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GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF RESEARCH ADMINISTRATION

RESEARCH PROJECT INITIATION

Date: July 18, 1973

Project Title: Feasibility Study of Architectural Aids

Project No: E-17-604

Principal Investigator Mr. I. Lewis Nix, Jr.

Sponsor: The Sunday School Board of the Southern Baptist Convention; Nashville, Tennessee

Agreement Period: From July 1, 1973 Until October 31, 1973

Type Agreement: Standard Industrial Agreement dated June 11, 1973

Amount: $7,218

Reports Required: Monthly Progress Letters; Final Report

Sponsor Contact Person (s):

Mr. Fred H. Turner
The Sunday School Board of the
Southern Baptist Convention
127 Ninth Avenue, North
Nashville, Tennessee 37234

Assigned to: School of Architecture

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GEORGIA INSTITUTE OF TECHNOLOGY

OFFICE OF RESEARCH ADMINISTRATION

RESEARCH PROJECT TERMINATION

Date: ~~July 18, 1974~~

Project Title "Feasibility Study of Architectural Aids" (Reactivated)

Project No: E-17-604

Principal Investigator: Dr. John E. Williams

Sponsor: Sunday School Board of the Southern Baptist Convention; Nashville, Tenn.

Effective Termination Date: ~~7-1-74 (Agreement expired)~~

Clearance of Accounting Charges: ~~ASAP - Final Report~~ subm. 7-11-74

Grant/Contract Closeout Actions Remaining: Final Invoice (Statement of Account), when all charges clear

Assigned to School of ~~Architecture~~

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File: E-17-604

A COMPUTER BASED BUILDING INFORMATION SYSTEM

prepared for the sunday school board for the southern baptist convention

june 1974

CONTRACT NO. E-17-604

REPORT AND TECHNICAL PROPOSAL
PHASE II

A Computer Based Building Information System

John E. Williams

June 20, 1974

Sponsored By:

The Sunday School Board for the Southern
Baptist Convention
Nashville, Tennessee

Department of Architecture
Georgia Institute of Technology

ABSTRACT

A Computer Based Building Information System

The Church Architecture Department of the Southern Baptist Sunday School Board offers a variety of building planning, programming and schematic design services to Baptist congregations throughout the United States. To assist the Department in reducing service time, a computer program has been developed which permits rapid selective retrieval of historical tracings and descriptive information appropriate to each new service request. Three hundred completed projects are included in the test data base with provision for a rotating set of one thousand buildings, older jobs migrating out as new ones are added. The basic building "Record Sheet" has been revised such that ninety characteristics describing each project can be easily recorded in machine format and stored in the data base. The system is interactive and easily accessible via a remote terminal to be located in the Architecture Department office and connected to Georgia Tech's UNIVAC 1108 computer. It is also user oriented, intended for technical staff use with each individual defining, to some extent, a unique vocabulary for acquiring only required information at the time it is needed.

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation to Dr. Rowland E. Crowder, Secretary of the Church Architecture Department and his staff for their complete support during the conduct of this study. I am particularly grateful to Mr. Fred Turner, Supervisor of the Architectural Services Section II, who was instrumental in developing the initial concept. His continuous input of ideas and gracious style have not only guided this effort, but more importantly caused each encounter to be a pleasant and rewarding experience.

Much of the credit for adapting the computer programs must go to Glenn Gresham, second year Architecture student who worked many nights to ensure timely completion and accurate results. And, finally, Mary Tapper deserves special thanks for typing this report in a very short period of time.

John E. Williams, Project Director

Atlanta, Georgia

June 26, 1974

LIST OF FIGURES

SECTION ONE — SUMMARY

The Church Architecture Department offers technical services to individual churches and provides those services upon request. They include building planning, programming and preliminary design. A project or job is initialed and a file begun when the Department receives a letter of inquiry. A questionnaire, shown in Figures 1 and 2, is sent to the church and may be supplemented by a field consultant visit to the site. His report and/or data obtained on the questionnaire are used by the building program consultants to formulate an architectural program of spaces. The program is reviewed by the field services supervisor and program consultant before being forwarded to the architectural services section for scheduling. Preliminary plans are prepared, reviewed and sent to the church and the file becomes inactive.

To perform these services, the Department maintains a full-time staff of thirty architects, draftsmen and clerical personnel in Nashville, Tennessee. They may be handling two hundred or more active jobs at any point in time ranging from major new construction to minor renovations and additions for existing facilities. The projects are geographically scattered throughout the United States. As in any architectural practice, the staff relies on insight gained from previous experience to generate the best possible solution for each new job. They must, as well, provide timely and accurate responses to client requests regarding the status of each active project. With more than 10,000 records for completed jobs and the large number and dispersion of active projects, fast, efficient information retrieval and communication are essential.

Phase I of this project was directed toward identifying specific areas where computer applications could accelerate and/or improve the Department's services.[1] This report, Phase II, describes a computer-based data retrieval system designed to assist the staff in developing building programs and preliminary design drawings. The data base is composed of ninety characteristics or parameters for each of three hundred buildings in the test sample. Provision is made for an eventual rotating group of one thousand jobs, older projects migrating out as new ones are added. The intent is to allow a programming consultant or designer to quickly identify all records and/or tracings for previous jobs similar to the one under consideration. Similarity is established by user supplied constraint values placed on one or more of the ninety defined parameters. The program generates a printout of selected parameter contents and appropriate drawing reference numbers for jobs which satisfy the constraints.

Information describing completed projects to be inserted in the data base is recorded by the staff on a building "Study Record",shown in Figure 3, as a normal part of project activity. When a file becomes inactive, that information will be transferred to machine readable form on paper tape or cards and input to the system. To facilitate the transfer procedure by placing the information in a machine compatible format, use of the revised building "Study Record", shown in Figure 4, is recommended. Information is retrieved by accessing a program on the UNIVAC 1108 computing system via a terminal to be located in the Department office. Selected characteristics will be displayed immediately at the terminal, while identified drawings must be acquired from the tracing file. A minimum of introduction will permit most staff members to address the system directly whenever a question arises.

As previously indicated, the initial system has been implemented on the Georgia Tech UNIVAC 1108 computing system. Although the Southern Baptist Sunday School Board does maintain computing capability a real time operating environment is considered essential and the existing Honeywell 1230 does not have this capability, at present. To place the system in full operation a start up cost of approximately $4,500 will be required for preparing an initial data base and instruction of the Department staff in terminal and program use. Annual operation expenses, excluding Department staff time, are anticipated to be between $1,500 and $3,500 depending upon the level of computer usage and applicable rates. Implementation time is estimated at about one month.

This study has focused on the development of an application level computer program for drawing retrieval. The intent is to provide an opportunity for the Church Architecture Department staff to become more familiar with computers through active participation and use. It is clear that many other potential applications exist and, having had this experience, the Department is in an excellent position to move forward. A close examination of Departmental services suggests two areas where immediate benefit could be obtained. First, the proposed data set could serve as a basis for quickly generating alternative building program requirements using statistical models. Secondly, by extending the data base to include digitized information for each project, the computer can assist in the production of design layouts and preliminary drawings by retrieving graphic data directly. It is recommended that, beginning with these studies, the Church Architecture Department continue to provide support for computer-aided planning, programming and design related efforts at an approximate rate of $10,000 to $15,000 during fiscal year 1974-75.

COMPLETE ALL INFORMATION ON BOTH SIDES OF THE SHEET. MAIL WITH OTHER NECESSARY MATERIALS TO ADDRESS BELOW. PLEASE PRINT OR TYPE.

Name of Church		Phone No. (Include Area Code)	Date
Address	City	State	Zip Code

Association	Total Church Membership	No. Resident Members	Previously Used Services of Department? ☐ YES ☐ NO	Contact Person

PASTOR		PLANNING COMMITTEE CHAIRMAN		ARCHITECT	
Name		Name		Name	Retained? ☐ Yes ☐ No
Address		Address		Firm	Phone No.
City	Zip Code	City	Zip Code	Address	
Home Phone (Include Area Code)	Pastor of Church SINCE 19 ___	Home Phone (Include Area Code)	No. Committee Members	City	Zip Code

PROGRAM INFORMATION

Existing Auditorium Capacity	Average Attendance Morning Service	Two Morning Services? ☐ YES ☐ NO

Women's Missionary Union (Indicate Needs)

Brotherhood (Indicate Needs)

Bus Ministry? ☐ YES ☐ NO	No. Buses	Size of Bus	No. People Bussed	☐ OWN BUS ☐ RENT BUS

PROGRAM	ENROLMENT	Average Attendance	Attendance To Plan For
CHURCH TRAINING			
CHURCH MUSIC			
KINDERGARTEN			
DAY CARE			

SUNDAY SCHOOL (SHOW YOUR PRESENT AGE GROUPINGS BY BRACKETING AGES TOGETHER IN COLUMN 3)

1. DIVISION	2. AGES	3. BRACKET GROUPING	4. NO. DEPTS.	5. NO. CLASSES	6. ENROLMENT	7. AVE. ATTENDANCE	8. ATTENDANCE TO PLAN FOR
PRESCHOOL Ages 0 - 5	0 - 1						
	1						
	2						
	3						
	4						
	5						
CHILDREN Ages 6 - 11 or Grades 1 - 6	6						
	7						
	8						
	9						
	10						
	11						
YOUTH Ages 12 - 17 or Grades 7 - 12	12						
	13						
	14						
	15						
	16						
	17						
YOUNG ADULTS	18 - 29						
ADULTS	30 - 59						
SENIOR ADULTS	60 UP						
		TOTAL					

NOTES:

Indicate Below Items Enclosed With This Sheet (Complete Before Mailing)

☐ DRAWING OF PROPERTY ☐ PRESENT FLOOR PLANS ☐ ZONING ORDINANCES/BUILDING CODE REQUIREMENTS
☐ TOPOGRAPHICAL SURVEY ☐ PICTURES OF PRESENT BUILDING ☐ LETTER ☐ OTHER ______

MAILING INSTRUCTIONS

SEND THIS COMPLETED INFORMATION SHEET WITH THE ITEMS BELOW TO

THE CHURCH ARCHITECTURE DEPARTMENT
THE SUNDAY SCHOOL BOARD OF THE
SOUTHERN BAPTIST CONVENTION
127 NINTH AVENUE, NORTH
NASHVILLE, TENNESSEE 37234

OTHER INFORMATION NEEDED

1. DRAWING OF PROPERTY SHOWING:

1. Dimensions - length, width
2. Location and names of streets
3. Location of present building(s) on property
4. North, east, south, west
5. Location of trees - items not to be changed
6. Location of alleys and easements (if any)
7. Amount of slope

2. BLUEPRINT (SKETCH) OF PRESENT BUILDINGS:

1. Exterior dimensions
2. Interior room dimensions-each direction
3. Stair/hall dimensions (show stair directions)
4. Location of doors, windows, and plumbing
5. Type heat - location of heat/air condition units
6. Load bearing walls, and other unchangeable features
7. Label present use of each room

3. ZONING ORDINANCES/BUILDING CODE REQUIREMENTS SHOWING:

1. Setbacks (building lines)
2. Height limitations
3. Parking requirements
4. Landscaping requirements

(Continued on Back Side)

Figure 1
Data Sheet - Part I

FINANCIAL INFORMATION

CONTRIBUTIONS LAST CHURCH YEAR		PROPOSED AMOUNT FOR BUILDING PROJECT (INCLUDE FURNISHINGS)	BUILDING FUND	
Total Amount	Budgeted Amount		Present Amount	Budgeted Amount
$	$	$	$	$

Does Church Intend to Use A Home Mission Board Loan?	If Using Loan, Has Church Contacted Home Mission Board?	OUTSTANDING DEBTS		
		Building	Other	Total
☐ YES ☐ NO	☐ YES ☐ NO	$	$	$

COMMUNITY INFORMATION

Type of Community	Describe Your Community and Church Field	Has Church Made a Community Survey?	Survey Date
☐ URBAN ☐ SUBURBAN ☐ RURAL		☐ YES ☐ NO	
		Results of Survey	

PROPERTY AND SITE DEVELOPMENT INFORMATION

Design A Master Site Plan For Placement of Future Units ☐ YES ☐ NO	Design Plan to Include ☐ PARKING ☐ BUS SPACES ☐ LANDSCAPING ☐ OTHER ______	
Church Planning to Purchase Additional Property? ☐ YES ☐ NO	Describe Additional Property	
Ultimate Attendance After Completion of All Future Units:	Church Needs to Relocate? ☐ YES ☐ NO	Reason For Relocation
For Auditorium / For Education	Church Plans to Relocate? ☐ YES ☐ NO	Indicate Initial Needs At New Site

BUILDINGS AND SPACE NEEDED NOW (COMPLETE ONLY THOSE AREAS THAT APPLY)

AUDITORIUM

Church Auditorium

- ☐ NEW INTERIM AUDITORIUM
- ☐ NEW PERMANENT AUDITORIUM — Total Capacity
- ☐ REMODEL PRESENT AUDITORIUM
- ☐ ENLARGE EXISTING AUDITORIUM — Total Capacity
- ☐ REDECORATE PRESENT AUDITORIUM
- ☐ CONVERT AUDITORIUM TO EDUCATION SPACE
- ☐ OTHER ______

Music Program — Auditorium Choir Capacity Desired

PLAN FOR
- ☐ PIPE ORGAN
- ☐ SEPARATE MUSIC SUITE
- ☐ BAND INSTRUMENT AREA
- ☐ OTHER CHOIR AND MUSIC ROOMS (SPECIFY) ______

EDUCATIONAL BUILDING

Educational Building

- ☐ FIRST UNIT EDUCATIONAL BUILDING
- ☐ ADDITIONAL EDUCATONAL BUILDING — Total Capacity
- ☐ REMODEL PRESENT EDUCATIONAL BUILDING
- ☐ ENLARGE EXISTING EDUC BUILDING — Total Capacity
- ☐ REDECORATE PRESENT EDUCATIONAL BUILDING
- ☐ NEED NEW FURNISHINGS
- ☐ OTHER ______

Offices Desired

- ☐ PASTORS STUDY
- ☐ CHURCH SECRETARY
- ☐ RECEPTION AREA
- ☐ EDUCATIONAL OFFICE
- ☐ MUSIC OFFICE
- ☐ FINANCIAL OFFICE
- ☐ ELEMENTARY DIRECTOR
- ☐ RECREATION OFFICE
- ☐ KITCHEN OFFICE
- ☐ S.S. DIRECTOR
- ☐ YOUTH DIRECTOR
- ☐ WORKROOM
- ☐ OTHER ______

Library — No. Books Planned For

- ☐ CHILDREN'S LIBRARY AREA
- ☐ INCLUDE VISUAL AID AREA
- ☐ STUDY CARREL AREA
- ☐ DISPLAY AREA
- ☐ LITERATURE AREA
- ☐ OTHER ______

Fellowship and Kitchen — Dining Room Capacity Desired

- ☐ SNACK AND DRINK MACHINE AREA
- ☐ KITCHEN STORAGE
- ☐ TABLE STORAGE
- ☐ FOOD STORAGE
- ☐ OTHER (LIST)

SPECIAL ROOMS (INDICATE QUANTITY, SIZE, AND CAPACITY WHERE APPLICABLE)

CHAPEL	SPECIAL EDUCATION	BRIDE'S ROOM
LEADER TRAINING	TELEVISION/RADIO	MAINTENANCE
KINDERGARTEN	OTHER WEEKDAY	OTHER ______
YARD TOOL STORAGE	STORAGE	OTHER ______

ACTIVITIES

Does Church Now Have A Recreational Program? ☐ YES ☐ NO	Describe Indoor Activities
Staff Member to Conduct Program? ☐ YES ☐ NO	Describe Outdoor Activities

OTHER

Describe Needs

OTHER INFORMATION NEEDED (Continued From Other Side)

4. TOPOGRAPHICAL SURVEY	5. PICTURES of PRESENT BUILDINGS and PROPERTY	6. LETTER FULLY EXPLAINING NEEDS and DESIRES
If land is not level, it would save time, if you would have a surveyor or local engineer make a complete topograph ical survey of the lot	Show all sides of the present building(s) and property, indicate street names, buildings, and other distinguishing factors	(In addition to this sheet)

THE CHURCH ARCHITECTURE DEPARTMENT
Rowland E. Crowder, Secretary

Church Program Services Group
James H. Daniel, Leader

Church Services and Material Division
Allen B. Comish, Director

The Sunday School Board of the
Southern Baptist Convention,
Nashville, Tennessee 37234
James L. Sullivan, President

Figure 2
Data Sheet - Part II

SECTION TWO — THE INFORMATION SYSTEM

Recording the Information

Although a variety of information is retained by the Church Architecture Department for each completed job, of interest here are the building Study Record, shown in Figure 3, and tracings of building layouts prepared by the Department staff. The Study Record describes the architectural character, size, capacity, location, etc. for auditoriums, educational buildings and associated sites. It further indicates the nature of any special studies performed for each project. As the research progressed, the parameters identified as "Modular", "Recreation", "Landscaping", and "Parking" were deleted. Two new parameters, "Gymnatorium" and "Bus" were added. Eight additional parameters were obtained by separating "Preschool", "Children", "Youth", and "Adult" departments and capacity into two groups, existing and new.

The revised Study Record, shown in Figure 4, provides space to record values for each of the resultant ninety characteristics. This document is designed to be completed by the Department staff in the same way they now perform this task. However, since the data must be converted directly to a machine readable form, several values placed on the Record have been slightly altered. The numeric intervals to be circled on the existing Record for parameters such as auditorium capacity, etc. are replaced by a simple actual value for each such parameter. Parameters such as shape, which previously required a check for one alpha-numeric alternative, "Square" for example, now require that the character string, "Square", be entered literally as the parameter value. Parameters, such as "Pastor's

Study Record

NO. [illegible] DESIGNER MY/ ~~DRAFTSMAN~~ 08516

State Mo City VANDALIA Church FIRST Date 13 NOV 73

AUDITORIUM ☐ New ☐ Remodel ☐ Design No. ________ Scale ______ =1'
Phase: First Unit ☐ Interim ☐ Chapel ☐ Final ☐
Total Capacity 0-100 100-150 150-200 200-250 250-300 300-350 350-400
(circle) 400-450 450-550 550-650 650-750 750-900 900-1050
1050-1200 1200-1500 1500-1800 1800-up
Non-reference ☐ (or) Width ______ Length ________ Area ________ Metric scale ☐
Shape: Rectangular ☐ Square ☐ Hexagon ☐ Octagon ☐ Triangle ☐ Fan ☐
Design: Contemporary ☐ Colonial ☐ Gothic ☐ Traditional ☐
Arrangement: Conventional ☐ Asymmetrical ☐ Divided Choir ☐ Reverse End ☐

Balcony ☐ Overflow seating ☐ Ground Floor ☐ Modular ☐

EDUCATIONAL BLDG. ☐ New ☐ Remodel ☐ Design No. ________ Scale _____ =1'

Total capacity 0-100 100-150. 150-200 200-250 250-300 300-350 350-400
400-450 450-550 550-650 650-750 750-900 900-1050
1050-1200 1200-1500 1500-1800 1800-up

		Depts.							
Program	Preschool	______	0-20	20-40	40-70	100-up			
	Children	______	0-20	20-40	40-60	60-90	90-120	120-up	
	Youth	______	0-20	20-40	40-60	60-90	90-120	120-up	
	Adult	______	0-40	40-60	60-90	90-120	120-180	180-240	240-up
Non-reference ☐ (or)		Width	0-30	30-40	40-45	45-50	50-55	55-60	60-up
Area ______		Length	0-60	60-100	100-160	160-up			

Basis: Minimum ☐ Recommended ☐
Shape: Rectangular "L" "T" "E" "H" Square Other
Stories: 1 2 3 4 5 plus ground floor ☐
Corridor: Interior ☐ Exterior ☐
Includes: Offices ☐ Fellowship ☐ capacity ______ Music ☐ capacity ______
Kindergarten ☐ capacity ______ Day Care ☐ capacity ______ Chapel ☐ capacity ______

PLOT PLAN ☒ All new ☐ Adding to ☒ Acres ______ Adequate ☐ or tight ☒
Nice ☐ Level ☒ Slight slope ☐ much slope ☐
Ultimate capacity: Worship 400-500 Education 400-500
Parking capacity: ____________ ratio ____________ to 1.
Shows Recreation ☐ Landscaping ☐ Parking ☐
Scale of Drawing: 1"= 8' 16' 20' 30' 32' 40' 50' 60' Other ☐ ________
Numbered Design ____________ First Unit ☐ Other ☐

SPECIAL STUDIES ☐ Area ____________

☐1. Assembly cap. ______
☐2. Book Store
☐3. Chapel cap. ______
☐4. Exterior Elevation
☐5. First Units-Mission cap. ______
☐6. Goodwill Center
☐7. Gymnasium Min. ☐ Avg. ☐
☐8. Interior Design
☐9. Kindergarten cap. ______
☐10. Kitchen: Serv. cap. ______
☐11. Landscaping
☐12. Library
☐13. Office - Assn. Rms. ______
☐14. Office - State
☐15. Office-Church
☐16. Pastor's Home
☐17. Portable Unit
☐18. Recreation Bldg.
☐19. Sign
☐20. Student Center small ☐ large ☐
☐21. Misc. ____________

ADDITIONAL INFORMATION to add to present record: ☐
Built ☐ Cost $______,000.

Church Architecture Department
THE SUNDAY SCHOOL BOARD / SOUTHERN BAPTIST CONVENTION

1173

Figure 3
Existing Study Record

STUDY RECORD

Church Architecture Department

THE SUNDAY SCHOOL BOARD / SOUTHERN BAPTIST CONVENTION

STATE CITY CHURCH

STATE	CITY	CHURCH NAME	DATE	DRAFTSMAN	BUILDING TYPE
AUDITORIUM CONSTRUCTION	AUD DESIGN NUMBER	AUD DRAWING SCALE	PHASE AUD CONSTRUCTION	AUD REFERENCED	AUD SHAPE
AUD DESIGN STYLE	AUD ARRANGEMENT	AUD REVERSE END	AUD BALCONY CONSTRUCTION	AUD OVERFLOW SEATING	AUD GROUND FLOOR
EDUCATIONAL CONSTRUCTION	EDU DESIGN NUMBER	EDU DRAWING SCALE	EDU UNIT REFERENCED	EDU DESIGN BASIS	EDU UNIT SHAPE
EDU UNIT CORRIDOR TYPE	EDU UNIT OFFICE	PLOT PLAN TYPE	SITE DESCRIPTION	SITE SLOPE	PARKING RATIO
SITE DRAWING SCALE	SITE DESIGN NUMBER	CONSTRUCTION DATE	FIRST UNIT OR OTHER	SPECIAL STUDY FOR BOOKSTORE	SS FOR EXTERIOR ELEVATION
SS FOR GYMNASIUM	SS FOR INTERIOR DESIGN	S S FOR LANDSCAPING	SS FOR LIBRARY	S S FOR CHURCH OFFICE	S S FOR STATE OFFICE
SS FOR PASTORS HOME	SS FOR PORTABLE UNITS	S S FOR RECREATION	SS FOR SIGN	SS FOR STUDENT CENTER	DRAWING REFERENCE NUMBER
IS THERE A GYMNATORIUM	CHURCH BUS	AUDITORIUM CAPACITY	AUD WIDTH	AUD LENGTH	AUD AREA
EDUCATIONAL UNIT CAPACITY	EDU UNIT WIDTH	EDU UNIT LENGTH	EDU UNIT AREA	EDU UNIT NUMBER OF STORIES	NUMBER OF PRESCHOOL DEPARTMENTS
PRESCHOOL CAPACITY	NUMBER OF CHILDRENS DEPT	CHILDREN CAPACITY	NUMBER OF YOUTH DEPARTMENTS	YOUTH CAPACITY	NUMBER OF ADULT DEPARTMENTS
ADULT CAPACITY	FELLOWSHIP CAPACITY	MUSIC CAPACITY	KINDERGARTEN CAPACITY	DAY CARE CAPCITY	CHAPEL CAPACITY
PLOT PLAN ACRES	ULTIMATE WORSHIP CAPACITY	ULTIMATE EDUCATIONAL CAPACITY	PARKING CAPACITY	CONSTRUCTION COST	SPECIAL STUDY AREA
S S ASSEMBLY CAPACITY	S S MISSION CAPACITY	S S KITCHEN SERVING CAPACITY	S S NUMBER OF OFFICES FOR ASSOC	NEW NUMBER OF PRESCHOOL DEPT	NEW PRESCHOOL CAPACITY
NEW CHILD DEPTS	NEW CHILD CAP	NEW YOUTH DEPTS	NEW YOUTH CAP	NEW ADULT DEPTS	NEW ADULT CAP

Figure 4
Revised Study Record

Home," which were either marked or left blank on the old Record are now assigned a literal "YES" or "NO". Drawings associated with each Study Record may be retrieved from the tracing file by using the parameter "Id number" as a reference.

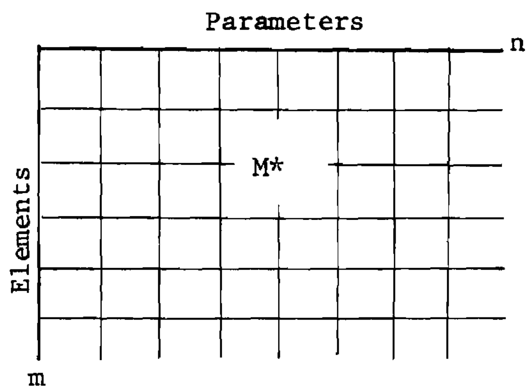
Each parameter has also been assigned an abbreviation for reference when a user requests information from the computer program. A complete list of parameter names, abbreviations and permissible values is provided in Appendix E. When preparing a Record, these values must be used exactly as indicated, all alpha-numeric character strings left justified in the field with trailing blanks and all numbers right justified with a radix point and two following digits plus necessary preceeding blanks to the left. For convenience in reading the data into the machine, the fifty alpha-numeric parameters are grouped at the beginning of each Record, followed by the forty numerics.

The data base resides as a file on a magnetic drum storage unit at the UNIVAC installation in Atlanta. New Study Records will be accumulated and used to periodically update the file, perhaps weekly or bi-weekly, depending upon the internal work load. The updating may be accomplished by forwarding Records to Georgia Tech for punching and batch processing or a short program can be developed which permits file updating from the remote terminal via paper tape or direct entry. In either instance, someone within the Church Architecture Department must be responsible for collecting and checking each Record and insuring its proper entry into the data base.

Logical Information Structure

To retrieve information from the data base, a user must acquire a terminal, establish a connection with the UNIVAC 1108 system, provide necessary identification, and access and execute the program. For detailed instructions on this procedure and program commands, see Appendix II. The reader may also wish to examine the output from a sample run in Appendix I. This section describes the logical data operations and the users relationship to the systems.

To accommodate a variety of circumstances, all information is maintained internally, within the system, and structured in such a way that convenient subsets can be readily defined and statistics acquired for individual parameters. Although, the retrieval and storage segment is general, i.e., can be applied to any consistent data set, the emphasis here is related to building descriptions. The basic structure is:



The matrix M* contains values, m^*_{ij}, for each element i, i = 1,m, and associated parameter j, j = 1,n. For the purposes of this discussion the term element is literally interpreted to mean building and parameter is synonomous with characteristic. There is no logical limit placed on either the number of elements or parameters. However, a characteristic defined for one building implies the logical existence, but not the content, of such a parameter for all m elements. Each element and characteristic is referenced by one or more dynamically defined names. The data set may be extended as required with the addition of elements, each having the existing group of parameters, or new parameters assigned to the fixed set of elements.

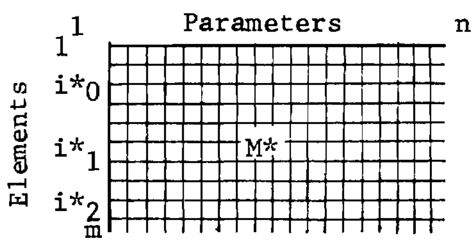
While the basic information, M^*, is never altered in any other way, logical subsets may be constructed and used for various computations. The subsets are defined by constraining values for one or more parameters as follows:

$$g^*_j \leq m^*_{ij} \leq d^*_j \qquad \text{for } i = 1,m \qquad (1)$$

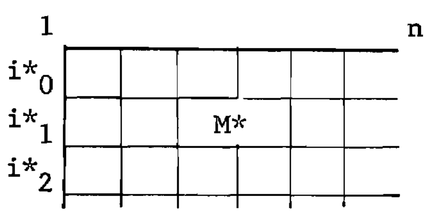
where: g^*_j = minimum value for parameter j

d^*_j = maximum value for parameter j

The maximum and minimum values can be established for any parameter j, j = 1,n. The resultant subset, M^{*S}, will contain all parameter values for those elements with characteristics, m^*_{ij}, which satisfy each constraint defined by relationship 1. Since the process is one of superimposing the prescribed limits on the initial data, there is no theoretical limit on the number of subsets which may exist simultaneously. Each subset is referenced by name and may be viewed logically as:



Basic Data



Subset

The element set (i^*_0, i^*_1, i^*_2) contains all parameter values, $m^*_{i^*_n j}$, $n = 1,3$, or the subset M^{*S}. The default set encompasses the entire basic data group.

New parameters can be developed through dynamic transformations performed on the initial data. The following operations are permitted:

$$m^*_{i,n+k} = m^*_{ij} \begin{bmatrix} + \\ - \\ X \\ \div \end{bmatrix} \begin{bmatrix} m^*_{ij} \\ Z \end{bmatrix} \quad \text{for } i = 1,m \tag{2}$$

where: Z = <u>real</u> constant

k = current number of added parameters

or, (3)

$$m^*_{i,\ n+k} = \log m^*_{ij}$$

The derived parameter is assigned a name which references all computed values, $m^*_{i,\ n+k}$. The operations may be concatenated in any order with integer constants inserted when required. The characteristics can be selectively displayed and two or more designated as the dependent factor and independent variable(s) for a regression analysis on any specified subset of cases. This structure offers ample opportunity to examine, expand and reshape available information.

<u>Relationship of the System and User</u>

Three characteristics are recognized as contributing to effective use of the system. First, a communications technique which is dynamically defined and adjusted to accommodate the users' need and custom. Secondly, that a sequence of operations, although logically constrained, not be limited in a prescriptive sense, i.e., a desired procedure may be invoked at any point of interaction. Third, that both human and machine resources be conserved to the extent possible, with special concern for the sensitive problem of handling large data sets efficiently. Without overemphasizing these factors, and thus, ignoring the principal objective, the program does satisfy the criteria to a large degree. Therefore, the contribution is related to a secondary and perhaps broader goal, that of developing a system which is not only useful but also usable.

The term "usable" is applied with specific reference to those of the building professions who design, build, own, and/or operate physical plant facilities. Each group, and each individual, has a relatively unique style and procedure. Experience has produced a diversified vocabulary of words and phrases peculiar to the needs and activities of single organizations or small homogeneous groups. Although the techniques of analysis exhibit only slight variations, the variable terminology exaggerates the condition to a point where consistent standards are difficult to achieve at best. The situation is further aggravated by what is, perhaps, the most common element of all, a strong, and often well-founded, distrust of quantative analytic tools and computer technology applied to tasks which have traditionally been resolved through a mostly intuitive procedure. Considering past performance, it is unlikely that this position will be significantly eroded within a short period of time. However, the need to advance in some direction has been recognized. Therefore, the intent of this system, with respect to the user, is to encourage that transition, through familiarity or usability, toward a more systematic, quantitative method of analysis.

Familiarity is established using the relatively simple concept of multiple English phrase references for all communication with the system.

Each parameter, element, operation and result is assigned an initial descriptive phrase, with data references explicitly defined by the user during initialization. The separate phrases must, of course, be unique to avoid ambiguity. All initial descriptions are intended to be self-explanatory. However, at the users' discretion, additional phrases or words may be designated to reference defined elements. For example, the basic description of explanatory characteristics associated with an impending regression analysis is "independent variable." Having become familiar with this component, the user can establish a shorthand notation such as "iv" which will also be recognized as referring to explanatory variable. The equivalence is specified as follows:

$$\left[\text{old phrase}\right] = \left[\text{new phrase}\right] \tag{4}$$

The basic vocabulary will also be extended as new variables are created:

$$\left[\text{new phrase}\right] = \left[\text{old phrase}\right]\left[\text{operator}\right]\left[\text{old phrase}\right] \tag{5}$$

There is no logical limit placed on the size of an initial or extended vocabulary and any number of phrases may be linked to an element within the system. The opportunity, therefore, exists for many individuals to use the same procedures, each having tailored communications to suit personal preferences.

To further complement the concept of individual usability, there exists no preconceived sequence of activities. Any operation or command will be executed upon request. For example, the sequence of examine data, perform regression is equally as acceptable if the activities are reversed. However, if a regression is designated prior to establishing a set of independent variables, a logically infeasible condition exists, and the request is ignored. A procedure is initiated when the system receives one or more input lines composed of commands, operators, existing variables, new variables, and/or constant values. The requests are constructed using appropriate reference phrases. There are two levels of precedence, operation, command, and, secondly, the order of appearance from right to left. Other than the priority relationship, commands and operations are logically equivalent. Variables and constants are acquired sequentially as required to satisfy the request. The elements may be concatenated as desired, provided that some logical interpretation can be derived. For example, the statement:

[command] [variable] [operator] [variable]

is legitimate and equivalent to the sequence:

[variable] [operator] [variable] [command]

Therefore, an individual may formulate system requests in a manner not totally unlike that of ordinary written or verbal communication. As familiarity evolves regarding possible alternative procedures, the shortened notation should cause a corresponding decline in the required descriptive format.

Each of the above characteristics enhances the user/machine effectiveness. Communicated information will dynamically reflect only that which is necessary for a complete understanding to exist. The user may always proceed directly to the activity of interest without intervening irrelevant operations. In addition, the basic data set need not contain elements which are derivatives of that information and can be obtained, as required, through internal transformations at the appropriate time. Finally, the system is more "usable" as a result of the user participating in the development, shaping the structure to satisfy an individual style.

Financial Considerations

The start up cost for the system is estimated to be $4,500.00. This assumes creation of an initial data base containing 1,000 buildings at approximately $4.00 per building for coding, reviewing and punching each Study Record and placing that data in the machine. An additional $500.00 is allocated for preparation and delivery of a two-day computer seminar for the Church Architecture Department staff in Nashville. The seminar would focus on the existing system as well as exploring terminal use, methods for identifying and developing other potential applications and the general structure of the UNIVAC 1108 computer.

Annual operating expenses for the system, exclusive of staff time, are estimated to be between $1,500.00 and $3,500.00 depending upon the level of usage and applicable computer rates.

The following costs are included:

*Terminal Rental (Model 33ASR with paper tape r/w)	$ 780.00	
Modem Rental (Bell Model 113B)	180.00	
Computer Time (UNIVAC with research contract @ $400.00 per CPU hour)	500.00	
Computer Time (UNIVAC without contract @ $600.00 per CPU hour plus $10.00 per connect hour and overhead).		$2,500.00
Totals	**$1,460.00	***$3,360.00

*Includes all maintenance
**With research contract
***Without research contract

Therefore, the cost of using the system during the first year would be between $6,000 and $8,000. Of course, the start up expenses are, for the most part, one time costs and subsequent years operating costs will be considerably reduced. It is difficult to forecase the increased staff time involved. However, a reasonable cost increase for punching the data and placing it in the machine on a regular basis, assuming that Study Records will be maintained with or without the computer system, is approximately $1.00 per building after the system is in full operation. If 500 jobs are added each year, the approximate long term operating cost would be between $2,000.00 and $4,000.00 annually. This cost will obviously increase if the number of buildings in the data base gets larger and/or additional staff usage develops.

SECTION-THREE-PHASE III RECOMMENDATIONS

It is recommended that the Church Architecture Department continue to support development of computer applications which will improve service and/or reduce delivery time. Two related activities appear to offer maximum potential. They are preparation of building programs and formulation of preliminary space layouts.

Programming consultants rely considerably on experienced judgement and historical information when confronted with a new situation. The judgemental response depends, of course, on the individual capacity for mentally recalling details of appropriate previous projects and the ability to obtain, analyze and synthesize past records. Although the computer cannot accelerate mental recall, it can assist the consultant in quickly obtaining and analyzing useful information concerning previous jobs.

The data base and information retrieval program constructed during Phase II offer some capability for the programming consultant. By extending the scope of the information and performing some relatively simple statistical analyses, preliminary feasible programs can be generated with a minimum of input from the client. This range of programs combined with similarly produced financial data would permit churches to obtain a quick overall picture of their space needs and the resources required. As more information is acquired from the church, the models become more detailed, allowing the consultant to develop consistently more accurate responses.

Since all programming data would be maintained in machine form, feasible preliminary space relationships can be generated automatically. The initial relationship would logically be displayed in some convenient format which the building designer could manipulate according to his own experience and desires. Related information describing any current aspect of the project could be retrieved interactively on request. Production of final drawings might also be carried out by a digitally controlled device.

A two year development program to explore these areas is proposed to include the following tasks.

Fiscal Year 1974-75

1. Develop familiarity with the current programming procedure.
2. Examine the current data base and suggest revisions if required.
3. Acquire a test data base.
4. Construct preliminary statistical models.
5. Test models in the field.
6. Suggest modifications to present procedures.
7. Implement an operational system.

Fiscal Year 1975-76

1. Develop familiarity with the current preliminary design process.
2. Develop method for transferring program space requirements into computer generated space layouts.
3. Test the method.
4. Revise the method if required.
5. Implement an operational system.

Estimated Budget

	FY 1974-75	FY 1975-76
Personnel	$ 7,000.00	$10,000.00
Computer	1,500.00	3,000.00
Supplies	300.00	500.00
Travel	1,000.00	1,000.00
Overhead (65%)	3,250.00	3,250.00
Retirement (8%)	400.00	800.00
Terminal Rental	1,200.00	2,400.00
	$12,650.00	$24,200.00

APPENDIX A—SAMPLE COMPUTER RUN

```
CXQT  ?IOPJECT.RUN


BUILDING    DATA     SYSTEM
JOHN E. WILLIAMS
JUNE  1, 1974

     DO YOU HAVE A NEW DATA SET ?
>YES
    COMMAND
>NEW DATA STRUCTURE
    COMMAND
>GET IDNUMBER CHURCH STATE
    COMMAND
>PRINT ACT SET


                           SUBSET  DEFAULT SET

                               STATE          CHURCH          IDNUMBER
JAN LEE .BURKBURNETT,TX         TX            JAN LEE          100163A
MT VERNON .DEARBORN,MI          MI            MT. VERNON       10161A
SALEM .SALEM,KU                 KY            SALEM            10160B
SOUTHSIDE  SOUTH BEND,IN        IND           SOUTHSIDE        101550
CODDINGTON .SANTA ROSACA        CAL           CODDINGTON       10153B
EVERGREEN .FRANKFORT,KY         KY            EVERGREEN        10147B
ELSTON HGTS .LAFAVET,IND        IND           ELSTON HIGHT     10146A
FERRY LAKE .OIL CITY,LA         LA            FERRY LAKE       10145B
CONCORD .BLEERKER,ALA           ALA           CONCORD          10140C
TAYLORVILLE .TAYLORVL,TL        TL            TAYLORVILLE      10137A
LANDER VALLEY .LANDER,WY        WY            LANDER VALLE     10132A
MT VIEW .CASPER,WY              WY            MT VIEW          10131B
SOUTHSIDE .SOUTH BEND,I2        IND           SOUTH SIDE       10129B
GREENWAY .PHONENIX,A?           A?            GREENWAY         10124B
CENTRAL .N LITTLE ROCKAK        ARK           CENTRAL          10120C
MOUNTIN VIEW .EL PASO,TY        TEXAS         MOUNTIN VIEW     10120E
SUNNYSIDE .CHEYENNE,WO          WO            SUNNYSIDE        10119C
SUNNYSIDE .CHEYENNE,WO?         WO            SUNNYSIDE        10118E
SECOND .BRIDGE CITY,TY          TEXAS         SECOND           10112B
RUGGLES FERRY .KNOXVILLE        TN            RUGGLES FERR     10105B
BRENT D CHPL .BRENT D,NY        NY            BRENT D CHPL     10096B
NORTHDALE .ALBUQUERQUENM        NM            NORTHDALE        10097B
FIRST .CRESCENT,OKLA            OKLA          FIRST            10091B
SOUTHSIDE .BOONEVILLE,AK        ARK           SOUTHSIDE        10090A
CALVERY .TUPELO,MISS            MISS          CALVERY          10086H
TRINITY .INDEPENDENCE,MO        NO            TRINITY          10077A
MURRAY LANE .SIKESTON,MO        MO            MURRAY LANE      10072B
BETHEL .ELLIOT CITY,MD          MD            BETHEL           100709
COLUMBIA .N OLMSTEAD,OH         OH            COLUMBIA RD      10074G
FIRST .DEL RIO,TX               TX            FIRST            10041B
FIRST .CHEOOTAH,OKLA            OKLA          FIRST            10043C
FIRST S .APPLE VALLEY,CA        CA            FIRST SOUTH      10050K
LAKEVIEW .SALINA,OK             OK            LAKEVIEW         10058A
GREENFLD F .BAKERSFLD,CA        CA            GREENFIELD F     10059B
SAND RUN . HEBRON,KY            KY            SAND RUN         10061B
SOUTHSIDE .PRINCETON,KY         KY            SOUTHSIDE        10062B
FIRST .CARL JUNCTION,MO         MO            FIRST            10064B
RIVERVIEW .FRANKLIN,OH          OH            RIVERVIEW        10065A
COLLEGE HGTS .GRANTS ,OR        OR            COLLEGE HGTS     10066B
L SHORE .LAKE DALLAS,TY         TX            LAKE SHORE       10007??
CRESTVIEW .SAN ANTONIOTX        TX            CRESTVIEW        10024C
FIRST .ADDISON,ILL,             ILL           FIRST            10002A
FIRST .WEATHERFORD,TX           TX            FIRST            10002D
GREENWOOD .GREENWOOD,LA         LA          G GREENWOOD        10017C
ST ROSE .ST ROSE,LA             LA            ST ROSE          10014B
PARKADE .COLUMBIA,MO            MO            PARKDADE         10009H
HARMONY .ROGERSVILLE,MO         MO            HARMONY          10008?
MT ZION .POMONA,CA              CA            MT ZION          10018A
RIDGE S .PARIDISE,CA            CA            RIDGE S          10010B
CAMPBELLSBURY .CHERRY,KY        KY            CAMPBELLSBUR     10005A
```

```
    COMMAND
>AUD.LEN MAXIMUM = 300.00 MINIMUM = 1.00
    COMMAND
>AUD .WIDTH MAXIMUM = 300.00 MINIMUM = 1.00
    COMMAND
>FOR TESTONE
    COMMAND
>ACTIVE TESTONE
    COMMAND
>PRINT ACT SET
```

SUBSET TESTONE

	STATE	CHURCH	IDNUMBER
SOUTHSIDE SOUTH BEND, IN	IND	SOUTHSIDE	101550
CODDINGTON .SANTA ROSACA	CAL	CODDINGTON	10153B
EVERGREEN .FRANKFORT,KY	KY	EVERGREEN	10147B
CONCORD .BLEERKER, ALA	ALA	CONCORD	10140C
TAYLORVILLE .TAYLORVL,TL	TL	TAYLORVILLE	10137A
LANDER VALLEY .LANDER,WY	WY	LANDER VALLE	10133A
SOUTHSIDE .SOUTH BEND, IZ	IND	SOUTH SIDE	10129B
GREENWAY .PHONENIX,AZ	AZ	GREENWAY	10124B
SOUTHSIDE .BOONEVILLE, AK	ARK	SOUTHSIDE	10090A
BETHEL .ELLIOT CITY,MD	MD	BETHEL	10070B
COLUMBIA .N OLMSTEAD,OH	OH	COLUMBIA RD	10024G
FIRST .CHEOOTAH,OKLA	OKLA	FIRST	10043C
LAKEVIEW .SALINA,OK	OK	LAKEVIEW	10058A
GREENFLD F .BAKERSFLD,CA	CA	GREENFIELD F	10059B
COLLEGE HGTS .GRANTS ,OR	OR	COLLEGE HGTS	10066B
FIRST .ADDISON, ILL	ILL	FIRST	10022A
ST ROSE .ST ROSE, LA	LA	ST ROSE	10014B

```
    COMMAND
>GET AUD.LEN AUD.WIDTH IDNUMBER
    COMMAND
>PRINT ACT SET
```

SUBSET TESTONE

	IDNUMBER	AUD.WIDTH	AUD.LEN
SOUTHSIDE SOUTH BEND, IN	101550	48.000	100.000
CODDINGTON .SANTA ROSACA	10153B	50.000	50.000
EVERGREEN .FRANKFORT,KY	10147B	52.000	117.500
CONCORD .BLEERKER, ALA	10140C	44.000	102.000
TAYLORVILLE .TAYLORVL,TL	10137A	30.000	65.500
LANDER VALLEY .LANDER,WY	10133A	29.000	70.000
SOUTHSIDE .SOUTH BEND, IZ	10129B	49.500	94.000
GREENWAY .PHONENIX,AZ	10124B	55.000	65.000
SOUTHSIDE .BOONEVILLE, AK	10090A	34.000	80.000
BETHEL .ELLIOT CITY,MD	10070B	67.000	149.000
COLUMBIA .N OLMSTEAD,OH	10024G	88.000	100.000
FIRST .CHEOOTAH,OKLA	10043C	67.000	119.000
LAKEVIEW .SALINA,OK	10058A	38.000	62.000
GREENFLD F .BAKERSFLD,CA	10059B	39.000	78.600
COLLEGE HGTS .GRANTS ,OR	10066B	40.000	96.600
FIRST .ADDISON, ILL	10022A	40.000	85.000
ST ROSE .ST ROSE, LA	10014B	33.660	72.600

```
    COMMAND
>FOR TEST2 PRE.#DEPT MINMAX = 3.00
    COMMAND
>ACTIVE TEST2
    COMMAND
>GET PRE.#DEPT IDNUMBER
    COMMAND
>PRINT ACT SET


                              SUBSET  TEST2

                                 IDNUMBER        PRE.#DEPT
 SALEM .SALEM,KU                  101608              3.000
 FERRY LAKE .OIL CITY,LA          10145P              3.000
 CONCORD .BLEERKER,ALA            10140C              3.000
 MT VIEW .CASPER,WY               10121P              3.000
 GREENWAY .PHOENIX,AZ             10124P              3.000
 RUGGLES FERRY .KNOXVILLE         10105P              3.000
 NORTHDALE .ALBUQUERQUENM         10097P              3.000
 SOUTHSIDE .BOONEVILLE,AK         10090A              3.000
 FIRST S .APPLE VALLEY,CA         10050K              3.000
 SAND RUN . HEBRON,KY             10061B              3.000
 FIRST .CARL JUNCTION,MO          10064B              3.000
 COLLEGE HGTS .GRANTS ,OR         10066B              3.000
 L SHORE .LAKE DALLAS,TX          100278B             3.000
 ST ROSE .ST ROSE,LA              10014B              3.000
 CAMPBELLSBURY .CMPBRY,KY         10005A              3.000
    COMMAND
>FOR TEST3 STATE MINMAX = TX
    COMMAND
>ACTIVE TEST3
    COMMAND
>PRINT ACT SET


                              SUBSET  TEST3

                                 IDNUMBER        PRE.#DEPT
 JANLEE .BURKBURNETT,TX           100162A             5.000
 FIRST .DEL RIO,TX                10041P              6.000
 L SHORE .LAKE DALLAS,TX          100278B             3.000
 CRESTVIEW .SAN ANTONIOTX         10024C              6.000
 FIRST .WEATHERFORD,TX            10022D              6.000
    COMMAND
>GET STATE CHURCH
    COMMAND
>PRINT ACT SET


                              SUBSET  TEST3

                                 CHURCH          STATE
 JANLEE .BURKBURNETT,TX           JANLEE          TX
 FIRST .DEL RIO,TX                FIRST           TX
 L SHORE .LAKE DALLAS,TX          LAKE SHORE      TX
 CRESTVIEW .SAN ANTONIOTX         CRESTVIEW       TX
 FIRST .WEATHERFORD,TX            FIRST           TX
```

```
    COMMAND
>AUDI.AREA = AUD.WIDTH * AUD.LEN
    COMMAND
>GET AUDI.AREA AUD.WIDTH AUD.LEN
    COMMAND
>PRINT ACT SET


                                   SUBSET   TESTONE


                                   AUD.LEN          AUD.WIDTH        AUDI.AREA
 SOUTHSIDE  SOUTH BEND,IN            100.000           48.000         4800.000
 CODDINGTON .SANTA ROSACA             50.000           50.000         2500.000
 EVERGREEN .FRANKFORT,KY             117.500           52.000         6110.000
 CONCORD .BLEERKER,ALA               102.000           44.000         4488.000
 TAYLORVILLE .TAYLORVL,IL             65.500           30.000         1965.000
 LANDER VALLEY .LANDER,WY             79.000           29.000         2291.000
 SOUTHSIDE .SOUTH BEND,IN             94.000           49.500         4653.000
 GREENWAY .PHOENIX,AZ                 65.000           55.000         3575.000
 SOUTHSIDE .BOONEVILLE,AK             83.000           34.000         2822.000
 BETHEL .ELLIOT CITY,MD              149.000           67.000         9983.000
 COLUMBIA .N OLMSTEAD,OH             120.000           88.000        10560.000
 FIRST .CHECOTAH,OKLA                119.000           67.000         7973.000
 LAKEVIEW .SALINA,OK                  68.000           38.000         2584.000
 GREENFLD F .BAKERSFLD,CA             78.660           29.000         2281.140
 COLLEGE HGTS .GRANTS ,OR             96.660           40.000         3866.400
 FIRST .ADDISON,ILL                   85.000           40.000         3400.000
 ST ROSE .ST ROSE,LA                  72.660           32.660         2373.076
    COMMAND
>INDEPENDENT VARIABLE AUDI.AREA
    COMMAND
>REGRESSION DEPENDENT VARIABLE AUD.LEN
    COMMAND
>PRINT REG RESULT

 DEPENDENT VARIABLE:     AUD.LEN

 NUMBER OF OBSERVATIONS:       17

 R:     .88596

 MEAN OF DEPENDENT VARIABLE:            90.88

 STANDARD ERROR OF ESTIMATE:            12.09

 INDEPENDENT        MEAN        STANDARD     REGRESSION     STANDARD        T
  VARIABLE                      DEVIATION    COEFFICIENT      ERROR     STATISTIC

 CONSTANT                                      53.5053
 AUDI.AREA        4483.80     2683.9415          .0083         .0011       7.3990
    COMMAND
>PRINT RESIDUALS


         AUD.LEN           ESTIMATE        RESIDUAL
                    100.00            93.52             6.48307
                     50.00            74.34           -24.34468
                    117.50           104.44            13.06222
                    102.00            90.92            11.08382
                     65.50            69.89            -4.38505
                     79.00            72.60             6.39749
                     94.00            92.29             1.70842
                     65.00            83.31           -18.30562
                     83.00            77.03             5.97120
                    149.00           126.72            22.27[illegible]
                    120.00           141.53           -21.5[illegible]
                    119.00           119.97             -.96[illegible]
                     68.00            75.04            -7.04420
                     78.66            72.52             6.13[illegible]
                     96.66            85.73            10.9[illegible]
                     85.00            81.85             3.15[illegible]
                     72.66            73.29             -.62[illegible]67
```

```
    COMMAND
>MINMAX
STATE MINMAX = OK
    COMMAND
>FOR TEST3
    COMMAND
>ACTIVE TEST4
    COMMAND
>PRINT ACT SET


                              SUBSET   TEST4


                               CHURCH         STATE
 LAKEVIEW .SALINA,OK            LAKEVIEW       OK
    COMMAND
>STATE = LOCATION
    COMMAND
>GET LOCATION CHURCH
    COMMAND
>ACTIVE TEST3
    COMMAND
>PRINT ACT SET


                              SUBSET   TEST3


                               CHURCH         LOCATION
 JAN LEE .BURKBURNETT,TX        JAN LEE        TX
 FIRST .DEL RIO,TX              FIRST          TX
 L SHORE .LAKE DALLAS,TX        LAKE SHORE     TX
 CRESTVIEW .SAN ANTONIOTX       CRESTVIEW      TX
 FIRST .WEATHERFORD,TX          FIRST          TX
    COMMAND
>NAME = CHURCH
    COMMAND
>GET NAME
    COMMAND
>PRINT ACT SET

                              SUBSET   TEST3


                               NAME
 JAN LEE .BURKBURNETT,TX        JAN LEE
 FIRST .DEL RIO,TX              FIRST
 L SHORE .LAKE DALLAS,TX        LAKE SHORE
 CRESTVIEW .SAN ANTONIOTX       CRESTVIEW
 FIRST .WEATHERFORD,TX          FIRST

    COMMAND
>GET CHURCH
    COMMAND
>PRINT ACT SET


                              SUBSET   TEST3


                               NAME
 JAN LEE .BURKBURNETT,TX        JAN LEE
 FIRST .DEL RIO,TX              FIRST
 L SHORE .LAKE DALLAS,TX        LAKE SHORE
 CRESTVIEW .SAN ANTONIOTX       CRESTVIEW
 FIRST .WEATHERFORD,TX          FIRST
    COMMAND
>RSTOP

NORMAL EXIT.  EXECUTION TIME:           5642 MLSEC.
>
```

The implemented system has fifteen basic commands, six operations and three references for desired output. Each will cause a unique algorithm or sequence of algorithms to be invoked. There is no logical difference between commands, operations or references with exception that, for a single string of concatenated requests, commands are given lowest priority, references second, and operations are processed first. All are designated with phrases composed of from 1 to 24 characters. Arguments for commands and operations are similarly referenced. Each command, operation, reference, and/or argument may be multiply defined by dynamically associating a new phrase with an existing phrase or argument. New phrases may contain any desired character sequence, including imbedded blanks, with one limitation, the new phrase must be unique within the system vocabulary. Constant values may be inserted as desired. The commands, operations, references, arguments, and constants may be concatenated in any way provided there exists a logical interpretation for the string and each is separated by at least one blank. Any request may be posed at any point of interaction and will be satisfied for the conditions existing at that time.

<u>System Commands</u>

NEW DATA STRUCTURE

Arguments: None.

Description:

This command will cause a read to be issued on logical I/O unit 9 to obtain a new data set composed of n elements and m parameters with i numerics for each element. The first input record must contain n, m and i FORMAT (316) . The following record must contain a name, from 1 to 24 characters, to be associated with the first element. The next (m/10) + 1 records contain the m parameter values, 10 per record, for the element 1 FORMAT (6A12 or 6F12.2) . The sequence is repeated for each of the n total elements. The m records, following the last set of parameter values, should contain the phrases, from 1 to 24 characters each and 1 phrase per record, to be associated with each parameter. The parameter phrases should be ordered in the same sequence as the parameter values.

[Aug 1] MAXIMUM = [Aug 2]

Arguments: Aug 1 is any parameter name defined in the system vocabulary.

Aug 2 is any constant value.

Description:
This command will set a maximum value, Aug 2, for the parameter specified in Aug 1. The maximum value establishes the upper bound which the parameter cannot exceed for the next subset operation. Up to 100 maximum/minimum pairs may be assigned to determine one subset.

[Aug 1] MINIMUM = [Aug 2]

Arguments: Same as those for MAXIMUM

Description:
This command is the same as MAXIMUM, with the exception that a minimum bound is established for the parameter.

FOR [Aug 1]

Arguments: Aug 1 is a new phrase, 1 to 24 characters in length.

Description:
This command forms a new element subset constrained by all maximum and minimum bounds established for various parameters since a prior invocation of the FOR command. The resulting subset of elements is assigned the phrase specified in Aug 1. A maximum of 20 unique subsets may exist at one time.

ACTIVE [Aug 1]

Arguments: Aug 1 is the phrase associated with an existing subset.

Description:
This command makes the subset specified in Aug 1 the current active subset. All subsequent operations or commands will be performed on that subset until another ACTIVE command is recognized. There is always an active subset, the default set containing all defined elements.

GET [Aug 1 ....Aug n]

Arguments: Aug 1 through Aug n are N parameter phrases, from 1 to 24 characters each, referencing parameters defined within the system.

Description:
This command makes the parameters specified in Aug 1 through Aug n the current active parameters until a subsequent GET command is issued. It is generally combined with the PRINT command to identify parameters for which values are to be displayed.

PRINT [Aug 1]

Arguments: Currently Aug 1 may be one of three phrases, ACT SET which specifies the current active set, REG RESULTS which specifies the current regression results, or RESIDUALS which specifies the residual values associated with the last regression analysis.

Description:
This command will print the results specified in Aug 1 on the logical I/O unit 6.

DEPENDENT VARIABLE [Aug 1 ... Aug n]

Arguments: Aug 1 through Aug n are N parameter phrases, 1 to 24 characters each, for parameters defined within the system.

Description:
If N is 1, then the parameter specified by Aug 1 is established as the dependent variable for the next regression analysis. If N is greater than 1, then the parameters specified by Aug 1 through Aug n are concatenated and the entire sequence is established as the dependent variable for the next regression analysis.

INDEPENDENT VARIABLE [Aug 1 ... Aug n]

Arguments: Aug 1 through Aug n are parameter phrases, 1 to 24 characters each, for parameters defined within the system.

Description:
This command established the parameters specified by Aug 1 through Aug n as the N independent variables for the next regression analysis.

REGRESSION
Arguments: None

Description:
This command causes a multiple regression analysis to be performed using data points for the parameters currently defined as dependent and independent variables. The analysis is completed using the current active subset of elements as cases. If there exists more

than one dependent parameter, the independent variable sets are duplicated for each concatenated dependent variable. Using the internal parameter OPYEAR will cause a sequential series of integer constants, from 1 to n, to be assigned as independent data points for each of N cases in the current subsets.

[Aug 1] MIN MAX = [Aug 2]

Arguments: Aug 1 is any parameter name
Aug 2 is any constant value

Description:
Causes maximum and minimum bounds to be set at Aug 2 for the parameter specified in Aug 1. (See MAXIMUM and MINIMUM)

REMOVE [Aug 1 ... Aug n]

Arguments: Aug 1 through Aug n are N phrases, 1 to 24 characters each, associated with elements defined within the system.

Description:
This command will cause the N elements specified in Aug 1 through Aug n to be explicitly removed from the current active subset.

STOP
Arguments: None.

Description:
This command causes execution to be terminated and control is returned to the operating system.

System Operators

Operators may be invoked as follows:

$$[\text{Aug } 1] = [\text{Aug } 2] \begin{bmatrix} + \\ - \\ \div \\ * \end{bmatrix} [\text{Aug } 3] \begin{bmatrix} + \\ - \\ \div \\ * \end{bmatrix} [\text{Aug } n]$$

Argument: Aug 1 through Aug n may be any acceptable combination of phrases, 1 to 24 characters each, specifying existing parameters, existing elements or new parameters, or constants.

Description:
The order of operator precedence is from right to left. If mathematical transformations are indicated for parameter values, the operation is performed for each of the n elements or the entire data set. The equivalence operator '=' may be used to define multiple references to elements, parameters or commands within the system by designating the

existing phrase in Aug 1 and the new equivalent phrase in Aug 2. New parameters created by transforming Aug 2 through Aug n are stored in the exiting data structure and may subsequently be referenced by the phrase designated in Aug 1.

[Aug 1] = LOG [Aug 2]

Arguments: Aug 1 is any new or existing phrase and Aug 2 any existing phrase, 1 to 24 characters each, designating parameters defined or to be defined within the system.

Description:
The common logarithms of values for the parameter designated in Aug 2 are stored in the existing or new parameter designated in Aug 1.

Algorithms and Data Structure

All interaction with the system is performed via an independent parsing subroutine. This subroutine maintains and processes the entire system vocabulary. The calling sequence is presented here.

CALL PARSE (Itype, Iname, Id, Inum, Ilen, pvar, Itot)

Arguments:

- Itype, is a full word integer specifying the process desired, 1 = add new phrases to the vocabulary, 0 = read and parse one record.
- Iname, is a real vector containing a sequence, length specified in Itot, of 24 byte character strings sent or received.
- Id, is a vector, length specified in Itot, of full word integers associated with each corresponding character string.
- Inum, is a second vector of full word integers the same as Id.
- Ilen, is a vector of full word integers, length specified in Itot, designating the actual length of each corresponding character string.
- pvar, is a vector of floating point constants returned as required.
- Itot, is a full word integer specifying the number of character strings passed or receifed.

If Itype = 0, one record, with a maximum length of 80 bytes, is read from logical I/O unit 5 and parsed as follows:

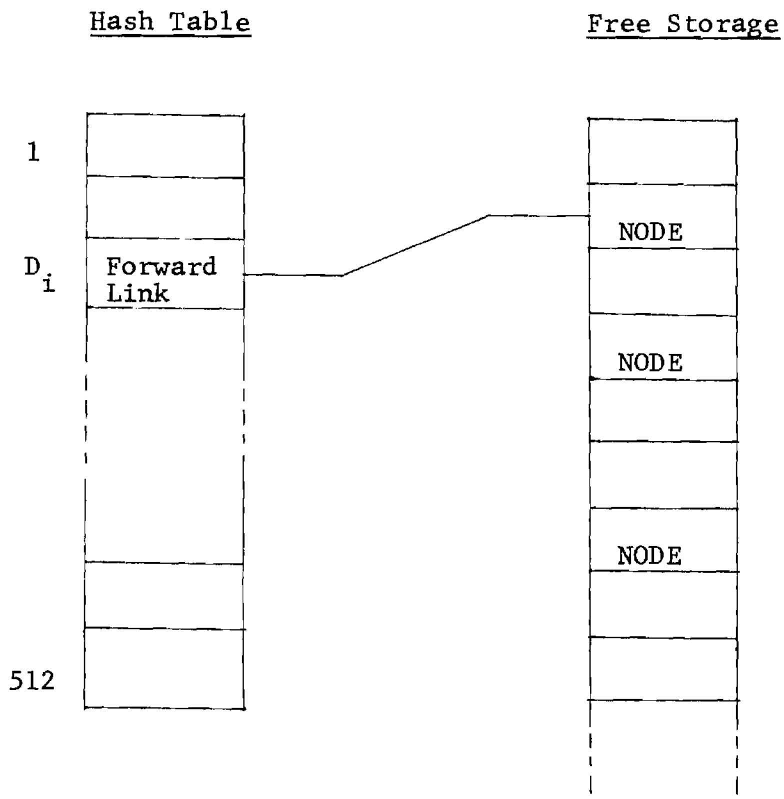
Input String: $\left[C_1 \;.....C_{k-1}C_kC_{k+1}\;.....C_{j-1}C_jC_{j+1}\;.....C_n\right]$

where: $1 \_\_n\_\_ 160$
C_i = Character Position 1

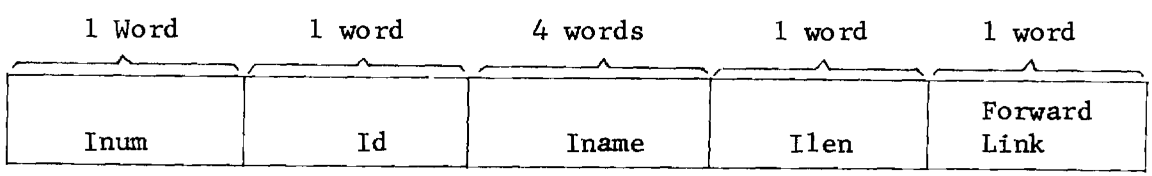
The string, C_1 through C_n, is scanned until the first blank is found, C_k. The length, k-1, is then compared with those of the existing vocabulary phrases, stored in the 'hash' table shown below. If the lengths match, the character string, C_1 through C_{k-1}, is compared with existing strings at the appropriate storage location, proceeding down the linked list, to determine if it is a previously defined phrase. If not the scan is continued with character C_{k+1} and proceeds until the next sequential black is encountered. If the blank, C_k, or the character, C_{k+1}, was the end of the record, and no match was found for the string C_1 through C_{k-1}, then it is returned as a new phrase. If a match was found, then the parameters specified in the calling sequence arguments are returned. If the next blank is found at C_j, the existing vocabulary is searched for the string C_1 through C_{j-1}. If matched, values are returned as above. If it is not, but C_{k+1} through C_{j-1} is matched, then C_1 through C_{k-1} is returned as a new string and the existing parameters are returned for C_{k+1} through C_{j-1}. The procedure is iterated, testing all possible non-blank string combinations each time a new blank is encountered. Each sequential unrecognized string is concatenated to previous unmatched strings until a match is found or, the entire sequence is returned as a new phrase.

The vocabulary is 'hashed' into a table as follows:

Phrase: $C_1 \ldots C_k$ $D_i = C_i + C_k$ for i=1, w phrases



Node



If the PARSE subroutine is called with Itype = 1, the new phrase contained in Iname and associated parameters are simply hashed into the vocabulary table for future reference.

After PARSE has returned values from a read in each of the arguments, they are processed and stacked in the command-operator data structure. Three stacks are created and entry is based on the value in Id as follows:

Id	Type	
1	Command	Command Stack
2	Operator	Operator Stack
3	Existing Parameter	Variable Stack
4	New Parameter	
5	Real Constant	
6	Interim Constant	

The first element in each stack is the forward link of the list and the second is Id.

Forward Link	Id

Command Stack

Forward Link	Id

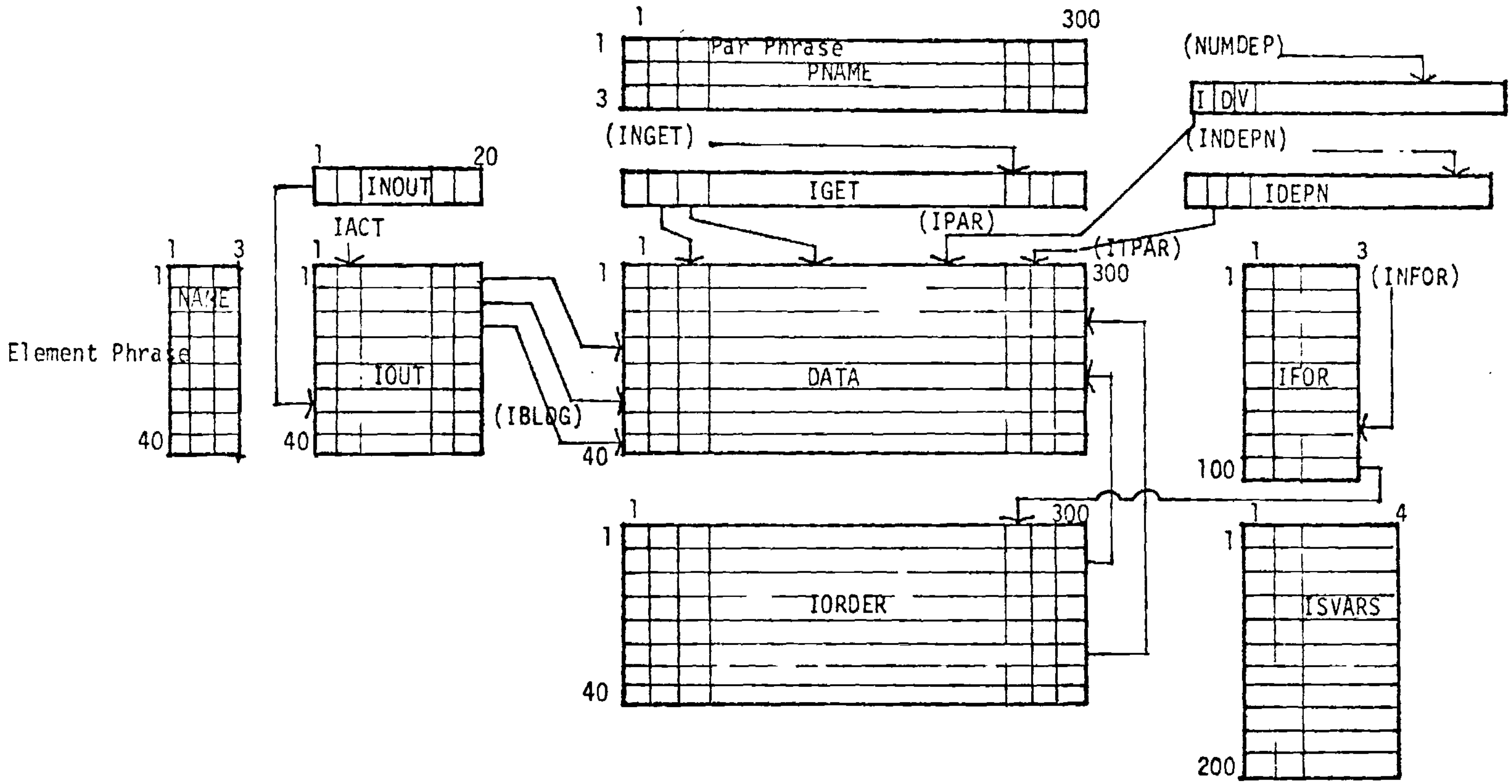
Operator Stack

If a variable is returned, a second number, Inum, is associated with it.

Forward Link	Id	Inum

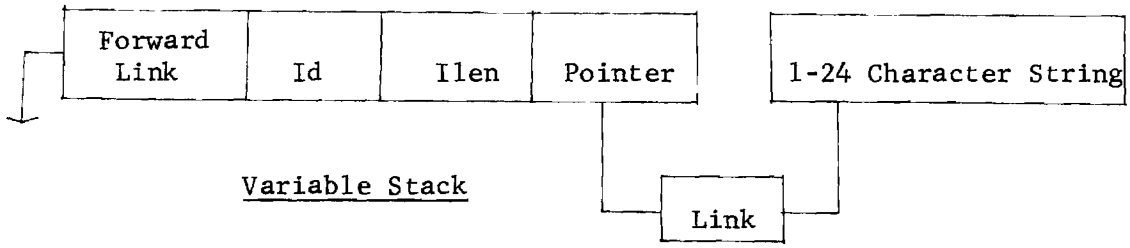
Variable Stack

If the variable is a real constant, Pvar will contain the value.



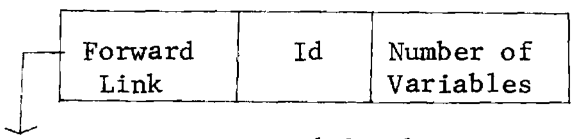
BASIC DATA STRUCTURE

Interim constants are created when arithmetic operations are concatenated and interim results must be saved in Inum. If the variable returned is not in the existing vocabulary, i.e., it is newly created, the Inum will contain the length, in characters, of the phrase which is stored in a separate stack and pointed to by a fourth element in the variable stack.



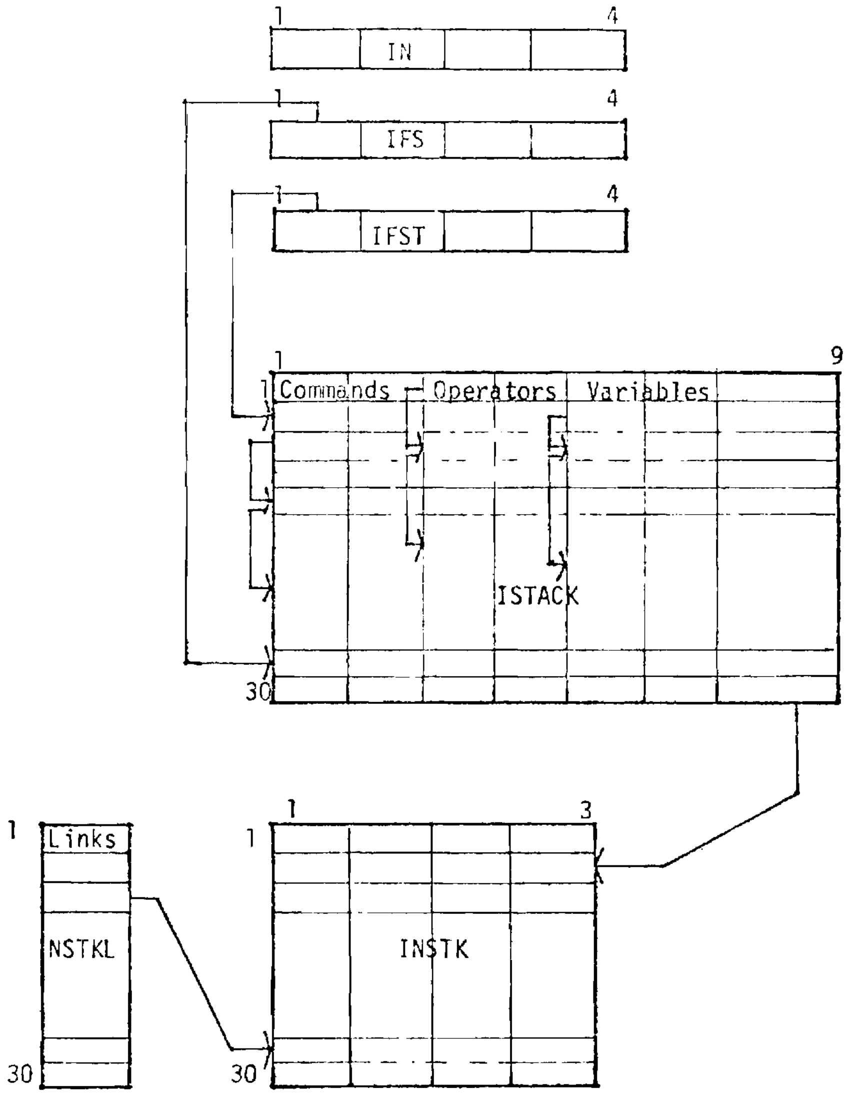
Variable Stack

If several commands are concatenated, one additional value is saved defining the number of variables associated with each distinct command and returned in the variable stack.



Command Stack

Three vectors are maintained to point to the first current free storage, and the first current value and total current values in each stack. Each time parameters are returned by PARSE, the stacks are examined in the order operators, commands, variables, to determine if any procedures can be completed. The operations stack must be empty before the command stack is examined. As many commands and operations are processed as possible with variable values acquired sequentially from the variable stack as required. When no further procedures can be executed, control is returned to PARSE for further input.



COMMAND-OPERATOR DATA STRUCTURE

The parameter values for each element contained in the information base are saved in matrix form and in the same order as they are read in.

Parameters

V_{11}		V_{1m}
V_{21}		
V_{31}		
V_{n1}		V_{nm}

<u>Information Matrix</u>

Each K^{th} vector is searched for the condition:

$$V_{P_{\ell k}} \geq S_k \quad \text{for } = 1,n$$

If that condition is found at ς = n-3, then the search proceeds from that point until the condition:

$$V_{P_{\varsigma k}} \geq M_k \text{ for } = n\text{-}3\text{+}1,\ n$$

or until ς = n, at which point the process is complete. If this condition is found at ς = n=2, then k = k+1 and the search initiated for the next sequential constrained parameter. However, with each iteration, the search will be shorter, with ς = n-3+1, n-w, etc. The result is a vector of pointers to that set of elements which satisfy all k constraints. Up to twenty defined subsets may exist at one time.

All mathematical operations are performed for each element of the specified parameters. Interim values for concatenated operations are saved in values V_{1m} through V_{nm}. If a new parameter is created as a result of the equivalence operator, values for that parameter will be inserted in V_{1a} through V_{na}, where a is the next available empty column in the initial matrix. If the matrix is full, the new parameter will replace the m^{th} existing parameter.

For regression operations, a single vector is constructed containing values for all independent and dependent variables.

Sequence 1			Sequence 2								
V_{1k}	....	V_{nk}	V_{1j}	... ...	V_{nj}	V_{1j}	...	V_{nj}	V_{1j}	..	V_{nj}

The k^{th} parameter is the dependent variable and each j^{th} parameter is one independent variable for j values between 1 and m. The maximum number of independent variables is 30. The number of values, n, for each variable is the number of elements contained in the current active subset. If multiple dependent parameters are specified, Sequence 1 will be repeated for k = 1,t variables and Sequence 2 will be duplicated t times.

1	t	1	t
Sequence 1	Sequence 1	Sequence 2	Sequence 2

If the internal variable OPYEAR is specified as an independent variable, a vector of integer constants, s, for s=1, t, is associated with each Sequence 2 repetition.

STUDY RECORD

Church Architecture Department
THE SUNDAY SCHOOL BOARD / SOUTHERN BAPTIST CONVENTION

TEXAS	BURKBURNETT	JANLEE
STATE	CITY	CHURCH

TX STATE	BURKBURNETT CITY	JANLEE CHURCH NAME	110374 DATE	N.W. DRAFTSMAN	AUDEDU BUILDING TYPE
AUDITORIUM CONSTRUCTION	AUD DESIGN NUMBER	1/16IN=1FT AUD DRAWING SCALE	INTERIM PHASE AUD CONSTRUCTION	YES AUD REFERENCED	RECT AUD SHAPE
AUD DESIGN STYLE	AUD ARRANGEMENT	AUD REVERSE END	AUD BALCONY CONSTRUCTION	AUD OVERFLOW SEATING	AUD GROUND FLOOR
REMODEL EDUCATIONAL CONSTRUCTION	EDU DESIGN NUMBER	1/16IN=1FT EDU DRAWING SCALE	NO EDU UNIT REFERENCED	EDU DESIGN BASIS	EDU UNIT SHAPE
EDU UNIT CORRIDOR TYPE	EDU UNIT OFFICE	ADDING TO PLOT PLAN TYPE	TIGHT SITE DESCRIPTION	SITE SLOPE	PARKING RATIO
1IN=40FT SITE DRAWING SCALE	SITE DESIGN NUMBER	CONSTRUCTION DATE	FIRST UNIT OR OTHER	SPECIAL STUDY FOR BOOKSTORE	SS FOR EXTERIOR ELEVATION
SS FOR GYMNASIUM	SS FOR INTERIOR DESIGN	SS FOR LANDSCAPING	SS FOR LIBRARY	SS FOR CHURCH OFFICE	SS FOR STATE OFFICE
SS FOR PASTORS HOME	SS FOR PORTABLE UNITS	SS FOR RECREATION	SS FOR SIGN	SS FOR STUDENT CENTER	10163A DRAWING REFERENCE NUMBER
YES IS THERE A GYMNATORIUM	CHURCH BUS	694.00 AUDITORIUM CAPACITY	AUD WIDTH	AUD LENGTH	AUD AREA
330.00 EDUCATIONAL UNIT CAPACITY	EDU UNIT WIDTH	EDU UNIT LENGTH	EDU UNIT AREA	EDU UNIT NUMBER OF STORIES	5.00 NUMBER OF PRESCHOOL DEPARTMENTS
46.00 PRESCHOOL CAPACITY	5.00 NUMBER OF CHILDREN'S DEPT	100.00 CHILDREN CAPACITY	2.00 NUMBER OF YOUTH DEPARTMENTS	84.00 YOUTH CAPACITY	3.00 NUMBER OF ADULT DEPARTMENTS
100.00 ADULT CAPACITY	FELLOWSHIP CAPACITY	MUSIC CAPACITY	KINDERGARTEN CAPACITY	DAY CARE CAPACITY	CHAPEL CAPACITY
PLOT PLAN ACRES	500.00 ULTIMATE WORSHIP CAPACITY	500.00 ULTIMATE EDUCATIONAL CAPACITY	PARKING CAPACITY	CONSTRUCTION COST	SPECIAL STUDY AREA
SS ASSEMBLY CAPACITY	SS MISSION CAPACITY	SS KITCHEN SERVING CAPACITY	SS NUMBER OF OFFICES FOR ASSOC	NEW NUMBER OF PRESCHOOL DEPT	NEW PRESCHOOL CAPACITY
NEW CHILD DEP'TS	NEW CHILD CAP	NEW YOUTH DEP'TS	NEW YOUTH CAP	NEW ADULT DEP'TS	NEW ADULT CAP

APPENDIX D—SAMPLE DATA FILE

```
000050000P9000003b
JANLEE .BURK.URNETT,TX   1
TX          KURKBURNETT  JANLEE       03-11-74     NW              AUDEDU       1
                         1/16IN=1FT   INTERIM                      RECT         1
                                                                                1
            REMODEL                   1/16IN=1FT   NO                           1
                                      ADDING TO    TIGHT                        1
                                                   1IN=40FT                     1
                                                                                1
                                                                                 1
                                      100163A                                    1
      694.00                                              330.00                 1
                                             5.00          46.00            5.001
      100.00        2.00       84.00         3.00         100.00                 1
                                                                          500.001
      500.00                                                                     1
                                                                                 1
MT VERNON .DEARBORN,MI   1
MI          DEARBORN HIGHT. VERNON    03-07-74     NW              AUDEDU        1
NEW                                   FIRST        NO                            1
                                                                                 1
            NEW                                    YES             MINIMUM       1
RECT                                  ADDING TO    TIGHT                         1
                                                   1IN=32FT        108MOD        1
                                                                                 1
                                                                                 1
                                      10161A                                     1
       92.00                                              100.00           35.001
       60.00      2100.00        2.00        2.00          16.00            3.001
       27.00         1.00       20.00        1.00          37.00                 1
                                                                          200.001
      200.00                                                                     1
                                                                                 1
SALEM .SALEM,KU            1
KY          SALEM       SALEM         03-06-74     BR              AUDEDU        1
NEW         S-245       1/8IN=1FT     FINAL        NO              RECTANGULAR   1
                                                                                 1
            REMODEL                   1/8IN=1FT    NO              MINIMUM       1
                                      ADDING TO    ADEQUATE        LEVEL         1
                                                   1IN=40FT                      1
                                                                                 1
                                                                                 1
                                      101608                                     1
      267.00                                              267.00                 1
                                             3.00          30.00            2.001
       30.00        2.00       36.00         1.00         100.00          132.001
                                                            1.50                 1
                                                                                 1
      132.00                                                                     1
STATE                    1
CITY                     1
CHURCH                   1
DATE                     1
DRAFTSMAN                1
BUILDING TYPE            1
AUD.CONSTRUCT            1
AUD.D_STG                1
AUD.SCALE                1
AUD.PHASE                1
REFERENCED?              1
SHAPE                    1
DESIGN                   1
ARRANGEMENT              1
REVERSE END?             1
BAL.CONSTRUCT            1
OVERFLO.SEAT.            1
GROUND.FLR?              1
MODULAR?                 1
EDU.CONSTRUCT            1
EDU.DESIGN.              1
EDU.SCALE                1
REFERENCED1?             1
BASIS                    1
SHAPE1                   1
EDU.CORRIDOR             1
```

APPENDIX E—PARAMETER DESCRIPTIONS

Parameter Number	Parameter Name	Parameter Abbreviation	Alternative Values
1	State	STATE	1-12 characters U.S. Postal Abbreviations
2	City	CITY	1-12 characters Name
3	Church Name	CHURCH	1-12 characters Name
4	Date	DATE	nn-dd-xx where: nn=month dd=day xx=year
5	Draftsman	DRAFTSMAN	1-12 characters Name
6	Building Type	BUILDING TYPE	AUDEDU-Auditorium/Educational AUD - Auditorium only EDU - Educational only
7	Auditorium Construction	AUD.CONSTRUCT	NEW, REMODEL
8	Auditorium Design Number	AUD.DESIGN#	1-12 characters Number
9	Auditorium Drawing Scale	AUD.SCALE	n/xIN=qFT where: n,x and q are digits
10	Phase of Auditorium Construction	AUD.PHASE	FIRST, INTERIM, CHAPEL, FINAL
11	Is Auditorium Referenced	AUD.REFERENCED?	YES, NO
12	Auditorium Shape	AUD.SHAPE	RECT, SQUARE, OCTAGON, TRIANGLE, FAN
13	Auditorium Design Style	AUD.DESIGN	CONTEMPORARY, COLONIAL, GOTHIC, TRADITIONAL
14	Auditorium Arrangement	AUD.ARRANGEMENT	CONVENTIONAL, ASYMMETRICAL, DIVIDED
15	Auditorium Reverse End	AUD.REVERSE END?	YES, NO

Parameter Number	Parameter Name	Parameter Abbreviation	Alternative Values
16	Auditorium Balcony Construction	AUD.BAL CONSTRUCT?	YES, NO
17	Auditorium Overflow Seating	AUD.OVERFLO SEAT?	YES, NO
18	Auditorium Ground Floor	AUD.GROUND FLR?	YES, NO
19	Educational Construction	EDU.CONSTRUCT	NEW, REMODEL
20	Educational Design Number	EDU.DESIGN#	1-12 characters Number
21	Educational Drawing Scale	EDU.SCALE	n/xIn=qFt where: n,x and q are digits
22	Is Educational Unit Referenced?	EDU.REFERENCED?	YES, NO
23	Educational Design Basis	EDU.BASIS	MINIMUM, RECOMMENDED
24	Educational Unit Shape	EDU.SHAPE	RECT,L,T,E,H,SQUARE
25	Educational Unit Corridor Type	EDU.CORRIDOR	INTERIOR, EXTERIOR
26	Educational Unit Office	EDU.OFFICE	YES, NO
27	Plot Plan Type	PLOT.PLAN	ALL NEW, ADDING TO
28	Site Description	SITE.DESC.	ADEQUATE, NICE, TIGHT
29	Site Slope	SITE.SLOPE	LEVEL, SLIGHT SLOPE, MUCH SLOPE
30	Parking Ratio	PARKING.RAT	1-12 characters Number
31	Site Drawing Scale	SITE.DWG.SC	nIN=xxFT where: n,x are digits
32	Site Design Number	PL.DESIGN#	1-12 characters Number

Parameter Number	Parameter Name	Parameter Abbreviation	Alternative Values
33	Construction Date	CONSTRUCT.DATE	nn-dd-xx where: nn=month dd=day xx=year
34	First Unit or Other	FIRST/OTHER	FIRST, OTHER
35	Special Study for Bookstore	S.S.BOOK	YES, NO
36	Special Study for Exterior Elevation	S.S.ELEV.	YES, NO
37	Special Study for Gymnasium	S.S.GYM	SMALL,MED,LARGE
38	Special Study for Interior Design	S.S.INTERIOR	YES, NO
39	Special Study for Landscaping	S.S.LANDSC	YES, NO
40	Special Study for Library	S.S.LIBRARY	YES, NO
41	Special Study for Church Office	S.S.OFFICE-Church	YES, NO
42	Special Study for State Office	S.S.OFFICE-STATE	YES, NO
43	Special Study for Pastor's Home	S.S.PARSON	YES, NO
44	Special Study for Portable Units	S.S.PORTABLE	YES, NO
45	Special Study for Recreation	S.S.RECRE	YES, NO
46	Special Study for Sign	S.S.SIGN	YES, NO
47	Special Study for Student Center	S.S.STUD	YES, NO
48	Drawing Reference Number	IDNUMBER	nnnnnD where: n is digit and D is letter
49	Is there a Gymnatorium?	GYMNATORIUM	YES, NO

Parameter Number	Parameter Name	Parameter Abbreviation	Alternative Values
50	Does Church Bus	BUS	YES, NO
51	Auditorium Capacity	AUD.CAP	Number of the form nnnnnnnnn.nn where: n's are digits
52	Auditorium Width	AUD.WIDTH	Number of the form nnnnnnnnn.nn where: n's are digits
53	Auditorium Length	AUD.LEN	Number of the form nnnnnnnnn.nn where: n's are digits
54	Auditorium Area	AUD.AREA	Number of the form nnnnnnnnn.nn where: n's are digits
55	Educational Unit Capacity	EDU.CAP	Number of the form nnnnnnnnn.nn where: n's are digits
56	Educational Unit Width	EDU.WIDTH	"
57	Educational Unit Length	EDU.LEN	"
58	Educational Unit Area	EDU.AREA	"
59	Educational Unit Number of Stories	EDU.#STOR	"
60	Number of Preschool Departments	PRE.#DEPT	"
61	Preschool Capacity	PRE.CAP	"
62	Number of Child-ren's Departments	CHILD.#DEPT	"
63	Children Capacity	CHILD.CAP	"
64	Number of Youth Departments	YOUTH.#DEPT	"
65	Youth Capacity	YOUTH.CAP	"
66	Number of Adult Departments	ADULT.#DEPT	"

Parameter Number	Parameter Name	Parameter Abbreviation	Alternative Values
67	Adult Capacity	ADULT.CAP	"
68	Fellowship Capacity	FELL.CAP	"
69	Music Capacity	MUSIC.CAP	"
70	Kindergarten Capacity	KINDER.CAP	"
71	Day Care Capacity	DAY.CARE.CAP	"
72	Chapel Capacity	CHAPEL.CAP	"
73	Plot Plan Acres	PL.PL.ACRES	"
74	Ultimate Workshop Capacity	ULT.CAP.WO	"
75	Ultimate Educational Capacity	ULT.CAP.ED	"
76	Parking Capacity	PARK.CAP	"
77	Construction Cost	CON.COST	"
78	Special Study Area	S.S.AREA	"
79	Special Study Assembly Capacity	S.S.ASSM	"
80	Special Study Mission Capacity	S.S.MISS	"
81	Special Study Kitchen - Serving Capacity	S.S.KITCH	"
82	Special Study Number of Offices for Association	S.S.OFF.ASSN	"
83	New Number of Preschool Depts.	NEW PRE.#DEPT.	"
84	New Preschool Capacity	NEW PRE.CAP	"
85	New Number Children's Depts.	NEW CHILD.#DEPT.	"

Parameter Number	Parameter Name	Parameter Abbreviation	Alternative Values
86	New Children	NEW CHILD.CAP	"
87	New Number of Youth Depts.	NEW YOUTH.#DEPT.	"
88	New Youth Capacity	NEW YOUTH.CAP	"
89	New Number of Adult Departments	NEW ADULT.#DEPT.	"
90	New Adult Capacity	NEW ADULT.CAP	"

REFERENCES

[1] "Recommendation for a Computer Aided Design Capability for the Architecture Department of the Baptist Sunday School Board," G. Evans and L. Nix, School of Architecture, Georgia Institute of Technology, 1973.

[2] Church Property/Building Guidebook, T. L. Anderton, Nashville, Tennessee: Convention Press, 1973.

RECOMMENDATION FOR A COMPUTER AIDED DESIGN CAPABILITY FOR THE ARCHITECTURE DEPARTMENT OF THE BAPTIST SUNDAY SCHOOL BOARD

Grayson Evans
Lewis Nix

School of Architecture
Georgia Institute of Technology

REPORT DIVISIONS:

I. Effects of a Computer Capability on Office, Organization and Work Procedure within the Architecture Department of the Baptist Sunday School Board

II. Computer Software Specifications

III. Computer Hardware Specifications

IV. Presentation and Economic Evaluation of Alternatives

CONTENTS OF DIVISION I

I. EFFECTS OF A COMPUTER CAPABILITY ON OFFICE ORGANIZATION AND WORK PROCEDURE

1. Introduction

1.1 Architects have had trouble defining what the computer can do for them.

1.2 Computer's greatest attribute is its ability to perform many iterations of a task defined as a mathematical equation.

1.3 Architects have viewed their profession as a mixture of science and art, and they have traditionally believed that science and art are so totally integrated in the design process, little attempts had therefor been made to isolate and define quantifiable and objective tasks which the architects must perform. While design requirements may generate unique architectural solutions, certain similar if not identical tasks are performed in the production of each solution and this is the value of the computer. For if each solution generation grew from a one-of-a-kind decision sequence, the computer would not be advantageous to the architect. Of course, some architectural offices lend themselves to computer-aided design more than others. This appropriateness of fit is determined usually by the volume of work and the repetitive nature of work performed in an architectural office.

1.4 Only the largest architectural offices have begun to sense the economic and time saving advantages of computerizing certain office tasks. Today many of these firms are using computers for accounting and structural computations, but only a few firms have attempted to employ the computer as an integral part of the design and drawing production process. An office which has defined its repetitive tasks and which have a large volume of such tasks should find that the computer when integrated into office functions, will allow office employees to exploit their potentialities which are peculiar to man, while the computer performs those repetitive tasks which it does so efficiently. We belive that the Architecture Departments of the Baptist Sunday School Board is such an office.

2. Identification of Architectural Services at Baptist Sunday School Board

2.1 The complete description of each task performed by the architectural department at the Baptist Sunday School Board (BSSB) and the detailed flow of work will not be itemized in this report. This report will, however attempt to discuss the major operations performed from the inception of a job through the possible production of building layout drawings and finally the cataloging of the drawings for retrieval. The portion of this report devoted to system software specifications defines the computer routines which are proposed to give the BSSB a computer capability compatible with its present architectural services.

2.2 To augment the description of the systems software specifications, a condensed identification of present tasks which will be affected by the proposed system software is needed. This is given as a list as follows:

2.2
1. Letter of inquiry received from Church and file is begun.

2.2
2. Questionnaire sent to Church.

2.2
3. Field consultant visits Church.

2.2
4. Sends report of visit to BSSB

2.2
5. Report used by Building Program Consultants to formulate architectural program of spaces.

2.2
6. Program reviewed by Field Services supervisor and program consultant.

2.2
7. Building program sent to Architectural Services supervisor.

2.2
8. Architectural Services supervisor schedules jobs and designates and assigns draftsmen according to the work units load given to each job.

2.2
9. Preliminary plans drawn by draftsmen
   a. References made to previous jobs of a similar nature
   b. Recommendations of building program consultant are used as guide

2.2
10. Job reviewed by Architectural Services section supervisor.

2.2
11. Drawing sent to Church.

2.2
12. File becomes inactive

2.2
13. Original drawings retained for 5 years.
End of 5 years - originals are microfilmed and then destroyed.

2.3 Of course, computerization will handle other tasks in addition to those listed above; however, since this condensed list gives in essence the work done on a job by the BSSB, only the effects of a computer capability upon these office chores is discussed. As shown in the Systems Software Specifications portion of this report, the key to the proposed computerized operation is the immediate access to files which contain information (records) on each active job. The tasks described in the previous section are redescribed below as if the proposed computerized operation had been implemented.

2.3
1. Repetitive clerical taks would be minimized once a church makes an inquiry and requests the services of the BSSB, the clerical correspondents would initiate a file by typing in the churche's name and address. The record on this church would at that time be otherwise empty. As the record begins to grow the correspondence clerk could refer to a CRT terminal to note a job's progress as inquiries are received.

2.3
2. The software would then schedule a questionnaire which should be sent to the Church. When the completed questionnaire is returned to the BSSB it would be read by the computer and any additional information needed would be requested in a letter typed by the system.

2.3
3. Field consultants' visits would be scheduled by the system, from criteria such as the length of time a job has been in backlog or the proximity of a church to other churches scheduled on the field consultant's routes. A letter of notification to a church would be printed by the computer.

2.3
4. Field consultants could submit standard information documents about the characteristics of a church - These documents could be read and stored by the system.

2.3
5 Questionnaire received from church, site characteristics, and field consultant's reports would then be coupled with formulas and ? techniques already in use by the BSSB to generate a building program of the number, titles, and square footages of spaces required by the church being served, to satisfy the requirements of its congregation.

2.3
6. The formulas now in use by the BSSB to determine the spatial requirements of a church congregation are always subject to research and change. Review of the building program by the field services consultants and building program consultants would insure that these formulas found within the computerized system could be expanded and updated as needed.

2.3
7. The building program generated by the system would then be retrieved from the system by the architectural services supervisor since the job would now be ready to be used by draftsmen and designers to produce preliminary drawings.

2.3

8. The BSSB now has as finite method of evaluating the work load of a particular office job; whence, the architectural services section supervisor must now manually calculate the number of work units associated with a job to schedule the job, the computer will have the method for measuring the work units programmed into the system.

2.3

9. At present draftsmen and designers must rely upon their own memories in order to retrieve drawings of churches which contain characteristics similar to a current job. The software system will contain a data base of churches with matching characteristics thus enabling the designer to refer to these drawings quickly especially because computer output will be displayed on a CRT terminal with interactive capabilities. The draftsmen will be able to assemble portions of drawings from similar churches then modify these drawings to satisfy the requirements of his building program. As interactive graphics is added to the system, drawings may be generated directly by the system from the building program specifications. Designers will always, however, have the freedom to alter these computer generated solutions.

2.3

10. If the job has been drawn through interactive computer graphics, the architectural services section supervisor can review the CRT display and then have the stored drawing printed by an electro-static printer. This would allow any last minute alterations to be made.

2.3

11. Drawings would be mailed to the church. At present original tracings of these drawings are retained but they do not constitute a data base from which a designer can draw information. When he is finished with a job, the designer will list the characteristics of his design. These characteristics can then be used at a future date to identify projects similar to a current job.

2.3

12. At present the job file becomes inactive when the job is completed. The effects and the knowledge gained from a job will not become inactive so quickly under the proposed system. Characteristics of all jobs will be retained on a back-up tape. Drawings will also be retained in a drawing file within the computer. They will be ? as the frequency with which they are recalled is diminished. This system would bring about a more efficient and economic storage system than the present five-year retention plan for all original drawings.

3. Effects of the Proposed Computer Capability on the Types and Organization of Employees

3.1 The integration of a computer capability into an architectural office depends primarily upon the ease of man machine communication within that office. While the Baptist Sunday School Board Architecture Department performs tasks, which can be computerized as described above, personnel must be able to integrate their office activities with input and output devices and view these devices as time saving tools much as one views the type - writer and calculator in the traditional office.

3.2 The operational structure of an architectural office with a computer capability can usually be described with the aid of the diagram shown in Figure 1.

3.2
1. Designing produce drawings and implement the design and analysis performed by the analytical and computer sections.

3.2
2. The analytical section is problem oriented. They formulate finite mathematical relationships which will in turn be used to develop the square footages, cost estimation, qualities of spaces, etc.

3.2.
3. The Computer Section is concerned with the writing of software which corresponds to mathematical relationships developed by the analytical section. The computer group would also translate management's decisions on job scheduling into a programmed sequence of orders which can be issued from the computer. Of course, the computer section would also be responsible for hardware maintenance and employee orientation to computer usage.

3.3 The existing organizational structure of the employees of the Architecture Department at the BSSB is shown on Figure 2. These employee titles are now placed on the operational structure shown in Figure 1 to produce Figure 3. Notice that additional employee titles appear on the diagram. Existing employees have meshed into the organizational diagram with few changes in their duties with the exception of their new communication with the computer.

3.3
1. The Church Architecture Department Secretary would set well-defined operating policies and procedures in insure that the computer installation would serve goals set by management of the Baptist Sunday School Board.

3.3
2. Draftsmen and Designers would continue to produce preliminary drawings as they presently do. However, an interactive graphics and an automated drawings search procedure will condense time required for the production of design solutions.

3.3
3. Field consultants and building program consultant will comprise the analytical group, since it is they who determine the finite mathematical relationships which are used to generate a building program of spaces. Field consultants, in reviewing completed jobs, can offer feedback which should effect necessary changes in pre-established mathematcial formulas.

3.3
4. Clerical Services will link projects completed in the designers' section to the storing of project data into the computer system. Clerical services will

enter the computer section via the keypunch operator or operators. Interaction with a CRT terminal/typewriter should eliminate the need for a large amount of keypunch operation.

3.3
5. The head of a computer section should be appointed from within the architecture department. He knows almost everyone within the department and this will tend to simplify communications. While he may not need to know software programming, he should be able to act as a liason between management and the computer group. He would be responsible for planning, scheduling, and making reports on the programming efforts and its usefulness to the designers and draftsmen who must finally implement a job. In view of the present duties of the Architectural Services Supervisors, he is the most likely candidate for such a position since his present duties closely parallel those duties mentioned above.

3.3
6. The Baptist Sunday School Board would need to employ the following additional employees:

    1. Programmer - He would translate mathematical relationships defined by the building program consultants into systems software. He might also work with outside consultants such as Georgia Tech to assist in the development of a system's software.

    2. An operator would be employed to operate all input-output equipment to process programs. He would note any failures within the equipment to insure proper maintenance.

    3. The scheduler's main job would be to schedule work to ensure that the system is used efficiently. He tries to minimize unusual time, and, therefore reduces lag time during peak periods of use. He keeps records on all transactions taking place in the computer.

    4. A program librarian might be employed as the computer capability grows. The librarian would act as an information center matching tasks to existing software capability.

4. Long Term Effects of a Computer Capability

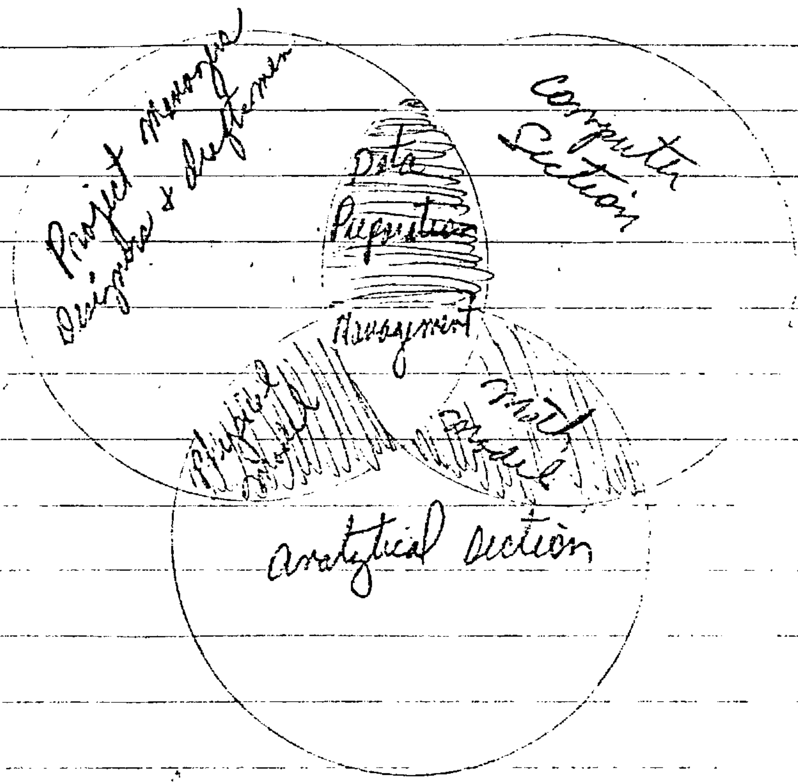
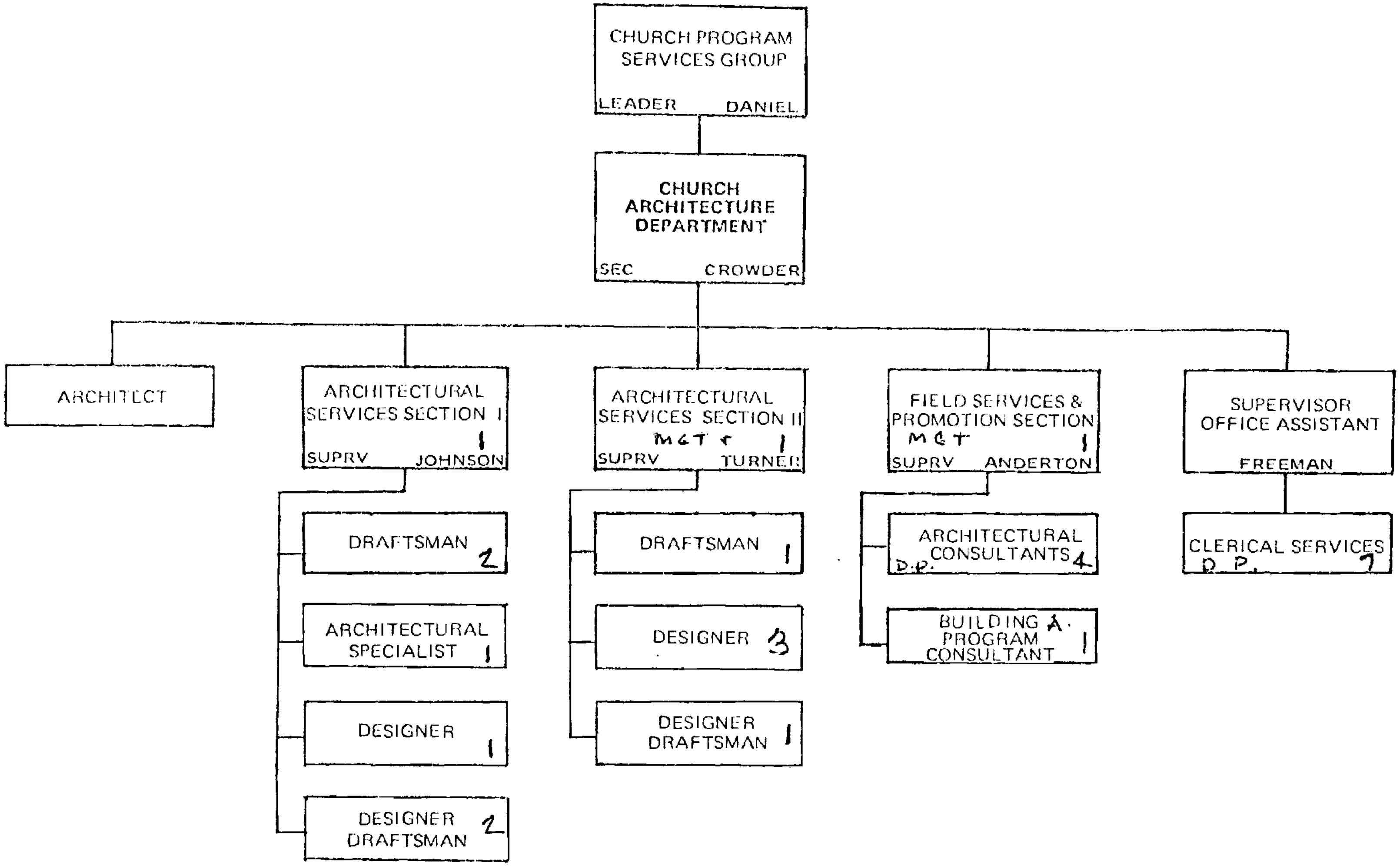


FIGURE. 1

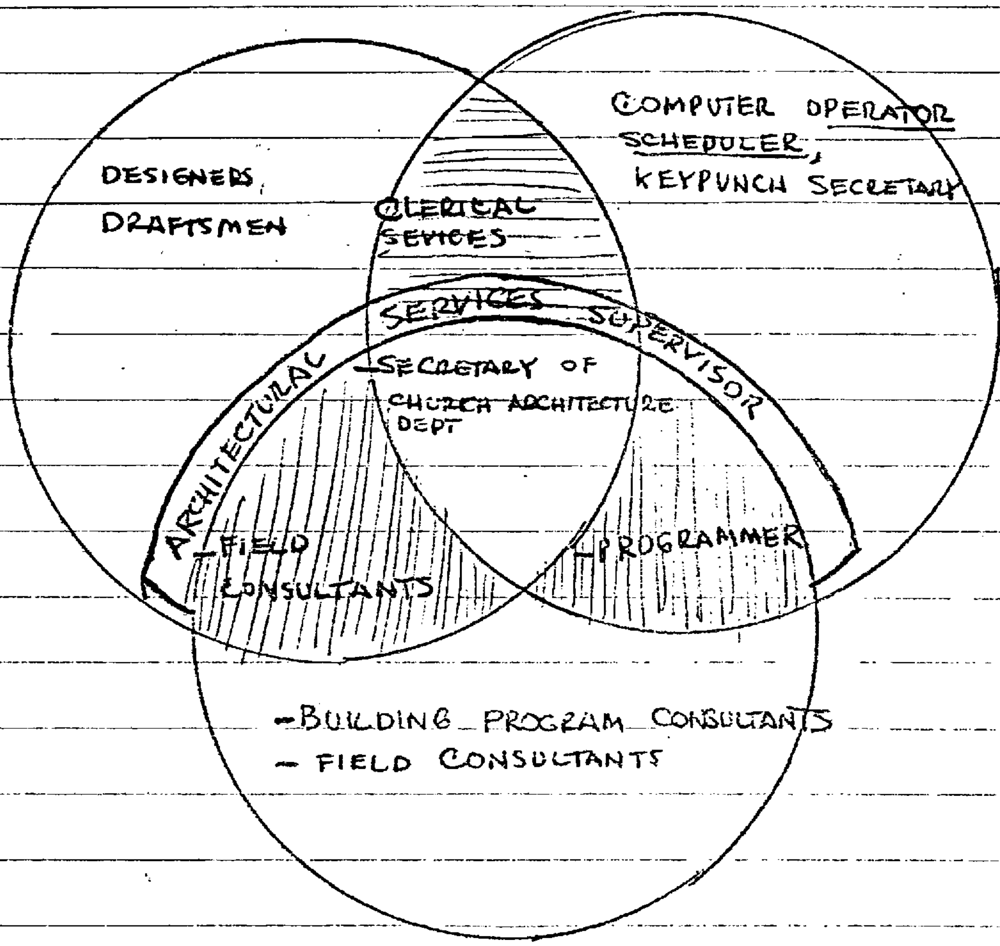
Computer Applications in An



CHURCH ARCHITECTURE DEPARTMENT – B
ORGANIZATION CHART

AUGUST 1, 1972
REPLACES FEBRUARY 1, 1972

FIGURE 2



DESIGNERS,
DRAFTSMEN
CLERICAL
SEVICES
COMPUTER OPERATOR
SCHEDULER,
KEYPUNCH SECRETARY
ARCHITECTURAL SERVICES SUPERVISOR
-SECRETARY OF
CHURCH ARCHITECTURE
DEPT
-FIELD
CONSULTANTS
-PROGRAMMER
-BUILDING PROGRAM CONSULTANTS
- FIELD CONSULTANTS

FIGURE 3.