Introduction to Building Design Specifications and Tools

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An Introduction to Building Design Specifications and Tools

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This course is adapted from the *Unified Facilities Criteria* of the United States government, which is in the public domain, has unlimited distribution and is not copyrighted.

1. OVERVIEW

This course will introduce you to the most important resource available to engineers and architects engaged in the design of buildings and related infrastructure. It represents the collective knowledge of thousands of engineers and architects over the past century. It will provide you with design guidance based on building and space types, design disciplines and objectives, and products and systems. It will provide you project management resources focused on project delivery teams, project planning and development, building commissioning, and project delivery and controls. You will have a single, easy-to-access source for operations and maintenance guidance, and exceptionally useful reference materials and tools. This is hands-on information that is easy to access and use that has been proven over-and-over on thousands of projects from small and routine to enormous and unique. You will learn how to quickly access and navigate this resource and put it to work for you on your next project. And….it is free!

2. THE KNOWLEDGE WE USE IN OUR PROFESSION

There are two types of knowledge we use in designing and managing the construction of buildings and related infrastructure:

- **Theoretical**
- **Experiential**

The *theoretical knowledge* we use is what we learned in engineering school, essentially the laws of applied physics (Bernoulli's equation, the laws of statics and dynamics, conservation of momentum, F=ma, the Second Law of Thermodynamics, etc.).

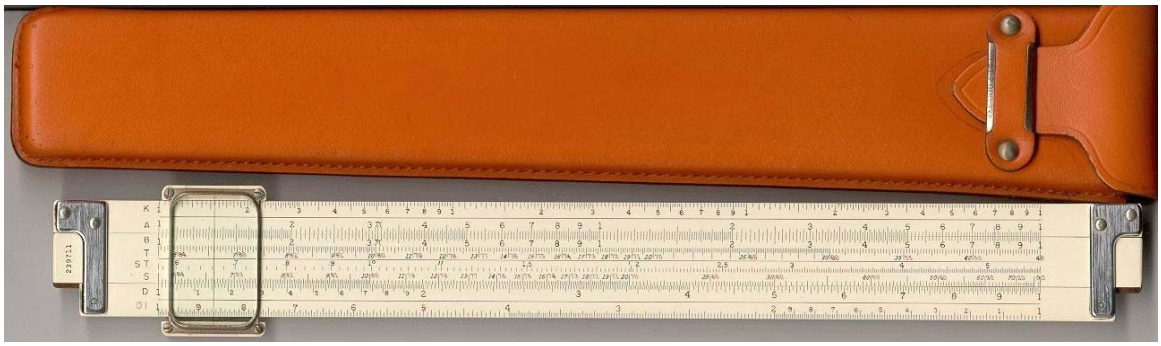
Experiential knowledge is what we have learned, or been informed about by others, through on-the-job experience (100 sf space allowance per occupant for office space, 1/4"/ft slope for drainage piping, 10 air changes per hour for restroom ventilation, etc.).

This course is about accelerating your *experiential knowledge*. You will learn from the millions of hours of experience of many thousands of engineers and architects over the past hundred years. You will learn about an accessible and easy-to-use resource that brings this information together and provides you with proven design and construction guidelines, standards and tools to use immediately in your day-to-day project design. This type of resource was not available ten years ago; it truly provides a new dimension to our enterprise….designing and managing the construction of buildings and related infrastructure.

This course will introduce you to a resource that will immediately put at your disposal the collective *experiential knowledge* of thousands of engineers and architects gained on thousands of large and small building and infrastructure projects over the past hundred years.

3. BUT FIRST, SOME HISTORICAL PERSPECTIVE….

Less than 50 years ago these were the tools available to engineers to apply *theoretical knowledge.* A slide rule….



….and a Marchant calculator.

With these rudimentary tools Hoover Dam, the Sears Tower, and most of the Interstate Highway System were designed. Today, of course, all manner of computing, calculating and graphic tools are available.

50 years ago to access and utilize *experiential knowledge* the only media available were hard-cover books, manuals, monographs and reports that were not

easy to be cognizant of and often difficult to obtain. For example, when designing the California State Water Project in the 1960s the "data base" of experiential knowledge was hard-cover manuals and documents published by the Tennessee Valley Authority, Corps of Engineers, and the Bureau of Reclamation. That was the state of the engineering art before the invention of the computer and the internet. Any information you could get was in hard-copy format.

In the last half of the 20th century federal agencies, particularly the Department of Defense (DOD), began to pull together and document the experiential knowledge its engineers had gained over the past 50 years in designing and constructing thousands of building and infrastructure projects. These initial efforts were parochial and there was not a lot of sharing among agencies even within DOD. The result was a lot of hard-copy documentation of experiential knowledge that was scattered, obscured and difficult to access.

The computer and the internet have of course completely changed not only the technology to apply *theoretical* knowledge (i.e. calculators, computers) but to access *experiential* knowledge (data bases, the internet, Googling, etc.) . To its credit the federal government, particularly DOD, has taken the initiative to correlate its scattered experiential knowledge bases and develop an internet-based platform that allows the building design and construction community at-large to access and benefit from it. It has done this utilizing the coordination efforts of the *National Institute of Building Standards* (NIBS). NIBS has undertaken to pull this federal experiential knowledge base together into a single, comprehensive, easily accessible, internet based resource called the *Whole Building Design Guide* (WBDG). This course will tell you how the WBDG is structured, walk you through some examples of how to access information you

need….and will tell you about the modules that are particularly valuable and others that, in their current state of development, are less so.

4. THE WHOLE BUILDING DESIGN GUIDE (WBDG)

The Whole Building Design Guide….

WHOLE BUILDING DESIGN GUIDE

http://www.wbdg.org/

National Institute of Building Sciences

is….

- an internet portal
- an easily accessible internet-based source of the ***experiential knowledge*** of thousands of engineers, architects and construction professional garnered over more than 100 years and tens of thousands of projects.
- reflective, primarily, of the most experienced building and infrastructure design and construction institution in the world….the U.S. federal government.
- a compilation of design and construction guidance, detailed specifications, and computer based tools and CAD details that are up-to-date and ready for use on projects today.
- continuously updated and revised by design and construction professionals to reflect changes in building and infrastructure design and construction methods and materials.

Before learning about what it can do for you in your day-to-day engineering activities, some comments are in order….

- ***First,*** do not make the mistake of assuming this *experiential knowledge* base is "federal" and therefore not useful "in the real world." This is not

the case. This is an engineering knowledge base that is applicable across the spectrum of building and infrastructure projects your company or agency will encounter.

- ***Second,*** do not assume that because it is a federally generated knowledge base that it is "excessively complex and bureaucratic." This is not the case. Building design and construction is a complex undertaking and a knowledge base for this enterprise must inherently reflect that complexity….but the WBDG is not *excessively* complex. Although you will see the names of federal agencies extensively throughout the base, you need to simply look past them to the substantive guidance provided.

- ***Third,*** an important factor in appreciation of resources accessible through the WBDG is that it is a "living" base of experiential knowledge that is continually updated and refined by engineers working daily on real projects. This is the only knowledge base that has this real-time/real-world aspect. There are information resources in the professional community that may parallel some components in the WBDG, but they are usually produced by volunteer committees and updated only episodically. This is not to depreciate their importance in professional practice, but they lack the timeliness and proven utility of the federal *experiential knowledge* accessible through the WBDG portal. The manner in which the WBDG is generated also reduces the possibility of inappropriate influence exerted by vendors in the development of design and construction guidance.

- ***Fourth,*** do not think of the WBDG as being a "cook book" approach to building design. It is not. The WBDG provides access to *guidance* that is always to be evaluated and tempered by professional judgment. It may

seem less useful to an experienced engineer, but it needs to be recognized that many engineers with lesser levels of qualification and experience are employed by companies and agencies, and they will find the guidance the WBDG provides helpful.

- ***Fifth, the WBDG can be useful when using "Design-Build."*** This is because if a company or public agency does not include design and construction criteria in its contract with a Design-Build Contractor, it will have little control over the quality of the work. The knowledge resources available through the WBDG provide a universe of design and construction criteria that can be incorporated *by reference* into a contract between a Company/Public Agency and a Design-Build Contractor. This can be very helpful to an owner in controlling the quality and cost of a project being constructed using Design-Build.

- ***And finally***, there are components and modules of the WBDG that are particularly useful, and others that….in their current state of development….are less so. To help you focus quickly on the best resources, topics of particular importance and utility will be designated with a  . Exceptionally useful features get  .

5. THE WHOLE BUILDING DESIGN GUIDE (WBDG) PORTAL

Click on the link **WBDG** **http://www.wbdg.org** and go to the opening page of the WBDG.

> In moving through this course you will be prompted to use your browser to go to internet pages. These prompts will look like this: WBDG http://www.wbdg.org/ . When you come to one of these, go to the indicated page in your browser and continue with the course.

The opening page is rather busy, which can lead to confusion. To minimize this, focus at least initially just on these "tabs" or "pull-down menus" (remember, the  indicates where exceptionally useful information is located)….

- ❑ DESIGN GUIDANCE
- ❑ PROJECT MANAGEMENT
- ❑ OPERATIONS AND MAINTENANCE

- ❑ DOCUMENTS AND REFERENCES

- ❑ TOOLS

The following two tabs are not very useful and will not be discussed further:

- ❑ CONTINUING EDUCATION
- ❑ BIM

6. DESIGN GUIDANCE

Click on the:

DESIGN GUIDANCE http://www.wbdg.org/design/index.php

link and you see the following tabs or pull-down menus:

- BUILDING TYPES: Information organized by type of building or use

- SPACE TYPES: Information organized by functional space in buildings
- DESIGN DISCIPLINES: Information organized by professional discipline

- DESIGN OBJECTIVES: Information organized by design goal
- PRODUCTS AND SYSTEMS: Information organized by design goal

The information in the BUILDING TYPES and SPACE TYPES elements is moderately useful, but the most useful design guidance information is in the UNIFIED FACILITIES CRITERIA which is buried deep in the DOCUMENTS & REFERENCES module. It will be explored in detail later. Here is a quick look at the BUILDING TYPES, SPACE TYPES and DESIGN OBJECTIVES elements. DESIGN DISCIPLINES and PRODUCTS AND SYSTEMS elements will not be discussed because in their current state of development they are not particularly useful. (An aside: The PRODUCTS AND SYSTEMS element contains links to the very useful Unified Facilities Guide Specifications (UFGS) and Veterans Administration Master Specifications (VAMS), however they are

also accessible from the CONSTRUCTION CRITERIA BASE (CCB) in the DOCUMENT AND REFERENCES module and will be discussed later.

BUILDING TYPES

Click on the:

BUILDING TYPES (http://www.wbdg.org/design/buildingtypes.php)

link and "drill down" in a couple of categories, for example….

- **Libraries**
  - **Public Libraries**
    - **Space Needs for Special Use Areas**

This table shows some typical square footages for special-use areas and is one type of information you may find useful in the BUILDING TYPES pages. These are only guidelines and not requirements, but they can be helpful in space planning for new construction or renovation of existing space. This type of information is usually available for the other BUILDING TYPES covered in this element. The occasional concept sketches may also be helpful. The text information in the various pages of the BUILDING TYPES module is a little too superficial to be of a lot of help to you.

Here is another example; drill down in….

- **Office Building**
  - **Conference Rooms**
    - **Example Program**

Again, you find some square footage information and a concept sketch that can provide a starting point in space planning, but the rest of the information is a little thin.

Explore the BUILDING TYPES and other modules on your own to become familiar with information they contain, as well as links to information resources. You may find nuggets of knowledge that are exactly what you need. Keep in mind that the WBDG portal is continually being updated and expanded, so a module which I may have characterized today as not too useful may become much more helpful in the future.

SPACE TYPES

Click on the:

SPACE TYPES (http://www.wbdg.org/design/spacetypes.php)

link.

To explore the information in this element click, for example, on the *Courthouse/Courtroom* element and you see narrative information, an example program, a couple of concept sketches and some links to other sources of information. As is fairly typical in the SPACE TYPES module, the narrative information is fairly shallow and the links to other sources of information are frequently to *organizations* that publish useful information commercially but not to the actual *information.* This is not always the case since links are sometimes to government sites where the information is directly available online at no cost. The concept sketches may be of some value, but the primary information that is useful is square footage numbers that can help in space planning. Another example you can look at is *Parking/Surface*. The narrative information and

sketches are shallow but there are some links to other resources that will be helpful.

DESIGN OBJECTIVES

The DESIGN OBJECTIVES information is not particularly useful, with one exception. Click on the:
DESIGN OBJECTIVES (http://www.wbdg.org/design/designobjectives.php) .
link. The information is organized like this:

- ACCESSIBLE
- AESTHETICS
- COST EFFECTIVE
- FUNCTIONAL/OPERATIONAL
- PRODUCTIVE
- SECURE/SAFE
- SUSTAINABLE

One helpful element is SUSTAINABLE. It has a nice presentation of the elements of what constitutes "sustainable" design. This is helpful because the "sustainable" concept is rather nebulous and usually depends on who you are talking to, the day of the week, and the time of day. Click on SUSTAINABLE (http://www.wbdg.org/design/sustainable.php) and take a look at it. You can almost use it as a "checklist" when you need to evaluate sustainability options for one of your projects. Also, it has some excellent links to more definitive information you can use on projects.

7. PROJECT MANAGEMENT

The PROJECT MANAGEMENT module is fairly shallow and not likely to be terribly useful. Click on:

PROJECT MANAGEMENT (http://www.wbdg.org/project/pm.php)

and you see the information is organized like this:

- ❑ PROJECT DELIVERY TEAMS
- ❑ PROJECT PLANNNIG AND DEVELOPMENT
- ❑ BUILDING COMMISSIONING
- ❑ PROJECT DELIVERY AND CONTROLS

But, as with all of the modules and elements of the WBDG, explore them because you may find something useful there and perhaps some may become more useful in the future as they are expanded and developed.

8. OPERATIONS & MAINTENANCE

The OPERATIONS & MAINTENANCE element is fairly shallow and not likely to be very useful. Click on:
OPERATIONS & MAINTENANCE (http://www.wbdg.org/om/om.php) and you see the information is organized like this:

- REAL PROPERTY INVENTORY
- COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEMS

The information provided is of limited value in design and construction, but may be of interest to operations and maintenance personnel. As will all of the modules and elements of the WBDG, explore them because you may find something useful and perhaps some may become more useful in the future as they are expanded and developed.

9. DOCUMENTS & REFERENCES 

This is where very useful information is located. Click on:

DOCUMENTS & REFERENCES (http://www.wbdg.org/references/docs_refs.php) .

The information in this module is organized like this:

- ❑ FEDERAL MANDATES
-  ❑ CONSTRUCTION CRITERIA BASE
- ❑ PERIODICALS
- ❑ CASE STUDIES
- ❑ PARTICIPATING AGENCIES
- ❑ INDUSTRY ORGANIZATIONS

The FEDERAL MANDATES, PERIODICALS, CASE STUDIES, PARTICIPATING AGENCIES and INDUSTRY ORGANIZATION elements are of limited utility but may provide helpful links to other web resources. The very valuable resource here is the CONSTRUCTION CRITERIA BASE (CCB). Click on:

CONSTRUCTION CRITERIA BASE (http://www.wbdg.org/ccb/ccb.php) and look at the contents of this component. Here is how the CCB is organized:

-  ❑ SPECIFICATIONS LIBRARY
- ❑ REGULATIONS LIBRARY
- ❑ STANDARDS LIBRARY

- ❑ DOCUMENTS LIBRARY
- ❑ CADD LIBRARY
- ❑ ENERGY LIBRARY
- ❑ ENVIRONMENTAL LIBRARY
- ❑ SUSTAINABLE DESIGN LIBRARY
- ❑ TOOLS LIBRARY*

(* The TOOL LIBRARY is presented on the WBDG web site as a separate "tab" and will be discussed in that framework.)

The SPECIFICATIONS LIBRARY and DOCUMENTS LIBRARY are very valuable. Both the CADD LIBRARY and TOOLS LIBRARY are also useful. The TOOLS LIBRARY in this CCB element, however, merely refers you to the main TOOLS module on the WBDG opening page and so we will discuss it later from that location. Look first at the SPECIFICATIONS LIBRARY (http://www.wbdg.org/ccb/browse_lib.php?l=02) .

Here is how it is structured:

- ❑ UNIFIED FACILITIES GUIDE SPECIFICATIONS (UFGS)
- ❑ NAVFAC SPECIFICATIONS
- ❑ NAVFAC STANDARD SPECIFICATIONS
- ❑ NAVFAC GUIDE PERFORMANCE WORK STATEMENTS
- ❑ VA MASTER SPECIFICATIONS (VAMS)
- ❑ DOE GENERAL DESIGN CRITERIA

- ❑ NIBS SPECIFICATIONS

The two elements in the SPECIFICATIONS LIBRARY that are very useful are the UNIFIED FACILITIES GUIDE SPECIFICATIONS (UFGS) (http://www.wbdg.org/ccb/browse_org.php?o=70) and the VETERANS ADMINISTRATION MASTER SPECIFICATIONS (VAMS) (http://www.wbdg.org/ccb/browse_org.php?o=8) . examine the UFGS in detail. The VAMS is structurally similar to the UFGS and so will not be discussed separately. Keep the VAMS in mind when designing a health care facilities project; it is an excellent guide specifications resource.

SPECIFICATIONS LIBRARY: Unified Facilities Guide Specifications (UFGS)

The UFGS is the most useful source of guide specifications available to engineers and architects engaged in the design and management of construction of buildings and related infrastructure. It is comprehensive, technically rigorous, always updated and current, and reflects the collective experiential knowledge of many thousands of engineers and architects acquired on hundreds of thousands of projects, small to monumental in size, undertaken over more than a century. Although developed and managed by federal government agencies, they are not in any substantive way peculiar to the federal government, they are not excessively complex, and they are not excessively bureaucratic. They are ideal for use as office standards for private companies and public agencies large and small. They are organized into the recognized 43 sections of the Construction Specifications Institute (CSI) format. To begin becoming familiar with them click on:

UNIFIED FACILITIES GUIDE SPECIFICATIONS (UFGS)
(http://www.wbdg.org/ccb/browse_org.php?o=70)

At this page you will see the list of UFGS Sections available to you to download without charge. Here is a small portion of what you will see:

EXAMPLE OF

SPECIFICATION SECTIONS

Division 03 - Concrete (11-2008) ZIP 677 KB

UFGS 03 01 30.71 Concrete Rehabilitation (04-2006) PDF 42 KB, 13 pgs | ZIP

UFGS 03 01 30 Restoration of Concrete in Historic Structures (04-2006) PDF 80 KB, 27 pgs | ZIP

UFGS 03 01 32 Concrete Rehabilitation for Civil Works (04-2006) PDF 195 KB, 75 pgs | ZIP

UFGS 03 11 13.00 10 Structural Concrete Formwork (04-2006) PDF 38 KB, 11 pgs | ZIP

UFGS 03 11 14.00 10 Formwork for Concrete (04-2006) PDF 38 KB, 10 pgs | ZIP

UFGS 03 15 13.00 10 Expansion Joints, Contraction Joints, and Waterstops (04-2006) PDF 44 KB, 13 pgs | ZIP

UFGS 03 15 14.00 10 Expansion, Contraction and Construction Joints in Concrete for Civil Works (04-2006) PDF 37 KB, 10 pgs | ZIP

UFGS 03 20 01.00 10 Concrete Reinforcement (10-2007) PDF 35 KB, 9 pgs | ZIP

UFGS 03 20 02 Steel Bars and Welded Wire Fabric for Concrete Reinforcement for Civil Works (04-2006) PDF 47 KB, 14 pgs | ZIP

These Sections can be downloaded as either a PDF or ZIP file. If downloaded as a PDF file, the file can be converted to a DOC file using any of several PDF/Word converters that are available. This, however, is not recommended because it introduces some unnecessary complexity. It is recommended that sections be downloaded as ZIP files. The downloaded ZIP files are in the SpecsIntact Editor (SIE) word processing software and it is recommended SIE be used for processing the UFGS sections. This is because the SIE has a number of helpful features that would not be useable if a section is converted to a Word (DOC) file. Also, the SIE word processing software has the same ease of use as Word, with the addition of some special features. We will discuss the SpecsIntact system and the SIE in more detail later. At this time, download various Sections and become familiar with manipulating and processing them.

After you have gained some initial familiarity with the Sections, their contents, and how to process them, take note of the following points….

Applicable Publications

With a few exceptions the sections are organized as follows:

- ❑ GENERAL
- ❑ PRODUCTS
- ❑ EXECUTION

In examining the various Sections you will observe a feature that could be construed as excessively bureaucratic and cumbersome. This is the provision in the General segment of each Section a component headed APPLICABLE PUBLICATIONS. This is an example:

EXAMPLE OF

APPLICABLE PUBLICATIONS

ASTM INTERNATIONAL (ASTM)	
ASTM A 123/A 123M	(2008) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM D 975	(2008a) Standard Specification for Diesel Fuel Oils
ASTM F 593	(2002; R 2008) Stainless Steel Bolts, Hex Cap Screws, and Studs

In the UFGS system an *Applicable Publication* segment is referred to in the *Products* or *Execution* segment of the Section in an abbreviated manner as "ASTM A307", ASTM F593", etc.

Why the *Applicable Publications* segment? The reason is that the federal government is the quintessential "deep pockets" and lawyers found a way to get into the pockets of federal taxpayers. Specifically, a lawyer-empathetic judge at an appellate level had ruled that a specific edition/revision of an "applicable publication" must be recited in extremis if it were to be enforceable. For example, it was not sufficient to require compliance with "ASTM F 593"; it was necessary to require compliance with "ASTM F 593 (2002; R 2008) Stainless Steel Bolts, Hex Cap Screws, and Studs." However compliance with "ASTM F 593" might be recited at several locations within a Section. To reduce the complexity of the specifications it was concluded that the best approach was to provide an *Applicable Publications* section with references thereafter to the reductive form "ASTM 593."

This complex approach to dealing with "applicable publications" can either be observed in its entirety as it is by federal agencies, or observed in a less complex way by private companies and public agencies large and small. The detailed exposition of an applicable publication is likely to become a bone-of-contention in few owner-contractor disputes. The risk, of course, increases if the owner is viewed as having "deep pockets" and when lawyers perceive there is a possibility of ripping off public tax-payers and honest, hard-working private companies. If your company/agency decides to use a simplified approach, the *Applicable Publications* section can be simplified or even eliminated in different ways.

Some Examples from the PRODUCTS Part of UFGS Sections

(Cast in Place Concrete)

PART 2 PRODUCTS

****
NOTE: Designer must verify that products meeting
the indicated minimum recycled content are
available, preferably from at least three sources,
to ensure adequate competition. If not, write in
suitable recycled content values that reflect
availability and competition.
****

2.1 MATERIALS FOR FORMS
Provide wood, plywood, plastic, carton, or steel. Use plywood or steel forms where a smooth form finish is required.

2.1.1 Wood Forms
Use lumber as specified in Section 06 10 00 ROUGH CARPENTRY and as follows. Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with PS1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining.[Submit data verifying that composite wood products contain no urea formaldehyde resins.][Virgin wood used must be FSC-certified.]

2.1.1.1 Concrete Form Plywood (Standard Rough)
Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 16 millimeter 5/8-inch thick.

2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)
Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 16 millimeter 5/8-inch thick.

2.1.2 Plastic Forms
Plastic lumber as specified in Section 06 10 00 ROUGH CARPENTRY. Provide plastic forms that contain a minimum of [50][100] percent post-consumer recycled content, or a minimum of [50][100] percent post-industrial recycled content.

2.1.3 Carton Forms
Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete until initial set. Provide carton forms that contain a minimum of [5][10][_____] percent post-consumer recycled content, or a minimum of [20][40][_____] percent post-industrial recycled content.

2.1.4 Steel Forms
Provide steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORM TIES AND ACCESSORIES
The use of wire alone is prohibited. Provide form ties and accessories that do not reduce the effective cover of the reinforcement.
2.2.1 Polyvinylchloride Waterstops
COE CRD-C 572.

2.2 BOILERS

****
NOTE: A selection will be made between hot water and steam service. Also select between firetube, water tube, cast iron, and condensing type boilers. Condensing type boilers should only be considered for hot water service. Natural draft/atmospheric burners will not be used for any boiler exceeding 300 kW (1,000,000 Btuh) output. Inapplicable references shall be deleted. A Life Cycle Cost Analysis should be performed to determine the appropriate type of boiler.
****

Each boiler shall have the output capacity in kilowatts (kW) British thermal units per hour (Btuh) as indicated when fired with the specified fuels. The boiler shall be furnished complete with the [oil] [gas] [combination oil/gas] burning equipment, boiler fittings and trim, automatic controls, [[forced] [induced] draft fan,] [natural draft/atmospheric burner,] electrical wiring, insulation, piping connections, and protective jacket. The boiler shall be completely assembled and tested at the manufacturer's plant. Boiler auxiliaries including fans, motors, drives, and similar equipment shall be provided with at least 10 percent excess capacity to allow for field variations in settings and to compensate for any unforeseen increases in pressure losses in appurtenant piping and ductwork. However, the boiler safety devices shall not be sized for a 10 percent excess capacity. The boiler and its accessories shall be designed and installed to permit ready accessibility for operation, maintenance, and service. Boilers shall be designed, constructed, and equipped in accordance with ASME BPVC SEC IV. Each boiler shall be of the [firetube] [watertube] [cast iron] [condensing] type and designed for [water] [steam] service as specified herein. The boiler capacity shall be based on the ratings shown in HYI-005 or as certified by the American Boiler Manufacturers Association, or American Gas Association.

2.2.1 Firetube Boiler

Boiler shall be self-contained, multipass, packaged type, complete with all accessories, mounted on a structural steel base. When the boilers are operating at maximum output, the heat input rates shall not be greater than 21 Kw/square meter 6,700 Btu/hr per square ft of fireside heating surface.

2.2.2 Watertube Boiler

****
NOTE: Select between standard, finned, or bent/flexible tube boiler. If bent or flexible tube boilers are not selected, remove all references to bent or flexible tube boilers. Standard water tube boilers are steel tube boilers that have historically been used for most heating applications. Finned tube boilers are typically small boilers (residential type) that utilize a finned tube arrangement. Bent or flexible tube boilers are steel tube boilers with bent tubes that experience multiple water tube passes. Bent/Flexible tube boilers typically require less space than standard water tube boilers. The bent or flexible tubes are also easier to replace than the standard water tubes; however, the interior surface of the tubes cannot be cleaned mechanically; they can only be chemically cleaned. Bent or flexible tube boilers also have a higher ratio of heat output to heating surface area.
****

The boiler shall be a [standard] [finned] [bent or flexible] type of water tube boiler. Boiler shall be self-contained, packaged type, complete with all accessories, mounted on a structural steel base. [The boiler heating surface area for bent or flexible tube boilers shall be at least 0.03 square meters/kW 4 square feet/boiler horse power. [The heat input rate for finned tube steam boiler or hot water generator shall not be greater than 12,000 Btu/hour based on internal heating area.]Bent or flexible tube boilers shall be provided with single or multiple downcomers for circulation without the need for exterior pumping. The tubes for bent or flexible tube boilers

shall be designed for replacement without requiring welding or rolling of tubes. Any special tools required for bent or flexible tube removal or installation shall be provided with the boiler.]

2.2.3 Cast Iron Boiler

Boiler shall be of the rectangular, sectional type, self-contained, packaged type, complete with accessories, mounted on a structural steel base. Cast iron sections shall be free of leaks under all operating conditions. Access shall be provided to permit cleaning of internal tube surfaces.

2.2.4 Condensing Boiler

****
NOTE: Due to the sulfur content of fuel oil, condensing boilers should only be considered if natural gas is used. The lower the return temperature of water entering the boiler the higher the resulting boiler efficiency. (See ASHRAE HVAC Equipment and Applications Handbook). The return water temperature should be at or below the dew point of the flue gas to result in the formation of condensate. This condition may not occur within a steam heating system. Therefore, condensing boilers should only be used for hot water service. In addition, the water distribution system and heating coils should be designed for higher temperature differentials. Condensing boilers may be in the form of fire tube boilers with pulse combustion, copper fire tube boilers, or multiple heat exchanger boilers. The military specifications listed in the preceding paragraphs concerning fire tube and water tube boilers do not apply to condensing boilers.
****

Each boiler shall be a self-contained packaged type, complete with accessories, mounted on a structural steel base or a steel base which is integral to the boiler shell. Each boiler shall conform to the commercial design used by the manufacturer and shall permit free thermal expansion without placing undue stress on any part of the boiler. Each boiler which experiences the formation of condensate within the flue gas shall be specifically designed for condensing application. Each boiler shall withstand the corrosive effects of condensate for each part which may be in contact with the condensate at all possible operating conditions. Each boiler shall be provided with a separate air intake, exhaust, and condensate drain. Each boiler shall be designed to withstand the water temperature differentials anticipated at the required operating conditions without experiencing any damage due to thermal shock.

2.2.5 Modular Configuration

****
NOTE: A modular configuration is a series of small cast iron type and/or condensing type boilers. The smaller boilers are manifolded together to provide heating for larger loads. This arrangement may be economical when heating load variances are expected. Delete this paragraph if a modular configuration is not desired.

PART 2 PRODUCTS

2.1 APPLICATION

Automatic transfer switch shall be capable of transferring the load from the normal power source to emergency power source, and from an emergency source to the normal power source. Locate switch where indicated. Switch shall be solenoid-operated, mechanically held, double-throw, rated for continuous duty, capable of transferring in 100 milliseconds or less, and conforming to the applicable requirements of UL 1008 and NFPA 70, Article 700, except as herein modified. Control and protective devices associated with automatic transfer switches shall be in accordance with Section 26 05 70.00 40 HIGH-VOLTAGE OVERCURRENT PROTECTIVE DEVICES and Section 26 05 71.00 40 LOW-VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

****
NOTE: Show required automatic transfer switch amperage, voltage, and frequency ratings on the drawings.
****

Automatic transfer switch shall be the two-pole type for single-phase application, and three-pole type for three-phase application. [Provide a solid neutral conductor connection for neutral transfer from normal source to emergency source.][Provide an additional switched neutral pole.] Automatic transfer switch shall be capable of being placed in either the normal or the emergency position.

****
NOTE: Add to this specification or to the drawings the short-circuit withstand current rating of the switch based on the calculated short-circuit current available at the switch location. Sample: the switch shall withstand symmetrical three-phased short circuits of [_____] amperes for a period of [_____] seconds without damage.
****

2.2 CONTACTS
Main contacts shall be wiping-action silver alloy that, when rated for operation at 50 amperes or greater, shall be protected against arcing. Auxiliary contacts and control transfer relay contacts shall have a minimum continuous current rating of not less than 10-amperes inductive at 120 volts ac. Provide the following auxiliary contacts: Generator-control contacts, normally open, that close on undervoltage or loss of normal power as specified, remaining closed until transfer back to normal power Emergency-position contacts, normally open when the switch is in the normal position, that close when the switch is in the emergency position Normal position contacts, normally closed when the switch is in the normal position, that open when the switch is in the emergency position Auxiliary contacts shall be two-pole.

****
NOTE: Fill in automatic transfer switch mounting location, such as: on door of enclosure, remote, or mounted externally on switchgear.
****

Provide a test automatic transfer switch mounted [_____] with contacts rated 10 amperes. Provide automatic transfer switch with overlapping neutral transfer contacts in addition to the two- or three-pole main bus contacts. Normal and emergency neutral shall be connected together only during the transfer and retransfer operation. They shall remain connected only until the power source contacts close/open to transfer from one source to the other. Overlapping neutral transfer contacts connection time shall not exceed 100 milliseconds.

2.3 INDICATING LIGHTS

Furnish Automatic transfer switch with two indicating lamps. One shall light to indicate that the switch is operating on normal power, and the other shall light to indicate that the switch is operating on emergency power. Fuse each indicating circuit.

2.4 TERMINAL BOARD

Control devices, indicating lights, auxiliary contacts, and internal control devices or auxiliary switches, shall be internally wired to a common output terminal board. Wire the internal functions to facilitate remote connections or monitoring.

2.5 OPERATION

Normal source voltage across phase lines shall be monitored by sensing devices. If the normal source voltage in phase drops to 90 percent or less for a timed period, the automatic transfer switch shall start the emergency source and transfer the load to the emergency source when voltage and frequency reach rated values or, if the emergency source is on, verify voltage and frequency of the alternate source and transfer the load to the alternate source. This time period shall be field adjustable from 1 to 30 seconds. Provide a voltage and frequency sensor relay to monitor rated values on the emergency side to prohibit transfer until the emergency source voltage and frequency reach at least 95 percent of the required rating. Provide phase failure protection, with 65 to 70 percent drop and 92 to 95 percent voltage pickup ratings. Furnish the automatic transfer switch with a time-delay feature, field adjustable from 2 to 30 minutes, that operates to delay automatic transfer back to normal power until the normal source voltage and frequency reach at least 95 percent of the rated voltage. However, if the emergency power fails, and the normal source is again available at 90 percent of the rated voltage, the time-delay circuitry shall be bypassed, and the load immediately transferred back to the normal source. Capability shall also be provided for manual transfer in either direction. Sensing relays shall operate without contact chatter or false response during voltage variations between dropout and pickup.

****
NOTE: Provide schematic wiring diagrams on the drawings to show this feature.
****

2.6 SELF-TEST CAPABILITY

Automatic transfer switch shall be provided with a control-circuit self-test feature that shall be capable of verifying the proper operation of the switch control circuit without moving the main contactor or causing discontinuity of service to the load. Self-test circuit shall have the following characteristics: A key-operated switch that disconnects the main actuator and connects in its place, an indicator light. Design the key-

Some Examples from the EXECUTION Part of UFGS Sections

(Cast in Place Concrete)

PART 3 EXECUTION

3.1 EXAMINATION
Do not begin installation until substrates have been properly constructed; verify that substrates are plumb and true. If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before processing. Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Architect/Engineer and wait for instructions before beginning installation.

3.2 PREPARATION

****
NOTE: Options for uses of excess concrete include: additional paving, post footing anchorage, swale riprap reinforcing, mud slab, flowable fill, footing bottom, retaining wall footing ballast, storm structure covers, underground utility pipe kickers, storm pipe flared end section, toe wash protection, and shoulder and toe outfall restraints for temporary erosion pipes. Diverting waste from the landfill contributes to the following LEED credit: MR2. Coordinate with Section 01 33 29 LEED(tm)DOCUMENTATION.

****

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

3.2.1 General

Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing. Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings. When subgrade material is semiporous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited. When subgrade material is porous, seal subgrade surface by covering surface with specified water barrier subgrade cover; this may also be used over semiporous, dry subgrade material instead of water sprinkling.

3.2.3 Subgrade Under Slabs on Ground Before construction of slabs on ground, have underground work on pipes and conduits completed and approved. Previously constructed subgrade or fill must be cleaned of foreign materials and inspected by the Contractor for adequate compaction and surface tolerances as specified. Actual density of top 300 millimeter 12 inches of subgrade soil material-in-place must not be less than the following percentages of maximum density of same soil material compacted at optimum moisture content in accordance with ASTM D 1557.

SOIL MATERIAL PERCENT MAXIMUM DENSITY

Drainage fill 100
Cohesionless soil material 100

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work or ordering any materials.

3.2 ERECTION OF BOILER AND AUXILIARY EQUIPMENT

****
NOTE: Consult boiler manufacturers for foundation requirements. Delete the requirement for packing the joint between the boiler and floor with non-asbestos rope, if not required. This packing is typically not required for smaller units.
****

Boiler and auxiliary equipment shall be installed in accordance with manufacturer's written instructions. Proper provision shall be made for expansion and contraction between boiler foundation and floor. This joint shall be packed with suitable nonasbestos rope and filled with suitable compound that will not become soft at a temperature of 40 degrees C 100 degrees F. Boilers and firing equipment shall be supported from the foundations by structural steel completely independent of all brickwork. Boiler supports shall permit free expansion and contraction of each portion of the boiler without placing undue stress on any part of the boiler or setting. Boiler breeching shall be as indicated with full provision for expansion and contraction between all interconnected components.

3.3 PIPING INSTALLATION

Unless otherwise specified, nonboiler external pipe and fittings shall conform to the requirements of ASME B31.1. Pipe installed shall be cut accurately to suit field conditions, shall be installed without springing or forcing, and shall properly clear windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Pipes shall be free of burrs, oil, grease and other foreign material and shall be installed to permit free expansion and contraction without damaging the building structure, pipe, pipe joints, or pipe supports. Changes in direction shall be made with fittings, except that bending of pipe 100 mm 4 inches and smaller will be permitted provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Vent pipes shall be carried through the roof as directed and shall be properly flashed. Unless otherwise indicated, horizontal supply mains shall pitch down in the direction of flow with a grade of not less than 0.2 percent 1 inch in 40 feet. Open ends of pipelines and equipment shall be properly capped or plugged during installation to keep dirt or other foreign materials out of the systems.
Pipe not otherwise specified shall be uncoated. Unless otherwise specified or shown, final connections to equipment shall be made with malleable-iron unions for steel pipe 65 mm 2-1/2 inches or less in diameter and with flanges for pipe 80 mm 3 inches or more in diameter. Unions for copper pipe or tubing shall be brass or bronze. Reducing fittings shall be used for changes in pipe sizes. In horizontal hot water lines, reducing fittings shall be eccentric type to maintain the top of the lines at the same level to prevent air binding.
3.3.1 Hot Water Piping and Fittings

Pipe shall be black steel or copper tubing. Fittings for steel piping shall be black malleable iron or cast iron to suit piping. Fittings adjacent to valves shall suit valve material. Grooved mechanical fittings will not be allowed for water temperatures above 110 degrees C 230 degrees F.

3.3.2 Vent Piping and Fittings

Vent piping shall be black steel. Fittings shall be black malleable iron or cast iron to suit piping.

3.3.3 Gauge Piping

Piping shall be copper tubing.

3.3.4 Steam Piping and Fittings

Piping shall be black steel. Fittings shall be black, malleable iron, cast iron or steel. Fittings adjacent to valves shall suit valves specified. Grooved mechanical fittings will not be allowed for steam piping.

3.3.5 Condensate Return Pipe and Fittings

Piping shall be black steel. Fittings shall be malleable iron, cast iron, or steel. Grooved mechanical fittings will not be allowed for condensate piping.

3.3.6 Joints

Joints between sections of steel pipe and between steel pipe and fittings shall be threaded, grooved, flanged or welded as indicated or specified. Except as otherwise specified, fittings 25 mm 1 inch and smaller shall be threaded; fittings 32 mm 1-1/4 inches and up to but not including 80 mm 3 inches shall be either threaded, grooved, or welded; and fittings 80 mm 3 inches and larger shall be either flanged, grooved, or welded. Pipe and fittings 32 mm 1-1/4 inches and larger installed in inaccessible conduit or trenches beneath concrete floor slabs shall be welded. Connections to equipment shall be made with black malleable-iron unions for pipe 65 mm 2-1/2 inches or smaller in diameter and with flanges for pipe 80 mm 3 inches inches or larger in diameter. Joints between sections of copper tubing or pipe shall be flared, soldered, or brazed.

(Automatic Transfer Switches)

PART 3 EXECUTION

3.1 INSTALLATION

Install automatic transfer switch as indicated, and in accordance with the manufacturer's installation instructions. Wall-mounted enclosures shall be fully aligned and installed at the indicated mounting height using a minimum of six M10 3/8-inch bolts. Use of sheet metal screws or small machine screws is not permitted. Submit Listing of Product Installations for automatic transfer switches showing the manufacturer has successfully manufactured automatic transfer switches of the size specified for a minimum period of 10 years. List shall include purchaser, address of installation, service organization, and date of installation.

3.2 FIELD TESTING
Automatic transfer switch shall be demonstrated to operate in accordance with the specification requirements in conjunction with the normal and emergency power sources.

-- End of Section --

Design Notes

One the most valuable features of the UFGS is the Design Notes that appear throughout the Sections to guide the designer in when and how to incorporate specific clauses in the specifications for a specific project. Here is what they look like….they are the text appearing between two horizontal lines of asterisks.

EXAMPLE OF

DESIGN NOTES

3.1.1.2 Spalls at Joints and Cracks

****
NOTE: Use this paragraph when repairing pavements.
****

For spalls to be repaired that are adjacent to joints and working cracks insert preformed joint filler to the working faces of the spall. Trim filler to fit shape of the working faces of joint or crack so epoxy material is prevented from bypassing filler. Where practicable, extend filler horizontally and vertically into joint or crack opening. Secure filler strip in place prior to and during placement of epoxy concrete. [Apply a bond breaker to working faces at keyed joints. Keep bond breaker off of concrete surface to be bonded.] After the epoxy concrete has completely cured, saw out the top inch of the preformed joint filler and install liquid joint sealer in accordance with Section [32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS][32 13 73 COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS].

3.1.1.3 Joints and Cracks

****
NOTE: Use this paragraph when repairing pavements. Fill in either Section 32 13 73, COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENT or Section 32 01 19.61, RESEALING OF JOINTS IN RIGID PAVEMENT.

NOTE: Insert the appropriate Section number and title in the blank below using format per UFC 1-300-02.
****

Clean and seal joints and cracks as specified in [_____].

3.1.2 Epoxy Mortar for Cracks and Saw Kerfs

When a specification Section is ready to be printed, the SIE provides a simple one-click function to remove the Design Notes from view and they are neither seen on-screen nor printed.

Inspection and Testing Notes

Similar to the *Design Notes*, *Inspection and Testing Notes* are provided at appropriate places in the Section to guide the engineer and inspector in verifying a contractor's work. They have the same format and appearance as the Design Notes. Here is an example:

EXAMPLE OF

INSPECTION AND TESTING NOTES

3.5 FIELD QUALITY CONTROL

3.5.1 Sampling

As soon as epoxy resin and aggregate materials are available for sampling, obtain by random selection a sample of each batch. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use and quantity involved.

3.5.2 Testing

****

NOTE: For runway repair projects and other projects requiring large amounts of epoxy repairs use the bracketed sentences.

****

At the discretion of the Contracting Officer, samples provided may be tested by the Government for verification. [Test samples by an approved laboratory. If a sample fails to meet specification requirements after two tests, replace the batch represented by the samples tested and retest. Test aggregates in accordance with ASTM C 117 and ASTM C 136.]

3.5.3 Inspection

****

NOTE: Use this paragraph for airfield repair projects and other projects having large patched surface areas.

****

Check each repaired area for cracks, spalls, popouts and loss of bond between repaired area and surrounding concrete. Check each repaired area for voids by tapping with a hammer or steel rod and listening for dull or

Get the "Government" out of my specifications!

Because the UFGS have been developed by federal agencies there are a couple of words-of-art that appear throughout: "Government" and "Contracting Officer". These can quickly be changed to whatever is your office standard, such as

"Owner" and "Engineer," with a simply find-and-replace function in SIE or Word. For example here is a typical paragraph as written in a UFGS specifications section:

EXAMPLE OF

AUTOMATIC WORD REPLACEMENT

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the **Government**.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

and which a find-and-replace, or find-and-replace-all, function in SIE or Word can quickly change to:

EXAMPLE OF

AUTOMATIC WORD REPLACEMENT

1.3 SUBMITTALS

Owner approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the **Owner**.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Another illustration of the of the ease and utility of the SpecsIntact word processing software used to edit the UFGS specifications sections is the one-stroke change of an entire section from English to metric measures. Here is a paragraph from a UFGS section with metric measures:

EXAMPLE OF

AUTOMATIC ENGLISH/METRIC INTERCHANGE

Maximum slump shown above may be increased **25 mm** for methods of consolidation other than vibration. Slump may be increased to **200 mm** when superplasticizers are used.[Provide air entrainment using air-entraining admixture. Provide air entrainment within plus or minus 1.5 percent of the value specified.][The water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days must not exceed [0.15] [1.00] [0.30]].[Note (a): Entrapped air must be 3% or less.]

This paragraph, as well as the entire section, can be changed from metric to English measures with a single "View" keystroke, thus:

EXAMPLE OF

AUTOMATIC ENGLISH/METRIC INTERCHANGE

<Maximum slump shown above may be increased **1 inch** for methods of consolidation other than vibration. Slump may be increased to **8 inches** when superplasticizers are used.[Provide air entrainment using air-entraining admixture. Provide air entrainment within plus or minus 1.5 percent of the value specified.][The water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days must not exceed [0.15] [1.00] [0.30]].[Note (a): Entrapped air must be 3% or less.]

SpecsIntact Editor

As noted, the UFGS specifications you download as a ZIP file from the *Specifications Library* of the *Construction Criteria Base* are in the *SpecsIntact Editor* word processing software. The WBDG positions information on this important tool in the SPECIFICATION AIDS element of the TOOL module, and we will discuss it from that location.

DOCUMENTS LIBRARY: Unified Facilities Criteria (UFC)

There are many valuable resources in the DOCUMENTS LIBRARY but none more useful than the UNIFIED FACILITIES CRITERIA (UFC). Awkwardly, it is buried in the WBDG and requires drilling down like this:

- DOCUMENTS AND REFERENCES
  - CONSTRUCTION CRITERIA BASE
    - DOCUMENTS LIBRARY
      - DOD CRITERIA
        - UNIFIED FACILITIES CRITERIA

To go directly to it click on the link:

UNIFIED FACILITIES CRITERIA (http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4) .

What you arrive at is a list of technical manuals and other resources that you can download and use without cost. Here is just a small part of this list. All manuals are downloadable as PDF files.

EXAMPLE OF

UFC MANUALS

SERIES 3-400: MECHANICAL

UFC 3-400-01 Energy Conservation, with Change 4 (07-05-2002) PDF 84 KB, 9 pgs

UFC 3-400-02 Design: Engineering Weather Data (02-28-2003) PDF 404 KB, 68 pgs

UFC 3-401-01FA Utility Monitoring and Control Systems (03-01-2005) PDF 13427 KB, 267 pgs

UFC 3-401-05N Estimating Energy and Water Consumption for Shore Facilities and Cold Iron Support for Ships (01-16-2004) PDF 520 KB, 102 pgs

UFC 3-410-01FA Heating, Ventilating, and Air Conditioning, with Change 3 (05-15-2003) PDF 144 KB, 27 pgs

UFC 3-410-02A Heating, Ventilating, and Air Conditioning (HVAC) Control Systems, with Change 1 (05-15-2003) PDF 11839 KB, 454 pgs

UFC 3-410-02N Heating, Ventilating, Air Conditioning and Dehumidifying Systems (06-08-2005) PDF 1411 KB, 234 pgs

UFC 3-410-03FA Heating, Ventilating, and Air Conditioning of Hardened Installations, with Change 1 (05-15-2003) PDF 7447 KB, 113 pgs

UFC 3-410-04N Industrial Ventilation (10-25-2004) PDF 2116 KB, 93 pgs

UFC 3-410-05N Heating Systems Operation and Maintenance (01-16-2004) PDF 15570 KB, 282 pgs

This is a valuable building design knowledge resource. Following are a few excerpts taken from some of these manual that illustrate the depth, technical rigor and hands-on utility of these publications.

EXAMPLE OF

UFC MANUAL CONTENT

TECHNICAL MANUAL
NO. 5-818-7

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *1 September 1983*

FOUNDATIONS IN EXPANSIVE SOILS

LIST OF FIGURES

EXAMPLE OF

UFC MANUAL CONTENT

Table 3-1. Field Reconnaissance

Indicators of swelling soil	1.	Desiccation cracks	Cracks appear in the ground surface during dry periods. Larger and more frequent polygon arrangements of cracks indicate greater potential swell. Dry strength of exposed surfaces is high.
	2.	Plasticity	Relative ease to roll into a small thread indicates greater potential swell.
	3.	Slickensides	Slickensides and fissures are abundant in freshly exposed surfaces of many swelling soils.
	4.	Texture	Slick, cohesive soil tending to adhere to shoes or tires of vehicles when wet indicates swelling soil.
	5.	Structure distortion	Relative size and frequency of cracks and distortion in nearby structures indicates the relative potential swell. Potential swell is approximately the sum of the crack widths. Appearance of power lines, fences, or trees often gives an indication of creep behavior.
	6.	Gilgai	Surface mounds of rounded or long, narrow shape.
Indicators of site access and mobility	1.	Restrictions on access.	
	2.	Locations of utilities and restrictions concerning removal of relocation.	
	3.	Locations of existing structures on site and adjacent to the site. Description of foundation types. Obtain photographs if it can be reasonably expected that existing structures may be affected by construction operations.	
	4.	Locations of trees and other major surface vegetation and restrictions concerning removal or disposition.	
	5.	Surface drainage including presence of ponded water.	
	6.	Examination of contour maps of the site: fill areas, slopes, rock outcrops, or other topographic features.	
	7.	Possible condition of ground at time of construction in relation to trafficability of equipment.	

ture interaction effects in swelling soil are complicated by the foundation differential movement caused by soil heave. Sufficient samples should be available to allow determination of the representative mean of the swell and strength parameters of each distinctive soil stratum. The lower limit of the scatter in strength parameters should also be noted.

a. Sampling requirements. The design of lightly loaded structures and residences can often be made with minimal additional subsurface investigations and soil testing if the site is developed, if subsurface features are generally known, and if the local practice has consistently provided successful and economical designs of comparable structures. Additional subsurface investigation is required for new undeveloped sites, multistory or heavy buildings, structures with previously untested or new types of foundations, and special structures that require unusually limited differential movements of the foundation such as deflection/length ratios less than 1/1000. Where the local practice has not consistently provided satisfactory designs, a careful review of the local practice is necessary. Corrections to improve performance compared with earlier structures may prove difficult to devise and implement and may require evaluation of the behavior of the subsurface foundation soils and groundwater conditions.

b. Distribution and depth of borings. The distribution and depth of borings are chosen to determine the soil profile and to obtain undisturbed samples required to evaluate the potential total and differential heave of the foundation soils from laboratory swell tests, as well as to determine the bearing capacity and settlement. Consequently, greater quantities of undisturbed samples may be required in swelling soils than normally needed for strength tests.

(1) Borings should be spaced to define the geology and soil nonconformities. Spacings of 50 or 25 feet and occasionally to even less distance may be required when erratic subsurface conditions (e.g., soils of different swelling potential, bearing capacity, or settlement) are encountered. Initial borings should be located close to the corners of the foundation, and the number should not be less than three unless subsurface condi-

EXAMPLE OF

UFC MANUAL CONTENT

BOILER CONTROL SYSTEMS

UFC 3-430-11
14 February 2001

CONTENTS

EXAMPLE OF

UFC MANUAL CONTENT

EXAMPLE OF

UFC MANUAL CONTENT

Table 6-1. Boiler Control Panel Indicators, Recorders and Totalizers
(X shows instrumentation item required)

INSTRUMENT	INDICATOR	RECORDER	TOTALIZER
Levels			
Boiler drum water [1]	X	X	
Flows			
Boiler steam [1]	X	X	X
Boiler feedwater [1]	X	X	X
Combustion air [1]	X	X	
Fuel gas [1]	X	X	X
Fuel oil [1]	X	X	X
Pressures			
Boiler steam drum	X		
Steam outlet header	X	X	
Boiler feedwater	X		
FD fan outlet	X		
Pilot gas	X		
Fuel gas	X		
Fuel oil	X		
Atomizing steam	X		
Draft			
Boiler furnace	X	X	
ID fan inlet	X		
Differential pressures			
Air preheater air	X		
Air preheater flue gas	X		
Temperatures			
Steam			
Steam drum	X		
Superheater inlet	X	X	
Superheater outlet	X	X	
Steam header	X	X	
Feedwater			
Supply header	X	X	
Economizer inlet	X	X	
Economizer outlet	X	X	
Fuel oil	X	X	
Combustion air			
Air preheater inlet	X	X	
Air preheater outlet	X	X	
Flue gas			
Superheater outlet	X		
Boiler outlet	X		
Economizer inlet	X	X	

CADD LIBRARY

The CADD LIBRARY contains a selection of CADD details that are downloadable without cost and are compatible with widely used CADD software systems. For example, one of the very useful collections is the NAVFAC CADD DETAIL (http://www.wbdg.org/ccb/browse_cat.php?o=78&c=232) .

This is a sample of the details you will find at that page:

EXAMPLE OF

CADD DETAILS

NAVFAC CADD Details

These documents are available in the following format:

CADD in compressed ZIP

CADD Civil Details - English (02-2008) ZIP 4442 KB
CADD Civil Details - Metric (02-2008) ZIP 3669 KB
CADD Electrical Lighting Details - English (02-2008) ZIP 1870 KB
CADD Electrical Lighting Details - Metric (02-2008) ZIP 1889 KB
CADD Electrical Manhole Details - English (02-2008) ZIP 859 KB
CADD Electrical Manhole Details - Metric (02-2008) ZIP 853 KB
CADD Electrical Pole Details - English (02-2008) ZIP 1760 KB
CADD Electrical Pole Details - Metric (02-2008) ZIP 1760 KB
CADD Electrical Schedules (02-2008) ZIP 37 KB
CADD Electrical Transformer Details - English (02-2008) ZIP 277 KB
CADD Electrical Transformer Details - Metric (02-2008) ZIP 224 KB
CADD Mechanical Details - English (02-2008) ZIP 19128 KB
CADD Mechanical Details - Metric (02-2008) ZIP 15048 KB

To reach this page without the direct link you need to drill down like this:

- ❑ DOCUMENTS AND REFERENCES
  - o CONSTRUCTION CRITERIA BASE
    - ▪ CADD LIBRARY
      - NAVFAC CADD DETAILS

12. TOOLS

There is a valuable resource of tools available for downloading from the TOOLS module, all without charge. Click on the link

TOOLS (http://www.wbdg.org/tools/tools.php)

and you see the tool resources organized by categories, like this….

- ❑ CODE COMPLIANCE
- ❑ COST ESTIMATING
- ❑ DESIGN & ANALYSIS
- ❑ ENERGY ANALYSIS
- ❑ LIFE-CYCLE COSTING/ASSESSMENT
- ❑ LIFE-CYCLE MANAGEMENT/MAINTENANCE
- ❑ PROFESSIONAL & CONSTRUCTION SERVICES
- ❑ PROGRAM & PROJECT MANAGEMENT
- ❑ SPECIFICATION AIDS

One of these tools is particularly useful. This is the SpecsIntact System because it is integral to use of the Unified Facilities Guide Specification (UFGS).

SPECSINTACT SYSTEM

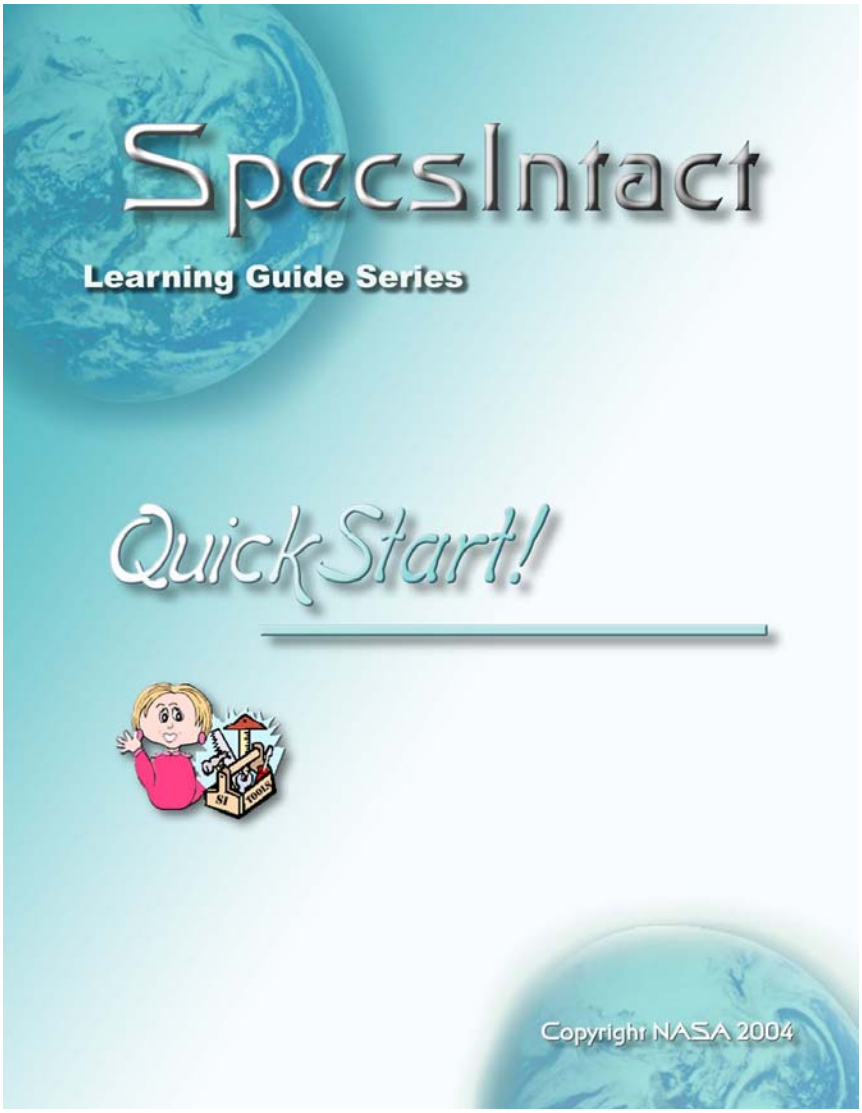
The key to understanding the SpecsIntact System and using it efficiently is the *SpecsIntact Quick Start Guide*. You access it by drilling down like this…

- ❑ TOOLS
  - o SPECIFICATION AIDS
    - ▪ SPECSINTACT
      - QUICK START GUIDE

You can reach it directly by clicking this link:

SPECSINTACT QUICK START GUIDE (http://si.ksc.nasa.gov/PDF/QSGuide.pdf) .

This takes you to:



which is the downloadable PDF manual that is your key to utilization of the UFGS and other specifications in the SPECIFICATIONS LIBRARY.

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Inside

About This Guide

The SI Learning Guide Series is designed to teach SpecsIntact users the concepts involved in successfully completing projects by fully utilizing all the tools provided in the SpecsIntact system. Each guide addresses a particular aspect of the system, and clearly outlines the major points a reader should understand at the completion of each chapter.

This *QuickStart* Guide provides a basic introduction to many of the concepts that will be covered in more depth in subsequent guides. It grew from a need to help new users get a fundamental understanding of SpecsIntact, but experienced users also find it helpful as a refresher course. It's not intended to cover in-depth every aspect of using SpecsIntact, but it is a good place to begin. This guide does not cover the installation process and assumes that you already have both SpecsIntact and Master text loaded on your computer system.

You are encouraged to use these guides in conjunction with the other user tools we provide, like the on-screen **Help**, *QuickTours* and our **web** site resources, which are all conveniently accessible from the SpecsIntact Explorer's **Help** menu.

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13. HOW TO USE THESE RESOURCES

The resources available through the WBDG can be used as a personal reference resource for individual engineers and architects. The most important are:

- **UNIFIED FACILITIES GUIDE SPECIFICATIONS (UFGS)**
- **UNIFIED FACILITIES CRITERIA (UFC)**

They can also be adapted as office standards for private companies and state and local public agencies. Companies and agencies should consider integrating these two resources into their offices processes. The starting point for integration of the UFGS is training beginning with the ***SpecsIntact Quick Start Guide.***

GOOD LUCK!