

# Reference Specifications for Energy and Resource Efficiency

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## ABSTRACT

- Internet reference for construction document development
- Covers energy efficiency, indoor air quality, and material resource efficiency
- For use by architects, engineers, lighting designers and specification writers

## Introduction

The science of energy efficient building design is fairly mature, yet most buildings designed today fail to reach optimum energy efficiency. While ample information is available about energy efficient components and systems, that information does not make it into the plans and specifications – the construction documents that guide contractors in the field. The technology of *specifying* efficient buildings is not yet mature.

Architects, engineers, and lighting designers generally wish to include energy efficient elements in their designs, but they don't have the information readily available. Typically, specifications from previous jobs are recycled and evolve slowly over time. Therefore, standard specifications usually fail to include up-to-date requirements for energy efficient materials, systems, and commissioning.

This paper and display describe a set of Internet-based reference specifications developed in California with public research and development funding. Architects, engineers, lighting designers and specification writers can use these reference specifications by selecting elements and inserting them into their construction documents. The purpose is to provide easily accessed information to help solve the problem of out-of-date specifications. The topics include:

- Energy efficiency of the building envelope, lighting and HVAC systems
- Indoor air quality
- Material resource efficiency

These specifications and supporting information were written by a team of practicing architects, engineers, lighting designers and energy consultants who are recognized experts in the field of energy efficiency, indoor air quality and green building design. The material is a combination of information developed for past design projects as well as examples from manufacturers and other reference sources (AIA 1997; CSI 1995; E Build; Holmes 1999).

## **Approach**

These specifications aim to provide a resource that is useful to building designers for specifying energy efficient systems, including:

- architects,
- engineers,
- lighting designers, and
- specification writers

They address portions of building specifications that are typically deficient or critical in ensuring that correct energy efficient equipment is installed and commissioned properly. These specifications supplement existing energy efficiency guidelines and references. Users may select portions of the reference specifications to insert into their current project specifications.

## **Building Types Covered**

The reference specifications are most useful for medium to large commercial and institutional (i.e. public) buildings. However, portions will be applicable to any building type.

## **Audience**

The targeted users are architects, engineers, and specification writers who develop specifications as part of the project manual component of the Construction Documents. These professionals are expected to have prior knowledge of specifications for traditional systems, but limited knowledge of the specific products or methods addressed by the reference specifications.

## **Contents**

Each of the reference specification sections addresses one or more of the following issues:

- Energy efficiency.
- Indoor air quality: total volatile organic compounds, individual volatile organic compounds, semi organic volatile organic compounds, microbial volatile organic compounds, particulates, and durability.
- Resource efficient materials: recycled content, recyclability, embodied energy, transportation energy, packaging materials, durability.

To address those issues, the reference specifications cover the following topics (as relevant for each section).

- Contractor responsibilities, capabilities, and/or qualifications.
- Scheduling
- Submittals
- Contract close out procedures

- Minimum or maximum values for performance characteristics (e.g. solar heat gain coefficient for glazing, volatile organic compound emissions, recycled content), and equipment efficiencies if appropriate.
- Required test standards for performance ratings, and/or required test methods and conditions.
- Installation or execution requirements.
- Commissioning requirements.
- Performance verification requirements.
- Coordination between trades
- Training.
- Operating and maintenance documentation.

Information is organized by the 16-division Construction Specifiers' Institute (CSI) format (CSI 1995). Each section includes specification language that may be cut and pasted into a designer's construction documents. In addition, each section includes a set of notes that explain the justifications, benefits, cost impact, and further resources for more information.

Most information common to many sections is combined into one of several Division 1 (General Requirements) specification sections. For example, general requirements for recycled content of materials is included in section *01350 Special Environmental Requirements*, and specific recycled content values are listed in individual sections such as *05120 Structural Steel*. Similarly, general building commissioning requirements are listed in *01810 Building Commissioning* while specific testing requirements are listed in individual sections. Table 1 lists the complete outline of topics covered by the reference specifications.

## **Market Research**

A market research study helped form the content and format of the reference specifications. The research consisted of eighteen (18) in-depth interviews with architects, mechanical engineers, electrical engineers, design build contractors, lighting designers, and specification writers.

All of the research participants were pre-recruited from the San Francisco Bay Area and Southern California. All Southern California and some Bay Area interviews were conducted by telephone. The remainder of the San Francisco Bay Area interviews were held in-person at the respondents' places of work. The in-person interviews were audio recorded.

Each interview lasted approximately 45 to 75 minutes each. All of the interviews loosely followed an interview guide, which appears in the Appendix of this report. The interviewer employed a Delphi technique to allow the earlier interviews to inform and enhance subsequent interviews.

This research indicates that there is a need for up-to-date, accessible, and reliable energy and resource efficiency information. A web site limited to the actual specification language of alternatives holds less appeal than a site offering more comprehensive general information on energy and resource efficiency alternatives in addition to the reference specifications.

## Table 1 Contents of Reference Specifications

### *Division 01 General Conditions*

01350 Special Environmental Requirements  
01575 Site Waste Management Program  
01810 Building Commissioning

### *Division 02 Sitework*

02870 Site Furnishings

### *Division 03 Concrete*

03050 Basic Concrete Materials and Methods  
03455 Precast Panels with Stone Veneer or Tile

### *Division 04 Masonry*

04050 Basic Masonry Materials and Methods  
04400 Stone

### *Division 05 Steel*

05120 Structural Steel  
05300 Metal Deck

### *Division 06 Wood and Plastics*

06070 Wood Treatment  
06080 Factory-Applied Wood Coatings  
06100 Rough Carpentry  
06200 Finish Carpentry  
06405 Interior Architectural Woodwork  
06650 Plastic Materials

### *Division 07 Thermal and Moisture Protection*

07211 Fiberglass Batt Building Insulation  
07212 Mineral Wool Batt Building Insulation  
07213 Cellulose (Blown-in) Building Insulation  
07214 Fiberglass (Blown-in) Building Insulation  
07215 Mineral (Blown-in) Building Insulation  
07216 Foam Board Building Insulation  
07217 Radiant Barrier Building Insulation  
07240 Exterior Insulating Finish System (EIFS)  
07500 Membrane Roofing  
07610 Sheet Metal Roofing

### *Division 08 Doors, Windows and Hardware*

08100 Metal Doors and Frames  
08200 Wood and Plastic Doors  
08331 Overhead Coiling doors  
08410 Metal-Framed Storefronts  
08520 Aluminum Windows  
08550 Wood-Framed Windows  
08560 Plastic-Framed Windows  
08565 Glass-Fiber-Framed Windows  
08620 Unit Skylights  
08630 Metal-Framed Skylights  
08810 Glass  
08910 Metal-Framed Curtain Wall

### *Division 09 Finishes*

09260 Gypsum Board Assemblies  
09310 Ceramic Tile  
09510 Acoustical Ceilings  
09650 Resilient Flooring  
09680 Carpet  
09720 Wall Covering  
09750 Stone Facing  
09900 Paints and Coatings

### *Division 10 Specialties*

10270 Access Flooring

### *Division 12 Furnishings*

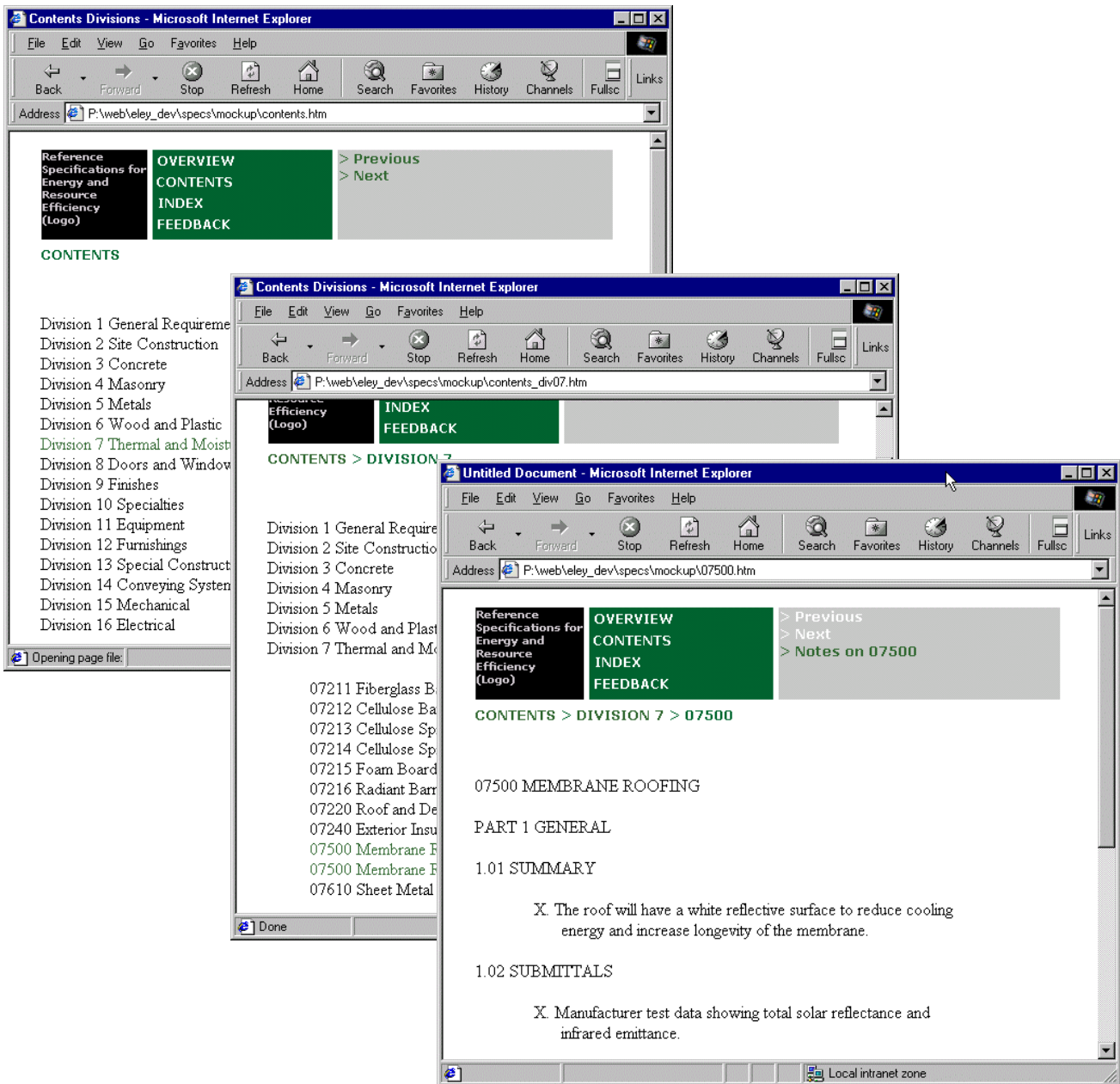
12490 Window shades  
12500 Furniture  
12515 Office Systems Furniture  
12520 Seating

### *Division 15 Mechanical*

15??? Operating and Maintenance documentation  
15xxx Training  
15180 Heating and Cooling Piping  
15510 Heating Boilers and Accessories  
15530 Furnaces  
15620 Packaged Water Chillers  
15640 Packaged Cooling Towers  
15720 Air Handling Units  
15730 Unitary Air Conditioning Equipment  
15740 Heat Pumps  
15780 Energy Recovery Equipment  
15810 Ducts  
15830 Fans  
15840 Air Terminal Units  
15860 Air Cleaning Devices  
15900 HVAC Instrumentation and Controls  
15950 Testing, Adjusting, and Balancing  
15995 Mechanical Systems Commissioning  
15xxx Evaporative cooling

### *Division 16 Electrical*

16xxx Lighting General Conditions  
Lighting Performance Monitoring  
Lighting Commissioning  
16xxx Operating and Maintenance documentation  
16xxx Training  
16510 Interior Luminaires  
16520 Exterior Luminaires  
16900 Occupancy sensors  
Time controls  
Daylighting controls



**Figure 1 Example of Internet Format for Reference Specifications**

Presentation of the information in a manner that addresses the diverse needs of architects, consulting engineers (including lighting designers), and specification writers will be a challenge. Potential users regard material selection and specification as a complicated process with which they need assistance. This is especially true when specifying energy and resource efficient products. Therefore, it is recommended that the site concept be expanded to include the advantages and disadvantages of material alternatives, including their relative costs. Optimally, these would include: first costs, maintenance costs, and life-cycle costs.

It is important to note, however, that despite the demand for comprehensive information on material/product alternatives, a web site devoted to specifications would nevertheless be well received, although by a much smaller market segment. Those who would use the site include specification writers, smaller architectural firms with a sustainable bent that write their own specifications, and “green” oriented engineering consultants.

In order to serve the interests and needs of all market segments, the site needs be heavily embedded, allowing architects quick views of energy and resource efficiency options while supplying the expanded detail necessary to address the needs of individuals writing actual specifications.

Architects quickly lose interest in a site if it lacks visual appeal and/or is too wordy. Therefore, it is important that the site be graphically pleasing. Consideration should also be given to providing photographs or renderings of examples. These enhanced visual dimensions will increase the likelihood that architects will access the site and its information.

In addition, the inclusion of links to manufacturers’ web sites for further product information as well as links to sites offering related information will increase the overall value of the proposed web site.

Utilizing CSI classifications affords target users easy access to the information in a familiar and welcomed industry standard format.

It is crucial that the site be updated frequently, at least quarterly or bi-annually. Without timely updates, the web site will quickly lose its credibility and value.

## **References**

AIA. 1997. *Environmental Resource Guide*. New York. John Wiley & Sons.

CSI. 1995. *MasterFormat<sup>TM</sup>, Master List of Numbers and Titles for the Construction Industry*. Alexandria, Virginia. The Construction Specifications Institute and Construction Specifications Canada.

E Build. *Environmental Building News*. Brattleboro, VT.

Holmes, Dwight, et al. 1999. *GreenSpec<sup>TM</sup>*. E Build Inc.