CONSTRUCTION SPECIFICATIONS WRITING

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Introduction to Principles and Procedures of Specifications Writing

A knowledge of specification writing principles and procedures is essential to the specifier in the architect's and engineeer's office in the preparation of sound, enforceable specifications. Unless these skills are properly developed, an expert knowledge of materials, contracts, and construction procedures cannot be communicated successfully to the ultimate users of the finished specifications. The users, namely, contractors and materials suppliers, will also have a better understanding of the nature of specifications, if they understand these principles.

What, then, constitute the principles of specification writing? Basically, the principles of specification writing should encompass those factors that permit architects or engineers to understand more clearly the relationship between drawings and specifications, between the graphic and the verbal, and to enable them to communicate more effectively by setting forth in a logical, orderly sequence the material to be incorporated within a specification.

PRINCIPLES

In broad terms, the principles of specification writing can be set forth as follows:

1. *The Role of the Specifications.* Specifications constitute one of the contract documents, together with the drawings and the agreement. Since they are written instructions, they are frequently adjudged by the courts as having greater importance than drawings when these documents are in conflict, and judgments are frequently resolved on the basis of the specifications. Also, the drawings, except for structural, mechanical, and electrical drawings, make no attempt at segregating the work of the various trades, and all of the architectural work is shown on them as an integrated whole. The specifications, on the other hand, segregate the information depicted on the drawings into the various specification sections so that a contractor can generally let subcontracts on the basis of the specification breakdown of sections.

2. *The Relationship between Drawings and Specifications.* Drawings are a graphic portrayal of the various elements. Specifications should describe the quality of materials, processes, and workmanship. There should not be duplication between these two documents; instead, they should be complementary. To improve coordination between drawings and specifications, there should be standardization of the information appearing in them.

3. *The Organization of Specifications.* For many years specifications were arranged in a series of sections based on the order or chronology in which the various trades appeared on the construction scene. However, it was found that our increasingly complex building structures did not necessarily follow these simple rules, nor was there a uniform, nationwide system of specifications.The *CSI Masterformat* has established a uniform arrangement of division–section organization.

4. *The Technical Section and Its Arrangement.* The technical section, which generally forms a subcontract, must be defined in terms of its scope and content. Until CSI promulgated the *3–Part Section Format*, there was no universal arrangement of information in an orderly, coherent series of paragraphs dealing with the content of the technical section.

5. *Types of Specifications.* Specifications can be prepared on the basis of either methods or results. The specifier can elect to specify in detail the method by which a contractor does certain operations in order to achieve a certain result. Conversely, the specifier can prepare a specification placing on the contractor the responsibility for securing the desired result, leaving to the contractor the method by which it is

secured. Generally, there are four different types of specifications: descriptive, performance, proprietary, and reference.

6. *Specifications Writing Techniques.* These techniques involve the use of scope clauses, the work of other sections, the use of "or equal" or base bid specifications, the avoidance of duplication and repetition, and the use of the residual legatee technique.

PROCEDURES

In broad terms, the procedures to be followed are based on standards developed by the American Institute of Architects (AIA), the Construction Specifications Institute (CSI), and by systems developed by the authors and by others from whom they have borrowed heavily. These include the following:

1. *General Requirements.* These are nonlegal, nontechnical portions of the specifications which are described in detail in Division 1 of the CSI 16-division *Masterformat.*

2. *Specifying Materials.* This procedure deals with the approach to writing open, closed, or base bid specifications for materials and products, citing the advantages and disadvantages of each system.

3. *Specification Language.* The use of clear technical language that can be understood by contractors, superintendents, and foremen is imperative. Legal phraseology or highly stilted formal terms and sentences are to be avoided. Sentences should be clear and concise; they should be written in simple terms to avoid misunderstanding. Sentence structure, punctuation, and the phraseology used in specification writing are an art in themselves.

4. *Specification Reference Sources.* Knowing where to look for information to be used in specifications is quite important. Materials standards have been established by the federal government, the American Society for Testing and Materials, the American National Standards Institute, and others. Association standards have been developed by materials manufacturers and subcontractors for materials and workmanship. Many textbooks on specification writing are available for reference purposes. Guide specifications are available from CSI and AIA, and several specification studies are available from the CSI.

5. *Materials Evaluation.* A systematic approach to the evaluation of materials is outlined suggesting the parameters to review in evaluating and selecting materials.

6. *Specification Writing Procedures.* A guide is recommended for the procedure to be used in gathering information, research, and writing to dovetail the completion of the specifications with the finalization of the drawings.

This book is intended to be an elaboration of the principles and procedures above, and it is designed for the student as well as those currently engaged in writing specifications.

CHAPTER 1

The Role of the Specifications

Whenever an architect or an engineer is commissioned by an owner to design a building or a structure, he must develop three basic documents which a third party, the contractor, must use when he undertakes to build the structure. These three basic documents are the drawings, the conditions of the contract, and the specifications. Together with certain additional documents as hereinafter enumerated, they constitute the contract documents.

CONTRACT DOCUMENTS

The *contract documents* consist of the following instruments:

Agreement. A written agreement between the owner and contractor setting forth the work to be performed, the time for completion, and the contract sum.

Conditions of the Contract. These consist of the general conditions, supplementary conditions, and other conditions (see Chapter 11).

Drawings. The graphic presentation of work to be done.

Specifications. Written, verbal description of work to be performed.

Addenda. Changes made before contract execution.

Modifications. Instructions, change orders, directives, and so on, written after execution of the contract.

Quite often the term *construction documents* is used as a synonym for contract documents.

BIDDING DOCUMENTS

Bidding documents is a term generally used to describe the documents furnished to bidders. They include not only the contract documents, but also the bidding requirements (see Chapter 9).

SPECIFICATIONS

The AIA classifies specifications as one of the contract documents—one of the necessary constituent elements of the contract. As one of the major contract documents, it is imperative that practicing architects and engineers have a very good working knowledge of the role that specifications play.

Whether the specifications are written by a specifier in a large office or by the job captain or architect and engineer in a small office, they are used by a diverse group of participants. To begin with, they are written for the contractor to tell him how to construct, manage, and direct the construction. They are also written for the estimator in the contractor's office, who prepares the estimate based on the specifications. They are written for the purchasing agent in the contractor's office, who procures the materials and equipment described in the specifications. They are written for the resident project representative or inspector, who must be given a document that can aid him in inspecting and controlling the work. They are written for the owner, who would like to know what he is buying and what he is entitled to receive. They are written for the subcontractors so that each can readily discern the scope of his subcontract. They are written for the manufacturers of building materials and equipment so that the grade and type are clearly defined with respect to the many variations they may manufacture.

Webster's Unabridged Dictionary gives the following definition of the term *specifications*: "Specifications (usually plural)—A written or printed description of work to be done, forming part of the contract and describing qualities

of material and mode of construction, and also giving dimensions and other information not shown in the drawings." But the dictionary description does not suffice. As we explore the full meaning of the term, we discover many areas solely within the province of the specifications that extend far beyond a mere elaboration of the drawings.

For example, the specifications alone, as a contract document prepared by the architect, set forth legal requirements, insurance requirements, bidding procedures, alternates, options, subcontractor limits, contractor limits, and inspection and testing procedures. In many instances, design decisions cannot be shown on the drawings, and the specifications are the only vehicle through which these design considerations can be transmitted to the contractor. The following list illustrates the functions of the specifications:

1. *Legal Considerations*

a. The courts have generally held that in the event of conflict between drawings and specifications, the specifications, as a written document, govern. Judgments are most frequently resolved on the basis of the specification requirements.

b. General conditions, whether they consist of AIA standard preprinted forms, federal, state, or municipal forms, Engineers Joint Contract Documents Committee forms, or individually prepared general conditions, are usually bound with the specifications and, by reference, made a part of the specifications. The content and role of the general conditions are elaborated on separately. Essentially, however, they establish the legal rights, responsibilities, and relationships of the parties to the contract.

2. *Insurance Considerations.* Insurance requirements governing owner's liability, contractor's liability, and fire insurance are usually incorporated in the general conditions or in supplementary conditions and, again, made a part of the specifications by incorporation therein.

3. *Bidding Requirements.* The bidding requirements include the Invitation to Bid, the Instructions to Bidders, the Bid Form, and the Bid Bond. These bidding requirements are developed by the architect solely for the use of the bidder and are intended to provide the bidder with information required to submit a proposal. These are usually bound with the specifications.

4. *Alternates, Options*

a. The specifications provide a basis for the contractor's estimate and the submission of a bid. Alternates are established by the architect and owner for the deletion of work, the addition of work, and for the substitution of materials. Alternates are listed in the Bid Form.

b. The technical specifications may permit the contractor, *at his option*, to use one of several materials or manufacturers' brands specified for use in the work. By selecting and specifying materials or products that are comparable and satisfactory to the specifier, the contractor is offered the option of using any one of those specified.

5. *Subcontractor's Limits.* Drawings generally show all of the work to be done and the interrelationship of the various parts. No attempt is made on the drawings to segregate the work of the several subcontractors, except that separate drawings are generally prepared for plumbing, heating, ventilation and air conditioning, and electrical work. The specifications segregate the work shown on the drawings into many sections, or units of work, to aid the general contractor unsubletting the work to various subcontractors.

6. *Contractor Limits.* When several prime contracts are desired, as mandated by either state, federal, or municipal agencies or an owner's requirements, the specifications, primarily in Division 1, General Requirements, will establish the limits of each prime contract.

7. *Inspection and Testing Procedures (Quality Control).* The specifications establish inspection and testing procedures to be followed during the construction operations. Standards for office and field inspection are described for numerous materials and building systems. Test procedures are given for evaluating the performance of completed mechanical installations.

8. *Design Criteria.* In some instances the drawings cannot be used to show or delineate design decisions. For example, the architect's selection of finish hardware for doors can be described only in the specifications. Specifications for paint materials, the number of coats of paint, and the degree of luster or sheen are similarly given only in the specifications.

PROJECT MANUAL

Everyone associated with the design profession (architects, engineers, and specifiers), as well as those involved in construction (contractors, subcontractors, and materials manufacturers), use the term "specifications" when referring to the written document that accompanies drawings. The definition has prevailed for years, even though this particular book contains some documents that cannot be strictly classified as specifications.

Some specifiers say that specifications are only the technical sections. Others state that the specifications constitute everything between the two covers of a book. The material usually bound in a book includes an Invitation to Bid, Instructions to Bidders, a Bid Form (or Proposal Form), a standard preprinted form of general conditions, supplementary conditions, a form of agreement, and forms for Bid Bonds, Payment Bonds, and Labor and Materials Bonds.

The inability to define specifications properly lies both in the failure to define many of the documents used in

construction and in the absence of any authoritative source establishing precise definitions. The terms "construction documents" and "contract documents" are sometimes used interchangeably. Although contract documents are defined in the *AIA General Conditions*, a definition for construction documents is nonexistent. The term "bidding documents" has been used rather loosely in the past. Some have employed it to mean the drawings and specifications available to bidders in preparing a bid; others have used it to mean the bidding requirements.

The bidding requirements are now defined by both AIA and CSI as including the Invitation to Bid, the Instructions to Bidders, and the Bid Form, together with certain sample forms such as Bid Bond, Performance and Payment Bonds, and similar documents.

The agreement on the definition of bidding requirements resolved somewhat the proper terms to be used for the parts that constitute these documents. Advertisement to Bid, Notice to Bidders, and Notification to Contractors have been used in place of the recently adopted term "Invitation to Bid." Other terms used for Instructions to Bidders have included Information for Bidders and Conditions of Bid. The terms "Bid Form" and "Proposal Form" have also been used extensively in the past. CSI documents and AIA documents now call it Bid Form.

Confronted by this profusion of terms, the profession is making progress in redefining some documents. In an attempt to clarify the various documents prepared by architects for detailing, specifying, bidding, and constructing a project, the AIA, through a national Committee on Specifications in 1965, produced the "Project Manual" concept.

The *Project Manual* concept is, in its simplest terms, a reorganization and renaming of that familiar book of bidding forms and contract documents, usually referred to as the "Specifications" or "Specs," which, along with the drawings are the documentary basis for all construction projects.

The Project Manual contains a great deal more than specifications. It normally includes the Bidding Requirements, that is, invitation, instructions, sample bid; bond and agreement forms; general and supplementary conditions; and information on alternate and unit prices, in addition to the *technical specifications* describing the materials and performance expected in the construction of the project. The book also frequently contains a schedule of the drawings pertaining to the project. The book is indeed a *manual of project bidding* requirements and contract documents.

While the Bidding Requirements are not part of the contract documents, for convenience they are assembled and bound with the technical specifications into a Project Manual.

By designating all of the written material as a Project Manual, as opposed to the graphic material which is designated as the drawings, the volume still known and referred to by many as the specifications is better described as a Project Manual.

The materials included in the Project Manual fall into two general categories: (1) those describing the requirements for bidding and (2) those that become part of the contract documents upon the signing of the construction contract. Within each of these two categories, all of the familiar instructions, forms, and the like are organized.

The sequence recommended for the material to be bound in the Project Manual is as follows:

- Title Page
- Table of Contents
- Addenda (if bound in Project Manual)
- Bidding Requirements
  - Invitation to Bid
  - Instructions to Bidders
  - Information Available to Bidders
- Sample Forms
  - Agreement
  - Bid Form
  - Bid Bond
  - Performance and Payment Bonds
  - Other Sample Forms
- Conditions of the Contract
  - General Conditions
  - Supplementary Conditions
- Schedule of Drawings
- Technical Specifications
  - Divisions 1 through 16

The term "specifications" has been used for a long time to describe the bound volume, and many specifiers are loathe to change, or to use the new term. We should be realistic, however, and recognize that some of the documents bound in the old familiar volume are not specifications, and that we cannot continue to refer to this volume as such.

CHAPTER 2

Relationship between Drawings and Specifications

WHAT GOES WHERE

The information that is necessary for the construction of any structure is usually developed by the architect by means of two basic documents: the drawings and the specifications. These two documents represent a means of communication of information between architect and contractor, but each document uses a special form of communication: one pictorial and the other verbal. Yet, in spite of these distinct methods of transmitting information, the documents should complement one another, and neither should overlap or duplicate the other. In this way, each document fulfills its own function. In broad terms, the drawings are a graphical portrayal, and the specifications are a written description of the legal and technical requirements forming the contract documents. Each should convey its own part of the story completely, and neither should repeat any part that properly belongs to the other, since duplication can very often result in differences of meaning.

Specifications are, by their very nature, a device for organizing the information depicted on the drawings. The drawings show the interrelationship of all the parts that go together to make the grand design. It has only been since about 1900 that mechanical, electrical, and structural information has been shown on separate drawings. All the general construction details are shown on drawings as they relate to one another, with no attempt to separate diverse materials. It is the specifications that break down the interrelated information shown on drawings into separate, organized, and orderly units of work, which we refer to as *technical sections* of the specifications.

To maintain the separate yet complementary character of these two documents and to ensure that they will be interlocking but not overlapping requires the development of definite systems for each. Hence what is better described in the specifications should not be shown on the drawings and, similarly, what is better shown on the drawings should not be described in the specifications.

DRAWINGS

Drawings present a picture, or a series of pictures, of the structure or parts of a structure to be erected. They give the size, form, location, and arrangement of the various elements. This information cannot be described in the specifications since it is graphically shown by means of lines, dots, and symbols peculiar to drawings. In fact, a drawing is a special language or means of communication to convey ideas of construction from one person to another. These ideas cannot be conveyed by the use of words.

Drawings should generally show the following information:

1. Extent, size, shape, and location of component parts.
2. Location of materials, equipment, and fixtures.
3. Detail and overall dimensions.
4. Interrelation of materials, equipment, and space.
5. Schedules of finishes, windows, and doors.
6. Sizes of equipment.
7. Identification of class of material at its location.
8. Physical extent of alternates.

SPECIFICATIONS

Chapter 1 sets forth in detail some of the more pertinent functions of the specifications. With respect to their relationship to drawings, the specifications complement the drawings by describing qualities of materials, systems, and equipment; workmanship on-site and off-site fabrication; and installation and erection.

Specifications should generally describe the following items:

1. Type and quality of materials, equipment, and fixtures.
2. Quality of workmanship.
3. Methods of fabrication, installation, and erection.
4. Test and code requirements.
5. Gages of manufacturers' equipment.
6. Allowances and unit prices.
7. Alternates and options.

Specifications should not overlap or duplicate information contained on the drawings. Duplication, unless it is repeated exactly word for word, is harmful because it can lead to contradiction, confusion, misunderstanding, and difference of opinion. Duplication, word for word, is redundant.

COORDINATING THE DESIGN PROCESS

To achieve proper separation of information between drawings and specifications, it is essential that the development of the specifications go hand in hand with the preparation of the drawings. At the outset, someone in the office should be made responsible for establishing and keeping the all-important checklist for a specific project. This checklist should establish a schedule of what is to appear on the drawings, what is to be described in the specifications, and what is to be itemized and listed in schedules on the drawings. The checklist should include preliminary or outline specifications, lists of all decisions made in the drafting room, and notes of all changes made on the drawings since the last set was printed for the specifier, including questions to be settled.

The broad guidelines previously noted for the separation of material that appears on the drawings and in the specifications do not go far enough in establishing a line of demarcation between these documents, inasmuch as there are areas of disagreement among authorities on specifications writing as to the specific information that should be shown or specified or both. For example, one authority suggests that the drawings should indicate a material such as concrete and the specifications should determine whether it is to be precast or cast-in-place concrete. Preferably the drawings should delineate the location of these two different materials. Another authority argues against the customary hatching and other indication of materials on plans and elevations. If the experts disagree, how can the draftsman and the neophyte specifier settle the issue? Duplication will exist between drawings and specifications when there is a lack of a clear-cut and well-defined policy.

Generally, each office establishes a policy to be followed in its own practice. However, systems can be formulated between the specifier and the draftsman, and as a general rule it will follow that common sense will dictate which medium serves as the better means of communication.

To ensure complete understanding on the part of the contractor, it is essential that standard terminology be employed and used consistently on both drawings and specifications. Too often draftsmen use certain terms to identify materials on the drawings, which may differ from the terms employed by the specifier. For example, a draftsman may use the term "caulking" to describe all caulking and sealant work, whereas the specifier will be selective and discriminate between the choice of materials and terms, resulting in ambiguity and misunderstanding on the part of the contractor.

Quite often it is essential to identify classes of materials at specific locations so that the contractor can readily differentiate among the variety of classes of materials. For example, there may be several types of flashings illustrated on the drawings or several varieties of sealants shown. By ascribing numerical or alphabetical characters to these flashings or sealants, both on the drawing and in the specifications, the contractor has no problems identifying what material goes where. This system precludes the necessity for describing in the specifications the location of classes of similar materials.

To illustrate, let us consider the use of various types of sealants and joint fillers for both interior and exterior applications. At various joint details, the draftsman can indicate "Sealant No. 1," or "Sealant No. 2," and so on. He can likewise show "Filler No. 1," "Filler No. 2," and so forth. The specifier will describe in the specifications the required sealant and filler by using the same identifying numbers. With systems such as this, any contractor will have no difficulty in determining what type of sealant and filler is required in a specific joint. Similar systems can be developed for other materials so that like terminology is used for drawings and specifications.

RESOLVING CONFLICTS

We have a Supreme Court to resolve differences that occur in interpreting our Constitution. We also require a mechanism to resolve conflicting duplications that may occur within drawings, within specifications, and between drawings and specifications.

No matter how carefully construction documents are prepared, there are bound to be discrepancies. To resolve these conflicts, it is essential to set guidelines. Paragraph 1.2.3 of the *AIA General Conditions*, Document A201 (see Chapter 11), requires amendment in order to resolve discrepancies. A recommended supplement to Par. 1.2.3 is set forth in Chapter 11.

DEVIATIONS FROM THE GENERAL RULES

The specifier must recognize that specifying is not an exact science. While rules and standards are devised to simplify and guide the specifier, it is sometimes more expedient and beneficial to bend the rules. As an example, in alteration work, it would be prudent to place notes or specification language on a drawing next to certain details rather than within a specification, to highlight a peculiar condition. Essentially, rules and standards are devices for simplification, but when they become burdensome in their execution, they should be modified.

CHAPTER 6

Types of Specifications

In general there are two basic approaches to writing specifications: the *method system* and the *results system*. When the method system is employed,the specifier describes in detail the materials, workmanship, installation, and erection procedures to be used by the contractor in the conduct of the work operations in order to achieve the results expected. When the specifier instead elects to specify results, he places on the contractor the responsibility for securing the desired results by whatever methods the contractor chooses to use.

The method system can best be described as a descriptive specification; the results system is best described as a performance specification. An appropriate analogy can be made by comparing these approaches with building code standards. The specifications code sets forth specific materials and methods that are permitted under the law in the construction of a building. Under the performance code, materials and methods are left to the architect and engineer, provided that performance criteria for fire protection, structural adequacy, and sanitation are met. As a matter of fact, both the descriptive specification and the performance specification can be used together in the same project specification, each in its proper place, in order to achieve the prime objective.

PERFORMANCE SPECIFICATIONS

Until the advent of systems building, the performance specification was used to a very limited extent. Buildings were designed using unit materials that could be defined and specified by means of descriptive, proprietary, or reference specifications. Performance specifications were used primarily when the specifier required the contractor to match or obtain a result consistent with an existing situation. Specifying in this manner constituted a performance specification.

Other examples of performance specifications are involved with relatively simple requirements. Since end results are paramount, a *performance specification* can be defined as specifying an end result by formulating the criteria for its accomplishment. The criteria for materials are established on the basis of physical properties of the end product. The criteria for equipment of a mechanical nature are established by operating characteristics. As an example, in a performance specification for a paint material, the end result is obtained by specifying or formulating the following criteria.

1. The painted surface shall withstand 10 washings with a mild detergent.
2. The painted surface shall show no sign of alligatoring or crazing.
3. The painted surface shall be resistant to abrasion when using the Taber abrasive method.
4. The painted surface shall have an eggshell finish.

Another example of a performance specification is one for a complete installation of a heating system. The specification spells out the following performance requirements:

1. The heating plant shall be capable of providing an interior temperature of 70°F when the outside temperature is 0°F.
2. The heating system shall use No. 6 oil and shall be a hot-water system.
3. The heating elements shall be fin-type baseboard radiation.
4. Controls such as thermostats, aquastats, and other safety devices shall be provided to regulate heat and prevent explosion.

Since the advent of systems building using major assemblies and subassemblies, there developed a need for more sophisticated procedures to specify end results. Performance

specifications encompassing these parameters are more fully explained in Chapter 7.

DESCRIPTIVE SPECIFICATIONS

A *descriptive specification* can be defined as one that describes in detail the materials to be used and the workmanship required to fabricate, erect, and install the materials. Described in cookbook fashion are the materials, workmanship, installation, and erection procedures to be employed by the contractor. This approach is based on the wealth of information and experience that has been gained by the specifier from use of known materials and methods.

The specifier is aware that if he specifies known bricks and mortar and proper workmanship techniques which have previously been used and put together in a specific fashion, the contractor can erect a quality masonry wall. As an example, a descriptive specification for a masonry wall would describe the materials to be used: the brick and mortar ingredients, composition of the mortar, tests of individual components, weather conditions during erection, workmanship involved in laying up the brick, type of brick bond, jointing, and, finally, the cleaning procedures. This allows all those concerned with specifications an opportunity to check each of the items specified. The supplier furnishes the brick and mortar as specified; the laboratory tests the components in accordance with specified test requirements; and the inspector checks the workmanship requirements so carefully specified. If the specifications have been accurately prepared, the masonry wall is erected accordingly, and the result the architect envisioned is achieved through his minute description.

REFERENCE SPECIFICATIONS

The *reference specification* is one that refers to a standard established for either a material, a test method, or an installation procedure. These standards similarly are predicated on either descriptive or performance criteria.

Before the advent of materials standards such as American Society for Testing and Materials (ASTM) specifications, American National Standards Institute (ANSI) standards, or federal specifications, materials were minutely described in the specifications so that the contractor was completely aware of what the specifier wanted. In many instances, these descriptive specifications for materials have been supplanted by the aforementioned standards. For example, in lieu of describing portland cement in detail, as to quality, fineness module, and other characteristics, the specifier now simply states that portland cement must "meet the requirements of ASTM C-150, Type—." This method of specifying has resulted in a type of specification that can best be described as a reference specification. By making reference to a standard, the standard becomes a part of the specification in the same way as descriptive or performance specification language is used.

The term "reference specifications" also can be applied to workmanship standards. Various trade associations, such as the Tile Council of America, the Gypsum Association, the Painting and Decorating Contractors of America, and others, have prepared standard workmanship specifications—for ceramic tile; furring, lathing, and plastering; painting; and so on—that can be incorporated by reference in project specifications. By so doing, the detailed descriptive workmanship clauses for these sections no longer need to be copied, but can simply be incorporated into the project specifications by means of the reference method.

It is essential that the architect and specifier be thoroughly familiar with the standards incorporated in the specifications. Some standards cover several types and grades, and unless the type or grade is specifically stated, the choice then becomes the contractor's option and not the architect's. In addition, a particular type or grade may be more suited for a particular project so that it should be selected and specified by the architect in preference to another type or grade. Sometimes the types or grades apply to a specific climate or geographical area, and they are used automatically unless another quality is specified.

Most standard specifications have been developed by committees representing materials manufacturers, government authorities, testing agencies, consumers, and those having a general interest in the particular standard. In many cases, these standards are compromises; in some cases, only minimum property standards are established. In some instances, it may be necessary to augment or strengthen certain provisions of these standards. This can be done quite readily by modifying the standard. However, one must be certain when modifying a standard that the material can be manufactured or furnished under these modified standards.

All reference specifications used by an architect should be on file in the architect's office. These standards are needed to make certain that the material or the installation procedure the architect specifies by means of these standards are satisfactory to the architect and are pertinent to the project. The architect needs them to check materials and test procedures submitted for approval. If the architect elects to use a reference specification for workmanship or for a construction procedure taking place at the site, it will also be necessary for the resident project representative to have a copy of that reference specification since the detailed requirements are specified in the standard rather than in the basic specification. For example, the architect may refer to an American Concrete Institute Standard for cold weather concreting, which describes procedures for placing concrete in freezing temperatures; or to an ASTM specification for masonry mortar, which describes various materials and mixing proportions of mortar; or to an ANSI specification for setting ceramic tile, which describes

installation procedures. A simple procedure to ensure that the inspector at the site has the specification reference is to include in the base specifications a provision requiring the contractor to furnish these standards at the same time he makes all his other submittals for review.

PROPRIETARY SPECIFICATIONS

A *proprietary specification* is one in which the specifier states outright the actual make, model, catalog number, and so on, of a product or the installation instructions of a manufacturer. Where certain options are available, the specifier should include those pertinent to the project.

REFERENCE STANDARDS

Benefits of Standards

Inasmuch as the subject of reference specifications has been discussed above, it is relevant to discuss in more detail here reference standards and the organizations that produce them.

Architects and specifiers constantly make use of reference standards in specifications, but many professionals are completely unfamiliar with the processes by which these standards are developed and promulgated. Furthermore, many are not aware of the contribution they can make in participating in the development and improvement of these standards.

Standards provide several important benefits. They reduce the number of types, sizes, and qualities of materials. They standardize methods of testing, and several provide standards on the quality of workmanship.

One major benefit is the reduction in size of construction specifications. By incorporating a reference standard in a specification, the volume of words required to specify a material and the method of testing it is reduced a hundredfold. This assures the specifier some degree of quality since the reference standard reflects the combined knowledge and experience of the people engaged in its development.

Nevertheless, it is imperative that if the quality of reference standards is to be improved, there must be greater participation by users. This means affiliation of individuals and companies as members of associations producing standards. Practicing architects, engineers, and specifiers are particularly encouraged to participate, since their interests are more objective and less colored than individuals representing manufacturers and industry.

Generally, most committees producing standards are a balanced working group representing all the interests concerned with the particular standard. Typically, they are composed of manufacturers of the basic ingredients of the material, the manufacturers of the end product, suppliers, independent testing agencies, consumer groups, contractors' associations, representatives of public authorities, and others who have special interests in a particular standard.

ASTM Standards

The product and test standards most widely used in both the private and public sectors of construction are ASTM standards. The American Society for Testing and Materials is an international, private, technical, scientific, and educational society devoted, in its words, to "the promotion of knowledge of the materials of engineering and the standardization of specifications and the methods of testing."

Since 1898, this organization has conducted research into the properties of materials and has developed numerous standards concerned with the specifications for materials, methods of testing, and definitions. An index to ASTM standards and information on membership may be obtained from the society headquarters at 1916 Race Street, Philadelphia, PA 19103.

Federal Specification Standards

Among federal agencies the reference standards that were mandatory until recently were Federal Specifications. ASTM committees are taking over the task of setting standards for products formerly in the FS series. Remaining federal specifications are in the custody of the General Services Administration. Copies of the Federal Specification Index may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

ANSI Standards

Another widely used reference standard is the ANSI standard, promulgated by the American National Standards Institute. In addition to developing standards on materials and testing procedures, many standards used in construction include workmanship and installation procedures. This standards body works closely with other technical societies engaged in developing standards, and many ANSI standards bear corresponding ASTM, AASHTO, NFPA, and CS standards numbers. An index of standards may be obtained from the association at 1430 Broadway, New York, NY 10018.

ACI Standards

The American Concrete Institute (ACI) is a nonpartisan organization that gathers and disseminates information about the properties and applications of concrete and promulgates recommended practices referred to as ACI standards. A catalog of publications of this institute is available from P.O. Box 19150, Detroit, MI 48219.

NFPA Standards

The National Fire Protection Association (NFPA) develops fire protection standards that are widely used as a basis for laws and ordinances. The more widely known standards used in construction are the National Electrical Code (NEC) and the Life Safety Code (LSC). Information on membership, technical committees, and NFPA standards may be obtained from the association at Batterymarch Park, Quincy, MA 02269.

AASHTO Standards

The American Association of State Highway and Transportation Officials (AASHTO) publishes standards on highway materials in two parts, one dealing with specifications for materials and the second with methods of testing. These AASHTO standards may be obtained from this organization at 444 N. Capitol Street, Washington DC 20001.

Standards of the National Institute of Standards and Technology

Commercial Standards (CS) and Simplified Practice Recommendations (SPR) are voluntary standards issued by the Institute and developed cooperatively with industry groups. CS establish quality requirements for products and SPR establish size and classes for stock items.

The Institute had consolidated these two types of standards and provided a new name, Product Standards (PS), to describe these new standards being developed. The list of standards may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

CHAPTER 8

Specifications Writing Techniques

Specifications writing techniques embody certain methods of presenting information and instructions peculiar to this literary form, and they are therefore different from the writing style in an essay or a novel. The specifications are written instructions intended to complement the graphic illustrations. Since both documents are combined to convey the entire message, the information contained in the specifications should be presented in a form that interlocks and does not overlap or contradict.

SCOPE OF WORK

A common form of duplication in specifications writing that is superfluous and that can be dangerous is the use of a heading entitled "Scope of Work," or "Work Included," under which the work specified in detail in the ensuing section is summarized in outline form. Many specifiers may disagree with this assertion, and I cannot hope to make any converts out of this group. However, a review of the fundamentals of specification writing will convince the specifications trainee that the scope of work subhead, as written by some practitioners, is redundant, dangerous, time-consuming, and simply amounts to padding the specifications.

The danger in preparing a scope of work lies in duplication. The difficulties created by duplication are elaborated under the heading "Duplication—Repetition" in this chapter. For example, there have been specifications with a scope of work written for masonry which goes into such detail as follows:

> The work under this contract shall include all labor and materials required for the construction of the masonry work as follows:
>
> 1. Exterior face brick in cavity wall construction with concrete block backup.
> 2. Exterior face brick with stone concrete backup.
> 3. Exterior face brick with common brick backup for parapets.
> 4. Common brick for interior partitions where noted.
> 5. Concrete block for backup in exterior masonry walls.
> 6. Concrete block for interior partitions where noted.
> 7. Structural facing tile soaps at exterior walls.

This is not quite the end of the scope of work, as it goes on ad infinitum, ad nauseam. What has the specifier accomplished? Has he given the estimator information to price the work, the builder's superintendent directions in construction, or the architect's supervisor a check on the character and quality of materials and workmanship?

The drawings, if properly rendered, indicate the location of all the materials. The specifications should not and need not describe their location since the draftsman can make subsequent changes without notifying the specifier. Another danger which sometimes results is that the scope of work list is not expanded on later in the specification, leaving only a brief outline in the scope of work that is incomplete and forms no sound basis for bidding. The estimator cannot use the scope of work as complete for fear that he will not make a comprehensive takeoff. The danger with the scope of work paragraphs is that they are not complete, but only indicate the major portions of the work under the section. The estimator may accept the scope of work as complete and fail to read the remainder of the specifications, which contains other information essential for an accurate estimate.

There may be some items listed in the scope of work that are not completely described in the specifications, whereas there are other items of work sometimes described in the specifications, but not listed in the scope. A contractor may contend that he should not be required to furnish anything not listed in the scope of work. Lawsuits have been started on lesser grounds, but this is not the only problem. It is the

incident trouble and annoyance to the owner and the possible delay to the job that must be avoided. The argument in favor of the scope of work clauses is that they are a convenience to the contractor, but such clauses tend to lead the estimator, who is pressed for time, into the too common error of accepting the scope of work as sufficient in itself—with disastrous results.

Article 3.4.1 of the *AIA General Conditions* states in part that the contractor shall include all labor and materials necessary for the proper execution of the work. The general conditions, in turn, are part of the contract documents, and when the technical sections are written specifying clearly all materials, labor, and everything necessary to secure the construction of all that part of the building properly included in that technical section, a scope of work becomes redundant.

In general, the section title should indicate the scope of the section, and the table of contents is useful in alerting a contractor to any subdivision of similar work. For example, the section "Concrete Work" by itself in the table of contents would indicate that this section included all concrete work; whereas a table of contents that included such sections as "Concrete Roads and Walks," "Concrete Work," and "Precast Architectural Concrete" would inform the contractor that there is a subdivision of these items of concrete. Similarly, if the table of contents listed only "Unit Masonry," then all masonry work would be included under the heading; whereas a table of contents listing "Brick", "Concrete Unit Masonry", and "Structural Clay Tile" would alert the contractor that a breakdown of masonry work shown on the drawings is being specified under separate section titles.

There are instances, however, where a section title may not necessarily be completely informative, and a delineation of the work included under the section may be required. For example, the section title "Curtain Wall" can be used in one specification, but its content may include glazing, sealing, venetian blind pockets, and convector enclosures. In another specification the section title "Curtain Wall" may be limited to only the metal framing and metal panels, with glazing, sealing, and other items specified under their respective sections. In this instance, a comprehensive scope of work would be appropriate to define the content of the section entitled "Curtain Wall."

If it is necessary to provide the contractor with an itemized list of the subjects contained in the specifications, it can be furnished in the form of a complete table of contents. This is quite evidently a convenience only, and an omission cannot do the legal harm that might be caused by an incomplete statement of work included under the scope of work.

In effect, when the specifier uses a section title for a scope of work, or if he writes an abbreviated scope of work as follows:

> The work under this section of the specifications includes all labor, materials, equipment and services necessary to complete the concrete work as shown on the drawings and herein specified.

he has specified all concrete work under this one section. There is, then, no reason for him to enumerate concrete foundations, pits, walls, slabs, beams, and girders. It should be obvious that if the drawing indicates an item to be concrete, a specification for concrete materials and the placing of same has included all concrete shown. This simplified scope and the heading "Work of Other Sections," which is described next, should be sufficient to define what is and what is not the work covered by a specific technical section.

WORK OF OTHER SECTIONS

The heading "Work of Other Sections" should be reserved to exclude from a section those items a contractor might normally expect to find under a specific section, but which the specifier for good and sufficient reasons has elected to specify under another section. For example, under the earthwork section the heading "Work of Other Sections" could list the following:

1. Excavation, trenching, and backfilling for mechanical and electrical work are specified under their respective sections.
2. Furnishing of topsoil is specified under "Lawn and Planting."

Under the concrete section the heading "Work of Other Sections" could list the following:

1. Concrete bases for mechanical and electrical equipment are specified under their respective sections.

By using the section title "Concrete Work" as a scope of work, or by writing an abbreviated scope of work in the manner previously illustrated, the specifier, in effect, is stating that all concrete work is specified in this section, and that the only exceptions are the concrete bases for mechanical and electrical equipment, which are listed under "Work of Other Sections." It is far simpler and safer to exclude an item by the device of the "Work of Other Sections," than to attempt to enumerate under a scope of work the sum of the parts that make up the whole.

Unfortunately, there are some specifications that use headings such as "Work by Others" and "Work Not Included" as a substitute for "Work of Other Sections." These headings can be misleading, inasmuch as they imply that the work listed under these headings is not part of the contract. The heading "Work Not Included" should be reserved for, and used only for, listing those items that are not to be included as part of a contract.

The heading "Work of Other Sections" should not list related items which are not pertinent to the scope of a particular section. For example, under the heading "Work of Other Sections," in a built-up roofing section, the following has been listed:

A. Work of Other Sections

1. Membrane waterproofing.
2. Dampproofing.

Any subcontractor understands that work which is in no way related to his own is naturally not included, especially if it is not mentioned in the section. It is only work that reasonably might be inferred to be part of this work that should be listed as specified under the work of another section when that is the architect's intention.

A heading "Work Not Included," if properly used, should not be encumbered with work that is not normally done. This can be illustrated by a typical paragraph found in a painting section as follows:

B. Work Not Included

1. Painting of asphalt tile.
2. Painting of glass.
3. Painting of marble.

Certainly, if the specifier describes paint materials and their application on specific surfaces—such as wood, ferrous metal, plaster, and concrete block—the contractor will not paint asphalt tile, glass, and marble, whether listed under the "Work Not Included" heading or not.

GRANDFATHER CLAUSES

Individuals who are not properly grounded in the principles of specifications writing habitually fall back on general and all-inclusive language, which often results in what are termed "grandfather clauses" by specifiers and "murder clauses" by contractors—clauses that embrace everything, yet fail to be specific. A typical example of a grandfather clause might read as follows: "The contractor shall furnish and include everything necessary for the full and complete construction of the building whether shown or specified or not shown or described." When an architect is incompetent, he entrenches himself behind such a series of clauses, which may be interpreted to mean anything or nothing. In their failure to be specific, these clauses will, during the course of construction, require interpretations by the architect that may be difficult to enforce.

A clause such as "concrete floors shall be finished level as approved by the architect" without stating a tolerance means to the contractor, "Guess what I will make you do." An instruction to a contractor by means of drawing or a specification must be specific, and no architect should expect a contractor to fulfill a nonspecific requirement.

RESIDUARY LEGATEE

Where several different kinds or classes of similar materials are used, they should be described in a manner that permits some material to be specified for every part of the building. Such a technique has been borrowed from the legal profession and is a system known as the *residuary legatee*. To illustrate, let us assume that in preparing a will an individual wishes to leave the bulk of his estate to his wife, but wishes to make several minor bequests to his children or to relatives. He first enumerates his minor bequests and then states, in substance, "the residue of my property I bequeath to my wife." She is then known as the "residuary legatee."

In applying this principle to specifications writing, the materials occurring in the smallest quantity or in the fewest places should be listed first, and the material occurring in the remaining places becomes the residuary legatee and can be covered by some such phrase as "the rest of the building."

As examples of this technique the following samples are offered:

1. In specifying glass one can list the following:
   a. Obscure glass—all toilet rooms.
   b. Tempered glass—entrance doors and side lights.
   c. Plate glass—borrowed lights.
   d. Window glass—all other locations.

2. In specifying paint:
   a. Plaster surfaces in toilets—semigloss enamel.
   b. Plaster surfaces in kitchens—gloss enamel.
   c. Plaster surfaces in bedrooms—flat enamel.
   d. All other plaster—latex emulsion paint.

3. In specifying concrete:
   a. 2500 psi concrete—concrete foundations.
   b. 3000 psi concrete—concrete pavements.
   c. 3500 psi concrete—all other concrete work.

If this method is followed, some material will always be specified for every part of the building, whereas any other plan obliges the specifier to check all his listings most carefully for fear of not including some minor portion.

DUPLICATION—REPETITION

In Chapter 2 it was noted that the necessary information for the construction of a building is communicated to a contractor

in two forms, graphic (the drawings) and written (the specifications), and that these documents should complement one another. If this information overlaps, there can be duplication which may lead to a difference in instructions and disagreements as to which is the proper document to follow.

If this duplication were exact in each instance and remained so, it might be harmless at best; but too often the information presented on the drawings and that specified either does not agree in the first place, or, owing to last-minute changes, errors and differences develop which create entirely new meanings. Repetition in the contract documents is always dangerous and should be avoided.

Technically, duplication is an exact repetition, word for word, of a sentence or a paragraph in a specification, or else it is an exact repetition of a detail on a drawing. For example, a steel ladder might be detailed on a drawing, giving the size of the side members and the diameter and spacing of the rungs. The specification should describe the quality of the material and how the rungs are let into the side members, but it should not repeat the sizes and spacing since the drawing may be altered by the draftsman, with a resulting conflict in the two documents. The unnecessary expense involved in writing and reproducing statements that merely repeat may be minor in comparison to the ultimate cost to the owner of mistakes in specification interpretation.

An exact duplication in the specification or drawing should cause no misunderstanding. However, it is seldom that we see an exact duplication. In most cases the specifier attempts to avoid duplication or repetition by stating in different words what has been said or stated elsewhere, in order to amplify. But it is precisely in attempting to amplify or reiterate in different words that conflict and ambiguity occur. It is therefore good practice to make a statement only once; if it is not satisfactory, it should be discarded and rewritten, rather than amplified or explained in other terms.

IMPERATIVE MOOD

Specifications are written as instructions to a contractor to perform work under a contract. What the contractor needs is a set of instructions that are clear and unencumbered by superfluous language. Since he is the contractor and the instructions are intended as means and methods of accomplishing a goal, each set of instructions need not be preceded by the phrase "The contractor shall." The instructions can be simplified by omitting this phrase and using the imperative mood, thereby shortening each statement without losing any of its force or clarity.

The following illustration indicates how this can be accomplished: "The contractor shall install vinyl asbestos tile with the grain running in one direction." By eliminating "The contractor shall" we achieve the imperative mood with a simple declarative statement, without losing any contractual requirement for the contractor to perform.

CHAPTER 13

Specifying Materials

The selection of materials and equipment in the design of a structure is the responsibility of the architect. His or her professional judgment dictates the quality of the item to be specified. The architect is similarly responsible for selecting materials for use in conjunction with other materials or assemblies of materials and equipment in a composite design. Inasmuch as architects are held accountable for the success or failure of their plans and specifications, they should as a logical consequence be the master of their own fate and have ultimate control in this selection.

In many instances, standards for materials have been established by certain recognized authorities. They include ASTM Standards, Federal Specifications, ANSI Standards, AASHTO Specifications, and Product Standards. These standards establish various types, grades, and qualities, and, in addition, may offer many options. The standards can be used if found satisfactory by the specifier, or the specifier can upgrade their requirements by specifying additional characteristics. It is also customary and quite necessary to use trade or brand names in specifying materials when reference standards have not been developed and when, in the judgment of the architect, these brands or proprietary materials will fulfill the project requirements.

When brand names are used as a standard in a specification, it is almost impossible to include the names of all competitive materials that the architect may be willing to use. Competition is invited in order to obtain equitable costs to the owner. To allow for the possible use of other brands or makes without naming them in endless profusion, it has been the custom to follow the name given in the specifications with the words "or equal." This device has often led to conflict between architect and contractor concerning who should determine the equality of materials proposed for substitution. Undoubtedly, no phrase in specifications has been subject to more severe criticism than the phrase "or equal." That the use of this term is not satisfactory in controlling the selection of materials and equipment specified is attested to by the problems that have arisen from its use, by the countless seminars that have been held to discuss alternative approaches, and by the many articles that have appeared over the years in attempts to arrive at a more satisfactory solution.

As a result, several other systems are in use today. Descriptions of them are set forth on the following pages, beginning with a summary of the disadvantages of the traditional or equal specifications.

OR EQUAL SPECIFICATIONS

Or equal specifications usually name one, two, or several brand names and follow with the term "or equal" or "or approved equal." The following are some of the reasons that have been advanced for eliminating the term "or equal" from specifications:

1. When the "or equal" phrase is used, a bidder attempts to secure a lower price on a material than that specified, and he will be in doubt as to whether the architect will approve it. If the bidder takes a chance on this lower price material, he risks being forced to buy the higher priced material specified. If the bidder does not take this chance, he loses the advantages of the lower price, which might make the difference between winning or losing the contract.

2. The "or equal" clause increases the amount of office work the architect must perform in order to investigate all the "or equal" substitutions that are submitted by the contractor for approval.

3. It permits the contractor more opportunity for last-minute substitutions, requiring overhasty consideration by the architect.

4. Where a continuing project is developed in two or more phases of construction, the or equal clause may allow different materials to be used in the same project, and the maintenance problems of the owner are multiplied.

5. Although an alternate product may be equal or similar to the one specified, its use in conjunction with other assemblies, materials, or products may be unproven, unacceptable, improper, or even faulty. At times, additional costs are incurred while making adaptations to accommodate the alternate product, and such costs are difficult to resolve. While the architect derives no benefit in making adaptations, it often has caused additional expense to the architect in connection with the changes.

6. It contributes heavily to "bid shopping," which results in delays in construction, since the substitution is usually submitted at the last moment and interferes with the routine process of careful evaluation by the architect.

7. It takes control of the project away from the architect who is responsible for its execution.

OPEN SPECIFICATIONS

The *open specification* for materials and equipment is written without reference to brand names or proprietary makes. This type of specification is used most commonly for public work, and it can be used in private work. It can be written quite simply by the use of reference specifications which make reference to recognized standards as discussed in Chapter 6. In the absence of standards for some items, notably for mechanical and electrical equipment, a descriptive or performance specification must be prepared to present complete and comprehensive data on the product required. The open specification is intended to invite the greatest amount of competition and to maintain complete impartiality among various manufacturers.

The open specification can be used for many basic materials when reference is made to recognized standards. These standards include such materials as structural steel, cement, gypsum, ceramic tile, concrete masonry units, roofing felts and bitumen, and a host of other materials. It becomes inadequate when the architect seeks to specify paints, many sealants, concrete admixtures, elastomeric waterproofing materials, and, generally, the man-made products of chemistry, since the promulgation of adequate standards lags far behind the development of these products. Standards are similarly inadequate for specifying such equipment as boilers, lighting fixtures, fans, pumps, and other items of a mechanical or electrical nature. For these products, the architect and engineer contrive to write an open specification setting forth descriptive or performance characteristics that create voluminous specifications.

When reference specifications are used, the architect and engineer can approve submissions quite readily by requiring certifications from manufacturers attesting to compliance of their products with the standards specified. However, when descriptive or performance specifications for materials and equipment are employed, the architect and engineer must carefully check the submission against all the provisions that have been minutely specified. Failure by the architect to check compliance with even one aspect of the specifications, which may result in a subsequent failure, can lead to legal action against the architect by the owner for having approved a product that did not comply with the specifications.

BASE BID OR CLOSED SPECIFICATIONS

A *base bid* or *closed specification* is one in which the architect specifies only one brand name or proprietary make for each individual material, piece of equipment, or product. Occasionally he may augment this brand name with a brief descriptive specification or cite performance characteristics. The intent of this type of specification is to limit the bidding to products that the architect or engineer has specifically selected for the project. The bidder has no choice under this base bid specification.

Under this system, product selection and responsibility rest entirely with the architect. It enables the architect to set room sizes, headroom, and vital dimensions, clearances, and foundations, especially for mechanical equipment. In addition, bid shopping is eliminated, which does away with unnecessary construction delays that are a by-product of this practice.

Under this system, competition is excluded, and the owner does not necessarily get the best value for his dollar. The architect is sometimes unfairly accused of favoritism by the manufacturer or supplier not included in the specifications. The contractor is compelled to use the product of a manufacturer or a supplier with whom he does not regularly do business and may experience difficulty with credit and delivery. In addition, the contractor may not have had experience in the installation of the specific product named and may be required to guarantee an installation with which he has had no previous experience.

BIDDER'S CHOICE OR RESTRICTED SPECIFICATION

The *bidder's choice* or *restricted specification* is akin to the base bid or closed specification, except that the architect names two or more brand names or proprietary makes for each item he or she wishes to use.

The architect should investigate each of the products he or she proposes to specify to make certain that like or equal products are put into competition with one another. This has an advantage over the base bid specification in that competition is invited. The architect must be careful not to

equate several materials where one is so much lower in price that it negates the advantage of competitive bidding and, in effect, creates a closed specification.

BIDDER'S LIST OF SUBSTITUTIONS

Under this method, the bidder is permitted to submit alternates or substitutions for the materials or equipment specified. These substitutions are listed and included with his bid, along with the net difference in cost if the substitution is accepted. Generally, the bid must also include the name, brand, catalog number, and manufacturer of the proposed substitute, together with complete specifications and descriptive data.

When one calculates the hundreds of items used in the construction of a building and the quantity of products manufactured, the number of substitutions can be staggering. An evaluation and analysis of bids to determine an acceptable low bidder would be a Herculean task, and the bids would no longer be predicated on the architect's original selection of materials and equipment.

This method does not entirely achieve the element of competition. Since each bidder is free to submit any substitution, and since each of the bidders is unaware of what substitutions his competitor may offer, there is no competition on the substitutions offered.

PRODUCT APPROVAL STANDARDS

Under this method, products are clearly defined by using specification standards where possible, by using specific product names, by specifying more than one product where possible, and by listing basic criteria where desirable. Bids are based on the use of any product meeting established standards (such as ASTM) or the products specified. However, upon application, bidders are permitted to request approval of products during the bidding period, within established limits. If the architect approves the product, it is listed in an addendum so that all bidders compete on the same basis.

Obviously, some of the disadvantages of methods discussed above can be applied to this method. However, this method does achieve the following:

1. Control of products by the architect.
2. Competition.
3. Fairness in attracting other products of which the architect may not have been aware at the time of preparation of documents.
4. Elimination of the risk to bidders in accepting products other than those specified.
5. Closer bidding.
6. Discouragement of bid peddling or shopping.
7. Administration of equality at the proper time and by the proper agency.
8. Complete flexibility.

Under the Product Approval Standards, manufacturers of materials and equipment receive consideration under competitive bidding procedures. The auction is over when the bids are submitted. The possibility of the successful contractor submitting after award of a contract (under the or equal method) material or equipment not previously known to all bidders, and which in effect prevents the owner from obtaining competitive prices, is precluded.

This method lends itself to use in projects involving public funds. According to the U.S. General Accounting Office, this procedure can be used by federal agencies if they so decide. Legal officers in state, county, and municipal governments can similarly be apprised of this solution and may give approval to this method so that the use of the term "or equal," as it has been used and abused, is placed in proper perspective.

Note that the intent of equality to obtain competition is not changed or excluded from the specification. Rather, the time for evaluation is adjusted so as to occur prior to the bid date.

The greatest apparent drawback is the possibility of a substantial number of requests for approval, within a limited time. Carefully prepared specifications, a slightly extended bidding period, and allotment of sufficient time prior to bid date as the deadline for approvals minimize the problem.

Control of the project is achieved so that at the time bids are received there is no doubt about the quality of products to be used. Competition is obtained through the basic qualification. In addition, other products that prove to be acceptable can further increase competition. No one with an acceptable product need be kept out. Prime contract bidders can be confident of the product bids they are using in their estimates. Less gamble, less contingency, and sharper bidding are the results.

Bid peddling and shopping are reduced, resulting in more competitive bids from product suppliers. The competitive products are known, and it is also known that a lower priced nonspecified product cannot be offered, and possibly accepted, after bids are received. Therefore, the best price possible consistent with the desired quality can be offered as a firm bid, with reasonable assurance that the price will not be undercut by an unknown or "nonequal." This method removes the problem of bidders claiming that a certain product is equal, and that it was used in their bid. The contractor is not damaged financially as a result of a rejected product. Complete flexibility can be easily realized. Recognized standards can be used completely if available. One product or 20 can be specified, depending on criteria and the owner's requirements, and every element of design and function can

be considered. Conditions can be varied from project to project, and from public work to private work. The length of time for approvals can be varied.

The same care is essential with this method as it is with most others. Products must be properly and clearly specified. The basis for evaluation of products must be stated. Proposed substitutions must be given complete consideration, careful review, and honest evaluation.

Administration of Product Approval Standards

State or specify the conditions only once under Section 01600, Material and Equipment (see Chapter 12); this establishes the conditions of consideration. The term "or equal" is omitted under individual specification sections or detailed requirements. This forces a bidder to refer to the proper article regarding approval. List all known products acceptable for the project. This is not an overwhelming task; a file can soon be built up to reduce the bulk of the work for most items. Wherever possible use only established standards—such as ASTM, Federal Specifications, and so on—that have been determined acceptable for the project, modifying them where necessary. Insofar as possible, list basic criteria that must be met for product consideration. However, meeting the criteria may not always qualify a product because of intangibles and variables.

Written requests are essential and should be mandatory for the following reasons:

1. They form a basis of understanding in the event of a later claim of misinterpretation.
2. Endless worthless hours on the telephone with persons who are reasonably sure that their product does not comply, but who feel that a phone try is worthwhile, are eliminated.
3. Written requests are generally submitted only by persons with a genuine interest in bidding.
4. They permit a review and evaluation in the quiet of normal office procedure, without the pressure of a sales pitch.
5. For a given level of quality, they weed out requests for products that are obviously below requirements. After an unsuccessful attempt or two, the person making the request stops trying.

Requests should be considered only from prime bidders. Time must be allotted for review and evaluation of requests. This may be difficult at first. However, time always has to be made available for such a review after bids are received, and the process is merely reversed to pre-bid time. This method must be administered and enforced with a strong will. Deviations cannot be permitted (even to friends in the industry). If the product is not specified, it cannot be used.

Occasionally an equal product is omitted, possibly by oversight. This does not change the conditions, and if the manufacturer does not find his product in the specification, he should request that it be included by one of the prime bidders. Each job and each owner's prejudices are individual considerations. A manufacturer cannot assume that he is approved.

In fairness to bidders, prompt consideration should be given. Addenda should be issued as the bidding period progresses so that those who make early application can know whether they are approved or not, in time for their "takeoff."

Specifying Product Approval Standards

The language to be incorporated in Section 01600 if product approval standards are to be used for specifying materials is illustrated in Chapter 12, Exhibit 12-9.

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Specification Language

It is not intended, nor indeed is it possible, for this chapter to be a treatise on English grammar and readable writing. Rather, we shall examine why it is necessary to use proper specification language. Each statement in a specification carries a dollar sign alongside it, whether it is concerned with specifying materials, instructing a contractor on installation procedures, or describing workmanship. The contractor expects to be paid for each order given him by the specifier, and the contractor's bid reflects every statement in the specifications. Using vague ambiguous language indicates that the specifier may want something but is unsure about demanding it. Statements such as "tests will be required unless waived." "additional shop drawings and samples may be required," and "uneven surfaces may be cause for rejection" are examples of equivocation that plague the contractor. Specification language should be precise, not vague. The precise specification can be enforced; the vague one may be difficult to enforce and will still cost the owner money because the contractor has included the cost in his bid.

The essential requirement for writing specifications, aside from technical know-how, is the ability to express one's self in good English. Although the specifications are one of the contract documents that becomes a legal document, legal phraseology is not necessary. A statement in good, clear English may be even more definite, unequivocal, and understandable to the superintendent and the foreman than legal wording.

Language is a means of communication. Unlike graphic communication, where symbols and cross-hatching have precise meanings, words must be carefully selected to transmit information. There are subtle variations in the choice of language, and the word or term selected to communicate an instruction may be interpreted by a contractor quite differently from what was intended by the specifier.

Consider the word "smooth." The dictionary defines it as "having an even surface; devoid of surface roughness." The term "smooth" has been employed in specifications as follows: "Bituminous road surfaces shall be smooth." Yet a preferred texture for the road surface to reduce skidding is a rough texture. Concrete floors have been specified to have a smooth, wood float finish; or a smooth, rubbed finish; or a smooth, trowelled finish. However, in each case the degree of smoothness varies. It would be preferable to select the tool that will accomplish a result and rely on it to achieve the surface finish desired by specifying its use as follows: "Finish concrete floors with a wood trowel," or "rub concrete steps with carborundum stone," or "steel trowel concrete floors."

In order to communicate with language, the architect should visualize grammar as well as he or she perceives design. Grammar is not just obeying rules; it is the power politics of language. Words rule other words; subjects have objects. Prepositions are powerful indicators, instruments of authority, and traffic directors. All this suggests the visual, and grammar should be visualized as much as possible.

There are three important Cs for specification writing. The wording of specifications should be *clear*, *correct* and *concise*: clear so there is no ambiguity; correct technically; and concise so there is no excessive verbiage. A good specification is one containing the fewest words that can be used to complete the description and make sense. Verbosity and repetition lead to ambiguity.

Considering those who are to use the specifications, it is evident that specifications must be made clear to some whose vocabulary may be limited. The meaning should be grasped readily even by the workmen. A specification written in English that is clear even to the mechanics on the job is the logical form to use. If a mechanic cannot interpret specifications, he will not be able to execute them.

Since specifications are instructions to the contractor, they should be definite and mandatory. To be mandatory they must be imperative. Therefore use the imperative "shall"

with reference to the work of the contractor and never use the vague and indefinite "will" or "to be." The proper place to use "will" is in a statement describing the acts of the owner or the architect.

Some examples of specification language are contained in a series of *Maxims for Specification Writing* by the late H. Griffith Edwards, FAIA, FCSI, as follows:

Maxim No. 2: Be Brief

Specifications tend to be too lengthy in spite of the greatest economy of words. A constant effort should be made by all specification writers to say the same thing with less verbiage and in a condensed manner. Avoid long and involved sentences.

The following submaxims will help in this regard.

a. *Specify Standard Articles by Reference to Accepted Standard Specification.* For example: Many words would be necessary to describe properly a common product such as portland cement: its chemical composition, fineness, soundness, compressive strength, tensile strength, and so on should be mentioned. All these words are eliminated by a simple reference to the standard, thus: *Portland Cement* shall meet the requirements of ASTM C 150, Types I and II.

b. *Avoid Repetition of Information Shown or Scheduled on the Drawings.* Also, avoid duplication within the specifications themselves. This will eliminate words and the possibility of contradiction.

c. *Do Not Include Inapplicable Text.* Avoid discussion of materials or methods that do not pertain to the construction work for which a set of specifications is prepared, as it is confusing to bidders. When old project specifications are used for the preparation of the new project specifications, the writer sometimes carelessly overlooks deleting inapplicable material.

d. *Never Make the Word "Contractor" the Subject of a Sentence in a Trade Section.* Instead, make the material or method the subject. This is a maxim from Arthur W. Farrell, Head Specification Writer, 6th U.S. Naval District of the Bureau of Yards and Docks. Not only will this make your sentence shorter, but it will also put up front the key word to serve as a title, thus:

Poor: *Rubbed Finish* Contractor shall apply a rubbed finish to exposed surfaces of concrete.

Better: *Rubbed Finish* shall be applied to exposed surfaces of concrete.

e. *Eliminate Superfluous Words Such as the Following:*

All:

The use of the word "all" is frequently unnecessary.

Poor: Store all millwork under shelter.

Better: Store millwork under shelter.

Which:

"Which" and other relative pronouns such as "who" and "that" should be used sparingly, if at all.

Poor: Install bathroom accessories which are to be purchased under an allowance. . . .

Better: Install bathroom accessories to be purchased under an allowance. . . .

The:

Definite article "the" and indefinite articles "a" and "an" need not be used in many instances. The following paragraph actually reads better with the underscored words deleted:

The Contractor shall strip the top soil from the area to be excavated and graded, and neatly pile it on the property; then, after all the backfilling is finished and all the areas graded, the available top soil shall be spread over the areas to be seeded or planted.

Of:

The preposition "of" may often be eliminated to shorten the text:

Poor: For colors see Schedule of Paint Finishes.

Better: For colors see Paint Finish Schedule.

Poor: Apply one coat of stipple finish to walls in the Office of the Manager.

Better: Apply one stipple finish coat to walls in Manager's Office.

f. *Use Numerals Instead of Writing Out Numbers.* The practice of using numerals, rather than writing out the numbers throughout specifications, is recommended for the reason that numerals are used on the drawings and they make for clearer, easier reading, and it shortens the text. Numerals on the drawings, which are part of the contract documents, are considered legally binding, and numerals in specifications are similarly legally binding.

Poor: Four feet, six inches, Twenty-six gauge. . . .

Better: 4 ft 6 in., 26 gauge. . . .

g. *Use Well-Known and Accepted Abbreviations.* The use of abbreviations facilitates reading, reduces the typing, and shortens the text without sacrificing clarity. The following abbreviations may be used with impunity:

General Abbreviations, such as ASTM, bbl, Co., Corp., cu, Fed. Spec., ft, gal, hr, in., Inc., lb, lin., max., min., o.c., oz, sec, sq, wt.

Engineering Abbreviations, such as ACI, AISC, ID, psi, psf, rd.

Lumber Abbreviations, such as AD, Btr., Com., Dim., EM, J&P, KD, M, Mbm, SIS, S2S, S4S, T&G, VIS, V2S, VG.

Electrical Abbreviations, such as Amp, kW, hp, AC, DC, NEC, AWG.

h. *Use Simple Imperative Mood and Simple Present Infinitive as Often as Possible to Shorten the Text.* Because specifications are written instructions addressed to the contractor, the simple imperative mood is quite appropriate.

Poor: Contractor shall install lighting fixtures which will be furnished by Owner.

Better: Install fixtures to be furnished by Owner.

i. *Consider the Use of Streamlined Specifications.* In *Pencil Points Magazine* in August 1939 there appeared an article entitled "Streamlined Specifications" by Horace W. Peaslee, FAIA, proposing writing specifications in an outline form without the use of complete sentences. For example, a paragraph in a masonry section would be written as follows:

MORTAR MATERIALS:

Portland Cement: ASTM C 150, Type I.

Masonry Cement: ASTM C 91, Type II.

Slag Cement: ASTM C 358.

Hydrated Lime: ASTM C207. Putty by adding water. Store 24 hr before use.

Sand: ASTM C 144.

Maxim No. 3: Use Simple and Clear Language

. . . which is readily understood by the average layman. Be specific. Avoid the use of indefinite words or clauses. Attempt to prepare specifications that will require no interpretation as to meaning.

Under this maxim there are the following submaxims:

a. *Use "Shall" in Connection with Acts of the Contractor, or with Labor, Materials, or Equipment to be Furnished by Him.* But the use of the simple imperative mood is even better.

Poor: Brick will be laid in running bond.

Better: Brick shall be laid in running bond.

Best: Lay brick in running bond.

b. *Avoid the Use of "Must" and "Is to" and Substitute the Word "Shall" or the Simple Imperative Mood.* This prevents the inference of different degrees of obligation.

Poor: Each joint must be filled solid with mortar.

Poor: Each joint is to be filled solid with mortar.

Better: Each joint shall be filled solid with mortar.

Best: Fill each joint solid with mortar.

c. *Do Not Use "Any" When a Choice Is Not Intended.* Because "any" implies a choice, it should not be used when a choice is not intended, as for example:

Poor: Any materials rejected shall be removed.

Better: Materials rejected shall be removed.

Best: Remove rejected materials.

when no choice is intended.

Poor: Glass panels shall be installed on either side of main entrance.

Better: Glass panels shall be installed on both sides of main entrance.

Best: Install glass panels on both sides of main entrance.

e. *Do Not Use "Same" as a Pronoun.*

Poor: If materials are rejected, the Contractor shall replace same at no additional cost.

Better: Replace rejected materials at no additional cost.

f. *Do Not Use "Said" as an Adjective.*

Poor: Said materials shall be replaced at no additional cost.

Better: Replace rejected materials at no additional cost.

g. *Do Not Use "and/or."* This is a stilted legal expression. The word "or" or "both" should be used in place of "and/or."

Poor: Brick shall be made of clay and/or shale.

Better: Brick shall be made of clay, shale, or a combination of both.

h. *Do Not Use "Etc."* Placed at the end of a list of items, "etc." shows that the specification writer obviously does not know what comprises the complete list, or he is too lazy to write it out. The use of "etc." is vague, puts unnecessary responsibility on the contractor, and therefore should not be used. As one specification writer puts it, "It is better to be definite even if you are wrong; then, at least, there is a firm basis for negotiating the corrections."

Poor: All standing trim, running trim, etc., shall be painted.

Better: Paint exposed millwork.

i. *Do Not Use Phrase "Contractor Shall Furnish and Install."* Since it is established by the general conditions that the contractor shall provide and pay for all materials, labor, water, tools, equipment, light, power, transportation, and other facilities, unless otherwise stipulated, for the execution and completion of the work, it is redundant to use the phrase in other sections.

Poor: Contractor shall furnish and install standard size face brick.

Better: Face brick shall be standard size.

j. *Do Not Use Phrase "To the Satisfaction of the Architect" and Similar Phrases Such as "as the Architect May Direct," "Acceptable to the Architect," and "in the Opinion of the Architect."* Instead, specify exactly what the architect's directions are, or definitely what would be satisfactory or

acceptable to the architect. Do not leave contractor guessing and at the mercy of architect's future decisions.

Poor: Brick shall be laid to the satisfaction of the Architect.

Better: Brick shall be laid plumb and true with all joints completely filled with mortar.

k. *Do Not Use Phrase "A Workmanlike Job" and Similar Phrases Such as "a High-Class Job" and "a First-Class Job."* Instead, the type of workmanship expected should be described in detail.

Poor: Brick shall be laid in a workmanlike manner.

Better: Brick shall be laid plumb and true with all joints completely filled with mortar.

Maxim No. 5: Make Specifications a Reference Text

A set of specifications is a reference text, and the preparation of an alphabetical cross-index is too involved and complicated to be practical. Furthermore, work should be separated into trade sections reflecting the methods by which work is sublet in the region of the job. Therefore, a logical arrangement of the data covered by the specifications becomes mandatory to facilitate reference and the subletting of work.

a. *Provide Titles for All Articles.* There is no need to use titles for paragraphs in novels and similar literature, but titles should be provided for articles and paragraphs in reference texts. Since specifications are used extensively for reference, titles should be provided, not only for the articles, but also for the paragraphs. Most specification writers accomplish this by choosing key word or words reflecting the contents, and identifying them as illustrated below:

1.01 *ARTICLES:* The titles of articles are capitalized.

A. *Paragraphs:* Titles of paragraphs are capitalized letters.

1. *Items* may also be lowercase and underlined.

2. *Numbering Items:* Items are usually numbered 1, 2, 3, and so on.

b. *Capitalize for Easy Reference.* The general rules regarding the capitalization of the first letter of certain words should be followed, but in addition, certain words are written the same as proper names in specifications. They are

1. *Parties to the Contract,* including Owner and Contractor and those defined in the General Conditions of the Contract including Architect and Subcontractor.

2. *Spaces of the Building,* such as Principal's Office, Auditorium, Library, Teachers' Lounge, and Clinic.

3. *The Contract Documents,* including Agreement, General Conditions of the Contract, Supplementary General Conditions, Drawings, and Specifications.

4. *Grades of Materials,* such as B and Btr southern pine, Intermediate Heat Duty fire clay brick, Standard Grade ceramic tile, and Type I Regular Core hardwood plywood.

c. *Minimize Cross-References in the Specifications to Drawings, to Specification Sections, and to Specification Articles and Paragraphs.* When absolutely necessary, do so by referring to titles instead of numbers (numbers are changed more often than titles during developmental stages).

Poor: *PILE CAPS* as detailed on Drawing No. S 1 are specified under Section No. 3A.

Better: *PILE CAPS* as detailed on Foundation drawings are specified under CONCRETE section.

d. *Do Not Use Long Block Articles, That Is, Long Unbroken Articles Covering Several Phases of One Subject.* Instead, break the article into paragraphs and give titles to paragraphs for ready reference and better comprehension, as illustrated by the following example:

Poor: *TESTS:* Materials used in this work shall be tested by the manufacturer before shipment. Drainage and vent piping shall be tested before fixtures are installed by capping or plugging the openings, filling the entire system with water, and allowing it to stand thus filled for 3 hr. Water supply piping and hot-water tanks and heaters inside the building shall be tested by capping or plugging the openings, connecting up a test pump, filling the system with water, and applying a hydrostatic pressure of 150 lb/in.^{2}. Water piping may be tested before fixtures or faucets are connected. Each fixture shall be tested for soundness, stability of support, and satisfactory operation of all its parts. After fixtures have been installed, all traps shall be filled and a smoke test shall be applied to show up any leaks in the fixtures or connections. Piping shall be absolutely tight under test. Screwed and soldered piping not tight under test shall be taken down and reassembled. Joints in cast iron piping not tight under test shall be replaced with new heaters and tanks. Certificates of tests and final acceptance, to be issued by the local Plumbing Inspector, shall be delivered to the Architect.

Better: *TESTS:* Materials used in this work shall be tested by the manufacturer before shipment.

a. *Drainage and Vent Piping* shall be tested before fixtures are installed by capping or plugging the openings, filling the entire system with water, and allowing it to stand thus filled for 3 hr.

b. *Water Supply* piping and the hot-water tanks and heaters inside the building shall

be tested by capping or plugging the openings, connecting up a test pump, filling the system with water, and applying a hydrostatic pressure of 150 lb/in.^{2}. Water piping may be tested before fixtures or faucets are connected.

c. *Fixtures:* Each fixture shall be tested for soundness, stability of support, and satisfactory operation of all its parts. After fixtures have been installed, all traps shall be filled and a smoke test shall be applied to show up any leaks in the fixtures or connections.

d. *Piping* shall be absolutely tight under test.

e. *Screwed and Soldered Piping* not tight under test shall be taken down and reassembled.

f. *Joints in Cast Iron Piping* not tight under test shall be dug out and joints recaulked and repoured.

g. *Tanks and Heaters* not tight under test shall be replaced with new heaters and tanks.

h. *Certificates of Tests* and final acceptance, to be issued by the local Plumbing Inspector, shall be delivered to the Architect.

Materials Evaluation

There are many factors to consider when selecting and evaluating materials, equipment, components, and systems for use in construction. Some considerations would include the proposed life span of the structure, the geographic location, the environment, and the proposed occupancy. Each of these factors has a bearing on the longevity of the selected product. To aid the specifier in analyzing those criteria that have an influence on an ultimate decision and to ensure that, in the process, no stone is left unturned, the performance characteristics shown in Exhibit 16-1 will aid the specifier in his quest.

The accomplished specifier will usually have no difficulty in assessing traditional building materials for specific geographic and environmental conditions. This is due to the fact that there is a long history of performance of certain materials under known conditions. However, with the more recently developed building materials, particularly those that are the products of modern-day chemistry, the same long-term performance behavior patterns cannot be applied. As a matter of fact, even traditional materials will experience faster degradation when exposed in new geographical environments, or when the environment changes. Here are several examples. Brownstone, quarried in arid climates in the American West, fared poorly when used for steps and facades of "brownstones" in New York City. Marbles, which withstood several millenia in structures on the Acropolis, in Athens, have seen marked deterioration in less than 100 years when exposed to the products of combustion generated by automobile fumes and acid rain.

USING PERFORMANCE CHARACTERISTICS

When using the performance characteristics shown in Exhibit 16-1, the specifier will be less likely to overlook an essential attribute. As a matter of fact, the utilization of an analytical approach, such as suggested by the exhibit, will trigger other essential inquiries that might not surface since this is a coherent interrogation. Although the list may be long, the specifier may not need to examine every attribute, since a particular material intended for use in a particular portion of the building may not be subjected to the specific performance.

In utilizing Exhibit 16-1, which is a list of attributes sought in a product, there are two additional elements that must be propounded and answered to determine whether the product meets the needs of the attribute. The two additional elements are (1) criterion, and (2) test. For example, if the attribute "flame spread" is an essential attribute for a ceiling material in an exit corridor, most fire codes and building codes would establish a flame spread not to exceed 25. The material to be utilized would be required to meet the criteria of a flame spread not to exceed 25, measured by test method ASTM E84; so that the performance could be expressed as:

Attribute: flame spread
Criterion: not to exceed 25
Test: ASTM E84

NEW PRODUCTS

For new products there are two major areas that involve materials evaluation. The first deals with the development of a product or a material to fit a particular situation created by specific requirements. The second involves an evaluation of the properties of a newly developed material or product to determine if the manufacturer's claims match his test results, thus warranting the use of his product.

For a product to be developed to meet a specific requirement, the specifier must establish the conditions under which

PERFORMANCE CHARACTERISTICS

Structural Serviceability

- Natural forces
  - Wind
  - Seismic
- Strength
  - Compression
  - Hardness
  - Indentation
  - Modules of rupture
  - Shear
  - Tension
  - Torsion

Fire Safety

- Fire resistance
- Flame spread
- Smoke development
- Toxicity

Habitability

- Acoustic properties
- Sound absorption
- Sound transmission
- Noise reduction coefficient
- Hygiene, comfort, safety
  - Air infiltration
  - Mildew resistance
  - Slip resistance
  - Toxicity
  - Vermin infestation
- Thermal properties
  - Thermal expansion
  - Thermal shock
  - Thermal transmittance and resistance
- Water permeability
  - Moisture expansion and drying shrinkage
  - Water absorption
  - Water vapor transmission

Durability

- Adhesion of coatings
  - Blistering
  - Delamination
- Dimensional stability
  - Expansion
  - Shrinkage
  - Volume change
- Mechanical properties
  - Resistance to bursting
  - Resistance to fatigue
  - Resistance to splitting
  - Resistance to tearing
- Resistance to wear
  - Abrasion
  - Scratching
  - Scrubbing
  - Scuffing
- Weathering
  - Bactericidal
  - Chemical fumes
  - Fading
  - Freeze–thaw
  - Ozone
  - Ultraviolet (UV) radiation

Compatibility

- Chemical interaction
- Differential thermal movement
- Galvanic interaction

EXHIBIT 16-1. **Performance Characteristics.**

it is to be used and the criteria for testing and acceptance. For example, if a floor is to be subjected to unusual hazards, such as moisture, acid spillage, hot jet fuels, and printers' ink, a standard flooring material might not be available to satisfy all the design conditions. The specifier would have to establish the design criteria. He or she would have to determine which unusual fluids would be likely to spill on the floor and to what extent the proposed flooring should resist the effects of such spillage. The specifier would have to take into account resistance to abrasion, slip resistance, indentation, hardness, heat resistance, and similar factors. He or she can establish the parameters by selecting certain ASTM test procedures by which these characteristics would be measured. After determining which test procedure to use, the specifier can set minimum and maximum values for the test results and ask manufacturers to formulate a product to meet these criteria. The end product from a manufacturer would be an epoxy, neoprene, polyester, acrylic, or a urethane formulation. The specific basic ingredient is not important to the architect and specifier. The end result (or the performance characteristics determined by the materials evaluation) is all that is essential.

New products are developed by manufacturers either to fill a specific need or to improve existing products. For the

:ost part, manufacturers, rather than architects, have taken :e lead in developing new products. After they are developed, :e manufacturer brings the items to the attention of architects :nd specifiers. Where the products are referenced by the :anufacturer to a reference standard, such as a federal, ASTM, or ANSI specification, there is no major problem :nvolved with evaluating the new product. However, many :ew products are specifically designed by the manufacturers :o keep ahead of their competition. In these cases, the physical :nd chemical properties are not referenced to known standards. A specifier investigating these products finds them difficult :o evaluate without normal standards of comparison. Some- :imes the manufacturer develops his own test methods, and :he results have no correlation with standard test procedures.

What procedures does a specifier follow in evaluating :ew products? He must take several factors into account. One is the integrity of the manufacturer. Has he had a successful record in the past for developing good products? Has he field tested the new product? Is there any correlation between his field tests and his laboratory testing? Has he tested the significant properties of the product?

The reliability of the source of information and its authenticity should be investigated. Check with other architects and engineers if they are given as references to determine whether the condition of use is similar to that proposed for your project. Demand additional test data if necessary. Suggest specific properties to be tested.

Review the problems to be encountered in the field in the handling and installation of a new product. Will there be an adequate fully trained corps of trades who understand how to handle the new product? Are there franchised applicators? Are there any special precautions to be observed with respect to volatile solvents, flammable materials, or staining of adjacent surfaces?

The evaluation of new or untried materials for possible use should include discussions with the manufacturer to obtain long-term guarantees to ensure additional safeguards for the client and the design professional.

For a more comprehensive treatise on materials and the evaluation and selection the reader is directed to *Construction Materials for Architecture* by Harold Rosen (New York: Wiley, 1985).

CHAPTER 17

Specifications Writing Procedures

How does one write a specification? The uninitiated practitioner faced with the task of writing a specification for his or her first project does what all other beginners have done who have not had a basic understanding of the principles of specification writing. In this emergency, the specifier begs from some friend of older practice the specifications of another undertaking as like in character to his or her own as can be found, and then cuts, pastes, writes in, and crosses out as well as he or she knows how, to make a patchwork that will apply more or less to the structure to be planned.

However, armed with the principles of specification writing, the task becomes less onerous and more manageable. A system of specifications writing procedures should include the work preliminary to the actual writing of the specifications, the outline or preliminary specifications, the sources of information, the form and arrangement of the specifications, the actual writing of the specifications, and, finally, the reproduction and binding of the specifications. These procedures deal with time-tested methods such as the use of guide or master specifications, checklists, work sheets, and catalog files.

Reduced to their simplest form, specifications should be written according to an organized system. A good draftsman develops systematic methods of laying out drawings. A good office has logical standards for indication of doors, windows, and the other countless elements of the drawings. Similarly, a specifier must have a system for the preparation of specifications, especially since they must be written after the drawings have progressed to a point where they are about 50% completed and the time available to write and complete the specifications is scant. The pressure of time thus makes a systematic approach essential.

PRELIMINARY OR OUTLINE SPECIFICATIONS

One of the first documents that a specifier must have is a preliminary or an outline specification. This is generally prepared during the design development phase and is used along with the design development drawings in the preparation of a preliminary estimate. It is also used to permit the architect and owner to have a mutually understood program of materials, equipment, and requirements for the project.

There are no AIA or CSI standards that establish the format, arrangement, or scope of preliminary specifications, and as a result of this omission, the requirements vary considerably. In essence, since they are intended to obtain a preliminary estimate, only a brief description of materials, finishes, and equipment is essential. Workmanship is not included, except if it would have a significant influence on cost.

While preliminary specifications are often changed in the development of final specifications, they are extremely useful to the specifier, since a good deal is retained that is beneficial in the preparation of final specifications.

While there are no hard and fast rules on form and content, a recommended preliminary specification is illustrated in Appendix A. This can be used as a guide.

PROJECT MANUAL CHECKLIST

The next step in the preparation of final specifications is to prepare a complete takeoff of every item from the working drawings. With the takeoff, a Project Manual checklist, and the outline specifications the specifier is now in a position to establish the technical sections pertinent to the project.

The Project Manual checklist acts as a reminder to the specifier to check with the project architect, job captain, and designer for specific information to be included in the specifications or to be noted on drawings. It is organized on the basis of the CSI Format and arranged so that items that apply to the project can receive a check mark, or be circled or underlined. Where blanks are provided the information is simply filled in. Where no information is required, the spaces can be left blank, or the items can be left unmarked or crossed out depending on the system adopted by the individual specifier.

Illustrated in Appendix B is a suggested Project Manual checklist that had been developed by the late Lester Seubert, FCSI, a former member of the AIA Specifications Committee. Since CSI documents are updated frequently, check the latest document for the correct broad-scope and narrow-scope five-digit numbers and titles. Another checklist source is *The Specifications Writer's Book of Checklists and Forms*, by H. Leslie Simmons, AIA, CSI (New York: Wiley, 1985).

WRITING THE SPECIFICATION

With the technical sections now established based on the complete takeoff of every item from the working drawings, on a review of the outline specifications, and on the Project Manual checklist, the specifier is now in a position to start and complete some sections, and to start and gather information on other sections, or do research on some materials where there is insufficient information. The nature of specification writing is such that one cannot start writing immediately and continue until the project is completed. There will be a need for conferences with the job captain and designer to arrive at decisions on many items, and it will be necessary to obtain information from manufacturers and their representatives on materials and products when the architectural details involving these items are in doubt and require clarification and research.

There are many sections that can be written on the basis of incomplete drawings. These should be written at the outset since they are not likely to change during the development of the drawings. Such sections include those under Division 9, Finishes, for example, ceramic tile, terrazzo, resilient flooring, and acoustic treatment. Other sections that can be written around partially completed drawings include earthwork, concrete, toilet partitions, and masonry.

To write these sections, many specifiers will have their own guide or master specifications, which they have carefully developed over the years. To be truly effective, these guides should not be static, and they should be revised as dictated by experience and new developments. Some people refer to these guides as canned specifications. However, it is difficult to see how any specification writer can do without such a valuable tool, which comprises the sum total of the specifier's experiences and best efforts to write better specifications.

Specifiers, like any other individuals, naturally develop their own personal idiosyncrasies with respect to the systems they will develop in organizing themselves, their work habits, and their approach to the task of writing specifications. Some use card systems on which they develop standard paragraphs; others use collections of notes and checklists. Whatever system is employed, it should be orderly and systematic.

The following principles will aid the beginner in establishing a procedure for writing specifications when the task is first approached.

1. Review the preliminary or outline specifications to obtain a better understanding of the project.

2. Review the preliminary drawings to visualize the project and obtain a better insight.

3. Since the architectural specifier is the focal point of all the specifications, determine who the consultants are for the structural, mechanical, electrical, and site specifications. Coordinate their activities and establish the form, arrangement, and numbering system of the technical sections. To ensure coordination between the respective sections so that there is no duplication or overlapping, submit a coordination list to all the consultants for agreement on what goes where. See Exhibit 17-1 for a Specification Coordination Checklist.

4. Review the working drawings and prepare a table of contents of the technical sections. (See Chapter 3 for typical section titles.)

5. Make a takeoff from the drawings of all the items and list them on work sheets under the appropriate section titles. For example, under the section title "Miscellaneous Iron and Steel," make a listing of such items as railings, ladders, stairs, saddles, gratings, and mesh partitions, and indicate the drawings on which the details occur so that they can be easily found again when the final specification is written.

6. Discuss questions relating to any of these items with the job captain, designer, or any other individual, and determine what will be shown on the drawings and what will be specified (see Chapter 2). Determine which items require additional research, note these, and perform the necessary investigation at a time when a lack of sufficient drawings precludes actual writing of specifications.

7. Commence the actual writing of the specifications. Use guide or master specifications where these are available and use the takeoff list and the checklists to ensure completeness of each section.

Project Architect _____

Mechanical and Electrical
Consultants _____

Structural Consultants _____

Site Consultants _____

Mark as follows:
F. Furnish I. Install FI. Furnish and Install

	Architectural	Food Service	Conveying Systems	Plumbing	Heating and Ventilation	Sprinkler	Electrical
1. Temporary water							
2. Temporary toilets							
3. Temporary heat							
4. Temporary fire protection							
5. Temporary light and power							
6. Temporary emergency lighting							
7. Excavation and backfill inside building for each trade if not by Architectural							
8. Excavation and backfill outside building for each trade if not by Architectural							
9. Keeping site and excavation free from water							
10. Underfloor drains							
11. Footing drains							
12. Drywells							
13. Connection of underfloor and footing drains to storm drain system							
14. Forms for foundations and pads for trade items							
15. Concrete for foundations and pads							
16. Headwalls							
17. Septic tank							
18. Disposal field							
19. Drainage manholes							
20. Sanitary manholes							
21. Steam manholes							
22. Electrical manholes and handholes							
23. Drainage catch basins							
24. Drainage manhole frames and covers							
25. Sanitary manhole frames and covers							
26. Steam manhole frames and covers							
27. Electrical manhole and handhole frames and covers							
28. Drainage catch basin frames and covers							
29. Pit frames and covers							
30. Catwalks to trade equipment							
31. Ladders to trade equipment and valves							
32. Supplementary steel for trade equipment							
33. Ornamental HVAC grilles							
34. Exterior wall louvers							
35. Louver connections to ducts							
36. Vent pipe cap flashing							
37. Vent pipe base flashing							
38. Curb cap flashing for trade equipment							
39. Curb base flashing for trade equipment							
40. Roof drains							
41. Roof drain flashing							
42. Waterproofing of ceramic tile showers							
43. Waterproofing of mop receptors							
44. Thermal insulation of boiler room ceiling							
45. Door louvers							
46. Access panels and support frames in plaster							
47. Access panels and support frames in masonry							
48. Access panels and support frames in acoustical tile							

EXHIBIT 17-1. **Specification coordination checklist.**

SPECIFICATION COORDINATION CHECKLIST	Architectural	Food Service	Conveying Systems	Plumbing	Heating and Ventilation	Sprinkler	Electrical
49. Vermiculite fireproof covering							
50. Cutting to accommodate trade items							
51. Rough patching							
52. Finish patching							
53. Prime painting of trade piping and ductwork							
54. Finish painting of trade piping and ductwork							
55. Prime painting of trade equipment							
56. Finish painting of trade equipment							
57. Color coding of piping							
58. Toilet room accessories							
59. Central soap dispensing system							
60. Kitchenette unit							
61. Kitchenette unit connections							
62. Walk-in refrigerator							
63. Walk-in refrigerator compressors, piping, and controls							
64. Valved supplies, waste, and vent piping for food service equipment							
65. Valved supplies, waste, and vent piping for laboratory equipment							
66. Valved supplies, waste, and vent piping for hospital equipment							
67. Sink strainers and tailpieces							
68. Supply fittings for food service equipment							
69. Supply fittings for laboratory equipment							
70. Supply fittings for hospital equipment							
71. Greasetraps							
72. Booster heaters							
73. Hoods for food service equipment							
74. Hoods for dishwashing equipment							
75. Hoods for laboratory equipment							
76. Ductwork for hoods							
77. X-ray equipment							
78. X-ray equipment supports							
79. X-ray equipment connections							
80. Sterilizer equipment							
81. Sterilizer equipment connections							
82. Surgical lights							
83. Surgical light supports							
84. Surgical light connections							
85. X-ray film illuminators							
86. X-ray film illuminator connections							
87. Panel heating system							
88. Panel heating system connections							
89. Sound control rooms							
90. Sound control room silencers							
91. Sound control room wiring and devices							
92. Sound control room connections							
93. Elevator machine support beams							
94. Elevator hoistway frames, doors, and saddles							
95. Conveying system controls							
96. Conveying system disconnect switch and power wiring							
97. Moving stair and sidewalk frames							
98. Sidewalk elevator frame and door							

EXHIBIT 17-1. **(Continued)**

SPECIFICATION COORDINATION CHECKLIST	Architectural	Food Service	Conveying Syster	Plumbing	Heating and Ven	Sprinkler	Electrical
99. Linen and garbage chutes							
100. Window washing equipment							
101. Pneumatic tube system							
102. Conveyor system							
103. Shower stall pan flashing							
104. Gang showers							
105. Prefabricated showers							
106. Fire hose and extinguisher cabinets							
107. Fire extinguishers							
108. Incinerator							
109. Incinerator connections							
110. Chimney breeching frame							
111. Chimney cleanout door							
112. Prefabricated chimney							
113. Convector enclosures							
114. Fan coil enclosures							
115. Induction unit enclosures							
116. Cabinet heater enclosures							
117. Lighting fixture supports							
118. Plaster rings for lighting fixtures							
119. Lightning protection							
120. Watchmen's system							
121. Intercommunications system							
122. Clocks							
123. Exterior transformer vault							
124. Transformer vault entrance							

EXHIBIT 17-1. **(Continued)**

8. Select those sections that will not be affected by further development of the drawings as previously described and complete these sections. Start those sections on which there is a good deal of information that can be gleaned from the drawings. Note the information that will be required in order to complete them at a later date. Arrange the information within each section as described in Chapter 5.

9. Do the required research on unknowns when you can no longer proceed with any actual specification writing.

10. Leave until the very last those sections that require almost complete working drawings, such as carpentry and millwork, and miscellaneous and ornamental metal.