under control of Intercom 500X at location 0900.

Operation: The special Intercom 500XN loader must be stored in channel nine. Either of two Intercom 1000 commands may be used to initialize this routine. They are 290900 and 080901. The subroutine stores the Intercom 1000 command 080901 in location 00 of line nine. The contents of the accumulator are unchanged by the routine.

Equipment: Basic Bendix G15D, 1000 S.P., D.P. and 500X.

Disclaimer: The Worthington Corporation assumes no responsibility for possible errors in this program.

William Fleischman

William Fleischman

WF:lcw

Abstract of Users Project No. 557
Class 1

Title: DESIGN OF SINGLE RECTANGULAR REINFORCED CONCRETE CONDUIT

Originator: U.S. Army Engineer District, Los Angeles, Corps of Engineers
Address: 751 South Figueroa Street, Los Angeles 17, California
Mode: Intercom 1000 (SP)
Date: July 1960

Given the loading conditions, inside dimensions of structure and preliminary wall and slab thicknesses, this program will design a single rectangular reinforced concrete conduit. The program computes fixed end moments for 4 loading conditions; makes a moment distribution for all fixed end moments; computes shears, reactions, and normal or thrust forces; computes the adjusted moments and required thickness for all sections. If required thickness does not equal preliminary thickness, program automatically recomputes problem using required thickness as new preliminary thickness.

Conduit and loads must be symmetrical about a vertical centerline. Live load must be considered as a uniform load, distributed over the entire span in accordance with AASHO. Internal pressure is either zero or varies from zero at soffit to normal hydrostatic pressure at the invert.

Input includes height of earth fill; pavement thickness; preliminary wall and slab thicknesses; minimum allowable wall and slab thicknesses; unit weight of earth, concrete, pavement, and water; lateral earth pressure; lateral pressure due to live load surcharge; live load and impact on top and bottom slabs; concrete cover to center of gravity of reinforcing steel in walls and slabs; allowable bond, shear, compressive stress in concrete, tensile stress in steel; ratio of modulus of elasticity in steel to that of concrete; allowable K value; and wearing surface of bottom slab.

The output format is shown in the writeup. Output includes positive and negative design moments, K values, and area of steel required per foot of channel at each foot of span of walls and slabs; the diagonal tension and perimeter of bars required at each interior face; design thicknesses of conduit; the input data for a check; and volume of concrete per foot required for the structure.

Data input requires 7 minutes. The time required for calculation and typeout varies between 20 and 50 minutes depending upon the number of times the thicknesses are revised. No auxiliary equipment is used.

Abstract of Users Project No: 558
Class: 1

Title: Bessel Function of the First Kind with a Complex Argument

Originator: National Research Council of Canada.

Date: November 2, 1960

Mode: Intercom 1000 Double Precision (.3121959)

Abstract: The program calculates the Bessel function $I_n\ (Re^{i\phi})$ from the series expansion

$$I_n(Re^{i\phi}) = u + iv = i^{-n}\ J_n(iRe^{i\phi})$$

$$= \sum_{t=0}^{\infty} \frac{1}{t!(n+t)!} \frac{R}{2}^{n+2t} \cos\ (n+2t)\phi$$

$$+ i \sum_{t=0}^{\infty} \frac{1}{t!(n+t)!} \frac{R}{2}^{n+2t} \sin(n+2t)\phi$$

Range: n a positive integer.

Input: Enter the values for n, R and ϕ.

Output. The real and imaginary parts, u and v, are typed out in floating point form.

Accuracy: at least nine digits

Execution Time: Depends on n and R, 40 seconds minimum.

Disclaimer:

Title: Intercom Check-Summing Subroutines

Originator: National Research Council of Canada

Date: November 1, 1960

Mode: Two versions are presented; for Intercom 500 and Intercom 1000 DP (.3121959)

Abstract:

These two programs perform certain operations in check-summing channels of interpretive memory. These are as follows (with the entering word position shown; note analogy to Intercom operation code).

	Entering Word Position
(a) Compute and type out the check sum of any channel, with the format CHOO .xxxxxxx	42
(b) Insert check sum in any channel, type channel number and check sum, punch channel.	39
(c) Read a tape punched by (b), and verify the check sum. If incorrect, ring bell, reverse tape and read again.	55
(d) Reverse paper tape one block	52

Disclaimer: No responsibility is assumed by the National Research Council of Canada for any errors or misrepresentations that may occur as a result of using this program. No responsibility is assumed by the Bendix Computer Division for the correct reproduction of this program.

Wolf

Research and Development Corporation

462 Boylston Street, Boston 16, Massachusetts COmmonwealth 6-1960

ABSTRACT of Users' Project No. 560

Title: AN/GMD-2 Data Reduction

Originator: Wolf Research and Development Corporation
Address: 462 Boylston Street, Boston 16, Massachusetts
Mode: Machine Language (S. P.)
Date: October 21, 1960

Given the output of an AN/GMD-2 (RAWINSONDE) sounding system, this program produces wind velocity and direction in successive zones of 2,000-foot thickness; and geopotential, atmospheric pressure, temperature, dewpoint temperature and relative humidity at various designated levels.

Input is by typewriter and consists of slant range, azimuth angle, elevation angle, temperature element frequency and humidity element frequency observations taken by the AN/GMD-2 system at constant time intervals along the flight path of the balloon. The temperature and humidity observations are corrected for frequency drift before insertion into the computer.

Output is by typewriter and is in two parts:

1. The wind velocity, direction, and the height of the zone ceiling above mean sea level for each successive zone are typed out as computed.

2. The geopotential, atmospheric pressure, temperature, dewpoint temperature, and relative humidity are computed and typed out whenever the input data indicates that:

   (a) A pressure level has occurred along the flight path which is a multiple of 50 millibars.

   (b) The balloon has passed into a stratum having a temperature lapse rate or vertical gradient different from the previous stratum.

Abstract of Users' Project No. 561

The FPR code for any format character is the octal digit corresponding to the three bit binary representation of the character. These code digits are entered successively as hexadecimal digits - that is, a zero is prefixed to the three bit binary representation. FPR squeezes these extra zeroes out to form the hexadecimal constants corresponding to the desired format. These constants are then stored in locations 0714 and 0715 of the Intercom 500X memory. These locations are used as the format for the 33 - fixed point output - code.

INTERCOM 1000 DOUBLE PRECISION MACHINE-
LANGUAGE SUB-ROUTINE TO FIND CLEAN TAPE

Abstract of Users' Project No.562

This program allows the programmer to relieve the operator of the task of finding clean tape. While using Intercom 1000 Double Precision and in the automatic mode it is possible to locate clean tape on up to four magnetic tape units. On the other hand the operator may utilize the program independently and without Intercom to locate clean tape on any one of four tape units.

Abstract of Users' Project No. 563
Class 1

Title: ALGO STAPER

Originator: The Standard Oil Company (Ohio)
Address: Midland Building, Cleveland 15, Ohio
Mode: Machine Language
Date: September 29, 1960

ALGO Source Tape Routines. It is the intention of this project to provide the user with a set of four routines which permit the preparation of ALGO source programs on punched tape. A list of the advantages of having source programs on tape might include the following:

1. A hard copy, or listing, of a taped ALGO source program can be made at any time.
2. Source programs can be changed with a minimum of re-typing.
3. Functions, algorithms, etc. can be taped and used in more than one program without being re-typed.
4. Extra print statements may be inserted to aid in checking out the logic and computation methods of complex programs. The extra statements may then be easily deleted from the source tape before the program is re-compiled.

This project also provides the user with a copy of the ALGO Editor routine (loader check sum .8031960), modified to accept ALGO statements on punched tape.

A brief description of the functions available to the user follows:

Function 0: "Pre-Editor" - This routine accepts an ALGO statement from the typewriter and echoes it from memory to be proofread by the operator. If the statement in memory is approved by the operator, it is punched on paper tape. If the statement is not approved, the routine returns to the statement type-in phase.

Function 1: "Reader" - ALGO statements are read one at a time from punched tape and listed on the typewriter.

Function 2: "Reproducer" - A routine similar to the "Reader", except that statements are duplicated on punched tape rather than listed.

Function 3: "Corrector" - This routine is helpful when a previously prepared ALGO statement tape is to be modified by deletion of old statements and/or insertion of new statements. A statement is read from tape and typed out. The operator then has the option of: (a) duplicating the statement as it stands, (b) deleting the statement, or (c) replacing the statement with one or more new statements which he then may type, proofread, and have punched.

An additional function, the "Checker", is also available. This routine provides the operator with an echo check of any series of characters he types into the computer.

HRBraden/mmh
10/17/60

Abstract of Users Project No. 563-1A
Class 1

TITLE: ALGO STAPER (REVISED FOR MAGNETIC TAPE MASTER)

ORIGINATOR: E. I. du Pont de Nemours and Co., Inc.
ADDRESS: Eastern Laboratory, Gibbstown, New Jersey
MODE: Machine Language
DATE: March 3, 1961

ALGO Source Tape Routines. This is similar to the original version of this project in that it provides the following service routines:

1. Pre-Editor. A routine for accepting ALGO statements from the typewriter and punching them on paper tape, one statement per block. Provision is made for correcting statements if errors are made in typing statements.

2. Reader. A routine for reading statements from a source tape and listing them on the typewriter.

3. Reproducer. A routine for duplicating source tapes.

4. Corrector. A routine for duplicating, correcting, adding, or deleting statements in a source tape.

5. Checker. A routine for echo checking characters on the alphanumeric typewriter.

The project also includes a copy of the ALGO Editor routine (u281960), modified to accept ALGO statements on punched tape.

In addition to the routines provided by the original version of this project, this revision also includes a housekeeper routine for recording ALGO Staper on magnetic tape along with the rest of the ALGO program, so that the entire system is included in one magnetic tape master program.

ABSTRACT OF USERS' PROJECT NO: 564

CLASS: 1

TITLE: A Program to Evaluate Over-all Interchange Factors for Radiant Heat Transfer Calculations

ORIGINATOR: National Research Council of Canada, Ottawa

MODE: Intercom 1000 SP

DATE: October, 1960

ABSTRACT: For two walls, m and n, of a room with temperatures T_m and T_n, and areas A_m and A_n, the net heat transfer rate by radiation is given by

$$q_{net} = A_m \, {}_mF_n \, \sigma \, (T_n^4 - T_m^4)$$

where σ is a constant. The over-all interchange factor ${}_mF_n$ depends on the geometry of the room and the emissivities of the surfaces. The calculation of ${}_mF_n$ requires the calculation of N + 1 determinants of order N, N being the numbers of surfaces involved. This program will calculate ${}_mF_n$ for up to 12 surfaces in 0.002 N^4 hours.

ABSTRACT OF USERS' PROJECT NO: 565
CLASS: 1

TITLE: Moseley Plotter Output Subroutine

ORIGINATOR: National Research Council of Canada, Ottawa

MODE: Two versions: one for Intercom 500X, one for Intercom 1000 DP (.3121959)

DATE: 4 November, 1960

ABSTRACT: These one-channel Intercom subroutines will output numbers from interpretive memory in a format for plotting on an F. L. Moseley Company Model 2A point-plotter with Model 50 tape translator and type D3 character printer. Tape format is

$\pm$xxx0 tab $\pm y_i y_i y_i S_i$ tab .... $\pm y_n y_n y_n S_n$ CR

where $n \leq 6 \quad 1 \leq i \leq n$

S_i is symbol to be plotted, $S_i = 1,2,...6$

xxx is the value of the x-variable

$y_i y_i y_i$ is the value of the i th y-variable to be plotted against x.

x and y must lie between ± 1. Each "tab" and "CR" is followed by a "stop code". The "plus" sign is punched as a "zero" digit. Information as to S_i and n is entered by the operator as a sexadecimal number.

The write-up includes operating instructions for N.R.C.'s Moseley plotter system.

Changes in MAP-29

ABSTRACT OF USERS' PROJECT NO. 566

The changes provide the following options and facilities:

(1) In the input routine, return to master control via scf, and the ability to load columns of zeros.

(2) A code "Z" typein for the output routine which initiates typeout of diagonal elements only.

(3) The changes of U. P. 277 in multiplication and interpreter routines.

(4) During transposition, a specified number of elements at the end of each row of the matrix can be punched out.

USERS' PROJECT NO. 566-1A

ABSTRACT

"Changes in MAP-29 - Correction and Revision"

Routine .05 of MAP-29 (matrix output) has been changed to incorporate a correction in the initial address set-up, and to permit punching rather than type-out of the diagonal elements of the matrix, if desired.

Wyoming Highway Department

HEADQUARTERS OFFICE

Cheyenne, Wyoming

ABSTRACT OF USER'S PROJECT NO.567
CLASS 1

TITLE: W-6 Table, Loadometer Study

ORIGINATOR: Wyoming Highway Department

ADDRESS: P. O. Box 931; Cheyenne, Wyoming

MODE: M.L. S.P.

DATE: December 2, 1960

Given: axle weights and spacings for various trucks weighed at field check points.

Required: to analyze this data for violations of State of Wyoming law and AASHO recommendations and, where any violations occur, to print out the data for table W-6 as defined by BPR circular memo dated July 11, 1960. Subject "Instructions for Reporting 1960 Truck Weight and Vehicle Classification Study."

Abstract of Users Project No. 568

Class 2

Title: RETAINING WALL ON PILE FOOTING

Originator: Richardson, Gordon and Associates
Address: 3 Gateway Center, Pittsbrugh 22, Pennsylvania
Mode: Intercom 1000 Single Precision
Date: November 1960

Given the physical dimensions of the stem and footing, location of piles (pile may be vertical or battered), backfill conditions, and allowable design stresses, this program will compute: the summation of the horizontal and vertical forces; the centroid of the vertical forces; the horizontal and vertical pile loads; the effective depth, the reinforcing steel area and perimeter required, and the shear at the critical sections for both heel and toe; the effective depth, reinforcing steel area and perimeter required for every one foot increment along the height of the stem; and also the shear at the base of the stem. The program will handle level backfill with or without surcharge, sloping backfill with or without surcharge and either case with or without a saturated condition.

The heel may be designed with or without footing pressure.

The output format is shown in the write-up.

The mathematical method follows the fluid pressure theory and all equations and assumptions are detailed in the writeup.

Computation and output time varies depending on the height of the wall but runs on the average five minutes per problem.

Program Abstract

Users Project No. 569

Title:	Seidel aberration program, RT-5
Class:	2
Equipment and Mode of Operation:	G-15D machine language.
Originator:	Optical Design Department, A. & O. Div., Eastman Kodak Co.
Program description:	The program traces a paraxial and a paraxial principal ray through a given lens, calculates and types out the seven Seidel aberration contributions at each surface, and then types the seven sums. Alternatively, only the sums may be typed.
Input data:	Lens data, and starting ray data.
Output:	Paraxial ray closing data, and all the Seidel contributions.
Limitations:	Maximum number of surfaces = 26 Maximum refractive index < 8 Maximum linear distance < 10 Maximum surface curvature < 10
Overflow halts:	An overflow halt is included at each surface.
Operating time:	Computation: 3 secs per surface Typeout: 7 secs per surface
Subroutines:	All necessary subroutines are included in the tape.
Originator:	R. Kingslake, Dept. 151, A. & O. Division Eastman Kodak Company, Rochester 4, New York

No responsibility is assumed by the originator or by the Eastman Kodak Company for any errors, mistakes, or misrepresentations that may occur, or damage that may result, directly or indirectly, through the use of this program. It is hoped that users will report any failure of the program to operate correctly under any particular set of circumstances so that the program itself may be corrected and rectified.

Abstract of Users' Project No. 570
Class 2

Title: Traverse Adjustment

Originator: Reynolds, Smith and Hills

Address: 227 Park Street - P. O. Box 4817, Jacksonville 1, Florida

Mode: Machine Language (D.P.)

Date: December 20, 1960

This program is a traverse adjustment program incorporating the compass and the transit rule methods of adjusting field measurements. It will process an unlimited number of traverses, each with an unlimited number of courses, without the necessity of re-reading the program for each traverse. The choice of adjustment of the traverse is optional; the selection being made after observation of the errors in latitude and departure.

The program was designed as an improvement to Applications Project #32. The major features which have been changed include unlimited traverses with unlimited courses, the joint type out of the unadjusted and adjusted traverses as the computation progresses around the traverse, and optional alphanumeric headings. A choice of angular input and output, as well as an area calculation of the unadjusted and adjusted traverses has also been added.

Input data is prepared on an off-line Flexo-writer, but an optional program is included for data preparation on the computer typewriter. Output is via the typewriter; output may be straight numeric or alphanumeric typeout as desired. The changes necessary to convert the program from alphanumeric to numeric are included in the report.

The data is processed twice. On the first pass the calculation requires three seconds per course. The length, error in x, error in y, and area in square feet and acres are typed out after all the courses are processed. On the second pass the tape is processed at the rate of 25 seconds per course for the typeout of the unadjusted and adjusted traverses. The station, distance, direction, and coordinates x and y for each course are printed. The print out for the unadjusted traverse requires 10 seconds per course, if the adjusted traverse is not desired.

Subroutines borrowed from A.P. #32 include sine-cosine, arctan, and square root of x. The four original conversion routines were re-written to make use of the special extract command and line 02. The routines are decimal-binary, binary-decimal, decimal-binary for angles to circles and binary-decimal for circles to angles.

The accuracy is .001 feet for distances and coordinates and .01 seconds for directions.

Abstract Of Users Project No. 571

Class 2

Title: BOND RETIREMENT SCHEDULE

Originator: Consoer, Townsend & Associates

Address: 360 East Grand Avenue, Chicago 11, Illinois

Mode: 1000 DP

Date: December 27, 1960

The principal payments and interest payments for each year are computed while retiring the bond issue in the least possible number of years commensurate with:

1. Amount of Issue
2. Rate of Interest
3. Estimated Revenue
4. Estimated Operating Costs
5. Depreciation
6. Reserve Required
7. Annual Coverage Factor Required
8. Minimum Principal Payment
9. Principal Rounding Required

Abstract of Users Project No. 572
Class 2

Title: TURBINE SPEED RISE AND WATER HAMMER ON LOAD REJECTION

Originator: Tippetts-Abbett-McCarthy-Stratton
375 Park Avenue, New York 22, New York
Mode: Intercom 500X
Date: January 1, 1961

1. DESCRIPTION

This program performs the arithmetic integration required to determine the magnitude of the turbine speed rise and water hammer arising during the process of closure of the guide vanes of a turbine after load rejection.

2. INPUT

Input consists of the following data:

a. The length and cross section area of the conduit.

b. The celerity of wave propagation in the conduit.

c. The runner diameter, the polar movement of inertia of rotating masses and the performance characteristics (this last item in the form of tabular values of unit H.P. and efficiency versus unit speed and guide vane opening) of the turbine.

d. The initial condition of the system which includes the initial water head, turbine speed and guide vane opening before gate closure.

e. The guide vane governor characteristics which include the effective time of closing, the dead time and cushioning characteristics, if any.

3. OUTPUT

The program will type out, for each time instant as determined by the guide vane governor characteristics until full closure, the following quantities:

a. Time elapsed since initiation of closure.
b. Guide vane opening.
c. Water head.
d. Turbine speed.
e. Unit speed, unit horsepower, efficiency and horsepower of turbine.
f. Discharge and velocity of flow in conduit.
g. Incremental change in velocity and time elapsed.

4. OPERATING TIME

The program will operate in either the English or the metric units, depending on the specification of a code number in the input procedure. The average time of computation and typeout between two time instants is a little more than one minute.

Abstract of User's Project No. 573

Class 1

Title: Rectangular Coordinate and Velocity Transformation

Originator: A. Dennis, Radio Corporation of America

Address: Patrick Air Force Base, Florida

Mode: Intercom 500X

Date: 5 January 1961

This routine will accept X, Y, Z position and velocity in a given earth-oriented, coordinate system and transform them through a geodetic transformation to any other earth-oriented coordinate system.

Twelve possible transformations are included such as earth tangent (coordinates) to earth center, earth tangent to earth tangent, etc. Also available are transformations from an earth-fixed system to a space fixed (inertial) system. Accuracy is limited to single-precision.

In addition, six input-output operation "pairs" are available, utilizing paper tape, the standard typewriter, and the flexowriter. Continuous automatic operation is possible to accomodate large quantities of data.

Abstract of Users Project No. 574

Class 2

Title: TUBE LENGTH, BEND AND TWIST CALCULATIONS

Originator: Canadian Pratt & Whitney Aircraft Company Limited

Address: P. O. Box 10, Longueuil, Quebec, Canada.

Mode: Intercom 500X

Date: December 8, 1960.

Given the projected dimensions off the front and side views of a piece of tubing having up to 18 bends, this program will compute the true length of all straight sections, the angle of bend between them, the total developed length of the tube and the direction and angle of twist between successive legs.

A minimum of two bends and a maximum of 18 bends may be handled although tubes with more than 18 bends may be processed in two or more parts.

Operating time including printout is approximately 20 sec./bend.

Prog. No. 149

FOOTING---- DESIGN AND/OR ANALYSIS

This program will design and/or analyze a rectangular footing with vertical loads and with horizontal loads in two directions applied at the top of the pier. Design depends upon given safety factors and allowable soil pressure and is accomplished by incrementing the length (6" increment); whereby the width is determined by the given ratio. The calculation of soil pressure is based on full bearing on the bottom of the footing. Code allowances regarding combined wind and other loads may be attained by changing the allowable unit stresses accordingly.

INPUT

The required input is as shown on the data form and further described as follows:

Code-Design: Enter "+1", the program will compute "L" and "B" to meet minimum safety factors, and allowable soil pressure.

Analysis: Enter "-1", the program will compute the safety factors and soil pressures for the input dimensions.

+
-B/L- Where a (+) value will change the width in that ratio, each time the length is incremented; a (-) value will compute the initial width for the given length and this width is maintained throughout. (B/L, less than or equal to 1.0)

W.L.- Wind load is used in a downward sense for calculation of maximum loading, and upward for minimum loading.

L.L.- Live load is used in a downward sense for calculation of maximum loading; not used at all for calculation of minimum loading.

p- Maximum allowable soil pressure is used for design only.

S.F.- Minimum safety factors are used for design only. Enter required minimum values except that the minimum value of "S.F.O." should be at least 1.5 in order to insure full bearing.

C & μ_s- Cohesion and coefficient of friction of soil to soil used in resisting uplift.

C_a & μ_c- Adhesion and coefficient of friction of soil to concrete used in resisting sliding.

March 30, 1960

FOOTING DESIGN AND/OR ANALYSIS CONT'D

OUTPUT

The format for either design or analysis will be the same and is as follows:

	JOB NO.	REF. NO.	PROG. NO.		
	S.F.O. (B)	S.F.O. (L)	Lo (ft)		
	S.F.S. (B)	S.F.S. (L)	Ls (ft)		
	S.F.U.	Lu (ft)			
	p_1 (p.s.f.)	p_2	p_3	p_4	
	Bp (ft)	Lp			
(L-direction)	M-all. (ft. kips)	M-act. (ft. kips)	v (p.s.i.)	A_s (sq. in)	Σ_o(in)
(B-direction)	M-all.	M-act.	v	A_s	Σ_o

Where moments, A_s (area of steel), and Σ_o (perimeter) are total for that dimension.
There will be no type out of Safety Factors in the direction of zero loads.
S.F.O. (B) means Safety Factor for overturning in the (B) direction; etc.
The lengths L_o, L_s, L_u, L_p, and B_p are those used in the computation of safety factors and bearing pressures.
A.C.I. specifications were followed in the design and the above values of A_s(total) may be decreased 15 percent for footings subjected to bending in two directions.
If the actual moments are greater than the allowable and if "v" is greater than a desired maximum, changes in the footing dimension should be made by the designer and the problem rerun.

NOTE:
The program computes factors of safety as follows:

$$S.F. = \frac{\text{Resisting forces}}{\text{Overturning forces}} \quad \text{thus,}$$

$$S.F.O. = \frac{W \times \frac{b}{2}}{H(a+d+t) + W.L. \times \frac{b}{2}} \quad ; \quad S.F.S. = \frac{W \times f}{H + W.L. \times f}$$

$$S.F.U. = \frac{W + Fc + Fu}{W.L.}$$

where: W= D.L + FTG + Soil
f= u and/or C
Fc= Cohesive Forces
Fu= frictional Forces
b = width of footing in direction of overturning

March 30, 1960
Revised. June, 1960

Abstract of Users' Project No. 576

CLASS 1

The energy carrier of dominant interest in commercial seismic exploration is th P- wave, and the division of the energy of this wave into four other waves is of considerable importance. Towards the end of the last century Knott analysed the division of the energy of plane waves impinging upon a boundary between media with differing accoustic impedences. Much tedious work is involved in the solution of Knott's equations with simple desk calculators, but the program below provides a series of points for various angles of incidence very quickly.

ABSTRACT

Class I

Three Element Shunt II Band Pass Filter - Full "T" Section

This program permits automatic computation and listing of circuit constants for any desired combinations of frequency, band pass width, and terminal impedance. Provision has been made to type in up to ninety-nine (99) values of frequency, m (ratio of lower cut-off frequency to upper cut-off frequency), and terminal resistance. This permits automatic computation and listing of as many as 970,299 sets of filter constants with one loading of input data. The type-out includes:

1. Lower cut-off frequency (f_1)
2. Ratio (m) of lower cut-off frequency to upper cut-off frequency.
3. Upper cut-off frequency (f_2)
4. $\omega_0 = 2\pi f_0$ where $f_0 = \sqrt{f_1 \times f_2}$
5. Terminal resistance (R)
6. Shunt inductance ($\frac{1}{2} L_2$)
7. Series capacitance (C_1)
8. Shunt capacitance ($2C_2$)

Allan R. Brown
LAND-AIR, INC.
7444 West Wilson Avenue
Chicago 31, Illinois

Abstract of Users Project No. 578

Class 2

Title: RIGHT-OF-WAY GEOMETRY

Originator: Richardson, Gordon and Associates
Address: 3 Gateway Center, Pittsburgh 22, Pennsylvania
Mode: Intercom 1000 Double Precision
Date: January, 1961

With a given roadway alignment and the adjacent right-of-way line control points defined by one of the three (3) methods described below this program will compute the geometry of the right-of-way line, including the north and east coordinates of the given control points and the distances and corresponding direction azimuths between the control points.

The roadway alignment may be on tangent, curve or spiral or any odd combination of the three. The roadway alignment may also include up to two station equations.

As mentioned, the right-of-way line control points may be defined by any one (or combination) of the three methods which are as follows:

Case 1 - by station and offset from the given roadway alignment.

Case 2 - by a station on the given roadway alignment at which a radial line extended will intersect a line with known direction azimuth passing through a known coordinated point.

Case 3 - by the north and east coordinates of the right-of-way line control point and an approximate station radially opposite the control point on the given roadway alignment.

The output format is shown in the write-up and standard equations for horizontal alignment are used in the mathematical method.

Computational and output time varies depending on the length of the problem. The program will handle up to eight (8) lines in the alignment traverse, unlimited number of right-of-way control points and two station equations per run. The average running time per right-of-way control point varies between 45 seconds and 1-1/2 minutes.

Abstract of Users Project No. 579
Class 2

Title: FIXED POINT PUNCTUATION SUBROUTINE

Originator: Reynolds, Smith and Hills
Address: P. O. Box 4850, Jacksonville 1, Florida
Mode: Machine Language Subroutine for Intercom 1000D
Date: January 17, 1961

This subroutine provides fixed point punctuation for typing the contents of the accumulator. Commas are inserted in the integer portion. The number may be preceeded by a $ sign or a space as desired. The number of digits to be typed before and after the decimal point may be specified. The sign is typed following the right hand digit. The alphanumeric typewriter is required.

ABSTRACT
Users' Project No. 580

TITLE: Highway Earthwork Quantities and Design Data

TYPE: General

CLASS: 1

EQUIPMENT AFFECTED: G-15D, machine language; Flexowriter

SUBROUTINES USED: None

ORIGINATOR: The State of Illinois, Division of Highways, Bureau of Research and Planning

GENERAL DESCRIPTION: This program differs from the original earthwork program and its modifications previously contributed as Users' Project No. 21 in the following respects:

1. The running time is twice as fast, ± 37 seconds per cross section.

2. One program tape handles all classes of roadway earthwork previously requiring 6 separate program tapes. These include single and dual roadways and the widening of existing pavements and roadways, with cross sections in all cases either in rod readings or direct elevations.

3. Earthwork quantities from other sources, such as side roads, borrow pits and channel excavation may be added into the summation of quantities at any location.

4. The new slope stake search routine eliminates the malfunctioning which occurred in the original program due to improper logic.

5. Insufficient cross sections are automatically extended and such extensions indicated in the output.

6. The number of permissible points used to define the roadway template has been increased from 6 to 20 for each half of the roadway, so that almost any form of template may be used. It is possible to run dual roadways on different grade lines by using the difference in elevation as a $\pm$ template dimension change, which can be handled automatically by collating blocks of template change data tape with the cross section tape. The same applies to variable width median. Template points, including superelevation, are entered as a series of vertical and horizontal offsets from each preceding point thus permitting a change in any one template dimensions without affecting any other dimensions, the only exception being that the fill slopes and the front and back slopes for ditches are entered as slope ratios with vertical limits.

7. The amount of output data has been increased to give the width and elevation of the ditch bottom and also its offset from centerline for right and left side ditches. This necessitates a two-row output per cross section.

January 2, 1961

ABSTRACT OF U. P. # 581

CLASS 1

TITLE: POLYNOMIAL PRODUCTS AND SUMS

ORIGINATOR: BENDIX-PACIFIC DIV., BENDIX CORPORATION

MODE: INTERCOM 500 X

PURPOSE: This routine will prove very useful in servo and guidance systems, where large products and sums of polynomials representing transfer functions are used.

ABSTRACT: This routine consist of the basic Intercom 500 X. One subroutine is used (Index Register Utilization). Four different coded operations may be performed. They consist of (o) clearing the current polynomial sum, (1) entering the multiplicand, (2) entering the multiplier and performing multiplication and type out, (3) summing current polynomial product or factor to previous sum.

ABSTRACT OF USERS' PROJECT NO. 582

TITLE: Integer Matrix Program

CLASS: 1

MODE: Machine Language

ORIGINATOR: Queen's University Computing Centre
Project No. 14A

DATE: September 1960

ABSTRACT

This program was designed for the rapid evaluation of the rank, linear relations, echelon form inverse of integer matrices as used in the teaching of matrix algebra. Consequently entries are limited to integers with a maximum of 108 entries.

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CALTEC, inc.

TOLEDO, OHIO · ANN ARBOR, MICHIGAN

REPLY TO:

3023 Sylvania Avenue
Toledo 13, Ohio
GReenwood 5-4623

January 20, 1961

ABSTRACT of
USERS PROJECT No. 583

TITLE: BEAM SHEAR, MOMENT AND DEFLECTION

MODE: Intercom 500X

CLASS: 1

ORIGINATOR: CALTEC, Inc.

EQUIPMENT AFFECTED: G-15D, Alpha-Numeric Typewriter

SUBROUTINES USED: Refer to the contents of this project.

INPUT: Physical Characteristics of the Beam
- a.) Moments of inertia at the tenth points
- b.) Span length
- c.) Modulus of elasticity of the beam

Loading Conditions
- a.) Uniform load
- b.) Magnitude and location of up to 19 concentrated loads
- c.) The end moments if beam is continuous

OUTPUT: The program will compute and read out the SHEAR, MOMENT and DEFLECTION at each tenth point of the beam for the given loading conditions. In addition, the maximum positive MOMENT and its LOCATION will also be read out. All column headings and labels will be typed by the computer.

METHOD: The beam deflections are found by the Conjugate Beam Method.

TIME: The time required is dependent upon the number of concentrated loads being considered. The minimum time is about 3 minutes and the maximum about 12 minutes.

LIMITATIONS: The program, as written, will consider only 10 subdivisions of a beam. The location of the maximum positive moment is computed to the nearest 1/1000 of the span length.

Abstract of Users Project No. 584

Title: PROGRAMMING IN INTERCOM MADE EASIER - PRIMER

Originator: Palmer & Baker Engineers, Inc.
Address: P. O. Box 346, Mobile, Alabama
Mode: Intercom 1000D
Date: September 9, 1960

The PRIMER simplifies the writing of programs in Intercom 1000D (3121959). Its purpose is to aid beginners and part-time programmers by taking care of housekeeping, conversions, and the details of programming.

Automatic operations include loading, input, tape reading, error indications, round-off, subsequent problems, and certain subroutines. The use of PRIMER will effect standard methods of procedure and will reduce programming time. PRIMER is especially useful for short repetitive problems.

The PRIMER method is not as flexible as is Intercom, and the operation is slightly slower. The real value of using the PRIMER method lies in decreased programming time.

Included in the project are a PRIMER manual, PRIMER tapes, and instructions for storing PRIMER on magnetic tape. A copy of Applications Project 61 is required.

Auxiliary Equipment Required: MTA-2

Subroutines Included: UP 375 Fraction Selector
Sq. Rt.; $Log_x A$; x^A;
sin, cos; arc tan; MTA-2

Abstract of Users Project No. 585

Title: Chi Square for 2 x 2 Contingency Tables, Corrected for Continuity

Class:

Mode: Machine Language

Originator: The Lafayette Clinic

Address: 951 E. Lafayette, Detroit 7, Michigan

Prepared by: Dr. Rhea S. Das, Psychophysiology Laboratory

Date: January 10, 1961

Subroutines: All subroutines used included in program tape.

Equipment Affected: G-15D, Alphanumeric Typewriter, Flexowriter (Optional)

Description: The program computes χ^2 for a 2 x 2 contingency table by the formula

$$\chi^2 = \frac{N(\ |AD-BC|\ -\ N/2)^2}{(A+C)(B+D)(A+B)(C+D)}$$

to four decimal places. Input may be entered on the typewriter or read from a data tape prepared on the Flexowriter. There is no limit on the number of problems which may be solved, but the total frequency (N=A+B+C+D) must not exceed 2047 for any problem.

ABSTRACT OF USERS PROJECT NO. 586

CLASS 1

TITLE: SIMPLIFIED RADIAL CIRCUIT CALCULATION (Electric)

Originator: J A Salin
Ebasco Services, Inc

Address: 2 Rector Street
New York 6 New York

Mode: Intercom 1000 SP

Date: June 1960

Starting with a given real and reactive load and per unit voltage at the receiving end of a section of a radial circuit the real and reactive load and per unit voltage is computed for the sending end of the section. The sending end conditions as modified by static or line charging capacitance and/or identical line sections connected at the sending end then become the receiving end conditions for the next section of line progressing toward the source. Computation continues from one section to the next until the source is reached at which point total power loss and an evaluation of investment and losses are computed.

A universal equation is used for each line section which takes into account a step up or step down transformer that may comprise the section. Circuit may contain a maximum of 20 sections.

One parameter in the equation (such as the size of a static capacitor bank at some point on the circuit) may be incremented (or decremented) when the above computation for the system is completed and the computation and cost calculation repeated for the new parameter value. Option is provided for carrying this process thru a fixed number of variations of the parameter or the parameter may be varied until the cost figure reaches a minimum. Option of typing or not typing answers until cost figure is minimized is also provided.

This program was originally intended to be a basis for much more elaborate economic calculations. However, in its present form it has found some use hence is made available "as is."

E. I. DU PONT DE NEMOURS & COMPANY, INC.

USERS' PROJECT NO. 587
(Class I)

Abstract

Energy Loss & Range of Charged Particles in Compounds

Calculated energy loss and range of heavy charged particles, electrons, and positrons are tabulated for ranges of particle energies, $E/M_o C^2$. These Calculations can be made for any compound for which the chemical formula is known. A more extensive description of the problem formulation can be obtained from Dr. Werner Brandt of the E. I. Du Pont Company, Engineering Deaprtment, c/o The Radiation Physics Laboratory located in Wilmington, Delaware.

The equations used in this program are based on the Bethe theory of stopping.

INTERNATIONAL PETROLEUM (COLOMBIA) LTD.

USERS' PROJECT NO. 588
(Class I)

Abstract

Production Forecast - Hyperbolic Decline
(Exploration #6)

This program will calculate the yearly production of an oil-field according to the formulae derived by Homer N. Mead in his paper "Modifications to Decline Curve Analysis", AIME, Vol. 207, pp.11-16, 1956.

The formula used for calculation of the loss-ratio of the field is

$$an = \frac{(Q-c)(1-b)}{P} \text{ plus } b \text{ where}$$

an = loss-ratio for the year n.

Q = the original ultimate recovery of the field.

c = accumulative recovery at the beginning of year n.

P = production for year n.

b = factor characterizing the type of producing field.

The program will follow one of two branches when production has reached or exceeded pipeline capacity, namely,

a) Follow the established drilling program, or

b) Calculate the number of development wells to be drilled to maintain production at the pipeline capacity until all development wells have been drilled.

Input consists of reservoir characteristics and a variable drilling program for exploratory and development wells.

INTERNATIONAL PETROLEUM (COLOMIBA) LTD.

USERS' PROJECT NO. 589
(Class I)

Abstract

Mortgage Amortization - Double Precision

The first part of the program computes the monthly payment given the principal, Interest Rate and Number of Payments using the relation.

$$M = P_o \frac{i/12}{I - (I - \frac{i}{12})^{-n}}$$

The second part of the program computes a complete amortization schedule and types out the Payment Number, Principal Reduction, Interest, New Principal Balance for each payment, using the relations

$$Ij = Pj \times \frac{i}{12}$$

$$PRj = M \cdot Ij$$

$$Pj + i = Pj - PRj$$

The maximum principal is 10,000,000.00

Wyoming Highway Department

HEADQUARTERS OFFICE

Cheyenne, Wyoming

ABSTRACT OF USERS PROJECT NO. 590
CLASS 1

TITLE: ½ X Section Terrain Plotter

ORIGINATOR: Wyoming Highway Department

ADDRESS: P. O. Box 931; Cheyenne, Wyoming

MODE: M.L. S.P.

DATE: January 20, 1961

Given: Survey notes for the line to be X sectioned. Required; to read in survey notes from punched cards through the 514 via the CA 2 and output through the PA 3 two plotted lines for each survey station; center line right and center line left. The scale is 20' = 1" in each direction. Approximately 5" of drum shift occur between each plotted line. This shift factor and the scale factors can be changed. Plots approximately 1½ miles per hour on 100' stationing.

DE LEUW, CATHER & COMPANY
ENGINEERS
150 NORTH WACKER DRIVE
CHICAGO 6
FINANCIAL 6-0424

USERS' PROJECT NO. 591

ABSTRACT
DC-S6

TITLE: Geometry for Bridge Stringers on Circular Curve
CLASS: 1
MODE: Intercom 1000 Double
ORIGINATOR: De Leuw, Cather & Company
DATE: February 1, 1961

PROBLEM STATEMENT:
The program computes the stationings, offsets from the centerline of the roadway, and top of roadway elevations of the stringers at centerline of piers and centerline of bearings; at division points of each stringer from centerline to centerline of piers or bearings; and for curved lines and division points of each curve from centerline to centerline of piers. Piers and stringers may be non-parallel. Curves must be concentric with centerline of roadway. Entire span must be on curve. Arc or chord definition is used. Should a PC, PT or PCC exist, the curve is extended. See De Leuw-Cather programs DC-S25 and DC-S33 for detail. See De Leuw-Cather program DC-S41, "Elevation Subroutines" for types of transverse cross-section.

INPUT DATA: Horizontal control data.
Radial dimensions of concentric curves.
Stringer spacings along centerlines of piers.
Vertical profile data.

OUTPUT: Stationings, offsets from centerline of roadway and top of roadway elevations for the following:
1. Intersections of stringers with centerlines of piers.
2. Intersections of stringers with centerlines of bearings, if any.
3. Intersections of concentric curves with centerlines of piers, if any; and division points for each curve.
4. Angles and lengths, and division points for each girder, if any.

TIME: About 30 seconds per point including input and output.

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USERS' PROJECT NO. 592

ABSTRACT
DC-S9

TITLE: Geometry for Concentric Circular Curves
CLASS: 1
MODE: Intercom 1000 Double
ORIGINATOR: De Leuw, Cather & Company
DATE: February 1, 1961
PROBLEM STATEMENT:
The program computes the stationings, offsets from the centerline of the roadway, and top of roadway elevations of intersection points of the concentric curves with the pier lines. All the pier lines must be parallel. All curves must be concentric with the centerline. Arc or chord definition may be used. Entire bridge must be on curve. Should a PC, PT or PCC exist, the curve is extended. See De Leuw-Cather programs DC-S25 and DC-S33 for detail. See De Leuw-Cather program DC-S41, "Elevation Subroutines" for types of transverse cross-section.
INPUT DATA: Horizontal control data.
Normal distances from the reference lines to the pier lines.
Radial dimensions of concentric curves.
Vertical profile data.
OUTPUT: Stations, skew angles, elevations for the intersection points of the centerline with the pier lines. Stations, skew offsets, elevations for the intersection points of the pier lines with the curves. Fascia stringer setting dimensions.
TIME: About 15 seconds per point including input and output.

DE LEUW, CATHER & COMPANY
ENGINEERS
150 NORTH WACKER DRIVE
CHICAGO 6
FINANCIAL 6-0424

USERS' PROJECT NO. 593

ABSTRACT
DC-S10

TITLE: Geometry for Bridge Stringers on Tangent
CLASS: 1
MODE: Intercom 1000 Double
ORIGINATOR: De Leuw, Cather & Company
DATE: February 1, 1961
PROBLEM STATEMENT:
The program computes the stations, offsets from the centerline of the roadway, and top of roadway elevations of the stringers at centerline of piers and centerline of bearings; at division points of each stringer from centerline to centerline of piers or bearings; and for bridge lines and division points of each line from centerline to centerline of piers. Piers and stringers may be non-parallel. Bridge lines must be parallel to the centerline of roadway. Entire span must be on tangent. Should a PC or PT exist, the tangent is extended. See De Leuw-Cather program DC-S33 for detail. See De Leuw-Cather program DC-S41, "Elevation Subroutines" for types of transverse cross-section.
INPUT DATA: Horizontal control data.
Normal dimensions of bridge lines.
Stringer spacings along centerline of piers.
Vertical profile data.
OUTPUT: Stations, offsets from centerline of roadway and top of roadway elevations for the following:
1. Intersections of stringers with centerline of piers.
2. Intersections of stringers with centerlines of bearings, if any.
3. Intersections of bridge lines with centerlines of piers, if any; and division points for each line.
4. Angles and lengths, and division points for each girder, if any.
TIME: About 20 seconds per point including input and output.

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ENGINEERS
150 NORTH WACKER DRIVE
CHICAGO 6
FINANCIAL 6-0424

USERS' PROJECT NO. 594

ABSTRACT
DC-S11

TITLE: Geometry for Parallel Bridge Lines
CLASS: 1
MODE: Intercom 1000 Double
ORIGINATOR: De Leuw, Cather & Company
DATE: February 1, 1961
PROBLEM STATEMENT:
The program computes the stations, offsets from the centerline of the roadway, and top of roadway elevations of the intersection points of the bridge lines with the pier lines. All the pier lines must be parallel. All bridge lines must be parallel to the centerline of roadway. Entire bridge must be on tangent. Should a PC or PT exist, the tangent is extended. See De Leuw-Cather program DC-S33 for detail. See De Leuw-Cather program DC-S41, "Elevation Subroutines" for types of transverse cross-section.
INPUT DATA: Horizontal control data.
Distances from the reference line to the pier lines.
Normal distances of the bridge lines.
Vertical curve data.
OUTPUT: Stations, normal and tangent distances from the reference line, and elevations for the intersection points of the centerline with the pier lines. Stations, offsets and elevations for the intersection points of the pier lines with the bridge lines.
TIME: About 12 seconds per point including input and output.

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ENGINEERS
150 NORTH WACKER DRIVE
CHICAGO 6
FINANCIAL 6-0424

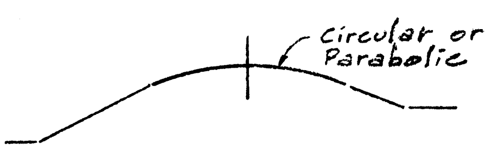
USERS' PROJECT NO. 595

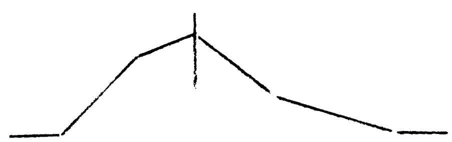
ABSTRACT
DC-S41

TITLE: Elevation Subroutines
CLASS: 1
MODE: Intercom 1000 Double
ORIGINATOR: De Leuw, Cather & Company
DATE: February 1, 1961
PROBLEM STATEMENT:

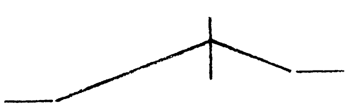
This program consists of 23 different types of bridge cross-sections. Each type consists of one block of tape, and is to be used as a subroutine, in conjunction with De Leuw-Cather programs DC-S6, "Geometry for Bridge Stringers on Circular Curve", DC-S9, "Geometry for Concentric Circular Curves", DC-S10, "Geometry for Bridge Stringers on Tangent", and DC-S11, "Geometry for Parallel Bridge Lines".

Some typical sections:

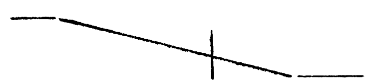




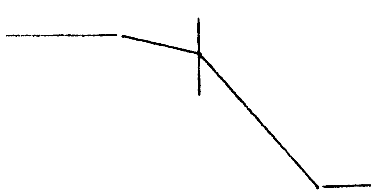
Transitions:



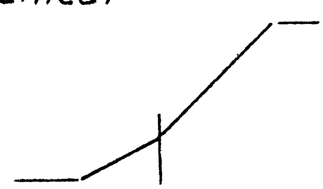
to



Reverse Parabolic or Linear



to



Linear

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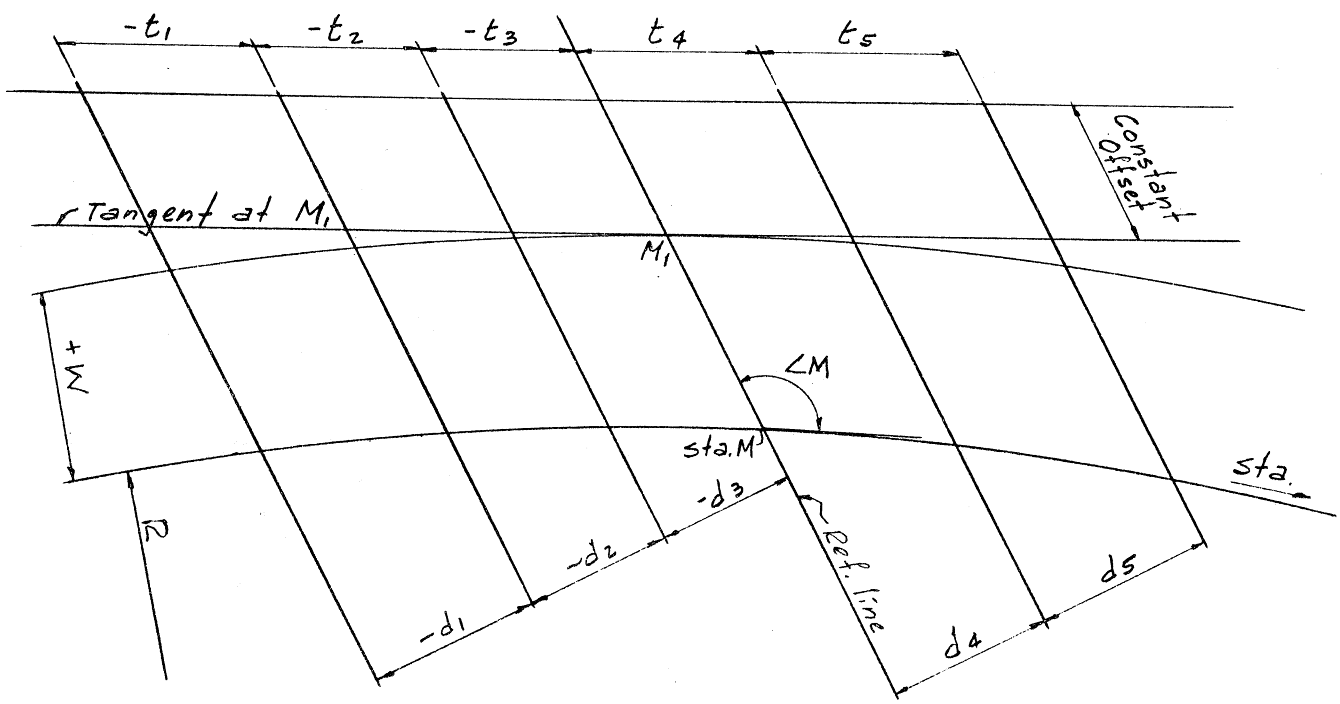
USERS' PROJECT NO. 596

ABSTRACT
DC-S18

TITLE: Skew Offsets to Circular Curves
CLASS: 1
MODE: Intercom 1000 Double
ORIGINATOR: De Leuw, Cather & Company
DATE: February 1, 1961
PROBLEM STATEMENT:
The program computes the skew offsets from the intersections of parallel skew lines and the tangent to a concentric curve at the intersection with the reference skew line, to the reference circular curve.
INPUT DATA: Horizontal control data.
Normal distances from the reference line to the pier lines.
OUTPUT: Normal distance from each pier line to the reference line.
Tangent distance from each pier line to the reference line.
Skew offsets from the tangent to the curve along each pier line.
TIME: About 10 seconds per point including input and output.



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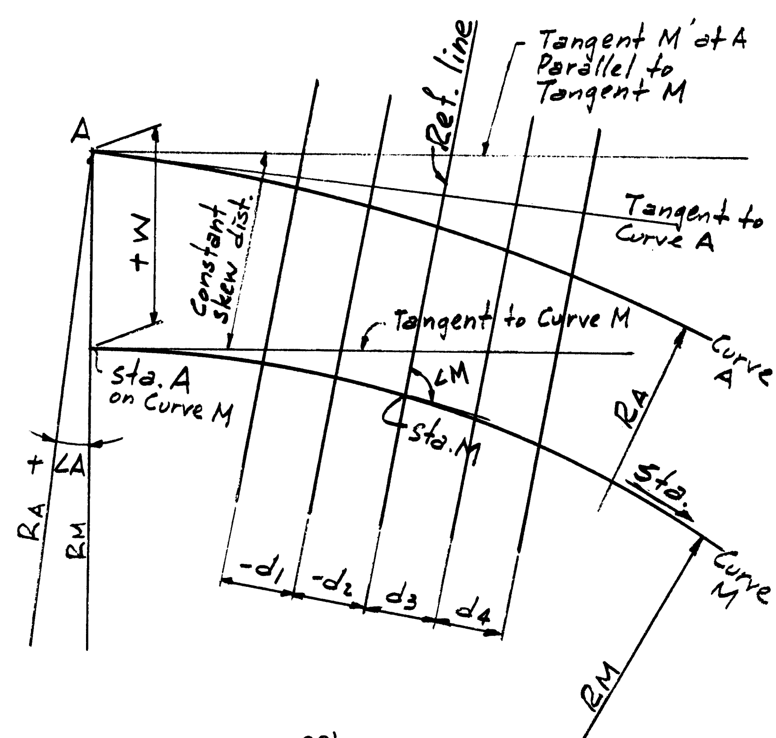
USERS' PROJECT NO. 597

ABSTRACT
DC-S24

TITLE: Skew Offsets Between Two Non-concentric Circular Curves
CLASS: 1
MODE: Intercom 1000 Double
ORIGINATOR: De Leuw, Cather & Company
DATE: February 1, 1961
PROBLEM STATEMENT:
The program computes the skew offsets between two non-concentric curves along a series of skew lines. Arc or chord definition may be used. All skew lines must be parallel.
INPUT DATA: Horizontal control data.
Normal distances from the reference line to the pier lines.
OUTPUT: Along each skew line:
1. Distances from tangent M to curve M.
2. Distances from tangent A to curve A.
3. Distances from tangent M to tangent A.
4. Distances from curve A to curve M.
TIME: About 15 seconds per point including input and output.



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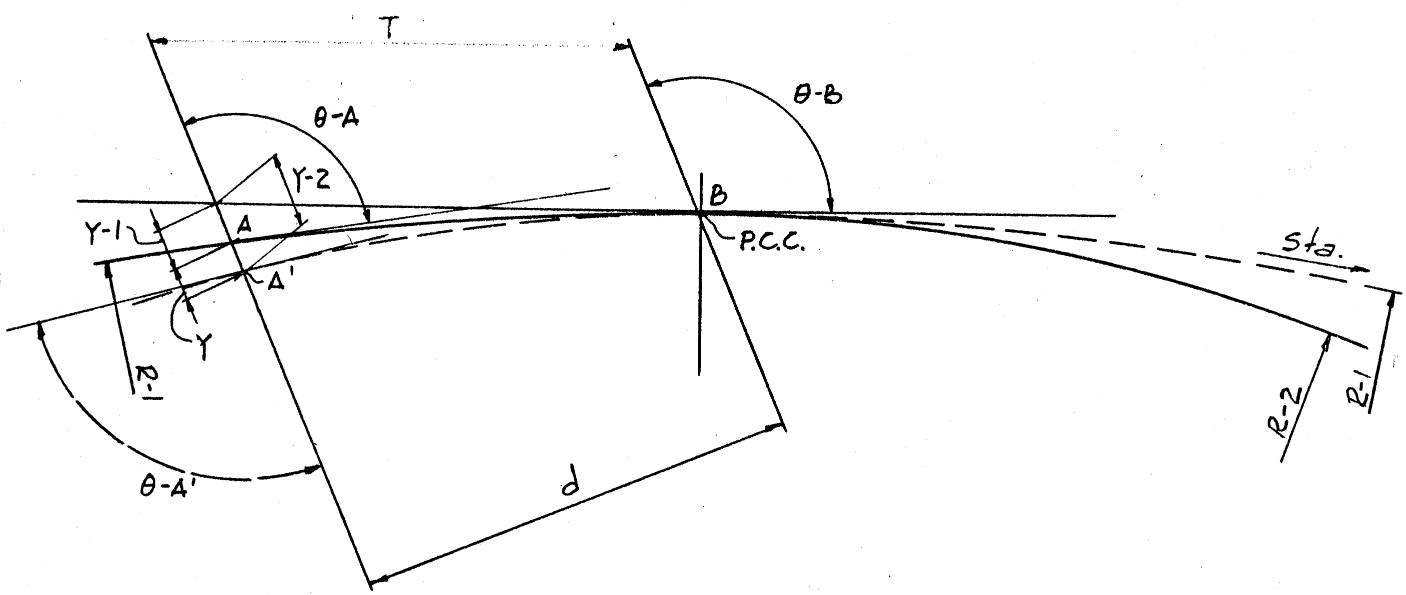
USERS' PROJECT NO. 598

ABSTRACT
DC-S25

TITLE: Geometry for PCC
CLASS: 1
MODE: Intercom 1000 Double
ORIGINATOR: De Leuw, Cather & Company
DATE: February 1, 1961
PROBLEM STATEMENT:

The program computes data which are necessary for obtaining input values to be used in De Leuw-Cather programs DC-S6, "Geometry for Bridge Stringers on Circular Curve" and DC-S9, "Geometry for Concentric Circular Curves".



INPUT:

Sta. A
Θ-A
Sta. B
R-1
R-2

OUTPUT:

Sta. A	Θ-A
Sta. B	Θ-B
d	y-1
T	
Sta. A'	Θ-A'
y-2	y

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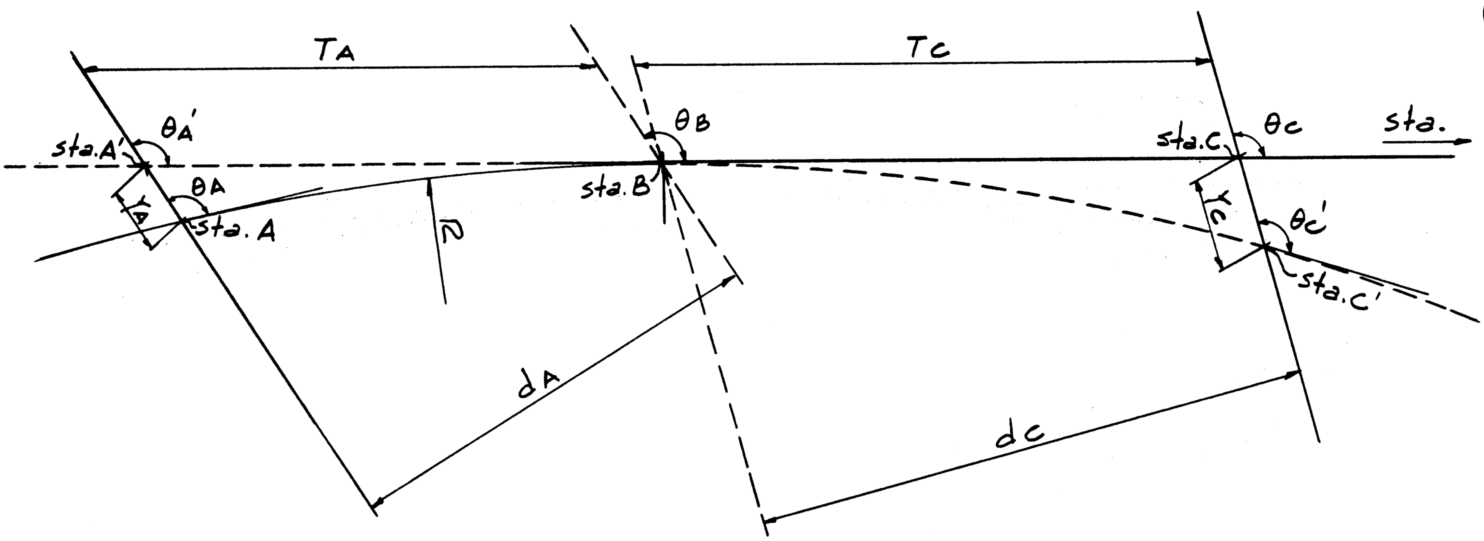
USERS' PROJECT NO. 599

ABSTRACT
DC-S33

TITLE: Geometry for PC or PT
CLASS: 1
MODE: Intercom 1000 Double
ORIGINATOR: De Leuw, Cather & Company
DATE: February 1, 1961
PROBLEM STATEMENT:
The program computes data which are necessary for obtaining input values to be used in De Leuw-Cather programs DC-S6, "Geometry for Bridge Stringers on Circular Curve" and DC-S9, "Geometry for Concentric Circular Curves", DC-S10, "Geometry for Bridge Stringers on Tangent", and DC-S11, "Geometry for Parallel Bridge Lines".



INPUT:	OUTPUT:	
Sta. A	Sta. A	θ-A
θ-A	Sta. B	θ-B
Sta. B	d-A	T-A
R	Sta. A'	θ-A'
Sta. C	y-A	
θ-C		
	Sta. C	θ-C
	d-C	T-C
	Sta. C'	θ-C'
	y-C	

Abstract of Users' Project No. 600
Class 1

Title: DESIGN OF REINFORCED CONCRETE CHANNEL T-WALL

Originator: U.S. Army Engineer District, Los Angeles, Corps of Engineers,
Address: 751 South Figueroa Street, Los Angeles 17, California
Mode: Intercom 1000 (SP)
Date: January 1961

Given the loading conditions and the preliminary dimensions of the structure this program will design a reinforced concrete channel T-wall section. The program checks the structure for overturning, sliding, and allowable soil pressure - in that order. If it is found that any of these conditions exist, one-half foot is added to the length of heel and the stability computations are recalculated. This is continued until either (1) all stability conditions are satisfied or (2) the maximum allowable length of heel is reached, in which case one-half foot is added to the length of toe. The stability computations are again recalculated until either (1) all stability conditions are satisfied or (2) the maximum allowable length of toe is reached.

The program then checks the slab for the allowable K values. If any K value is above the allowable, one inch is added to the slab thickness at the earth face and once again the stability computations are recalculated. This process is repeated until all K values are less than the allowable.

Input includes preliminary dimensions of structure and maximum dimensions of structure; depth of water; vertical surcharge (number of feet of earth to be added for surcharge); sloping backfill; unit weight of earth, concrete, and water; concrete covers to c.g. of reinforcing steel in both faces of slab and land face of stem; wearing surface; allowable bond, shear, tensile stress in steel, compressive stress and compression factor in concrete, and ratio of modulus of elasticity of steel to that of concrete; angle of internal friction of earth; and horizontal components of active earth pressure for (1) design of wall and (2) for stability computations if a surcharge condition exists.

The output format is shown in the writeup. Output includes positive and negative design moments at 1-foot intervals for the slab and stem as follows: (1) In wall with channel empty, (2) in slab with channel empty, and (3) in slab with channel full or partially full. The area of steel and K values for the corresponding moments are computed in each of the three cases. Output also includes soil and net pressures at four points on the slab; the diagonal tension and perimeter of bars at the earth face and channel face; final design criteria; and volume of concrete per foot required for the structure.

Data input requires about 3 minutes. The time required for calculation and typeout varies depending upon the number of times the size of slab is revised. Each revision requires approximately one minute for recalculating the stability computations.

No auxiliary equipment is required.

USERS PROJECT NO. 601

An Application of Harmonic Analysis Methods to Surface Fitting

ABSTRACT

The methods of harmonic analysis in two dimensions can easily be extended to three dimensions so that the periodic function Z = f(X, Y) can be represented by a finite trigonometrical series.

$$Z = f(X,Y) = \sum_{\substack{m=0\\n=0}}^{M,N} a_{mn} \text{ Cos } mx \text{ Cos } ny + \sum_{\substack{m=0\\n=1}}^{M,N} b_{mn} \text{ Cos } mx \text{ Sin } ny$$

$$+ \sum_{\substack{m=1\\n=0}}^{M,N} c_{mn} \text{ Sin } mx \text{ Cos } ny + \sum_{\substack{m=1\\n=1}}^{M,N} d_{mn} \text{ Sin } mx \text{ Sin } ny$$

The Fourier coefficients a_{mn}, b_{mn}, c_{mn} and d_{mn} are computed for the case where M=N=5. This restriction requires that one hundred twenty one values of the function be given at equidistant intervals of X and Y. The function is then normalized to the intervals X = [0, 2π], Y = [0, 2π]. Once the coefficients have been computed, the program evaluates the function at intermediate values of X and Y.

VITRO LABORATORIES

Division of Vitro Corporation of America

THE BENDIX COMPUTER USERS ORGANIZATION

REFERENCE: ADMINISTRATIVE CODE, ARTICLE VI, SEC. 2A

ABSTRACT OF USERS PROJECT NO.: 602
CLASS 2

TITLE: Distillation Tower Design by Short-Cut Methods

ORIGINATOR: The Lummus Company
385 Madison Avenue
New York 17, N. Y.

MODE: Intercom 500

DATE: 1/27/61

This program yields an approximate design of a distillation tower by a short-cut method which uses the Fenske equation for total reflux (1) the Underwood minimum reflux equations (2) and an equation which has been fitted to the Gilliland curve (3) for reflux ratio vs equilibrium stages.

Given the feed quantities, the feed condition (q), equilibrium values, and the desired recovery of the key components, this program will type out the composition of the overhead and bottoms products at total reflux, the minimum reflux, the minimum number of theoretical stages and a tabulation of reflux ratio vs. theoretical stages. The minimum reflux ratio is based on product compositions at total reflux.

The limitations on these results are the same as those that apply to the above mentioned equations. The program can handle up to 18 components including a maximum of 3 light keys, 3 heavy keys, 2 split keys, 8 light non-distributed components and 8 heavy non-distributed components.

Total calculation time is approximately 20 minutes.

Abstract of Users Project No. 603

Class 1

TITLE: Significance of Difference Between Two Proportions

Originator: American Can Company, W. A. Fourier

Address: Barrington, Illinois

Mode: Intercom 1000 (Double)

Date: April 12, 1960.

This program will test two experimentally determined proportions (or percentages) to determine whether a statistically significant difference exists between the populations from which the samples were drawn. On input of the two experimental fractions, the computer types the appropriate value of chi-squared.

The method used is the solution of 2x2 contingency tables which is not accurate if the expected value in any cell of the contingency table is less than 5. For the exact solutions of such problems, Canco program A6 may be used.

Disclaimer:

No responsibility is assumed by the American Can Company or by Mr. W. A. Fourier for any mistakes, errors, or misrepresentations that may occur when using this program; nor is responsibility assumed by the Bendix Computer Division for the correct reproduction of this routine.

Abstract of Users Project No. 604

Class 1

TITLE: Fisher's Exact Method of Comparing Two Percentages

Originator: American Can Company, Mr. R. G. Fairbrother

Address: 11th Avenue & St. Charles Road, Maywood, Illinois

Mode: ALGO

Date: February 28, 1960.

The program will test two sample proportions (or percentages) to determine whether there is a statistically significant difference between the two populations from which the samples were drawn. On input of the two sample proportions, the computer types the one and two tailed probabilities.

The method used is Fisher's Exact Method. Where all four input data are large, output will be relatively slow. In such cases, the contingency table solution of Canco tape #12 is recommended.

ABSTRACT OF USERS' PROJECT NO. 605

CLASS 1

Title: Aspheric Lens Data

Originator: JOHN R. MILES COMPANY
Address : 3724 Oakton Street, Skokie, Illinois

Mode : Intercom 1000D (Fixed Point)

Date : January 23, 1961

Given the coefficients of the standard Aspheric Lens Equation

$$X = AY^2 + BY^4 + CY^6 + DY^8 + EY^{10}$$

which is used for optical lenses and reflectors, this program computes and types out in fixed point double precision,the coordinates Y and X as well as the slope dx/dy of the normal to the curve at points Y and the local radii of curvature R of the curve at points Y. The values of coefficients used by the program are typed in by the user. The delta y (difference of y) and limit of Y, (which the user types in), are called for by the program with labels automatically.

When a formula for an aspheric lens or an aspheric optical reflector is available to an optical designer, opti-= cal technician, or lens maker, he frequently needs to know the slope of the normal to the surface at many points, as well as the coordinates for a very large number of points. The lens maker also needs to know, in addition to coordinates, the local radius of curvature at a large number of points, all the way from the center to the edge of the aspheric optical surface. The program supplies all this information for as many points as desired. For example:
On a 6 inch diameter aspheric lens, delta Y can be typed in as .001 inches and limit of Y as 3 inches, giving 3000 values between Y = 0 and Y = 3 inches for X, dx/dy, and local radius of curvature R.

The radius of curvature R is found in the program by the formula:

$$R = \frac{(1 + X'^2)^{3/2}}{X''}$$

where X' is the first derivative of X with respect to y, and

Abstract of Users' Project No. 605
Class I
Title: Aspheric Lens Data
Page Two

and X'' is the second derivative of X with respect to y, or:

$$X' = dx/dy = 2AY + 4BY^3 + 6CY^5 + 8DY^7 + 10EY^9$$

$$X'' = 2A + 12BY^2 + 30CY^4 + 56DY^6 + 90EY^8$$

The input format and output formats are shown on the sample program in this case, since all input and output data are labeled automatically.

Data input type-in takes about two (2) minutes, and each line compilation and type-out takes about fifteen (15) seconds. Intercom 1000 double-precision is required, but no auxiliary equipment is used.

John R. Miles
JOHN R. MILES

ABSTRACT OF USERS' PROJECT NO. 606

CLASS 1

Title: Polynomial Data

Originator: JOHN R. MILES COMPANY
Address : 3724 Oakton Street, Skokie, Illinois

Mode : Intercom 1000D (Fixed Point)

Date : February 7, 1961

Given the coefficients of an aspheric lens equation (or general polynomial)

$$X = AY + BY^2 + CY^3 + DY^4 + EY^5$$

this program computes and types out in fixed point double precision, the coordinates Y, X, slope of normal dx/dy at points Y, and R the local radius of curvature. The values of coefficients used by the program are typed in by the user. The delta y (difference of Y) and limit of Y, which the user types in, are called for by the program with labels automatically.

When a formula for an Aspheric lens, or an aspheric optical reflector, are available to an optical designer, optical technician, or lens maker, he frequently needs to know the slope of the normal to the surface at many points as well as the coordinates for a very large number of points. The lens maker also needs to know, in addition to coordinates, the local radius of curvature R at a large number of points, all the way from the center to the edge of the aspheric optical surface. The program supplies all this information for as many points as desired. For example, on a six (6) inch diameter aspheric lens, delta Y can be typed in as .001 inches, and limit of Y as three (3) inches, giving 3000 values between Y = 0 and Y = 3 inches for X, dx/dy, and local radius of curvature R.

The radius of curvature R is found in the program by the formula:

$$R = \frac{(1 + X'^2)^{3/2}}{X''}$$

where X' is the first derivative of X with respect to y, dx/dy, and X'' is the second derivative of X with respect

Abstract of Users' Project No. 606
Class 1
Title: Polynomial Data
Page Two

to y, or

$$X' = dx/dy = A + 2BY + 3CY^2 + 4DY^3 + 5EY^4 \quad \text{and}$$

$$X'' = 2B + 6CY + 12DY^2 + 20EY^3$$

The input format and output formats are shown on the sample program in this case, since all input and output data are labeled automatically.

Data input type-in takes about two (2) minutes, and each line computation and type-out takes about fifteen (15) seconds. Intercom 1000 double precision is required, but no auxiliary equipment is used.

John R. Miles

JOHN R. MILES

QUEEN'S UNIVERSITY COMPUTING CENTRE

ABSTRACT OF USER'S PROJECT NO. 607

TITLE: FORCED VIBRATIONS

CLASS: I

CATEGORY: CIVIL ENGINEERING

MODE: BENDIX G-15-D, 500 X

ORIGINATOR: J.A.N. LEE

SUBROUTINES USED: SINE-COSINE, (contained in this package)

DATE:

ABSTRACT:

The response of a one-degree-of-freedom structure to a pulsating load is one of the classical problems of structural dynamics. No account is taken herein of the effect of damping. The method of analysis is "step-by-step" integration in which the forcing function is represented by constant loads over certain time intervals. The results consist of the displacement at chosen time intervals and the corresponding velocity.

DISCLAIMER:

Abstract of Users' Project No. 608

Class 2

Title: PRESTRESSED BRIDGE BEAM ANALYSIS OR PARTIAL DESIGN

Originator: Parsons, Brinckerhoff, Quade & Douglas

Address: 165 Broadway, New York 6, New York

Mode: Intercom 500 X

Date: February 1961

The program can be used either to completely analyze a prestressed bridge beam or to obtain a partial design. It consists of three parts:

Part 1 - This portion is common to both the analysis and partial design options. The required input consists of the basic beam section properties (or code to indicate one of the standard beams), the type of prestress (if known), various beam and deck dimensions, loading data, and concrete strength. The output produced are the net and composite section properties and the top and bottom flexural stresses, at five sections along the beam, caused by the given loads.

Part 2 - This is used only if a complete analysis is desired. The following must be given: the number, type (parabolic post tension drapes or straight pretension strands or combination strands and drapes or pulled down strands or drapes) and location of prestressing elements; the jacking force per element and the final (effective) prestressing force per element (the program computes the elastic losses); areas of tendons, ducts (if any), and stirrups; allowable ultimate and working stresses. The results produced are the stresses at the five sections caused by the prestress force before and after losses; the combined stresses due to prestress and external loads; the ultimate strength provided and the ultimate strength required; the stirrup spacing; horizontal shear at the key; camber and deflection data.

Part 3 - This is used in conjunction with Part 1 only for the partial design option. The given data for this section is the estimated ratio between the final prestress force and the initial prestress force. (Initial prestress force equals jacking force minus the elastic losses.) The output consists of the theoretical prestress force and the eccentricity at midspan needed to balance the tensile stresses found in Part 1; the theoretical prestress force and eccentricity assuming that compression will govern the design; and finally the end block stresses caused by these two forces and eccentricities.

Computations are based on "Criteria for Prestressed Concrete Bridges" - Bureau of Public Roads, 1954. Coding sheets and memory map are included with the write-up. An attempt has been made to keep the program in distinct blocks to facilitate making changes or additions.

ABSTRACT OF USER'S PROJECT NO. 609

CLASS 2

Title: SQUIRT, Surfacing Quantities Individual Roadway Totals

Originator: Consoer, Townsend & Associates
Address: 360 E. Grand Ave., Chicago 11, Illinois
Mode: Intercom 1000 DP 5/14/61
Equipment: G-15D
Date: March 30, 1961

This program is used to compute totals and subtotals for up to 10 different quantities of highway construction materials.

Up to 15 Section quantity templates may be stored for reference by any one run. Each template will describe a cross section of roadway in terms of the quantity (cu. yrds., sq. ft., gals., tons, etc.) of each material per foot of roadway.

In addition to the template data, lists of Stations and Section numbers are needed to operate the program.

If the Section numbers for two adjacent Stations are equal, quantities equal to the product of the template values and the distance between the Stations will be calculated and stored. If the Section numbers are not equal, the quantities will be based on the average of the template values.

In one run, up to 10 Stations may be flagged with a negative sign which will cause lump sum quantities to be added at that point. This permits the picking up of quantities from cross roads or ramps at desired locations.

By inserting flags of xxxxx, yyyyy or zzzzz after a Station, a subtotal will commence at that Station and continue until a Station followed by the same flag is reached or until the end of the run. These three subtotal flags may start or finish together or apart and may overlap in any way desired.

Limitations:

Max. quantity templates 15 (it is convenient to make Sect. 0 all zero's to be used at Station equations).

No more than 10 Stations may be flagged for lump sums.

There are only three subtotal flags; however, the same flag may be started again after having been stopped either at the same Station or a previous Station.

The subtotal is typed out at every second occurrence of a given flag or at the end of the run if the flag occurs an odd number of times. (Do not use subtotal flags after the last Station.)

There is a limit of 50 for the total of Stations and subtotal flags.

All Stations must be less than 1333+32.00.

Abstract of Users Project No. 610

Class 1

TITLE: ALGO ALPHANUMERIC ROUTINE

ORIGINATOR: E. I. du Pont de Nemours & Co., Inc.
Eastern Laboratory, Gibbstown, New Jersey

MODE: Machine Language Library Subroutine for ALGO

DATE: April 20, 1961

This program is a library routine for ALGO which permits items of alphanumeric information, such as labels, headings, instructions, or questions, to be typed by the computer under control of an ALGO program. The routine provides for alphanumeric input or output during execution of a program and also for preparation, inspection, and corrections of alphanumeric items during compilation of the object program.

The input or output routines may be included in an ALGO program by a statement of the form

2. LIBRAry INPUT(0209000), TYPE(0210000)

Each alphanumeric item to be typed by the program is assigned a name which is used to refer to the item. Thus, an identifier to be typed out might be named LABEL and it would be typed by writing the statement

TYPE LABEL

A memory location would be assigned to LABEL during compilation of the program and the numerical value stored in this location is the location in memory of the alphanumeric item LABEL. This location is filled in automatically by the program when the alphanumeric items are compiled.

The write-up includes a sample program for purposes of illustrating the use of the routine.

ABSTRACT OF USERS PROJECT NO. 611
Class 1

TITLE: Automatic Acceleration and Deceleration for Compac 01 Input Data Tapes.

ORIGINATOR: R. C. Lowery
Engineering Computer Center
Bendix Products Division
The Bendix Corporation
401 North Bendix Drive
South Bend, Indiana

MODE: G-15D Machine Language.

EQUIPMENT: AN-2

This routine eliminates the requirement of the process planner writing acceleration and deceleration blocks for the milling process sheets. Coordinate movements which are to be accelerated and decelerated are coded by special R numbers. This program then generates the required blocks for the Compac 01 input data tape. Included in the program is the generation of data blocks for a special movement of the Z coordinate to a clearance plane, an X and Y movement, and a movement in Z from the clearance plane to a final value of Z, with accelerations and decelerations in each movement.

USERS PROJECT NO. 612

Class 2

Abstract

Title: Solution of Six Layer Refraction Profile

Originator: International Petroleum (Colombia) Ltd.

Mode: Intercom 1000 S. P.

Date: January, 1961

Given the time-distance plots of a reversed refraction profile, this program solves for dip and depth of interfacies. The graphical straight-line method of computation is used.

Input consists of apparent velocities, distance between shot-points, times, up-hole times and elevation, all expressed in meters and seconds.

Output is true velocities, depths of interfacies below surface in meters, dip of interfacies and depths of interfacies below sea level in feet.

The program will handle up to and including a six layer case. Only profiles without faulting should be used. Apparent velocities must be extended to intercept the time axis and a constant distance between two shot points must be used for all velocities.

Subroutines used are square root, sin-cos, and arctangent. Average time for solution of a six layer problem is 12 minutes including data input type-in and the type-out.

No accessory equipment is required.

Abstract of Users Project No. 613

TITLE: Geometry and Elevations of Tangent Bridges With Constant or Transitional Superelevations

CLASS: 2

MODE: Intercom 1000

ORIGINATOR: H. W. Lochner, Inc.

DATE: May 18, 1959

Given a highway bridge on a tangent alignment referenced to the tangent base line, this program will compute stations and applied grade elevations. The program also computes roadway and related elevations through crowned, superelevated and transitional sections of the structure.

The input includes the station and skew angle at intersection of skew lines, such as pier center line, bearing line, back of abutment, etc., with the tangent base line; distances between points such as stringers, sidewalks, parapets, etc., along skew lines and properties of the vertical alignment. Lane widths, parabolic crown and superelevation properties, distances from base line to applied grade lines and elevation differences between top of roadway and related structure points such as top of beam, top of pad, top of parapet, etc., complete the input. For the purpose of this program, all intersections of skew lines with structure lines such as beams, sidewalks, parapets, etc., are called stringer points.

The output consists of the station, applied grade elevation, roadway elevation and related structure elevations, such as top of beam, top of pad, top of parapet, etc., for each stringer point taking into account crowned, superelevated and transitional pavements.

Limitations

Any skew line may not contain more than 17 stringers.
Each bridge may not have more than five lanes on each side of the base line.
Each lane may not have more than 3 superelevation transitions.
Vertical alignment may not contain more than two vertical curves.
Transitions must be linear.

Subroutines used: flexowriter conversion

Auxiliary equipment used: none

Computation time: 1 skew line, 17 stringers, includes typeout - 13 min.

Abstract of Users Project No. 614

Class 2

Title: Footing Design

Origination: Ellerbe and Company
333 Sibley Street
St. Paul 1, Minnesota

Mode: 500-X

Date:

Given the dead load, total load, width of column or pedestal, concrete stress, steel stress, allowable soil pressure and the ratio, n, this program finds the thickness, length of side, size, number and spacing of reinforcing bars for a square reinforced concrete footing.

The mathematics conforms to Chapter 12 of the A.C.I. Building Code, 1956. The program will proportion the footings for dead load balance. The area of the footing is based on unit dead load soil pressure. Shear and bending are based on total load. If uniform dead load pressure is not desired, the input for dead load and total load should be made the same.

The program finds the minimum depth, in even inches, that will take care of the shear. This is checked for bending and increased if necessary. The length of a side of then found. The area of steel for bending and the summation of perimeters for bond are found. The largest bar which will give the required ratio of area to perimeter is selected and the number and spacing of bars are found. The spacing is checked against the desired maximum and if the maximum is exceeded a second selection of a smaller bar is made.

The maximum spacing is set at 9 inches in the program and is stored in 1233 as 9 inches and in 1234 as 0.75 feet. Both are used in the program. These constants can be changed if desired.

For each footing the input is dead load, total load in kips and t, the width of column or pedestal in inches.

The program is set for a minimum depth of 12", 8" effective depth plus 4" cover. The 8 stored in 1235, and can be changed if desired.

Computation time, not including input, is about one minute per footing.

THE STANDARD OIL COMPANY

Users Project No. 615

Abstract

HANDY-ANDY

Handy-Andy compiles and punches a machine language loader, including check sums, for an Intercom 1000 Double Precision program already in memory. It also punches out the program. An identifier may be inserted in the program if desired.

When the Intercom program is read into memory using the loader, control is transferred to the automatic mode starting at any desired location.

Two other operations available, after changing two commands in the Intercom package, are:

1. The operator may change the bases in Index Register I at any time during input without transferring to manual or affecting the command counter.

2. The operator may, by cycling the compute switch, either repeat an entire program or transfer to manual after execution of a 67 command.

This program is most useful when the user has several separate programs to run occasionally or when he has one program which he repeats several times in a row.

J. E. GREINER COMPANY
Consulting Engineers
Baltimore 1, Maryland

USERS PROJECT NO. 616

Soil Classification Program G-22.3034

Program Class 2

Program Abstract

This program reduces raw data from the soils laboratory by computing natural moisture content, air-dried moisture content, liquid limit (corrected), plasticity index, group index, interpolated answers for up to 3 desired particle sizes from hydrometer tests, and the Highway Research Board or Ohio S.H.T.L. classifications.

The use of certain laboratory data not necessary for HRB classifications as input data will produce soil classifications under the Ohio State Highway Testing Laboratory standards.

Input - Raw Laboratory data on fixed-point, single precision tape.

Output - One line on 14-inch paper per soil sample.

Running Time - One minute or less per soil sample.

Abstract of Users' Project No. 617

Title: Analysis of Multistory Frames (Version I)

Class: 2

Mode: Intercom 1000 S.P.

Originator: Parsons, Brinckerhoff, Quade and Douglas

The program analyzes multistory frames of up to 16 stories in height and 7 bays in width, containing not more than 104 joints and subjected to vertical and/or horizontal loads, cantilever moments, or stresses due to settlement or temperature variations. It produces (a) end moments on all members (b) interior moments and end shears in the beams and (c) vertical loads on the columns.

The columns of the lowest story may be of unequal length and each column may be either fixed or hinged. The results are obtained by Kani's method of successive approximations. The designer has direct control over the accuracy of the results by specifying the number of iterations to be used in the solution of his particular problem. The data are stored in punched tape which may be verified by the program.

Program Limitations

1. All members must have constant cross sections.

2. The frame must not have offset or discontinuous members.

ABSTRACT OF USERS PROJECT NO. 618

TITLE: SIMPSONS INTEGRATION

ORIGINATOR: BENDIX-PACIFIC DIVISION, BENDIX CORPORATION

MODE: Intercom 500X

PURPOSE: This routine will facilitate the integration of many programmable functions not normally found in texts.

ABSTRACT: The routine consists of one line of coding (line 09). Two modes of operation are possible; (1) using the routine as a control program operating on an integrand with typeouts of successive approximations to the integral and the current relative error, or (2) using routine as a subroutine to integrate under control of a main program. Both methods require the address of the integrand, upper and lower limits, and a desired error.

METHOD: An effective quadrature (integration) formula is given by Simpson's Rule by which a curve is approximated by arcs of parabolas having vertical axes. The sum of these areas of segments bounded by ordinates and parabolic arcs is an approximation to the integral. However f(x) is never computed more than once for any x. Successive x's are computed until the error criterion is met.

Title: CLOSING COORDINATED POINTS WITH DIRECTION AZIMUTHS TO A GIVEN CURVED ALIGNMENT

Originator: Richardson, Gordon and Associates
Address: 3 Gateway Center, Pittsburgh 22, Pennsylvania
Mode: Intercom 1000 Double Precision (3121959)
Date: May 1961

This program will compute a closure between given coordinated points with direction azimuths and a given curved alignment. The input for the curved alignment includes: A starting station, north and east coordinates of the starting station, direction azimuths and distances (from starting station to first P.I. and/or from P.I. to P.I.), radii at all P.I.s and up to two station equations. The input for the coordinated points with direction azimuths includes: A station (or identifying number), north and east coordinates of the coordinated point and a direction azimuth through the coordinated point. The input data for the coordinated points with direction azimuths may be independently obtained and entered in this program, or it may be the output (punched on tape) from the "CURVED ALIGNMENT GEOMETRY" program submitted as Users' Project No. 446.

The output from this program includes: Given station (or identification number) of the coordinated point, station of the closure point on the curved alignment, closure distance between coordinated point and alignment (measured along given direction azimuth), north and east coordinates of the closure point on the curved alignment and the given direction azimuth (directed toward the alignment) through the coordinated point.

The output format is shown in the write-up and standard equations for horizontal alignment are used in the Mathematical Method.

The program will handle up to fourteen (14) radii and two (2) station equations in the alignment and an unlimited number of coordinated points per run.

The running time per coordinated point varies from 35 seconds to 1 minute.

Abstract of Users' Project No. 620

Class 1

Title: Subroutine for Evaluation of Euler's Gamma Function Γa

Range: $0 < a \leq 2$

Originator: T. Gendron, Philips Laboratories, Irvington-on-Hudson, New York

Mode: Machine language subroutine for use with Intercom 500X

Date: 4/28/61

The subroutine evaluates a seventh order approximating polynomial to the gamma function in the range $1 < a < 2$ and makes use of this polynomial and the relation $\Gamma x = \frac{1}{x}\Gamma(1+x)$ in the range $0 < a < 1$. Error halts are provided for arguments beyond the scope of the subroutine. Accuracy is five decimal digits.

This subroutine is substantially a transcription of Users' Project No. 237 into a form suitable for use with the Intercom 500X system.

Abstract of Users Project No. 621

Class 2

TITLE: Crown Cantilever Analysis of Arch Dams

ORIGINATOR: Harza Engineering Company

ADDRESS: 400 West Madison Street, Chicago

MODE: Intercom 1000 S

Given the arch dam geometry, foundation deformation constants and reservoir elevation, this program will perform a crown cantilever analysis of a non-symmetrical arch dam for horizontal water load. From six through eleven unit width arches can be included in an analysis, depending on the choice of the designer. Each arch must be circular and of constant thickness. The program solves for the load distribution between cantilever and arch action by setting up and solving a system of simultaneous equations which equate radial deflections at the intersections of the chosen arches with the crown cantilever. Output consists of stresses at the abutment of the chosen arches, stresses in the crown cantilever at points where it intersects with the arches, and the load carried by the cantilever at these points.

The computation and typeout time varies from 20 minutes when six unit arch elements are included to 40 minutes when eleven are included.

USERS PROJECT NO. 622

ABSTRACT

SADIE APPENDIX PACKAGE

This package adds four lines to the SADIE Appendix. The functions provided are as follows:

011: (1) Reads Intercom 107 tape into SADIE memory. This is especially useful for graph-plotting operations.
(2) Separates integers and fractions. Operates only on A Register. Leaves integer in A Register and stores fraction in memory.

012: (1) Generates random numbers with uniform distribution between 0 and 1.

(2) Generates random numbers with a Gaussian (normal) distribution with mean of 0 and standard deviation of 1.

013: (1) Clears memory under control of an L Register.

(2) Stores A Register in memory under control of an L Register.

014: (1) Stores contents of a memory location in an Index Register.

(2) Stores contents of an Index Register in a memory location.

ABSTRACT AND DESCRIPTION

Angle Conversion Subroutines:

Description:	This subroutine will convert an Intercom D.P. number representing degrees, minutes, and seconds to (or from) decimal degrees. The conversion to degrees, minutes and seconds also stores a format in locations 07.06, 07, for use with OP-Code 33.
Entry:	Loc. 00 for degrees, minutes, seconds to decimal degrees Loc. 02 for decimal degrees to degrees, minutes, seconds and store format Loc. 08 for decimal degrees to degrees, minutes, seconds and not store format
Exit:	Loc. 45, to 04.63 (Normalize)
Data Input:	Angle in 21.00, 01 Degrees as Integer; Minutes and Seconds or Fractional Degrees as Fraction: DDD.MMSSSS or DDD.DDDD
Data Output:	Angle in 21.00, 01
Sealing:	Angle $< 2^{10}$, or Angle less than 512.0 degrees
Accuracy:	10^{-11} degrees
Execution Time:	7 Drum Cycles, (8 for angle less than 64 degrees)
Short Lines Used:	23.00, 01, 02, 03, 22.01, 21.00, 01, 20.01
Locations Used:	00 - 48, inclusive 49 - Balancer 51 - Check-sum
Storage:	Any line available for Intercom Subroutine storage
Operating Line:	05, uses O.P.-Code 02. (Ck. Sum 130500) 19, uses O.P.-Code 08 (Ck. Sum 130600)

Abstract of Users Project No. 624

Class 1

Title: Analysis of Variance, Two Way Crossed Classification (AV2X)

Originator: McMaster University, Hamilton, Ontario

Mode: Intercom 1000 D.P.

Date: June 8th, 1961

This program uses Intercom 1000 D.P. (floating point) and computes an Analysis of Variance table for a two-way crossed design with replication. The data ($x_{ij\alpha}$, $i = 1,2,\ldots p$, $p \leq 6,7$ or 8 depending on whether transformation of data is required; $j = 1,2,\ldots,q$; $\alpha = 1,2,\ldots,n$, where $qn \leq 50$) may be transformed using the Arcsin$\sqrt{}$, $\sqrt{}$, or $\log_{10}$ transformations.

A supplementary program permits typeout of cell, row, column and grand means.

Computation time depends on whether transformations are used, and upon the size of numerical input, and varies from 1-20 minutes.

Abstract for Users Project No. 625

Title: INVERSE TRAVERSE

Mode: Intercom 1000D
Originator: Palmer & Baker Engineers, Inc.
Address: P. O. Box 346, Mobile, Alabama
Date: March 30, 1961

Input consists of initial station and coordinates of points entered in the desired order.

Output consists of verification of input, the station of each point in ascending order, the distance and bearing between consecutive points.

Input and Output are on the same form and up to eighty-three points can be handled in a single problem.

Input can be by either typewriter or computer tape, and a correction routine is included for either case. The option of punching a computer tape of the Input data is provided.

Subroutines used: Square root; arc tangent; UP 375 fraction selector.

Auxiliary Equipment used: None

Computation Time: Varies

ABSTRACT OF USERS PROJECT NO. 626

Title	:	Alphanumeric Input/Output Library Subroutine for Algo
Class	:	I
Mode	:	Algo
Originator:		Modification of Applications Sections Project No. 118, by P. A. C. Cook and P. J. Simonetti, Research and Development Division, Consolidation Coal Company.
Date	:	24 July, 1961

This alphanumeric library subroutine enables the users of Algo to type alphanumeric information automatically during execution of an Algo program. Alphanumeric information is loaded under control of the Algo program. Two versions are supplied. The first version is used when no other library routine is used by the program, the second version is used when another library routine is used, such as the "sine" routine.

ABSTRACT OF USERS' PROJECT NO. 627

Title : ATL (Algo Tape Lister)

Class : I

Mode : Basic machine language (POGO)

Originator: P. A. C. Cook, Research and Development Division
Consolidation Coal Company

Date : July 26, 1961

This program permits the listing of an Algo program tape prepared by Magazine No. 1 (Editor) or by Magazine No. 5 (Updater). ATL will list the statement numbers beginning with the first "begin" statement in the program, or with any statement specified after the first begin statement. ATL is especially useful in typing a correct listing of statements after several major changes have been made with the Updater.

Abstract of Users' Project No. 628-2

Class 2

TITLE: BRIDGE LENGTH-END SPANS

ORIGINATOR: Scientific Computers, Inc.

ADDRESS: 1315 Fourth St. S. E., Minneapolis 14, Minn.

MODE: Intercom 1000 Double Precision

DATE: September, 1961

PROBLEM STATEMENT: This program calculates or locates the position of the back face of the abutment. Given the required input data, the end slope of the ground under is calculated at both ends of the abutment. The critical abutment end is limited to a 1.5:1 slope. The slope at the other end of the abutment is calculated using the end span bridge length as required for the critical case. Provision is made at the end of the type out to "round off" the bridge length by inserting a new value of the end span length from which a corresponding end slope will be calculated at both ends of the abutment. This program is limited to bridges entirely on a horizontal tangent over and under. The program works with one end at a time. Limiting end slopes other than 1. 5:1 can also be handled if specified.

INPUT DATA: Station and elevation (control point) at the intersection of the road center lines over and under, the vertical curve data over and under, skew angle (α), distances from ℄ road over out to the points where the slope is to be calculated (W_1 & W_2), vertical height from the profile grade over to the berm line (h_1), height from the profile grade under to the bottom of the ditch (h_2), distance from the back face of the abutment to the berm line (B), and the distance from the distance from the center line at the road under to the ditch line (V).

OUTPUT DATA: Station and elevation of the back face of the abutment, distance from back face of the abutment to the control point (L) and the slopes at each end of the abutment.

PALMER & BAKER ENGINEERS, INC.

DESIGN COMPUTATIONS SHEET NO. 1

MADE BY Hurst DATE 7-25-61

SUBJECT MATTER PROGRAM FOR BENDIX G-15D COMPUTER CHECKED BY ______ DATE ______

Abstract of Users Project No. 629-2

Title: TRAVERSE COMPUTATIONS

Mode: Intercom 1000D
Originator: Palmer & Baker Engineers, Inc.
Address: P.O. Box 346, Mobile, Alabama
Date: July 25, 1961

Input consists of initial bearing, initial coordinates, final coordinates, final bearing, a deflection angle for each point and distances between points for a limit of 21 points.

The first part of the output consists of adjusted values of angles and coordinates at each point; and adjusted distances and bearings between points.

The second part of the output consists of total length, errors of closure and the area enclosed by the traverse.

All the above mentioned data is typed out on an Input-Output Form.

The angular error of closure is distributed evenly to all angles requiring adjustment. Coordinates are adjusted by application of the Compass Rule and adjusted distances are obtained from adjusted coordinates.

Angles which are not adjusted are angles with given values of zero and 180, and angles selected by the user. In addition, the user may select distances which will not be adjusted.

The projection of adjusted angles and distances will not always produce the adjusted coordinates as the methods of adjustment follow those given in American Society of Civil Engineering Manual of Engineering Practice, Manual No. 20; Horizontal Control Surveys to Supplement the Fundamental Net.

The program will also compute open-end traverses, but makes no adjustment. There is no type out of trigonometric functions, latitudes or departures.

Subroutines used: square root; sin, cos; arc tangent.

Auxiliary Equipment used: none

Computation time: varies

ABSTRACT OF USERS' PROJECT NO. 630-1
Class II

TITLE: Capper

ORIGINATOR: Curtis Lacy
Pacific Union College
Data Processing Laboratory
Angwin, California

TYPE: Service Routine

EQUIPMENT AFFECTED: G-15D, CA-2, IBM Card Reading Equipment
Intercom 500

Capper provides for input from IBM cards under (Intercom 500) program control. It will accept commands, floating point data, or fixed point data. Each card contains one piece of input, the Intercom 500 address (CHWD) in which the input is to be stored, and a flag identifying the type of input. Reading is halted by a blank card, and control is returned to the Intercom 500 manual mode.

ABSTRACT OF USERS' PROJECT NO. 631-2

Class 2

Title : Program to Evaluate Coulter Counter Data

Originator: D. R. Bomberger, R & D Division, Consolidation Coal Company

Address : Library, Pennsylvania

Mode : Intercom 500X

Date : June 6, 1961

A coulter counter is an analytical instrument that enables one, through appropriate computations, to obtain a particle size distribution, with particle sizes being measured down to 2 microns. This instrument counts individual particles suspended in water by measuring the change in electrical resistance across an aperture as a particle passes through. Considerable and painstaking computations are required, however, to obtain from these raw counts a particle size distribution. The program in question performs these computations.

Briefly, the computation proceeds as follows:

The computer obtains the diameters counted at a given dial setting t' and I according to the expression

$$d^3 = \frac{k^3}{\sqrt{2}} F\ t'\ (I-1) = k^3 t \tag{1}$$

where k is the calibration constant and F is a complex function of the aperture resistance R and the series resistance R_n associated with the given dial setting. From the raw counts, the program calculates the differential volume at a given diameter, as

$$\Delta v = \left(\frac{t_n + t_n + 1}{2}\right) \left(\Delta n\right) \tag{2}$$

where t is defined by eq (1) and Δn is the difference in counts between adjacent settings or diameters, where these counts have been corrected for the coincidence error. The program provides an estimate of the particle volume below the counted range by minimizing the standard deviation (on log-probability coordinates) of the relation on the counted range by a vigorous technique and then extrapolating. Tabulated answers give the cumulative volume percent as a function of particle diameter.

EBASCO SERVICES
INCORPORATED

ENGINEERS - CONSTRUCTORS - MANAGEMENT CONSULTANTS

TWO RECTOR STREET
NEW YORK 6, N.Y.

CABLE ADDRESS "EBASCOE"

Abstract of Users' Project No. 632-1
Class 1

TITLE: Sizing of Steam Condensing System

ORIGINATOR: Ebasco Services, Incorporated
Two Rector Street
New York 6, New York

MODE: Intercom 103

DATE: August 1, 1961

This program computes maximum capability of turbine generator unit and annual average fuel cost for each of several combinations of Turbine Exhaust, condenser and cooling tower sizes.

Input Data Requirements are:

Turbine: Exhaust Characteristics

Condenser: Heat Load, Surface Area, GPM, Heat Transfer Coefficient.

Cooling Tower: Cold Water Characteristics.

Annual average fuel costs to the boiler are determined for a 35 - 40 year life on the basis of a given turbine-generator loading schedule at the 25, 50, 75 and 100 per cent load points and with average cold water temperatures for each of the four seasons of the year. Maximum capability is evaluated at the circulating water temperature expected at the time of system peak.

Without changing input data to the computer, the program can handle as many as 99 different condenser sizes, 2 alternative tube materials and 4 cooling tower sizes.

Running time is approximately 2-1/2 minutes per case consisting of one size of turbine exhaust, condenser and cooling tower.

ABSTRACT

U. P. 633-1

500X PLOTTING SUBROUTINE

This is a machine-language subroutine designed to permit plotting capability for 500X programs. The standard typewriter is used, and the function to be plotted covers 10 inch graph paper. Either points (periods) or X's may be plotted.

ABSTRACT

U. P. 634-1

PLOT

This is a combined 500X/machine-language routine designed to permit full utilization of the plotting capabilities of the standard typewriter. The graph width is 120 spaces (10 inches on the standard typewriter) so that a resolution of approximately 0.8% is achieved.

The program accepts as input either punched paper tape or data stored in channels 8, 11, 13, 14, 15, or 16, as specified by station constants.

If tape input is used, each block may be plotted sequentially, if desired, or single or combinations of blocks may be plotted separately.

Either (x) or (.) may be plotted, thus permitting two functions to be plotted on the same graph with a minimum of interaction.

If a point lies outside the range of the normalized data, the edited point will be typed out.

ABSTRACT

U. P. No. 635-2

OPRA

The Use of Orthogonal Polynomial Values in Regression Analysis

Polynomials of any degree may be fitted using the usual computational methods in regression analysis. However, if a polynomial of the form

$$y = \alpha_0 + \alpha_1 x + \alpha_2 x^2 + \ldots + \alpha_k x^k \qquad (1)$$

is to be fitted to data consisting of n pairs of observations (x_i, y_i) i = 1, 2, ... n where the levels of the independent variable x are equally spaced and an equal number of observations are made at each level, the method consists of transforming the levels x to the integers 1, 2, ..., r and then fitting model (1) in its equivalent form

$$y = \beta_0 P_0 + \beta_1 P_1 + \beta_2 P_2 + \ldots + \beta_k P_k$$

where the β 's are constants and the P_i are orthogonal polynomials of degree i. The polynomials, P_i, evaluated for the integers 1, 2, ..., r, are given in various tables.

The analysis of variance is computed, also.

All computations are floating point, double precision. The number of data points per run is not limited.

ACTIVITY COEFFICIENTS FOR LIQUID-LIQUID EXTRACTION

ABSTRACT

U. P. 636-2

Activity coefficients for all components in multicomponent liquid-liquid extraction problems are determined by utilization of a single ternary diagram and binary vapor-liquid equilibrium data of the two non-solvent components of the ternary diagram. Using these coefficients and mutual solubility data from the literature, the optimum solvent ratio-stage relationships can be calculated for a liquid-liquid extraction process with feed consisting of any number of components.

Users Project No. 637-1
Class 1

ABSTRACT

Four-Factor Analysis of Variance for Data From Equal Number or Equal Weight Designs

This program calculates a four-factor or four-dimensional analysis of variance problem for data from an equal number or equal weight design, typing out the complete analysis of variance table. It is patterned after the method developed by H. O. Hartley, Iowa State University.* It consists of two parts, namely, Part I and Part II. These two parts make 5 runs through the total data and deviate storage locations needed for a particular size design.

*Mathematical Methods for Digital Computers, A. Ralston and H. S. Wilf, John Wiley and Sons, 1960; p. 221.

Abstract of Users' Project No. 638
Class: 1

Title: Capper S.R. and Capper^{-1}

Originator: Data Processing Laboratory
Pacific Union College
Address: Angwin, California
Mode: Machine Language subroutine for Intercom 500
Date: August 28, 1961

The Capper S.R. will read cards under Intercom 500 program control. The card may contain one command, fixed point number, or floating point number. There are three items of information on the card:

(1) A flag to designate the type of input, either a command, fixed point number, or a floating point number.

(2) A four-digit number specifying the interpretive address where the input is to be stored.

(3) The actual input.

The routine will read cards at any speed up to 100 cards/min., using the CA-2 card coupler. Input is halted when the routine detects a blank card, and control is passed to the next Intercom command.

Capper^{-1} punches Capper cards, floating point data only, with the standard Capper format. It operates in three modes:

(1) Single shot, which punches a single card

(2) Channel mode, which punches an entire channel from word zero up through any word specified by the programmer

(3) Non-zero mode, which is the same as the channel mode, except that only non-zero elements will be punched.

This routine also operates at any speed up to 100 cards/min.

ABSTRACT OF USERS PROJECT NO. 639
CLASS: I
CROSS INDEX SECTION: 3.3

Title: POLYNOMIAL CURVE FITTING BY LEAST SQUARES WITH ERROR ESTIMATES

Originator: National Research Council of Canada, Ottawa.
Date: 12 September 1961
Mode: Intercom 1000D (.3121959)
Abstract: The routine fits a set of N + 1 pairs of data (x_i, y_i) with a polynomial of the form

$$y(x) = \sum_{k=0}^{n} a_k x^k$$

by the method of least squares. It is limited to $1 \leq n \leq 9$ and $<N \leq 49$. Also computed are the mean absolute and root mean square deviations between the observed function and its calculated approximation, E_{RMS} an estimate ofthe RMS deviation between the true function and the observed one and $(\delta a_k)_{RMS}$ an estimate of the RMS error in each of the calculated coefficients a_k.

Except for the calculation of E_{RMS} and $(\delta a_k)_{RMS}$ this program is the same as that of Users Project 527. This program requires several times the running time of UP 527.

Disclaimer:

No responsibility is assumed by National Research Council of Canada for any errors or misrepresentations that may occur as the result of using this program. No responsibility is assumed by the Bendix Computer Division for the correct reproduction of this program.

Abstract for User's Project No. 640

Class 1

Title: STEPWISE MULTIPLE REGRESSION ANALYSIS*

Originator: The Dow Chemical Company, Pittsburg, California

Mode: Intercom 500

Date: June 2, 1961

Multiple regression analysis is used in data analysis to fit an equation of the form:

$$y = b_0 + b_1x_1 + b_2x_2 + \ldots. + b_nx_n$$

where y is the independent variable and the x_i are assumed independent. Most of the programs for regression analysis supply values for the b_i as well as some estimate as to the significance of these coefficients. Where some of the coefficients do not significantly differ from zero, the corresponding variables may be deleted from the matrix and the regression equation again calculated.

The stepwise regression differs from the above procedure in that the variable that causes the greatest decrease in the standard error of y is the first to enter the regression. The regression equation with this variable is typed out if the F value is greater than a preselected F_1. The next most significant variable enters the regression, etc., until no remaining variable is significant at the F_1 level. If, during this procedure the F associated with a variable already in the regression drops below a preselected F_2 level, this variable will be removed from the regression.

This program is written to accommodate twenty-two variables (x + y). There are no restrictions on the total number of runs. Pre-editing or transforming of the data must be done prior to entering the program, however. Flexowriter prepared tape or, with minor modification, binary data tape serves as input.

*This procedure is excellently described by M. A. Efroymson, "Mathematical Methods for Digital Computers", edited by Ralston and Wilf.

In order to maintain significance using Intercom 500, the data tapes are read twice; first, to calculate the $\overline{x_i}$ and second, to calculate the $\sum_{ij}(x_i - \overline{x_i})(x_j - \overline{x_j})$. This avoids the calculations which utilize small difference between large numbers. The appropriate alphanumeric headings are typed out as computation progresses. Comparisons of calculated versus observed values may also be carried out.

Abstract of Users Project No. 641-2

Class 2

Title: GENERAL MEMBER INFLUENCE LINE PROGRAM FOR STATICALLY DETERMINATE TRUSSES

Originator: Roy F. Johns, Jr., Consulting Engineer
Address: 1306 Allen Street, Aliquippa, Pennsylvania
Mode: Intercom 500X
Date: September 12, 1961

This program will handle simply supported spans, simple spans with cantilevers or multiple statically determinate spans with hinges. However, it is basically set up to handle a simply supported center span with cantilevers and suspended end spans but with a little imagination, practically any statically determinate truss can be handled by the program. The diagonal system can be either Pratt, Warren, Howe or any combination of the three.

The input consists of location of supports and hinges, influence lines for reaction at supports and hinges, elevation of panel points, lengths of all members, the panel length and the total number of panels.

The output gives the panel number, influence line ordinates for all members as well as a punched paper tape of all influence lines which can be utilized by a separate program or a Part II which will follow later to calculate the live load and dead load stresses in all members.

This program will handle up to 32 panels and the running time for a 20 panel truss is approximately 1 hour and 15 minutes.

ABSTRACT OF BENDIX
Users Project No: 642-1
Class : 1
Cross-Index Section: 1-6-1
1-6-3

Title: FLOATING POINT NUMBER CONVERSION AND INTERCOM LOADER SUBROUTINE.

Originator: National Research Council of Canada

Date: September 22, 1961

Mode: Machine language subroutine for Intercom 500 and 1000D.

Abstract: The program converts single precision floating point data to double precision, double precision to single precision and reads and executes a loader. Intercom 1000D may be loaded under control of Intercom 500 and Intercom 500 under control of Intercom 1000D. Also included are a revised Intercom 1000D loader which starts computing at 1100 after loading and a revised Intercom 500 loader which starts computing at address 1000.

ORIGINATOR: STANLEY ENGINEERING COMPANY
PROGRAM TITLE: WATER SYSTEM NETWORK ANALYSIS

I. ABSTRACT

This program, based on the Hardy Cross method of distribution system analysis, calculates flows and head losses in a water distribution system for a given flow condition. Corrections are made to assumed flows so that flows approach a condition where the head losses from one point in the system to another point are equal, regardless of the route. The number of corrections to be made is controlled by (1) specifying an allowable difference in head losses around individual loops and (2) specifying the number of corrections to be applied. The network is processed, one loop at a time, until all loops have had one correction applied to each main. Mains common to two loops will have had two corrections -- one in each loop. This procedure makes up one program cycle. When a cycle is completed, the computer stops if the specified head loss limitation is met in all loops or if the number of cycles specified have been completed. If neither condition is met, the computer will proceed automatically into the next cycle.

As each loop is corrected, the flow correction and head "unbalance" is typed out. This permits continuous observation of the progress towards the ultimate solution. After observing these typed out results, the engineer may wish to change the number of cycles specified and/or the head loss limitation.

The program is applicable to systems containing up to 200 mains. (Note that a main common to two loops must be counted twice.) Time required for solution of the system depends upon the number of cycles needed to satisfy limitations set by the engineer and the number of mains in the system. A formula which will approximate the time required for a given system is:

$$\text{Time in Minutes} = \frac{(\text{No. of Mains}) \quad [16 + (\text{No. of Cycles})\,(3.3)]}{60}$$

The typeout consists of the length*, roughness coefficient*, diameter*, a "K" resistance factor, an "indicator" which is used to cross reference common mains*, initial assumed flow*, final flow and final head loss.
(* items are input)

II. COMPUTATIONAL APPROACH

Formulas:

(1) $$K = \frac{10.43L}{C^{1.85}\ D^{4.87}}$$

(2) $$H = K\ Q^{1.85}$$

(3) $$\Delta Q = \frac{\sum H}{n \sum \left| \frac{H}{Q} \right|}$$

(4) $$H' = 0.4331\ H$$

Abstract of Users Project No. 644-2
Class 2

Title: ANALYSIS OF SANITARY SEWERS

Originator: D. J. Olsen

Address: 1100 Meadow Road
Northbrook, Illinois

Equipment: G-15D

Mode: Intercom 501

September 25, 1961

The program consists of two parts which may, if so desired, be run independently of each other. Part I calculates the quantity of flow each section (or segment) in the sewer system is expected to carry. Part II analyses the section of sewer to determine the velocity and capacity when the pipe is flowing full. Part II then compares the "required" flow from the determination in Part I with the pipe capacity to determine the amount of excess capacity or deficiency in the sewer line.

The program is set to handle a maximum of 89 sewer sections at one time consisting of mains, branches and laterals in any combination. Only circular pipe may be used.

The input for Part I consists of the following:

- Tributary population
- Commerical (maximum of two types), industrial, and special use areas
- Per capita flow for residential areas
- Unit flow per acre for commercial, industrial, and special use areas
- Infiltration allowance per acre (maximum of two different rates)
- Table of values relating maximum and minimum flows
- Code number given to each sewer section which defines its relationship to the entire system.

The output for Part I consists of the following:

All input data on population and areas.
Average and maximum flows.
Cumulative maximum sanitary flows.
Incremental and cumulative infiltration.
Total maximum flows.

The input for Part II of the program consists of the following:

Size of pipe.
Length of sewer section.
Upstream and downstream invert elevations.
Code number (same as for Part I).
Roughness coefficient ("n" factor in Kutter's equation) of the pipes.
Total maximum flow to be carried by the section.

The output for Part II consists of the following:

Pipe size, length, invert elevations and "n" factor.
Velocity and capacity when the pipe is flowing full.
Total maximum flow to be carried ("required" capacity).
Amount of excess capacity or deficiency in the sewer section.

The approximate running times per iteration are as follows:

Part I	Input	0.627 min.
	Output	0.296 "
Part II	Input	0.516 "
	Output	0.258 "

No auxiliary equipment is used.

Abstract of Users' Project No. 645

Class 2

Title: Flood Routing

Originator: Parsons, Brinckerhoff, Quade and Douglas

Address: 165 Broadway, New York 6, N. Y.

Mode: Intercom 500 X

Date: October, 1961

The program "routs" an inflow hydrograph through a reservoir equipped with up to three outlets having different flow characteristics, and located at different elevations. Tailwater effects are taken into account, and two of the outlets may be submerged.

Input consists of reservoir and outflow characteristics, and data on time vs. inflow, reservoir storage vs. reservoir elevation, and outflow vs. tailwater elevation.

The routing process is accomplished by a series of iterations. Starting with assumed reservoir and tailwater elevations the program adjusts outflow with tailwater elevation, and utilizes the outflow thus obtained to recompute the reservoir elevation (taking storage into account). This process is repeated until the difference between assumed and computed elevations is less than the maximum error specified by the designer.

HERCULES POWDER COMPANY

Abstract of Users Project No. 646-1

Class

Title:	SYNCRO-MONROE ADD-PUNCH INPUT ROUTINE - INTERCOM 500X
Originator:	C. E. Green and T. M. Kusala
Address:	Hercules Powder Company Research Center Wilmington 99, Delaware
Mode:	Machine Language
Date:	October 12, 1961

Acknowledgment is made to Mr. R. J. Margolin of the Program and Systems Development Group, Bendix Corporation Computer Division for the original contents of the program, Applications Section Project No. 113.

This program is a revision of the Flexowriter Input Routine for Intercom 500X. It is to be used for input data tapes made from the Syncro-Monroe Add-Punch Machine. The program utilizes the automatic reload feature available only on an alphanumeric machine, thereby eliminating punching reload codes after each four-word group.

In addition, it also eliminates punching marker codes before the stop code of each block of tape. The tape punching instructions are available with the program.

Limitation: If this program is to be used repeatedly in an Intercom 500X program, the Index Registers CD9 and CL9 may not be used as the program uses Locations u6 and u7 for commands.

The program may be altered by changing one command which enables the computer to read in the data tapes on one or more additional photoreaders, such as a PR-1M.

Equipment needed: Alphanumeric Computer and a Syncro-Monroe Add-Punch.

Abstract of Users Project No. 647-1 Index 1.6.7

Class 1

TITLE: ALGO Object Program Corrector Or Documenter (ALGO OPCODE)

ORIGINATOR: E. I. du Pont de Nemours & Co., Inc.
Eastern Laboratory, Gibbstown, New Jersey

MODE: Machine Language Service Routine for ALGO

DATE: November 6, 1961

The ALGO Algebraic Compiler takes as input a source program in the form of algebraic statements and control statements and compiles this into an object program which can be executed on the G-15 computer. This object program is in an interpretive language and is run with the ALGO Interpreter (Magazine 4) in the computer memory. Corrections in a program may be made by correcting the source program and compiling a new object program.

This program is a service routine which permits one to inspect and correct the object program directly, thus frequently eliminating the need for recompilation. Interpretive commands in the object program are listed in the form of a three-letter Opcode and an address, which may be a three-digit number, possibly followed by an indexing flag, or a non-numeric address.

Examples:	ADD 863 A	Add to accumulator the contents of location (863 + contents of index register A)
	MPY C	Multiply accumulator by contents of index register C.
	TAB 005	Type five tabs.

The routine can list all formats, floating-point constants, and commands in a program, thus permitting the inspection or documentation of an object program. There is also provision for typing in formats, constants, or commands, so that a corrected object program may be prepared. After all corrections are typed in, the corrected program tape is punched by loading ALGO Magazine 4.

The program write-up also describes techniques for examining and possibly saving an incomplete compilation which has been stopped by an error halt in Magazine 3, as well as for complete program preparation at the object level with no compilation at all. In this way, the program may be considered to be the compiler of an Intercom system, with ALGO Magazine 4 serving as the interpreter.

USERS' PROJECT NO. 648-2

ABSTRACT

Title: Symmetric and Nonsymmetric Correlation Matrices for Data With Missing Values
Part A: Data Conversion Program
Part B: Computation Program

Class: II

Mode: Machine Language

Originator: The Lafayette Clinic

Address: 951 E. Lafayette, Detroit 7, Michigan

Prepared by: Dr. Rhea S. Das, James R. Wall and S.J. Singer

Date: June 30, 1961

Subroutines: All subroutines used included in program tape.

Equipment Affected: G-15D, Alphanumeric Typewriter, Magnetic Tape Unit (MTA-2), Flexowriter

Description: Part A converts a data tape prepared on the Flexowriter, scaling the numbers 2^{-28} and writing the data on magnetic tape. Part B computes the product moment correlation coefficients between pairs of variables, X and Y, by the formula

$$r = \frac{\Sigma xy}{N\sigma_x\sigma_y}$$

for data matrices with missing values. The number of variables must not exceed 106. The number of subjects is limited by the capacity of a single 29 bit word to accumulate sums of squares and crossproducts scaled 2^{-28}. Either symmetric or nonsymmetric correlation matrices may be computed.

TITLE: Film Tensile Test Data Processing Program (Floor Model Instron)

ORIGINATOR: E. I. du Pont de Nemours & Co., Inc., Film Department

ADDRESS: Experimental Station, Wilmington 98, Delaware

MODE: Machine Language

EQUIPMENT AFFECTED: G-15D, MTA-4, MTA-3

DATE: September, 1961

Description:

Numerical information representing points on a stress-strain curve is used by this program to compute tensile properties. The same information, as is plotted on the regular strip chart, is also recorded on magnetic tape via the MTA-4. Input to the computer is via the magnetic tape accessary unit (MTA-3). The program makes a point by point analysis of such data, and with appropriate constants available, computes the following parameters (for films):

(1) Specimen length corrected for slack
(2) Tensile modulus, initial maximum
(3) Off-set yield stress (3% elongation)
(4) Percent elongation at maximum stress
(5) " " " break
(6) Tensile stress, maximum
(7) " " at break
(8) Work-to-break

The program gives standard deviations as well as averages for each parameter. Error checks are incorporated into the program. Output is via the computer typewriter.

OPERATING SPEED: Input time is variable, depending on length of original tensile test. Computation and output = 25 to 35 seconds.

DISCLAIMER CLAUSE: No responsibility is assumed by E. I. du Pont de Nemours and Co., Inc., for any errors or misrepresentations which may occur as a result of using this program.

ABSTRACT OF USERS PROJECT NO. 650-1
CLASS 1

TITLE: AZIMUTH & DISTANCE FROM GEOGRAPHIC POINTS & VICE VERSA (No. 33X1G422)

ORIGINATOR: U. S. ARMY ENGINEER DISTRICT, LITTLE ROCK
P. O. BOX 867, LITTLE ROCK, ARKANSAS

MODE: INTERCOM 1000 (D.P.)

DATE: 1 NOVEMBER 1961

GIVEN THE LATITUDE AND LONGITUDE OF A POINT AND THE AZIMUTH (MEASURED FROM SOUTH) AND THE DISTANCE TO ANOTHER POINT, THE PROGRAM PRODUCES THE LATITUDE AND LONGITUDE OF THE SECOND POINT. ALSO INCLUDED IN THE PROGRAM, THE LATITUDE AND LONGITUDE OF TWO POINTS CAN BE GIVEN AND THE PROGRAM PRODUCES THE AZIMUTH (MEASURED FROM SOUTH) AND THE DISTANCE FROM THE FIRST POINT TO THE SECOND POINT.

THE PROGRAM WAS WRITTEN TO HANDLE BOTH CASES MENTIONED IN THE ABOVE PARAGRAPH. THE FIRST CASE MENTIONED IS IDENTIFIED BY A +2 TYPE PROBLEM. THE SECOND CASE MENTIONED IS IDENTIFIED BY A -1 TYPE PROBLEM.

THE INPUT FOR A +2 TYPE PROBLEM CONSISTS OF THE FIRST HUB NO. (ALL NUMERIC VALUES), THE LATITUDE AND LONGITUDE OF THE FIRST POINT, AND THE AZIMUTH AND DISTANCE TO THE SECOND POINT. THE INPUT FOR A -1 TYPE PROBLEM CONSISTS OF THE FIRST HUB NO. (ALL NUMERIC VALUES), THE LATITUDE AND LONGITUDE OF THE FIRST POINT, THE SECOND HUB NO. (ALL NUMERIC VALUES), AND THE LATITUDE AND LONGITUDE OF THE SECOND POINT.

THE OUTPUT FOR A +2 TYPE PROBLEM CONSISTS OF THE FIRST HUB NO., THE SECOND HUB NO., THE LATITUDE OF THE SECOND HUB AND THE LONGITUDE OF THE SECOND HUB. THE OUTPUT FOR A -1 TYPE PROBLEM CONSISTS OF THE FIRST HUB NO., THE SECOND HUB NO., THE AZIMUTH FROM THE FIRST HUB TO THE SECOND HUB, AND THE DISTANCE BETWEEN THE TWO HUBS.

THE AZIMUTH, LATITUDE AND LONGITUDE ARE EXPRESSED TO THE NEAREST ONE THOUSANDTH OF A SECOND FOR BOTH INPUT AND OUTPUT. THE ONLY OTHER LIMITATIONS ARE THOSE THAT ARE NORMALLY FOLLOWED WHEN USING A DOUBLE PRECISION PROGRAM IN INTERCOM 1000. THIS PROGRAM IS LIMITED TO THE NORTHERN HEMISPHERE.

THE COMPUTER TAKES APPROXIMATELY ONE MINUTE TO PERFORM EITHER OF THE TYPE PROBLEMS MENTIONED. THERE IS NO OFF-LINE EQUIPMENT REQUIRED. THE ONLY ON-LINE EQUIPMENT NEEDED IS THE BASIC G-15D COMPUTER AND TYPEWRITER.

USERS PROJECT NO. 651

MICHIGAN STATE HIGHWAY DEPARTMENT HOMOGENEITY PROGRAM

ABSTRACT

This program tests for the homogeneity (independence) of two sets of data by application of the Chi-square test.

$$\chi^2 = \frac{N^2}{N_1 N_2}\left[\Sigma\left(\frac{f_i^2}{T_i}\right) - \frac{N_1^2}{N}\right]$$

where f_i = observations from first set of data

f_i' = observations from second set of data

$T_i = f_i + f_i'$

$N_1 = \Sigma f_i$

$N_2 = \Sigma f_i'$

$N = N_1 + N_2$

with $i \leq 999$

$N \leq 99999999$

$0 < f_i \leq 99999$

$0 < f_i' \leq 99999$*

Card input and typewriter output are used with cards reading at maximum speed of 100 cards per minute.

*The above limitations could be changed with minor program modifications.

ABSTRACT OF USERS PROJECT NO. 652-1 Index No. 3.5

NAME: Correlation and Regression Program (CARP)
ORIGINATOR: U. S. Navy Weather Research Facility
MODE: Machine Language
DATE: 22 November 1961

Class I

CARP is a statistical program designed to compute the coefficients of a linear regression equation expressing a dependent variable (predictand) as a function of as many as eleven independent variables (predictors).

CARP first inspects the variables, dependent and independent, computes the mean, variance, and standard deviation of each, and prints this information. The program then correlates each predictor with the designated predictand, thus creating a list of correlation coefficients. From this list of correlation coefficients, CARP selects that one which has the largest absolute value, thereby identifying the predictor which can best predict the predictand. Having computed and typed out the coefficients A and B of a linear regression equation involving the predictand and the selected predictor

$$y' = Ax + B$$

CARP uses this equation to create residuals R, where

$$R = y' - y.$$

This step ends one iteration of the program. The residuals thus created are stored on magnetic tape, so that the entire program may now be repeated, merely by cycling the Compute Switch, so as to find a new prediction equation whereby another predictor is used to predict the residuals generated by the first iteration. In like manner, the program may be repeated as many times as desired.

CARP is divided into two sections. The first of these merely receives the data from punched cards via the CA-2 adapter, converts the data, and stores them on two magnetic tape units. Any other program which will accomplish this same purpose may be used instead, provided that the data are placed on the tapes in accordance with the prescribed CARP format. The second portion of CARP then carries out the statistical computation. The program requires one 514 or 523 card reader (and hence a CA-2 adapter), two magnetic tapes, and an alpha-numeric typewriter. With some modification to the program, the alpha-numeric typewriter may be omitted.

For further details on the program, the user may contact the originator.

Abstract of Users Project No. 653
Class 2

Title: NUMERICAL SOLUTION OF THE CONVOLUTION OF TWO FUNCTIONS

Originator: Vernon E. Tatsch and William H. Cox
Address: Sun Oil Company, Beaumont, Texas
Mode: Intercom 500X
Date: September 29, 1961

In numerical convolution of two functions, the convolution integral is approximated by a summation. Amplitudes of functions A and B are sampled at regular intervals for numerical representation. These amplitude values are normalized and the convolution integral is evaluated as a summation for each increment of relative displacement between the functions. Displacement increments are equal to the sampling interval used to represent the functions A and B. The range of displacement used includes all values for which the two functions overlap.

Input consists of values of amplitudes of the two functions plus the number of values from each function. Data input time varies with the number of values to be considered. About eight values can be entered and checked per minute.

Output consists of two formats: (1) a list of the normalized values of input data (preceded by the normalizing factors) and (2) values of m and corresponding values of $\Phi_{ab}(m)$. Output time varies; a total of 100 values of An and Bn will require possibly 30 minutes for both formats.

No auxiliary equipment is required.

Abstract of Users Project No. 654-1

Class 1
Index No. 1.6.1

Title; Intercom 1000D Integer Separation Subroutine

Originator: Reynolds, Smith and Hills
Address: P. O. Box 4850, Jacksonville 1, Florida
Mode: Machine Language Subroutine for Intercom 1000D
Date: November 27, 1961

This subroutine provides for replacing of the fractional portion of the number in the accumulator with zeros. The integer portion of the number remains in the accumulator. A separate entry to the subroutine permits adding a round off factor of 0.5 to the magnitude of the accumulator prior to truncation of number. Entries are provided for these two functions using either OP=08 or OP=02.

A special formater entry is provided for use in obtaining a format composed of eleven integer digits with the period located between the 2nd and 3rd digits from the right end of the number. This has the effect of dividing the decimal output by 100 on the type out.

Combined use of these routines permits computations involving dollars and cents to be made with no loss of accuracy in pennies due to conversion of fractional portions of dollars.

All of the above are included with the standard formater subroutine (1001601) which is a part of the basic 1000D package (3121959). The tape can be placed on the 1000D magazine or in the appendix magazines in place of the standard fraction selector subroutine.

Abstract of User's Project No. 655

Class 1

TITLE: Solution of a System of Second Order Differential Equations by Runge-Kutta-Nyström Method

ORIGINATOR: Omni Ray AG.
Computer Department
Dufourstrasse 56
Zurich 8, Switzerland

MODE: Intercom 500

DATE: May 30, 1961

Given a set of second order ordinary differential equations. The program will solve this system of differential equations by a step-by-step integrating method (Runge-Kutta-Nyström). The maximum number of equations is equal to five. The operator must enter all initial values and the step length h. He must write a program for the right hand sides of the equations.

The operator has the choice to plot anyone of the variables or of the first derivative of anyone variable as a function of time.

A plot of the first derivative of anyone of the variables as function of the variable itself (phase plane diagram) can also be made.

Abstract of Users' Project No. 656
Class 1

Title: GENERAL MOMENT DISTRIBUTION ROUTINE

Originator: U. S. Army Engineer District, Los Angeles, Corps of Engineers
Address: 751 South Figueroa Street, Los Angeles 17, California
Mode: 500-X
Date: December 1961

This program was specifically written as a moment distribution routine for rectangular or combinations of rectangular concrete culvert sections. It may, however, be used to distribute moments for any rigid section.

The structure may not be more than three sections high and three sections wide or any combination thereof.

Input consists of the distribution factors and fixed end moments for each existing member. A flag (-1) is used to indicate no existing joint; a flag (+1) is used to indicate each existing joint. Carry over factors are assumed to be .5 for all members but may be changed if so desired.

The output format is shown in the writeup and is in the general shape of the section. The input data for each set of fixed end moments is first typed out as a visual check on accuracy followed by typeout of all distributed moments.

The time required for computation and typeout is dependent on the number of members in the structure and the number of distribution cycles desired.

Although input data is normally prepared off-line by use of a Flexowriter, it may be entered manually through the typewriter.

Abstract of Users' Project No. 657
Class 1

Title: LEVEE CUT AND FILL

Originator: U. S. Army Engineer District, Los Angeles, Corps of Engineers
Address: 751 South Figueroa Street, Los Angeles 17, California
Mode: Intercom 500-X
Date: April 1961

Specifically, this is a program for the computation of earthwork quantities for a channel with a soft-bottom, trapezoidal levee type template, or for a channel having a variable template. In general, it is a series of routines which compute all intersection points of 2 irregular courses and the sums of alternate areas enclosed between both courses and successive intersections.

As applied to the earthwork problem, the 2 irregular courses are the ground course (taken from survey cross sections or topo sheets) and the template course (taken from design criteria or as-built dimensions). The sums of alternate areas enclosed between intersections of the 2 courses are the cut and fill areas.

Results obtained are cut and fill areas, cut and fill volumes between successive stations, cumulative volumes, balance of cumulative volumes, and slope stake data.

Input consists of offsets and elevations of the ground course, and template control data from which offsets and elevations of each template point are computed as part of the program.

The program consists of 4 main parts under control of a master control routine. These 4 main parts are the data entry, intersection routine, area routine, and volume computation and type-out routine. These may be thought of as comprising the basic skeleton of the program. This skeleton is intended to be employed with an appropriate master control routine and template computation (or read-in) routine and special routines which may be incorporated to accommodate specific requirements of the problem type. The master control routine is written to direct the flow of computation to the skeleton routines and special routines.

The program as assembled contains 2 options. Option I is for a levee type channel and utilizes a template computation routine in which basic template control data is employed for automatic computation of the template point coordinates. This option also incorporates special routines for side slope search, and segregation of any existing miscellaneous fill, i.e., fill below the invert.

Option II is included to illustrate how the skeleton routines may be used for a simple cut and fill program. This option utilizes a template read-in routine in which the coordinates of each template point are given as input data. By studying the master control of option II, it is possible for a person with little knowledge of the computer solution for the cut and fill problem to acquire an understanding of it and to learn how and when the various parts of the program may be employed. It is also worthwhile to study the master control for option I, as it demonstrates the ability of the program to solve a cut and fill problem of moderate complexity.

J. E. GREINER COMPANY
Baltimore, Maryland

Computer Program G-22.311 User's Project No. 658

REDUCE GEODIMETER READINGS

ABSTRACT

The reduction of geodimeter readings has been applied to the Bendix G-15D computer to obtain computer speed and accuracy in this operation. The computation has also been extended to include the reduction of surveyed slant distances to horizontal distances and the application of a grid correction factor to the horizontal distances to obtain grid distances.

Normal application of the program requires the use of a basic G-15 and an off-line tape-punching device. Computation speed is somewhat dependent on input data, but several readings per minute will be the normal computing speed.

U. S. ARMY ENGINEER DISTRICT, LITTLE ROCK
CORPS OF ENGINEERS
FEDERAL OFFICE BUILDING
700 WEST CAPITOL
LITTLE ROCK, ARKANSAS

ADDRESS REPLY TO:
DISTRICT ENGINEER
U. S. ARMY ENGINEER DISTRICT, LITTLE ROCK
P. O. BOX 867
LITTLE ROCK, ARKANSAS

REFER TO FILE NO.

ABSTRACT OF USERS PROJECT NO. 659

CLASS 2

TITLE: SIMPLE CURVE DATA FOR LONG CHORD & R., LONG CHORD & $\Delta/2$ AND CURVE LENGTH & R. (LRD NO. 038)

ORIGINATOR: U. S. ARMY ENGINEER DISTRICT, LITTLE ROCK
P. O. BOX 867, LITTLE ROCK, ARKANSAS

MODE: INTERCOM 1000 (D.P.)

DATE: 2 JANUARY 1962

GIVEN THE LONG CHORD AND ONE HALF DELTA, LONG CHORD AND RADIUS, AND THE LENGTH OF CURVE AND THE RADIUS, THE PROGRAM WILL COMPUTE ALL DATA THAT IS PERTINENT TO A SIMPLE CURVE. THIS PROGRAM DOES NOT COMPUTE THE DEFLECTIONS.

THIS PROGRAM IS SEPARATED INTO THREE PARTS. THE FIRST PART, WHICH IS IDENTIFIED BY A $1_{\circ}$, REQUIRES AN INPUT OF THE LONG CHORD AND THE RADIUS. THE SECOND PART, WHICH IS IDENTIFIED BY A $2_{\circ}$, REQUIRES AN INPUT OF THE LONG CHORD AND ONE HALF DELTA. THE THIRD PART, WHICH IS IDENTIFIED BY A $3_{\circ}$, REQUIRES AN INPUT OF THE LENGTH OF CURVE AND THE RADIUS.

THE OUTPUT FOR EACH SECTION OF THIS PROGRAM CONSISTS OF THE TANGENT DISTANCE, THE DEGREE OF CURVE, THE LENGTH OF CURVE, THE LONG CHORD AND ONE HALF DELTA. THIS OUTPUT WILL VARY ACCORDING TO THE INPUT DATA.

THE COMPUTER TAKES APPROXIMATELY ONE MINUTE TO PERFORM ANY OF THE THREE SECTIONS OF THIS PROGRAM.

THERE IS NO OFF-LINE EQUIPMENT REQUIRED. THE ONLY ON-LINE EQUIPMENT REQUIRED IS THE BASIC G-15 D COMPUTER WITH AN ALPHANUMERIC TYPEWRITER.

Abstract of Users Project No. 660-2

Class 2

Title: DEAD LOAD AND MAXIMUM LIVE LOAD STRESSES FROM TRUSS INFLUENCE LINE ORDINATES

Originator: Roy F. Johns, Jr., Consulting Engineer
Address: 1306 Allen Street, Aliquippa, Pennsylvania
Mode: Intercom 500X and Machine Language
Date: December 20, 1961

This program will calculate the dead load stress, maximum positive and negative uniform sidewalk live load stresses, maximum positive and negative stresses for a uniform live load condition with a concentrated load and for a truck loading condition with three wheels. The truck loading condition is made optional since the time of computation increases substantially when the search for maximum is performed.

The input consists of influence line ordinates for all members on punched paper tape (tape can be automatically prepared by User's Project No. 641,"General Member Influence Line Program For Statically Determinate Trusses") or tape can be punched independently with the influence line information. Other input consists of dead loads at all panel points, number of panels, panel length, uniform sidewalk live load, uniform live load and concentrated load and if the option is used, all wheel loads and wheel spacing.

The output gives the member number, dead load stress, maximum positive and negative ordinates, summation of positive and negative area under influence line, maximum positive and negative sidewalk live load stresses, maximum positive and negative stresses for uniform live load condition and truck loading condition.

This program will handle a maximum of 32 panels and the running time per member is approximately one and one-half minutes without the truck loading option. However, with the truck loading condition included, the program running time can be as high as ten minutes per member.

ABSTRACT

USERS' PROJECT NO. 661-1

Title: CLIP (Command Line Interrogation Program)

Class: 1

Mode: Machine Language

Originator: General Mills, Inc., Electronics Group

The program will search through a machine language program on punched paper tape or a single line (line 18), examining each word to determine if it uses a specific memory location typed in by the operator. If the word of the line being interrogated utilizes the location in question as either a source or destination, its address is typed out.

Locations which may be specified include lines 00-19, words 00-u7; lines 20-23, words 00-03; and two-word registers, even and odd.

The program uses lines 00 - 03, 18 and 19 for operation, storage, and input-output.

Example:

Command Sequence		CLIP Tests
.00	u.05.05.0.02.20	2000 s
.05	.08.10.4.20.25	.03230xx
.10	.12.15.0.31.24	.00 .05 .10
.15	.56.01.0.24.31	
.01	v.03.06.3.23.31	2600 s
.06	.07.08.0.25.02	.05 .15
		0203 s
		.00 .01

Abstract of Users' Project No. 662-2
Cross Index Reference 6.4.6.3
Class 2

Title: STRINGER GEOMETRY FOR SPIRAL SPANS

Originator: Tippetts-Abbett-McCarthy-Stratton
375 Park Avenue
New York 22, New York

Mode: INTERCOM 1000 D.P. (Revised March 1959)

Auxiliary Equipment: Flexowriter (Not Required)

Date: January 15, 1962

This program, used in conjunction with U.P. 396, "Roadway Elevations," will be found useful for computing the horizontal and vertical geometry required in detailing stringers and piers which lie wholly or partially within the limits of spiralled portions of highway alignments.

Given: (in the form of a Flex tape, or typed in data)

1. Segment of a spiralled highway alignment defined by:
   a. Station of transition from tangent to spiral, or spiral to tangent
   b. Length of transition spiral (Barnett's Spiral)
   c. Radius of circular curve
2. Locations of two adjacent piers which lie on the tangent, spiralled or circular portions of the highway alignment specified in 1. above. The arrangement of the piers relative to the stationing line are defined by:
   a. Stations of intersection of ℄ Piers and Stationing Line.
   b. Skew angle of the ℄ Piers.
3. Arrangement of stringers at each of the Piers described in 2. above. The arrangement of stringers relative to the ℄ Piers are defined by:
   a. Location of ℄ Bearings relative to ℄ Piers.
   b. Individual stringer spacings along each ℄ Pier.

The program will compute and tabulate:

1. For each intersection of ℄ Pier and ℄ Stringer:
   a. Station
   b. Offset
2. For each intersection of ℄ Bearing and ℄ Stringer:
   a. Station
   b. Offset
   c. Skew angle each stringer makes with each ℄ Bearing
3. Length of each stringer
4. For any desired number of division points along each ℄ Stringer:
   a. Station
   b. Offset

Abstract of Users Project No. 663-1
Class 1

Title: EVALUATION OF NAVIGATION COMPUTERS.

Originator: Central Experimental and Proving Establishment, Royal Canadian Air Force.
Address: RCAF Station Uplands, Ontario, Canada.
Mode: Intercom 500.
Date: 19 April 1961.

This program has been written for the analysis of data derived during flight tests aimed at evaluating automatic navigation equipment. The test procedure is to fly from point A to B to C etc recording the readings of the equipment under test at each point. The program compares the geographic position indicated by the equipment under test with the true position and calculates the resulting errors.

The program computes distances and bearings between two points when given the latitudes and longitudes. The computation equations are:-

$$\Delta N_{AB} = 60(\phi_B - \phi_A)$$

$$\Delta E_{AB} = 60(\lambda_B - \lambda_A)\cos\left(\frac{\phi_A + \phi_B}{2}\right)$$

$$AB = (\Delta N_{AB}^2 + \Delta E_{AB}^2)^{\frac{1}{2}}$$

$$\theta_{AB} = \mathrm{Tan}^{-1}\left[\frac{\Delta E}{\Delta N}\right]_{AB}$$

where ϕ = latitude (degrees)
λ = longitude (degrees)
AB = distance between two points (nautical miles)
θ_{AB} = The bearing of B from A (degrees)

To make the program suitable for all types of equipment, an Evaluation Subroutine (ESR) must be prepared for each type of equipment to transform it's particular readings into geographic latitudes and longitudes. The program includes two ESRs; one for use when the readings are in latitudes and longitudes (Mode B) and one for use when the readings are given as along and across errors from a specified reference track (Mode D).

Because the computations are made using plane trigonometery accounting for the average meridian convergency, tests should be confined to legs less than 400 miles in length and at latitudes less than 60°.

The input is paper tape prepared by flexowriter which contains the true latitudes and longitudes of each pinpoint along with the corresponding equipment readings plus suitable identification numbers.

The output contains the leg distance and track, the radial error magnitude and bearing and the along and across track errors for each flight leg. These answers are typed and punched on paper tape. The input data can also be typed out by altering three or four commands depending which ESR is used. The punching of an answer tape can be deleted by changing one command.

The computation time is approximately 45 seconds per point.

Abstract of Users' Project No. 664-1
Class 1

Title:	Analysis of Continuous Frame by Moment Distribution
Originator:	U. S. Army Engineer District, Los Angeles, Corps of Engineers,
Address:	751 South Figueroa Street, Los Angeles 17, California
Mode:	Intercom 1000, Single Precision
Date:	April 1961

This program analyzes a continuous rigid frame for multiple loadings including sidesway and is capable of typing out all the information required for design of a continuous frame.

Data required are horizontal load at floor line; length, width, and depth or moment of inertia of each member; fixed end moment or uniform and/or concentrated load for each beam; location of the concentrated load; distance from ¢ of each support that moment typeout is required; modulus of elasticity; amount of column or support settlement; number of joints; and number of spans.

Conventional methods are used for the calculation of the distribution factors and moment distribution routine.

The typeout consists of all moments around each beam joint, the loading on each span, the beam shears at each end, location and size of the maximum positive moments, location of the points of inflection, and the moments at the preselected points.

Operating time varies, depending on the loading conditions and number of joints and spans.

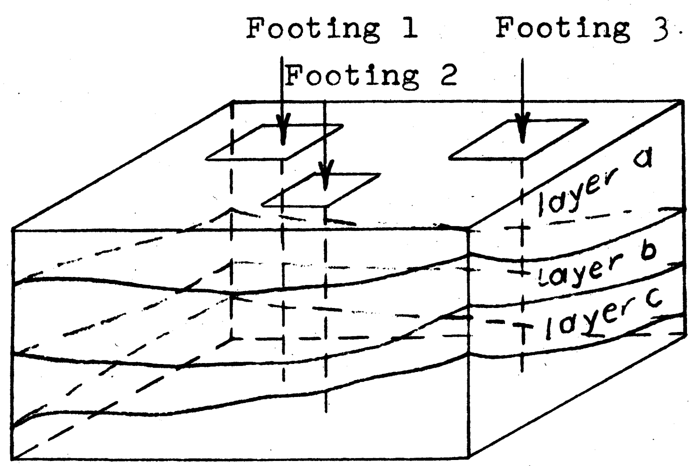
No auxiliary equipment is used.

Abstract of Users' Project No. 665-2

Class 2

Title: SETTLEMENT ANALYSIS FOR FOOTING GROUPS ON NON-HOMOGENEOUS SOILS.

Originator: R.L. Nicholls
Address: Civil Engineering Department, University of Delaware, Newark, Delaware
Mode: Intercom 500
Date: January 12, 1962



Footing group on stratified deposit

This program can be used to study the influence of footing locations, footing sizes and total footing loads on the differential settlements of footings in a group resting on nonhomogeneous soils. Given the x, y, and z coordinates of the centers of bases of up to 20 footings in a group, the maximum design load for each footing and the predicted average load for each footing with respect to time, the program computes the required square footing size and the ultimate settlement of each footing on soils which are nonuniform with respect to consolidation characteristic, bearing capacity, and strata thickness.

The settlement computation consists of determining the pressure at the center of each layer or stratum of soil at a point directly under the center of each footing caused by the loads on all footings. The pressure computations use Holl's integration of the Boussinesq formula for vertical pressure at a point below one corner of a uniformly loaded rectangular area (see reference 1, pp. 226-232). With the pressures computed by this equation and the void ratio-pressure characteristic for each layer obtained from consolidation tests and entered as input data, the program computes the consolidation of each layer under the center of each footing. Finally the consolidation of individual layers under each footing are summed to obtain footing settlements.

The program has been written with a halt before entering final void ratios so that pressure computations can be adjusted by "dispersion" or "concentration" factors for cases where the soil mass varies considerably from the conditions assumed in the Boussinesq solution (reference 2, pp. 259-261). For the program to work properly the z=0 datum must be below all input values of z.

The designer may wish to investigate settlements for footing sizes and shapes other than the square footings computed in the first part of the program. To do this the half widths and half lengths of all footings are entered as input data and computation is started at a point after the beginning of the program. By this method settlements resulting from the use of combined footings and footings proportioned to carry unit loads other than those which would be computed by the program can be analyzed. The program is limited to the use of rectangular footings or footings such as L-shaped ones which can be divided into component rectangular sections.

For the maximum programmed capacity of 20 footings and 3 soil layers under each footing, data input requires approximately 35 minutes and calculations and typeout require in the order of two hours, depending on the geometrical relationship between footing locations and layer thicknesses. For only three footings, calculation requires approximately 12 minutes. No auxiliary equipment is used.

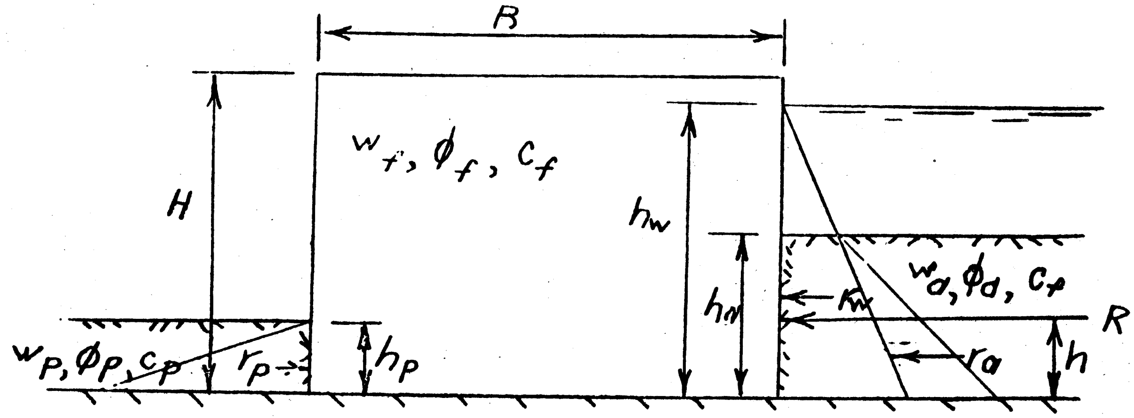
Abstract of Users' Project No. 666-2

Class 2

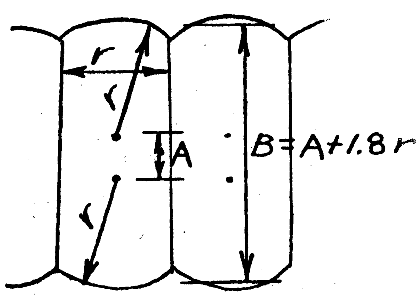
Title: CELLULAR COFFERDAM DESIGN FOR MINIMUM TOTAL SHEET PILING WEIGHT

Originator: R.L. Nicholls
Address: Civil Engineering Department, University of Delaware
Newark, Delaware

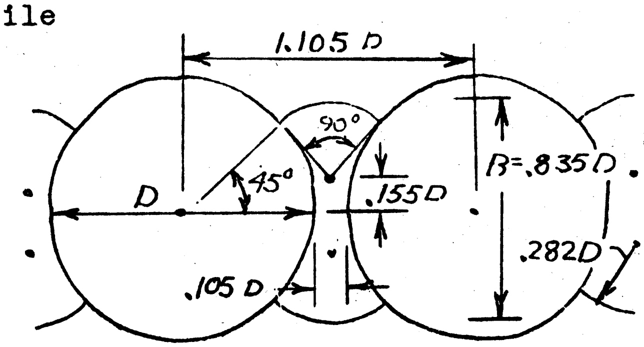
Mode: Intercom 1000 (D.P.)
Date: January 12, 1962



Profile



Diaphragm Plan



Circular Plan

Given the required height (H) of a cellular cofferdam resting on a firm stratum, the heights of backwater (hw) and active and passive soil zones (ha and hp), and the cohesion, internal friction angles, and unit weights of the stream bed and back fill soils, the program computes the minimum allowable effective width (B) and the maximum allowable radius (r) of both circular and diaphragm type cofferdams for any allowable interlock tension (t) of the sheet piling. By including as input a table of weights in pounds per square foot effective surface area and allowable interlock tensions for the standard straight web section sheet pile sizes, the program also computes the sheet pile size and cofferdam dimensions which require the minimum total weight of sheet piling per foot length of cofferdam.

Computations based on the four possible methods of failure of cellular cofferdams, i.e. overturning, sliding, rupture due to vertical shear, and failure in interlock tension are used to determine the minimum width (B) and maximum radius (r).

The solution assumes free drainage of the material within the cofferdam. The solution is applicable only to the case of cofferdams resting on relatively firm strata and the results are not valid (but on the conservative side) for the case where the sheet piling partially penetrates into deep soft strata.

The output consists of the required width (B), radius (r), pounds of sheet pile per linear foot of both circular and diaphragm type cofferdams, and the surface area within the cells per linear foot of cofferdam for each of 4 straight web sheet pile sections listed in the input table.

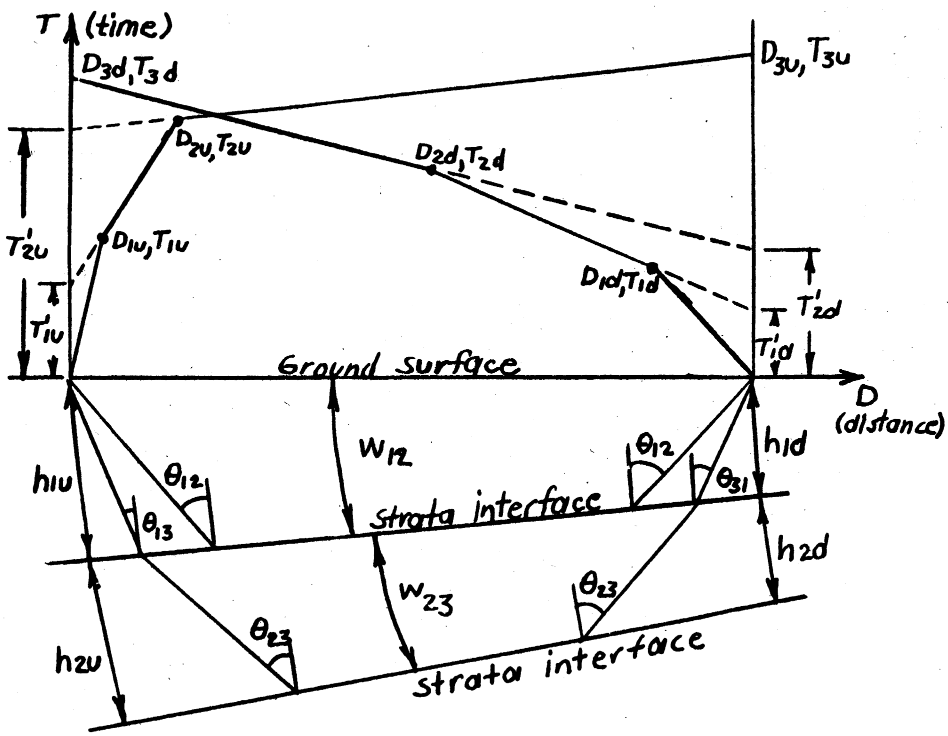
Data input requires 2 minutes and calculations and typout require 2 minutes. No auxiliary equipment is used.

Abstract of Users Project No. 667-2

Class 2

Title: THICKNESS OF DIPPING STRATA FROM SEISMIC DATA

Originator: R.L. Nicholls
Address: Civil Engineering Department, University of Delaware, Newark, Delaware
Mode: Intercom 1000 (D.P.)
Date: January 12, 1962



Notation

$V_{1,2,3}$: velocities in strata 1,2,3

h1u,h2u: thicknesses of strata 1,2 at one end of survey profile

h1d,h2d: thicknesses of strata 1,2 at opposite end of survey profile

$\Theta(xy)$: critical angle of incidence for wave traveling from strata (x) to strata (y)

Given the time and distance coordinates of the changes in slope on a time-distance plot of reversed profile seismic data, the program computes the thicknesses of up to two strata beneath each end of the profile. This is accomplished by solving the basic equations for seismic wave propagation, taking into account speed of travel, travel distance, and refraction angles at the interfaces of strata having different dynamic moduli.

Applicability of the seismic method, and therefore of the program as well, is limited to the case where higher velocity media underlie lower velocity media.

Data input requires 15 minutes for 10 sets of problem data. Calculations and typeouts require 7 minutes for 10 sets. No auxiliary equipment is used.

Abstract of Users Project U-668
No.:
Cross-Index Section: 2.5
Class: 1

Title: INTERMAP MATRIX SHRINKER

Originator: National Research Council of Canada, Ottawa

Date: 29 January, 1962

Mode: Intermap

Problem Statement:

Given an N x M matrix in an Intermap accumulator, shrink the matrix by deleting specified rows or columns. To delete row ab for instance, move row ab+1 to row ab, ab+2 to ab+1, ... N to N-1.

Method:

The program asks for type-in of the required information: Accumulator number, row or column to be deleted, and N or M. Then repeated use is made of the "u" or "v" command of Op code 02.

Memory Required:

The Intermap sequence occupies locations 80 through 98, but can be re-located.

Execution Time:

Depends mainly on the searching time to locate the necessary Op codes, and so on the number of rows or columns which have to be moved. For example, a deletion in a 4 x 4 matrix using magnetic tape master takes about 40 seconds to delete row 3, but 90 seconds to delete row 1.

USERS' PROJECT #669

ABSTRACT

PART-I Consists of a program designed for typewriter input of an indentifier and eleven-point calibrations for any telemetry channel.

The machine counts are punched on cards as they are typed. After the eleventh calibration has been typed the computer computes the slopes and constants and punches them on cards.

The program is in Machine Language and uses a G-15D, CA-2 and IBM-523. The CA-2 must be wired straight 80-80 while a special output board is used. Columns 1 thru 6 and 37 thru 43 are used.

PART II is the Telemetry Digital and Octal Reduction Program and provides for straight line interpolation for any number of calibration points from two through eleven.

The program is designed to handle several different types of data through the use of a mode selection. Mode I will reduce Encoded PDM data; Mode 2 will reduce FM/FM and PCM data; Mode 3 will reduce PDM data and Mode 5 will reduce Typhon PDM data.

Zero time is established by typing in a six digit time correction including three decimal digits. Output of time consists of three integers and three decimals. Output of data consists of four integers and three decimals.

The program is in Machine Language and uses a G-15D, CA-2 and two IBM-523's. The CA-2 uses straight 80-80 wiring while the IBM-523's require special input and output boards.

The program will handle approximately 80 cards input and 20 cards output in one minute. On the average it will compute one box (2000) of IBM cards in twenty-five minutes.

USERS' PROJECT NO. 670-1

CLASS I

PREP, Precession Punch for Algo

ABSTRACT

When a data or constant array is punched with Algo, no precession occurs and the entire channel is punched regardless of the size of the array. PREP enables Algo to precess the array before punching.

Abstract of Users Project No. 671-1
Class 1

Title: Numerical Control Tape Verification Program

Originator: The Dow Chemical Company
Address: Post Office Box 2131, Denver, Colorado
Mode: Machine Language
Date: February, 1962

This program is designed to verify the accuracy of control tapes for machine tools controlled by Bendix Controllers.

It reads two axis control tape in straight binary code and types out the cumulative coordinates of the end points of all Δx and Δy motions, the feed rates for each block of motion and plots to any scale desired, the resultant Δx and Δy motion. A parity checking feature is also included.

The pulse value of the numerical controllers for which this program is designed is .000025 inches.

Roughly ten blocks of motion may be processed in one minute.

Equipment necessary is the Alphanumeric G-15-D, AN-1 and PA-3.

The program has been operational since May 1961. No errors are known to exist.

USERS' PROJECT NO. 672 CLASS: 2
ORIGINATOR: STANLEY ENGINEERING COMPANY MODE: 500-X
PROGRAM TITLE: BUILDING HEAT GAIN PROGRAM

PART I - ABSTRACT

A. This program, given basic data, computes cooling requirements, in terms of Btu and Cfm for sensible and latent heat, for each room in a building. These are summarized for the building and a preliminary size for the cooling unit is computed.

B. The following items are computed for each room:

1. Transmission loads for 12 or less surfaces at 5 different times of the day.
2. Lights and resistance load from total wattage or watts per sq. ft.
3. Electric motor load from horsepower.
4. Load due to occupancy (people).
5. Maximum total sensible heat gain based on a total of Items 2 through 4 plus the largest of the transmission loads.
6. Latent heat due to occupancy (people).
7. Miscellaneous latent heat (Btu/hr. entered as input).
8. Total latent heat gain which is the sum of Items 6 and 7.
9. Room area in sq. ft. and volume in cu. ft.
10. Required Cfm based on air changes per hour (entered as input)(minimum).
11. Total room cooling air requirements, based on Item 5.
12. Total room heat gain based on the sum of Items 5 and 8.
13. Ventilation air requirement, Cfm, based on either Cfm/person, Cfm/sq. ft., or air changes/hr.
14. Heat gain due to ventilation, sensible, latent and total.

C. The summary for the building includes the totals for the above items except area and volume and:

1. Sensible heat percent (without including ventilation air).
2. Total air supply required (Cfm including ventilation air).
3. Sensible heat percent (including ventilation air).
4. Grand total cooling load.
5. Tons of air conditioning required.

D. Two blocks of flexowriter input data tape are required for each room.

E. Limitations:

1. A maximum of 6 sets of room area and volume dimensions may be entered for any one room.
2. A maximum of 12 transmission surfaces may be entered for any one room.
3. The number of rooms that may be processed in any one problem is unlimited.

F. Operating time is approximately 1 minute and 30 seconds for an average room.

G. Equipment: G-15D with Alpha-numeric Typewriter.

Abstract of Users' Project No. 673-1

Class 1

TITLE: SPIRAL PACKAGE - PART A
RADIAL PROJECTION - POINT TO A PARALLEL SPIRAL

ORIGINATOR: COOK COUNTY HIGHWAY DEPARTMENT
130 N. WELLS STREET
CHICAGO 6, ILLINOIS

MODE: INTERCOM 1000 DP

DATE: MARCH 1962

This is one of four programs dealing with transitional spirals of the form RL = C, where L is the distance along the spiral from the tangent, R is the radius of curvature of the spiral at L, and C is a constant. All of these programs include the projection of a point on the basic spiral to the corresponding point on another curve located a fixed radial distance from the basic spiral. This second curve is referred to as a "parallel spiral". It does not have the same equation as the basic spiral, but is, nevertheless, a spiral, and is, in a sense, parallel or concentric to the basic spiral. The basic spiral can be considered a parallel spiral located zero distance from itself.

This portion of the spiral package computes the radial projection of a point to a parallel spiral. This is accomplished by a series of iterations carrying the solution to some predetermined level of accuracy.

The data input consists of the spiral length L_s, the coordinates of the tangent to the spiral at the point of infinite radius, the azimuth of this tangent, the radius of the spiral at the point corresponding to length L_s on the spiral, the coordinates of the point to be projected, and the distance to the parallel spiral.

The output consists of the coordinates of the required point on the parallel spiral, the spiral length along both the basic and the parallel spirals corresponding to the point of projection, and the distance from the original point to the required point.

For compatibility, the data entry locations used in this program are similar to those used in the other programs in the spiral package. To minimize data entry in going from one spiral program to another, a code is provided to indicate that portion of the data to be typed into the computer. The input data (line 11) is not destroyed during loading or operation of this program or by any of the other three spiral programs in this group.

Abstract of Users' Project No. 673-1

Class 1

TITLE: SPIRAL PACKAGE - PART B
INTERSECTION OF A STRAIGHT LINE WITH
A PARALLEL SPIRAL.

ORIGINATOR: COOK COUNTY HIGHWAY DEPARTMENT
130 N. WELLS STREET
CHICAGO 6, ILLINOIS

MODE: INTERCOM 1000 DP

DATE: APRIL 1962

This is one of four programs dealing with transitional spirals of the form RL = C, where L is the distance along the spiral from the tangent, R is the radius of curvature of the spiral at L, and C is a constant. All of these programs include the projection of a point on the basic spiral to the corresponding point on another curve located a fixed radial distance from the basic spiral. This second curve is referred to as a "parallel spiral". It does not have the same equation as the basic spiral, but is, nevertheless, a spiral, and is, in a sense, parallel or concentric to the basic spiral. The basic spiral can be considered a parallel spiral located zero distance from itself.

This portion of the spiral package computes the intersection of a straight line with a parallel spiral. This is accomplished by a series of iterations carrying the solution to some predetermined level of accuracy.

The data input consists of the spiral length L_s, the coordinates of the tangent to the spiral at the point of infinite radius, the azimuth of this tangent, the radius of the spiral at the point corresponding to length L_s on the spiral, the distance to the parallel spiral, the coordinates of some point on the intersecting line, and the azimuth of this line.

The output consists of the coordinates of the desired intersection, the length L' on the parallel spiral at this point of intersection, and the corresponding length L on the basic spiral. For problem identification, the distance, D, to the parallel spiral is also typed out along with the computed output.

For compatibility, the data entry locations used in this program are similar to those used in the other programs in the spiral package. To minimize data entry in going from one spiral problem to another, a code is provided for partial data entry.

Abstract of Users' Project No. 673-1B

Class 1

TITLE: SPIRAL PACKAGE - PART C
PARALLEL SPIRALS - COORDINATES OF POINTS AT SPECIFIED INCREMENTS ALONG A PARALLEL SPIRAL.

ORIGINATOR: COOK COUNTY HIGHWAY DEPARTMENT
130 N. WELLS STREET
CHICAGO 6, ILLINOIS

MODE: INTERCOM 1000 DP

DATE: APRIL 1962

This is one of four programs dealing with transitional spirals of the form RL = C, where L is the distance along the spiral from the tangent, R is the radius of curvature of the spiral at L, and C is a constant. All of these programs include the projection of a point on the basic spiral to the corresponding point on another curve located a fixed radial distance from the basic spiral. This second curve is referred to as a "parallel spiral". It does not have the same equation as the basic spiral, but is, nevertheless, a spiral, and is, in a sense, parallel or concentric to the basic spiral. The basic spiral can be considered a parallel spiral located zero distance from itself.

This portion of the spiral package computes the coordinates of points along a parallel spiral. The program starts computation at some designated first point L on the basic spiral and then continues incrementation along the parallel spiral at either a designated fixed increment or at designated variable increments. Incrementation along the basic spiral can be achieved by changing one command in the program.

The data input consists of the spiral length L_s, the coordinates of the tangent to the spiral at the point of infinite radius, the azimuth of this tangent, the radius of the spiral at the point corresponding to length L_s on the spiral, the distance to the parallel spiral, the basic spiral length L for the first point, and either the fixed increment or the variable increments on the parallel spiral.

The output consists of L, X, Y on the basic spiral followed by L', X', Y' on the parallel spiral for each point to be computed. Computation ceases when the addition of the new increment to the old L exceeds the total spiral length L.

For compatibility, the data entry locations used in this program are similar to those used in the other programs in the spiral package. To minimize data entry in going from one spiral program to another, a code is provided to indicate that portion of the data to be typed into the computer.

Users' Project: 674-1
Class:
Cross-Index Section:

ABSTRACT

Title: INTERCOM 100D INPUT-OUTPUT FOR CA-2

Originator: White Sands Missile Range, White Sands, New Mexico

Mode: Intercom 100D

Problem Statement:

These subroutines were designed to provide other types of input and output for Intercom 100D.

Using the CA-2 and IBM 523, it is in two parts:

a) CA-2 Output (Program and Data)
b) CA-2 Program Input

Output:

This routine prepares 1 header card and 11 hexadecimal cards per Intercom line which may contain program or data. The header card contains an ID code, transfering command if last line to be loaded, word U7 of the particular line, and the check sum of the line.

There are two types of output provided:

1) One line to be loaded and control transfered to the line.
2) Or several lines loaded and control transfered to the last line.

This is accomplished by using positive or negative ID codes.

Program Input:

This part of the subroutine loads a program punched by part a) above.

The header card is read. If a negative ID is detected a transfer command is placed in line 23. If the ID is positive no transfer will occur. After the header card is read and the various set-ups required are made, the 11 cards containing the input data are read. The line is checked summed. It may be incorrect and a halt will occur (C equals 3). If the line is the last to be read (negative ID) control is transfered to line 23 and then to the desired location in memory.

USERS' PROJECT NO. 675-1

ABSTRACT

The CA-2 Data Input Subroutine was designed to provide a flexible and more rapid data input for Intercom 1000 Double Precision. Input may be one card or many cards as input is terminated by the reading of a card field of z's (7-8 double punches).

Input on the card must be in excess fifty notation. The subroutine occupies words 00-74 of channel CH and therefore may be stored in line 05:00-74. It is designed to work out of line 19 with an 08 OP code. With several modifications it could be made to operate out of line 05 with the 02 OP code. Entrance is at word time 17.

Input time per card is approximately one (1) second, or about 65 cards per minute.

Abstract of User's Project No. 676

Class 1

Title: LPR 500 (Loader Preparation Routine for Intercom 500)

Originator: Computing Center, University of Delaware
Address : 360 P. S. duPont Hall
University of Delaware
Newark, Delaware

Mode : Machine Language

Date : March 5, 1962

This program punches on paper tape an automatic loader for an Intercom 500 program already in the interpretive memory, then punches out the Intercom program, followed by a flag block. Before each block is punched, a number identifying its location in memory is inserted by the program and its check sum is balanced to zero. The operator chooses from the typewriter the desired form of exit to be taken by the loader. He may choose either to return to the manual mode of Intercom or to begin the Intercom program automatically at any point. Since a line is punched whenever it contains a number other than Intercom zero, punching of a line will occur if index registers located in the line have been used, even though the first hundred words in the line are zero. If, accidentally, a line containing significant information happens to have the same check sum as a line filled with Intercom zeros, this line will not be punched on tape automatically. So that no lines will be missed, however, the operator may specify additional lines to be punched before the flag block is prepared by LPR 500 to end the tape. The order in which blocks are punched, except for the loader and flag blocks, is immaterial. The preparation routine exits to the Intercom manual mode and does not disturb the interpretive memory. This routine is entered normally by enable action but can be entered through Intercom if desired.

The loader that is produced may be entered by enable action or through Intercom. If entered by enable action, the routine clears the interpretive memory to Intercom zero and the index registers to machine zero. If entered through Intercom, memory clearing is optional. The loader then reads and check sums each block of tape. If the check sum is not zero, the block is reread. If the check sum is zero, the block is transferred to the line in which it resided when punched out. When the flag block is read, the predetermined exit is performed.

These routines use lines 5 and 19. Words u0 and ul are not punched nor is any information read into them by the loader. These routines can be modified easily (modifications included in write-up) to be used with Intercom 1000 DP if line 5 and words u0 and ul are not used in the interpretive memory.

Operating time is very nearly equal to the sum of the input/output times. No auxiliary equipment is used.

County of Cook
DEPARTMENT OF HIGHWAYS

Computer Program

RAINFALL INTENSITY-DEPTH TABLES

This program will compute and typeout in tabular form; opposite the time (t) in minutes; the rainfall intensity (i), in inches per hour and the total depth (d), in inches, for the formulae:

$$i = \frac{a}{t^b + c}$$

$$d = \frac{a\,t}{60(t^b + c)}$$

The data input is accomplished through a program controlled alpha-numeric loader which labels the required input data for the three coefficients in the formulae and allows the selection of the time interval between tabulated values and the total duration for which the table is required. The program automatically types out columnar headings.

Users' Project 678

ABSTRACT

COMPOSITE BEAM SECTION PROPERTIES

Intercom 1000 DP (May 14, 1959)

Application

Computes first moments, section moduli, and moments of inertia for a composite beam (welded plate girder or standard rolled beam). Permits variation of section dimensions by "base, difference, limit" input.

Input

Plate Girder	Rolled Beam
Fillet	Fillet
Web Depth	Beam Code
Web Thickness	Beam Area
Slab Width	Beam I
Slab Depth	Beam Depth
Top Plate Width	Slab Width
Top Plate Thickness	Slab Depth
Bottom Plate Width	Top Plate Width
Bottom Plate Thickness	Top Plate Thickness
	Bottom Plate Width
	Bottom Plate Thickness

Output

Moments of inertia, section moduli, and 1st moments for steel and composite section based on "n" values of 10 and 30. Also gives the composite I for n=8.

Users' Project No. 679-1

PART VIII

ABSTRACT

This project is a fixed point, single precision program which reduces field cross section notes and plots the sections with the PA-3 Graph Plotter Accessory.

Three versions of the program are available; one plots original and final sections, the second plots original sections only and the third plots original sections and a template.

With appropriate modification of U P 30 (Michigan Earthwork Computations), data tapes prepared for this program may be used later for earthwork computations.

The Standard Oil Company

Users' Project No. 680-2

ABSTRACT

BFG MTA-2 is a revision of User's Project No. 520, the B. F. Goodrich Multiple Correlation Program, for use with one magnetic tape unit.

All command input is still via paper tape; all data input-output is written on and read from magnetic tape unit No. 1 with the exception of the b tape from Part 2. The program is completely automated so that the operator need only place the proper magazine on the photo-reader when needed. The only halt after selecting input mode is at the end of Part 2 to allow selection of either the Shrinker or Part 3.

The mag tape subroutine is replaced with ASP #151-A which writes file blocks compatible with MTSR and MTUR.

Depending on the size of the problem, the revision is 30% or more faster than the original program.

Abstract of Users Project No. 681
Class 2

Preliminary Abstract

Title: INFLUENCE ORDINATES FOR CONTINUOUS BEAMS

Originator: Alfred Benesch & Company
Address: 10 South Wabash Avenue, Chicago 3, Illinois
Mode: Intercom 500X
Date: April 13, 1962

This program produces influence line ordinates for moments at any point and reactions at the supports of two, three, or four span continuous beams having moments of inertia variable at each tenth point of each span. It is also applicable to continuous beams of any number of spans. Values are given for unit concentrated loads placed at successive tenth points across the beam, for single span uniform loading, and for uniform load across the beam. The influence ordinates for moment at the interior supports are given automatically; required points within the spans are input items. If desired, the effect of a 100 ft. -kip cantilever moment at either end of the beam is also computed.

This program does essentially what UP 24, "Influence Line for Continuous Beam Design", and part of UP 119, "Shear and Moment Influence Lines for Intermediate Panels. . . . ," do. This program possesses the following advantages over the others:

1. Uniform loading in single spans is considered.
2. Continuous beams with cantilevers are optional.
3. Cantilever moment data and superposition make this program applicable to beams of more than four spans.
4. No restriction exists on location of moment points.
5. Typeout is in fixed point.
6. The polygon-parabola approximation error is eliminated.
7. Support moments and reactions are printed on a single sheet of paper.
8. The program proceeds automatically from support moments and reactions to the optional interior moments.
9. Running time has been reduced by 25% (average) over UP 24.
10. Only one program tape is required.
11. Alphanumeric headings are optional.
12. Data tape or manual input are optional.

The Conjugate Beam and Maxwell's Reciprocal Theorem are used in the solution. Unit moments are applied successively to each end of each span acting as a simple beam, and the rotations and deflections at each tenth point are computed. Scale factors are then computed by equating the slopes at the interior supports. Multiplying these by the deflections due to unit moments gives the support moment influence ordinates. The remainder is simple statics.

Running time for support moments and reactions is 11-1/2 minutes for the 3-span beam and 16 minutes for the 4-span. Cantilevers add 1-1/2 minutes. Interior moments require 1-1/2 to 2 minutes per point required.

Abstract of Users' Project No. 682
Class 1

Title: CONVERSION OF TRANSVERSE MERCATOR PLANE COORDINATES TO GEOGRAPHIC POSITION AND VICE VERSA (FOR THE UNITED STATES)

Originator: U.S. Army Engineer District, Los Angeles, Corps of Engineers
Address: 751 South Figueroa Street, Los Angeles 17, California
Mode: Intercom 1000 (DP)
Date: February 1962

Given the origin latitude and longitude (base latitude ϕ_o, and central meridian λcm) and the scale ratio (SR) at the central meridian of <u>any</u> state zone based upon the Transverse Mercator system of plane coordinates, this program will compute plane coordinates from geographic position or vice versa.

Input consists of the 3 defining zone parameters (ϕ_o, λcm and scale ratio at λcm), and the plane coordinates or the geographic position of the point as required.

Output consists of the given input data followed by results (Transverse Mercator plane coordinates if geographic position is given, or geographic position if plane coordinates are given).

Input may be through the typewriter keyboard or via flexowriter tape. Typewriter input is in fixed point decimal; flexowriter tape input is punched in Intercom floating point notation. Output is in fixed point decimal via the typewriter keyboard.

Abstract of Users Project No 683

Class 1

TITLE: Reduction of a single output Boolean function to a set of prime implicants.

CATEGORY: 2.9

Originator: Ecole Polytechnique

Address: 2500, avenue Marie-Guyard
Montreal 26, P.Q. Canada.

Mode: Machine language (SP)

Date: Janauary 17, 1962.

Given a single output Boolean function expressed as a canonical sum of products, this program will reduce it to a set of prime implicants using the Quine-McCluskey method.

A two bit per character internal representation is used in order to take care of the four values a variable can assume: True, False, don't care, not used. It is thus possible to handle a function of up to 14 variables, although the memory capacity of the computer will probably be the limiting factor in cases where many intermediate terms are generate. There is no checking for memory over flow.

Computing time varies considerably from one problem to another. In a typical case a Boolean function of 108 terms of 7 variables each was reduced to 35 prime implicants in 5.5 hours.

An alphabetic typewriter is essential.

Abstract of Users' Project No: 684
Class: 2
Cross-Index Section: 5.4

Title: Flexibility, Stress and Deflection of Piping Systems

Originator: Royal Canadian Navy (in co-operation with the National Research Council of Canada, Ottawa)

Date: 28 March 1962

Mode: Intercom 1000 SP

Abstract:

This program finds the forces and moments at each anchor and constraint of a piping system due to thermal expansion. The program then proceeds to compute the combined stresses and deflections at selected points in the system. The flexibility coefficients of each member can be typed out if required. The flexibility coefficients of each complete anchor branch are punched out. The output from the stress calculation includes the results of bending and torsional moments, the longitudinal and transverse forces, and the angles between the resultant force and moment with the member at the point under consideration. The output of deflection contains both the translation and rotation.

It is required that the piping system should not have more than seven anchors and three constraints and should contain no closed loop. With the reduction of one anchor in the system, six more constraints can be added to the problem to form a maximum total of thirty-nine unknowns. Unlimited number of pipe members, however, can be included in the problem and there is no restriction to the orientation of either the straight pipe or elbow member.

This program is based on "A Matrix Method for Flexibility Analysis of Piping Systems", Journal of Applied Mechanics, 1952, by J. E. Brook. It represents a more complete solution to the problem than does Users' Project 326, since some of the limitations of that program are removed. The present program includes, for example, extension to three dimensions, use of arbitrary Poisson's ratio, restraining forces in any direction, and the incorporation of restraining moments.

Users' Project No. 685

ABSTRACT

MTA Data Transferrer

This program copies DDD blocks of data from file #BBB on MTA #1 to file #AAA on MTA #1. It also searches for clean tape and writes file #AAA if instructed to do so.

AAA, BBB, and DDD are input data.

The program was written primarily for use with User's Project Number 680, the B.F.G. Multiple Correlation Program-MTA-2 Version. With this program, it is no longer necessary to enter input data twice if a regression problem using the same data is to be repeated with U.P.#680.

ABSTRACT OF USERS PROJECT NO. 686-1

Title:	Floating Point Package
Originator:	US Navy Weather Research Facility
Date:	24 May 1962
Mode:	Machine Language

Class I   Index No. 1.4

The Floating Point Package (FPP) is a routine designed to permit the programmer to perform floating point arithmetic in his own machine language programs. This allows the programmer to virtually disregard scaling problems which arise in fixed point programs when treating quantities which may vary over large ranges.

The routine consists of a basic package occupying three lines of memory, and a set of optional subroutines occupying one line each. The basic package runs in Lines 01, 02, and 03, and permits the ordinary floating point operations of addition, subtraction, multiplication, and division as well as input and output conversions, and standard fixed-to-floating conversions. The basic package also contains a few other miscellaneous operations. The optional subroutines, if used, run in Line 04. They provide for square root, sine and cosine, arctangent, exponentials, and logarithms. These subroutines are designed to accept floating point arguments, and return floating point results.

All the operations of FPP are invoked by a Marked Transfer to the package, with exits from FPP always consisting of a Return to Mark in Line 00. Thus FPP is a subroutine type of package (cf. Autopoint 24) as opposed to an interpretive type of package such as Intercom.

FPP is so designed that floating point decimal data either punched on paper tape at a Flexowriter, or punched on IBM cards can be entered and converted in that form.

TITLE: Data Transcription Program

ORIGINATOR: National Research Council of Canada, Ottawa

MODE: Machine Language

DATA: May 1962

ABSTRACT: This machine language program is a part of the DBR data recording system[1] since it produces on magnetic tape a record of the data that are originally recorded on punched paper tape. Besides transcribing the data the program allows for editing and conversion of the data from the fixed point decimal form to the floating point binary form used by Intercom 501. The program is divided into the following four subprograms:

I. To type out the last file number and the number of lines in the file and position the magnetic tape ready for further data transcription.

II. To assemble a "file identification line" and write it and a file code on magnetic tape.

III. The data transcription routine. This includes reading paper tape, unpacking, checking, converting to floating point binary and writing on magnetic tape.

IV. Error correction routine.

---

(1) Stephenson, D. G. and C. J. Shirtliffe. An automatic recording system for data processing by the Bendix G-15 digital computer. Proceedings, 6th National Conference, Bendix G-15 Users Exchange Organization, Part VI, August 1961.

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Abstract of Users' Project No. 688

Title: Numerical Solution of a First Order Differential Equation, or Two Simultaneous First Order Differential Equations with Variable Interval of Integration, using either the Modified Euler or Runge Kutta Methods.

Class 1
Category 2.2
Equipment G-15D
Mode Intercom 1000 D.P.
Originator Marion H. Taylor
Date June 1962

Using either the Modified Euler integration procedure or the Runge Kutta procedure and an error control based on the method commonly called "extrapolation to zero step size" for determining the interval of integration, these programs will integrate numerically linear and non-linear first order differential equations. Four separate programs are designed to handle either one, or two equations with either the Modified Euler or Runge Kutta methods, rather than one general program to shorten running time. The interval of integration is automatically found and adjusted by the program throughout the integration so that it is small enough to produce desired accuracy when there is non linear behavior in small regions and at the same time does not remain unnecessarily small throughout the entire range, causing loss in speed. The speed of integration is also improved by the fact that output does not necessarily occur at each step of integration, but only at a specified interval.

Abstract of Users Project No. 689

Class 1

Title: FAST INTERCOM 500X TRUNCATE ROUTINE

Originator: Air Force Special Weapons Center (SWRB)

Address: Kirtland Air Force Base
Albuquerque, New Mexico

Mode: Machine Language Intercom Subroutine

Date: 26 March 1962

Given a number in the 500X floating format in the Intercom accumulator (2101), this subroutine truncates the number to its integer value in floating format and places the truncated number in the Intercom accumulator. The following examples show the number before and after such truncation: 123.45 = 123.00; 123.75 = 123.00; 123.00 = 123.00; -123.45 =-123.00; -123.88 = -123.00; 0.0000 = 0.0000; 0.123 = 0.0000; 0.999 = 0.0000; -0.999 = 0.0000, etc.

No round-off is done on the numbers; only the integer part of the number remains in the accumulator. The sign of the number is preserved in the output except in the following case. Any number whose absolute value is less than one is truncated to positive zero.

Entry to the subroutine is at word 00 (to take advantage of the 500X w3CH00 command) with an alternate entry at word 30. There are no error returns. Overflow is reset on exit. Execution of the subroutine itself, exclusive of transfer in and transfer out is one drum revolution for the word 00 entry and two drum revolutions for the word 30 entry.

Abstracts of Users' Project No. 691

Class 1

Title: Gompertz Long Term Trend Curves

Originator: Management Services Department,
Canadian Industries Limited,

Address: 630 Dorchester Blvd. W., Montreal, Quebec.

Mode: 1000D

Date: 18th June, 1962.

The equation of the Gompertz Curve is $Ye = 10^{a+bR^t}$ Where Ye is the estimate of a quantity whose trend is being investigated, and t is the periods of time from some base period. Factors R, a and b are to be computed.

The method used in this program is the Pimentel-Gomes Method, which is essentially fitting a trend curve in such a way that the sum of squares of deviations of calculated values from observed ones is a minimum (i.e. least square fit).

Input to this program, which is under program control, consists of type in of the number of data points and the number of periods of projection required followed by input data. Transformation of data proceeds simultaneously with type in. A maximum of 50 data inputs is permissible.

Output consists of R, a and b followed by an indexed table of observed and calculated quantities with corresponding percentage differences.

Input and output formats are as shown in sample sheet.

Computation time varies with each problem depending on the number of inputs as well as the condition of each set of inputs. The present version of program utilizes the method of successive approximation in the solution of implicit equation. A section of program is also available for the type out of intermediate results for each cycle of calculation. This is intended for initial familiarization of the program and is by passed for production runs.

Ref: 1. "The Use of Mitscherlich's Regression Law in the Analysis of Experiments with Fertilizers" F. Pimental - Gomes "Biometrics" Vol. 9

Ref: 2. "Numerical Methods" R. A. Buckingham
Pitmans p. 249

Ref: 3. "The Use of the Ferranti Mercury Computer to plot Gompertz Long Term Trend Curves" I.C.I. Report No. PL1/17/35/B

Abstract of Users' Project No. 690

Class 1

TITLE: ALGO Magnetic Tape Subroutine

ORIGINATOR: B.F.Goodrich Chemical Company
Development Center, Avon Lake, Ohio

DATE: May 25, 1962

This library routine permits magnetic tape operations in an ALGO program. The magnetic tape options available are: write data, read data, record file block, search for file block and search for blank tape.

The write and read magnetic tape data options use parts of the standard ALGO punch and read paper tape sequences. Prior to reading or writing data on magnetic tape, the ALGO commands must be modified. There is a library declaration which does this. Before reading or punching paper tape, the altered commands must be restored with another library statement.

File blocks are compatible with existing magnetic tape routines. File numbers must be consecutive and in ascending order. The specifications in Technical Memorandum No. 59 have been adhered to.

The subroutine has five entry points and may be included in an ALGO program with a library statement as follows.

```
2.  LIBRAry  Set(0428000), Restore(0463000), Record(0414000),
             Search(0400000), Blank(0403000)
```

"Set"	modifies ALGO to read and write magnetic tape
"Restore"	restores ALGO to read and punch paper tape
"Record"	writes a file code and block
"Search"	searches for a specific file block
"Blank"	searches for blank tape

The write-up includes a complete discussion of each option and a sample program to illustrate the operation of the routine. The subroutine check sum is .0400000.

Abstract of Users' Project: 692
Class: 1
Cross Index Section: 2.3

Title: Harmonic Analysis by Algo

Originator: National Research Council of Canada

Date: 6 June, 1962

Mode: Algo

Equipment: G15, alphabetic typewriter, Flexowriter (optional)

Abstract:

Given a set of equally spaced values of a function F(t) over an interval (0,T), compute the Fourier coefficients and phase angles for the expansion

$$F(t) = a_0 + \sum_{1}^{N} (a_n \cos \frac{2n\pi t}{T} + b_n \sin \frac{2n\pi t}{T}) = a_0 + \sum_{1}^{N} c_n \sin (\frac{2n\pi t}{T} + \phi_n)$$

The input data is the set of data points F_i, i = 1,2,.. V, and values of N and V. V must be less than 100. The input data can be entered in one of three modes: typewriter, binary tape, or Flexowriter - prepared tape. The output is a heading followed by sets of values

$$n \quad a_n \quad b_n \quad c_n \quad \phi_n$$

for n = 0,1,... N. Weddle's Rule for numerical integration is used over as many groups of seven points as possible, and the trapezoidal rule over the remainder. The running time is 0.07 VN minutes.

Disclaimer:

Abstract of Users' Project No.: 693
Class: 1
Cross Index Section: 1.6.7

Title: Algo Interim Magnetic Tape Library Routine

Originator: National Research Council of Canada

Date: 7 June, 1962

Equipment: G15D, 2 MTA-2 tape units, alphabetic typewriter

Mode: Algo Library Routine

Abstract:

This program is to be used as an ALGO library routine. It contains provision for reading from and writing onto a magnetic tape unit, searching for file codes, reversing paper tape, and typing out alphabetic information from paper tape or memory. However, no provision is made for writing or searching for file numbers; and because of this and other limitations, this routine is not regarded as a final magnetic tape routine for ALGO - rather it will serve as an interim one. The magnetic tape units must be positioned properly relative to known data before this routine can be used. This will probably be done using file numbers which have been written and searched for the Magnetic Tape Service Routine (MTSR, A.S.P. No. 61), the Magnetic Tape Utility Routine (MTUR, A.S.P. 169), or Intercom 500 (A.S.P. 134A or 134B).

Disclaimer:

693-1

ABSTRACT FOR USER PROJECT NO: 694

CLASS: 1

CROSS INDEX SECTION: 5.4

TITLE: Transverse Stability of Ships

ORIGINATOR: Royal Canadian Navy in cooperation with the National Research Council of Ottawa.

DATE: 6 July, 1962

MODE: Intercom 500

ABSTRACT: To find the righting moment arm and displacement of a ship at a given draft and inclination with zero trim.

LIMITATIONS: Each transverse section is limited to 39 waterlines or offsets. The number of sections is limited by the storing capacity of the magnetic tape. Inclination of 0^o is not acceptable.

INPUT: Most of the data is prepared in flexowriter tape with a few being typed in under program control.

OUTPUT: Result is typed out.

Abstract of User's Project No. 695

Class 1

Title: MULTIVARIATE ANALYSIS PACKAGE

Originator: McMaster University

Mode: Intercom 1000 Double Precision (modified version)

Date: November 1961

This package consists of a series of programs written in Intercom 1000 D.P., floating point, which are designed to be used for the multivariate statistical analysis of data. The programs can handle only up to 10 variables, but the number of replications (items) is not limited. The individual programs are as follows:

A: calculates the sums of squares and products, covariance matrix and correlation matrix for up to 10 variates. The matrices may be punched on tape for further use if so desired.

B: extracts latent roots and vectors from a correlation or covariance matrix, using the Jacobi method. Tapes prepared by A may be used as input, or the input may be by typewriter. Output is in the form of the latent roots, and their associated latent vectors or principal component coefficients.

C: adds sums of squares and products matrices calculated and punched on tape by A (or uses specially prepared tapes), and calculates the "within classes" and "total" sums of squares and products for Analysis of Dispersion. The second half of the program (which may be used separately) evaluates the "within classes" and "total" sums of squares and products determinants, using the square root method, so that the value of Wilk's criterion (Λ) may be obtained.

D: utilizes sums of squares and products matrix tapes prepared using program A, and calculates discriminant functions, Mahalanobis' D^2 for all

Abstracts of Users' Project No. 696

Class 1

Title: Random Number Generator

Originator: Management Services Department, Canadian Industries Limited.

Address: 630 Dorchester Blvd. W., Montreal, Quebec.

Mode: G-15D Machine Language

Date: 24th July, 1962.

It is required to generate a random number for modifying word and channel portion of an intercom command. This subroutine is designed to generate a pseudo random number M (where $0 \leq M \leq 127$) and store it into the No. 2 index register word base. Any intercom command with K = 2 will have its address modified by the random number, e.g., for Random No. equal to 120 the command 2421000 will clear and add contents in 1120.

The method used for generating pseudo random numbers is the middle of the product method, i.e., the random number is extracted from the product of two seven digit hex. numbers.

The equation used is:-

$$x_i = 5'' \times x_{i-1} \quad (\text{Mod. } 2^{29})$$

where x_i is represented by the least significant half of the product.

A new series of pseudo random numbers can be obtained by setting $x_0 = x_0 + 2$.

Ref. Report No. 855 of Ballistics Research Laboratory

Aberdeen Proving Grounds, Md.

Abstract of Users' Project No: 097
Class: 1
Cross Index Section: 2.2

Title: Runge-Kutta Solution of a Set of Differential Equations

Originator: National Research Council of Canada

Date: 22 May, 1962

Equipment: G15, alphabetic typewriter

Mode: Algo

Abstract:

This program provides an ALGO staper tape (Users Project 563) for the solution of a set of first-order, ordinary differential equations for $y_k(x)$, $k = 0,1,\ldots L$.

$$\frac{dy_k(x)}{dx} = z_k(x,y_0,y_1,\ldots y_L)$$

$$y_k(x_0) = yi_k$$

over the range $x_0 \leq x \leq x_{max}$. The Runge-Kutta fourth order method is used with constant step width. L must be less than 19 (but this limitation can easily be removed).

The user must prepare an ALGO staper tape for a function "RHS" which computes the right hand sides of the equations, splice it onto the present program tape, and compile the complete source tape.

Running time per step is about 8 seconds per variable plus four times the time to compute the right hand sides. Output consists of a table of x and the y_k values in fixed or floating point and four every m'th step, where m is specified by the operator.

Disclaimer:

Abstract of Users' Project No: 698
Class: 1
Cross Index Section: 5.4

Title: Bendix G-15 "Algo" Computer Program for Calculating the Steady Temperature Under Arbitrary Areas on the Surface of a Semi-infinite Solid.

Originator: National Research Council of Canada.

Date: June 1, 1962.

Equipment: G-15, Flexowriter.

Mode: Algo

Abstract: An area, whose outline is given in Cartesian coordinates, is subdivided into circular sectors with any specified degree of approximation. The temperature at various depths under the common apex is computed through summation of the calculated contribution of each sector.

Abstract of Users Project No. 699
Class 1

Title: CHANNEL CUT AND FILL

Originator: U. S. Army Engineer District, Los Angeles, Corps of Engineers,
Address: 751 South Figueroa Street, Los Angeles 17, California
Mode: Intercom 500
Date: August 1962

Given the channel control data and ground cross sections, this program computes earthwork quantities for a rectangular reinforced concrete channel of standard L or U-wall design. The channel control data consists of vertical alignment, all necessary left and right wall dimensions, berm widths, and cut and fill slopes, ℄ shift, equations or omissions, etc.

Input includes the channel control data, a detailed description of which is given in the writeup, and a ground cross section for each station. After the first station, only the channel control data which changes is given.

The output format is shown in the writeup. Output includes cut and fill areas, cut and fill volumes between stations, accumulated cut and fill volumes, and right and left slope stake data.

Computation time for each station is from 5 to 10 minutes, depending upon the number of ground points per cross section.

Input is from punched paper tape. A Friden Flexowriter, model 35-4, is required for preparation of data tape.