ELECTRONIC DATA PROCESSING EQUIPMENT APPLIED TO CONSTRUCTION SPECIFICATIONS

By

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ELECTRONIC DATA PROCESSING EQUIPMENT

APPLIED TO CONSTRUCTION

SPECIFICATIONS

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PREFACE

The application of electronic data processing equipment to construction specifications is not a new concept. Architects, engineers, and contractors have considered the possibility since the advent of the digital computer; however, as far as can be determined, a practical method for its utilization is not currently available. The preparation of specifications is usually a repetitive type of operation from one job to another. Since the digital computer is extremely efficient in processing repetitious operations, it would seem ideally suited for this function. The purpose of this study is to investigate possible methods with which electronic data processing equipment may be used to assist in preparing specifications.

Indebtedness is acknowledged to Professor F. C. Salmon for his advice and guidance during graduate study; to Dr. T. S. Dean for his counselling and assistance in the preparation of this study; and to Dr. Dale Grosvenor, director of Oklahoma State University's computing center, for his technical assistance and advice regarding electronic data processing equipment.

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TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The use of the digital computer, the heart of all electronic data processing systems, as a valuable tool which one may employ to assist in the solution of many problems is widely recognized today. An individual just beginning to learn to use the computer can be considered analogous to the novice who is learning how to drive an automobile.

As a result of the many successful innovations in automotive development, the new driver is confronted with the rather simple process of learning how to steer and to recognize which buttons and pedals control, say, the lights or the brakes. He has no need to understand the technical design and construction of the automobile. Similarily the computer user need not be concerned with the engineering development and operation of a computer, but can concentrate on the problem of how the computer can assist him in solving a particular problem. Many people who have no detailed knowledge of how an automobile engine runs have become excellent drivers. In much the same way, a number of people have learned how to use the computer to obtain the types of results that are best handled in the rapid fashion of a computer (1).

A common concern now prevalent among those persons unfamiliar with electronic computers is that machines will usurp the decision-making process. This concern, or belief, has become a popular myth, and, of course, is not the case at all. IBM (2) states that a machine (digital computer) can be set up to make rather complex decisions, if they are expressible in quantitative terms, but it must be instructed how to make the decisions and what to do in each alternative. The machine cannot exercise judgement unless it has been given explicit directions for making a decision. In short, the machine can perform only those tasks and alternatives which the user has directed; therefore, the user makes the ultimate decisions, not the machine.

Since the development of the first electronic computer in 1947, Gregory and Van Horn (3) report that over 12,000 electronic computers of various sizes have been built for business, engineering, and scientific purposes by 1963. In February 1966 a manufacturers review listed 31,391 computers installed with an additional 16,073 orders unfilled (4). Massive volumes of literature have been published describing various applications and uses of these machines and their capabilities. However, as far as can be determined, no reference to the use of this equipment as applied to construction specifications has been published.

In December 1965, the ten leading manufacturers of electronic computers were queried to obtain any additional devel-

opments from the industry itself. Of the two replies received (IBM and RCA), both indicated that studies of this area were being undertaken, but that results were not available for publication.

Purpose of Investigation

The purpose of this thesis is to investigate the capabilities and limitations of electronic data processing equipment in order to develop a method by which this equipment can be used to assist in the preparation of construction specifications. Such a method would greatly reduce the time and expense now required and tend to reduce error.

For the purpose of this thesis electronic data processing equipment is defined as a digital computer and its associated equipment: magnetic tape units, card reader and punch units, and high speed printer. Ancillary equipment such as key punch machines, interpreter, reproducing punch, and sorter are included.

Instructions which direct a digital computer to perform specific operations must be written in a language which can be interpreted and understood by the computer. The grouping of a set of these instructions to perform several computations is defined as a program. There are many programming languages currently in use, but the two most widely known in the United States are COBOL, Common Business Oriented Language, and FORTRAN, or formula translator. COBOL, as its

name implies, is normally used in programs concerned with business problems; while FORTRAN, which is similar to the symbols and conventions used in mathematics, is widely used by architects, engineers, and scientists.

Construction specifications are normally written by architects and engineers. Since FORTRAN is the computer language best known to these professions, it was selected for use in this thesis.

As computers are best suited to numerical computations, a system of numbering the various parts of the specifications is necessary. Once obtained, the numbering system is applied to the specifications in a manner which is acceptable to the computer. This system is then translated into a FORTRAN program and applied to the computer in order to check and evaluate the method. Each of these steps are discussed in detail in the appropriate chapters which follow.

CHAPTER II

COMPUTER CAPABILITIES AND LIMITATIONS

The capabilities and limitations discussed herein are confined to the application of digital computing systems to construction specifications using the FORTRAN Language. They should not be considered as applicable to the equipment in its overall usage.

Specifications consist of a grouping of words and numbers in order to describe a specific material, method, or quality of performance desired in the finished product. Thus, in order to utilize the computer for this purpose, it must be capable of processing both alphabetical and numeric information. Generally, all computers have this capability in one form or another; although it may be limited in some installations.

The combination of both alphabetical and numeric information is referred to as alphameric in data processing systems. The FORTRAN Language provides two methods of processing alphameric information. The first is the Hollerith, or "H", Format specification. The Hollerith specification requires a Format statement for each line that is to be printed. Statement Number 720 in Program Number 2, Appendix C,

is an example of a Hollerith specification. This type of alphameric information is normally used for labeling of numerical output or similar statements relatively short in length. The "H" type of statement cannot be changed or manipulated internally by the computer; therefore, it is not practical for use in construction specifications.

The second method is the "A" Format specification. Input information using this computer specification can be internally processed and manipulated by the computer. In addition, one Format statement can be used to process an entire array of alphameric data or information. This array can be variable in both width and length and may be considered synonymous with one or several paragraphs of construction specifications. The "A" Format specification is then ideally suited to the processing of alphameric information such as construction specifications. Data processing systems without this capability are in general limited to processing numerical data and could not be adapted for this use without engineering changes.

The total sum of construction specifications utilized by any architectural or engineering office requires a large expanse of storage space. In order to be usable to the specification writer these "master" or "guide" specifications must be available to select those sections and components desired for any particular job. If electronic data processing systems can be applied to this use, all of these master

specifications must be stored within the system. The internal storage, or memory block, of a digital computer is limited to a fixed size and would not be adequate for this large volume of data.

Many devices are currently available which are used to supplement the storage capacity of the computer. Of these devices, magnetic tapes are the best known and most widely used. Information, or data, can be processed by the computer, written on the tapes, and then filed until it is required. By using magnetic tapes, the computer, through programming, can read a specific section of the data from the tape, transfer this to internal storage, and process it as instructed. This method of storage and programming eliminates the requirement for large internal storage capacity of the computer itself. Thus, magnetic tapes are readily adapted to the storage of master or guide specifications. Once written, this tape file would require a relatively small area for physical storage and would always be available for use.

CHAPTER III

THE NUMBERING SYSTEM AND METHOD

Selection of a Numbering System

There are probably as many systems of numbering sections and paragraphs in use today as there are architectural and engineering firms; each catering to a particular system and style developed through experience. However, due to the vast quantity of new materials and methods of construction introduced to the building industry over the past twenty years, increased recognition has been devoted to the need for a uniform system of designation.

The Construction Specifications Institute (CSI) actively began work in 1961 to develop a workable system of this type. All segments of the construction industry were invited to participate in the project. The completed project, "The CSI Format for Construction Specifications," consists of sixteen major divisions, and was published in 1964 (5). Since publication, it has enjoyed wide recognition and has been adopted by a large number of firms, and such governmental agencies as the Corps of Engineers, the Federal Aviation Agency (FAA), and the National Aeronautics and Space Administration (NASA).

In July 1965 the CSI distributed to its members "Study

22B, A Proposal Concerning Section Titles" (6), for review and comment. This study-proposal contained a suggestion for additional levels of numbering and more specific names for section titles within each major division of the CSI Format.

As the CSI Format is the only widely accepted system now in use; it, together with Study 22B, is selected as the basis of specification numbering. The numbering described up to this point includes only the divisions, subdivisions, and sections of the specifications. In order to obtain a complete system which includes all parts of the specification, it is necessary to devise a numbering of the paragraphs within each section.

The designation of numbers to identify paragraphs implies a degree of consistency in arrangement be maintained from one section to another. Most specification writers are in general agreement as to the content of the paragraph, but vary widely in their choice of arrangement.

Edwards (7) suggests eight major paragraph headings for each section while Rosen (8) recommends fifteen major headings. In order to keep the number of digits in any one number to as few as possible, and as there are only ten singular digits (0 through 9), an arbitrary decision was made to have not more than nine paragraphs in each section. A complete section containing each paragraph is outlined as follows:

0. Section Title.

1. General: includes shop drawings, materials

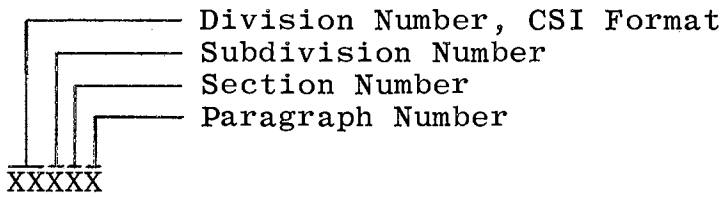
storage, samples, permits, ordinances, etc.

2. Materials: description of each material required.
3. Combinations of Materials: proportions and strengths of concrete, asphalt, mortar, etc.
4. Preliminary Work: work by other trades that must be performed prior to that of this section.
5. Installation: description of method of fabrication, erection, or installation of materials listed in paragraph 2.
6. Tests: description and number of required tests.
7. Protection, Cleaning, and Patching: description of the final work to be accomplished.
8. Guarantee: use only if a specific type or extended length of guarantee is required.
9. Schedules: listing of hardware items, plumbing fixtures, lighting fixtures, etc.

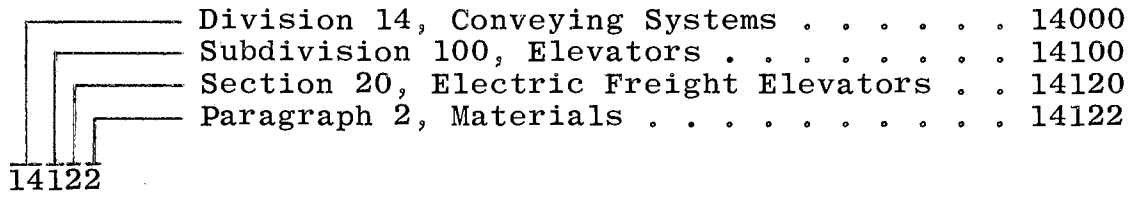
Using this arrangement, the numbers of the paragraphs remain the same for all sections. For example, paragraph 2 is a complete listing of the applicable materials whether in the Structural Concrete Section, the Structural Steel Section, or any other section. Likewise, paragraph 6 is a full

description of the tests required in each section that it is used. If a particular paragraph is not required, its number is not used. The absence of a paragraph number indicates that it is not applicable to that section.

The numbering system is now complete. A number has been assigned to each level of the specification components. These numbers are joined to form a singular identifiable number for each item as follows:



Example:



A complete listing of the numbering system is contained in Appendix A.

Statement of Objectives

The numbering system obtained, the next step is to develop a method with which it can be applied to the data processing system. There are two primary objectives to be satisfied to successfully utilize this equipment to assist in the preparation of specifications. First, and most important,

the method of application must be sufficiently flexible to permit changes or modifications of the master specifications to adapt them to a specific job. Second, it must be programmed to reduce the inherent repetition of the preparation process.

The flexibility necessary for modification of the master specifications can be acquired in two steps. The first is to provide options in the initial selection process, and the second is to change by editing. Both of these are necessary and are discussed in detail in Chapters IV and V.

Reduction of repetition by programming can be accomplished with relative ease, although it must be tailored to the requirements of the user. Most architectural and engineering firms have developed construction standards which are repeated from one job to another. For example, a standard roof construction for school or light commercial type structures could include built-up roofing over metal or wood decking placed on structural steel joists. Known in advance, this data could be programmed and each time built-up roofing is selected, the decking and joists would be automatically included. The options could be exercised to vary the manufacturer or the technical requirements. In this example, built-up roofing was used as a selector of both decking and joists.

Hardenbergh (9) defines a selector as taking the form of a question, "Is a certain requirement needed for the project." In the example used, this definition has been modified to

represent a condition of standard design or practice. Selectors can also be used to select individual materials. This will be discussed in greater detail in the next chapter.

Development of the Method

Earlier in this chapter specifications have been classified as having four levels: divisions, subdivisions, sections, and paragraphs. Since the body of the specifications consists only of sections and paragraphs, the listing of divisions and subdivisions is confined to the specifications index.

Within each section there are several types of paragraphs. These can be grouped into three distinct types: a typical paragraph, which is always similar in structure and form; a materials paragraph; and an installation paragraph. Each section can now be classified as containing four levels of division within: the section number and title, the typical paragraphs, the materials paragraph, and the installation paragraph. In turn, each individual paragraph can be divided into two parts: the paragraph number and title, and the body, or content.

This last division is the basis of the method used to process specifications by the data processing system. If sufficient information can be included along with the paragraph number and title which will completely describe the content in terms understood by the computer, then processing

of the complete paragraph can be accomplished. This data is defined as a "header" and provides the necessary information for processing the paragraph content which follows it.

The provision of using the "A" Format to process the paragraph in array form was discussed in Chapter II. The width of this array is arbitrarily fixed at sixty-six characters; this being the number of characters that conveniently fit an $8\frac{1}{2}$-inch width of paper with one-inch margins on each side. This length data must be furnished in the paragraph header.

Figure 1 is an illustration of a typical header card. The format of the card columns is as follows:

Columns	Description
1	Level of paragraph: 1. Section number and title 2. Typical paragraph 3. Materials paragraph 4. Installation paragraph
2-6	Paragraph number.
7-8	Subparagraph number, used only in the materials and installations paragraphs.
9-10	The number of lines of paragraph content which follow.
11-12	The number of standard paragraphs included in the section, or the number of selec-

tors in a materials paragraph; not used in a typical or installation paragraph.

13-72 Paragraph title.

73-80 Identification for sorting.

All numbers must be right adjusted within the column field.

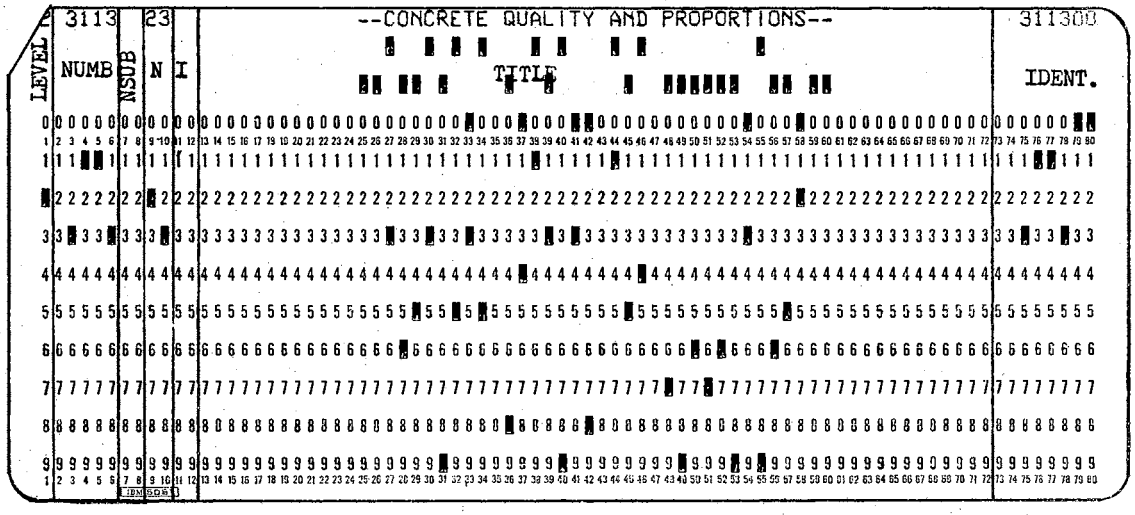


Figure 1. Typical Header Card

CHAPTER IV

THE MASTER FILE

Preparation of the Master File

In data processing systems information written and stored on magnetic tape for reuse is referred to as a file; thus, the storage of the master specifications on tape is defined as the Master File.

Each of the four divisions of a section consists of slightly different information. The section title and number identifies the specific paragraphs which compose it, and must be the leading element on the file. As the paragraphs within a section may vary from one job to another, a provision must be included to select only those paragraphs desired. This selection of paragraphs is the first of two options that are available during the initial requesting process.

Normally, certain paragraphs, such as the materials and installations paragraphs, will always be included in any section. These paragraphs are considered "standard." Other paragraphs, such as the guarantee, will only be used when required for a specific job. Such paragraphs are considered as "optional." To eliminate repetitious requests for stand-

ard paragraphs, the file is written to automatically include these in each section. This programming is accomplished as part of the section title and number. Figure 2 illustrates this principle. The first card is the header, which includes the section number and title. The number seven in column twelve is an index for the computer, indicating seven standard paragraphs within this section. The second card contains the numbers of these paragraphs and immediately follows the header.

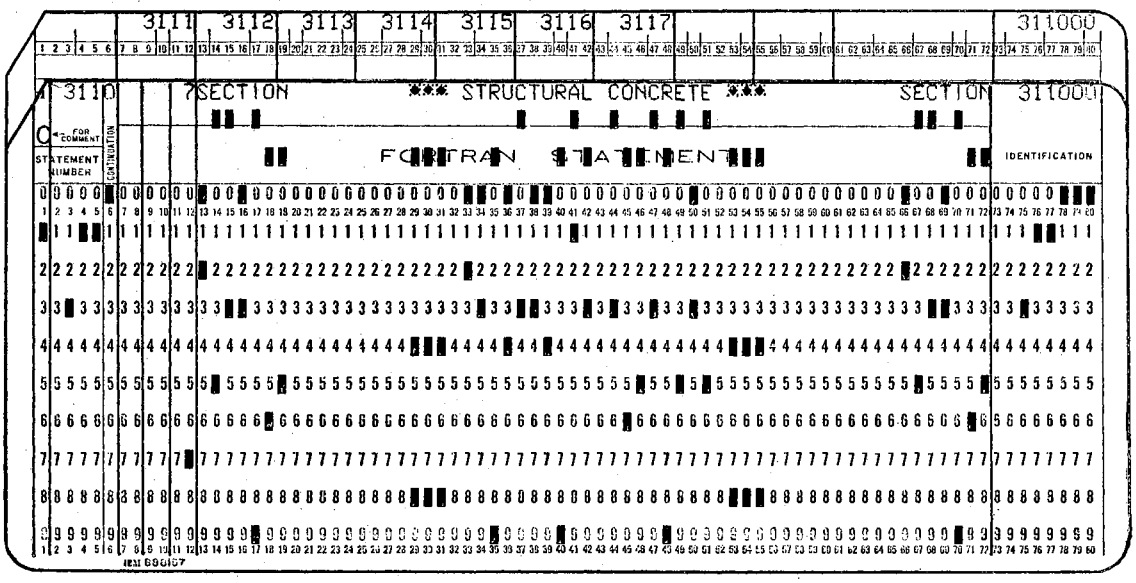


Figure 2. Section Header and Standard Paragraphs

The typical paragraph is made up of a header card and its following content. Figure 1 illustrates a header card for this type of paragraph. An example of a complete paragraph of this type is located in Appendix B.

The materials paragraph is similar to the section title and number with respect to the standard paragraphs. As with the standard paragraphs, there are standard materials which are generally included each time the section is required. These also will be automatically included. The upper cards of Figure 3 are an example of the input data for a materials paragraph. The first card is the header and is similar to the section header with one exception. The number 17 in columns nine and ten in this case is an index indicating that seventeen materials subparagraphs will follow. The second card contains the numbers of the standard materials used in this section.

The materials subparagraph, while similar in some aspects to a main paragraph, is unique in others. In general, there are more than nine types or manufacturers of materials that could be applicable to any one section. In the example used in the figure there are seventeen; six types of cement, three variations of aggregate, two types of forms, and several types of hardeners and curing compounds; although only seven of these are used in the completed specification. Experience indicates that the number of these materials for a particular section will probably never exceed 100; thus, a

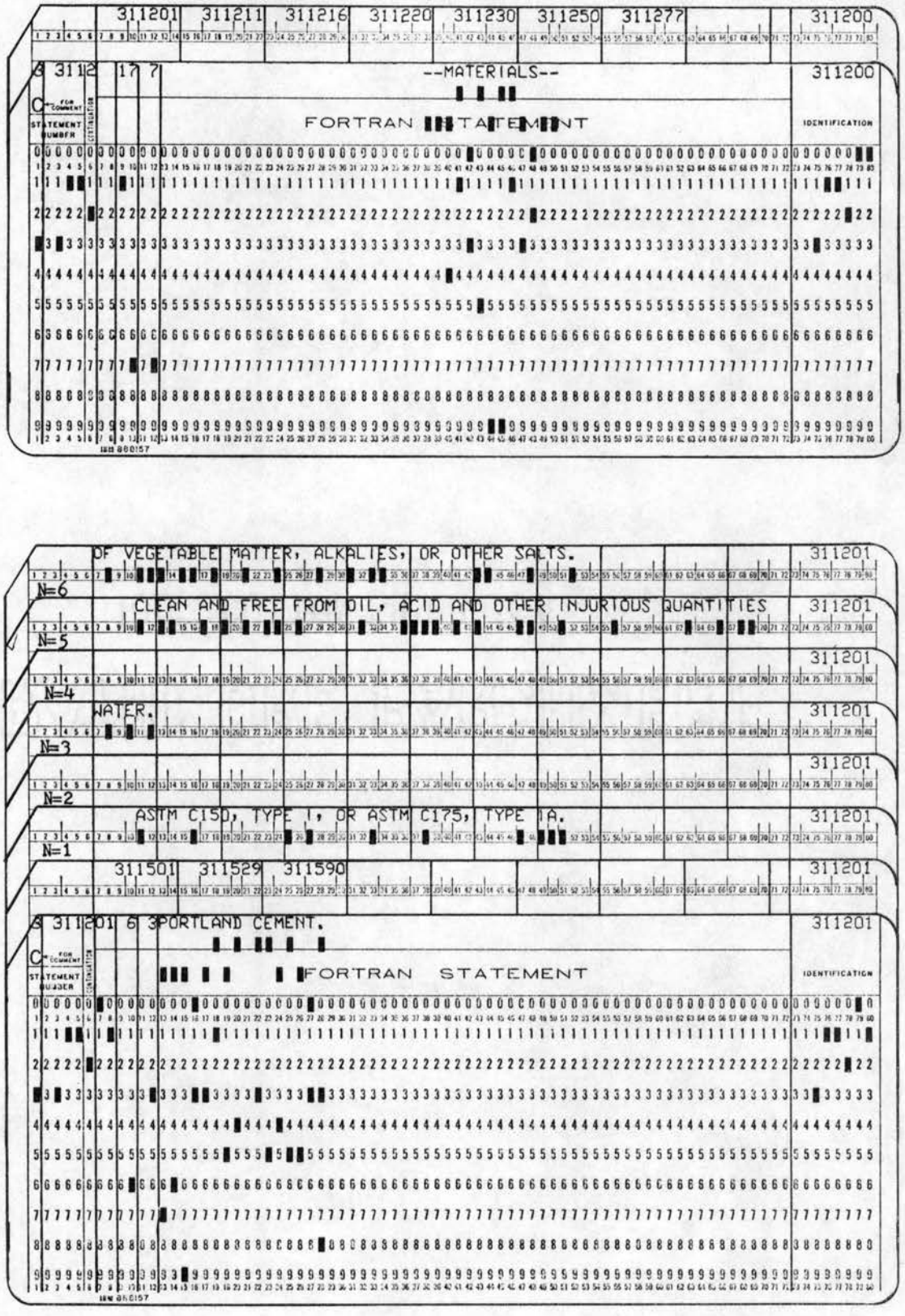


Figure 3. Typical Materials Paragraph

two-digit number (01 thru 99) is used to identify these subparagraphs.

For a specific material to be used in a project, it must be fabricated, erected or otherwise installed. Each material subparagraph then, produces a corollary installation description of that material. In other words, whenever a material is used, it automatically selects the installation description of itself. This is accomplished through the use of selectors. These selectors can also be used to include other sections which would be used as a manner of practice. The roofing example in Chapter III could be programmed using this technique. The lower set of cards in Figure 3 illustrate a materials subparagraph for portland cement. The first card is the header and contains the necessary data for processing the remaining cards. The number 3 in column twelve is an index indicating three selectors follow. The number 6 in column ten indicates that six lines of paragraph content follow.

It will be noted that two of the cards in the paragraph are blank. These cards are used to introduce blank lines in the printed output. With a little experience the arrangement of the data on the cards can be adjusted to suit any desired style of printing.

The installation paragraph is similar to the materials paragraph with the exception of the standards. Since the installation description is selected by the use of a material, standard paragraphs are not required. The number located in

columns nine and ten of the header card is, like the materials header, an index of the number of subparagraphs which follow. Likewise, the installation subparagraphs are similar to the materials subparagraphs except that selectors are not used. Complete examples of each type of paragraph are included in Appendix B.

Program Number 1, Appendix C, is the FORTRAN Program used to transfer the punched card data onto the magnetic tape, or Master File. It is divided into four levels, one for each division within the section. Each level reads those cards applicable to that paragraph level and then writes this same data on the tape. The second phase of the program provides a printed output of the data as written on the tape.

A special condition has been established to provide a signal within the FORTRAN Program which allows recognition of the end of data written on the tape. The FORTRAN Language cannot recognize this condition; therefore, the last card of input data must be a 1 level with the number 99999 in columns two through six. The program will instruct the tape to rewind itself to the starting position upon reading this number on the tape.

Prior to writing the Master File, the input data must be arranged in ascending order. If any card, group of cards, or a complete section is not in numerical sequence, an error condition will be initiated and the program terminated.

Selection from the Master File

Selection from the Master File is essentially the reverse of its preparation. The tape is read and the required sections of specifications selected from it. Program Number 2, Appendix C, is the FORTRAN Program which enables this selection.

This program is divided into two phases, each containing the four levels of division of the specification section. The numbers of the desired sections are placed on punched cards and read into the computer. The program then instructs the computer to read the specifications on the tape and compare the section numbers with that on the punched card. The computer continues to read until an equality is obtained between the two numbers.

At this point, the program checks the initial card read into memory to determine whether or not the section is to include the standard paragraphs, or some other combination of paragraphs. This is the first of the two options referenced earlier. If this option has been selected by the specification writer, the program instructs the computer to read the next punched card. This card contains the numbers of the desired paragraphs. If this option is not used, the program instructs the computer to write only the standard paragraphs. The top set of cards in Figure 4 indicates a typical selection card with no options. Columns 12 and 13 would contain

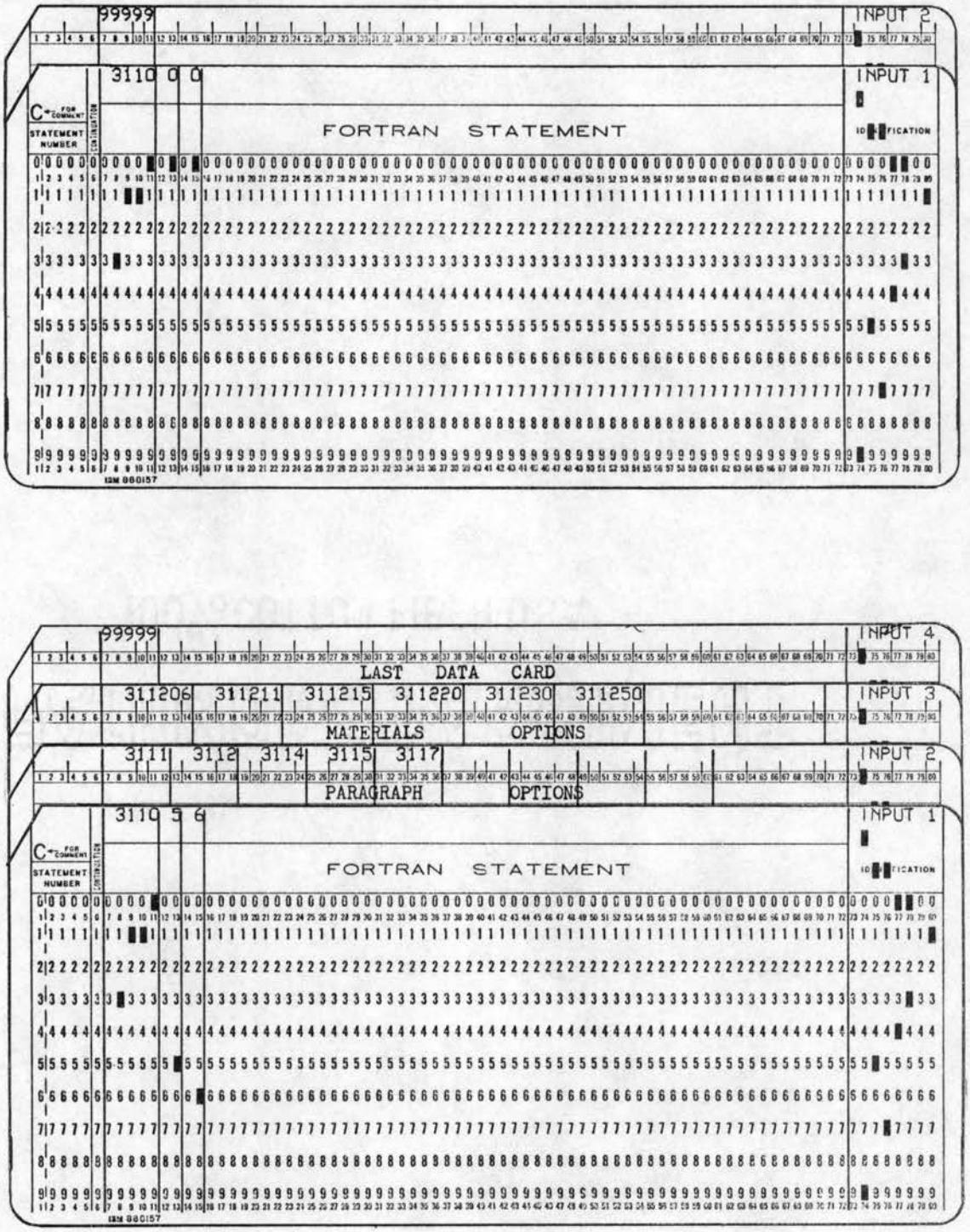


Figure 4. Typical Input Selection Cards

the number of paragraphs to be included if this option is exercised.

As the computer reads the paragraphs from the Master File, it compares each number with those on the input cards or the standards and writes the selected paragraphs on the first auxillary tape. Upon encountering the materials paragraph, the program checks the initial selection card again to determine whether or not the standard materials are to be selected. This is the second of the two options that are employed. If this option has been exercised, the computer is instructed to read the next punched card which must contain the subparagraph numbers of the required materials. If not used, the standard materials are selected. A zero in column 15 of the upper cards of Figure 4 is representative of this latter condition. The lower set of cards in this figure illustrate a sample selection in which both options are used. The second card contains the paragraph options and the third card the materials options.

The method of identification used to select a particular material requires a combination of the five digit paragraph number and the two digit subnumber to form a new seven digit number (six for Divisions 1 thru 9). A favorable comparison of this number to the material number results in selection of the required material.

Upon selection of a material, the selectors for it are internally stored. These selectors are then verified to

determine their type. The digits in the thousands and ten-thousands positions are compared with the same digits of the material paragraph number. If an equality exists, the selector is redefined as an installation selector. If no equality exists, it is redefined as a materials selector. The decking and steel joists of the roofing example would be of this type. The installation selectors are utilized in the selection of the appropriate installation subparagraphs, while the materials selectors are used to select a material from a completely different section or an entirely new section.

Some materials may have more than one installation selector while others may utilize identical selectors. For example, a materials subparagraph for structural steel requires installation descriptions for both fabrication and erection, while the materials subparagraph for bolts also requires the installation description for erection. The FORTRAN Program automatically compensates for this duplication so that the installation description for erection is only selected once.

The last card in both sets of cards in Figure 4 contains the number 99999. This number is used to signal the program that all of the initial selections of the specification writer have been processed. Upon reading this number the Master File will be read to the end of the written data and then rewound to the starting position. This procedure is required to prevent possible erasure of data before the end of the file is reached. During assembly of the punched input

cards, it is essential that they be placed in ascending order in the same manner as the Master File is written.

All of the requested sections are now written on the first auxiliary tape and the first phase of selection is terminated. Phase II consists of reading the sections from the auxiliary tape and comparing them to any material selectors that were activated during Phase I. If no material selectors were activated, the selected sections are read from the auxiliary tape and written on the Job File. Simultaneously, a printed record of the same data being written on the Job File is produced on the system printer.

If material selectors were activated during Phase I, the Master File is read again and both the selected sections from the Master File and those from the auxiliary tape are written in correct sequence on the second auxiliary tape. Additional reading and writing passes of the auxiliary tapes and the Master File are initiated until all of the activated selectors are satisfied. Depending on programming of the selectors, this is usually not more than three passes. The Job File and the printed output are then written and Phase II is terminated. The selection process is now complete and all of the requested sections of specifications are stored on the Job File.

To the specifications writer faced with a rapidly approaching deadline, this process would probably appear awkward and time consuming. However, the specification writer

need not be concerned with the process itself; only how it can be used to obtain the required results. Figures 5 and 6 are typical forms which can be used by the specifier as a checklist to indicate the components required in the specification. These forms may be coded by data processing personnel and punched cards produced. A short time later the printed output would be available for initial editing.

The two forms illustrated were used to obtain the sample specifications illustrated in Appendix D. The underlining of titles in the Structural Steel Section was manually inserted.

Sheet 1 of 2

Section 3110
Structural Concrete

SPECIFICATIONS REQUEST

Specification Writer			Key Punch	
Date of Request: 10 March 66 Name of Writer: John Doe	YES	NO	Number	Standard
1. General paragraph required?	✓		3111	
2. Storage of materials required?	✓			
3. Shop drawings required?	✓			
4. Materials?	✓		3112	
Portland cement, Type I or IA	✓		311201	
Portland cement, Type II or IIA		✓	311202	
Portland cement, Type III or IIIA		✓	311203	
Portland cement, Type IV		✓	311204	
Portland cement, Type V		✓	311205	
Portland cem., Type I or III, optional		✓	311206	
Fine aggregate	✓		311211	
Coarse aggregate, varying sizes		✓	311215	
Coarse aggregate, standard	✓		311216	
Reinforcing	✓		311220	
Expansion joints, premolded	✓		311230	
Forms, wood	✓		311250	
Carton forms		✓	311255	
Chemical curing compound		✓	311270	
Floor hardener, interior (chips)		✓	311275	
Floor hardener, exposed slabs	✓		311277	
Integral waterproofing, chemical		✓	311280	
5. Mix design:				
2000 psi.		✓	Change	
2500 psi.	✓		3113	
3000 psi.	✓			

Figure 5. Specifications Request - Structural Concrete

Sheet 2 of 2

Section 3110
Structural Concrete

SPECIFICATIONS REQUEST

Specification Writer			Key Punch	
Date of Request: 10 March 66 Name of Writer: John Doe	YES	NO	Number	
3500 psi.		✓	Change	
6. Notice to other trades prior to pouring?	✓		3114	
7. Tests required (standard compression)?	✓		3116	
8. Protection against rapid drying?	✓		3117	
9. Repair of voids and honeycombs?	✓			
10. Patching of tieholes, etc.?	✓			
11. Schedule required?		✓	3119	
Remarks: Return as soon as possible!				

CARD INPUT:(right adjusted)

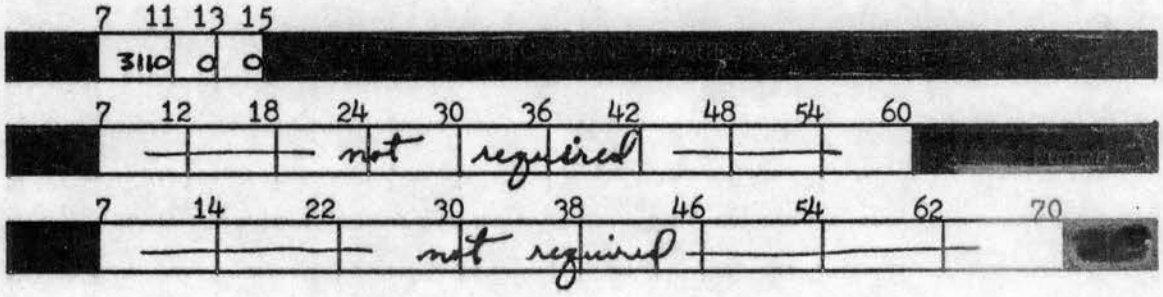


Figure 5. (Continued)

Sheet 1 of 1

Section 5110
Structural Steel

SPECIFICATIONS REQUEST

Specification Writer			Key Punch	
Date of Request: 10 March 66 Name of Writer: John Doe	YES	NO	Number	
1. General paragraph required?	✓		5111	
2. Shop drawings required?	✓			
3. Special storage requirements?		✓	Change	
4. Materials?	✓		5112	
Structural steel, ASTM A7?	✓		511201	
Structural steel, ASTM A36?		✓	511202	
Structural steel, ASTM A7 or A36?		✓	511203	
Structural steel, ASTM A242?		✓	511204	
Welding electrodes, ASTM A233?	✓		511220	
Bolts, ASTM A235?	✓		511230	
Rivets, ASTM A141?	✓		511240	
Paint, primer and rust inhibitive?	✓		511290	
5. Any testing required?		✓	5116	
6. Protection (personnel) required?	✓		5117	
7. Any schedules required?		✓	5119	
Remarks: Return as soon as possible!				

CARD INPUT:(right adjusted)

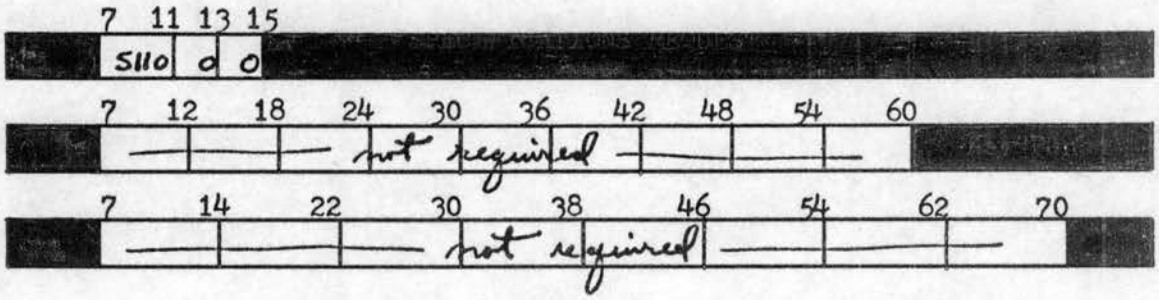


Figure 6. Specifications Request - Structural Steel

CHAPTER V

THE JOB SPECIFICATIONS

Revisions of the Job File

The probability that the specifications, now selected and stored on the Job File, completely satisfy the specific requirements of the construction project is remote. If the specifications were acceptable in this form, they would now be ready for reproduction. In most cases, some of the sections will be acceptable without change, while others will require revision.

Program Number 3, Appendix C, is the FORTRAN Program with which the revisions are accomplished. This program instructs the computer to read the Job File and rewrite it on one of the auxiliary tapes. Concurrently, the revisions are read into memory and inserted in the proper location. The resulting specifications on the auxiliary tape are rewritten on the Job File for storage. Using this technique revisions can be inserted into the Job File as many times as necessary.

In order to process each revision the FORTRAN Program is furnished a complete description of it in data terms. In general, revisions are classified as one of four types:

1. deletion of an entire paragraph.

2. addition of an entire paragraph.
3. replacement of a paragraph by adding a new paragraph in the same location.
4. changes to the internal word or sentence structure of a paragraph.

These types are defined as levels of change for use by the program to determine how the revision is to be entered. The level of change is one of the data terms required to process the revision. These terms are punched in a header card which precedes each revision. The following format is used in the preparation of this card.

Columns	Description
1-6	Blank.
7-13	Number of the paragraph to be revised.
16	Level of the paragraph.
19	Level of change.
21-22	Lower limit of revision for internal change.
24-25	Upper limit of revision for internal change.
28	Indicator for change in the number of lines of paragraph content; 0 - indicates no change 1 - indicates a change

The first card in Figure 7 illustrates a typical

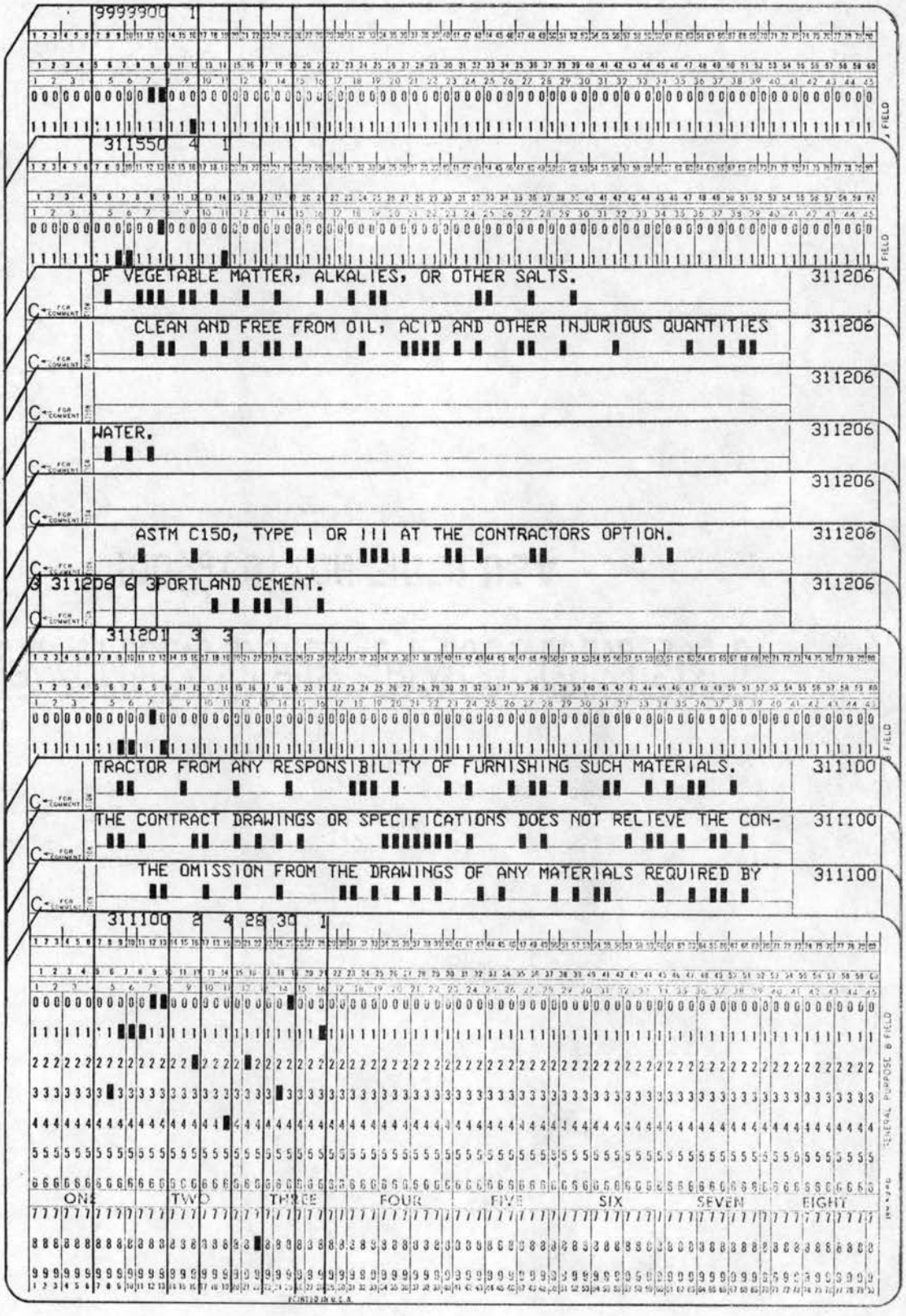


Figure 7. Typical Revision Cards

revision header card. Since this card indicates a type four revision, it is followed by three cards containing the new lines to be inserted in the paragraph. It should be noted that one or more complete lines must be revised; individual words or groups of words can be changed only by revising the line they appear in.

The fourth card in Figure 7 is another header card indicating replacement of the material subparagraph, number 311201, with a new subparagraph, number 311206. The next seven cards contain the subparagraph header and its following content. Selectors are not used in the revision process.

The thirteenth card requires the deletion of a paragraph. Deletion is accomplished by not writing that paragraph on the auxiliary tape after reading the Job File. The last card in this figure contains the number 9999999, and as in previous programs, it is used to signify the end of the revisions. It must be the last card of the revision deck.

This program can also be used to insert new paragraphs into the Master File, or updating it.

Writing the Specifications

When all necessary revisions to the Job File have been entered, the completed specifications are ready to be written and reproduced for distribution. Program Number 4, Appendix C, is used to obtain the specifications from the Job File. This program reads the Job File and transfers the specifica-

tions to the system printer for a printed listing in the required format for reproduction. In addition, an optional punched card output can be obtained if desired.

There are numerous methods by which the printed specifications can be prepared for reproduction. For a large set of specifications containing over 75 to 100 pages, offset masters can be prepared directly on the high speed printer. Offset ribbons and perforated edge masters are currently available from several suppliers. With printing speeds in excess of 1000 lines per minute, a complete set of specifications can be written and ready for reproduction in less than ten minutes. A similar technique can utilize the on-line system to produce punched cards and an off-line printer to print the offset masters.

For smaller sets of specifications unruled paper can be inserted in the system printer, and Xeroxed masters produced directly from the printer output. A relatively new ribbon should be used on the printer to obtain successful transfer of image to the offset master if this method is employed.

There are many variations to these suggested methods and many others that could be used; any of which, will result in a reduction of time for reproduction.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Electronic data processing equipment can be effectively applied in the preparation of construction specifications. The two objectives necessary for practical application; flexibility by selection from the master specifications and changes by revision, are achieved by preplanning and programming.

A set of specifications prepared by the "scissors and paste" method requires many hours of an architect's or engineer's time plus the clerical processing of filing and typing. Through the use of electronic data processing this time element can be reduced to a minimum.

Using the method developed in this study, a set of specifications with 30 to 35 sections can be produced from the Master File in less than thirty minutes. Assuming fifty per cent of the specifications thus obtained require revision, an additional 10 to 15 minutes of processing time is required. The revisions entered, the completed specifications could be printed on offset masters in approximately 15 to 20 minutes. Thus, in approximately one hour of machine time the specifications are ready for reproduction. Assuming commercial

rates for data processing time at $120 per hour, this cost is roughly equivalent to that incurred by one clerk working forty hours.

Current forecasts of the building industry estimates the gross area of institutional buildings alone required during the next twenty years will exceed that which has been constructed to date. Without the assistance of electronic data processing, this volume of construction will be extremely difficult to attain. The application of this equipment to specifications offers an additional means of assistance in meeting this challenge.

In response to a question concerning the use of electronic data processing as an aid in specifications, one architect replied:

> "The results of such identical specifications would be that contractors would become thoroughly familiar with the specifications as would the architect; only the changes would be left as areas of disagreement. The statement that 'architects are individuals and don't want to be confined by the same specifications as their competitors' is nonsense. The basic design is on paper---not in the specification---and if, for example, the structure is of concrete, basically the materials and methods of placement are similar for every job. Forming might vary to achieve a shape or surface texture, and with an automated specification you could [and would] change the formwork to suit. The specification writer would have the time he once used to put together scraps of old specs. to use for research on the formwork."[1]

---

[1]Berhard B. Rothschild FCSI, AIA, "Specification Writers on Specifications," Architectural & Engineering News, December 1965, p. 44.

Suggestions for Future Study

Possibly the greatest drawback in the method developed herein, is the time required to transfer the master specifications into punched cards prior to writing the Master File. The optical scanner, a recent development in data processing equipment, could possibly be used for direct transfer to the Master File; eliminating the punching of cards.

The programs presented are but a beginning. Improvements and refinements will undoubtedly come through additional use and experience. As written, Program Number 3, does not contain provisions for deletion or addition of a complete section. Further research could determine whether or not this feature is desired. Another area of research might investigate the possibility of including additional options during the initial selection process of Program Number 2.

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APPENDIX A

SPECIFICATIONS NUMBERING SYSTEM

The numbering of divisions, subdivisions, and sections are derived from The CSI Format for Construction Specifications. Washington: The Construction Specifications Institute, July 1964.

TABLE I

DIVISIONS INDEX

Division Number	Title
1000	General Requirements
2000	Site Work
3000	Concrete
4000	Masonry
5000	Metals
6000	Carpentry
7000	Moisture Protection
8000	Doors, Windows, and Glass
9000	Finishes
10000	Specialities
11000	Equipment
12000	Furnishings
13000	Special Construction
14000	Conveying Systems
15000	Mechanical
16000	Electrical
99999	End-of-File

TABLE II

DIVISIONS, SUBDIVISIONS, AND SECTIONS

Number	Title
Division	
Subdivision	
Section	
1000	General Requirements
1100	General Project Requirements
1110	Commencement, Prosecution, & Completion
1120	Measurements and Dimensions
1130	Standards
1140	As-Built Drawings
1150	Progress Meetings
1160	Progress Photographs
1170	Work Performed Under Separate Contracts
1180	Construction Procedure
1190	Site Examination
1200	Temporary Construction
1210	Project Signs
1220	Temporary Stairs and Hatchways
1230	Temporary Enclosures
1240	Temporary Partitions
1250	Temporary Ladders
1260	Temporary Roads
1270	Temporary Fences, Lanterns, & Barricades
1280	Temporary Field Offices and Sheds
1290	Temporary Sanitation Facilities
1300	Temporary Utilities
1310	Temporary Water
1320	Temporary Electricity
1330	Temporary Telephone
1340	Temporary Gas
1350	Temporary Steam
1360	Temporary Heat
2000	Site Work
2100	Site Preparation

TABLE II (Continued)

Number	Title
2110	Demolition
2120	Structure Moving
2130	Clearing and Grubbing
2200	Earthwork
2210	Soil Treatment
2220	Soil Stabilization
2230	Finish Grading
2240	Dewatering
2250	Shoring
2260	Underpinning
2270	Subgrade Drainage
2290	Tunneling
2300	Site Drainage
2310	Storm Drains
2320	Drainage Structures
2400	Paving
2410	Bituminous Paving
2420	Concrete Paving
2430	Curbs, Gutters, and Walks
2490	Stabilized Aggregate
2500	Site Improvement
2510	Athletics Facilities
2520	Fencing
2530	Retaining Walls
2540	Yard Facilities
2590	Sprinkling and Irrigation Systems
2600	Special Foundations
2610	Drilled Piers
2620	Piling
2630	Caissons
2700	Landscaping
2710	Seeding and Sodding
2720	Spriging
2730	Planting

TABLE II (Continued)

Number			Title
	2800		Railroad Work
	2900		Marine Work
3000			Concrete
	3100		Cast-In-Place Concrete
		3110	Structural Concrete
		3120	Concrete Topping
		3130	Insulating Concrete
	3200		Precast Concrete
		3210	Precast Architectural Concrete
		3220	Precast Structural Concrete
		3230	Precast Concrete Deck
		3240	Lift-Slab Construction
		3250	Tilt-Up Construction
	3300		Prestressed Concrete
		3310	Prestressed Cast-In-Place Concrete
		3320	Prestressed Precast Framing
		3330	Prestressed Precast Deck
	3400		Gypsum Concrete
		3410	Precast Gypsum
		3420	Cast-In-Place Gypsum
	3500		Pneumatically Placed Concrete
4000			Masonry
	4100		Unit Masonry
		4110	Brickwork
		4120	Blockwork
		4130	Hollow Tile Work
		4140	Structural Facing Tile
		4150	Reinforced Masonry
		4160	Chimneys
		4170	Glass Block Work
		4180	Ceramic Veneer
		4190	Decorative Veneer

TABLE II (Continued)

Number		Title
4200		Stone Work
	4210	Cut Stone
	4220	Cast Stone
	4230	Natural Stone
	4240	Stone Floors
	4250	Interior Veneer
4300		Masonry Restoration
4400		Mortars
5000		Metals: Structural & Miscellaneous
5100		Structural Metal Work
	5110	Structural Steel
	5120	Structural Aluminum
	5130	Standard Steel Joist
	5140	Longspan Steel Joist
	5170	Lightweight Metal Framing
5200		Metal Decks
	5210	Metal Floor Decks
	5220	Metal Roof Decks
5300		Metal Panels
	5310	Metal Roof Panels
	5320	Metal Wall Panels
5400		Miscellaneous Metal Work
	5410	Metal Stairs
	5420	Metal Gratings
	5450	Wire Mesh Partitions
5500		Ornamental Metal Work
5600		Special Sheet Metal Work
6000		Carpentry
6100		Carpentry and Millwork

TABLE II (Continued)

Number	Title
6110	Rough Carpentry
6120	Wood Decking
6130	Wood Treatment
6140	Insulation
6150	Finish Carpentry
6160	Millwork
6170	Cabinet Work
6180	Panels
6200	Drywall Construction
6300	Glulam Construction
6400	Prefabricated Wood Components
6500	Prefabricated Plywood Components
6600	Preformed Deck Units
7000	Moisture Protection
7100	Waterproofing
7110	Membrane Waterproofing
7120	Elastomeric Waterproofing
7130	Metallic Waterproofing
7140	Hydrolithic Waterproofing
7200	Damproofing
7210	Bituminous Damproofing
7220	Silicone Treatment
7300	Membrane Roofing
7310	Built-Up Roofing
7320	Elastomeric Roofing
7330	Roll Roofing
7400	Shingle Roofing
7410	Asphalt Shingles
7420	Wood Shingles
7430	Slate Roofing
7440	Tile Roofing
7450	Cement Asbestos Roofing

TABLE II (Continued)

Number		Title
	7460	Metal Shingles
7500		Sheet Roofing, Siding, and Flashing
	7510	Roll Metal Roofing
	7520	Flashing
	7530	Corrugated Asbestos
	7540	Formed Metal
	7550	Formed Plastic
7600		Wall Flashing
	7610	Spandrel Flashing
	7620	Column Flashing
	7630	In-Wall Flashing
7700		Roof Accessories
7800		Calking and Sealings
7900		Weatherstripping
8000		Doors, Windows, and Glass
8100		Curtain Walls
8200		Metal Doors and Frames
	8210	Hollow Metal Doors and Frames
	8220	Non-Ferrous Metal Doors and Frames
8300		Wood Doors and Frames
	8310	Hollow Wood Doors and Frames
	8320	Institutional Doors and Frames
	8330	Solid Wood Doors and Frames
8400		Speciality Doors
	8410	Fire Doors
	8420	Flexible Doors
	8430	Gates and Shutters
	8440	Glass Doors
	8450	Kalamein Doors
	8460	Revolving Doors
	8470	Rolling Doors

TABLE II (Continued)

Number		Title
	8480	Sliding Doors
	8490	Vault Doors
8500		Moving Dividers and Partitions
	8510	Accordian Partitions
	8520	Folding Partitions
	8530	Pneumatic Secured Partitions
	8540	Coiling Partitions
8600		Metal Windows
	8610	Steel Windows
	8620	Aluminum Windows
	8630	Bronze Windows
8700		Wood Windows
8800		Store Front Construction
8900		Glazing
	8910	Glass Glazing
	8920	Plastic Glazing
	8930	Mirrors
	8940	Art Glass Work
	8950	Glass Treatment
9000		Finishes
9100		Lathing and Plastering
	9110	Lathing
	9120	Plastering
9200		Painting and Decorating
	9210	Drywall Finishing
	9220	Painting, Interior
	9230	Painting, Exterior
	9260	Sheet Wall Covering
	9290	Painted Signs, Lettering, & Decoration
9300		Tilework
	9310	Ceramic Tile

TABLE II (Continued)

Number	Title
9320	Mosaic Tile
9330	Quarry Tile
9340	Glass Tile
9350	Plastic Tile
9360	Cabinet and Counter Tops
9390	Speciality Veneers
9400	Terrazzo and Composition Flooring
9410	Terrazzo
9420	Epoxy Terrazzo
9430	Oxychloride Cement
9440	Elastomeric Flooring
9450	Proprietary Systems
9500	Resilent Flooring
9510	Asphalt Flooring
9520	Vinyl Flooring
9530	Vinyl-Asbestos Flooring
9540	Rubber Flooring
9550	Linoleum Flooring
9560	Cork Flooring
9570	Conductive Flooring
9590	Special Flooring
9600	Wood Flooring
9610	Strip Flooring
9620	Parquet Flooring
9630	Gymnasium Flooring
9640	Industrial Wood Floor
9700	Acoustical Treatment
9710	Acoustic Ceilings
9720	Speciality Acoustical Work
9800	Special Ceilings
9900	Special Coatings
9910	Spray-on Fireproofing
9920	Spray-on Thermal Insulation
9930	Corrosion Protection
9940	Vapor Barrier Protection

TABLE II (Continued)

Number	Title
9950	Decorative Coatings
10000	Specialties
10100	Finish Hardware
10200	Special Partitions and Compartments
10210	Demountable Partitions
10220	Movable Partitions
10230	Toilet Partitions
10240	Shower Compartments
10250	Dressing Cubicles
10260	Steam Baths
10270	Clinical Partitions
10280	Lockers
10290	Postal Specialties
10300	Manufactured Units
10310	Cabinets
10320	Showcases
10330	Scoreboards
10340	Fireplaces and Chimneys
10350	Portable Fire Extinguishers
10360	Incinerators
10370	Storage Units
10400	Miscellaneous Specialties
10410	Chalk and Display Boards
10420	Flagpoles
10430	Directories, Signs, and Lettering
10440	Chutes
10450	Loading Dock Accessories
10460	Scales
10470	Toilet Accessories
10900	Structural Plastics
11000	Equipment
11100	Athletic Equipment
11110	Indoor Athletic Equipment
11120	Outdoor Athletic Equipment

TABLE II (Continued)

Number	Title
11130	Swimming Pool Equipment
11140	Bowling Alleys
11200	Bank Equipment
11300	Casework
11310	Wood Casework
11320	Metal Casework
11330	Laboratory Casework
11340	Hospital Casework
11350	Store Fixture Casework
11400	Domestic Equipment
11500	Food Service Equipment
11600	Medical Equipment
11700	Laundry Equipment
11800	Industrial and Shop Equipment
11900	(Specific Use) Equipment
12000	Furnishings
12100	Blinds and Shades
12110	Shades
12120	Venetian Blinds
12130	Vertical Blinds
12200	Draperies and Curtains
12210	Draperies
12220	Cubicle Curtains
12300	Floor Coverings
12310	Carpeting
12320	Mats
12400	Furniture
12410	Domestic Furniture

TABLE II (Continued)

Number	Title
12420	Office Furniture
12430	Hotel Furniture
12440	Institutional Furniture
12450	Hospital Furniture
12460	Ecclesiastical Furniture
12500	Seating
12510	Auditorium Seating
12520	Stadium Seating
12900	Art Work
13000	Special Construction
13100	Controlled Environment Rooms
13110	Temperature-Humidity Controlled Rooms
13120	Sound Isolation Rooms
13130	Hyperbaric Rooms
13140	Clean Rooms
13150	Radio Free Rooms
13160	Test Rooms
13200	Prefabricated Buildings
13210	Prefabricated Steel Buildings
13220	Prefabricated Wood Buildings
13230	Green Houses
13300	Insulated Storage Rooms
13400	Integrated Ceilings
13500	Integrated Floors
13600	Radiation Protection
13610	Fallout Shelters
13620	Medical Radiation Facilities
13630	Industrial Radiation Facilities
13700	Special Purpose Structures
13710	Swimming Pools
13720	Aviaries

TABLE II (Continued)

Number	Title
13730	Observatories
13800	Vibration Control
13900	Exterior Signs
14000	Conveying Systems
14100	Elevators
14110	Electric Passenger Elevators
14120	Electric Freight Elevators
14130	Electric Service Elevators
14140	Hydraulic Passenger Elevators
14150	Hydraulic Freight Elevators
14160	Hydraulic Service Elevators
14200	Moving Stairs and Walks
14300	Dumbwaiters
14400	Lifts
14410	Sidewalk Lifts
14420	Man Lifts
14430	Automotive Lifts
14440	Stage Lifts
14450	Platform Lifts
14460	Dock Levelers
14500	Cranes and Monorails
14510	Monorail Hoists
14520	Gantry Cranes
14530	Boom Cranes
14600	Conveyors
14610	Specific Use Conveyor
14620	Specific Type Conveyor
14700	Pneumatic Tube System
15000	Mechanical
15100	Plumbing

TABLE II (Continued)

Number	Title
15110	Outside Utilities
15120	Interior Plumbing
15200	Heating
15210	Boiler Plant
15220	Steam and Hot Water Heating
15230	Furnace
15240	Warm Air Distribution
15250	Thermal Insulation
15260	Heating Controls
15300	Ventilation
15310	Air Handling Units
15320	Air Distribution
15400	Air Conditioning
15410	Distribution System
15420	Air Conditioning Refrigeration
15430	Cooling Tower
15440	Thermal Insulation
15450	Air Conditioning Controls
15500	Commercial Refrigeration
15600	Process System
15610	Equipment
15620	Piping
15630	Instrumentation
15700	Water Treatment Systems
15800	Sewage Disposal Systems
15900	Fire Protection Systems
16000	Electrical
16100	Lighting and Convenience Wiring
16110	Switch Gear and Panels
16120	Distribution and Wiring Devices
16130	Fixtures

TABLE II (Continued)

Number	Title
16200	Communications Systems
16210	Telephone Systems
16220	Program Systems
16230	Intercomm Systems
16240	Background Music Systems
16250	Alarm Systems
16300	Plant Power Systems
16310	Transformers and Substations
16320	Switch Gear and Panel Boards
16330	Generators
16340	High Voltage Systems
16350	Power Distribution
16400	Standby Electrical Systems
16500	Exterior Lighting
16600	Electrical Control Systems
16700	Lightning Protection
16800	High Tension Distribution
16900	Special Electrical Systems
99999	End-of-File Condition Utilized by Computer Program

APPENDIX B

SAMPLE SPECIFICATIONS INPUT

SAMPLE SPECIFICATION INPUT

CARD COLUMN REFERENCE

```
00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

SECTION NUMBER AND TITLE

```
1 3110     7SECTION          *** STRUCTURAL CONCRETE ***          SECTION  311000
        3111  3112  3113  3114  3115  3116  3117                           311000
```

PARAGRAPHS 1, 3, 4, 6 THRU 9

```
2 3111  32                          --GENERAL--                              311100
        THE DRAWINGS INDICATE THE TYPE AND LOCATION OF ALL CONCRETE          311100
    AND CEMENT WORK REQUIRED.  BIDDERS MUST BE THOROUGHLY EXPERIENCED        311100
    IN THIS CLASS OF WORK AND MUST HAVE CARRIED THROUGH SUCCESSFULLY         311100
    BUILDING OPERATIONS OF REASONABLE SIZE.  ALL LABOR MUST BE IN            311100
    CHARGE OF AN EXPERIENCED FOREMAN.                                        311100
                                                                             311100
        MATERIALS STORAGE.                                                   311100
                                                                             311100
        MANUFACTURED MATERIALS, SUCH AS CEMENT,ARE TO BE DELIVERED AND       311100
    STORED IN FULL ORIGINAL PACKAGE, BAGS OF STANDARD SIZE, PLAINLY          311100
    MARKED WITH THE BRAND AND MANUFACTURERS NAME.  MATERIALS IN BROKEN       311100
    CONTAINERS OR IN PACKAGES SHOWING EVIDENCE OF DAMAGE WILL BE             311100
    WHOLLY REJECTED.  BAGS ARE TO BE PROPERLY STACKED, COMPLETELY COV-       311100
    ERED, AND PROTECTED FROM WEATHER AND DAMPNESS.  HANDLE AND STORE         311100
    AGGREGATES SO AS TO PREVENT CONTAMINATION BY FOREIGN MATERIAL.           311100
    PROTECT ALL REINFORCING STEEL UNTIL USED.                                311100
                                                                             311100
        SHOP DRAWINGS.                                                       311100
                                                                             311100
        CONTRACTOR IS TO PREPARE, AT HIS OWN EXPENSE, COMPLETE SHOP          311100
    DRAWINGS OF STEEL REINFORCING AND SUBMIT THESE FOR APPROVAL TO THE       311100
    ARCHITECT.  NO FABRICATION IS TO BE ACCOMPLISHED UNTIL THESE DRAW-       311100
    INGS HAVE BEEN CHECKED AND MARKED APPROVED BY THE ARCHITECT. THESE       311100
    DRAWINGS WILL BE SUBMITTED IN THREE(3) COPIES INDICATING REINFORC-       311100
    ING PLANS, DETAILS, DIAGRAMS, AND SCHEDULES.  WHEN CORRECTIONS ARE       311100
    REQUIRED, THE DRAWINGS WILL BE NOTED AND RETURNED AND SUBMITTED          311100
    AGAIN.                                                                   311100
        EACH SHEET IS TO BE DATED AND ALSO BEAR THE DATE AND TITLE OF        311100
    EACH CORRECTION AND REVISION.  THE OMISSION FROM THE DRAWINGS OF         311100
    ANY MATERIALS REQUIRED BY THE CONTRACT DRAWINGS OR SPECIFICATIONS        311100
    DOES NOT RELIEVE THE CONTRACTOR FROM ANY RESPONSIBILITY OF FUR-          311100
    NISHING SUCH MATERIALS.                                                  311100
```

SAMPLE SPECIFICATION INPUT CONTINUED

CARD COLUMN REFERENCE

```
00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

PARAGRAPH 2 - MATERIALS

```
3 3112  17 7                          --MATERIALS--                          311200
        311201  311211  311216  311220  311230  311250  311277               311200
```

MATERIALS SUBPARAGRAPHS

```
3 311201 6 3PORTLAND CEMENT                                                  311201
        311520  311529  311590                                              311201
          ASTM C150, TYPE I, OR ASTM C175, TYPE IA                           311201
                                                                             311201
      WATER.                                                                 311201
                                                                             311201
          CLEAN AND FREE FROM OIL, ACID AND OTHER INJURIOUS QUANTITIES        311201
      OF VEGETABLE MATTER, ALKALIES, OR OTHER SALTS.                         311201

3 311215 4 1COARSE AGGREGATE, VARYING SIZES.                                 311215
        311570                                                               311215
          ASTM C33. MAXIMUM SIZE OF AGGREGATE IS LIMITED TO 1/5 OF THE       311215
      NARROWEST DIMENSION BETWEEN FORMS OF THE MEMBER FOR WHICH THE CON-     311215
      CRETE IS TO BE USED, AND TO 3/4 OF THE MINIMUM CLEAR SPACING BE-       311215
      TWEEN REINFORCING. TABLE II, ASTM C33 GOVERNS GRADUATION.              311215

3 31122012 1REINFORCING                                                      311220
        311510                                                               311220
          DEFORMED BARS, EITHER INTERMEDIATE NEW BILLET, ASTM A15, OR        311220
      HARD RAIL, ASTM A16. STANDARD PATTERNS OF DEFORMATIONS MUST MEET       311220
      THE REQUIREMENTS OF ASTM A305. STIRRUPS AND TIES MAY BE STRUCTURAL     311220
      GRADE PLAIN BARS. METAL IS TO BE CLEANED OF ALL RUST, SCALE, PAINT     311220
      OR COATINGS THAT WILL REDUCE BOND. ALL REINFORCING IS TO BE BENT       311220
      TO THE REQUIRED SHAPES BEFORE PLACEMENT. SPLICING OR WELDING BE-       311220
      TWEEN SUPPORTS WILL NOT BE ALLOWED UNLESS SPECIFICALLY DETAILED ON     311220
      THE DRAWINGS. STEEL WELDED WIRE FABRIC CONFORMING TO ASTM A185, OR     311220
      COLD DRAWN STEEL MEETING THE REQUIREMENTS OF ASTM A82 IS SIZED AS      311220
      INDICATED. INCLUDE ALL SPACERS, CHAIRS, TIES AND OTHER DEVICES RE-     311220
      QUIRED FOR PROPER PLACING, SPACING, SUPPORTING AND FASTENING REIN-     311220
      FORCING SECURELY IN POSITION.                                          311220
```

SAMPLE SPECIFICATION INPUT CONTINUED

CARD COLUMN REFERENCE

```
00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

PARAGRAPH 5 - INSTALLATION

```
4 3115  10   --PLACING FORMS,REINFORCING,CONCRETE,FINISHES AND CURING      311500
```

INSTALLATION SUBPARAGRAPHS

```
4 311529 6  CONSTRUCTION JOINTS.                                          311529
        WHERE STOPS IN PLACEMENT OF MORE THAN TWO HOURS ARE NECESSARY,    311529
      JOINTS ARE TO BE LOCATED IN THE CENTER OF BEAMS AND SLABS.  TEM-    311529
      PORARY FORMS ARE TO BE CONSTRUCTED SO THAT JOINTS WILL BE SQUARE.   311529
      THE SURFACE OF THE CONCRETE IS TO BE THOROUGHLY CLEANED, AND ALL    311529
      VERTICAL JOINTS ARE TO BE WETTED AND SLUSHED WITH A COAT OF NEAT    311529
      CEMENT BEFORE PLACING NEW CONCRETE.                                 311529

4 311510 7  PLACING REINFORCING.                                          311510
        PLACE REINFORCING ACCURATELY IN THE LOCATIONS INDICATED ON THE    311510
      DRAWINGS.  CLEANING, BENDING, AND PLACEMENT IS TO BE IN ACCORDANCE  311510
      WITH THE AMERICAN CONCRETE INSTITUTE(ACI) PUBLICATIONS 315 AND      311510
      318.  REINFORCING IS TO BE SECURED AT INTERSECTIONS WITH ANNEALED    311510
      IRON WIRE NOT LESS THAN 18 GAUGE OR SUITABLE METAL CLIPS.  OTHER    311510
      SUPPORTS WILL BE FURNISHED BY METAL CHAIRS, SPACERS, OR HANGERS.     311510
      MINIMUM CLEARANCE FROM CONCRETE SURFACES IS 3/4-INCH.               311510

4 311590 8  CURING.                                                       311590
        CURING IS TO BE ACCOMPLISHED BY MAINTAINING CONCRETE IN A         311590
      MOIST CONDITION FOR A PERIOD OF AT LEAST SEVEN(7) DAYS AFTER THE    311590
      PLACEMENT, EXCEPT THAT HIGH EARLY STRENGTH CONCRETE WILL BE MOIST   311590
      CURED FOR AT LEAST THE FIRST TWO(2) DAYS.  ALL SLABS ARE TO BE      311590
      COVERED WITH CURING MATS, 1-INCH DAMP SAND, OR PONDED WITH WATER    311590
      TO EFFECT CURING.  CURING COMPOUNDS WILL NOT BE USED WHERE GROUT    311590
      OR OTHER MATERIALS ARE TO BE BONDED TO THE SURFACE, NOR WHERE CON-  311590
      CRETE HARDENERS ARE TO BE APPLIED.                                  311590
```

```
00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

APPENDIX C

COMPUTER PROGRAMS

PROGRAM NUMBER 1

```
C      PROGRAM NO. 1                                          2 FEBRUARY 1966   1
C               WRITING CONSTRUCTION SPECIFICATIONS MASTER TAPE                  1
C      LANGUAGE - FORTRAN IV            HARDWARE - IBM 7040, 729V TAPE UNIT     1
C                                                                                1
C         *    *    *    *    *    *    *    *    *    *    *    *              1
C                                                                                1
C                                JAMES D. MARTIN                                 1
C         DEPARTMENT OF ARCHITECTURE - ARCHITECTURAL ENGINEERING                 1
C                           OKLAHOMA STATE UNIVERSITY                            1
C                                                                                1
C         *    *    *    *    *    *    *    *    *    *    *    *              1
C                                                                                1
      DIMENSION NSEL(15),SPEC(100,11),TIT(10),MATCOM(20),NPAR(9)                 1
C     INPUT FORMAT STATEMENTS                                                    1
500   FORMAT(I1,I5,3I2,10A6)                                                     1
505   FORMAT(6X,9I6)                                                             1
510   FORMAT(6X,8I8)                                                             1
515   FORMAT(6X,11A6)                                                            1
C     OUTPUT FORMAT STATEMENTS                                                   1
600   FORMAT(1H0,5X,I1,4X,4I5,5X,10A6)                                           1
605   FORMAT(9I10)                                                               1
610   FORMAT(5X,8I10)                                                            1
615   FORMAT(6X,11A6)                                                            1
C     TRACE FORMAT STATEMENTS                                                    1
700   FORMAT(1H0,4I8///44HERROR IN INPUT SEQUENCE,DUMP-TERMINATE PROG.)          1
705   FORMAT(1H0,17HWRITING COMPLETED)                                           1
      REWIND 4                                                                   1
5     READ(5,500)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                                 1
      GO TO(10,20,30,40),L                                                       1
C                                                                                1
C     SECTION NUMBER AND TITLE, LEVEL IS 1                                       1
C                                                                                1
10    IF(NUMB.EQ.99999)GO TO 15                                                  1
      N1=NUMB/10                                                                 1
      READ(5,505)(NPAR(M),M=1,I)                                                 1
15    WRITE(4)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                                    1
      IF(NUMB.EQ.99999)GO TO 17                                                  1
      WRITE(4)(NPAR(M),M=1,I)                                                    1
      GO TO 5                                                                    1
17    WRITE(6,705)                                                               1
      GO TO 95                                                                   1
C                                                                                1
C     PARAGRAPHS 1,3,4,6 THRU 9, LEVEL IS 2                                      1
C                                                                                1
20    IF(NUMB/10.NE.N1)GO TO 90                                                  1
      READ(5,515)((SPEC(IN,JN),JN=1,11),IN=1,N)                                  1
      WRITE(4)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                                    1
      WRITE(4)((SPEC(IN,JN),JN=1,11),IN=1,N)                                     1
      GO TO 5                                                                    1
C                                                                                1
C     PARAGRAPH 2 - MATERIALS, LEVEL IS 3                                        1
C                                                                                1
30    IF(NUMB/10.NE.N1)GO TO 90                                                  1
      READ(5,510)(MATCOM(M),M=1,I)                                               1
C     MATCOM IS THE STANDARD MATERIALS USED IN THIS SECTION.                     1
      N2=NUMB                                                                    1
      WRITE(4)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                                    1
```

PROGRAM NUMBER 1 CONTINUED

```
      WRITE(4)(MATCOM(M),M=1,I)                                          1
      K1=N                                                               1
C                                                                        1
C     MATERIAL COMPONENT SUBPARAGRAPHS.                                  1
C                                                                        1
      DO 35 IND1=1,K1                                                    1
      READ(5,500)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                         1
      READ(5,510)(NSEL(M),M=1,I)                                         1
C     NSEL IS THE INSTALLATION PAR. FOR THIS MATERIAL OR SELECTOR FOR AN  1
C     ASSOCIATED MATERIAL.                                               1
      READ(5,515)((SPEC(IN,JN),JN=1,11),IN=1,N)                          1
      IF(NUMB.NE.N2)GO TO 90                                             1
      IF(NSUB.EQ.0)GO TO 90                                              1
      WRITE(4)L,NUMB,NSUB,N,I,(TIT(M),M=1,10),(NSEL(M),M=1,I),((SPEC(IN,  1
     1JN),JN=1,11),IN=1,N)                                               1
35    CONTINUE                                                           1
      GO TO 5                                                            1
C                                                                        1
C     PARAGRAPH 5 - INSTALLATION OF MATERIALS, LEVEL IS 4                1
C                                                                        1
40    IF(NUMB/10.NE.N1)GO TO 90                                          1
      N3=NUMB                                                            1
      WRITE(4)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                            1
      K2=N                                                               1
C                                                                        1
C     INSTALLATION COMPONENT SUBPARAGRAPHS                               1
C                                                                        1
      DO 45 IND2=1,K2                                                    1
      READ(5,500)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                         1
      READ(5,515)((SPEC(IN,JN),JN=1,11),IN=1,N)                          1
      IF(NUMB.NE.N3)GO TO 90                                             1
      IF(NSUB.EQ.0)GO TO 90                                              1
      WRITE(4)L,NUMB,NSUB,N,I,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11),IN=  1
     11,N)                                                               1
45    CONTINUE                                                           1
      GO TO 5                                                            1
C                                                                        1
C     STATEMENT 90 IS ONLY EXECUTED WHENEVER AN ERROR IN SEQUENCE OCCURS 1
C                                                                        1
90    WRITE(6,700)NUMB,N1,N2,N3                                          1
95    REWIND 4                                                           1
C                                                                        1
C     THE FOLLOWING STATEMENTS ARE OPTIONAL.  THEY ALLOW EDITING THE     1
C     DATA WRITTEN BY PRINTING ON THE SYSTEM PRINTER FOR MANUAL SCAN.    1
C                                                                        1
105   READ(4)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                             1
      GO TO(110,120,130,140),L                                           1
110   IF(NUMB.EQ.99999)GO TO 115                                         1
      READ(4)(NPAR(M),M=1,I)                                             1
115   WRITE(6,600)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                        1
      IF(NUMB.EQ.99999)GO TO 195                                         1
      WRITE(6,605)(NPAR(M),M=1,I)                                        1
      GO TO 105                                                          1
120   READ(4)((SPEC(IN,JN),JN=1,11),IN=1,N)                              1
      WRITE(6,600)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                        1
      WRITE(6,615)((SPEC(IN,JN),JN=1,11),IN=1,N)                         1
      GO TO 105                                                          1
```

PROGRAM NUMBER 1 CONTINUED

```
130   READ(4)(MATCOM(M),M=1,I)                                                  1
      WRITE(6,600)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                               1
      WRITE(6,610)(MATCOM(M),M=1,I)                                             1
      K1=N                                                                      1
      DO 135 IND3=1,K1                                                          1
      READ(4)L,NUMB,NSUB,N,I,(TIT(M),M=1,10),(NSEL(M),M=1,I),((SPEC(IN,J        1
     1N),JN=1,11),IN=1,N)                                                       1
      WRITE(6,600)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                               1
      WRITE(6,610)(NSEL(M),M=1,I)                                               1
      WRITE(6,615)((SPEC(IN,JN),JN=1,11),IN=1,N)                                1
135   CONTINUE                                                                  1
      GO TO 105                                                                 1
140   WRITE(6,600)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                               1
      K2=N                                                                      1
      DO 145 IND4=1,K2                                                          1
      READ(4)L,NUMB,NSUB,N,I,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11),IN=1        1
     1,N)                                                                       1
      WRITE(6,600)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                               1
      WRITE(6,615)((SPEC(IN,JN),JN=1,11),IN=1,N)                                1
145   CONTINUE                                                                  1
      GO TO 105                                                                 1
195   REWIND 4                                                                  1
      STOP                                                                      1
      END                                                                       1
```

PROGRAM NUMBER 2

```
C                                  STATEMENT                                    DECK/REV
C                                                                                    2
C     PROGRAM NO. 2                                  30 JAN 66, REV 4 MAR 66       2
C     SELECTING SECTIONS OF CONSTRUCTION SPECIFICATIONS FROM MASTER TAPE           2
C                        AND WRITING THE JOB TAPE                                  2
C     LANGUAGE - FORTRAN IV          HARDWARE - IBM 7040, 729V TAPE UNIT           2
C                                                                                  2
C        *    *    *    *    *    *    *    *    *    *    *    *                 2
C                                                                                  2
C                                JAMES D. MARTIN                                   2
C        DEPARTMENT OF ARCHITECTURE - ARCHITECTURAL ENGINEERING                    2
C                          OKLAHOMA STATE UNIVERSITY                               2
C                                                                                  2
C        *    *    *    *    *    *    *    *    *    *    *    *                 2
C                                                                                  2
      DIMENSION SPEC(100,11),NPAR(9),TIT(10),J(17),MATCOM(20)                      2
      DIMENSION SPEC1(50,11),TIT1(10)                                              2
      INTEGER OPTPAR,OPTMAT,SEL(20),SELIN(20),SELMAT(17,10),TEMP                   2
C     DATA INPUT(SELECTED SECTIONS AND OPTIONS) FORMAT STATEMENTS                   2
400   FORMAT(6X,I5,2I2)                                                            2
405   FORMAT(6X,9I6)                                                               2
410   FORMAT(6X,8I8)                                                               2
C     OUTPUT FORMAT STATEMENTS FOR SYSTEM PRINTER                                  2
500   FORMAT(////26X,I5,3X,10A6,3X,I5///)                                          2D
505   FORMAT(///26X,I5,3X,10A6,3X,I5///)                                           2D
510   FORMAT(///26X,I5,3X,10A6,3X,I5/)                                             2D
515   FORMAT(//31X,10(A6)/)                                                        2D
520   FORMAT(31X,11A6)                                                             2D
525   FORMAT(//5X,I8,18X,10A6//(31X,11A6))                                         2D
530   FORMAT(//61X,7H--END--)                                                      2D
535   FORMAT(1H1)                                                                  2
C     TRACE FORMAT STATEMENTS(OPTIONAL).  USED IN DEBUGGING PROGRAM                2
700   FORMAT(1H0,5HTRACE,I5,I10,I4,2I5,5X,10A6,5HTRACE)                           TRACE
705   FORMAT(6X,5HTRACE,I8,2I3,5X,5HTRACE)                                        TRACE
710   FORMAT(6X,5HTRACE,5X,8I8,5HTRACE)                                           TRACE
715   FORMAT(1H0,22HLAST DATA CARD ENTERED)                                       TRACE
720   FORMAT(1H0,19HCOMPLETED PASS NO. ,I2)                                       TRACE
725   FORMAT(1H0//(10X,10I10))                                                    TRACE
C                                                                                  2
C     PHASE I - SELECTING APPLICABLE SECTIONS FROM MASTER TAPE                     2
C                                                                                  2
      NPASS=1                                                                      2
      NWRITE=0                                                                     2
      LRET=0                                                                       2
      NT1=4                                                                        2
      NT2=1                                                                        2
      JOB=0                                                                        2
      K1=10                                                                        2C
      REWIND NT1                                                                   2A
      REWIND JOB                                                                   2A
C                                                                                  2
C     INPUT SELECTIONS AND OPTIONS                                                 2
C                                                                                  2
5     READ(5,400)NSECT,OPTPAR,OPTMAT                                               2
      WRITE(6,705)NSECT,OPTPAR,OPTMAT                                             TRACE
      IF(NSECT.EQ.99999)WRITE(6,715)                                               2
```

PROGRAM NUMBER 2 CONTINUED

```
7     READ(NT1)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                          2
      GO TO(10,20,30,60),L                                              2
C                                                                       2
C     SECTION SELECTION, LEVEL IS 1                                     2
C                                                                       2
10    IF(NUMB.EQ.99999)GO TO 12                                         2
      READ(NT1)(NPAR(M),M=1,I)                                          2
      WRITE(6,700)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                       TRACE
      IF(NUMB.NE.NSECT)GO TO 7                                          2
      IF(LRET.GT.1)GO TO 7                                              2B
      N1=NUMB/10                                                        2
      K1=0                                                              2
      GO TO 13                                                          2
12    REWIND NT1                                                        2
      IF(NPASS.GT.1)GO TO 19                                            2
      WRITE(6,720)NPASS                                                 2
13    WRITE(NT2)L,NUMB,NSUB,N,(TIT(M),M=1,10)                           2
      WRITE(6,700)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                       TRACE
      IF(NPASS.GT.1)GO TO 15                                            2
      IF(OPTPAR.GT.0)GO TO 17                                           2
15    K2=I                                                              2
      GO TO 18                                                          2
17    READ(5,405)(NPAR(M),M=1,OPTPAR)                                   2
C     READ IN PARAGRAPH OPTIONS                                         2
      K2=OPTPAR                                                         2
18    IF(NUMB.NE.99999)GO TO 7                                          2
19    IF(LRET.GT.0)GO TO 7                                              2B
      K=1                                                               2
      IF(NWRITE.EQ.1)GO TO 190                                          2
      GO TO 100                                                         2
C                                                                       2
C     PARAGRAPHS 1,3,4,6 THRU 9 SELECTION, LEVEL IS 2                   2
C                                                                       2
20    READ(NT1)((SPEC(IN,JN),JN=1,11),IN=1,N)                           2
      WRITE(6,700)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                       TRACE
      IF(NUMB/10.NE.N1)GO TO 7                                          2
      IF(LRET.GT.1)GO TO 7                                              2
      DO 25 IND1=1,K2                                                   2
      IF(NPAR(IND1).NE.NUMB)GO TO 25                                    2
      WRITE(NT2)L,NUMB,NSUB,N,(TIT(M),M=1,10)                           2
      WRITE(NT2)K2,((SPEC(IN,JN),JN=1,11),IN=1,N)                       2
      WRITE(6,700)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                       TRACE
      K1=K1+1                                                           2
      NPAR(IND1)=0                                                      2
25    CONTINUE                                                          2
      GO TO 95                                                          2
C                                                                       2
C     PARAGRAPH 2 - MATERIALS SELECTION, LEVEL IS 3                     2
C                                                                       2
30    READ(NT1)(MATCOM(M),M=1,I)                                        2
      WRITE(6,700)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                       TRACE
      K3=N                                                              2
      IF(NUMB/10.NE.N1)GO TO 34                                         2
      IF(LRET.GT.1)GO TO 37                                             2B
      DO 32 IND2=1,K2                                                   2
      IF(NPAR(IND2).NE.NUMB)GO TO 32                                    2
      WRITE(NT2)L,NUMB,NSUB,N,(TIT(M),M=1,10)                           2
      WRITE(6,700)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                       TRACE
```

PROGRAM NUMBER 2 CONTINUED

```
      WRITE(6,710)(MATCOM(M),M=1,I)                                          TRACE
      K1=K1+1                                                                 2
      NPAR(IND2)=0                                                            2
32    CONTINUE                                                                2
      GO TO 37                                                                2
34    DO 35 IND3=1,K3                                                         2
      READ(NT1)L,NUMB,NSUB,N,I,(TIT(M),M=1,10),(SEL(M),M=1,I),((SPEC(IN,      2
     1JN),JN=1,11),IN=1,N)                                                    2
35    CONTINUE                                                                2
      GO TO 95                                                                2
37    IF(NPASS.GT.1)GO TO 38                                                  2
      IF(OPTMAT.GT.0)GO TO 39                                                 2
38    K4=I                                                                    2
      GO TO 40                                                                2
39    READ(5,410)(MATCOM(M),M=1,OPTMAT)                                       2
C     READ IN MATERIAL OPTIONS                                                2
      K4=OPTMAT                                                               2
40    K5=0                                                                    2
      WRITE(6,710)(MATCOM(M),M=1,K4)                                         TRACE
      IF(LRET.NE.1)GO TO 45                                                   2
      K6=0                                                                    2
      DO 42 IND4=1,K4                                                         2
      IF(MATCOM(IND4).EQ.N7)K6=K6+1                                           2
42    CONTINUE                                                                2
      IF(K6.NE.0)GO TO 45                                                     2
      K4=K4+1                                                                 2
      MATCOM(K4)=N7                                                           2
45    DO 58 IND5=1,K3                                                         2
      READ(NT1)L,NUMB,NSUB,N,I,(TIT(M),M=1,10),(SEL(M),M=1,I),((SPEC(IN,      2
     1JN),JN=1,11),IN=1,N)                                                    2
      IF(LRET.EQ.2)GO TO 47                                                   2
      GO TO 50                                                                2
47    K4=1                                                                    2
      MATCOM(1)=N8                                                            2
50    DO 58 IND6=1,K4                                                         2
      N2=(100*NUMB)+NSUB                                                      2
C     N2 IS THE COMPLETE NUMBER OF THE SUBPARAGRAPH                           2
      IF(MATCOM(IND6).NE.N2)GO TO 58                                          2
      MATCOM(IND6)=0                                                          2
      IF(LRET.EQ.2)K4=K14+1                                                  2E
      WRITE(NT2)K4,L,NUMB,NSUB,N,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11),      2
     1IN=1,N)                                                                 2
      IF(LRET.EQ.2)K4=K4-(K14+1)                                             2E
      WRITE(6,700)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                            TRACE
      DO 57 IND7=1,I                                                          2
      II=SEL(IND7)/100000                                                     2
      IF(II.NE.NUMB/1000)GO TO 54                                             2
      IF(K5.EQ.0)GO TO 53                                                     2
      DO 52 IND8=1,K5                                                         2
      IF(SEL(IND7).EQ.SELIN(IND8))GO TO 55                                    2
52    CONTINUE                                                                2
53    K5=K5+1                                                                 2
      SELIN(K5)=SEL(IND7)                                                     2
      GO TO 55                                                                2
54    J(II)=J(II)+1                                                           2
      JJ=J(II)                                                                2
      SELMAT(II,JJ)=SEL(IND7)                                                 2
55    SEL(IND7)=0                                                             2
57    CONTINUE                                                                2
58    CONTINUE                                                                2
```

PROGRAM NUMBER 2 CONTINUED

```
      WRITE(6,710)(SELIN(M),M=1,K5)                                          TRACE
      IF(LRET.EQ.2)GO TO 185                                                  2
      GO TO 95                                                                2
C                                                                             2
C     PARAGRAPH 5 - INSTALLATION OF MATERIALS SELECTED, LEVEL IS 4            2
C                                                                             2
60    K7=N                                                                    2
      WRITE(6,700)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                            TRACE
      IF(NUMB/10.NE.N1)GO TO 64                                               2
      IF(LRET.GT.1)GO TO 67                                                   2B
      DO 62 IND9=1,K2                                                         2
      IF(NPAR(IND9).NE.NUMB)GO TO 62                                          2
      WRITE(NT2)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                 2
      WRITE(6,700)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                            TRACE
      K1=K1+1                                                                 2
      NPAR(IND9)=0                                                            2
62    CONTINUE                                                                2
      GO TO 67                                                                2
64    DO 65 IND10=1,K7                                                        2
      READ(NT1)L,NUMB,NSUB,N,I,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11),IN      2
     1=1,N)                                                                   2
65    CONTINUE                                                                2
      GO TO 95                                                                2
67    DO 75 IND11=1,K7                                                        2
      READ(NT1)L,NUMB,NSUB,N,I,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11),IN      2
     1=1,N)                                                                   2
      IF(LRET.EQ.3)K5=2                                                       2
      DO 75 IND12=1,K5                                                        2
      N2=(100*NUMB)+NSUB                                                      2
      IF(SELIN(IND12).NE.N2)GO TO 75                                          2
      IF(LRET.NE.3)GO TO 72                                                   2
      IF(IND12.NE.2)GO TO 72                                                  2
      L1=L                                                                    2
      NUMB1=NUMB                                                              2
      NSUB1=NSUB                                                              2
      NS=N                                                                    2
      DO 68 M=1,10                                                            2
      TIT1(M)=TIT(M)                                                          2
68    CONTINUE                                                                2
      DO 70 IN=1,N                                                            2
      DO 70 JN=1,11                                                           2
      SPEC1(IN,JN)=SPEC(IN,JN)                                                2
70    CONTINUE                                                                2
      LRET=4                                                                  2
      GO TO 73                                                                2
72    IF(LRET.EQ.3)K5=K15+1                                                   2F
      WRITE(NT2)K5,L,NUMB,NSUB,N,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11),      2
     1IN=1,N)                                                                 2
      IF(LRET.EQ.3)K5=K5-(K15+1)                                              2F
      WRITE(6,700)L,NUMB,NSUB,N,I,(TIT(M),M=1,10)                            TRACE
73    SELIN(IND12)=0                                                          2
75    CONTINUE                                                                2
      IF(LRET.GT.2)GO TO 143                                                  2
95    WRITE(6,705)NUMB,K1,K2                                                 TRACE
      IF(K1.NE.K2)GO TO 7                                                     2
C     K1 IS COUNTER, K2 IS THE NUMBER OF PARAGRAPHS                           2
      N1=0                                                                    2B
      K2=0                                                                    2C
```

PROGRAM NUMBER 2 CONTINUED

```
      IF(NPASS.EQ.1)GO TO 5                                                    2
      LRET=0                                                                   2
      GO TO 185                                                                2
C                                                                              2
C     PHASE II, SECONDARY SELECTIONS AND WRITING OF JOB TAPE                   2
C                                                                              2
100   K=0                                                                      2
      SELMAT(17,10)=9999999                                                    2
      NPASS=NPASS+1                                                            2
      N3=1                                                                     2
      IF((2*(NPASS/2))-NPASS.EQ.0)N3=2                                         2
      GO TO(101,102),N3                                                        2
101   NT2=1                                                                    2
      NT3=2                                                                    2
      GO TO 103                                                                2
102   NT2=2                                                                    2
      NT3=1                                                                    2
103   REWIND NT2                                                               2
      REWIND NT3                                                               2
C                                                                              2
C     THE STATEMENTS THRU 105 ARRANGE ARRAY 'SELMAT' IN ASCENDING ORDER        2
C                                                                              2
      DO 105 MI=1,17                                                           2
      DO 105 NI=1,9                                                            2
      LI=11-NI                                                                 2
      DO 105 JI=2,LI                                                           2
      IF(SELMAT(MI,JI-1).LE.SELMAT(MI,JI))GO TO 105                            2
      TEMP=SELMAT(MI,JI)                                                       2
      SELMAT(MI,JI)=SELMAT(MI,JI-1)                                            2
      SELMAT(MI,JI-1)=TEMP                                                     2
105   CONTINUE                                                                 2
      WRITE(6,725)((SELMAT(MI,JI),JI=1,10),MI=1,17)                            TRACE
      WRITE(6,535)                                                             2
      NZERO=0                                                                  2
      MI=0                                                                     2
107   MI=MI+1                                                                  2
      JI=0                                                                     2
108   JI=JI+1                                                                  2
      IF(SELMAT(MI,JI).EQ.0)GO TO 180                                          2
      N4=SELMAT(MI,JI)/100                                                     2
      IF(LRET.EQ.2)GO TO 133                                                   2
109   READ(NT3)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                   2
      IF(N4/10.LT.NUMB/10)GO TO 170                                            2
      GO TO(110,120,130,140),L                                                 2
C                                                                              2
C     SECTION NUMBER AND TITLE, LEVEL IS 1                                     2
C                                                                              2
110   IF(NWRITE.EQ.1)GO TO 112                                                 2
      WRITE(NT2)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                  2
      GO TO 115                                                                2
112   K11=0                                                                    2
      WRITE(JOB)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                  2
      WRITE(6,500)NUMB,(TIT(M),M=1,10),NUMB                                    2
115   IF(NUMB.NE.99999)GO TO 109                                               2
      GO TO 185                                                                2
C                                                                              2
C     PARAGRAPHS 1, 3, 4, 6 THRU 9 - LEVEL IS 2                                2
C                                                                              2
```

PROGRAM NUMBER 2 CONTINUED

```
120   READ(NT3)K12,((SPEC(IN,JN),JN=1,11),IN=1,N)                                    2
      IF(NWRITE.EQ.1)GO TO 125                                                       2
      WRITE(NT2)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                        2
      WRITE(NT2)K12,((SPEC(IN,JN),JN=1,11),IN=1,N)                                   2
      GO TO 160                                                                      2
125   K11=K11+1                                                                      2
      WRITE(JOB)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                        2
      WRITE(JOB)((SPEC(IN,JN),JN=1,11),IN=1,N)                                       2D
      WRITE(6,505)NUMB,(TIT(M),M=1,10),NUMB                                          2
      WRITE(6,520)((SPEC(IN,JN),JN=1,11),IN=1,N)                                     2
      GO TO 160                                                                      2
C                                                                                    2
C     PARAGRAPH 2 - MATERIALS, LEVEL IS 3                                            2
C                                                                                    2
130   K13=0                                                                          2
      N5=0                                                                           2
      IF(NWRITE.EQ.1)GO TO 132                                                       2
      WRITE(NT2)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                        2
      GO TO 134                                                                      2
132   K11=K11+1                                                                      2
      WRITE(JOB)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                        2
      WRITE(6,510)NUMB,(TIT(M),M=1,10),NUMB                                          2
      GO TO 134                                                                      2
133   N5=N5+1                                                                        2
      N1=0                                                                           2B
134   READ(NT3)K14,L,NUMB,NSUB,N,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11),             2
     1IN=1,N)                                                                        2
      N12=(100*NUMB)+NSUB                                                            2
      IF(SELMAT(MI,JI).LT.N12)GO TO 135                                              2
      K14=K14+N5                                                                     2
      GO TO 137                                                                      2
135   LRET=2                                                                         2
      N8=SELMAT(MI,JI)                                                               2
      GO TO 172                                                                      2
137   IF(NWRITE.EQ.1)GO TO 138                                                       2
      WRITE(NT2)K14,L,NUMB,NSUB,N,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11)             2
     1,IN=1,N)                                                                       2
      GO TO 139                                                                      2
138   WRITE(JOB)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                        2D
      WRITE(JOB)((SPEC(IN,JN),JN=1,11),IN=1,N)                                       2D
      WRITE(6,525)N12,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11),IN=1,N)                 2D
139   K13=K13+1                                                                      2
      IF(K13.LT.(K14-N5))GO TO 134                                                   2
      GO TO 160                                                                      2
C                                                                                    2
C     PARAGRAPH 5 - INSTALLATION OF MATERIALS, LEVEL IS 4                            2
C                                                                                    2
140   K16=0                                                                          2
      N6=0                                                                           2
      IF(NWRITE.EQ.1)GO TO 141                                                       2
      WRITE(NT2)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                        2
      GO TO 145                                                                      2
141   K11=K11+1                                                                      2
      WRITE(JOB)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                        2
      WRITE(6,510)NUMB,(TIT(M),M=1,10),NUMB                                          2
      GO TO 145                                                                      2
143   N6=N6+1                                                                        2
      N1=0                                                                           2B
```

PROGRAM NUMBER 2 CONTINUED

```
145   READ(NT3)K15,L,NUMB,NSUB,N,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11),  2
     1IN=1,N)                                                             2
      N12=(100*NUMB)+NSUB                                                 2
      IF(LRET.EQ.2)GO TO 153                                              2
      IF(LRET.NE.4)GO TO 155                                              2
      IF(NUMB1.GE.N12)GO TO 155                                           2
      IF(NWRITE.EQ.1)GO TO 150                                            2
      WRITE(NT2)K15,L1,NUMB1,NSUB1,NS,(TIT1(M),M=1,10),((SPEC1(IN,JN),JN  2
     1=1,11),IN=1,NS)                                                     2
      GO TO 154                                                           2
150   WRITE(JOB)L1,NUMB1,NSUB1,NS,(TIT1(M),M=1,10)                        2D
      WRITE(JOB)((SPEC1(IN,JN),JN=1,11),IN=1,NS)                          2D
      WRITE(6,525)N12,(TIT1(M),M=1,10),((SPEC1(IN,JN),JN=1,11),IN=1,NS)   2D
151   N6=N6+1                                                             2
      GO TO 155                                                           2
153   IF(SELIN(1).EQ.0)GO TO 155                                          2
      IF(SELIN(1).LT.N12)GO TO 154                                        2
      GO TO 155                                                           2
154   LRET=3                                                              2
      GO TO 172                                                           2
155   K15=K15+N6                                                          2
      IF(NWRITE.EQ.1)GO TO 157                                            2
      WRITE(NT2)K15,L,NUMB,NSUB,N,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11)  2
     1,IN=1,N)                                                            2
      GO TO 159                                                           2
157   WRITE(JOB)L,NUMB,NSUB,N,(TIT(M),M=1,10)                             2D
      WRITE(JOB)((SPEC(IN,JN),JN=1,11),IN=1,N)                            2D
      WRITE(6,525)N12,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11),IN=1,N)      2D
159   K16=K16+1                                                           2
      IF(K16.LT.(K15-N6))GO TO 145                                        2
      LRET=0                                                              2
C                                                                         2
C     END OF PARAGRAPH 5, TERMINAL DECISION                               2
C                                                                         2
160   IF(K11.EQ.K12)GO TO 165                                             2
C     K11 IS COUNTER, K12 IS THE NUMBER OF PARAGRAPHS                     2
      GO TO 109                                                           2
165   IF(NWRITE.EQ.1)GO TO 166                                            2
      GO TO 109                                                           2
166   WRITE(6,530)                                                        2
      WRITE(6,535)                                                        2
      GO TO 109                                                           2
170   N7=SELMAT(MI,JI)                                                    2
      LRET=1                                                              2
      NSECT=10*(N4/10)                                                    2B
      GO TO 175                                                           2
172   N1=NUMB/10                                                          2B
175   BACKSPACE NT3                                                       2
      GO TO 7                                                             2
180   NZERO=NZERO+1                                                       2
      IF(NZERO.EQ.169)NWRITE=1                                            2
C                                                                         2
C     IF NUMBER OF ZEROS NOT EQUAL TO 169, MAKE ANOTHER PASS              2
C                                                                         2
185   CONTINUE                                                            2
      SELMAT(MI,JI)=0                                                     2
```

PROGRAM NUMBER 2 CONTINUED

```
      IF(JI.LT.10)GO TO 108                                                  2
      IF(MI.LT.17)GO TO 107                                                  2
      WRITE(6,720)NPASS                                                      2
      IF(NWRITE.NE.1)GO TO 100                                               2
      IF(NPASS.EQ.2)K=1                                                      2
      REWIND JOB                                                             2
      REWIND NT2                                                             2
      REWIND NT3                                                             2
190   IF(K.NE.1)GO TO 195                                                    2
C     PREVENTS REWIND OF MASTER TAPE PRIOR TO REACHING THE END OF DATA.      2
      GO TO 200                                                              2
195   NSECT=99999                                                            2
      GO TO 7                                                                2
C                                 'LA FINI'                                  2
200   STOP                                                                   2
      END                                                                    2
```

PROGRAM NUMBER 3

```
C                             STATEMENT                                DECK/REV
C     PROGRAM NO. 3                                    10 MARCH 1966    3
C           CHANGES TO CONSTRUCTION SPECIFICATIONS JOB TAPE             3
C     LANGUAGE - FORTRAN IV        HARDWARE - IBM 7040, 729V TAPE UNIT  3
C                                                                       3
C       *   *   *   *   *   *   *   *   *   *   *   *                   3
C                                                                       3
C                          JAMES D. MARTIN                              3
C       DEPARTMENT OF ARCHITECTURE - ARCHITECTURAL ENGINEERING          3
C                     OKLAHOMA STATE UNIVERSITY                         3
C                                                                       3
C       *   *   *   *   *   *   *   *   *   *   *   *                   3
C                                                                       3
      DIMENSION SPEC(75,11),TIT(10)                                     3
C     INPUT FORMAT STATEMENTS                                           3
400   FORMAT(6X,I7,5I3)                                                 3
C     OUTPUT FORMAT STATEMENTS FOR SYSTEM PRINTER                       3
500   FORMAT(1H1////26X,I5,3X,10A6,3X,I5///)                            3
505   FORMAT(///26X,I5,3X,10A6,3X,I5///)                                3
510   FORMAT(///26X,I5,3X,10A6,3X,I5/)                                  3
515   FORMAT(31X,11A6)                                                  3
520   FORMAT(//5X,I8,18X,10A6//(31X,11A6))                              3
525   FORMAT(//61X,7H--END--)                                           3
530   FORMAT(1H0,50X,17HWRITING COMPLETED)                              3
C     TRACE FORMAT STATEMENTS(OPTIONAL).  USED IN DEBUGGING PROGRAM     3
700   FORMAT(1H0,5HTRACE,I5,I10,2I5,5X,10A6,5HTRACE)                    TRACE
C                                                                       3
C     PHASE I - READ JOB TAPE, WRITE AUXILLARY TAPE                     3
C                                                                       3
      JOB=4                                                             3
      NT2=1                                                             3
      REWIND JOB                                                        3
      REWIND NT2                                                        3
C                                                                       3
C     READ CHANGE HEADER CARD.                                          3
C                                                                       3
5     READ(5,400)NUMCHG,LEVPAR,LEVCHG,L1,L2,L3                          3
      N1=NUMCHG/1000                                                    3
      N2=NUMCHG/100                                                     3
7     READ(JOB)L,NUMB,NSUB,N,(TIT(M),M=1,10)                            3
      GO TO(10,20,30,30),L                                              3
C                                                                       3
C     SECTION NUMBER AND TITLE, LEVEL IS 1                              3
C                                                                       3
10    IF(NUMB/10.GT.N1)GO TO 15                                         3
      WRITE(NT2)L,NUMB,NSUB,N,(TIT(M),M=1,10)                           3
      WRITE(6,700)L,NUMB,NSUB,N,(TIT(M),M=1,10)                         TRACE
      IF(NUMB.NE.99999)GO TO 7                                          3
      REWIND JOB                                                        3
      REWIND NT2                                                        3
      GO TO 100                                                         3
15    BACKSPACE JOB                                                     3
      CALL RDWRTE(NT2)                                                  3
      GO TO 5                                                           3
C                                                                       3
C     PARAGRAPHS 1,3,4,6 THRU 9, LEVEL IS 2                             3
C                                                                       3
20    IF(NUMB.GT.N2)GO TO 28                                            3
      IF(N1.EQ.9999)GO TO 25                                            3
```

PROGRAM NUMBER 3 CONTINUED

```
      IF(NUMB/10.NE.N1)GO TO 25                                          3
      IF(LEVPAR.NE.2)GO TO 25                                            3
      IF(NUMB.LT.N2)GO TO 25                                             3
      CALL CHANGE(JOB,NT2,L,NUMB,NSUB,N,TIT,LEVCHG,L1,L2,L3)             3
      GO TO 5                                                            3
25    READ(JOB)((SPEC(IN,JN),JN=1,11),IN=1,N)                            3
      WRITE(NT2)L,NUMB,NSUB,N,(TIT(M),M=1,10)                            3
      WRITE(NT2)((SPEC(IN,JN),JN=1,11),IN=1,N)                           3
      WRITE(6,700)L,NUMB,NSUB,N,(TIT(M),M=1,10)                          TRACE
      GO TO 7                                                            3
28    BACKSPACE JOB                                                      3
      CALL RDWRTE(NT2)                                                   3
      GO TO 5                                                            3
C                                                                        3
C     PARAGRAPHS 2 AND 5, LEVELS ARE 3 AND 4                             3
C                                                                        3
30    IF(NUMB.GT.N2)GO TO 50                                             3
      IF(NSUB.NE.0)GO TO 35                                              3
      WRITE(NT2)L,NUMB,NSUB,N,(TIT(M),M=1,10)                            3
      WRITE(6,700)L,NUMB,NSUB,N,(TIT(M),M=1,10)                          TRACE
      GO TO 7                                                            3
35    IF(N1.EQ.9999)GO TO 45                                             3
      IF(NUMB.NE.N2)GO TO 45                                             3
      N3=(100*NUMB)+NSUB                                                 3
      IF(N3.LT.NUMCHG)GO TO 45                                           3
      CALL CHANGE(JOB,NT2,L,NUMB,NSUB,N,TIT,LEVCHG,L1,L2,L3)             3
      GO TO 5                                                            3
45    READ(JOB)((SPEC(IN,JN),JN=1,11),IN=1,N)                            3
      WRITE(NT2)L,NUMB,NSUB,N,(TIT(M),M=1,10)                            3
      WRITE(NT2)((SPEC(IN,JN),JN=1,11),IN=1,N)                           3
      WRITE(6,700)L,NUMB,NSUB,N,(TIT(M),M=1,10)                          TRACE
      GO TO 7                                                            3
50    BACKSPACE JOB                                                      3
      CALL RDWRTE(NT2)                                                   3
      GO TO 5                                                            3
C                                                                        3
C     PHASE II - REWRITING JOB TAPE AND WRITING PRINTER OUTPUT.          3
C                                                                        3
100   N4=99999                                                           3
105   READ(NT2)L,NUMB,NSUB,N,(TIT(M),M=1,10)                             3
      GO TO(110,120,130,130),L                                           3
110   IF(NUMB.GT.N4)GO TO 112                                            3
      GO TO 115                                                          3
112   WRITE(6,525)                                                       3
115   WRITE(JOB)L,NUMB,NSUB,N,(TIT(M),M=1,10)                            3
      WRITE(6,500)NUMB,(TIT(M),M=1,10),NUMB                              3
      N4=NUMB                                                            3
      IF(NUMB.NE.99999)GO TO 105                                         3
      GO TO 200                                                          3
120   READ(NT2)((SPEC(IN,JN),JN=1,11),IN=1,N)                            3
      WRITE(JOB)L,NUMB,NSUB,N,(TIT(M),M=1,10)                            3
      WRITE(JOB)((SPEC(IN,JN),JN=1,11),IN=1,N)                           3
      WRITE(6,505)NUMB,(TIT(M),M=1,10),NUMB                              3
      WRITE(6,515)((SPEC(IN,JN),JN=1,11),IN=1,N)                         3
      GO TO 105                                                          3
130   IF(NSUB.NE.0)GO TO 135                                             3
      WRITE(JOB)L,NUMB,NSUB,N,(TIT(M),M=1,10)                            3
      WRITE(6,510)NUMB,(TIT(M),M=1,10),NUMB                              3
      GO TO 105                                                          3
```

PROGRAM NUMBER 3 CONTINUED

```
135   READ(NT2)((SPEC(IN,JN),JN=1,11),IN=1,N)                                3
      N5=(100*NUMB)+NSUB                                                     3
      WRITE(JOB)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                3
      WRITE(JOB)((SPEC(IN,JN),JN=1,11),IN=1,N)                               3
      WRITE(6,520)N5,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11),IN=1,N)          3
      GO TO 105                                                              3
C                                                                            3
C     TERMINAL                                                               3
C                                                                            3
200   WRITE(6,530)                                                           3
      REWIND JOB                                                             3
      REWIND NT2                                                             3
      STOP                                                                   3
      END                                                                    3
$IBFTC RDWRTE  NODECK
      SUBROUTINE RDWRTE(J)                                                   31
C     SUBROUTINE SUBPROGRAM FOR READING AND WRITING SPECIFICATIONS.          31
      DIMENSION SPEC(75,11),TIT(10)                                          31
405   FORMAT(I1,I5,2I2,2X,10A6)                                              31
410   FORMAT(6X,11A6)                                                        31
700   FORMAT(1H0,5HTRACE,I5,I10,2I5,5X,10A6,5HTRACE)                         TRACE
      READ(5,405)L,NUMB,NSUB,N,(TIT(M),M=1,10)                               31
      READ(5,410)((SPEC(IN,JN),JN=1,11),IN=1,N)                              31
      WRITE(J)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                  31
      WRITE(J)((SPEC(IN,JN),JN=1,11),IN=1,N)                                 31
      WRITE(6,700)L,NUMB,NSUB,N,(TIT(M),M=1,10)                              TRACE
      RETURN                                                                 31
      STOP                                                                   31
      END                                                                    31
$IBFTC CHANGE  NODECK
      SUBROUTINE CHANGE(I,J,L,NUMB,NSUB,N,TIT,K,L1,L2,L3)                    32
C     SUBROUTINE SUBPROGRAM FOR CHANGING SPECIFICATION PARAGRAPHS.           32
      DIMENSION SPEC(75,11),TIT(10)                                          32
410   FORMAT(6X,11A6)                                                        32
700   FORMAT(1H0,5HTRACE,I5,I10,2I5,5X,10A6,5HTRACE)                         TRACE
      READ(I)((SPEC(IN,JN),JN=1,11),IN=1,N)                                  32
      GO TO(10,20,30,40),K                                                   32
10    GO TO 99                                                               32
20    BACKSPACE I                                                            32
      BACKSPACE I                                                            32
      CALL RDWRTE(J)                                                         32
      GO TO 99                                                               32
30    CALL RDWRTE(J)                                                         32
      GO TO 99                                                               32
40    READ(5,410)((SPEC(IN,JN),JN=1,11),IN=L1,L2)                            32
      IF(L3.NE.0)N=L2                                                        32
      WRITE(J)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                  32
      WRITE(J)((SPEC(IN,JN),JN=1,11),IN=1,N)                                 32
      WRITE(6,700)L,NUMB,NSUB,N,(TIT(M),M=1,10)                              TRACE
99    RETURN                                                                 32
      STOP                                                                   32
      END                                                                    32
```

PROGRAM NUMBER 4

```
C                                  STATEMENT                                    DECK/REV
C     PROGRAM NO. 4                                          12 MARCH 1966      4
C                          'FINAL READING OF JOB TAPE'                          4
C     LANGUAGE - FORTRAN IV          HARDWARE - IBM 7040, 729V TAPE UNIT       4
C                                                                               4
C        *    *    *    *    *    *    *    *    *    *    *    *              4
C                                                                               4
C                                  JAMES D. MARTIN                              4
C        DEPARTMENT OF ARCHITECTURE - ARCHITECTURAL ENGINEERING                 4
C                           OKLAHOMA STATE UNIVERSITY                           4
C                                                                               4
C        *    *    *    *    *    *    *    *    *    *    *    *              4
C                                                                               4
      DIMENSION SPEC(75,11),TIT(10)                                             4
C     OUTPUT FORMAT STATEMENTS FOR SYSTEM PRINTER.                              4
500   FORMAT(1H1////26X,I5,3X,10A6,3X,I5///)                                    4
505   FORMAT(///26X,I5,3X,10A6,3X,I5///)                                        4
510   FORMAT(///26X,I5,3X,10A6,3X,I5/)                                          4
515   FORMAT(31X,11A6)                                                          4
520   FORMAT(//5X,I8,18X,10A6//(31X,11A6))                                      4
525   FORMAT(//61X,7H--END--)                                                   4
530   FORMAT(1H0,50X,17HWRITING COMPLETED)                                      4
C     OUTPUT FORMAT STATEMENTS FOR PUNCHED CARD OUTPUT(OPTIONAL)                4
600   FORMAT(////I6,3X,10(A6)///)                                             PUNCH
605   FORMAT(///I6,3X,10(A6)///)                                              PUNCH
610   FORMAT(///I6,3X,10(A6)/)                                                PUNCH
615   FORMAT(//6X,10(A6)/)                                                    PUNCH
620   FORMAT(6X,11A6)                                                         PUNCH
625   FORMAT(//35X,7H--END--)                                                   4
C                                                                               4
C                                  'BEGIN READING'                              4
C                                                                               4
      JOB=4                                                                     4
      REWIND JOB                                                                4
      N4=99999                                                                  4
105   READ(JOB)L,NUMB,NSUB,N,(TIT(M),M=1,10)                                    4
      GO TO(110,120,130,130),L                                                  4
C                                                                               4
C     SECTION NUMBER AND TITLE, LEVEL IS 1.                                     4
C                                                                               4
110   IF(NUMB.GT.N4)GO TO 112                                                   4
      GO TO 115                                                                 4
112   WRITE(6,525)                                                              4
      PUNCH 625                                                               PUNCH
115   WRITE(6,500)NUMB,(TIT(M),M=1,10),NUMB                                     4
      PUNCH 600,NUMB,(TIT(M),M=1,10)                                          PUNCH
      N4=NUMB                                                                   4
      IF(NUMB.NE.99999)GO TO 105                                                4
      GO TO 200                                                                 4
C                                                                               4
C     PARAGRAPHS 1,3,4,6 THRU 9, LEVEL IS 2.                                    4
C                                                                               4
120   READ(JOB)((SPEC(IN,JN),JN=1,11),IN=1,N)                                   4
      WRITE(6,505)NUMB,(TIT(M),M=1,10),NUMB                                     4
```

PROGRAM NUMBER 4 CONTINUED

```
      WRITE(6,515)((SPEC(IN,JN),JN=1,11),IN=1,N)                                    4
      PUNCH 605,NUMB,(TIT(M),M=1,10)                                               PUNCH
      PUNCH 620,((SPEC(IN,JN),JN=1,11),IN=1,N)                                     PUNCH
      GO TO 105                                                                     4
C                                                                                   4
C     PARAGRAPHS 2 AND 5, LEVELS ARE 3 AND 4.                                       4
C                                                                                   4
130   IF(NSUB.NE.0)GO TO 135                                                        4
      WRITE(6,510)NUMB,(TIT(M),M=1,10),NUMB                                         4
      PUNCH 610,NUMB,(TIT(M),M=1,10)                                               PUNCH
      GO TO 105                                                                     4
135   READ(JOB)((SPEC(IN,JN),JN=1,11),IN=1,N)                                       4
      N5=(100*NUMB)+NSUB                                                            4
      WRITE(6,520)N5,(TIT(M),M=1,10),((SPEC(IN,JN),JN=1,11),IN=1,N)                 4
      PUNCH 615,(TIT(M),M=1,10)                                                    PUNCH
      PUNCH 620,((SPEC(IN,JN),JN=1,11),IN=1,N)                                     PUNCH
      GO TO 105                                                                     4
C                                                                                   4
C                                    'TERMINAL'                                     4
C                                                                                   4
200   WRITE(6,530)                                                                  4
      REWIND JOB                                                                    4
      STOP                                                                          4
      END                                                                           4
```

APPENDIX D

SAMPLE SPECIFICATIONS OUTPUT

SAMPLE SPECIFICATION

3110 SECTION *** STRUCTURAL CONCRETE *** SECTION 3110

3111 **GENERAL-- 3111

THE DRAWINGS INDICATE THE TYPE AND LOCATION OF ALL CONCRETE AND CEMENT WORK REQUIRED. BIDDERS MUST BE THOROUGHLY EXPERIENCED IN THIS CLASS OF WORK AND MUST HAVE CARRIED THROUGH SUCCESSFULLY BUILDING OPERATIONS OF REASONABLE SIZE. ALL LABOR MUST BE IN CHARGE OF AN EXPERIENCED FOREMAN.

MATERIALS STORAGE.

MANUFACTURED MATERIALS, SUCH AS CEMENT,ARE TO BE DELIVERED AND STORED IN FULL ORIGINAL PACKAGE, BAGS OF STANDARD SIZE, PLAINLY MARKED WITH THE BRAND AND MANUFACTURERS NAME. MATERIALS IN BROKEN CONTAINERS OR IN PACKAGES SHOWING EVIDENCE OF DAMAGE WILL BE WHOLLY REJECTED. BAGS ARE TO BE PROPERLY STACKED, COMPLETELY COVERED, AND PROTECTED FROM WEATHER AND DAMPNESS. HANDLE AND STORE AGGREGATES SO AS TO PREVENT CONTAMINATION BY FOREIGN MATERIAL. PROTECT ALL REINFORCING STEEL UNTIL USED.

SHOP DRAWINGS.

CONTRACTOR IS TO PREPARE, AT HIS OWN EXPENSE, COMPLETE SHOP DRAWINGS OF STEEL REINFORCING AND SUBMIT THESE FOR APPROVAL TO THE ARCHITECT. NO FABRICATION IS TO BE ACCOMPLISHED UNTIL THESE DRAWINGS HAVE BEEN CHECKED AND MARKED APPROVED BY THE ARCHITECT. THESE DRAWINGS WILL BE SUBMITTED IN THREE(3) COPIES INDICATING REINFORCING PLANS, DETAILS, DIAGRAMS, AND SCHEDULES. WHEN CORRECTIONS ARE REQUIRED, THE DRAWINGS WILL BE NOTED AND RETURNED AND SUBMITTED AGAIN.

EACH SHEET IS TO BE DATED AND ALSO BEAR THE DATE AND TITLE OF EACH CORRECTION AND REVISION. THE OMISSION FROM THE DRAWINGS OF ANY MATERIALS REQUIRED BY THE CONTRACT DRAWINGS OR SPECIFICATIONS DOES NOT RELIEVE THE CONTRACTOR FROM ANY RESPONSIBILITY OF FURNISHING SUCH MATERIALS.

SAMPLE SPECIFICATION CONTINUED

3112 - MATERIALS-- 3112

PORTLAND CEMENT

ASTM C150, TYPE I, OR ASTM C175, TYPE IA

WATER.

CLEAN AND FREE FROM OIL, ACID AND OTHER INJURIOUS QUANTITIES OF VEGETABLE MATTER, ALKALIES, OR OTHER SALTS.

FINE AGGREGATE

ASTM C33. MODIFY AS FOLLOWS. CLEAN, SHARP, HARD UNCOATED GRAINS FREE FROM SILT, LOAM AND CLAY. GRADE IN SIZE FROM FINE TO COARSE WITH 100 PERCENT PASSING 3/8 INCH SIEVE, 95 TO 100 PERCENT BY WEIGHT PASSING NO. 4 SIEVE, 45 TO 80 PERCENT PASSING NO. 16 SIEVE, 5 TO 30 PERCENT PASSING NO. 50 SIEVE, AND 3 TO 8 PERCENT PASSING NO. 100 SIEVE.

COARSE AGGREGATE

ASTM C33. CLEAN, SHARP, HARD UNCOATED CRUSHED STONE OR WASHED GRAVEL. GRADE IN SIZE FROM FINE TO COARSE WITH 100 PERCENT BY WEIGHT PASSING 1-1/2 INCH SIEVE, 35 TO 70 PERCENT PASSING 3/4-INCH SIEVE, 10 TO 30 PERCENT PASSING 3/8-INCH SIEVE, AND NOT MORE THAN 5 PERCENT PASSING NO. 4 SIEVE. MAXIMUM SIZE OF AGGREGATE IN CONCRETE SECTIONS LESS THAN 4-INCHES IN THICKNESS IS 3/4-INCH.

REINFORCING

DEFORMED BARS, EITHER INTERMEDIATE NEW BILLET, ASTM A15, OR HARD RAIL, ASTM A16. STANDARD PATTERNS OF DEFORMATIONS MUST MEET THE REQUIREMENTS OF ASTM A305. STIRRUPS AND TIES MAY BE STRUCTURAL GRADE PLAIN BARS. METAL IS TO BE CLEANED OF ALL RUST, SCALE, PAINT OR COATINGS THAT WILL REDUCE BOND. ALL REINFORCING IS TO BE BENT TO THE REQUIRED SHAPES BEFORE PLACEMENT. SPLICING OR WELDING BETWEEN SUPPORTS WILL NOT BE ALLOWED UNLESS SPECIFICALLY DETAILED ON THE DRAWINGS. STEEL WELDED WIRE FABRIC CONFORMING TO ASTM A185, OR COLD DRAWN STEEL MEETING THE REQUIREMENTS OF ASTM A82 IS SIZED AS INDICATED. INCLUDE ALL SPACERS, CHAIRS, TIES AND OTHER DEVICES REQUIRED FOR PROPER PLACING, SPACING, SUPPORTING AND FASTENING REINFORCING SECURELY IN POSITION.

SAMPLE SPECIFICATION CONTINUED

EXPANSION JOINTS.

PREMOLDED STRIPS OF FIBERBOARD IMPREGNATED WITH ASPHALT TO BE PROVIDED WHERE SLABS ON GRADE JOIN VERTICAL SURFACES UNLESS OTHERWISE INDICATED. JOINTS ARE TO BE FILLED THE FULL DEPTH OF THE SLAB WITH MINIMUM THICKNESS TO BE 1/2-INCH.

FORMS, WOOD

FORMS ARE TO BE CONSTRUCTED OF GOOD, SOUND LUMBER, OF SUFFICIENT SIZE AND STRENGTH TO WITHSTAND THE DESIGN LOADS WITHOUT BENDING OR CRUSHING. ALL BEAM BOTTOMS ARE TO BE NOT LESS THAN TWO (2) INCHES STOCK SIZE AND ARE TO BE SUPPORTED AT CLOSE INTEVALS TO PREVENT DEFLECTION AND TO OBTAIN A TRUE LOWER SURFACE. SIDES ARE TO BE NOT LESS THAN 1-INCH STOCK SIZE. ALL FORMS ARE TO BE CLEANED THOROUGHLY BEFORE RE-USE AND FREE FROM WARP AND BULGE.

FLOOR HARDENER.

ALL EXPOSED FLOOR SLABS ARE TO RECEIVE THREE COATS OF CONCRETE SURFACE HARDENER. HARDENER IS TO BE LAPIDOLITH AS MANUFACTURED BY L. SONNEBORN SONS INC., SANISEAL AS MANUFACTURED BY MASTER BUILDERS, OR ANTACIDOL AS MANUFACTURED BY THE UPCO COMPANY.

3113 --CONCRETE QUALITY AND PROPORTIONS-- 3113

THE MIX IS TO BE PROPORTIONED TO GIVE ADEQUATE WORKABILITY WITHOUT EXCEEDING THE FOLLOWING WATER-CEMENT RATIOS,

2500 PSI CONCRETE	7.5 GALLONS/SACK
3000 PSI CONCRETE	6.5 GALLONS/SACK

THE MINIMUM ULTIMATE 28-DAY COMPRESSIVE STRENGTH OF 2500 PSI IS TO BE USED FOR FOOTINGS AND SIDEWALKS AND 3000 PSI FOR ALL OTHER CONCRETE. THE MINIMUM BAGS OF CEMENT IS 5.2 FOR 2500 PSI AND 5.5 FOR 3000 PSI CONCRETE, COMBINED WITH FINE AND COARSE AGGREGATE TO MAKE A WORKABLE MIX. CONSISTENCY IS TO BE SUCH THAT THE CONCRETE CAN BE PLACED AND WORKED INTO ANGLES AND CORNERS OF FORMS, AROUND REINFORCING AND INSERTS WITHOUT SEGREGATION AND WITHOUT WATER AND FINE MATERIALS RISING TO THE SURFACE. THE SLUMP, AS MEASURED BY THE STANDARD TEST, ASTM C143, IS TO BE NOT LESS THAN 3-INCHES NOR MORE THAN 6-INCHES. METHODS OF MEASURING CONCRETE MATERIALS ARE TO BE SUCH THAT THE PROPORTIONS CAN BE ACCURATELY CONTROLLED DURING MIXING AND EASILY CHECKED AT ANY TIME BY THE ARCHITECT.

SAMPLE SPECIFICATION CONTINUED

ALL CONCRETE IS TO BE EITHER JOB OR PLANT MIXED IN AN APPROVED TYPE OF POWER OPERATED MIXER THAT WILL INSURE A UNIFORM DISTRIBUTION OF THE MATERIAL THROUGHOUT THE MASS.

READY-MIXED CONCRETE MAY BE USED PROVIDED IT MEETS THE REQUIREMENTS OF THESE SPECIFICATIONS AND THOSE OF ASTM C94.

3114 --PREPARATION FOR WORK OF OTHER TRADES-- 3114

ALL PARTIES INTERESTED MUST BE NOTIFIED BY CONTRACTOR IN AMPLE TIME BEFORE PLACEMENT OF CONCRETE TO ALLOW INSTALLATION OF CONDUITS, SLEEVES, ETC. SUBCONTRACTORS REQUIRING OPENINGS FOR THEIR WORK MUST FURNISH AND PLACE THEIR SLEEVES. UNLESS NOTED, PIPE SLEEVES WILL BE INSTALLED THROUGH CONCRETE SLABS FOR ALL RISERS FOR PLUMBING AND HEATING. ELECTRICAL CONDUITS MUST BE LOCATED SO AS NOT TO AFFECT THE STRENGTH OF THE CONCRETE, SUCH LOCATION BEING SUBJECT TO APPROVAL OF THE ARCHITECT. CONDUITS GENERALLY ARE TO BE PLACED ABOVE THE REINFORCING STEEL.

3115 --PLACING FORMS,REINFORCING,CONCRETE,FINISHES AND CURING-- 3115

FORM ERECTION AND REMOVAL

FORMS ARE TO CONFORM TO THE SHAPE, LINES, AND DIMENSIONS OF THE MEMBERS AS INDICATED ON THE DRAWINGS. THEY MUST BE SUFFICIENTLY TIGHT TO PREVENT LEAKAGE OF MORTAR, AND PROPERLY BRACED OR TIED TOGETHER SO AS TO MAINTAIN POSITION AND SHAPE. ALL FORMS WILL BE ADEQUATELY SHORED AND CLEATED TO PREVENT ENDANGERING PERSONNEL OR THE MEMBERS BEING CAST. THEY ARE TO BE CONSTRUCTED SO THAT THEY MAY BE EASILY REMOVED WITHOUT DAMAGE TO THE CONCRETE. WHERE REQUIRED,FORMS WILL BE HELD APART BY SEPARATORS WHICH CAN BE EASILY REMOVED AS THE WORK PROGRESSES, OR WHICH MAY BE INCORPORATED IN THE CONCRETE WITHOUT DAMAGE TO IT. TEMPORARY OPENINGS ARE TO BE PROVIDED FOR CLEANING AND INSPECTION WHERE REQUIRED.

FORMS MAY BE REMOVED FROM SLABS AND BEAM SIDES NOT EARLIER THAN SEVEN(7) DAYS AFTER COMPLETION OF THE POUR. IN CASE OF CONTINUED DAMP WEATHER, TEN(10) DAYS SHALL ELAPSE BEFORE REMOVAL. BOTTOM FORMS OF BEAMS MUST REMAIN FOR A PERIOD OF TEN(10) DAYS OR UNTIL SUCH TIME AS THE CONCRETE HAS ATTAINED SUFFICIENT STRENGTH TO SUPPORT THE MEMBER ITSELF PLUS ANY CONSTRUCTION LOADS PLACED UPON IT, IF LONGER, BEFORE REMOVAL OF FORMS. FORMS ARE NOT TO BE REMOVED FROM ANY OF THE WORK UNTIL APPROVAL IS OBTAINED FROM THE ARCHITECT.

SAMPLE SPECIFICATION CONTINUED

PLACING REINFORCING.

PLACE REINFORCING ACCURATELY IN THE LOCATIONS INDICATED ON THE DRAWINGS. CLEANING, BENDING, AND PLACEMENT IS TO BE IN ACCORDANCE WITH THE AMERICAN CONCRETE INSTITUTE(ACI) PUBLICATIONS 315 AND 318. REINFORCING IS TO BE SECURED AT INTERSECTIONS WITH ANNEALED IRON WIRE NOT LESS THAN 18 GAUGE OR SUITABLE METAL CLIPS. OTHER SUPPORTS WILL BE FURNISHED BY METAL CHAIRS, SPACERS, OR HANGERS. MINIMUM CLEARANCE FROM CONCRETE SURFACES IS 3/4-INCH.

PLACING CONCRETE.

CONCRETE IS NOT TO BE PLACED UNTIL FOUNDATIONS, FORMS, REINFORCING STEEL, PIPES, CONDUITS, SLEEVES, HANGERS, ANCHORS, INSERTS, WATERPROOFING, AND OTHER WORK REQUIRED TO BE BUILT-IN HAS BEEN INSPECTED AND APPROVED BY THE ARCHITECT. A THOROUGH INSPECTION MUST BE MADE IN ADVANCE OF PLACING CONCRETE TO REMOVE ALL CHIPS AND DIRT, AND ALL TEMPORARY BRACING AND CLEATS, AND TO INSURE THAT ALL FORMS ARE TIGHT AND SECURE AND REINFORCING PROPERLY PLACED.

NO CONCRETE IS TO BE PLACED WHEN THE AIR TEMPERATURE IS 45 DEGREES F. OR LESS AND FALLING. CONCRETE MAY BE PLACED WHEN THE TEMPERATURE IS 45 DEGREES, OR MORE AND RISING, PROVIDED THERE IS NO REASON TO EXPECT A DROP TO BELOW 45 DEGREES WITHIN 12 HOURS OF THE CONCLUSION OF THE POUR.

ALL FORMS ARE TO BE THOROUGHLY WET BEFORE CONCRETE IS PLACED, CARE BEING TAKEN NOT TO WASH FRESH CONCRETE. ANY CONCRETE WHICH MAY BE SPILLED ON FORMS OR REINFORCING, OR ANY WHICH IS SET AND DRY IN ADVANCE OF COMPLETED WORK, MUST BE REMOVED AND FORMS AND REINFORCING WASHED CLEAN BEFORE DEPOSITING FRESH CONCRETE.

NO CONCRETE THAT HAS PARTIALLY HARDENED OR BEEN CONTAMINATED WILL BE DEPOSITED ON THE WORK, NOR RETEMPERED CONCRETE BE USED.

CONCRETE MUST BE CONVEYED TO PLACE WITHOUT MOVING FORMS OR REINFORCING. CARE MUST BE USED TO PREVENT MOVEMENT OF NAILER STRIPS, CONDUITS, OR OTHER MATERIAL EMBEDDED IN THE CONCRETE. THE CONCRETE WILL BE CONVEYED FROM THE MIXER TO THE PLACE OF DEPOSIT BY METHODS WHICH PREVENT SEPARATION OR LOSS OF MATERIALS. CONCRETE WILL NOT BE POURED FROM A HEIGHT OF MORE THAN 5 FEET. TROUGHS OR CHUTES WHICH ARE USED TO CONVEY THE MIX MUST HAVE BAFFLE BOARDS WHEN USED ON STEEP SLOPES. THE LOWER END OF SUCH DEVICES WILL BE BURIED IN THE FRESH CONCRETE AND WILL BE KEPT CLEAN AND FREE OF COATINGS OF HARDENED CONCRETE.

CONCRETE IS TO BE PLACED IMMEDIATELY AFTER MIXING AND IS NOT TO BE USED IF NOT PLACED WITHIN 30 MINUTES AFTER WATER IS ADDED. UPON STARTING PLACEMENT, IT IS TO BE CARRIED ON AS A CONTINIOUS OPERATION UNTIL A PANEL OR SECTION IS COMPLETED.

ALL CONCRETE IS TO BE THOROUGHLY COMPACTED BY MECHANICAL VIBRATING EQUIPMENT WITH HAND-SPADING, RODDING AND TAMPING DURING PLACEMENT AND THOROUGHLY WORKED AROUND REINFORCING, EMBEDDED FIXTURES AND INTO THE CORNERS OF FORMS. WHERE CONDITIONS, AS IN WALL FORMS, MAKE COMPACTING DIFFICULT, OR WHERE THE REINFORCING IS CON-

SAMPLE SPECIFICATION CONTINUED

GESTED, BATCHES OF MORTAR CONTAINING THE SAME PROPORTION OF CEMENT TO SAND AS USED IN THE CONCRETE, IS TO BE DEPOSITED IN THE FORMS TO CUSHION SUBSEQUENT PLACEMENT.

CONSTRUCTION JOINTS.

WHERE STOPS IN PLACEMENT OF MORE THAN TWO HOURS ARE NECESSARY, JOINTS ARE TO BE LOCATED IN THE CENTER OF BEAMS AND SLABS. TEMPORARY FORMS ARE TO BE CONSTRUCTED SO THAT JOINTS WILL BE SQUARE. THE SURFACE OF THE CONCRETE IS TO BE THOROUGHLY CLEANED, AND ALL VERTICAL JOINTS ARE TO BE WETTED AND SLUSHED WITH A COAT OF NEAT CEMENT BEFORE PLACING NEW CONCRETE.

EXPANSION JOINTS.

SET EXPANSION JOINT MATERIAL AS INDICATED. SEAL JOINTS TIGHTLY WITH COAL-TAR PITCH OR ASPHALT MASTIC AROUND PREMOLDED STRIPS AND SPACES AROUND PIPES OR DUCTS PENETRATING THE CONCRETE.

APPLICATION OF FLOOR HARDENER.

ALL SLABS TO RECEIVE CONCRETE SURFACE HARDENER ARE TO BE THOROUGHLY CLEANED AND ALL STAINS, PAINTS, ETC., REMOVED PRIOR TO APPLICATION. THE HARDENER IS TO BE SPRAYED OR MOPPED IN STRICT ACCORDANCE WITH MANUFACTURERS DIRECTIONS AND APPLIED IN THE QUANTITY RECOMMENDED BY THE MANUFACTURER.

FINISHES.

ALL EXPOSED SLABS ARE TO RECEIVE MONOLITHIC FINISHES. THE WET CONCRETE IS TO BE SCREEDED WITH A STRAIGHT EDGE AT THE PROPER GRADE OF THE FINISHED SLAB. AGGREGATE IS TO BE TAMPED TO A MINIMUM OF 1/4-INCH BELOW FINISHED SURFACE. THE SURFACE IS THEN FLOATED AND LIGHTLY TROWELED. WHEN THE CONCRETE HAS SET SUFFICIENTLY TO RING UNDER THE TROWEL, IT WILL BE GIVEN A SECOND TROWELING TO PRODUCE A SMOOTH DENSE SURFACE. DUST COATING WILL NOT BE PERMITTED. CARE MUST BE USED TO MAINTAIN ADEQUATE SLOPES TO ALL FLOOR DRAINS. CUPPING AT THE DRAIN IS NOT PERMITTED. UNLESS NOTED, ALL EXTERIOR SLABS ARE TO RECEIVE A LIGHT BRUSH FINISH AFTER TROWELING.

SLABS WHICH ARE TO RECEIVE OTHER MATERIALS AS FINISHES, ARE TO BE FINISHED TO A TRUE AND EVEN PLANE AT THE PROPER HEIGHTS FOR THE RECEPTION OF THE FINISHED FLOOR AND THOROUGHLY BROOM CLEANED JUST BEFORE INSTALLATION OF THE FINISHED FLOOR.

ALL EXPOSED CONCRETE SURFACES, OTHER THAN SLABS, ARE TO BE RUBBED WITH CARBORUNDUM STONE TO A SMOOTH FINISH, FREE FROM MARKS OR HONEYCOMBS.

CURING.

CURING IS TO BE ACCOMPLISHED BY MAINTAINING CONCRETE IN A MOIST CONDITION FOR A PERIOD OF AT LEAST SEVEN(7) DAYS AFTER THE PLACEMENT, EXCEPT THAT HIGH EARLY STRENGTH CONCRETE WILL BE MOIST CURED FOR AT LEAST THE FIRST TWO(2) DAYS. ALL SLABS ARE TO BE COVERED WITH CURING MATS, 1-INCH DAMP SAND, OR PONDED WITH WATER TO EFFECT CURING. CURING COMPOUNDS WILL NOT BE USED WHERE GROUT OR OTHER MATERIALS ARE TO BE BONDED TO THE SURFACE, NOR WHERE CONCRETE HARDENERS ARE TO BE APPLIED.

3116 --+CONCRETE TESTS-- 3116

BEFORE BEGINNING CONCRETING ON THE JOB, ONE SET OF LABORATORY COMPRESSION TEST CYLINDERS ARE TO BE CAST USING THE MATERIALS AND PROPORTIONS SPECIFIED. THESE TEST CYLINDERS ARE TO BE CAST SUFFICIENTLY IN ADVANCE OF ACTUAL CONCRETING TO OBTAIN RESULTS OF THE SEVEN(7) DAY TEST TO DETERMINE THE ACCEPTABILITY OF THE MIX.

DURING THE ACTUAL PLACEMENT OF CONCRETE THREE(3) TEST CYLINDERS ARE TO BE CAST FOR EACH FIFTY(50) YARDS OF CONCRETE PLACED, OR IF LESS IN ONE DAYS POUR, THREE(3) CYLINDERS WILL BE CAST FOR EACH DAYS POUR. NORMALLY, ONLY TWO CYLINDERS WILL BE TESTED. IF ONE(1) OF THE CYLINDERS BREAKS BELOW THE SPECIFIED STRENGTH, THE THIRD CYLINDER WILL BE TESTED. ALL TEST CYLINDERS ARE TO BE CAST AND TESTED IN ACCORDANCE WITH ASTM C31 AND C39. ALL TESTS WILL BE CONDUCTED AT THE EXPENSE OF THE CONTRACTOR.

3117 --PROTECTION, REPAIR OF IMPERFECT CONCRETE, AND PATCHING-- 3117

ALL CONCRETE IS TO BE PROTECTED AGAINST RAPID DRYING THROUGHOUT THE CURING PERIOD.

VOIDS OR STONE POCKETS DISCOVERED UPON REMOVAL OF FORMS ARE NOT TO BE REPAIRED UNTIL PASSED BY THE ARCHITECT OR HIS INSPECTOR. ALL SUCH VOIDS ARE TO BE ENTIRELY REMOVED UNTIL SOLID CONCRETE IS REACHED. THE DEFECTIVE AREA IS TO BE CHIPPED OUT TO A DEPTH NOT LESS THAN ONE(1) INCH PERPENDICULAR TO THE SURFACE, CLEANED, AND WETTED, TO INCLUDE THE AREA SURROUNDING THE DEFECT FOR AT LEAST SIX(6) INCHES. THE NEW CONCRETE IS TO BE MIXED FROM THE SAME MATERIALS AND PROPORTIONS AS THE ORIGINAL CONCRETE, EXCEPT THAT THE COARSE AGGREGATE WILL BE OMITTED. THE MORTAR IS TO BE APPLIED SO AS TO FLUSH IT AGAINST THE OLD CONCRETE AND THEN SCREEDED TO LEAVE THE NEW SURFACE SLIGHTLY ABOVE THE SURROUNDING. IT IS THEN TO BE

SAMPLE SPECIFICATION CONTINUED

ALLOWED TO OBTAIN INITIAL SHRINKAGE(1 TO 2 HRS) BEFORE FINISHING .
TIE HOLES LEFT BY WITHDRAWAL OF RODS OR TIES WILL BE THOROUGHLY WETTED AND FILLED COMPLETELY WITH MORTAR. EXCESS MORTAR AT THE SURFACE WILL BE STRUCK OFF. HONEYCOMBS AND OTHER MINOR DEFECTS ARE TO BE CLEANED, WETTED, AND FINISHED WITH MORTAR.

--END--

SAMPLE SPECIFICATION

5110 SECTION *** STRUCTURAL STEEL *** SECTION 5110

5111 -*GENERAL-- 5111

THE DRAWINGS INDICATE THE TYPE, LOCATION, QUANTITY, AND DETAILS OF THE STRUCTURAL STEEL REQUIRED FOR THE STRUCTURE. ANCHOR BOLTS AND OTHER INCIDENTAL ITEMS OF STRUCTURAL STEEL WHICH ARE BUILT INTO CONCRETE OR MASONRY ARE TO INCLUDE INSTRUCTIONS OR TEMPLATES FOR THEIR INSTALLATION AND ARE TO BE DELIVERED AT THE EARLIEST POSSIBLE DATE.

STRUCTURAL STEEL INCLUDES ALL STEEL LINTELS, BEAMS, COLUMNS, TRUSSES, PURLINS, BRACES, CONNECTIONS, JOISTS, ETC., USUALLY INCLUDED FOR THE COMPLETION OF THE BUILDING. CARE MUST BE USED IN STORING, HANDLING, AND ERECTION OF MATERIALS TO PREVENT PIECES FROM BEING BENT OR TWISTED.

SHOP DRAWINGS.

SHOP DRAWINGS, IN THREE(3) COPIES, ARE TO BE PREPARED AT THE EXPENSE OF THE CONTRACTOR. THESE DRAWINGS ARE TO INDICATE SETTING DIAGRAMS AND DETAILS OF ALL STRUCTURAL MEMBERS, DETAILS OF CONSTRUCTION, METHOD OF ASSEMBLING, ACCESSORIES AND ATTACHMENTS. THE DRAWINGS ARE TO BE SUBMITTED TO THE ARCHITECT AND APPROVED BY HIM BEFORE ANY STEEL IS FABRICATED OR ASSEMBLED.

THE ARCHITECTURAL OR STRUCTURAL DESIGN DRAWINGS INDICATE THE GENERAL SIZES, SHAPES, AND LOCATION OF THE VARIOUS ELEMENTS WITH RELATION TO THE FINISHED STRUCTURE. DURING PREPARATION OF THE SHOP DRAWINGS THE NECESSARY DIMENSIONS ARE TO BE CHECKED AND VERIFIED. ANY ERRORS OR ENCROACHMENTS MUST BE REFERRED TO THE ARCHITECT FOR ADJUSTMENTS.

THE DESIGN OF CONNECTIONS IS TO CONFORM TO THE REQUIREMENTS OF THE A.I.S.C. THE UNIT STRESSES PERMITTED BY THAT SPECIFICATION WILL IN NO CASE BE EXCEEDED.

THE ARCHITECTS APPROVAL OF THE SHOP DRAWINGS DOES NOT RELIEVE THE CONTRACTORS RESPONSIBILITY FOR ANY OMISSION OR INACCURACY IN THEM, THE CORRECTION OF WHICH MUST BE ACCOMPLISHED TO CONFORM TO THE CONTRACT DRAWINGS DRAWINGS AND SPECIFICATIONS.

SAMPLE SPECIFICATION CONTINUED

5112 + MATERIALS-- 5112

STEEL.

ALL STEEL REQUIRED FOR THIS STRUCTURE IS TO CONFORM TO THE SPECIFICATIONS FOR STEEL BRIDGES AND BUILDINGS, ASTM A7.

WELDING ELECTRODES.

ALL WELDING ELECTRODES ARE TO CONFORM TO THE SPECIFICATION FOR IRON AND STEEL ARC-WELDING ELECTRODES, ASTM A233.

BOLTS.

BOLTS ARE TO BE HIGH STRENGTH STEEL, ASTM A325.

RIVETS.

RIVETS ARE TO BE STRUCTURAL RIVET STEEL, ASTM A141.

PAINT.

PRIMER IS TO BE DUPONT ZINC CHROMATE PRIMER NO. 1614-724, OR EQUAL. RUST INHIBITIVE PAINT IS TO CONFORM TO FEDERAL SPECIFICATION TT-P-636B.

5115 --FABRICATION, ERECTION, AND PAINTING-- 5115

FABRICATION.

WORKMANSHIP IS TO CONFORM TO THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION(AISC) CODE OF STANDARD PRACTICE AND SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS, TO INCLUDE THE FOLLOWING,

BEARING SURFACE TO BE TRUE AND ABUTTING SURFACES CLOSELY FITTED.

ALL COLUMNS AND BEARING SURFACES SHALL BE MILLED TO PRO-

VIDE FULL BEARING OVER THE CROSS-SECTION. COLUMN BASE PLATES MAY BE USED WITHOUT PLANNING.

SHOP CONNECTIONS MAY BE RIVETED OR WELDED. FIELD CONNECTIONS MAY BE RIVETED, BOLTED WITH DARDELET RIVET BOLTS, OR FIELD WELDED.

RIVET HOLES ARE TO BE DRILLED OR PUNCHED TO EXACT LOCATION 1/16-INCH LARGER THAN THE RIVETS, AND MUST REGISTER TRUE UPON ERECTION. IF THE THICKNESS OF THE MATERIAL IS NOT GREATER THAN THE NORMAL DIAMETER OF THE RIVET PLUS 1/8-INCH, THE HOLES MAY BE PUNCHED. IF IT IS GREATER, THE HOLES WILL BE DRILLED OR SUB-PUNCHED AND REAMED. LARGER ERRORS ARE TO BE CAUSE FOR REJECTION. SMALL ERRORS MAY BE REPAIRED BY REAMING IF THIS ACTION IS APPROVED BY THE ARCHITECT OR STRUCTURAL ENGINEER.

WELDING.

ALL WELDING IS TO BE ACCOMPLISHED BY SKILLED OPERATORS WHO HAVE BEEN PREVIOUSLY QUALIFIED BY TESTS AS PRESCRIBED BY THE AMERICAN WELDING SOCIETY. THE TECHNIQUE OF WELDING EMPLOYED, THE APPEARANCE AND QUALITY OF WELDS, AND THE METHOD OF CORRECTING DEFECTIVE WORK ARE TO CONFORM TO THE AMERICAN WELDING SOCIETY CODE FOR ARC-WELDING IN BUILDING CONSTRUCTION.

EQUIPMENT IS TO BE OF SUFFICIENT QUANTITY AND TYPE TO PERMIT THE OPERATOR TO PRODUCE SATISFACTORY WELDS. ELECTRODES MUST BE SUITABLE FOR POSITION AND OTHER CONDITIONS OF INTENDED USE IN ACCORDANCE WITH THE INSTRUCTIONS WITH EACH CONTAINER. ADEQUACY OF EQUIPMENT AND ELECTRODES IS TO BE APPROVED BY THE ARCHITECT OR HIS STRUCTURAL ENGINEER.

SURFACES TO BE WELDED MUST BE FREE FROM LOOSE SCALE, RUST, GREASE, PAINT, OR OTHER FOREIGN MATERIAL. JOINT SURFACES ARE TO BE FREE FROM FINS AND TEARS. WELDING WILL NOT BE ACCOMPLISHED WHEN THE TEMPERATURE OF THE BASE METAL IS BELOW 0 DEGREES F. AT TEMPERATURES BETWEEN 0 AND 32 DEGREES F., THE SURFACES OF ALL AREAS WITHIN 3-INCHES OF A POINT WHERE THE WELD IS STARTED ARE TO BE HEATED UNTIL THEY ARE TOO HOT TO TOUCH BEFORE STARTING WELD.

FINISHED MEMBERS MUST BE TRUE TO LINE AND FREE FROM TWIST, BENDS, AND OPEN JOINTS. FINISHED WORK IS SUBJECT TO FINAL APPROVAL OF THE ARCHITECT OR HIS STRUCTURAL ENGINEER.

RIVETING.

ALL RIVETS, BOTH FIELD AND SHOP, ARE TO BE POWER DRIVEN TO COMPLETELY FILL THE HOLES AND BE TIGHT. DRIVEN RIVETS ARE TO HAVE FULL CONCENTRIC HEADS. HEADS ON ABUTTING AND BEARING SURFACES ARE TO BE COUNTERSUNK AND CHIPPED FLUSH. HEADS IN SURFACES CARRYING MASONRY WALLS ARE TO BE FLATTENED TO 3/8-INCH. ASSEMBLED PARTS MUST BE BROUGHT INTO CLOSE CONTACT, WITH DRIFT PINS BEING USED ONLY FOR ALIGNING MEMBERS, NOT TO DISTORT OR ENLARGE HOLES.

SAMPLE SPECIFICATION CONTINUED

ERECTION.

ERECTION INCLUDES THE SETTING OF ALL COLUMNS, BEAMS, AND OTHER STRUCTURAL STEEL, BUT DOES NOT INCLUDE THE SETTING OF LOOSE LINTELS WHICH ARE TO BE SET BY THE MASON. ALL NECESSARY BRACING AND SCAFFOLDING REQUIRED IS INCLUDED. SPECIAL TEMPORARY BRACING IS TO BE PROVIDED WHERE REQUIRED TO POSITION MEMBERS UNTIL COMPLETION OF PERMENANT CONNECTIONS.

UNLESS INDICATED ON THE DRAWINGS OR SPECIFIED HEREIN, ALL DETAILS OF ERECTION ARE TO BE IN ACCORDANCE WITH THE SPECIFICATIONS FOR DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS(RIVET, BOLTED, AND ARC-WELDED CONSTRUCTION) AND THE CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES AS ISSUED BY THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION.

FIELD ERRORS WILL NOT BE CORRECTED BY BURNING WITHOUT THE PERMISSION OF THE ARCHITECT OR STRUCTURAL ENGINEER. SPECIAL ATTENTION IS TO BE GIVEN TO THE HANDLING OF STEEL DURING CONSTRUCTION, TO PREVENT OVERLOADING OF GREEN FLOOR SLABS. THE ARCHITECTS INSTRUCTIONS WILL BE STRICTLY ADHERED TO IN THIS RESPECT.

ALL LINTELS ARE TO HAVE A 12-INCH BEARING, 6-INCHES ON EITHER SIDE. BEARING OF STRUCTURAL MEMBERS ON CONCRETE IS A MINIMUM OF 6-INCHES, ON STEEL SUPPORTS, 3-INCHES.

FIREPROOFING OF ALL STRUCTURAL STEEL EXCEPT THAT ENCASED BY MASONRY, IS AS INDICATED ON THE ARCHITECTURAL DRAWINGS. ALL STEEL TO BE PROTECTED BY MASONRY IS TO BE PARGED WITH 1/2-INCH NEAT CEMENT BEFORE THE MASONRY WORK IS BEGUN.

PAINTING.

ALL STEEL IS TO RECEIVE A MINIMUM OF ONE COAT OF PRIMER AND ONE COAT OF RUST-INHIBITIVE PAINT AT THE SHOP. PARTS WHICH ARE INACCESSIBLE AFTER ASSEMBLING ARE TO RECEIVE TWO(2) COATS OF RUST-INHIBITIVE PAINT.

THE STEEL IS TO BE CLEANED IN THE SHOP TO REMOVE MILL SCALE. ALL SURFACES WILL BE DRY, FREE FROM RUST, SCALE, AND GREASE BEFORE PAINTING. FIELD PAINTING IS TO BE LIMITED TO SPOT AND TOUCH-UP OF ALL FIELD RIVETS, BOLTS, AND WELDS, AND TO ABRASIONS USING ONE COAT OF RUST-INHIBITIVE PAINT.

SAMPLE SPECIFICATION CONTINUED

5117 --*PROTECTION-- 5117

DURING ERECTION SPECIAL ATTENTION MUST BE PROVIDED FOR WORKMEN OF OTHER TRADES WORKING IN THE SAME AREA TO INSURE THEIR PROTECTION AND SAFETY. CRANE OPERATORS ARE TO BE CAUTIONED ABOUT OVERHEAD OBSTRUCTIONS SUCH AS POWER AND COMMUNICATION LINES. ANY DAMAGE THAT IS THE RESULT OF MISHANDLING IS TO BE REPAIRED AT THE EXPENSE OF THE CONTRACTOR.

--END--

VITA

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Master of Architectural Engineering

Thesis: ELECTRONIC DATA PROCESSING EQUIPMENT APPLIED TO CONSTRUCTION SPECIFICATIONS

Major Field: Architectural Engineering

Biographical:

Personal Data: Born at Lyman, South Carolina, October 16, 1933, the son of C. B., Jr. and Geneva James Martin.

Education: Attended grade school at Lyman, South Carolina; graduated from W. L. T. High School at Wellford, South Carolina in May 1951; received the Bachelor of Science degree, with a major in Agricultural Engineering, from Clemson College in June 1955; received the Bachelor of Science degree, with a major in Architectural Engineering, from the University of Oklahoma in June 1962. Attended Oklahoma State University from January 1965 to May 1966; completed the requirements for the Master of Architectural Engineering degree in May 1966.

Professional Experience: Entered the United States Air Force in 1955, and is now a Captain in the Civil Engineering career field. Except for the period from January 1964 to December 1964, when served as a Construction Advisor to the Vietnamese Air Force, has served in capacities of an architectural and construction engineer for the U. S. Air Force.

Organizations: Tau Beta Pi honorary engineering fraternity member. Associate member, American Society for Testing and Materials. Professional member, Construction Specifications Institute. Engineer-in-Training, State of Oklahoma.