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ARCHITECTURE AND ENGINEERING DIVISION PROJECT MANAGER'S MANUAL AND BUILDING DESIGN AND CONSTRUCTION STANDARDS

by

Architecture & Engineering Division
Department of General Services
City of Tucson

Architecture and Engineering Project Manual and Construction Standards Index

The General Services Department A/E Division's Design Standards are intended to standardize the requirements and expectations of everyone involved in each project at each step of the design. Compliance is required where called for in contractual agreements. Where modifications to these standards are proposed, submit comprehensive explanatory data to the A/E Division's Project Manager for review.

TABLE OF CONTENTS

Introduction - see Section 01 PM Manual

Project Manager's Manual

Section 01: Building Design and Construction Standards and Project Manager's Manual Overview
Section 02: Schedule
Section 03: Planning
Section 04: Construction Costs
Section 05: Fee Proposal
Section 06: Survey Requirements
Section 07: Structural
Section 08: Master Plan
Section 09: Program
Section 10: Schematic Design
Section 11: Design Development Review
Section 12: Construction Documents
Section 13: Space Criteria
Section 14: Work Space Standard
Section 15: Work Order Estimate
Section 16: Contracts
Section 17: Bid Steps
Section 18: Construction Closeout
Section 19: ADA Requirements
Section 20: Plans Guidelines for P.M.'s & consultants
Section 21: Cell Tower Plan Review & site Inspection

Construction Standards Manual

Division 01 General Requirements
Division 02 Existing Conditions
Division 03 Concrete
Division 04 Masonry
Division 05 Metals
Division 06 Wood, Plastics and Composites
Division 07 Thermal and Moisture Protection
Division 08 Openings
Division 09 Finishes
Division 10 Specialties
Division 11 Equipment
Division 12 Furnishings
Division 13 Special Construction
Division 14 Conveying Equipment
Division 21 Fire Suppression
Division 22 Plumbing
Division 23 HVAC
Division 25 Integrated Automation Standard (BAC or EMCS)
Division 26 Electrical
Division 27 Communications
Division 28 Electronic Safety
Division 29 Landscape
Division 31 Earthwork
Division 32 Exterior Improvements
Division 33 Utilities
Division 50 COT Solar
Division 51 COT Drawing Standards (Autocad/Revit)

INTRODUCTION – Building Design and Construction Standards and Project Manager's Manual

The Building Standards and Project Manager's Manual (jointed called the A&E Standards) were prepared by the City of Tucson General Services Department, Architecture and Engineering (A&E) Division as requirements and expectations of everyone involved in City of Tucson building construction projects. The standards are prepared as an aid to A&E Project Managers, Design Consultants, Contractors/Construction Managers at Risk and Job Order Contractors. The criteria set forth herein are designed to create standards for the designing and constructing of new and renovation of existing City facilities. The intent is to ensure quality of design, economy of operation and ease of maintenance for City facilities.

The latest version of the A&E standards can be found at http://www.tucsonaz.gov/generalservices/architecture

The A&E Standards establish the City A&E Project Manager's expectations of consultants, such as: expected deliveries and distribution, owners' preferences, maintenance preferences, and preferred methods and materials. However, these A&E Standards are not to be considered a contract document, they are to be considered supplementary requirements. The A&E Standards impose no obligations or requirements on architects, engineers and contractors. The A&E Standards must never be used as a substitute or supplement to the specifications and other contract requirements. The A & E Standards do not replace requirements of applicable federal, state, county statutes and City of Tucson codes and ordinances.

The A&E Standards are "living" documents. Sections are updated and modified frequently. The A&E Standards contain many references to other publications and documents in order to minimize any repetition of information found in other publications. A record copy of the A&E Standards will not be filed at the beginning of each project. If any item becomes a point of contention, the designer and/or consultant project manager should review the latest version of the standards. If modifications to the A&E Standards are proposed, submit comprehensive explanatory data in an electronic format to the A&E Division's Administrator.

A&E Division Mission Statement

The Architecture and Engineering Division provides expert planning with professional project and budget management for the functional design and cost-effective construction of healthy, safe, code compliant and energy efficient buildings for the City of Tucson.

City facilities, as public buildings, shall be designed, constructed, and altered for accessibility and use by the disabled. In this connection, with the ADA, the Department of Justice 2010 ADA Standards for Accessible Design (ADAAG) for Title II entities shall determine the criteria to be used for the design of these facilities to ensure accessibility and compliance.

A PDF Format copy can be downloaded from the DOJ site at:
http://www.ada.gov/regs2010/2010ADAStandards/2010ADAStandards_prt.pdf

The specific design criteria applicable to provisions for the disabled shall be incorporated in the Architectural Design Program document for the facility.

The DOJ standards stipulate minimums and maximums as guidelines. The City of Tucson uses these guidelines as the minimum or maximum allowable standards within which we prefer to provide the most comfortable design to provide universal access.

DSD shall be consulted early, and as the project proceeds, to specifically review ADA issues/requirements.

6. Exterior wall elevations with major materials identified

7. Typical building sections with major material, building and structural systems identified

8. Architectural Floor plans, all levels

   Partition layout of all spaces.
   Accurate toilet room, elevator and stair layouts. Furniture and movable equipment layouts, for ALL spaces.

9. Room finish concept for all major spaces

10. Plumbing Systems Plan

    a. Fixture locations.
    b. Equipment locations.
    c. Narrative describing systems

INDEX

Backup Procedures ..... page 4
CADD Project Archive Guidelines ..... page 5-6
CADD Files Project Archive Form ..... pages 7-9

General CAD Drafting Practices.....page 10
Drawing Numbering System.....page 11
File Naming Convention.....page 12

City of Tucson A/E Group Color to Width & Pattern Matrix.....page 13
Scale Factors .....page 14-15
Text-Fonts.....page 16

CAD Layer Guidelines-Layer Name Format.....pages 17-20
Architectural Abbreviations .....pages 21-23
Wildcard Characters.....page 24

AutoCAD General Error Recovery & Possible Causes .....page 25
Softdesk Macros Help File .....page 26-27
Linetypes to Confirm Definitions..... page 28-30

Text Height Conversion Chart ..... page 31
Metrication Chart..... page 32
Insertion Conversion Scale Table/Drawing Height Conversion Chart..... pages 33-34

Attachment "A" - Confirmation of Receipt form…….. page 35

Attachment "B" – City of Tucson / Architecture and Engineering Standard Titleblock

Attachment "C" - City of Tucson / Architecture and Engineering Standard Graphic Illustration Coversheet Example with required information

Attachment "D" – City of Tucson / Architecture and Engineering Standard Coversheet Example with required information

BACKUP PROCEDURES

This method assures daily, weekly and monthly backups. If a computer were to crash on Thursday, the data could be easily recovered by restoring one of the Total backups from Monday and the modified backups from Tuesday and Wednesday.

BACKUP SCHEDULE

Week	Monday	Tuesday	Wednesday	Thursday	Friday
Week 1	TAPE 1 Modified Backup	TAPE 1 Modified Backup	TAPE 1 Modified Backup	TAPE 1 Modified Backup	**TAPE 1** Total Backup
Week 2	TAPE 2 Modified Backup	TAPE 2 Modified Backup	TAPE 2 Modified Backup	TAPE 2 Modified Backup	**TAPE 2** Total Backup
Week 3	TAPE 3 Modified Backup	TAPE 3 Modified Backup	TAPE 3 Modified Backup	TAPE 3 Modified Backup	**TAPE 3** Total Backup
Week 4	TAPE 4 Modified Backup	TAPE 4 Modified Backup	TAPE 4 Modified Backup	TAPE 4 Modified Backup	**TAPE 4** Total Backup

Tapes are clearly labeled BACKUP with the type of backup and day of the week indicated.
For example: Modified-1_Monday. Friday tapes must be stored off-site until they are reused 4 weeks later.

Note:
Tapes are optional, C.D.'s are approved means of backup as well. This backup method is simply identified to help and/or assist your office with backup procedures if you don't have one in place already. It is always a good idea to keep backup records of drawings "on-site" and an additional set "off-site".

(When submitting "As-built Electronic ACAD files" to the City of Tucson – Architecture and Engineering Division, you must submit in C.D. format, USB Flashdrive or SD Memory Card that has enough capacity and is capable of holding all of the project files. See page five, under "ELECTRONIC DRAWINGS SUBMITTAL".)

CADD PROJECT ARCHIVE GUIDELINES

ARCHIVE ISSUES:

* Archiving should be done at project completion or when there is the potential for loss of CADD data (beyond normal backup procedures.)
* CADD project archives are done in addition to normal backups.
* Electronic files are not legal documents, sealed drawings are.

PROGRESS BACKUPS (__% Complete Backups)

1. Determined by Project Manager when:
   A. Two or more weeks pass with no work being done on the project CADD files.
   B. There may be a need to return to a previous stage of work.
2. Project notebook
   A. Include a completed copy of the PROJECT ARCHIVE FORM.
   B. Include a completed copy of the DRAWING INFORMATION sheets and DLIST.
   C. Printout of directories and files in each that are archived.
3. Archive
   A. Perform 2 backups of the project.
      a. One backup is stored in the safe.
      b. The second backup is stored off site.
   B. The archive tape is to backup all project drawings and associated files.

FINAL ARCHIVE

1. Get approval from Project Manager.
2. Circulate copies of laser plots for detail extraction. When candidates have been identified, WBLOCK off drawings, store in appropriate subdirectory under C:\STNDS and document.
3. Split out any drawing files that may have more than one drawing in them.
4. Purge all files - keep only pertinent information.
5. Project notebook, include the following:
   A. DRAWING INFORMATION sheet, completed in detail.
   B. Updated laser plots drawings (8 1/2” x 11” or 11” x 17”).
   C. Project information necessary to help explain how the job was put together for future use.
   D. PROJECT ARCHIVE FORM
   E. Printout of directories and files in each that are archived.
   F. Store one copy in safe.
   G. The second copy is stored off site.
6. Archive
   A. The archive tape is to backup all project drawings and all associated files.
   B. Perform 2 backups of the project
      a. One backup is stored in safe.
      b. The second backup is stored off site.

ELECTRONIC DRAWINGS SUBMITTAL

1. Drawing files must be in AutoCAD format Release 2006 or more recent.
2. All electronic files must be in “as-built” form and submitted in C.D. format, USB Flashdrive or SD Memory Card that has enough capacity and is capable of holding all of the project files. Also, the media shall be accompanied with “as-built” plotted Mylar’s in full size. Please be sure to create proper directories (See example 1, page 6) on the C.D.(s) so that files are properly archived in there profession’s named directory. A print out of the directories and files shall be submitted along with the C.D.(s), flashdrive or memory card.
3. If multiple numbers of C.D.s are submitted, please label “C.D. #1 of 2, C.D. #2 of 2, etc.”

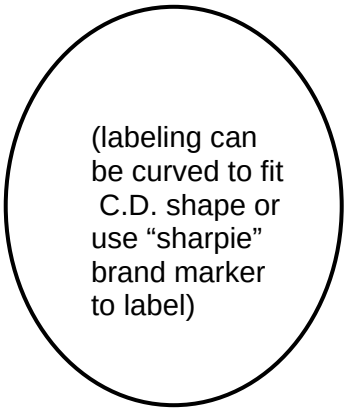
and submit a print out for each.

<u>Example 1</u>

(*C.D. or Disk drive* →**D:**) **** (*FD&M Job #* → **"8123"**) **** *(Profession's Name* → **Arch**) **** (*ACAD files in each of there pertaining directories. Xref files & fonts must have there own directory)*

**Struc **
**Elec **
**Mech **
**Data **
**Land **
**Civil **
**Xref, etc. **

4. C.D.'s shall be labled on the outside as follows:



<u>C.D.</u>

4. As-built files must include clouded areas with alternative, addendum or change order number next to the cloud. Revision box in the title block must be described and dated.
5. Files reduced in size by means of compaction through a file reducer software will <u>not</u> be an acceptable means of submittal*****. Files shall be submitted in full size (be sure to use the "purge" command for all files, to keep only pertinent information) and as directed in item 2, under "Electrical Drawings Submittal".

CADD FILES PROJECT ARCHIVE FORM

PROJECT INFORMATION:

Project Name:

Project Job Number: _____ Project Manager:

Requested By: _____ Request Date:

Project Team Members (CAD related):

City of Tucson:

Consultant:

Consultant:

Consultant:

Other:

ARCHIVE INFORMATION:

Archiver:_____ Archive Date:

Project Size (in MB):

Other information to include
on Archive tape label:

Initial and date when completed:

TASK	INITIAL	TAPE LABEL#	DATE	RESPONSIBILITY
1 Tape set to safe:				
1 Tape set off site:				
1 Notebook to safe:				
1 Notebook off site:				

**** Return form to originator when archive is complete. ****

Project: Date:

Project No.:

Sheet No.	CAD File No.	Drawing Title	Assoc. Files No.	Plan No.	Person

Drawing Information

Drawing
Title:

Sheet No.: File No.: Plot Scale: Plan No.: Person:

Drawing
Notes
Paper
Space

GENERAL CAD DRAFTING PRACTICES

1. **SAVING:** Save frequently, AutoCAD's autosave feature must be set to save every 15 minutes or less. Use the SAVETIME command.
2. **DRAWING ORIGIN:** The lower left hand corner of all title blocks should orginate from the global 0,0 point.
3. **LIMITS:** Drawing limits match plotting sheet size.
4. **COLOR & LINETYPE:** Element color and linetype are set bylayer, not by entity. Do NOT change entity color or linetype with the CHANGE PROPERTY command, use layers to these parameters.
5. **SNAPS & OBJECTS:** Snaps and objects are to be used for all precision placement.
6. **LTSCALE:** LTSCALE should equal DIMSCALE.
7. **REGENAUTO:** REGENAUTO is turned off and the EXPERT variable is set to 0.
8. **HIGHLIGHT:** HIGHLIGHT is always set to 1 (on).
9. **EXITING A DRAWING:** Always save drawings with the full drawing visible (Zoom All).
10. **BLOCKS:**
    A. All blocks are always created on layer 0.
    B. Blocks that are used in drawings of various scales are to be created at full scale, 1"=1".
    C. Do not explode BLOCKS or hatch patterns.
11. **XREFS:**
    A. All xrefs shall be binded to the drawing file used in the final archival submittal(s).
12. **TEXT:**
    A. Only standard AutoCAD and Softdesk architectural fonts are to be used. “Chisel.shx” font style is to be used or approved equivalent.
    B. Text heights are not set with the STYLE command.
    C. CHISEL font is used for all notes and titles.
    D. All plotted notes are 1/8" high, upper case.
    E. All plotted titles are 1/4" high, upper case
    F. Arrow size shall be the same as the text height and solid terminator. Architects must use Tick Marks when dimensioning; these shall be 1/8” long and 1/64” thick when dimensioned in paper space, and they shall be slanted 45 degrees to the dimension line.
13. **PAPER SPACE VS. MODEL SPACE:**
    A. Title blocks, general notes, sheet notes, and entities that are not attached to entities that represent “ real objects”, must be placed in Paper Space. The rest will be placed in Model Space.
14. **TITLE BLOCK:**
    A. C.O.T. title block will be used as an insertable drawing with title block. It contains an editable text block with the insertion point at the lower right hand corner of the outline border; it may be edited with the DDATTE command. Title Blocks files must be inserted in Layer 0 in Paper Space in 0,0 coordinate; they are drawn at 1” = 1”.
    B. At title of drawing, the bubble size must be 11/16” in diameter, text inside the bubble and title must be 1/4” high, text of the drawing scale must be 1/8” high.
    C. At section and details cuts, the bubble size must be 9/16” in diameter, text inside bubble must be 1/8”.
    D. The current City of Tucson / Architecture and Engineering titleblock shall be required for all projects small or large. See Attachment “B”. Contact **Octavio A. SantaMaria, Jr.** at **(520) 791-5111 x331 or** octavio.santamaria@tucsonaz.gov to obtain ACAD files.
    E. The coversheet for every project will not need a titleblock. The coversheet shall require the information (at a minimum) provided on the coversheet example. See Attachment “D”.
    Note:
    The coversheet does not need to look exactly like the example, but all information shown on the example is required. Projects that are new stand alone facilities, major renovations or expansions will require an additional coversheet in front of the above mentioned sheet containing some type of graphical illustration and the title of the project. See Attachment “C”. If you have any questions, please contact **Octavio A. SantaMaria, Jr.** at **(520) 791-5111 x331 or** octavio.santamaria@tucsonaz.gov .

DRAWING NUMBERING SYSTEM

A. Facilities Design and Management has adopted the standard system offered by The Architect's Handbook of Professional Practice as outlined by the American Institute of Architects. The type of system used is for "Average to Large Projects". (See Attachment "A"). For your convenience we have reproduced the architectural section below.

ARCHITECTURAL DRAWINGS

A0.1,2,3... Index, Symbols, Abbreviations, Notes, Location Map
A1.1,2,3... Demolition, Site Plan, Temporary Work
A2.1,2,3... Plans, Room Material Schedule, Door Schedule, Key Drawings
A3.1,2,3... Sections, Exterior Elevations
A4.1,2,3... Detailed Floor Plans
A5.1,2,3... Interior Elevations
A6.1,2,3... Reflected Ceiling Plans
A7.1,2,3... Vertical Circulation, Stairs, Elevators, Escalators
A8.1,2,3... Exterior Details
A9.1,2,3... Interior Details

B. These nine sections will always remain the same no matter how large or small the project may be. Additional drawings may be added with groups without interrupting the alphanumerical order. For small projects, unused sections will not be noted and will be skipped; always maintaining the 0 to 9 numbering system.

EXAMPLE 1.- If a large project has 4 floors plans that need to be divided into West and East sections, a sample of the drawings to be used may be numbered as followed:

A4.1.1 for Detailed Floor Plan of the first floor West/East section
A4.3.2 for Detailed Floor Plan of the third floor East/West section

EXAMPLE 2.- If a large project has 9 floors of reflected ceiling floor plans and the architect wishes to divide each floor into restrooms, lobby, offices and conference rooms, and the conference rooms are to be divided into small and large, a sample of the drawings to be used may be numbered as followed:

A6.3.2.1 for Reflected Ceiling Plans of the third floor, conference room small/large
A6.4.2.2 for Reflected Ceiling Plans of the fourth floor, conference room large/small

EXAMPLE 3.- If a small project has only one sheet with a location map and notes, one floor plan, two exterior elevations and one stair detail, the full index of drawings may be as follows:

A0 Index, Location Map and Notes
A2 Floor Plan
A3.1 North Elevation
A3.2 South Elevation
A7 Stair Details

EXAMPLE 4.- If a project is only comprised of the demolition of a two story office building, the full index of drawings may be as follows:

A0 Index, Location Map and Temporary Work
A1.1 Site Plan and General Notes
A1.2.1 Demolition Phasing Plan-Stage 1
A1.2.2 Demolition Phasing Plan-Stage 2
A1.2.3 Demolition Phasing Plan-Stage 3

FILE NAMING CONVENTION

A. In order to associate electronic files with hard copy drawings, files names must correspond with the drawing numbers that are apart of the drawing set. Xref files names reflect the type of drawing and some information pertaining to the specific location or characteristic of the building area, or simply sequential numbering. Study sketch file names should reflect the number assigned in a sketch log for the particular job the sketch is drawn.

B. File names are limited to eight characters, therefore some special cases may occur and names might be slightly altered. In this case keep in mind that the general concept is to assist you in searching for files later on. The following are examples of the relation of sheet numbering system explained above and CADD file names:

SHEET NUMBER	CADD FILE NUMBER
A0.1.2	A00102
A1.1	A101
A1.2.3.4	A1020304
A9.1	A901
A9.10.11	A9010011

In naming files, the computer will not accept dots, dashes, colons, ampersands, or any other type of punctuation, therefore you replace "." for zeros.

C. The following is a partial list of accepted abbreviations or the "type" of drawings used when naming XREF'S files. (Any other abbreviation not included herein would have to be approved by FD & M.)

TYPE OF DRAWING	ABBREVIATION
Site Plan	SIT
Demolition	DEM
Floor Plan	PLN
Detailed Floor Plan	PLND
Reflected Ceiling Plan	RCP
Elevation (Exterior)	ELV
Elevation (Interior)	ELVI
Section	SEC
Stairs	STR
Elevators	EVT
Escalators	ESC
Details	DET

D. A sheet containing third floor plans may be named A2.3, as described by the AIA standards; its CADD number may be A203, replacing the "." for a zero, and its associated file (XREF) may be named APLN203. "A" refers to the discipline (Architecture); "PLN" refers to floor plan; "2" refers to the AIA numbering system for plans; "0" is the replacement of the ".", and the "3" is for third floor.

E. The actual drawing in model space and the title block are to be XREF's, and then brought forward to the actual sheet from which the plotting is to be made. Except for a few objects actually drawn on the sheet's paper space, no other object should be able to be altered while viewing the sheets on your screen.

11. Fire Protection System Narrative
    a. Provide system description.
    b. Provide system description of all special use Fire Protection Systems (Mission critical computer rooms, e.g.)

12. Mechanical System Plan & Narrative

    a. Equipment locations and types.
    b. Supply, return, and exhaust duct one-line diagram.
    c. Controls concept. (narrative)
    d. Establish life cycle analysis of energy consuming equipment and options (conceptual).
    e. HVAC load and sizing calculations shall be provided indicating the size of the major mechanical system components (narrative).

13. Power Distribution
    Power distribution equipment locations. (Utility source, service entrance gear, distribution and lighting panels, "first pass" amperages and voltages of each. At SD's, square foot basis is acceptable.)

14. Lighting
    a. Lighting fixture concept and layout shown for the majority of interior and exterior lit areas.
    b. Special requirements noted.
    c. Life cycle cost analysis, for the purpose of analyzing lighting system options (conceptual).

15. Roofing
    Roofing systems with a minimum slope of ½" per foot (slopes less than ½"per foot is not permitted per City standard):
    Provide a roof as described in the standards that has a Full System Guarantee with no dollar limit including all roof penetrations. Guarantee shall include the roof system from the deck up. Damage repair as part of the guarantee shall include replacement of wet insulation and damaged decking.
    Roofing systems for slopes greater than 3" per foot shall rely on the manufacture's best warranties

THESE ARE SUGGESTED PEN COLORS AND THICKNESSES, ANY DEVIATION THEREOF WILL REQUIRE A PCP FILE TO BE INCLUDED WITH SUBMITTALS

PEN #	COLOR	City of Tucson A/E Division	MM	PIXEL	SCREEN
1	RED	2	0.35	6	
2	YELLOW	4	0.70	11	
3	GREEN	3	0.50	8	
4	CYAN	1	0.25	4	
5	BLUE	4	0.70	11	
6	MAGENTA	2	0.35	6	
7	WHITE	1	0.25	4	
8	DARK GRAY			8	9
9	DARK RED	7			
10	BROWN	2			
11	DARK GREEN	6		8	
12	LIGHT BLUE	4			
13	DARK BLUE	8			
14	PURPLE	6		8	7
15	GRAY	5		8	9

SCALE FACTORS

Scale factors are probably one of the most difficult aspects of CADD to visualize and remember. Hopefully, the following explanation will assist in clearing up this issue.

On a printed or hand drafted drawing, drawing scale represents a ratio. For example on a 1/4"=1'-0" drawing, a 1/4" represents 1' in real space. With a hand drafted drawing at this scale a wall 10' long is drawn 2-1/2" long. In CADD this same wall is drawn at its true or full scale length of 10'. When plotted AutoCAD reduces the drawing so that the wall is 2-1/2" long. The ratio of reduction is determined by the drawing scale. For 1/4"=1'-0" this ratio or scale factor is 48. This is determined by dividing the left side of the equation into the right side. How many 1/4" are there in 1'-0"? There are 48. This method of determining a drawing scale factor is applicable to all scales regardless of types of units used.

Text, diagrammatic symbols, north arrows, base titles, etc. need to be enlarged by the drawing scale factor, since objects created in a CADD drawing are drawn at full scale and only reduced when plotted.

Here is a way to visualize this concept. Since the building is created in AutoCAD at full scale, when you are viewing the total building on screen it is the same as if you were several feet above an actual building. If you were hovering above a building and looking down on it, to read text painted on the sidewalk you would have to paint it several inches tall.

To determine how tall to make 1/8" text in a drawing at 1/4"=1'-0" just multiply 0.125" times the drawing scale factor of 48. This yields a text height of 6" in the CADD drawing.

When creating base titles, diagrammatic symbols, north arrows, etc. draw them at full scale. For example a base title 42"x30" would be input at 42"x30". When inserting the block (all blocks created full scale) into a drawing it would be scaled up the drawing scale factor. Using this method enables you to use the blocks at any scale.

Following are scaling tables to assist when placing text and other scale sensitive elements.

Scaling Factors

These SCALING FACTORS and SCALE CONVERSION FORMULA are used to determine the INPUT SCALE of any FULL SCALE block or text string.

Drawing Scale	Scaling Factor
1” = 50’	600
1” = 40’	480
1” = 30’	360
1” = 20’	240
1” = 10’	120
3/32” = 1’-0”	128
1/8” = 1’-0”	96
3/16” = 1’-0”	64
1/4” = 1’-0”	48
3/8” = 1’-0”	32
1/2” = 1’-0”	24
3/4” = 1’-0”	16
1” = 1’-0”	12
1 1/2” = 1’-0”	8
3” = 1’-0”	4

Plotted Text Height	Height Factor [HF]
3/32”	10.67
1/8”	8.00
1/4”	4.00

SCALE CONVERSION FORMULA: SF/HF = INPUT SCALE

1. Styles - City of Tucson-Architecture and Engineering Division uses the standard AutoCAD fonts and the fonts which come with Auto-Architect. When using them please take note of the following:

A. There is a frequent misunderstanding with AutoCAD as to the difference between a text style and a text font. The style is the user given name of a text style. The text font is the font file name that is designated for the user named text style. All styles at City of Tucson-Architecture and Engineering Division are named after their corresponding font file.

Example:

COMMAND: STYLE Text style name (or ?) <CHISEL>:
Font file <CHISEL>:
Height <0'-0">:
Width factor <1.0>:
Obliquing angle <0.00>:
Backwards? <N>
Upside-down? <N>
Vertical? <N>
CHISEL is now the current text style.

B. Typical creation parameters for user created styles.

a. It is advisable that you do not fix the height of a text style with the style command. This allows for variations of heigth with the same style and font while reducing the number of styles used. If you do fix the height that text style is fixed and can not be adjusted for future use or modification.

Example:
Text style <CHISEL>
Font file <CHISEL>
Height: <0'-0">
Width factor: <1.0>
Obliquing angle: <0.00>
Backwards: <No>
Upside-down: <No>
Vertical: <No>

CAD Layer Guidelines - Layer Name Format

The City of Tucson utilizes the AIA standard layering guidelines as described below:

Long Format

Major Group- 1 Character. This categorization breaks the list into manageable sections, using the divisions of architectural, structural, mechanical, plumbing, fire protection, electrical, and civil engineering/site work.

Minor Group- 4 Characters. Generally Minor Groups designate assemblies or

Modifier- 4 Characters (Optional). This is an optional field for further differentiation of drawing element such as distinguishing full height walls from partial height walls or emergency lighting from general lighting.

User Defined- 1-8- Characters (Optional). This optional field may be used to accommodate special project requirements.

Examples

A-Wall	Walls
A-Door-Iden	Door Numbers

Short Format

Major Group- 1 character.
Minor Group- 2 character.
Modifier- 2 characters (Optional).
User Defined- 1-2 characters (Optional).

Examples

AWA	Walls
ADOID	Door Numbers

Source: CAD Layer Guidelines, Copyright 1990, AIA Press

*Softdesk Layer Default File: c:/adcadd/aa/setup/lan/aa_layer.dat									
*Description	Keyname	Layername	Color	Linetype	Trade	Plan	Level	Modifier	Auto Create
~ Architectural									
Appliances	APPL	A-FLOR-APPL	9	CONTINUOUS	0	0	1	1	0
Case work	CASE	A-FLOR-CASE	10	CONTINUOUS	0	0	1	1	0
Casework tags	CASENO	A-CASE-IDEN	1	CONTINUOUS	0	0	1	1	0
Ceiling major features	CEIL	A-CLNG	5	CONTINUOUS	0	0	1	1	0
Ceiling objects	CEILOBJ	A-CLNG	10	CONTINUOUS	0	0	1	1	0
Ceiling grid	CEILGRID	A-CLNG-GRID	5	CONTINUOUS	0	0	1	1	0
Columns	COLUMN	S-COLS	4	CONTINUOUS	0	0	1	1	0
Construction tags	CONSTNO	A-CONS-IDEN	1	CONTINUOUS	0	0	1	1	0
Demolition tags	DEMONO	A-DEMO-IDEN	1	CONTINUOUS	0	0	1	1	0
Doors	DOOR	A-DOOR	10	CONTINUOUS	0	0	1	1	0
3D Doors	3DDOOR	A-DOOR-ELEV	10	CONTINUOUS	0	0	1	1	0
3D Door accessories	DOORAC	A-DOOR-ELEV	10	CONTINUOUS	0	0	1	1	0
Door elevation	DOORE	A-DOOR-ELEV	10	CONTINUOUS	0	0	1	1	0
Door elevation swing	DSWING	A-DOOR-ELEV-SYMB	10	HIDDEN	0	0	1	1	0
Door elevation swing (3D)	DSWING3D	A-DOOR-ELEV-SYMB	10	HIDDEN	0	0	1	1	0
Door swing arc plan	DSWINGP	A-DOOR-SWG	10	HIDDEN	1	0	1	1	0
Door jamb	DJAMB	A-WALL-JAMB	8	CONTINUOUS	0	0	1	1	0
3D Door jamb	3DDJAMB	A-WALL-JAMB-ELEV	8	INVISIBLE	0	0	1	1	0
2D Door sills	DSILL	A-DOOR-SILL	9	CONTINUOUS	0	0	1	1	0
Door and window Headers	HEADER	A-WALL-HEAD	15	INVISIBLE	0	0	1	1	0
Door tags	DOORNO	A-DOOR-IDEN	1	CONTINUOUS	0	0	1	1	0
Disabled access guides	HANDICLR	A-AREA-INFO		CONTINUOUS	0	1	1	0	0
Electrical components	ELEC	E-LITE	11	CONTINUOUS	0	0	1	1	0
Electrical tags	ELECNO	E-LITE-IDEN	11	CONTINUOUS	0	0	1	1	0
Equipment	EQUIP	A-EQUI	7	CONTINUOUS	0	0	0	0	0
Equipment tags	EQUIPNO	A-EQUI-IDEN	1	CONTINUOUS	0	0	1	1	0
Finish tag: Base	FINBASE	A-WALL-IDEN	1	CONTINUOUS	0	0	1	1	0
Finish tag: Ceiling	FINCEIL	A-CLNG-IDEN	1	CONTINUOUS	0	0	1	1	0
Finish tag: Floor	FINFLOOR	A-FLOR-IDEN	1	CONTINUOUS	0	0	1	1	0
Finish tag: Combo	FINCALL	A-WALL-IDEN	1	CONTINUOUS	0	0	1	1	0
Finish tag: Wall	FINWALL	A-WALL-IDEN	1	CONTINUOUS	0	0	1	1	0
2D Fireplace	FIRE2D	A-FLOR-FIRE	9	CONTINUOUS	0	0	1	1	0
3D Fireplace	FIRE3D	A-FLOR-FIRE-ELEV	9	CONTINUOUS	0	0	1	1	0
3D Fireplace hearth	FHEARTH	A-FLOR-FIRE-ELEV	9	CONTINUOUS	0	0	1	1	0
3D Fireplace mantle	FMANTLE	A-FLOR-FIRE-ELEV	9	CONTINUOUS	0	0	1	1	0
2D Chimney	CHIM2D	A-ROOF-CHIM	9	CONTINUOUS	0	0	0	1	0
3D Chimney	CHIM3D	A-ROOF-CHIM-ELEV	9	CONTINUOUS	0	0	0	1	0
Framing members	FRAMING	S-FRAM	4	CONTINUOUS	0	0	1	1	0
Framing extents	FRAMEXT	S-FRAM-DIMS	5	CONTINUOUS	0	0	1	1	0
Kitchen/bath counter	CNTR	A-FLOR-WDWK	7	CONTINUOUS	0	0	1	1	0
3D Kitchen/bath counter	CNTR3D	A-FLOR-WDWK-ELEV	7	CONTINUOUS	0	0	1	1	0
Plumbing fixtures	PFIXT	P-FIXT	6	CONTINUOUS	0	0	1	1	0
Plumbing tags	TOILNO	A-PLUM-IDEN	1	CONTINUOUS	0	0	1	1	0
Toilet stalls	STALL	A-FLOR-TPTN	14	CONTINUOUS	0	0	1	1	0
Toilet stall 2D doors	STALLD2D	A-FLOR-TPTN	9	CONTINUOUS	0	0	1	1	0
Toilet stall 3D doors	STALLD3D	A-FLOR-TPTN-ELEV	6	CONTINUOUS	0	0	1	1	0

Toilet accessories	TOILACC	A-FLOR-SPCL	2	CONTINUOUS	0	0	1	1	0
Floor	FLOOR	A-FLOR-OTLN	12	CONTINUOUS	0	0	1	1	0
Floor edge	FLREDGE	A-FLOR-OTLN	12	CONTINUOUS	0	0	1	1	0
Floor grid	FLRGRID	A-FLOR-GRID	12	CONTINUOUS	0	0	1	1	0
Foundation walls	FND	S-FNDN	4	CONTINUOUS	0	0	1	1	0
3D Foundation walls	FND3D	S-FNDN-ELEV	15	CONTINUOUS	0	0	1	1	0
Footing	FOOTING	S-FNDN-FOOT	7	CONTINUOUS	0	0	1	1	0
Footing 3D	FOOTING3D	S-FNDN-FOOT-ELEV	3	CONTINUOUS	0	0	1	1	0
Furniture	FURN	A-FURN	10	CONTINUOUS	0	0	1	1	0
Furniture tags	FURNNO	A-FURN-IDEN	1	CONTINUOUS	0	0	1	1	0
Seating tags	SEATNO	A-SEAT-IDEN	1	CONTINUOUS	0	0	1	1	0
3D Furniture	FURN3D	A-FURN-ELEV	10	CONTINUOUS	0	0	1	1	0
3D Table elements	TABLE3D	A-FURN-ELEV	6	CONTINUOUS	0	0	1	1	0
Office panels	PANEL	A-FURN-PNLS	1	CONTINUOUS	0	0	1	1	0
Roof lines 2D	ROOF	A-ROOF-OTLN	11	CONTINUOUS	0	0	1	1	0
Roof faces 3D	ROOF3D	A-ROOF-ELEV	90	CONTINUOUS	0	0	1	1	0
Roof fascia & soffit 3D	ROOFSOF	A-ROOF-EDGE	20	CONTINUOUS	0	0	1	1	0
Roof slope information	ROOFTAG	A-ROOF-IDEN	1	CONTINUOUS	0	0	1	1	0
Roof gutters	ROOFGUT	A-ROOF-GUTR	9	CONTINUOUS	0	0	1	1	0
Room tags	ROOMNO	A-AREA-IDEN	2	CONTINUOUS	0	0	1	1	0
Closet shelves	SHELF	A-FLOR-WDWK	13	CONTINUOUS	0	0	1	1	0
Closet rods	ROD	A-FLOR-OVHD	6	HIDDEN	0	0	1	1	0
Site	SITE	C-PSIT	7	CONTINUOUS	0	0	1	1	0
Space planning	SPACE	A-AREA	3	CONTINUOUS	0	0	1	1	0
Sprinklers	SPRINK	F-SPRN-CLHD	5	CONTINUOUS	0	0	1	1	0
Sprinkler tags	SPRINKNO	F-SPRN-IDEN	5	CONTINUOUS	0	0	1	1	0
Stairs	STAIR	A-FLOR-STRS	2	CONTINUOUS	0	0	1	1	0
Stair handrails	STAIRH	A-FLOR-RAIL	3	CONTINUOUS	0	0	1	1	0
Stair risers	STAIRR	A-FLOR-RISR	1	HIDDEN4	0	0	1	1	0
Stair 3D treads	3DSTAIR	A-FLOR-STRS-3D	10	CONTINUOUS	0	0	1	1	0
Stair 3D riser	3DSTAIRR	A-FLOR-RISR-3D	8	CONTINUOUS	0	0	1	1	0
Stair 3D handrail	3DSTAIRH	A-FLOR-HRAL-3D	9	CONTINUOUS	0	0	1	1	0
Stair 3D balusters	3DSTAIRB	A-FLOR-BALS-3D	15	CONTINUOUS	0	0	1	1	0
Stair 3D stringers	3DSTAIRS	A-FLOR-STNG-3D	8	CONTINUOUS	0	0	1	1	0
Elevator	ELEVAT	A-FLOR-ELTR	2	CONTINUOUS	0	0	1	1	0
Walls	WALL	A-WALL	15	CONTINUOUS	0	0	1	1	0
Walls - air gap	WALLGAP	A-WALL-AGAP	15	CONTINUOUS	0	0	1	1	0
Walls - 3D	WALL3D	A-WALL-ELEV	15	CONTINUOUS	0	0	1	1	0
Walls - low	WALLL	A-WALL-PRHT	15	CONTINUOUS	0	0	1	1	0
Masonry walls	WALLM	A-WALL-MASN	2	CONTINUOUS	0	0	1	1	0
Wall center lines	WALLCL	A-WALL-CENT	1	CENTER2	0	0	1	1	0
Wall poche	POCHE	A-WALL-PATT	14	CONTINUOUS	0	0	1	1	0
Wall jamb lines (break cap)	JAMB	A-WALL-JAMB	15	CONTINUOUS	0	0	1	1	0
Wall 3D openings (non-vertical)	JAMB3D	A-WALL-ELEV	15	CONTINUOUS	0	0	1	1	0
Wall 3D head closures	3DHEAD	A-WALL-ELEV	15	INVISIBLE	0	0	1	1	0
Wall 3D sill closures	3DSILL	A-WALL-SILL-ELEV	12	INVISIBLE	0	0	1	1	0
Wall tags	WALLNO	A-WALL-IDEN	1	CONTINUOUS	0	0	1	1	0
Window glazing	WIND	A-GLAZ	13	CONTINUOUS	0	0	1	1	0
3D Windows	3DWINDOW	A-GLAZ-ELEV	5	CONTINUOUS	0	0	1	1	0
Window jamb	WJAMB	A-WALL-JAMB	14	CONTINUOUS	0	0	1	1	0
Window metal frame sill	WSJAMB	A-GLAZ-JAMB	14	CONTINUOUS	0	0	1	1	0

Window sills	WSILL	A-GLAZ-SILL	12	CONTINUOUS	0	0	1	1	0
Window footers	FOOTER	A-WALL-PRHT	11	CONTINUOUS	0	0	1	1	0
Footers below sills	FOOTERH	A-WALL-PRHT	15	INVISIBLE	0	0	1	1	0
Glazing: Normal (3D)	3DGLAZE	A-GLAZ-ELEV	5	CONTINUOUS	0	0	1	1	0
Glazing: Special (3D)	3DGLAZE2	A-GLAZ-ELEV	5	CONTINUOUS	0	0	1	1	0
Window and Door Casing (3D)	3DCASE	3DCASE	10	CONTINUOUS	0	0	1	1	0
Window and Door Trim (3D)	3DTRIM	3DTRIM	10	CONTINUOUS	0	0	1	1	0
Window elevation	WINDEL	A-GLAZ-ELEV	5	CONTINUOUS	0	0	1	1	0
Window elevation swing	WSWING	A-GLAZ-ELEV-SYMB	3	HIDDEN	0	0	1	1	0
Window plan swing arc	WSWINGP	A-GLAZ	13	CONTINUOUS	1	0	1	1	0
Window elevation swing (3D)	WSWING3D	A-GLAZ-ELEV-SYMB	3	HIDDEN	0	0	1	1	0
Window tags	WINDNO	A-GLAZ-IDEN	1	CONTINUOUS	0	0	1	1	0
Parking symbols	PRK-SYM	C-PKNG	7	CONTINUOUS	0	0	1	1	0
Parking stalls	PRK-STALL	C-PKNG-STRP	7	CONTINUOUS	0	0	1	1	0
Site utilities	UTIL	C-PULT	7	CONTINUOUS	0	0	1	1	0
Drainage symbols	DRAINAGE	C-STRM	7	CONTINUOUS	0	0	1	1	0
People	PEOPLE	A-ELEV-SYMB	7	CONTINUOUS	0	0	1	1	0
Plants - outdoor	PLANTS	L-PLNT	3	CONTINUOUS	0	0	1	1	0
Plants - indoor	PLANTSI	A-FURN-PLNT	3	CONTINUOUS	0	0	1	1	0
Vehicles	VEHICLES	C-PKNG-CARS	6	CONTINUOUS	0	0	1	1	0
Structural steel	STEEL	S-FRAM	7	CONTINUOUS	0	0	1	1	0
Elevation (misc.)	ELEV	A-ELEV	10	CONTINUOUS	0	0	1	1	0
Elevation mark	ELEVMRK	A-DETL	1	CONTINUOUS	0	0	1	1	0
Elevation text	ELEVTXT	A-DETL	1	CONTINUOUS	0	0	1	1	0
Section (misc.)	SECT	A-SECT	2	CONTINUOUS	0	0	1	1	0
Shadows	SHADOW	C-BLDG-PATT	8	CONTINUOUS	0	0	1	1	0
~ Line Layers									
Thin lines	THIN	THIN	1	CONTINUOUS	1	1	1	1	0
X-Fine lines	XFINE	XFINE	14	CONTINUOUS	1	1	1	1	0
Color (halftone) lines	COLOR	COLOR	6	CONTINUOUS	1	1	1	1	0
~ Text Layers									
X-Fine text	TEXTXF	TEXTXF	3	CONTINUOUS	1	1	1	1	0
Fine text	TEXTF	TEXTF	1	CONTINUOUS	1	1	1	1	0

ARCHITECTURAL ABBREVIATIONS

A/C	AIR CONDITIONING
AB	ANCHOR BOLT
ABV	ABOVE
AC	ACOUSTICAL
ACC	ACCESS
ACFL	ACCESS FLOOR
ACP	ACOUSTICAL CLNG PANEL
ACPL	ACOUSTICAL PLASTER
ACR	ACRYLIC PLASTER
ACT	ACOUSTICAL PLASTER
ACT	ACOUSTICAL TILE
AD	AREA DRAIN
ADD	ADDENDUM
ADH	ADHESIVE
ADJ	ADJUSTABLE
ADJT	ADJACENT
AFF	ABOVE FINISHED FLOOR
AGG	AGGREGATE
AHU	AIR HANDLING UNIT
ALT	ALTERNATE
ALUM	ALUMINUM
ANC	ANCHOR(AGE)
ANOD	ANODIZED
AP	ACCESS PANEL
AP	ACCESS POINT
APPROX	APPROXIMATE
APT	APARTMENT
ARCH	ARCHITECT(URAL)
ASB	ASBESTOS
ASC	ABOVE SUSPENDED CLNG
ASPH	ASPHALT
AT	ASPHALT TILE
AUTO	AUTOMATIC
BBD	BULLETIN BOARD
BBR	BASEBOARD RADIATION
BD	BOARD
BEL	BELOW
BIT	BITUMINOUS
BJT	BED JOINT
BLDG	BUILDING
BLK	BLOCK
BLKG	BLOCKING
BLST	BLUESTONE
BM	BEAM
BMK	BENCH MARK
BOT	BOTTOM
BP	BACK PLASTERED
BPL	BEARING PLATE
BRG	BEARING
BRK	BRICK
BRZ	BRONZE
BS	BOTH SIDES
BSMT	BASEMENT
BTWN	BETWEEN
BUR	BUILT UP ROOF
BVL	BEVELED
BW	BOTH WAYS
CAB	CABINET
CAD	CADMIUM
CB	CATCH BASIN
CEM	CEMENT
CF	CUBIC FOOT
CFL	COUNTER FLASHING
CG	CORNER GUARD
CHAM	CHAMFER
CHBD	CHALKBOARD
CHT	CEILING HEIGHT
CI	CAST IRON
CIPC	CAST-IN-PLACE CONC
CIR	CIRCLE
CIRC	CIRCUMFERENCE
CJ	CONTROL JOINT
CLG	CEILING
CLK	CAULK
CLKG	CAULKING
CLL	CONTRACT LIMIT LINE
CLR	CLEAR
CLS	CLOSURE
CMT	CERAMIC MOSAIC TILE
CMU	CONC MASONRY UNIT
COL	COLUMN
COMB	COMBINATION
COMP	COMPRESS(ED)(ION)(IBLE)
COMPO	COMPOSITE
COMPT	COMPARTMENT
CONC	CONCRETE
CONST	CONSTRUCTION
CONT	CONTINUOUS
CONTR	CONTRACTOR
COR	CORRUGATED
CORR	CORRIDOR
CPG	COPING
CPR	COPPER
CPT	CARPET
CR	CHROMIUM PLATED
CRG	CROSS GRAIN
CRS	COURSE(S)
CS	COUNTERSINK
CSMT	CASEMENT
CST	CAST STONE
CT	CERAMIC TILE
CTHK	COATHOOK
CTR	COUNTER
CTSK	COUNTERSUNK SCREW
CX	CONNECTION
CY	CUBIC YARD
D	DRAIN
DA	DOUBLE ACTING
DEM	DEMOLISH, DEMOLITION
DEP	DEPRESSED
DET	DETAIL
DF	DRINKING FOUNTAIN
DH	DOUBLE HUNG
DIAG	DIAGONAL
DIAM	DIAMETER
DIM	DIMENSION
DIV	DIVISION
DL	DEAD LOAD
DMPR	DAMPER
DMT	DEMOUNTABLE
DN	DOWN
DP	DAMPROOFING
DPL	DISPOSAL
DPR	DISPENSER
DR	DOOR
DRB	DRAINBOARD
DS	DOWNSPOUT
DT	DRAIN TILE
DTA	DOVETAIL ANCHOR
DTS	DOVETAIL ANCHOR SLOT
DW	DISHWASHER
DWG	DRAWING
DWR	DRAWER
DWTR	DUMBWAITER
E	EAST
EA	EACH
EB	EXPANSION BOLT
EF	EXHAUST FAN
EJ	EXPANSION JOINT
EL	ELEVATION
ELEC	ELECTRIC(AL)
ELEV	ELEVATOR
EMER	EMERGENCY
ENCL	ENCLOSURE
EPBD	ELECTRIC PANELBOARD
EPS	EXTERIOR PAINT SYSTEM
EQ	EQUAL
EQPT	EQUIPMENT
ESCL	ESCALATOR
ESTM	ESTIMATE
EV	EXPANSION BOLT
EWC	ELECTRIC WATER COOLER
EXCA	EXCAVATE
EXG	EXISTING
EXH	EXHAUST
EXMP	EXPANDED METAL PLATE
EXP	EXPOSED
EXS	EXTRA STRONG
EXT	EXTERIOR
FA	FIRE ALARM
FAI	FRESH AIR INTAKE
FAS	FASTENER
FB	FACE BRICK
FBD	FIBERBOARD
FBO	FURNISHED BY OTHERS
FBRK	FIRE BRICK
FD	FLOOR DRAIN
FE	FIRE EXTINGUISHER
FEC	FIRE EXTINGUISHERCAB
FF	FACTORY FINISH
FFE	FINISHED FLR ELEVATION
FFL	FINISHED FLOOR LINE
FG	FIXED GLASS
FGL	FIBERGLAS
FHMS	FLATHEAD MACH SCREW
FHS	FIRE HOSE STATION
FHWS	FLATHEAD WOOD SCREW
FIN	FINISH(ED)
FIXT	FIXTURE
FJT	FLUSH JOINT
FLCO	FLOOR CLEANOUT
FLG	FLASHING
FLR	FLOOR
FLUR	FLUORESCENT
FLX	FLEXIBLE
FN	FENCE
FNDN	FOUNDATION
FOC	FACE OF CONCRETE
FOF	FACE OF FINISH
FOM	FACE OF MASONRY
FOS	FACE OF STUDS
FP	FIREPROOF
FPG	FIREPROOFING
FPL	FLOOR PLATE
FR	FRAME(D)(ING)
FRC	FIRE RESISTANT COATING
FRGD	FORGED
FRPL	FIREPLACE
FRT	FIRE RETARD TREATED
FS	FULL SIZE
FTG	FOOTING
FURR	FURRED, FURRING
FUT	FUTURE
GA	GAUGE
GALV	GALVANIZED
GB	GRAB BAR
GC	GENERAL CONTRACTOR
GF	GROUND FACE
GI	GALVANIZED IRON
GKT	GASKET

GL	GLASS, GLAZING
GLB	GLASS BLOCK
GLF	GLASS FIBER
GP	GALVANIZED PIPE
GPDW	GYPSUM DRYWALL
GPL	GYPSUM LATH
GPPL	GYPSUM PLASTER
GPT	GYPSUM TILE
GRD	GRADE, GRADING
GRN	GRANITE
GRPG	GLASS REINF POLY GYP
GSS	GALVANIZED SHT STEEL
GST	GLAZED STRUCTURAL TILE
GT	GROUT
GVL	GRAVEL
GWB	GYPSUM WALLBOARD
GYP	GYPSUM
H/C	HANDICAP(PED)
HB	HOSE BIBB
HBD	HARDBOARD
HC	HOLLOW CORE
HD	HEAVY DUTY
HDNR	HARDENER
HDR	HEADER
HDWR	HARDWARE
HES	HIGH EARLY STR CEMENT
HH	HANDHOLE
HJT	HEADJOINT
HK	HOOK
HKS	HOOKS
HM	HOLLOW METAL
HORZ	HORIZONTAL
HPT	HIGH POINT
HR	HOUR
HT	HEIGHT
HTG	HEATING
HVAC	HEAT, VENT & AIR COND
HWD	HARDWOOD
HWH	HOT WATER HEATER
HX	HEXAGONAL
ID	INSIDE DIAMETER
ILK	INTERLOCK
INCIN	INCINERATOR
INCL	INCLUDE(D), INCLUDING
INS	INSULATE, INSULATION
INSC	INSULATING CONCRETE
INSF	INSULATING FILL
INT	INTERIOR
INTM	INTERMEDIATE
INV	INVERT
IPS	INTERIOR PAINT SYSTEM
JC	JANITOR'S CLOSET
JF	JOINT FILLER
JST	JOIST
JT	JOINT
KIT	KITCHEN
KO	KNOCKOUT
KPL	KICK PLATE
L	LENGTH
LAB	LABORATORY
LAD	LADDER
LAM	LAMINATE(D)
LAV	LAVATORY
LB	LAG BOLT
LBL	LABEL
LC	LIGHT CONTROL
LF	LINEAR FOOT
LH	LEFT HAND
LL	LIVE LOAD
LMS	LIMESTONE
LPT	LOW POINT
LT	LIGHT
LTL	LINTEL
LVR	LOUVER
LW	LIGHT WEIGHT
LWC	LIGHT WEIGHT CONCRETE
LWF	LIGHT WEIGHT FILL
M	METER(S)
MAS	MASONRY
MAX	MAXIMUM
MB	MACHINE BOLT
MBR	MEMBER
MC	MEDICINE CABINET
MECH	MECHANICAL
MED	MEDIUM
MET	METAL
MFD	METAL FLOOR DECKING
MFR	MANUFACTURER
MH	MAN HOLE
MI	MALLEABLE IRON
MIN	MINIMUM
MIR	MIRROR
MISC	MISCELLANEOUS
MLDG	MOLDING
MM	MILLIMETER(S)
MMB	MEMBRANE
MO	MASONRY OPENING
MOD	MODEL
MODU	MODULAR
MOV	MOVABLE
MR	MOP RECEPTOR
MRB	MARBLE
MT	MOUNT
MTD	MOUNTED
MTHR	METAL THRESHOLD
MTL	MATERIAL
MULL	MULLION
MWK	MILLWORK
N	NORTH
NAT	NATURAL
NCX	NONCOMBUSTIBLE EXT
NI	NICKEL
NIC	NOT IN CONTRACT
NL	NAILABLE
NMT	NONMETALLIC
NOM	NOMINAL
NR	NOISE REDUCTION
NRC	NOISE REDU COEFFICIENT
NTS	NOT TO SCALE
OA	OVERALL
OBS	OBSCURE
OC	ON CENTER
OD	OUTSIDE DIAMETER
OH	OVERHEAD
OHMS	OVALHEAD MACH SCREW
OHWS	OVALHEAD WOOD SCREW
OJ	OPEN-WEB JOINT(S)
OP	OPAQUE
OPH	OPPOSITE HAND
OPNG	OPENING
OPP	OPPOSITE
OPS	OPPOSITE SURFACE
PAR	PARALLEL
PB	PANIC BAR
PBD	PARTICLE BOARD
PCC	PRECAST CONCRETE
PCF	POUNDS PER CUBIC FOOT
PE	PORCELAIN ENAMEL
PERF	PERFORATE(D)
PERI	PERIMETER
PFB	PREFABRICATE(D)
PFN	PREFINISHED
PFS	POUNDS PER SQ FOOT
PG	PLATE GLASS
PIR	PAPER TOWEL RECEPTOR
PK	PARKING
PL	PROPERTY LINE
PLAM	PLASTIC LAMINATE
PLAS	PLASTER
PLF	POUNDS PER LIN FOOT
PLT	PLATE
PMT	PAVEMENT
PNL	PANEL
PNT	PAINT
PNTD	PAINTED
POLY	POLYETHYLENE
PR	PAIR
PRF	PREFORMED
PSC	PRESTRESSED CONCRETE
PSF	POUNDS PER SQ FOOT
PSI	POUNDS PER SQ INCH
PT	POINT
PTC	POST-TENSIONEDCONC
PTD	PAPER TOWEL DISPENSER
PTN	PARTITION
PTR	PAPER TOWEL RECEPTOR
PVC	POLYVINYL CHLORIDE
PVG	PAVING
PVMT	PAVEMENT
PWD	PLYWOOD
QT	QUARRY TILE
R	RISER
RA	RETURN AIR
RAD	RADIUS
RAG	RETURN AIR GRILLE
RAI	RETURN AIR INTAKE
RB	RUBBER BASE
RBL	RUBBLE STONE
RBT	RABBET
RCP	REINFORCED CONC POPE
RD	ROOF DRAIN
RE	REINFORCE(D),
REF	REFERENCE
REG	REGISTER
REM	REMOVE
REQD	REQUIRED
REQS	REQUIREMENTS
RES	RESILIENT
RET	RETURN
RETG	RETAINING
REV	REVISION
RFG	ROOFING
RFH	ROOF HATCH
RFL	REFLECT(ED)(IVE)(OR)
RH	RIGHT HAND
RL	RAIL(ING)
RM	ROOM
RO	ROUGH OPENING
ROW	RIGHT OF WAY
RT	FIRE RETARD TREATED
RT	RUBBER TILE
RTG	RATING
RV	ROOF VENT
RVS	REVERSE SIDE
RVT	RIVET
RWC	RAINWATER CONDUCTOR
RWL	RAINWATER LEADER
S	SOUTH
SC	SOLID CORE
SCH	SCHEDULE
SCN	SCREEN
SCT	STRUCTURAL CLAY TILE
SD	STORM DRAIN
SECT	SECTION
SF	SQUARE FOOT
SFGL	SAFETY GLASS
SG	SHEET GLASS
SH	SHELF, SHELVING
SHO	SHORE, SHORING
SHT	SHEET
SHTH	SHEATHING
SIM	SIMILAR
SKLT	SKYLIGHT

16. Communication and alarm systems description and floor area space requirements

    a. Identification and scope. (narrative)
    b. Data, CATV, audio video, and phone drops location. (narrative)
    c. Communications equipment room(s) sized and located on floor plans.
    d. Special communication needs, wireless, antenna mast, fire alert system, mobile data computer, Internet Protocol Media Network (IPMN) and Information Transport Systems (ITS). (narrative)
    e. Where large meeting rooms, classrooms, and auditoriums are part of the project, SD is when an Acoustic Engineer and/or AV specialists should begin providing information and design criteria. rev4/22/08

17. Outline Specifications

    a. Table of contents for technical sections.
    b. All sections project specific.
    c. Written description of recommended additive alternates and special construction scheduling requirements (coordinated with the CM@R contractor if applicable).

18. LEED and the Sustainable Energy Standard – as required by Mayor and Council Resolution each new facility or renovation project of over 5,000 sq. ft. must meet the LEED Silver Criteria and offset a minimum of 5% of its energy needs thru the use of solar energy. In addition, for new construction, the project must earn a combined 7 points in EA1 and EA2 and for existing buildings 9 points combined in EA1 and EA2.

    a. Show all available LEED points in tabular form which indicates what points are probable yes's, no's and maybe's. Provide an order of magnitude estimate as appropriate for the cost or credit available for obtaining each point and the responsible party (City, design consultant, sub-consultants or general contractor).
    b. Include a determination of how the project will meet the requirement for offset of its overall energy needs with solar energy in the form of daylighting, electric generation or water heating.

    c. Building Energy Modeling.

        i. For buildings over 5,000 square feet an hourly simulation shall be performed by a Certified Energy Manager (CEM by the Association of Energy Engineers)

SL	SOLID CORE
SLNT	SEALANT
SP	SOUNDPROOF
SPC	SPACER
SPEC	SPECIFICATION
SPECS	SPECIFICATIONS
SPKR	SPEAKER
SPL	SPECIAL
SQ	SQUARE
SSK	SERVICE SINK
SSTL	STAINLESS STEEL
STA	STATION
STD	STANDARD
STG	SEATING
STL	STEEL
STOR	STORAGE
STRUC	STRUCTURAL
SUS	SUSPEND(ED)
SYM	SYMETRICAL
SYN	SYNTHETIC
SYS	SYSTEM
T	TREAD
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
TB	TOWEL BAR
TC	TERRA COTTA
TEL	TELEPHONE
TEMP	TEMPORARY
THK	THICK(NESS)
THR	THRESHOLD
TKB	TACKBOARD
TKS	TACK STRIP
TMPD	TEMPERED
TOC	TOP OF CURB
TOL	TOLERANCE
TOM	TOP OF MASONRY
TOS	TOP OF STEEL
TP	TACK PANEL
TPD	TOILET PAPER DISPENSER
TPL	TOP OF PLATE
TPTN	TOILET PARTITION
TR	TRANSOM
TR	TREAD
TSL	TOP OF SLAB
TV	TELEVISION
TW	TOP OF WALL
TYP	TYPICAL
TZ	TERRAZZO
UC	UNDERCUT
UGD	UNDERGROUND
UNF	UNFINISHED
UR	URINAL
VAR	VARNISH
VAT	VINYL ASBESTOS TILE
VB	VAPOR BARRIER
VERT	VERTICAL
VF	VINYL FABRIC
VG	VERTICAL GRAIN
VIF	VERIFY IN FIELD
VIN	VINYL
VJ	V-JOINTED
VNB	VINYL BASE
VNR	VENEER
VPR	COPPER
VRM	VERMICULITE
VT	VINYL TILE
VWC	VINYL WALL COVERING
W	WEST
W/	WITH
W/O	WITHOUT
WB	WOOD BASE
WC	WATER CLOSET
WD	WOOD
WG	WIRE GLASS
WH	WALL HUNG
WHB	WHEEL BUMPER
WI	WROUGHT IRON
WIN	WINDOW
WM	WIRE MESH
WP	WATERPROFFING
WPR	WATER REPELLENT
WPT	WORKING POINT
WR	WASTE RECEPTACLE
WRP	WATER REPELLANT
WS	WATER STOP
WSCT	WAINSCOT
WTW	WALL TO WALL
WWF	WELDED WIRE FABRIC
WWM	WELDED WIRE MESH

WILDCARD CHARACTERS

- * Matches any string. It can be used anywhere in the search pattern; at the beginning, middle, or end of string.
- ? Matches any single character; alphabetic, numeric, and non-alphameric (i.e. $ or !).
- @ Matches a single alphabetic character.
- # Matches a single numeric character.
- . Matches a single non-alphameric character.
- ~ If a tilde "~" is the first character in pattern, then AutoCAD lists everything except the string that follows. You can think of it as meaning "anything but...", or "not...".
- [...] Brackets match any one of the literal characters enclosed between them. Wildcards such as # or @ would be taken literally. Exceptions include the hyphen "-" and tilde "~" characters.
- [~...] Matches any character not enclosed. The tilde must be the first character within the brackets or it will be treated literally.
- - When a hyphen is used inside brackets, it specifies a range. To specify a literal hyphen "-", make it the first or last bracketed character (as in [-AB] or [AB-]).
- , Commas act as a multi-pattern separator (i.e. A*, B*).

WILD CARD PATTERNS:

Pattern	Will match or include...	But not...
ABC	Only ABC	
~ABC	Anything but ABC	
A?C	Any 3 characters sequence beginning with A and ending with C.	AC, ABCD, AXXC, or XABC
AB?	ABA through ABZ	AB, ABCE, or XAB
?BC	ABC through XBC	AB, ABCD, BC, or XXBC
A*C	AAC, AC, ABC, AXXC, etc.	XA or ABCD
A*	Anything starting with A	XAAA
*AB	Anything ending with AB	ABX
AB	AB anywhere in string	AXB
~*AB*	All strings without AB	AB, ABX, XAB, or XABX
'*AB	*AB	AB, XAB, or *ABC
[AB]C	AC or BC	ABC, or XAC
[~AB]C	XC or YC	AC, BC, or XXC
[A-J]C	AC, BC, through JC	ABC, AJC, or MC
[-A-J]C	Any character not in the range A-J, followed by C.	AC, BC, or JC

AUTOCAD GENERAL ERROR RECOVERY AND POSSIBLE CAUSES

Almost all errors are caused by corruption of one of the following:

1. The drawing file that AutoCAD is reading
2. The temporary files that AutoCAD has generated
3. AutoCAD's working environment under MS WINDOWS.

Drawing files can be corrupted due to several reasons: disk drives may need cleaning and alignment, a voltage spike during a read or write to disk can corrupt data, the disk drive may be highly fragmented, over-heated, etc. Remember that you cannot recover the drawing file in question using a binary/hex editor to patch the data, or one of the popular unerase utilities under MS-DOS, like Norton Utilities. Norton's Disk Doctor also will not recover corrupted drawing files since it only relocates all the readable bytes to another area of the disk, ignoring the unreadable ones. AutoCAD drawing files are extremely sensitive and as much as one misplaced bytes can render the file unreadable. The hex dump that follows the Error message is merely a traceback of internal addresses, telling the AutoCAD programmer the sequence of most recent function calls that preceded the error. It holds little significance for the general customer.

Temporary files can be corrupted at run-time due to the reasons above, and also due to improper configuration. For example, if you are running AutoCAD on a machine with EXTended memory, ensure that AutoCAD has detected the presence of any RAM disks or partitioned EXPanded memory. If it has failed to do so, then any data that AutoCAD has paged into its Extended I/O page space runs the risk of being over-written by other information that is being written to the RAM disk or the "other memory partition".

Under MS-DOS, AutoCAD establishes and maintains a tight working environment consisting of memory blocks, data resources and software interrupts. Should an ill-behaved TSR program or a device driver alter this carefully maintained state without AutoCAD's knowledge, any data that AutoCAD is operating on runs the risk of being corrupted during execution.

Whenever these error messages occur, AutoCAD is almost certainly reporting a genuine case of data or environment corruption. On rare occasion, this may point back to a software bug within AutoCAD. These cases are almost always repeatable and occur due to a specific sequence of events; e.g., if drawing a circle and trimming it to 1/4" of its radius always generates an error in any drawing, then you may have discovered a software bug.

What do I do if I encounter one of these errors ?

First of all, don't panic. If the drawing file itself is corrupted, you will encounter the error while calling up the drawing on any machine or copy of AutoCAD. In this situation, you can either: return to the backup of the drawing file in question (backing up your data on a regular basis is critical), or use the procedure outlined in Appendix F of the Reference Manual under "Disaster Handling".

Softdesk Macros Help File

(Specific products required where indicated)

Macro Description

" - Transparent Osnap toggle
3M - 3D Mesh
3P - 3D Polyline
AC - Arc
AD - Attribute Define
AE - Area
AR - Array
BA - Break @
BF - Break First
BL - Block
BR - Break
BX - Box (ACAD13)
C3 - 3 Point Circle
CC - Continuous Copy
CE - Change Entity
CF - Chamfer
CH - Change
CI - Circle
CL - Change Layer (Pro-Tools)
CM - Copy Multiple
CN - Cone (ACAD13)
CO - Copy
CP - Change Property
CY - Cylinder (ACAD13)
D - Draw by Example (Pro-Tools)
DAL - Aligned dimension
DAN - Angular dimension
DBA - Baseline dimension
DCE - Center marks
DCO - Continue dimensioning
DDI - Diameter dimension
DHO - Horizontal dimension
DI - Distance
DIV - Divide
DLE - Dimension Leader (Pro-Tools)
DO - Doughnut
DOB - Oblique dimension
DOR - Ordinate dimension
DRA - Radius dimension
DRO - Rotate dimension
DS - Plot Daystamping (Pro-Tools)
DV - Dview
DVE - Vertical dimension
EA - Attribute Edit
EB - Edit Block (Pro-Tools)
EH - Edit Hatch
EL - Erase Last
ELP - Ellipse
EM - Edit Multi-Line
EP - Edit Polyline
ER - Erase
ES - Edit Spline (ACAD13)
ESU - Edge Surface
ET - Edit Text
EXP - Explode
EXT - Extend
F0 - Fillet Radius 0
FA - 3Dface
FI - Fillet Set Radius
FR - Fillet Radius
GL - Group Level
GM - Group Modifier
GP - Group Plan Type
GR - Grid
GT - Group Trade
GU - Glue (Pro-Tools)
GV - Group View
GX - Group Toggle On/Off
HA - Boundary Hatch
HD - Dynamic Hatch
HE - Help Catalogue
HI - Hide
IN - Insert
IP - Isoplane Toggle
L1 - Layer Isolate
LA - Layer Command
LC - Layer Properties
LD - Layer Dialogue
LF - Layer Off
LG - Lengthen (ACAD13)
L - Line
LI - List
LK - Layer Lock
LL - List Layer (Building Base)
LO - Layer On
LS - Layer Set
LSP - Load Lisp
LSU - Ruled Surface
LT - Layer Thaw
LU - Layer Unlock
LVP - Viewport Layer Controls
LZ - Layer Freeze
MB - Make Block (Pro-Tools)
ME - Measure
MI - Mirror
ML - Multi-Line
MN - Menu Command
MO - Move
MS - Mspace
MV - Mview
OF - Offset
OP - Oops
OS - Osnap
PA - Pan
PE - Pedit
PG - Polygon
PL - Pline
PN - Plan
PO - Point
PR - Print/Plot
PS - Pspace
QC - Quick Copy (Pro-Tools)
QM - Quick Move (Pro-Tools)
QU - Quit
RB - Redefine Block (Pro-Tools)
RC - Rectangle

RE - Redrawall
RG - Regenall
RL - Ray Line
RO - Rotate
ROC - Rotate Copy
RQ - Rotate Quick (Building Base)
RS - Reset Settings
RSU - Revolution Surface
SA - Save
SC - Scale
SD - Change Softdesk Product
SE - Select
SK - Sketch
SN - Snap
SO - Solid
SM - Symbol Manager
SP - Spell
SPH - Sphere (ACAD13)
SR - Snap Rotate
SS - Build Selection Set
ST - Stretch
STR - Stretch Remove (Building Base)
STS - Stretch Select (Building Base)
SV - System Variables
SY - Set Style
TS - Text Small
TI - Tilemode Toggle
TL - Text Large
TM - Text Medium
TO - Torus (ACAD13)
TQ - Text Quality
TR - Trim
TT - Text Title
TX - Text Medium
TXF - Text X-Fine (Building Base)
UB - Undo Back
UC - UCS
UM - Undo Mark
UP - UCS Previous
UV - UCS View
UW - UCS World
VA - View ALL
VI - View
VP - Vports
VR - View Restore
VS - Vslide
VT - Vpoint
WB - Wblock
WC - Window Copy
WD - Wedge (ACAD13)
WE - Window Erase
WH - Window Change
WM - Window Move
WP - Window Chprop
WR - Window Rotate
WS - Window Scale
XL - Infinite Line
XP - Explode
XSU - Extruded Surface
XT - Extend
YC - Layer Copy (Pro-Tools)
YE - Layer Erase (Pro-Tools)
YH - Layer Change
YM - Layer Move
YP - Layer Chprop
YR - Layer Rotate
YS - Layer Scale
ZA - Zoom All
ZC - Zoom Center
ZD - Zoom Dynamic
ZE - Zoom Extents
ZF - Zoom Left
ZI - Zoom In
ZL - Zoom Limits
ZM - Zoom View Max
ZO - Zoom Out
ZP - Zoom Previous
ZW - Zoom Window

Linetypes are to confirm to the following definations

```
*BORDER,__ __ . __ __ . __ __ . __ __ . __ __ . __ __ . __ __ .
A,.5,-.25,.5,-.25,0,-.25
*BORDER2,__.__.__.__.__.__.__.__.__.__.__.__.__.__.__.__.__.__.__.__.__.__
A,.25,-.125,.25,-.125,0,-.125
*BORDERX2,____ ____ . ____ ____ . ____ ____ . ____ ____ .
A,1.0,-.5,1.0,-.5,0,-.5

*CENTER,____ _ ____ _ ____ _ ____ _ ____ _ ____ _ ____ _ ____ _ ____ _
A,1.25,-.25,.25,-.25
*CENTER2,___ _ ___ _ ___ _ ___ _ ___ _ ___ _ ___ _ ___ _ ___ _ ___ _ _
A,.75,-.125,.125,-.125
*CENTERX2,________ __ ________ __ ________ __ ________ __ ____
A,2.5,-.5,.5,-.5

*DASHDOT,__ . __ . __ . __ . __ . __ . __ . __ . __ . __ . __ . __ . _
A,.5,-.25,0,-.25
*DASHDOT2,_._._._._._._._._._._._._._._._._._._._._._._._._._._._._._._._.
A,.25,-.125,0,-.125
*DASHDOTX2,____ . ____ . ____ . ____ . ____ . ____ . ____
A,1.0,-.5,0,-.5

*DASHED,__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
A,.5,-.25
*DASHED2,_ _ _ _
```

```
*CENTER4,___ _ ___ _ ___ _ __ (1/2 of Center2)__ _ ___ _ ___ _ ___ _ _
A,.375,-.0625,.0625,-.0625
*CENTER8,___ _ ___ _ ___ _ __ (1/2 of Center4)__ _ ___ _ ___ _ ___ _ _
A,.1875,-.03125,.03125,-.03125

;; Auto-Arch CenterF is like ACAD Center, but has finer spacing around dash
*CENTERF,_____ _ _____ (Finer short dashes than Center) _____
A,1.25,-.125,.125,-.125
;; Auto-Arch CenterF2 is like ACAD Center2, but has finer spacing around dash
*CENTERF2,___ _ ___ _ ___ _ ___ _ ___ _ ___ _ ___ _ ___ _ ___ _ ___ _ _
A,0.75,-0.0625,0.0625,-0.0625
;; Auto-Arch additions for finer linetypes.
*CENTERF4,___ _ ___ _ ___ _ __ (1/2 of CenterF2)__ _ ___ _ ___ _ ___ _ _
A,.375,-.03125,.03125,-.03125
*CENTERF8,___ _ ___ _ ___ _ __ (1/2 of CenterF4)__ _ ___ _ ___ _ ___ _ _
A,.1875,-.0015625,.0015625,-.0015625

;; Auto-Arch additions for finer linetypes.
*DASHED4,_ _ _ _ _ _ _ _ (1/2 of Dashed2)_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
A,.125,-.0625
*DASHED8,_ _ _ _ _ _ _ _ (1/2 of Dashed4)_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
A,.0625,-.03125


*DEMOx2,____      ____      ____      ____      ____
A,.250,-.5
*DEMO,__   __   __   __   __   __   __   __   __   __   __
A,.125,-.25
*DEMO2,_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
A,.0625,-.125
*DEMO4,_ _ _ _ _ _  (1/2 of Demo2) _ _ _ _ _ _ _ _ _ _ _
A,.0625,-.125
*DEMO8,_ _ _ _ _ _  (1/2 of Demo4) _ _ _ _ _ _ _ _ _ _ _
A,.03125,-.0625

*INVISIBLE,.       (Dot at endpoints only)            .
A,0,-1000

;; Auto-Arch additions for finer linetypes.
*DOT4,....................(1/2 of Dot2)...............................
A,0,-.06125
*DOT8,....................(1/2 of Dot4)...............................
A,0,-.03125
*DOT16,...................(1/2 of Dot8)...............................
A,0,-.0015625

*HIDDEN4,_ _ _ _ _ _ _ _ (1/2 of Hidden2)_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
A,.0625,-.03125
*HIDDEN8,_ _ _ _ _ _ _ _ (1/2 of Hidden4)_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
A,.03125,-.015

*PHANTOM4,___ _ _ ___ _ _ (1/2 of Phantom2)__ _ _ ___ _ _ ___ _ _ ___ _ _
A,.3125,-.0625,.0625,-.0625,.0625,-.0625
*PHANTOM8,___ _ _ ___ _ _ (1/2 of Phantom4)__ _ _ ___ _ _ ___ _ _ ___ _ _
A,.15625,-.03125,.03125,-.03125,.03125,-.03125

*CONTOUR,_______  _______  _______  _______  _______  _______  _______  _______
A,.375,-.09375
*CONTOUR2,____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____
A,.25,-.0625
*COLDWR,___ _ ____ _ _____ _ _____ _ _____ _ ____
A,.25,-0.075,0.075,-0.075
*HOTWR,___ _ _ ___ _ _ ___ _ _ ___ _ _ ___ _ _ ___
```

```
A,.25,-0.075,0.075,-0.075,0.075,-0.075
*HCW,_____ _ _ _ _____ _ _ _ _____ _ _ _ _____
A,1,-0.125,0.125,-0.125,0.125,-0.125,0.125,-0.125
*BOUNDARY,___________ __ __ ___________ __ __ ______
A,1.75,-0.125,0.125,-0.125,0.125,-0.125
*BOUNDARY2,_____ _ _ _____ _ _ _____ _ _ _____ _ _ _____
A,1,-0.0625,0.0625,-0.0625,0.0625,-0.0625
*STREAM,_________ . . ___________ . . ___________
A,1,-0.125,0,-0.125,0,-0.125
*PNEUM,__ ___ ___ ___ ___ ___ ___ ___ ___ ___ __
A,0.2,-0.1,0.2,-0.1
*WASTE,__ __ __ __ __ __ __ __ __ __ __ __ __ __
A,.25,-.125
*2DASHES,____ _ _ _____ _ _ ____ _ _ ____ _ _ ____
A,0.75,-0.25,0.1,-0.25,0.1,-0.25
*EWIREUP,__ . __ . __ . __ . __ . __ . __ . __ .__
A,.25,-.075,0,-.075
*EWCELL,___ ___ . ___ ___ . __ __ . __ __ . __ __
A,.25,-.075,.25,-.075,0,-.075

;; Additional linetype for details
*EVENDASH,--  --  --  --  --  --  --  --  --  --  --
A,.125,-.125

;; Additional Plumbing linetypes
*DCW,Domestic Cold Water ___ _ _____ _ ____
A,1.25,-0.06,0.08,-0.06
*DCW2,Domestic Cold Water __ _ _____ _ _____ _ ____
A,.625,-0.03,0.04,-0.03
*DCWX2,Domestic Cold Water _____ ___ _____
A,2.5,-0.12,0.16,-0.12
*DHW,Domestic Hot Water ___ _ _ _____ _ _ ____
A,1.25,-0.06,0.08,-0.06,0.08,-0.06
*DHW2,Domestic Hot Water __ _ _ _____ _ _ ____ _ _ __
A,.625,-0.03,0.04,-0.03,0.04,-0.03
*DHWX2,Domestic Hot Water _____ ___ ___ ___ _____
A,2.5,-0.12,0.16,-0.12,0.16,-0.12
*DHWR,Domestic Hot Wtr Return _____ __ __ __ _____
A,1.25,-0.06,0.08,-0.06,0.08,-0.06,0.08,-0.06
*DHWR2,Domestic Hot Wtr Return ___ _ _ _ _____
A,.625,-0.03,0.04,-0.03,0.04,-0.03,0.04,-0.03
*DHWRX2,Domestic Hot Wtr Return ____ ___ ____ ____ ____
A,2.5,-0.12,0.16,-0.12,0.16,-0.12,0.16,-0.12
*VENT,Sanitary Vent Pipe __ __ __ __ __ __ __ __ __ __
A,0.16,-0.08
*VENT2,Sanitary Vent Pipe _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
A,0.08,-0.04
*VENTX2,Sanitary Vent Pipe ____  ____  ____  ___
A,0.32,-0.16
*COND,Steam Condensate __ __ __ __ __ __ __ __ __ __ __
A,0.16,-0.08
*COND2,Steam Condensate _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
A,0.08,-0.04
*CONDX2,Steam Condensate ____  ____  ____  ____
A,0.32,-0.16
```

TEXT HEIGHT CONVERSION CHART

Drawing Scale	Plotted Text Height	Text Input Scale, in inches
3/32" = 1'-0"	3/32"	13.5
3/32" = 1'-0"	1/8"	18
3/32" = 1'-0"	1/4"	36
1/8" = 1'-0"	3/32"	9
1/8" = 1'-0"	1/8"	12
1/8" = 1'-0"	1/4"	24
3/16" = 1'-0"	3/32"	6.75
3/16" = 1'-0"	1/8"	9
3/16" = 1'-0"	1/4"	18
1/4" = 1'-0"	3/32"	4.5
1/4" = 1'-0"	1/8"	6
1/4" = 1'-0"	1/4"	12
3/8" = 1'-0"	3/32"	3
3/8" = 1'-0"	1/8"	4
3/8" = 1'-0"	1/4"	8
1/2" = 1'-0"	3/32"	2.25
1/2" = 1'-0"	1/8"	3
1/2" = 1'-0"	1/4"	6
3/4" = 1'-0"	3/32"	1.5
3/4" = 1'-0"	1/8"	2
3/4" = 1'-0"	1/4"	4
1 ½" = 1'-0"	3/32"	.75
1 ½" = 1'-0"	1/8"	1
1 ½" = 1'-0"	1/4"	2
3" = 1'-0"	3/32"	.375
3" = 1'-0"	1/8"	.5
3" = 1'-0"	1/4"	1

METRICATION CHART

Fraction Inches	Dec. Inches	Millimeters	Fraction Inches	Dec. Inches	Millimeters
1/64	0.0156	0.3962	33/64	0.5156	13.0962
1/32	0.0312	0.7925	17/32	0.5312	13.4925
3/64	0.0469	1.1913	35/64	0.5469	13.8913
1/16	0.0625	1.5875	9/16	0.5625	14.2875
5/64	0.0781	1.9837	37/64	0.5781	14.6837
3/32	0.0937	2.3800	19/32	0.5937	15.0800
7/64	0.1094	2.7788	39/64	0.6094	15.4788
1/8	0.1250	3.1750	5/8	0.6250	15.8750
9/64	0.1406	3.5712	41/64	0.6406	16.2712
5/32	0.1562	3.9675	21/32	0.6562	16.6675
11/64	0.1719	4.3663	43/64	0.6719	17.0663
3/16	0.1875	4.7625	11/16	0.6875	17.4625
13/64	0.2031	5.1587	45/64	0.7031	17.8587
7/32	0.2187	5.5550	23/32	0.7187	18.2550
15/64	0.2344	5.9538	47/64	0.7344	18.6538
1/4	0.2500	6.3500	3/4	0.7500	19.0500
17/64	0.2656	6.7462	49/64	0.7656	19.4462
9/32	0.2812	7.1425	25/32	0.7812	19.8425
19/64	0.2969	7.5413	51/64	0.7969	20.2413
5/16	0.3125	7.9375	13/16	0.8125	20.6375
21/64	0.3281	8.3337	53/64	0.8281	21.0337
11/32	0.3437	8.7300	27/32	0.8437	21.4300
23/64	0.3594	9.1288	5/64	0.8594	21.8288
3/8	0.3750	9.5250	7/8	0.8750	22.2250
25/64	0.3906	9.9212	57/64	0.8906	22.6212
13/32	0.4062	10.3175	29/32	0.9062	23.0175
27/64	0.4219	10.7163	59/64	0.9219	23.4163
7/16	0.4375	11.1125	15/16	0.9375	23.8125
29/64	0.4531	11.5087	61/64	0.9531	24.2087
15/32	0.4687	11.9050	31/32	0.9687	24.6050
31/64	0.4844	12.3038	63/64	0.9844	25.0038
1/2	0.5000	12.7000	1	1.0000	25.4000

Inches X 25.40 = Millimeters
Feet X .3048 = Meters
Yards X .9144 = Meters

Millimeters X .03937 = Inches
Meters X 3.281 = Feet
Meters X 1.0936 = Yards

or licensed engineer to evaluate the best energy strategies. Software and methodology to be used for the evaluation shall be approved by the City prior to use. At this phase of the design the model is to be utilized for determining strategies to be recommended for achieving the project goals for energy efficiency and meeting the LEED criteria. It is understood that much of the data for an accurate model is not available at this time. The LEED submission will require a detailed model which must be performed at a later time.

ii. For buildings less than 5,000 square feet the prescriptive method may be used as described in Table 702.2(30) of the IECC for climatic zone 14a.

iii. Energy cost shall be provided by the City of Tucson at the request of the consultant.

19. Basis of Design Narrative - Provide narrative descriptions of major systems including; functionality, features, limitations, design assumptions and design parameters. Design assumptions shall also be indicated such as # of occupants, indoor and outdoor HVAC design parameters, maintained foot-candles, hours of operation, roof design loads, etc. It is expected that these narratives and design assumptions will be updated and included in each subsequent design submittal in a report format. The basis of design documents will ultimately be included in the project as-built or record set of plans for ease of future access on full size sheets. It is anticipated that the basis of design sheets will simply be reproduced onto full size plan sheets numbered, titled and index with the plans when the consultant turns over the record set of plans to the City. The basis of design is not expected to be included in the plans submitted for permits or construction bidding

20. Third Party Commissioning - new construction or major renovation project of over 5,000 sq.ft. must be third party commissioned. The City PM will hire the 3rd party commissioning agent for the project at the completion of the SD project phase. The City PM is responsible for ensuring the budget reflects the cost for commissioning and directing the commissioning agent throughout the project. The design consultant needs to fully cooperate and coordinate with the commissioning agent. The SD report should note the project will be commissioned.

All of the above information is to be reproduced in color, bound and ten (10) copies (unless otherwise noted in the contract) distributed to the City of Tucson Architecture & Engineering office, which will in turn distribute copies to each of the user departments and agencies. Also,

	INSERTION CONVERSION SCALE TABLE - IMPORTED DWG/EXISTING DWG														
IMPORTED	1"=50'	1"=40'	1"=30'	1"=20'	1"=10'	1/8"=1'	3/16"=1'	1/4"=1'	3/8"=1'	1/2"=1'	3/4"=1'	1"=1'	1.5"=1'	3"=1'	1"=1'
EXISTING															
1"=50'	1.0	1.25	1.67	2.5	5.0	6.25	9.375	12.5	18.75	25.0	37.5	50.0	75.0	150.0	600.0
1"=40'	0.8	1.0	1.33	2.0	4.0	5.0	7.5	10.0	15.0	20.0	30.0	40.0	60.0	120.0	480.0
1"=30'	0.6	0.75	1.0	1.5	3.0	3.75	5.625	7.5	11.25	15.0	22.5	30.0	45.0	90.0	360.0
1"=20'	0.4	0.5	0.667	1.0	2.0	2.5	3.75	5.0	7.5	10.0	15.0	20.0	30.0	60.0	240.0
1"=10'	0.2	0.25	0.333	0.5	1.0	1.25	1.875	2.5	3.75	5.0	7.5	10.0	15.0	30.0	120.0
1/8"=1'	0.16	0.2	0.267	0.4	0.8	1.0	1.5	2.0	3.0	4.0	6.0	8.0	12.0	24.0	96.0
3/16"=1'	0.1067	0.1333	0.1778	0.2667	0.5333	0.6667	1.0	1.33	2.0	2.67	4.0	5.33	8.0	16.0	64.0
1/4"=1'	0.08	0.1	0.1333	0.2	0.4	0.5	0.75	1.0	1.5	2.0	3.0	4.0	6.0	12.0	48.0
3/8"=1'	0.0533	0.0667	0.0889	0.1333	0.2667	0.333	0.5	0.6667	1.0	0.0417	2.0	2.667	4.0	8.0	32.0
1/2"=1'	0.04	0.05	0.0667	0.1	0.2	0.25	0.375	0.5	0.75	1.0	1.5	2.0	3.0	6.0	24.0
3/4"=1'	0.0267	0.0333	0.0444	0.0667	0.1333	0.1667	0.25	0.3333	0.5	0.6667	1.0	1.3	2.0	4.0	16.0
1"=1'	0.02	0.025	0.033	0.05	0.1	0.125	0.1875	0.25	0.375	0.5	0.75	1.0	1.5	3.0	12.0
1.5"=1'	0.0133	0.0167	0.0222	0.0333	0.0667	0.0833	0.125	0.1667	0.25	0.3333	0.5	0.6667	1.0	2.0	8.0
3"=1'	0.0067	0.0083	0.0111	0.0167	0.0333	0.0417	0.0625	0.0833	0.125	0.1667	0.25	0.3333	0.5	1.0	4.0
1"=1"	0.0017	0.0021	0.0028	0.0042	0.0083	0.0104	0.0156	0.0208	0.0313	0.0417	0.0625	0.0833	0.125	0.25	1.0

	DRAWING HEIGHT CONVERSION CHART - PLOTTED IN. = DRAWING FT.													
DWG SCALE	1"=50'	1"=40'	1"=30'	1"=20'	1"=10'	1/8"=1'	3/16"=1'	1/4"=1'	3/8"=1'	1/2"=1'	3/4"=1'	1"=1'	1.5"=1'	3"=1'
ELEMENT HGT														
1/16" Ft:	3.125	2.5	1.875	1.25	0.625	0.5	0.333333	0.25	0.166667	0.125	0.083333	0.0625	0.09375	0.1875
In:	37.5	30	22.5	15	7.5	6	4	3	2	1.5	1	0.75	1.125	2.25
1/8" Ft:	6.25	5	3.75	2.5	1.25	1	0.666667	0.5	0.333333	0.25	0.166667	0.125	0.1875	0.375
In:	75	60	45	30	15	12	8	6	4	3	2	1.5	2.25	4.5
3/16" Ft:	9.375	7.5	5.625	3.75	1.875	1.5	1	0.75	0.5	0.375	0.25	0.1875	0.28125	0.5625
In:	112.5	90	67.5	45	22.5	18	12	9	6	4.5	3	2.25	3.375	6.75
1/4" Ft:	12.5	10	7.5	5	2.5	2	1.333333	1	0.666667	0.5	0.333333	0.25	0.375	0.75

	In:	150	120	90	60	30	24	16	12	8	6	4	3	4.5	9
3/8"	**Ft:**	18.75	15	11.25	7.5	3.75	3	2	1.5	1	0.75	0.5	0.375	0.5625	1.125
	In:	225	180	135	90	45	36	24	18	12	9	6	4.5	6.75	13.5
1/2"	**Ft:**	25	20	15	10	5	4	2.666667	2	1.333333	1	0.666667	0.5	0.75	1.5
	In:	300	240	180	120	60	48	32	24	16	12	8	6	9	18
3/4"	**Ft:**	37.5	30	22.5	15	7.5	6	4	3	2	1.5	1	0.75	1.125	2.25
	In:	450	360	270	180	90	72	48	36	24	18	12	9	13.5	27
1"	**Ft:**	50	40	30	20	10	8	5.333333	4	2.666667	2	1.333333	1	1.5	3
	In:	600	480	360	240	120	96	64	48	32	24	16	12	18	36

Attachment "A"

City of Tucson / Architecture and Engineering

Confirmation of Receipt

I have received a copy of the City of Tucson / Architecture and Engineering AutoCAD standard and guidelines dated mm/dd/yyyy and understand as an architectural / engineering consulting firm working for and/or contracted with the City of Tucson / Architecture and Engineering Division that I/we must abide by these policies.

_____ _____

Signature of Receiver representing the A & E firm Date

_____

A & E firm name and address

PLEASE RETURN THIS FORM TO:

AE-Archivist@tucsonaz.gov
Joseph D. Varelas
4004 S. Park Ave., Bldg. 2
Tucson, AZ. 85714
(520) 837-6375
joseph.varelas@tucsonaz.gov

include one (1) set of black and white reproducible plans. The cover sheets on plans and booklets should include the project name and address, date and approval signatures for each department user group and Architecture & Engineering Division.

Any comments received from previous reviews shall be included in the SD submittal with consultant responses. Responses should be coordinated with the City's project manager.
Major changes in scope should be discussed and agreed to by the PM.

The A/E Project Manager will distribute the SD documents to appropriate interested parties for their review and comment. Review timeline is typically two weeks. The PM shall collect and review all comments. The PM will distribute comments to the consultant for their review and recommendations.

There is typically an SD review meeting held at the end of the SD review period. This meeting shall be attended by all design disciplines at the discretion of the PM. Appropriate City of Tucson staff will be in attendance. The A&E Project Manager reserves the right for final approval of format and content.

Consultant Deliverables Summary – The following are the minimum expected consultant deliverables for the schematic phase of the project:

- Drawings
- Specifications

Schedule

Design Narratives

- Cost Estimate
- LEED Point Evaluation
- Building Energy Model
- Meeting Minutes from SD review period

DESIGN DEVELOPMENT PHASE

The Design Consultant shall provide Design Development (DD) Documents based on the approved Schematic Design (SD) Documents and updated overall budget for the Project. The DD Documents shall illustrate and describe the development and refinement of the design of the Project, establishing the scope, relationships, forms and size and appearance of the Project by means of plans, sections and elevations, typical construction details, and equipment layouts. The DD Documents shall include specifications that identify major materials and systems and establish in general their quality levels.

The goal at the completion of the DD phase is for the City to have a clear understanding of the overall project scope, cost and schedule. Major design decisions should have been made at the completion of the DD phase and the plan for securing required LEED points should be well established.

The design consultant shall submit with the DD submission responses to all SD comments. The City Project Manager (PM) is responsible for reviewing each comment, consultant's response and disseminating the information to appropriate City Staff

While this DD section is built around a typical design- bid- build (DBB) project, the same items generally need to be provided for alternative delivery methods although the responsible party might change (for example in DBB, the designer typically provides the cost estimate while under a Construction Manager At Risk (CMAR) project the general contractor generally provides the construction cost estimate). The City PM is ultimately responsible for ensuring the required tasks are completed and for coordinating the scopes of work.

The design development drawings and report shall include but shall not be limited to:

1. Overall detailed Project Schedule (Design & Construction). The City PM is to work with the design consultant to establish the overall project schedule. The overall schedule as well as the construction schedule shall show the critical path as well as probable 'float'. The construction schedule shall be presented to the City PM in MS Project format electronically and hardcopy. The City PM is to produce the overall project schedule in MS Project format.

2. Construction cost estimate with detailed breakdown by major construction disciplines (+/- 10% accuracy). If the scope is over budget the design team should define and document add alternates that can be prioritized and added to the scope depending on available budget. Construction Manager shall provide the construction cost estimate for CMAR projects. If requested, the design consultant is also expected to provide a cost estimate by major discipline for comparison to the CMAR's estimate. Consultant is to provide a comprehensive cost estimate and work with the City PM to establish the overall project budget

3. Provide HVAC, lighting and electric load calculations, and develop estimates for the cost of operating and maintaining the facilities designed under this Contract. Assumptions shall be clearly noted. The estimated operation and maintenance costs are to be projected for each of the thirty (30) consecutive fiscal years following acceptance of the facilities by the City. Each system shall be evaluated for operating cost. The evaluation will take into consideration replacement. All economic cost evaluations shall be taken as simple payback with the yearly owning cost averaged over the period. The ASHRAE HVAC Applications Handbook 2011 shall be used as a reference and chapter 35 in particular for service life estimates. All calculations shall be submitted and will become the property of The City. The following operating cost estimates are to be provided:

   a. Estimate of annual utility costs for gas, electrical, water, and sewer.
   b. Estimate of annual maintenance costs.*
   c. Suggested additive or deductive alternatives with estimated costs.*
      * (City Project Manager is to provide copies to the Maintenance Superintendents and Energy Manager.)

3. Site Plan
   a. Site description.
   b. Scope of work.
   c. Conceptual grading plan.
   d. List references to all pertinent codes and regulations.
   e. List design assumptions.
   f. Conceptual design of paving, sidewalks, curbs, fences, gates, parking, roads, and other site improvements showing conceptual horizontal and vertical control data.
   g. Drainage, detention / retention ponds and water harvesting concept, refer to: http://dot.ci.tucson.az.us/stormwater/downloads/2006WaterHarvesting.pdf . Include the latest revision stating that rainwater harvesting systems capture 100% of the rooftop rainfall over a 72 hr period.
   h. Utility design plans for gas, water, electrical, telephone, sewer, TV cable, Fiber Optic, Microwave, Wireless and other data properly identified and labeled (private, public ...).
   i. Communications UG conduits, conduit size and location with 2500# traceable muletape, innerduct, maxcell, tracer wire. Include trench details with traceable foil I.D. tape that lays in the trench 18" above the conduit.

j. Ensure there is to be no gravel in mechanical yards, use asphalt or concrete paving.
k. Accessibility ADA: Identify accessible route beginning from point of public transportation, including parking, sidewalks, curb ramps, site ramps, stairs, and provide slope information for all.

4. Landscape Plan (City Project Manager to review with City Urban Landscaping Planner for conformance with Xeroscape requirements.)
   a. Identified Vegetation
   b. Conceptual Landscape Plan
   c. Conceptual Irrigation Plan
   d. Drainage and water retention concept.
   e.

5. Code Analysis with preliminary approval by Development Services and other authority having jurisdictions. Provide a list of all the necessary permits with probable costs and estimated time durations for securing these permits.

6. Foundation Plans
   a. Foundation system definition with conceptual foundation layout and sections.
   b. Slabs on grade showing estimated thicknesses and other pertinent details needed for the final design.

7. Structural framing Plans
   a. Roof structure with typical sections and details
   b. Structural framing system, plans, sections, elevations and details.
   c. Structural roof masts and independent towers for communications.

8. Exterior wall elevations, and sections defining all materials, supports, bracing, ties, reinforcing etc.

9. Typical interior bearing or firewalls sections defining thickness, supporting concept, etc.

10. Typical architectural roofing and flashing details

11. Floor plans, all levels and roofs
    a. Partition type identifications.
    b. Smoke and fire compartmentalization.
    c. Built-ins and fixed equipment shown and noted.
    d. 1/4” scale furniture and movable equipment layouts, for <u>ALL</u> spaces.
    e. Accessibility (ADA): Depict required floor clearances and maneuvering space at all elements required to be accessible, i.e. plumbing fixtures, doors, counters, etc.

12. Reflected Ceiling Plan
    a. Lights, diffusers, grilles, sprinkler heads and unusual conditions.

13. Room finish, door schedules, and a narrative of the door hardware functions for all areas/spaces, include wall texture, surfacing material, and paint types and color.

14. Fixed equipment schedule, locations, and service requirements.

15. Plumbing Systems
    a. Fixture schedule, locations.
    b. Equipment schedule, locations.
    c. Water piping, locations (sizes for pipes larger than 1”).
    d. Waste piping, locations (sizes for pipes larger than 4”).
    e. Catalog sheets of exposed fixtures.
    f. Water pressure data and calculations.
    g Show maintenance access to vital pieces of plumbing equipment.

16. Roof drainage system, locations, and key sizes

17. Fire Protection Systems
    a. Provide system performance design criteria.
    b. Fire Riser location.

18. Mechanical Systems
    a. Equipment schedule, locations, sizes, types, load information.
    b. Equipment filter sizes and quantities with adequate maintenance clearances.
    c. Supply, return, and exhaust duct layout.
    d. Catalog sheets of exposed fixtures.
    e. Control concepts and sequence of operation for major equipment.
    f. Reestablish life cycle analysis of energy saving equipment and options from the Schematic Phase.
    g. Provide separate storage room for 1 year supply of filters (shall also include space for 1 year supply of lamps & fuses for electrical. Provide for “attic stock” ceiling tile storage on site).
    h. Show maintenance access to vital pieces of mechanical equipment.

19. HVAC piping, locations, and sizes for pipes larger than 1”

20. Power Distribution
    a. Panel locations and schedules.
    b. Terminal distribution to equipment and receptacles.
    c. Motor control schedules.
    d. One Line diagram.
    e. Load calculations.
    f. Fault calculations.

21. Lighting
    a. Final fixture and switch locations and branch circuits.
    b. Catalog sheets.
    c. power density calculations for each space
    d. lighting fixture schedule

22. Communication and alarm systems description and floor area space requirements

    a. Identification and scope.
    b. Data and phone drops located.
    c. Communications equipment room(s) sized and located on floor plans.
    d. Communication room wall elevations and rack locations. Include ladder-ways, electrical layout on the racks, and fire retardant A/C ¾" plywood location.
    e. Show grounding buss on everything with a one line diagram from the main electrical equipment. .
    f. Number all tele/data information outlets.
    g. Show conduits, size and location.
    h. Redundant cooling
    i. Emergency lighting

23 Special systems
    a. Final layout and specification.
    b. Catalog sheets.
    c. Where large meeting rooms, classrooms, and auditoriums are part of the project, DD is when ceiling heights and design is established with an Acoustic Engineer. AV control location are located and AV layout is established with an AV specialist.

24 Description of proposed additive alternates and cost estimates for each

25 Materials and color boards

26 Specifications
    a. Table of contents for technical sections.
    b. All sections project specific.
    c. Written descriptions of all options, allowances, unit prices, and special construction scheduling requirements.
    d. Provide checklist of all close out requirements to be followed at close out of project to be updated at 100% CD's
    e. Provide checklist of excess products and quantities to be handed over to City such as ceiling tiles, carpet, flooring and wall tiles and to be updated at 100% CD

27 Third Party Commissioning Agent (CA) – The City PM is responsible for ensuring the commissioning agent has been contracted and has reviewed the project basis of design and design documents. The design consultant is required to include the Construction

Administrator's review of the basis of design, SD comments, preliminary commissioning plan and preliminary commissioning specifications in the DD report. The CA will review and comment to the design consultant on the DD phase report. All systems to be commissioned will be identified and noted by the design consultant. Commissioning is to be performed to meet the requirements for the U.S.G.B.C. LEED enhanced commissioning credit.

28. LEED and the Sustainable Energy Standard – update required information from SD phase as needed including 5% for solar offset and solar readiness. Working with the City PM the design consultant shall provide an estimate for achieving LEED. The estimated cost for LEED would include those items necessary for achieving LEED Silver over a baseline of a 2005 City standard building.

29. All of the above information is to be reproduced in black and white and ten (10) copies (unless otherwise noted in the contract) distributed to the City of Tucson Architecture & Engineering Office, which will in turn distribute copies to each of the user departments and agencies. The cover sheets on plans and booklets should include the project name and address, phase, list of alternates, date and approval signatures from each department user group and Architecture & Engineering. Option: provide electronic submission of the above for DD review documents.

30. Written Documentation - All written documentation shall be submitted in electronic files in Microsoft Office format.

A&E reserves the right for final approval of format and content.

The Consultant is to prepare the following documentation for this phase of the work to include but not be limited to:

A. Facts: Facts are documented to describe present aspects of the proposed site. They are intended to answer the question: What is known about the site? Facts should include but not be limited to:

- Site survey
- Site size
- Adjacent uses
- Slope and grades
- Vehicular Access
- Pedestrian Access
- Sun Path
- Water, sewer and gas lines
- Power, telephone, cable and data lines
- Zoning Analysis
- Archeological Report
- Hydrology Report
- Geotechnical Investigation
- Environmental Analysis and Report
- Traffic Access Analysis
- On - site Traffic Analysis
- Vegetation
- Public Transportation

B. Needs: To be based upon the previously approved Architectural Design Program.

C. Concepts: To be based upon a combination of the Facts, Needs and Budget. Develop several key alternatives for review and approval by the planning committee. Special considerations, as applicable:

- Components by size, type and description;
- Alternative approaches to project resolution;

CONSTRUCTION DOCUMENTS PHASE

The Architect shall provide Construction Documents based on the approved Design Development Documents and updated budget for the Cost of the Work. The Construction Documents shall set forth in detail the requirements for construction of the Project. The Construction Documents shall include Drawings and Specifications that establish in detail the quality levels of materials and systems required for the Project. The Architect shall assist A&E in establishing a list of prospective bidders or contractors. The Architect shall assist A&E in bid validation or proposal evaluation and determination of the successful bid or proposal, if any. The Construction Documents shall include but shall not be limited to:

1. Project Schedule

2. Construction cost estimate with area breakdowns (net and gross) and analysis.

    a. List and description of proposed Additive alternates.
    b. Reaffirm annual utility costs for gas, electrical, water, and sewer.
    c. Reaffirm annual maintenance costs.

3. Site Plan

    a. Detailed design of paving, sidewalks, curbs, fences, parking, roads, and other site improvements showing conceptual horizontal and vertical control data needed for construction.
    b. Drainage, detention / retention ponds and all necessary details for water harvesting.
    c. Utility design plans for gas, water, electrical, telephone, sewer, TV cable and other data properly identified. Sections shall clarify congested areas.
    d. Detailed Landscape design plans.
    e. Cut - fill estimated quantities with specified shrink factor.
    f. No gravel in mechanical yards, use asphalt or concrete paving.
    e. Accessibility (ADA): Provide detailed information for parking, layout(s), signage, sidewalks, curb ramps, site ramps, stairs, and railings.

4. Foundation Plans

a. Definition of materials, allowable bearing pressures, and definition of any special conditions effecting the construction.
b. Foundation, sizes, reinforcement, construction joints etc.
c. Waterproofing details and energy code insulation installation details.
d. Slabs on grade showing thickness, joints, reinforcement etc.

5. Structural framing Plans

a. Definition of codes, design loads, materials, and methods or programs used for the design.
b. Roof structure with typical sections and details
c. Framing plans, sections, elevations and details identifying all member sizes.
d. Complete connection details identifying No. of bolts or sizes of welds etc.
e. Fireproofing requirements (NFPA designation) and all necessary details.
f. Vibration isolation or other special details.

6. Exterior wall elevations, and sections identifying all materials, supports, bracing, ties, reinforcing etc.

7. Typical interior bearing or firewalls sections.

8. Floor plans, all levels and roofs

a. Partition type identifications.
b. Smoke and fire compartmentation.
c. Built-ins and fixed equipment shown and noted.
d. 1/4" scale furniture and movable equipment layouts, for ALL spaces.
e. Evacuation plans (See example at the end of this document):
11X17 in black metal picture frame with glass.
White Background, black walls doors and fixtures, red arrows marking the direction of exit.
Each plan shall be titled, dated and with a north arrow indicator.
Identify central locations for evacuation.
Each plan shall be printed as if facing wall where evacuation plan is mounted.
Must include "you are here" with a dot indicating the current position.
Must include, in "red", the word "EXIT" at each fire exit door(s).

f. Accessibility (ADA): Provide detailed information for the slope, clearance, mounting height, and location, of all elements needed for compliance and required to be accessible.

9. Reflected Ceiling Plan

   a. Lights diffusers, grilles, sprinkler heads and unusual conditions.

10. Room finish and door schedules for all areas/spaces

11. Miscellaneous specialties and equipment schedule

12. Fixed equipment schedule, locations, and service requirements

13. Plumbing Systems

   a. Fixture schedule, locations.
   b. Equipment schedule, locations.
   c. Water piping, locations (sizes for pipes larger than 1").
   d. Waste piping, locations (sizes for pipes larger than 4").
   e. Water pressure data and calculations.

14. Roof drainage system, locations, and key sizes

15. Fire Protection Systems

   a. Provide system performance design criteria.

16. Mechanical Systems

   a. Equipment schedule, locations, sizes, types, load information.
   b. Equipment filter sizes and quantities with adequate maintenance clearances.
   c. Supply, return, and exhaust duct layout.
   d. Control system schematic diagrams, details, complete points list, catalog cuts, and control sequence of operation.
   e. Detailed training and commissioning plans.

f. Provide separate storage room for 1 year supply of filters (shall also include space for 1 year supply of lamps for electrical).

17. HVAC piping, locations, and sizes for pipes larger than 1"

18. Power Distribution Diagram

    a. Panel locations and schedules.
    b. Terminal distribution to equipment and receptacles.
    c. Motor control schedules.
    d. Line diagram.
    e. Load calculations.
    f. Fault calculations.

19. Lighting

    a. Final fixture and switch locations and branch circuits.
    b. Catalog sheets.

20. Special systems

    a. Final layout and specification.
    b. Catalog sheets.

21. All disciplines are to be coordinated.

22. Project specifications (marked up for project)

23. Description of proposed options and cost estimates for each

24. Materials and color boards

25. Specifications

    a. All sections complete and edited project specific.
    b. Written descriptions of all options, allowances, unit prices, and special construction scheduling requirements.

c. Table of contents for technical sections.

d. Consultant to provide lists in specifications, on separate pages, a complete descriptions of :

- Two year warranties by item and duration are standard (make a list of specified items that are other than the standard two year warranty)
- O&M manuals (the Contractor is to provide 5 sets of O.& M. Manuals)
- Special test
- Special inspections
- Close out items (documentation, test, certifications)
- Training (on which items and duration)
- Items that are to be returned to City of Tucson (where and when) with labels and tags.
- Extra material (items and quantities and where delivered to) with labels and tags
- Certifications
- Submittals to include manufacturers Warranty

26. Written Documentation

All written documentation shall be submitted in electronic files in Microsoft Office format, compatible with Windows NT.

A&E reserves the right for final approval of format and content.

WORKSPACE STANDARDS

The Workspace Standards which follow are intended for programming, design and layout of workspaces commonly associated with administrative, clerical, managerial, technical, data entry and design personnel. Non standard spaces such as conference rooms, classrooms, storage, reception, and technical rooms should follow professional standards of practice. Refer to A&E Design Standards for further requirements during each phase of work.

As a point of reference, this information has been adapted from the April 1990, State of Arizona, Department of Administration Building System Space and Building Development Standards to fit the criteria of the City of Tucson, Division of Architecture & Engineering.

GOALS

- Equity in the quality of workspace for each level of employee throughout the City of Tucson.
- Ergonomic performance for all design configurations. Especially important is the selection of task chairs, computer set-up, keyboard adjustment, reach distances for transaction counters and worksurface.
- Modularity of layout based upon type of workspace.
- Uniformity and interchangeability of system components.
  Planned flexibility for future layout changes.
- Accessibility (ADA): City facilities, as public buildings, shall be designed and constructed for accessibility and use by the disabled. Refer to Division 01, General Conditions, ADA Section 013500 of the Architecture and Engineering design and construction standards.

MODULARITY

The space standards assume that the workspaces will follow a basic symmetrical grid. In new construction, a planning grid should be established that matches the building structural grid to the workspace grid. In existing construction the designer should work to establish a symmetrical grid to the maximum extent possible within the confines of the existing structure.

The guidelines are the same for both shared open areas and private offices. Private offices are to be configured with the same modular dimensions, computer setup and worksurfaces as the open

spaces. The permanent walls are to be located to match the modular dimensions of the open areas. For future flexibility all components are to be interchangeable.

BUILDING GRID

With new building design, the entire departmental work area should be laid out on a standard workspace grid such as 4'x4', 6', 8' x 8' or 10', etc. Conference rooms, private offices, storage rooms and other enclosed spaces should be laid out to match this grid. Future addition or removal of permanent walls can then be accommodated with this grid.

MATERIALS

All panels, worksurfaces and storage components are to be finished with standard manufacturer materials. Custom finishes, fabrics and upholstery are not acceptable unless with the written approval of A&E.

AREA

The areas listed herein represent net useable square feet, unless noted otherwise, for each specific room type and do not include the required additional factors for departmental circulation and layout. Departmental layout area must be multiplied the net-to-gross square footage conversion factor that account for major fire corridors, vertical circulation, toilets, walls and engineering systems. The circulation and layout factor is added to the sum of the interior spaces itemized by department and division. For this application the factor varies between 15% and 21% depending upon the proportionate magnitude of the planned space. The appropriate factors for each component are displayed on the space requirements database forms.

APPLICATION

The material which follows explains the methodology for calculating and applying the standards to the needs of the occupants of the building or part thereof. Drawings of suggested office, workstation, conference room and reception layouts and form many types of furniture and equipment are provided at the end of this section.

PRIVATE OFFICES

Private offices are reserved for Department Heads, Assistant Department Heads and Division Administrators. Private offices for personnel below this level shall only be approved with written authorization by A&E. The assignment of private offices for other personnel shall only be considered when the job description requires an unusually high degree of privacy. In these areas, it has been assumed that the furniture is functionally appropriate and arranged for the convenience of the person using it. Private offices are enclosed by fullheight partition walls or partitions and are suitable for individuals requiring some degree of acoustical privacy.

Accessibility (ADA): City facilities, as public buildings, shall be designed and constructed for accessibility and use by the disabled. Refer to Division 01, General Conditions, ADA Section 013500 of the Architecture and Engineering design and construction standards.

OPEN or PARTITION WORKSTATIONS

In general office area, the duties inherent in the position determine the type of workstation assigned. Work station which may be used by personnel in open areas include desks, chairs, side chairs, credenzas, and computers. The net square footage required for each station is determined by adding the physical area of the work surface to the working space required by the person using the station. The space is then increased by one-half of the aisleway necessary to approach the workstation.

Although the height of workstation partitions will be determined by the space planner and the client, it is suggested that at least two or three partition heights be considered when the system manufacturer is selected. This will permit the interior planners and designers to exercise some discretion in assigning workstation partition heights and provide them flexibility to address the needs for privacy, storage and supervision of employees.

Every workstation shall be considered to have a computer unless noted otherwise.

CONFERENCE AND MEETING ROOMS

Enclosed conference rooms to seat 10 to 12 people should be provided for every 20 people. In addition, open breakout area to seat 4 to 6 should be provided for every 12 people. The size of spaces should be based on good professional standards. Special consideration should be given to requirements for Communication and Audio Visual. Smart screens may be appropriate for some rooms.

Install assistive listening devises for any new city meeting room with an occupant load of more than 50 or where an audio amplification system is installed. We should provide a minimum of 3 receivers. If the occupant load is 100 or more provide 5 receivers or 4% of the total seating, whichever is greater. Signage complying with 1106.16.2 of the UBC shall also be installed notifying citizens of the availability of the listening system.

Accessibility (ADA): City facilities, as public buildings, shall be designed and constructed for accessibility and use by the disabled. Refer to Division 01, General Conditions, ADA Section 013500 of the Architecture and Engineering design and construction standards.

TECHNOLOGY

Architecture & Engineering wishes to implement buildings incorporating the latest in planning and technology systems. This applies to furnishings, communication equipment (computers, telephone, fax, cad, etc.), energy management systems, engineering and architecture. Design of

the core and shell is critical in achieving future planning flexibility, efficient operating costs, good space utilization, serviceability, ease of maintenance, security, comfort and image.

SITE ORIENTATION

Buildings shall be oriented to maximize potential views from within the site and towards the surrounding environs. Orient the structure to maximize the positive climate characteristics of the site and minimize adverse environmental impacts. The building envelope shall be designed to utilize passive solar design where applicable. (i.e. low E glazing shade south exposure, etc). The positive benefits of Arizona's abundant sunlight for natural daylighting of interior spaces.

Building Design Criteria

Building Configuration Requirements: Provide appropriate bay sizes, bay depths, distance from natural light, access to services so that the following definitions and requirements can be met.

Floor Sizes: Minimum floor sizes of 25,000 NSF for typical office and administrative, buildings. Other special floor size considerations might include:

Usable Space Depth: The structure shall be designed so that the depth of space from the exterior wall to the interior corridor wall (or other permanent wall) shall not be less than a nominal 30'-0" or more than a nominal 45'-0" unless there is an interior atrium or light well no greater than 45'-0" from any occupied space.

Proportion: Provide overall average building daylighting ratio (NSF of Occupied workspace, not including conference, storage and other support areas, divided by lineal feet of perimeter glass surface, not deducting for intervening perimeter columns less than 36" wide) of less than 60 (this is an expression of the average maximum depth of space from natural light). Buildings with a slenderness ratio of lower than 40 (NSF per lineal foot of glass) may be too narrow and not provide sufficient interior space to allow development of tenant support and special areas.

Distance From Natural Light: In all above grade space other than training and conference areas, that is considered NSF, no less than 90% of all space shall be within a distance of not more than 45 feet from natural light. This 45 feet is to be measured by occupant's line of site from their workspace to the light source. The natural light may be provided by:

Perimeter Perimeter glazing with unobstructed interior open space, not obstructed by full height partitioning nor full height glazing.

Atrium Glazing into an atrium area
Skylight By proximity to a skylight if on the top level of a building,

- Impact on surrounding neighborhood--architectural compatibility, traffic patterns, noise and light levels, visual impact;
- Site evaluation--existing site, traffic/parking; zoning/legal restrictions, future site enhancements; agricultural assessment;
- Hazardous material evaluation;
- ADA requirements;
- Environmental impact (including Greenhouse Gas Emissions Estimates);
- Energy conservation (should include specific concepts which must be analyzed on a life-cycle cost basis);

D. Construction phasing.

E. Phasing of the entire project with appropriate scope and budget for each phase.

F. Recommended Priority for Phasing and Master Plan Concept.

G. Cost Summary.

A&E reserves the right for final approval of format and content.

Distance to Services: No workstation or NSF will be enclosed private office and special area spaces bounded by partitions on all sides. These full height partitions generally will be located adjacent to or as extensions to core elements. In no instance should these full height spaces be placed directly adjacent to an atria space and only in the instance of some larger private offices should they be placed on the perimeter of a building. The placement of this full height space should not obstruct access to natural light from atriums or the perimeter. The building footprint and form should demonstrate how an average of 10% of the NSF can be placed in a location that does not create a corridor situation (for fire exiting purposes), nor does it obstruct access to natural light while at the same time not violating the above rules and performance criteria regarding distance from workstations to natural light.

Floor to Floor Height: Floor to Ceiling Clearance: The building's structure shall be designed so that the minimum ceiling height from finished floor to finished ceiling is 9'-0" on all office floors. Ceiling height shall be uniform throughout assignable space on each floor and shall be uniform on all floors above grade.

The base building installation of mechanical duct loops, sprinkler lines, bulk heads and any other items installed in the ceiling plenum spaces shall allow sufficient clearance for the tenant's ceiling-lighting system while maintaining the specified clear ceiling height throughout a minimum of 97% of all NSF. This allows 3% to be obstructed to lower the height to 8'-6" clear and/or to not allow a light fixture in that location, to accommodate transfer beams and mechanical ducts. Provide a minimum of 8-inches clear under all piping, ducts, conduits and structure so that all light fixtures can be relocated without obstructions. Utility lines installed above ceiling to be held as close as possible to upper level floor or roof structure.

Bay Size: The general interior space planning concept requires open bays without interior bearing walls within 45 feet of the perimeter building enclosure. Interior bearing walls shall be allowed only at core locations where the surround core elements (stair, elevator, mechanical and electrical shaft walls) or large tenant rooms.

Building Module: The open bay plan shall allow for the layout of office landscape type workstations and enclosed office/conference rooms on a repetitive module. Perimeter column spacing may range from 20'-0" minimum to 30'-0". Column spacing at the perimeter closer than 20' center to center shall not be allowed. Column and window mullion spacing shall accommodate office widths of 8', 12', 16' and 20'. Office and enclosed spaces located at the perimeter must be developed without requiring "jogs" in the wall to align with window mullions or column faces.

Maximum Height: The maximum height of the building shall be as allowed by the Tucson Land Use Code. All levels of the building shall be served by freight and centralized passenger elevators. At the main entrance there shall be a high bay space providing a centralized entrance with a two story volume, space allowing visual identification of lobbies, waiting areas, counters and major sub-division entrances at both the first and the second levels.

Exposed Roofs: Considering that a building may have a large footprint and be low-rise, it is likely that different levels of the building may be of different floor sizes. This creates the possibility of some lower level roofs being exposed from office space on upper levels. Extensive exposed roof areas are to be avoided. A combination of vertical visual barriers and window bulkhead heights on upper floors to obstruct the vision of undeveloped roof levels from a location that is 20 feet from the perimeter as observed by a person 6 feet tall should be used to prevent vision of an exposed roof. The line of vision of a person 6 feet tall standing 20 feet inside of the perimeter bulk head must not observe unfinished roof area above the bulkhead or below a 9'-0" ceiling height. Landscaping on terraces may NOT be employed to obscure the view.

Vertical Flow: A centralized ceremonial stairway or open stair is encouraged to interconnect the first two levels of the building. All stairways will be used for interfloor movement of personnel and thus must be appropriately designed to promote their use.

Central Areas: At a minimum, a central building support area must be provided which surrounds the central/vertical movement element, lobby, freight decks, and central services. Within this area shall be located high volume and public oriented spaces including counters, waiting areas, information delivery areas, public information displays, training rooms, auditorium and centralized location of conference rooms. Centralized employee services, coffee stations and break areas, lounges, mail delivery stations and on-floor service centers will be located in this area.

Accessibility (ADA): City facilities, as public buildings, shall be designed and constructed for accessibility and use by the disabled. Refer to Division 01, General Conditions, ADA Section 013500 of the Architecture and Engineering design and construction standards.

Public Facilities: Adjacent to the elevators on all public levels in the building, there shall be public restrooms. All public restrooms shall be designed in accordance with all building codes and ADA requirements, however, the minimum size of public restrooms to be provided are:

Men's Room: The public men's room shall provide two water closets, two urinals and three lavatories.

Women's Room: The women's restroom shall provide three water closets and three lavatories.

Accessibility (ADA): City facilities, as public buildings, shall be designed and constructed for accessibility and use by the disabled. Refer to Division 01, General Conditions, ADA Section 013500 of the Architecture and Engineering design and construction standards.

Live loads: The minimum uniformly distributed live load for the general office floors shall be 75 pounds per square foot (PSF) unless otherwise restricted by code requirements. This does not include the weight of the raised floors where they may be installed. Additional loading

requirements of 125 PSF shall be required adjacent to core walls and between core elements on typical office floors for bulk storage and filing rooms in a minimum of 10% of the NSF and applied only to full structural bays. It shall not be located where there is a raised floor.

Tolerances: Total surface tolerance in all public view locations (horizontal and vertical) shall be 1/4-inch maximum in 10' - 0" for exposed to public view locations, including structural flatwork to receive such floor finishes as carpet, resilient tile and furniture systems in general office areas. Comply with ACE 301.

Within any structural bay it is necessary to have a reasonably level floor to accommodate the installation of furniture systems. Excessive unlevelness within a bay can result in a lack of visual alignment of the tops of the furniture systems from one linkage or cluster to another. Generally furniture systems will be installed in clusters of six to ten workstations which could be anywhere from 24 to 42 feet in length and 16 feet in width.

The Owner will verify the degree of levelness before carpet tile and systems furniture are installed. Therefore, the result of the leveling (if required) cannot reduce the overall ceiling clearance height provided.

Window Area: A minimum of 90% of all general office areas shall be within 45 feet from a window or natural light of a minimum surface area of 10 sq. feet - this allows a maximum of 10% of above grade space to be more than 45' feet from natural light and essentially "without access" to natural light. This is where storage file, conference, equipment, and other enclosed space will be located.

Window Dimensions: Window mullion spacing, (or dimensions between unglazed perimeter construction materials), shall be a modular 4'-0" on center to allow for the placement of private offices partitions that may vary between 8'- 0" and 20' - 0" in width in 4' increments. Partitions and open space panel systems located at the perimeter must be developed without requiring "jogs" in the wall to align with window mullions of column faces.

Perimeter windowsill heights shall be a minimum of 30-inches and a maximum of 33-inches AFF for minimum of 90% of the perimeter where there are windows. In the balance (10%) sill height may be anywhere from 3" AFF to clerestory height.

Window Treatments: Horizontal mini-blinds should be provided on all windows.

Security: Provide connections for future CCTV to a central security center. The security officer shall monitor all life safety alarms as well as elevator annunication panels. Elevator access during off hours shall be monitored. Provide provisions for future cameras located at various, agreed upon locations which includes but are not limited to the loading dock for surveillance and monitoring of the roll-up door and loading dock parking entrances, building doors, upper level primary circulation, transit/landing and other selected locations after normal business hours. Installation of conduits and J boxes are included.

Stairs: Stairwells shall be used for movement of personnel from one floor to another during normal business hours with the availability of security and access control devices, designed into the base building, restricting exiting from the stairwell to floors other than ground level.

Stairs will be used by staff to go from floor to floor. Stair doors into tenant spaces shall be left in the open position, doors shall be double width on magnetic hold opens and close in the event of fire. This shall apply to all stairs serving tenant office space.

All surfaces in the stairwells shall be finished and designed to be attractive for regular use by building tenants as part of base building construction. Special consideration shall be given to sound attenuation in those stairwells.

Accessibility (ADA): City facilities, as public buildings, shall be designed and constructed for accessibility and use by the disabled. Refer to Division 01, General Conditions, ADA Section 013500 of the Architecture and Engineering design and construction standards.

Elevators: Elevator service must accommodate 12% of the building population above levels accessed from grade in the peak 5-minute period. Cycle time shall not exceed 28 seconds/loading capacity of 70% shall be assumed. Density above the first floor will average 160 NSF per person for this calculation. Calculation should assume that 70% of all staff below the main floor will use a stairway and that 50% of staff on the first level above the main floor will use a stairway. Assume one (1) freight elevator will remain in service for passengers during morning peak periods.

The finish in passenger elevators should include:

1. Floor: Durable carpet or natural stone to match lobby.

2. Walls: Hardwood, mirror, polished stainless steel.

3. Lighting: Soft, indirect, avoid bulbs being visible to users when looking up at numbers.

All elevators serving a given floor shall be located in the same elevator bank and visible from one waiting point. Consideration shall be given to an elevator core location that allows installation of additional elevators when building expands and maintain a future central elevator location convenient to all space.

Elevators in “banks” with openings facing another elevator bank shall not be closer together than 12 feet. Vestibule floor finish shall be similar to public lobby.

The building shall provide a minimum of one (1) elevator suitable for the movement of freight to all occupied floors of the building. One (1) freight elevator can be shared with building elevators to provide passenger movement capacity during peak operating hours.

The freight elevator shall be able to accommodate standard drywall 4’ x 10’ and other building materials moved on carts and stacked vertically. The freight elevator shall be deep enough and/or have a platform large enough to accommodate a 30” x 72” desk or piece of furniture moved horizontal on furniture dollies without tipping the desk on end.

A minimum platform size of 6’2” wide and 8’4” deep with a minimum clear height of 10’ and a minimum weight capacity of 4,500 pounds is desirable.

Provide front and/or rear opening doors to minimize freight movement and staging in public areas and elevator lobbies. Provide lock-out controls. The rear access door to the freight elevator shall be controlled by key or other electronic device. Access from the rear door of a combination passenger/freight elevator to any floor that the tenant occupies in total shall be restricted by electronic key card in the elevator car.

Accessibility (ADA): City facilities, as public buildings, shall be designed and constructed for accessibility and use by the disabled. Refer to Division 01, General Conditions, ADA Section 013500 of the Architecture and Engineering design and construction standards.

Core Area: Design of the core should provide for access of all rooms in the core from one or two sides at most, to eliminate the need for circulation around the entire core.

Toilet rooms:

Allocate facilities in accordance with code, local requirements and practice. In no instance, however shall toilet facilities be provided that do not support an average occupied floor of one person per 160 NSF and provisions for 44% male and 66% female occupancy. This 10% excess coverage allocation shall allow for staff distribution flexibility.

Restrooms shall be located along primary circulation paths and near other core elements (stairs). In no instance shall any workstation be more than 150 feet from the restroom entrance.

Vestibule design shall provide visual privacy without use of multiple doors. An alternative to providing a two door privacy vestibule at each toilet room location is to separate lavatories from water closets and urinals by a door, rendering the lavatory/mirror area as the vestibule.

Provide full-height tile on walls behind and adjacent to fixtures and on floor surfaces in toilet rooms.

Metal partitions shall be used throughout except in rooms with showers. Provide ceiling hung toilet partitions that are corrosion and tamper resistant. Wall mounted urinal screens shall match the partitions and be firmly braced to resist impact.

All toilet rooms shall have recessed paper towel dispensers and waste receptacles; mirrors shall be full height and a stainless steel shelf, minimum 8” deep above wash basins to accommodate

books, purses, etc. Men's toilet rooms shall have rear wall mounted toilet seat cover and partition mounted roll toilet tissue dispensers. Women's toilet rooms shall have rear wall mounted toilet seat cover dispenser, partition mounted napkin disposal and toilet tissue dispenser, recessed feminine napkin-tampon vendors.

Water closets shall be wall-hung, flush valve type of vitrified china. Urinals shall be wall-hung, vitrified china with extended bowl, flush valve type. Lavatories shall be vitrified china wall mounted. All toilet rooms shall be provided with floor drains as required.

Accessibility (ADA): City facilities, as public buildings, shall be designed and constructed for accessibility and use by the disabled. Refer to Division 01, General Conditions, ADA Section 013500 of the Architecture and Engineering design and construction standards.

Janitor Closet

Each tenant floor shall be provided with one janitor closet or one per 25,000 GSF of larger single floor buildings. They should be centrally located or distributed on a primary circulation path, equipped with hot and cold running water and a drain that is part of the central core area, janitor receptors shall be floor mounted, and a hose bib mixing faucet shall be provided at each location. It shall have 10 feet of 24" deep floor to ceiling open shelving, an overhead light and one duplex electrical outlet. The closed shall provide 60 sf of open floor area. It is not included in NSF as it is a core element.

Electrical Closets:

As required by the overall building requirements.

Communication Closets:

These closets provide the interconnection between the Backbone Riser Facility and the Horizontal Distribution Facility. They shall be located at regular intervals around the core throughout each floor of the building and may also house any electronic equipment service the area, such as Local Area Network File Servers, fiber-to-electric bridge equipment, etc. Each closet shall contain approximately 150 square feet of floor space.

Each closet shall contain adequate wall and floor space for the mounting of backboards and installation of equipment cabinets and racks to contain wire termination equipment.

Security locks shall be provided on the doors(s) to this room.

Walls shall be constructed with a one-hour fire rating. A fire suppression system should be provided to this room.

The space shall be temperature and humidity controlled and contain sufficient 110 volt power outlets for connection of equipment to be located within.

Each closet shall serve no more than 20,000 square feet of building floor space.

The maximum distance between closets shall not exceed 350 feet.

Recycled Box and Paper Storage Room

Space shall be adjacent to the freight elevators for recycled papers and boxes to be taken to the holding area on a daily basis.

Public Telephone

Public telephones should be coin and credit card type. Provide a minimum of (3) three telephones adjacent to the primary Public lobby and at the public transit access area.

Accessibility (ADA): City facilities, as public buildings, shall be designed and constructed for accessibility and use by the disabled. Refer to Division 01, General Conditions, ADA Section 013500 of the Architecture and Engineering design and construction standards.

Water Coolers

Water coolers shall be recessed, wall hung, handicapped accessible. A minimum of one per general office floor or one with each restroom complex (whichever is greater) shall be provided.

Accessibility (ADA): City facilities, as public buildings, shall be designed and constructed for accessibility and use by the disabled. Refer to Division 01, General Conditions, ADA Section 013500 of the Architecture and Engineering design and construction standards.

Fire Extinguisher and Cabinet:

Fire extinguishers shall be the multi-purpose dry chemical type with UL rating. Cabinets shall be recessed with a flat steel door.

Interior Finishes:

Design attention shall be given to assure the compatibility of all component finishes in tenant and public space including exit signs, fire hose cabinets, and drinking fountains. Corridor walls shall have protective rails and corner guards.

Design, procurement and installation attention shall be given to the interior finishes and furnishings to ensure indoor air pollutant source control. Such finishes and furnishings shall be tested for pollutant emissions, at the Designer's/Builder's expense, prior to installation in the building. Products which do not meet the pollutant emission guideline or air quality standard set forth elsewhere in this document will not be procured nor installed.

Rated corridors required to connect all core penetrations and leading from one stairway to another shall be finished in accordance with building standards in a manner compatible with the design of the elevator lobbies.

Building Support:

Loading Dock

Bays: An appropriate facility shall be provided for the receipt of freight from step vans, straight body trucks and semi-trailers for all tenants.

Weather Protection: The facility shall provide weather protection for the movement of material from service vehicles to the building at truck dock height without utilizing ramps or steps.

Dock Leveler: This project shall provide a dock leveler or other direct access docking feature.

Dock Bumpers: Laminated neoprene with integrally welded steel frame at all non-leveler locations.

Truck Restraint Device: Provide at each truck bay one truck restraining device or equivalent.

Lighting: Provide lighting to load and unload trucks.

coiling doors: Provide motor operated coiling or vertical telescoping service doors at the loading dock and service vehicle entrance and exit.

Access: Material movement from trucks to the freight elevator vestibule shall be direct and unobstructed. There shall be direct access from the freight elevator without utilizing public lobby space for the movement of trash, janitorial and maintenance supplies.

Staging Area: The space required to move material from trucks to the freight elevator shall be appropriate in size for movement of building construction materials and standard office furniture. This space shall be made available to all tenants.

Exhaust from vehicles using the loading dock and its vicinity shall be vented in such a manner that it does not: (a) infiltrate the building through its envelope; nor (b) become entrained in the building air supply system.

Compactor and Dumpster

One compactor and a 40 cubic yard trash dumpster are to be located adjacent to the loading dock for general trash.

Microwave Transmission System: Verify if required.

Satellite Receiving System: Verify if required.

Window Washing Equipment

Provide motorized equipment capable of reaching exterior glass that is more than 22 feet from grade or provide keyed (but not operable by users without a key) windows. The equipment shall include hinged davit sockets with anchorage's, portable davit assemblies, work platform with restrain devices, hoists, wire ropes, electric power cable and safety ropes. All embedded metal shall be galvanized. It shall comply with all applicable code requirements. Provide a weather enclosure for storage.

Vending

A limited number of vending machines supplied by an outside service company will be provided in designated centralized area throughout the facility. Allow space and provide outlets for 18 machine capacity.

Accessibility (ADA): City facilities, as public buildings, shall be designed and constructed for accessibility and use by the disabled. Refer to Division 01, General Conditions, ADA Section 013500 of the Architecture and Engineering design and construction standards.

Emergency Generator and UPS

Verify if required. If required, provide mechanical space, pads, vertical shafts and provisions for a standby generator or UPS. Ample space shall be included for maintenance procedures.

Communications Service System:

This facility serves the building as the connection point between the inter-building communications distribution system and the inter-building communications distribution system. All incoming telephone and data circuits serving the building enter and terminate in this facility. The room might also contain any electronic components which serve all of the building, such as security and alarm systems. It should be located at the lowest level of the building.

Adequate wall and floor space shall be provided for the mounting of backboards and installation of equipment cabinets on racks to contain wire termination equipment consistent with the telephone company's and the users' requirements for voice and data systems. Wiring pathways with allowance for future growth shall be provided between this room and the Main communications Room. Also, allowance shall be made for future incoming service requirements to this room from outside the building.

For purposes of sizing the incoming telephone cable to the building, it shall be estimated that there will be one telephone ever 100 s.f. of the office space. An additional 5% of this capacity shall be provided for dial access modem lines using voice-grade telephone service.

Allowance shall be made for a number of incoming leased data lines (20% of voice requirements) and additional fiber optic lines may be added in the future. Provide a minimum of 120 dial-in circuits and 500 data circuits.

The main Communications Room/network Support Room should have the following design features:

This room will contain large equipment serving the building, such as voice/data switching equipment, etc. provisions shall be made for the future installation of Private Branch Exchange (PBX). Provide this space at a lower level of the building, adjacent to the computer room. This space is not part of NSF.

Provide adequate wall and floor space for the mounting of backboards and installation of equipment cabinets and racks to contain wire termination equipment. There shall be a minimum clear distance of 36" behind and in front of nay racks or cabinets installed in this room.

The main door to this room shall be a minimum 4'- 0" wide. Accessibility to the freight elevator is required to move large equipment in and out of the room. Security locks shall be provided on the door to this room.

Walls shall be constructed with a two-hour fire rating. A fire suppression system shall be provided to this room.

Wiring pathways with allowance for 50% future growth shall be provided from this room to the Backbone Riser Facility (ies).

The space shall be temperature and humidity controlled and also contain sufficient 110 volt and 208 volt power outlets as required for connection of equipment to be located within.

The backbone facility consists of the vertical and horizontal pathways between the Service Entrance Facility and Main Communications Room to all Communications Closets located throughout the building. Tray shall be suitable for fiber optic cable. Allowance for 50% future growth in the number of cabinets shall be included. Pathways for the backbone will be required to serve any computer located within the building.

Horizontal Distribution Facility.

This facility is comprised of the pathways between the Communications Closets and the individual workstations on the floor. Provide conduits or plenum rated cables to all outlets adjacent to or within systems furniture.

Care should be exercised in designing a cable tray layout for a ceiling distribution system to insure that sufficient cable tray space is available for future cabling needs and also that cable trays are conveniently located to columns to be used for the workstation drops.

Operations and Maintenance Manuals – Electronic submissions of the O&M's are required. One hard copy of the O&M's is also to be provided. Break the O&M's down by trade and put in 2" binders. Minimum information required for each piece of equipment: Warranty Information, recommended preventative maintenance schedule, spare parts lists, operating instructions, troubleshooting information schematic drawings of equipment (electrical, mechanical, hydraulic, pneumatic), paint manufacturer codes and colors by location any software information such as licenses, and product keys to software and any special tools if needed for maintenance.

Electronic submission of plans and specifications is required in addition to hardcopy submission as detailed scope of services or contract.

Temporary Utilities – The general contractor is responsible for temporary utility connections. The tie-in points to existing must be approved by the City. The cost of utilities is on a project by project basis. Typically for new construction projects the contractor is responsible for paying the cost of utilities and for renovations to existing facilities, the utility costs are typically paid by the City.

Project Schedules – Contractor and consultants shall provide to the project manager a schedule prepared on MS Project or similar program. The contractor's schedules shall show all major elements required in the construction of the project including, but not limited to: time for shop drawing preparation and owner and consultant review, identification of the critical path and identified float at the beginning and end of each task. The consultant, general contractor and the City's project manager should all sign-off and agree to the approved construction schedule.

Project Submittals and Shop Drawings, – Comply with expected turn-around times and expedite items in the critical path as noted on the Project Schedule.

RFI's, Supplemental Instructions, and Invoices,-. Reviews should be expeditious as possible. RFI's and Supplemental Instructions are not for means and methods.

Product Substitutions – the City expects our design consultants to specify materials, equipment and products that can be competitively bid and to provide an acceptable list of those items that meet the intent of the specifications. The listing of acceptable materials, equipment and products should be the acceptable list and we will not accept substitutions after the time of bid or when the contract price is determined. Contractors must request pre-approval of substitutes during the bid or

The cable tray/ladder shall serve the extend up into the ceiling plenum and/or down into the ceiling plenum below and continue above primary paths/circulation to provide horizontal distribution around all core elements, to locations adjacent to all columns and to the location of pre-set electrical/communication boxes in the floor slab, and to distribute cabling to the perimeter of the floor where it is then distributed in wire manager, conduit, etc. along the baseboard for non-raised floor areas.

Indoor Air Quality:

An adequate building outdoor air supply which is protected (from pollutant sources, including the building's own exhaust, parking facilities, and outdoor smoking pavilion);

Adequate and effective fresh air delivery to occupants shall be provided.

Properly designed and implemented exhaust systems to service special areas, as well as the general office spaces. Such exhaust systems shall be designed for compatibility not only with air intake system(s), but also for compatibility with future development.

Strict pollutant source control, implemented by specification and testing of interior furnishings, construction materials and installation/construction procedures.

Design of the internal HVAC delivery systems shall incorporate the ability to redirect without great expense the internal air flows as occupancy and activity patterns change over the life of the building. The HVAC system shall be designed and balanced to deliver specified airflows to the occupant's working locations, taking into account any interference which may be created by workstations and other furnishings. Occupied stagnant air zones will not be allowed.

General Services Department Architecture & Engineering Division	Project Manager's Manual FEE PROPOSAL		
ISSUED DATE	REFERENCE PERSON	REVISION #	REVISION DATE
9/1/2007	Administrator	1	6/18/2008
		Revised Pages	PAGE
		1	Page 1 of 1

		PROGRAMMING LABOR	MASTER PLAN LABOR	NON-LABOR	TOTAL
(Firm)	(Discipline)				
	Project Management				
	Programming				
	Design				
	Cost Est.				
	Structural				
	Architectural				
	Mechanical				
	Electrical				
	Civil				
	Geotechnical				
	Fueling Systms				
	Landscape				
	Communications (RCDD)				
	Construction Administration				
	Furnishings				
	Graphics				
	Aerial / Surveying				
		$	$	$	$0

Project: _____ Date: _____

Architect: _____

1. Drawing Requirements:

   a. Drawing sheets shall be trim size _____ X _____with left binding edge.

   b. Use scale best suited to utilize full drawing, include graphic scale. (Survey Drawing may be incorporated into contract documents for "information only".

   c. Locate North at the top of the sheet, or _____

   _____.

   d. Include legend of symbols and abbreviations used on the drawing(s).

   e. Spot elevations on paving or other hand surfaces to be the nearest .05' (or 1/2"), on other surfaces to the nearest .10' or (1"). If using aerial survey information, establish ground control data and possible error in aerial survey elevations.

   f. Boundary and topographic information, where both are required, shall be on the same drawing unless otherwise requested.

   g. State basis for use of local or national elevation datum and location of nearest permanent vertical geodetic benchmark. A permanent benchmark should be established on the site at a location suggested by the Architect for the benefit of the Owner and future reference.

   h. Furnish to the Owner one reproducible transparency and three prints of each drawing to the Architect. The Licensed Land Surveyor shall sign and seal each drawing and shall certify that to the best of the Surveyor's knowledge, information and belief all information thereon is true and accurately shown.

2. Land (Boundary) Survey: (Check Required Task)

_____ a. Show boundary lines, giving length and bearing (including reference or basis) on each straight line; interior angles; radius, point of tangency and length of curved lines. Where no monument exists, set permanent iron pin (monument) or other suitable permanent monument at property corners; drive pin into ground adequately to prevent movement, mark with wood stake; state on the drawing(s) whether corners were found or set and describe each. If ground monument differs from surveyor's boundary survey, set new monument pin and state offset.

_____ b. Confirm or furnish the legal description which conforms to the Record Title Boundaries. Prior to making this survey, insofar as possible, acquire data including, but not limited to, deed maps, certificates or abstracts of title, section lines and other boundary line locations in the vicinity.

_____ c. Give area in square feet if less than one acre, in acres (to .001 acre) if over an acre.

_____ d. Note identity, jurisdiction and width of adjoining streets and highways, noting right-of- ways, width and type of pavement. Identify pertinent landmarks. Include platted, but not constructed, streets, highways, etc.

_____ e. Plot location of all structures on the property. Plot the structures which are on adjacent property within 20 feet of subject property. Dimension perimeters in _____ feet and inches to nearest 1/2";_____ feet and decimals to .05'. State the character and number of stories. Dimension to property lines and/or other buildings. vacant property, including adjacent parcels, shall be noted "Vacant".

_____ f. Show encroachments, including building projections either way across property lines, easements, right-of-ways, set backs, etc.

_____ g. Describe fences and walls including retaining walls. Identify party walls and locate them with respect to property lines. Show all walks, steps, ramps, planters, etc.

_____ h. Show recorded or otherwise known easements and right-of-ways; state the owner of record of each.

_____ i. Note anticipated street widenings.

_____ j. Show individual lot lines and lot block numbers; show street numbers of buildings, if available.

_____ k. Show zoning of property; if more than one zone, show extent of each. Show zoning of adjacent property and property across the street(s) or highway(s).

_____ l. Show building lines and set back requirements, if any.

_____ m. Provide names of abutting property owners.

_____ n. Reconcile or explain any discrepancies between the survey and the recorded legal description.

_____ o. Provide coordinate benchmark to permit future coordinate baselines to be established. Benchmark to be based on County or local coordinate system. (Can be combined with task 3.1).

3. Topographical Survey Requirements:

_____ a. Provide minimum of one permanent benchmark on site for each four acres; description and elevation to be nearest .01'. (Maximum of four).

_____ b. Contours to be at _____ foot intervals. Extend contours approximately twenty feet beyond property line or to the extent that direction of off-site storm drainage can be determined.

_____ c. Spot elevations at each intersection of a _____ foot square grid covering the property.

_____ d. Spot elevations at street intersections and at _____ feet on center on curb, sidewalk and edge of paving, including far side of paving. If elevations vary from established grades, state established grades also. Identify abrupt changes in grade, swales and ditches, with direction of flow indicated.

_____ e. Plot location of structures, above and below ground, man-made (e.g. paved areas) and natural features; all floor elevations and elevations at each entrance of buildings on the property.

_____ f. Location, size, depth and pressure of water and gas mains, central steam and other utilities including, but not limited to, buried tanks and septic field serving, or on, the property.

_____ g. Location of fire hydrants available to the property and the size of the main serving each.

_____ h. Location and characteristics of power and communication systems above and below grade.

_____ i. Location, size, depth and direction of flow of sanitary sewers, storm drains and culverts serving, or on, the property; locations and rim elevations of catch basins and manholes, and inverts of pipe at each.

_____ j. Mean elevation of water in any excavation, well or nearby body of water.

_____ k. Indicate flood plain limits and its' characteristics.

_____ l. Location of test and/or soil borings, if evident, and grade elevation of the top of holes.

_____ m. Location of flagged, or tagged, specimen trees or shrubs; locate to the center within 6" tolerance.

_____ n. Outline only perimeter of thickly wooded area.

_____ o. Name of operating authority of each utility serving site.

4. Special Requirements: (if any, on separate sheet)

PROJECT SCHEDULE

Project Schedule: The consultant is required to provide a Microsoft Project schedule in PDF format to include:

A. Events that will satisfy each of the project phases through two-year warranty

B. Dates each event will start and be completed

C. Elements which will hinder normal progress

D. Submit updates with each change. Show actual progress plotted against the original baseline.

E. Submit updates with each change showing actual progress plotted against the original baseline.

F. Furnish five copies of original work schedule, along with electronic format, within 10 days after written Notice to Proceed is issued by City, and thereafter five copies of any approved revisions.

Please include in the schedule the Architecture/Engineering Division's Three (3) Step Review process (per City Project Manager's option):

1. Technical Review Meeting with the Consultant Team and each of our respective staff to coordinate the requirements and concept of the building.
2. Plan review at 100% Design Development at which time each system is reviewed with written comments to the consultant.
3. Plan review at 100% Construction Documents with written comments to the consultant.

The Architecture/Engineering Division reserves the right for final approval of format and content.

SPACE CRITERIA

GENERAL INFORMATION:

Workplace Name: Net Area (S.F.):
Reference Person: Number of Occupants:
Telephone Number: Date:

Source(s) of Information:
Please give a simple generic description of the purpose and function of this space:

Does this workplace need to be located directly adjacent to or near another space?

If so, please list in order of priority (1 highest):

Priority	Space Number	Workspace Name	Directly Adjacent	Nearby

ARCHITECTURAL REQUIREMENTS:

Architectural Finishes
Floor: Base:
Walls:
Ceiling: Ceiling Height:
Openings:
Doors: Type: Material: Glazing:
Hardware Considerations:
Windows: Window Type Required: Window Covering:
Critical dimensional requirements, eg. door height, room width:

Is vehicular access from outside of building required?
Are unusual structural loads anticipated?
Are raised "computer floors" required?
Are there other special architectural considerations?
Sound Considerations?

Area Layout

Provide a rough sketch of the workplace showing desired furniture, equipment and services locations.

General Equipment Requirements

How many lineal feet of the following items are required?
Countertop Desired
Storage cabinets Above
Storage Cabinets Below
Other Casework
Tall Storage Cabinets
Open Storage Shelves
Other

Which of the following items are required and how many are required?:

Markerboard	lineal feet
Chalkboard	lineal feet
Tackboard	lineal feet

pricing negotiations. Where the designer feels approval equals should be allowed this must be approved but the A&E Project Manager.

STRUCTURAL

GENERAL:

In addition to meeting the requirements of the referenced codes and standards herein, the design of the facilities shall meet a special requirements defined by A&E. These requirements are going to be updated as necessary to eliminate a frequent errors creating operational, maintenance or safety problems.

REFERENCES AND STANDARDS

1.1. The latest editions of the following codes, specifications, standards and publications, with applicable supplements and revisions thereto, form a part of this Manual

1.1.1. American Society for Testing Materials (ASTM) A 36 Specification for Structural Steel.

A 82 Specification for Steel Wire, Plain, for Concrete Reinforcement.

A 108 Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.

A123 Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products.

A 153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

A 185 Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

A 307 Carbon Steel Externally Threaded Standard Fasteners.

A 525 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

A 563 Specification for Carbon and Alloy Steel Nuts.

A 615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

A 706 Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.

A 775 Specification for Epoxy-Coated Reinforcing Steel Bars.

C 31 Making and Curing Concrete Test Specimens in the Field.

C 33 Specifications for Concrete Aggregates.

C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens.

C 42 Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

C 94 Specification for Ready-Mixed Concrete

C 138 Method of Test for Unit Weight, Yield and Air Content (Gravimetric) of Concrete.

C 143 Method of Test for Slump of Portland Cement Concrete.

C 150 Specification for Portland Cement.

C 171 Sheet Materials for Curing Concrete.

C 172 Method of Sampling Freshly Mixed Concrete.

C 192 Method of Making and Curing Concrete Test Specimens in the Laboratory.

C 231 Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.

C 260 Specification for Air-Entraining Admixtures for Concrete.

C 309 Liquid Membrane-Forming Compounds for Curing Concrete.

C 311 Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.

C 494 Specification for Chemical Admixtures for Concrete.

C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

C 685 Specification for Concrete Made by Volumetric Batching and Continuous Mixing.

C 920 Specification for Elastomeric Joint Sealants.

C 1017 Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

D 1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

D 1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

F 436 Specification for Hardened Steel Washers.

1.1.2. American Concrete Institute (AOl)

117 Tolerances for Concrete Construction and Materials

301 Specifications for Structural Concrete for Buildings

305 Specification for Hot-Weather Concreting

306 Specification for Cold-Weather Concreting

315 Manual of Standard Practice for Detailing Reinforced Concrete Structures

318 Building Code Requirements for Reinforced Concrete

347 Formwork for Concrete

1.1.3. American Institute of Steel Construction (AISC)
Specification for Structural Steel Buildings.

Code of Standard Practice for Steel Buildings and Bridges.

1.1.4. Concrete Reinforcing Steel Institute (CRSI)
Manual of Standard Practice for Reinforced Concrete Construction

1.1.5. American Welding Society (AWS)
Dl .4 Structural Welding Code - Reinforcing Steel
Dl .1 Structural Welding Code - Steel

1.1.6. Occupational Safety and Health Administration (OSHA)
Title 29, Part 1910 and Part 1926

1.1.7. Steel Structures Painting Council
Steel Structures Painting Manual - Vol. 2
Systems and Specifications

1.1.8. American Concrete Institute (ACI)

1.2. The latest revision of the following are recommended as guides to meet the requirements of this Manual

1.2.1. American Concrete Institute (AOl)

211.1 Standard Practice for Selecting Proportions for Normal and Heavyweight Concrete

302 Guide for Concrete Floor and Slab Construction

304 Guide for Measuring, Mixing, Transporting and Placing Concrete

308 Standard Practice for Curing Concrete

309 Guide for Consolidation of Concrete

311 ACI Manual of Concrete Inspection

347 Guide to Formwork for Concrete

SPECIAL A&E REQUIREMENTS:

Concrete Structures:

Slabs on grade:

Minimum strength of concrete for slabs on grade shall be 3,000 psi in 28 days.

All interior slabs on grade shall be reinforced with reinforcing bars. No wire fabric mesh is acceptable.

Exterior and pavement slabs can be reinforced with fibermash concrete reinforcing fiber. Unless specific conditions such as architectural appearance specify otherwise, the cracks in slabs on grade exceeding the width of 0.03 inch (credit card is 0.03" thick) are not acceptable. The Contractor shall repair cracks wider then 0.03 in.

The control joints shall not be spaced farther then 2 to 3 times the slab thickness expressed in feet.

Concrete mix design, timely application of curing methods and saw cutting of the control joints has to be clearly identified in the concrete construction specifications for each project.

CONSTRUCTION COST ESTIMATE

The Architecture & Engineering Project Manager is responsible for the total project budget. The Consultant is responsible in their design, for the construction and other related budget items. At the inception of a project, the A&E Project Manager must provide the construction budget to the Consultant. This will be an official written document for everyone's reference throughout design. This budget will not change unless by written notice to the Consultant from the A&E Project Manager. Construction cost estimates must be realistically and objectively prepared, but if these estimates exceed the construction budget, the Consultant must bring the situation to the attention of the A&E Project Manager immediately. The Project Manager and Consultant will schedule a meeting with all relevant parties to discuss ways to bring the project back in budget.

THE CONSTRUCTION BUDGET INCLUDES THE FOLLOWING:

- All construction costs including base bid and alternates
- 1% of project costs for public art on projects that require it
- Asbestos abatement (testing and specifications are included with design)
- Any temporary facilities required for facility occupants
- Furnishings, Furniture, Signage and Graphics

IT DOES NOT INCLUDE:

- Land Acquisition
- City of Tucson administration costs
- Consultant Fees
- Design and construction contingencies
- City of Tucson plan review fee and building permit fee
- Pima County building &/or sewer connection fees
- Special testing fees
- Moving
- Telephones
- Movable Equipment

ALTERNATES:

City of Tucson projects are done within rigid budgets. A project that bids over budget can mean a missed deadline, major schedule slips, and redesign by the Consultant. Therefore it is ESSENTIAL that the estimated cost for the project's base bid be 90% of the construction budget. The remaining 10% of the construction budget must be in additive alternates that will be accepted only if the bids are as favorable as the Consultant estimated. The City of Tucson must

consider alternates in order, therefore, priorities must be established with the City of Tucson. Alternates must be clearly identified on the drawings and noted on the cover page.

THE PROJECT MANAGER SHALL THEN PREPARE THE PROJECT BUDGET TRACKING FORM
See: e:\forms\projtrac.xls

REVIEW & APPROVAL PROCESS FOR CONSTRUCTION CHANGE ORDERS

The following processes and procedures have been developed in cooperation with the Construction Focus Group Change Order Subcommittee, the Office of Equal Opportunity Programs and the Procurement and Budget Departments to provide direction on the approval process required for various construction change orders. The procedures outlined herein shall be effective immediately and shall apply to **all new and existing** specific construction contracts (e.g. IFB's) and all Alternate Project Delivery Methods (e.g. RFQ's for Job Order Contracts, Design Build Contracts and Construction Manger at Risk Contracts).

I. Field Change-Order:

Field Changes are defined as modifications to a construction contract that are made to address 1) unforeseen conditions, or 2) minor design errors or omissions and that do not amount to $10,000 or 10% of the contract amount (whichever is less). Field Changes may be approved by the project manager unless the change involves a significant change in the scope of work.

The Contract Officer in Procurement shall be notified in writing of the Field Change within five (5) business days with a formal change order document to follow. Notification that a Field Change has been authorized should also be sent to any stakeholders for their information and records. Notification to the Contract Officer and stakeholders must be in writing (e.g. job meeting minutes, fax or e-mail). The notification shall clearly identify the contract number, project description, contractor name, change order number, description of the change and purchase order number.

Several of these minor change orders can be approved before a formal change order is issued. However, the contractor cannot be paid for the changes until a formal change order has been completely executed.

II. Changes Greater Than $10,000 or 10% of the Contract Amount (whichever is less):

For non-emergency changes over $10,000 or 10% of the contract amount (whichever is less) the project manager shall receive the following approvals **prior** to proceeding:

A. **Internal Department and/or Client Approvals** (e.g. chief engineer, internal financial or budget personnel, etc.)

B. **Office of Equal Opportunity Programs:** The OEOP shall have the opportunity to review change orders that total $50,000 or more (individually or cumulatively) for DBE or S/M/WBE subcontracting goal opportunities. Project mangers shall provide a narrative, estimated cost and subcontracting opportunities information via email to the Groupwise address 'OEOP Goals.' **Please indicate in the narrative whether or not the change is an addition or deletion to existing work versus new work that has not already been subject to a goal review and whether or not a new subcontractor or supplier will be required**. Once all the required information has been received, OEOP has committed to a one business day response time.

C. **Budget**: The assigned budget analyst must approve changes in excess of $10,000 or 10% of the contracted amount (whichever is less) prior to the authorization of the work.

D. **Procurement:** The assigned contract officer must approve changes in excess of $10,000 or 10% of the contracted amount (whichever is less) prior to the authorization of the work.

To expedite approvals, e-mail can be use to obtain prior approvals as required above. Copies of approval emails should be included with the change order form for final processing.

ARCHITECTURAL EVALUATION AND PLANNING SERVICES

The Architect shall provide a preliminary evaluation using information furnished by A&E and the using agency, such as the using agency's program and schedule requirements and budget for the cost of the work. The Architect shall review such information to ascertain that it is consistent with the requirements of the project and shall notify A&E of any other information or consultant services that may be reasonably needed for the project.

The Architect shall provide a preliminary evaluation of the using agency's site for the project based on the information provided by the agency or A&E of site conditions, and the agency's program, schedule and budget for the cost of the work. In addition, the following elements are to be developed by the Architect in conjunction with using agency and included in the Evaluation and Planning Documents.

- Goals: Goals are to be developed in conjunction with a planning committee and are intended to answer the question: What does the City of Tucson want to accomplish with the project.
- Project Description: Describe the history and scope of work.
- Service function of the using agency.
- Space Criteria Sheets: Each space/room shall be identified and the form filled out. An example is provided. Included should be sketches for typical offices, workspaces, special work areas, equipment and casework requirements.
- Summary Area Tabulation: A summary of all spaces in net square feet with appropriate gross area multipliers for walls, building systems and circulation.
- Adjacency Diagram
- Establish energy and maintenance goals
- Establish site environment goals
- Cost Summary (+/- 5% accuracy)
- List of interview participants

The formal change order document shall include sign-off/acknowledgement from the following:

- General Contractor
- Design Consultant
- City Field Coordinator
- City Project Manager
- Client Representative
- Client Budget Representative
- Budget Representative
- Procurement Contract Officer
- OEOP Goals (sign-off/approval required over $50,000, informational copy only under $50,000)

The Project Manager may issue the Contractor a notice to proceed once all approvals have been secured.

III. Emergency and Unknown Cost Change Orders:

Certain changes may be authorized immediately in the field that do not have a written contractor cost proposal or internal approvals. These changes could be the result of an emergency (where a threat to health, welfare or safety exists), or where if immediate action is not taken a significant cost to the City or significant negative impact to citizens will result.

In these rare instances, the contractor will be permitted to proceed to protect the public interest. The approval requirements for these changes would vary based upon the estimated cost of the change. For changes with an estimated cost over $10,000 or 10% of the contract (whichever is less) the approvals outlined in Section II should be secured within three (3) business days including a justification of why the situation warranted field authorization. To expedite, initial approvals can be obtained via email or facsimile with a formal change order document to follow. Changes estimated below $10,000 or 10% can be processed in accordance with Section I, Field Change Orders.

IV. Administrative Change Orders:

Change orders that are required to make internal/administrative changes (e.g. an account number change) can be processed using a short form change order.

V. Change Order Deducts:

Reductions in the work that result in a zero dollar or negative dollar impact on the contracted amount shall be subject to OEOP review if the reductions have a potential impact on the subcontracting opportunities that were previously identified and on which goals were established.

VI. Schedule Changes:

Any change orders requesting additional days must be approved through a formal change order to the contract. Schedule changes must be proven by a schedule analysis.

VII. Copies of Change Orders & Pay Estimates:

Copies of all change orders, regardless of dollar amount, shall be forwarded by the project manager to OEOP. In the event modifications are made to the change order during the execution process, the project manager will notify OEOP. Copies and/or notifications may be sent electronically.

Notwithstanding existing approval requirements, copies of all fully executed pay estimates for specific construction contracts, construction manager at risk contracts and design build contracts shall be forwarded to the Procurement Contract Officer and OEOP.

Construction Closeout
Check off List

DES #	FM #	FACILITY	DATE	COMMENTS
PROJECT NAME …				
PROJECT MANAGER …		PROJECT COORDINATOR …		
CONTRACTOR …		CONTRACTOR PHONE NUMBER		

(Note: use TAB to move through document)

	Date of Completion	Responsible Party
☐ **DSD Final Inspections** (check online)		PC
☐ **Certificate of Occupancy / Letter of Completion**		PC (data from GC)
☐ 1 copy to Project Manager (PM)		PC
☐ 1 copy to Using Dept		PC
☐ 1 copy to Construction File		PC
☐ Original is picture framed and posted in building		PC
☐ **Substantial Completion Walk Through**		PC
☐ 1st Punch List Completion Check		PC
☐ Facilities shop supervisor's notification		PC
☐ IT (communications)		PC
☐ Consultant		PC
☐ Using Dept		PC
☐ Project Manager (PM)		PC
☐ Other:		
☐ 2nd Punch List Completion Check		PC
☐ Facilities shop supervisor's notification		PC
☐ IT (communications)		PC
☐ Consultant		PC
☐ Using Dept		PC
☐ Project manager (PM)		PC
☐ Other:		
☐ **Final Walk Through**		PC
☐ Facilities shop supervisor's notification		PC
☐ IT (communications)		PC
☐ Consultant		PC
☐ Using Dept		PC
☐ Project Manager (PM)		PC
☐ Other:		
☐ **Utilities** (Startup & Change Over)		PC (from GC to COT)
☐ Electrical		PC (from GC to COT)
☐ Water		PC (from GC to COT)
☐ Gas		PC (from GC to COT)
☐ Telephones		PC (from GC to COT)
☐ Fiber Optics		PC (from GC to COT)

Construction Closeout
Check off List

(Note: use TAB to move through document)

	Date of Completion	Responsible Party
☐ **Training**		PC
☐ Facilities shop supervisor's notification		PC
☐ Using Dept		PC
☐ Consultant		PC
☐ General Contractor (GC) & Subs		PC
☐ Manufactures Rep		PC
☐ Other:		
☐ **Extra Stock Materials** (Turn over to Gordon Hogrefe)		PC
☐ **Operation & Maintenance Manuals**		PC (data from GC)
☐ List of subcontractors & suppliers phone Numbers		PC (data from GC)
☐ List of building components & equipment		PC (data from GC)
☐ Operation Instructions		PC (data from GC)
☐ Maintenance Instructions		PC (data from GC)
☐ Paint list & numbers		PC (data from GC)
☐ Turn over copies of O&Ms		PC (data from GC)
☐ **Warranties**		PC (data from GC)
☐ Warranty Letter from GC		PC (data from GC)
☐ Warranty Letters from Sub Contractors		PC (data from GC)
☐ Warranty Folders for FM		PC (data from GC)
☐ Scheduled 2 year warranty review		PM (data from GC)
☐ **Communications Data Line On Site Testing**		PC & GC
☐ GC & Sub		PC (to invite)
☐ Comm. Maintenance		PC (to invite)
☐ IT to review and comment		PC (to IT for response)
☐ **Air Balance Report**		
☐ Air Balance Report Reviewed		PC or ME
☐ 1 copy to Facilities		PC
☐ Original to Construction File		PC
☐ **Consent of Surety & Power of Attorney**		GCs Bonding Co. to PC
☐ Original & Signed Purchase Order stapled to final Pay App.		PC to PM
☐ 1 copy to Construction File		PC
☐ **Redlines** (to consultant)		GC to Consultant
☐ **As-Builts** (from consultant)		Consultant to PM
☐ Auto Cadd CD		Consultant to PM
☐ Mylar's		Consultant to PM
☐ Blue lines		PM to PC
☐ 1 copy to Facilities or Job Site		PC
☐ **Specifications** (to archive)		PC

Construction Closeout
Check off List

(Note: use TAB to move through document)

	Date of Completion	Responsible Party
☐ **Keys**		PC (keys from GC)
☐ Signed Request Form		PC (form signed by GC)
☐ Returned Keys (to lock shop)		PC
☐ **Re-Keying of New Facility**		PC & Lock Shop
☐ **Substitute Securities Final Payment**		?
☐ **Commissioning Report**		
☐ Review Report (add items to punchlist as needed)		PC or ME
☐ 1 copy to Facilities		PC
☐ Original to Construction File		PC
☐ **Commissioning Review**		PC
☐ Schedule or Task 10 month post occupancy commissioning review		PC
☐ **Controls Mapping Invitation**		PC
☐ Facilities Mechanical Dept (EMCS section)		PC
☐ Climatec (controls contractor)		PC
☐ Using Dept		PC
☐ General Contractor (GC)		PC
☐ Project Manager (PM)		PC
☐ Other:		
☐ Letter from (controls contractor)		?
☐ **Construction Evaluation**		PC
☐ 1 copy to Using Dept		PC
☐ Signed copy from Using Dept.		User to PC
☐ **Consultant Evaluation**		PC
☐ 1 copy to Using Dept		PC
☐ Signed copy from Using Dept		User to PC
☐ **Contractor Post Project Evaluation Filled Out**		PC
☐ 1 copy to Using Dept		PC
☐ Signed copy from Using Dept		User to PC
☐ **Consultant Post Project Evaluation Filled Out**		PC
☐ 1 copy to Using Dept		PC
☐ Signed copy from Using Dept		User to PC
☐ **Finalized Permits** (copies in construction file)		PC
☐ **Final Project Tracking and Benchmarking**		PM
☐ **Financial Information Completed**		PM
☐ **Design LEED Certification Submittal** (verified by PM)		Consultant to PM
☐ **Construction LEED Certification Submittal** (verified by PM)		Consultant to PM
☐ **Final Submission LEED** (verified by PM)		Consultant to PM

ACCESSIBILITY – Americans with Disabilities Act (ADA)

City facilities, as public buildings, shall be designed, constructed, and altered for accessibility and use by the Disabled. In this connection, with the ADA, the Department of Justice (DOJ) 2010 ADA Standards for Accessible Design for Title II entities shall determine the criteria to be used for the design of these facilities to ensure accessibility and compliance.

A PDF Format copy can be downloaded from the DOJ site at:
http://www.ada.gov/regs2010/2010ADAStandards/2010ADAStandards_prt.pdf

The specific design criteria applicable to provisions for the disabled shall be incorporated in the Architectural Design Program document for the facility.

The DOJ standards stipulate minimums and maximums as guidelines. The City of Tucson uses these guidelines as the minimum or maximum allowable standards to provide universal access.

DSD shall be consulted as early as is practical in the design process for coordination, but this coordination shall begin no later than the end of the schematic design phase. Coordination with DSD to specifically review ADA issues, requirements and design solutions shall continue throughout the project, including a review prior to completion of the construction documents.

PREPARING THE ESTIMATE:

1. Receive the WOE. Determine/verify that the WOE has been logged in by FM-ESTIMATE. If so, the WOE has a tracking number. If the WOE does not have a tracking number, route the WOE to FM-ESTIMATE for processing.

2. Read the Customer's (Client's) Scope of Work (SOW) in the WOE and gain an understanding of what the Client wants.

3. Call the Customer and discuss the SOW in detail with particular attention to correcting any misconceptions.

4. If an existing facility, retrieve archive documents. Make copies of pertinent documents to aid during your site survey.

5. If, in your estimate, the entire WOE process will take 4 hours or more of A&E Division's time, request that the Client provide you with an account number. (This can be done at any time during the WOE process.)

6. Familiarize yourself with the existing facility through the archive documents, as related to the SOW, before you make a site visit.

7. Meet with the Customer on site; confirm the budget and schedule; understand the entire SOW.

8. Write a brief, but thorough, description of the project that fits within the DETAILS OF WORK TO BE PERFORMED on the WOE form.

9. Decide what information, resources and activities are required to develop a valid budget and schedule. Determine:
   - Is a Permit required?
   - Is the JOC method of contracting the best way to hire a contractor for this project?
   - Can the JOC do the construction drawings through the design portion of his contract?
   - Can the JOC get the permit?
   - Do you need to hire a consultant to do the design and get the permit?
   - Is Means Cost Estimating Manuals adequate for estimating construction costs?
   - Are there in house experts you can access?

10. Assemble information and calculate the construction cost (use AE ESTIMATE form.xls at E:\oooAEmiscform\AE Estimate form.xls.)
11. Estimate the soft costs or let the estimating spreadsheet calculate soft costs, such as Permit fees, GSD FM & AE Admin costs, etc.

12. Select and use an appropriate Contingency percentage as developed for the scope of the project. Example: if selective demolition is involved where unknown conditions may be present – use a higher Contingency than you normally would.

13. Review the final project costs and construction costs with the size of the project. Verify quantities, unit costs and spreadsheet formulas. Small projects usually cost more per unit than larger projects.

14. Perform a peer review by sending copies of your draft WOE to your co-workers with a comment/question sheet with a reply due date. Resolve any comments or questions with each individual.

15. Send the WOE to the AE administrator for review and corrections, if any, and the administrator will process the WOE to the Customer through FM-ESTIMATE.

16. Verify with the Customer in 5 to 8 days if they have received the WOE and, if so, do they have any questions?

17. The Customer may want you to adjust the WOE and the original SOW to fit the Customer's budget. If so, notify FM-ESTIMATE there will be a revised WOE and proceed again from item #8 above.

18. Once you have an approved WOE, with the Customer's signature and account number, set-up the project as usual, include a schedule, budget tracking, and add the project to the A&E ACCESS database.

INTRODUCTION TO SOLAR READINESS GUIDELINES FOR CITY BUILDINGS

These guidelines were drafted by CH2MHill, consultants hired through the City of Tucson's Solar America Cities grant in 2010. The intention is to integrate these solar readiness guidelines into the Architecture & Engineering (A&E) Standards and Project Managers Manual and place them on the A&E website so that all future City-funded buildings will be solar ready.

In order to ensure that New and Renovated City of Tucson Buildings comply with the Mayor and Council required Sustainable Energy Standard and specifically the requirement that at least 5% of the buildings energy usage be offset by solar energy utilization we have issued these Solar Readiness Guidelines for City Buildings. In addition to the 5% energy offset it is the City of Tucson's desire to have all buildings designed and built for future solar energy utilization. These guidelines provide direction for ensuring the City's desired result.

By preparing all city buildings for future installation of solar panels, the City of Tucson will continue the pro-solar policies in place since 1999 which lead to Tucson becoming a US DOE Solar America City. This approach is also consistent with suggested actions of the City's Climate Change Committee, which has recommended continued adoption of solar technology on City facilities. By looking ahead to a time when all possible City rooftops are used for solar energy generation, the City continues this tradition. These Guidelines explain the necessary detail to implement such a policy.

February, 2012

FINAL REPORT

Solar Photovoltaic (PV) Readiness Guideline for Municipal Buildings

Facilities Management Division
General Services Department

City of Tucson, AZ

Prepared for

City of Tucson

17 June 2010/ 11 February 2011

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Contents

Section **Page**

Contents ii

1.0 General Requirements 1

2.0 Applicable Codes and Standards 2

3.0 Solar Photovoltaic System 3

4.0 Architectural System 4

5.0 Structural System 7

6.0 Mechanical System 9

7.0 Electrical System 11

8.0 ADOSH (Arizona Department of Occupational Safety and Health) 13

9.0 Fire Department Access 14

10.0 Quality Assurance/Review 16

11.0 References 17

12.0 Appendices 18

Appendix A – Recommendations for Building Solar Ready Buildings

Photovoltaic Systems 19

Appendix B – Structural Calculations 25

- Deliverables: The final document is to be reproduced in black and white, bound in 81/2 x 11 format, and ten (10) copies (unless otherwise noted in the contract) distributed to the City of Tucson Architecture & Engineering office, which will in turn distribute copies to each of the user departments and agencies. Also, include one (1) set of black and white reproducible plans. The cover sheets on plans and booklets should include the project name and address, date, and approval signatures for each department user group and Architecture & Engineering Division.

A&E reserves the right for final approval of format and content.

SOLAR PV-READINESS GUIDELINE
For
Municipal Buildings

1.0 General Requirements

A. This **SOLAR PV_READINESS GUIDELINE** (Guideline) is intended for the use of the **City of Tucson** (City). The Guideline is a list of criteria for the designer specifications. The Guideline establishes the design considerations of the City for the installation of solar photovoltaic components (Solar PV) on municipal buildings and building-like structures owned by the City. The design consideration of the building shall accommodate Solar PV installed either during the building construction or in the future.

B. The Architect and/or Engineer shall prepare a Design Narrative hereafter called the Basis of Design (BOD) for the Solar PV system anticipated for the proposed building. The Architect and/or Engineer shall coordinate with the City for the BOD requirements. The BOD shall be included in the schematic design submission. The requirements noted in this Guideline will be addressed for a specific project based on the BOD that is developed for the project.

   Within the BOD, the Architect and/or Engineer shall provide a proposed means of achieving 5% of the total building energy consumption by use of solar energy. This 5% shall include solar energy utilization by a combination of Solar PV, daylighting and/or a solar hot water system. If possible, the BOD should identify a south facing roof with sufficient solar access for solar applications, minimize shadows from chimneys and other obstructions, identify a conduit path from Solar PV panel location to building electrical panel, and identify an inverter location. The BOD shall include Solar PV type, location, and extent by addressing the design considerations listed in this Guideline.

   The City's goal is to have new building construction achieve the Mayor and Council required 5% offset in conventional energy usage by using solar energy. A further goal is to include a large amount of solar energy utilization on the building when it is constructed and provide accommodations for usage of additional solar energy in the future.

2.0 Applicable Codes and Standards

A. International Building Code (IBC), latest edition adopted by the City.

B. American Society of Civil Engineers Standard 7 (ASCE 7) – latest edition reference by the IBC.

C. International Fire Code (IFC), latest edition adopted by the City.

D. International Mechanical Code (IMC), latest edition adopted by the City.

E. Uniform Plumbing Code (UPC), latest edition adopted by the City.

F. National Electrical Code (NEC), latest edition adopted by the City.

G. International Energy Conservation Code (IECC), latest edition adopted by the City.

H. Arizona Department of Occupational Health and Safety (ADOSH), latest edition adopted by the State of Arizona.

3.0 Solar Photovoltaic System

A. System Description

1. This provision is intended to provide direction on the decisions of the City in regards to the types of Solar PV covered. As technology develops in this area, it will be necessary to update this Guideline in relation to these new technologies. The criteria below give reference to specific Solar PV system types reviewed when compiling this Guideline. The revision and date of this Guideline will track the revisions as new technologies become available, as this Guideline incorporates and interfaces with the current codes and standards. It is the intent of this section to establish alignment of the City installations with the current codes and standards adopted by the City specific to Solar PV installations to ensure that the installation is in compliance with the building systems. It is also the intent of this section that building systems accommodate future Solar PV systems During schematic design, potential solar device location areas should be identified and protected unless cost prohibitive or in conflict with other City policies.

2. Solar Photovoltaic System shall be defined as described in the NEC. The total components and subsystems that, in combination, convert solar energy into electric energy suitable for connection to utilization load.

B. Design Criteria

1. Skylight Mullion Systems – These systems utilize framed PV modules or frameless PV module laminates with building integration into skylights as a translucent and/or opaque shading device.

2. Curtain Wall Systems – These systems utilize framed PV modules or frameless PV module laminates with building integration into curtain walls as a translucent and/or opaque shading device.

3. Non-penetrating Roof Mounting Systems – These systems use weight (ballast), laminate adhesives, are self-ballasting or are combinations thereof to withstand wind and seismic loading. This system is typically installed on low slope flat roofs with less than ½:12 pitch.

4. Penetrating Roof Mounting Systems – These systems anchor the PV racks to building structure to withstand wind and seismic loading.

5. Building integrated PV-photovoltaic cells incorporated into shingles, awnings, windows or other parts of the building envelope.

4.0 Architectural System

A. System Description

1. This provision is intended to provide direction on the decisions of the City in regards to architectural systems. The criteria below give reference to specific code provisions described in the IBC. It is the intent of this section to establish alignment of the City installations with the IBC specific to Solar PV installations to ensure that the installation is in compliance with the building architectural systems and to ensure that the building architectural system is designed to accommodate a Solar PV system

B. Design Criteria

1. The building exterior envelope, includes but is not limited to, weather protection, fire classification and appearance in regards to roof assembly and exterior wall envelope. The building exterior envelop design regulated by the IBC shall accommodate the ability to install Solar PV systems while meeting the provisions of the IBC. Other provisions of the IBC may apply as appropriate to the Solar PV design of the building. When installing the Solar PV systems described in section 3.0 above, care should be given to the requirements of the IBC.

    a. Roofing

        i. Moisture Protection - Solar PV systems shall be designed, installed and maintained in a manner consistent with IBC section 1503. The roof assembly integrity shall be preserved to prevent moisture, rodents and insects from entering the wall and roof at anchorage points of Solar PV systems. Employment of flashing, coping, and roof drainage shall be used as described in section 1503 to meet the requirements of preventing moisture from penetrating the weather protection attributes of the roof assembly.

        ii. Fire Classification – Solar PV systems shall be designed, installed and maintained in a manner consistent with IBC section 1505. The roof assembly integrity shall be preserved related to fire classification. The installation of the Solar PV systems shall not remove the elements of the roof assembly that provide the fire classification.

iii. Appearance – Solar PV systems shall be designed, installed and maintained in a manner consistent with IBC sections 1507 and 1509. The installation methods of roofing materials described in 1507 shall be preserved with the installation. The requirements described in 1509 related to rooftop structures shall apply to Solar PV systems.

b. Walls

i. Moisture Protection - Solar PV systems shall be designed, installed and maintained in a manner consistent with IBC sections 1403, 1404 and 1405. The exterior wall envelope integrity shall be preserved to prevent moisture from entering the wall at anchorage points of Solar PV systems. Employment of flashing, coping, and wall drainage shall be used as described in sections 1403, 1404 and 1405 to meet the requirements of preventing moisture, rodents and insects from penetrating the weather protection attributes of the exterior wall envelope.

ii. Fire Classification – Solar PV systems shall be designed, installed and maintained in a manner consistent with IBC section 1406. The fire classification of the exterior wall envelope shall be preserved. The installation of the Solar PV systems shall not remove the elements of the exterior wall envelope that provide the fire classification.

C. Coordination

1. The building architectural system should be designed and installed in coordination with a future Solar PV system as determined by the BOD. The building architectural system should be designed to accommodate the Solar PV system in terms of its power capacity, location and ease of installation. Architectural features to be located on the roof shall be installed to provide sufficient area for the Solar PV system based on the BOD. The following items shall be included but not limited to:

a. The design for roof fire resistance and worker access at roof edge conditions shall consider how the Solar PV system will be mounted on the roof as determined by the BOD.

b. The design for the building scale form and identification shall consider how the Solar PV system will be mounted on the building form as determined by the BOD. The roof/wall surface where the Solar PV array is to be located should be oriented directly toward the solar resources (to the south).

c. The design for environmental lighting of interior spaces with natural lighting and location of skylights, clerestories and other natural light features shall consider how the Solar PV system will be mounted on the roof as determined by the BOD.

d. The design for roofing materials and weatherproofing shall consider how the Solar PV system will be mounted on the roof as determined by the BOD.

e. The siting of the building location on the property shall consider the orientation of the Solar PV system to the sun as determined by the BOD. Refer to the following document for specific considerations, Solar Powering Your Community: A Guide for Local Governments, January 2011, Section 3.1 (See References). Describe the solar easement needed on the adjacent properties to allow for continued access to the sun for the location of the Solar PV system.

f. The location of any existing (or future) foliage that may shade the photovoltaic array should also be considered. It is recommended that the building's landscape design avoid tall trees and other objects that may eventually cast a shadow on the photovoltaic array. Areas to the east, south, and west of the building should be carefully landscaped to avoid shading the array during the high solar irradiance part of the day (9am-3pm).

5.0 Structural System

A. System Description

1. This provision applies to the new construction of buildings and building-like structures to assure that adequate structural capacity is provided in the design to accommodate future Solar PV systems installation.

2. The provision addresses structural requirements for several types of Solar PV systems currently available on the market. The Guideline will need to be periodically updated to reflect new products that may become available in the future.

3. Since the provision covers a range of possible Solar PV systems, it has to be narrowed down to a specific system to be included in the Building Design Specifications or the BOD document. The extent of the proposed future system should be illustrated on the proposed roof plans and also be included in the documents.

B. Design Criteria

1. Table 1.4 specifies structural design criteria in terms of additional gravity, seismic, and wind loads associated with the Solar PV infrastructure to be used in the building structural design. It was prepared in accordance with 2006 International Building Code (IBC) with the City of Tucson Amendments, and ASCE 7-05, Minimum Design Loads for Buildings and Other Structures. All roofs must provide a minimum of five additional lbs/sf in the design to allow for future Solar PV installation regardless of other systems described in the BOD. Table descriptions include the following:

    a. Table 1.4 applies only to rooftop Solar PV systems installation, with the roof pitch not exceeding ½ inch in 12 inches.

    b. Table 1.4 specifies additional design loads due to Solar PV system infrastructure to be considered in structural design of the roof deck, roof purlins and girders, columns, foundations, and lateral load resisting system. Dead load and seismic mass are specified in pounds per square foot (psf) of the projected roof area occupied by the proposed system. Horizontal wind loads are specified in terms of additional effective projected area per lineal foot of the Solar PV racks. Uplift wind loads are specified in terms of percentage of the horizontal wind load and are to be used for design of roof deck and purlins.

    c. The loads shown are service level loads. Appropriate code prescribed load factors shall be used for the Allowable Stress Design (ASD) and Load and Resistance Factor Design (LRFD) load combinations.

TABLE 1.4 – Loading Schedule				
PV System Type	**Additional Design Loads**			
	Dead load, psf (2)	Seismic Mass, psf (2)	**Wind Load**	
			Horizontal load, effective projected area, sf/ft	Uplift load for roof deck and purlin design, percent of horizontal wind load
Non-penetrating, ballasted	20 (1)	15	12 (3)	0
Non-penetrating, low profile, self-ballasted	5 (1)	5	0	0
Laminate roofing membrane	2	2	0	0
Laminate membrane on metal backing	3	3	0	0
Penetrating system with the racks supported directly on the roof	6 (1)	6	12 (3)	25%
Penetrating system with the racks supported on long span steel framing elevated above the roof	16	16	16 (4)	0

Notes:

1. Dead load is non-concurrent with the roof live load.
2. The dead load and seismic mass are to be applied on the horizontal projection of the proposed solar PV system.
3. Horizontal wind load is applied at 3 feet above the roof surface.
4. Horizontal wind load is applied at 7 feet above the roof surface.

6.0 Mechanical System

A. System Description

1. This provision is intended to provide direction on the decisions of the City in regards to mechanical systems. The criteria below give reference to specific code provisions described in the IMC. The adjacency of mechanical roof penetrations and clearances to the Solar PV systems can be critical to the provisions of IMC. Rooftop equipment in various building systems should be located in a manner that meets the requirements of the BOD. It is the intent of this section to establish alignment of the City installations with the IMC specific to Solar PV installations to ensure that the installation is in compliance with the building mechanical systems and to ensure that the building mechanical system is designed to accommodate a Solar PV system to the greatest extent possible.

B. Design Criteria

1. The building mechanical system, includes but is not limited to, exhaust and recirculation of air for building occupancy. The mechanical system regulated by IMC shall accommodate the ability to install Solar PV systems while meeting the provisions of the IMC. Other provisions of the IMC may apply as appropriate to the Solar PV design of the building. When installing the Solar PV systems described in section 3.0 above, care should be given to the requirements of the IMC.

    a. Vent and Exhaust - Solar PV systems shall be designed, installed and maintained in a manner consistent with IMC sections 401.6, 501.2, 801.2, 908.3 and 1008.2. The vent and exhaust system discharge should not be placed in a location that would cause a nuisance to the Solar PV system (e. g. fuel burning appliance vent; vapor plumes; blow off valves; grease, hazardous dust, and other product conveying exhausts.)

    b. Solar Systems – Other solar systems, equipment and appliances intended to utilize solar energy for space heating or cooling, domestic hot water heating, swimming pool heating or process heating are governed by IMC chapter 14 beginning with section 1401.1.

C. Coordination

1. The building mechanical system should be designed and installed in coordination with a potential Solar PV system as determined by the BOD. The building mechanical system should be designed to accommodate the Solar PV system in terms of its power capacity, location and ease of installation. The following items shall be included but not limited to:

SCHEMATIC DESIGN PHASE

The Architect/Design Consultant shall provide Schematic Design Documents based on the mutually agreed-upon program, schedule, and budget for the Cost of the Work. The documents shall establish the conceptual design (including options) of the Project illustrating the scale and relationship of the Project components as well as options for systems and major components. The design consultant will analyze each option and provide a recommendation to the City. The Schematic Design Documents shall include a conceptual site plan, if appropriate, and preliminary building plans, sections and elevations. At the Architect's option (unless specified elsewhere), the Schematic Design Documents may include study models, perspective sketches, electronic modeling or combinations of these media. Preliminary selections of major building systems and construction materials shall be noted on the drawings or described in writing. The Schematic Design Documents shall include but shall not be limited to:

1. Overall Project Schedule including breakdown of major project activities. This includes but is not limited to major construction activities (including any planned construction phasing), project design phases with owner review cycles indicated. Construction manager to provide the construction schedule for CM@R projects.

2. Construction cost estimate with breakdown by major construction disciplines (+/-20% accuracy). Construction manager to provide the construction cost estimate for CM@R projects. The design consultant is also expected to provide a cost estimate by major discipline for comparison to the CM@R's estimate.

3. Assist PM in developing/revising the overall project budget

4. Sitework (shown on site plans or in narrative form as appropriate and agreed to by the Project Manager).

    a. Paving, sidewalk, curb, fence, parking, and other site improvements.
    b. Drainage, including a discussion of potential of the project to effect surrounding properties (watershed), deterioration, detention / retention locations. A narrative conceptualizing the drainage issues is expected. Plans to show conceptual detention/retention pond sizes and locations.
    c. Utility location site plans showing where utilities enter the site and the routing for gas, water, electrical, telephone, sewer, cable, and data.

a. Mechanical equipment to be located on the roof should be installed in such a way to leave sufficient area for maintenance, access and a Solar PV array based on specifications determined in the BOD. Mechanical equipment includes but is not limited to: vents and exhaust systems, HVAC equipment, and any related conduit and piping for mechanical equipment (e.g. gas lines).

7.0 Electrical System

A. System Description

1. This provision is intended to provide direction on the decisions of the City in regards to electrical systems. The criteria below give reference to specific code provisions described in the NEC. The use of electrical systems for the Solar PV systems can be critical to the long term viability of the electrical systems as well as life safety provisions of NEC. It is the intent of this section to establish alignment of the City installations with the NEC specific to Solar PV installations to ensure that the installation is in compliance with the building electrical systems and to ensure that the building electrical system is designed to accommodate a Solar PV system to the greatest extent possible.

B. Design Criteria

1. The building electrical system includes, but is not limited to, the main electric service as supplied by the utility, switchgear, transformers, branch circuits serving building loads, grounding, emergency or supplementary power systems, and the Solar PV system. The building electrical systems shall meet all provisions of the NEC. The building electrical system shall accommodate future Solar PV systems as described in the BOD, while meeting the provisions of the NEC for the building. When installing the Solar PV systems described in section 3.0 above, care should be given to the requirements of the NEC.

    a. Solar Photovoltaic Systems - Solar PV systems shall be designed, installed and maintained in a manner consistent with NEC article 690.

C. Coordination

1. The building electrical system should be designed and installed in coordination with a future Solar PV system as determined by the BOD. The building electrical system should be designed to accommodate the Solar PV system to the greatest extent possible in terms of its power capacity, location and ease of installation. The following items shall be included but not limited to:

a. Capacity and ability of the electric service to accommodate the power generated by a Solar PV system as determined by the BOD so that it can be interconnected with the building system. (A location within the main disconnect panel for a dedicated Solar PV circuit breaker should be labeled as “Future Circuit Breaker From PV System” and left vacant. This breaker position must be located at the opposite end of the panel from the main utility breaker.) This circuit breaker location should allow for a 240-volt breaker.

b. Sufficient space allocated for Solar PV equipment such as the inverter, disconnects, metering, etc. as determined by the BOD (interior or exterior locations may be considered).

c. To facilitate wiring, consider adding conduit and/or stub-ups to the roof and terminating at the location of the Solar PV array. The size and number of conduits will be determined by the BOD.

d. Electrical equipment to be located on the roof should be installed in such a way to leave sufficient unshaded area for a Solar PV array based on specifications determined in the BOD. Electrical equipment includes but is not limited to: electrical conduit, lightning protection cables, bird deterrent devices, or any other items requiring wiring.

e. To minimize electrical losses associated with the transmission of DC energy, the distance between the Solar PV array and the inverter should be minimized to the greatest extent possible.

f. Any pre-installed components should be properly labeled to ensure that a Solar PV system will take advantage of the accommodations that were made (such as circuit breaker location, conduit or stub-ups installed with pre-determined wire sizes, conduit fill capacities, Solar PV system output limitations at main service panel if known, etc.)

8.0 ADOSH (Arizona Department of Occupational Safety and Health)

A. System Description

1. It is the intent of this section to establish alignment of the City installations with the ADOSH specific to Solar PV installations to ensure that the installation is in compliance with ADOSH and to ensure that the worker access system is designed to accommodate a Solar PV system to the greatest extent possible.

B. Design Criteria

1. When designing, installing and maintaining the Solar PV systems described in section 3.0 above, care should be given to the requirements of ADOSH, including:.

    a. 29 CFR part 1910 subpart D contains requirements specific to walking-working surfaces safety.

    b. 29 CFR part 1910 Subpart E contains requirements for means of egress safety.

    c. 29 CFR part 1910 Subpart S contains requirements for electrical safety.

    d. 29 CFR part 1926 Subpart K contains requirements for electrical safety.

    e. 29 CFR part 1926 Subpart M contains requirements for fall protection safety.

    f. 29 CFR part 1926 Subpart X contains requirements for ladder safety.

C. Coordination

1. ADOSH compliance should include but not be limited to:

    a. The design of the roof, exterior fenestration for window washing, should consider the location and extent of the Solar PV system as determined by the BOD.

    b. The design of the access to the roof to accommodate the workers for maintenance of roof top equipment should consider the location and extent of the Solar PV system as determined by the BOD.

9.0 Fire Department Access

A. Description

1. This provision is intended to provide direction on the decisions of the City in regards to fire department access. The criterion below gives reference to specific code provision described in the IFC. The access to roofs during a fire event can be critical to the long term viability of the building as well as the safety of the occupants within. It is intent of this section to establish alignment of the City installations with the IFC specific to Solar PV installations to ensure that the installation is in compliance with the fire department access systems and to ensure that the fire department access systems are designed to accommodate a Solar PV system to the greatest extent possible.

B. Criteria

1. The building fire system requirements address but are not limited to access to roofs, electrical systems and building occupancy. The fire department access design regulated by IFC shall accommodate the ability to install Solar PV systems while meeting the provisions of the IFC. Other provisions of the IFC may apply as appropriate to the Solar PV design of the building. When installing the Solar PV systems described in section 3.0 above, care should be given to the requirements of the IFC.

    a. Access to Roofs - Solar PV systems shall be designed, installed and maintained in a manner consistent with IFC Section 504.

    b. Electrical - Solar PV systems shall be designed, installed and maintained in a manner consistent with IFC Section 605.

C. Coordination

1. The fire department access system should be designed and installed in coordination with a future Solar PV system as determined by the BOD. The fire department access system should be designed to accommodate the Solar PV system to the greatest extent possible in terms of its power capacity, location and ease of installation. The following items shall be included but not limited to:

    a. The BOD should provide designs that comply with access requirements and edge restrictions contained in IFC 2012.

    b. The site design for fire truck access and accommodating hose connections from hydrant to fire truck to fire nozzles should consider location and extent of the ground mounted Solar PV system as determined by the BOD.

c. The site design for outdoor safe dispersal areas to meet IBC section 1024.6 and accommodating exit routes from exterior doors to the public ways should consider the location and extent of any ground mounted Solar PV system as determined by the BOD.

d. The design of the electrical panel system and fire department access to de-energize during a fire event per NEC Article 690.14 should consider the size and electrical demands of the Solar PV system as determined by the BOD.

10.0 Quality Assurance/Review

A. Description

1. The completion of the design of the buildings incorporating the impact of Solar PV systems upon the building is achieved through a series of incremental design and construction milestones. The BOD shall be completed at the Schematic Design phase of the building design so that Solar PV systems type, location, and cost can be established, decreasing the need for rework in the design documents. The BOD shall describe the Solar systems (in the present design and future) for the building in a graphic representation of site plan, floor plans and sections. A written narrative shall accompany and support the graphic form.

11.0 References

A. City of Tucson, Solar Integration Plan, March 2009 – Plan laying groundwork for accelerating development of solar energy facilities in and around Tucson. http://www.tucsonaz.gov/energy/Solar%20Plan%20Final.pdf

B. Solar America Cities, Solar Powering Your Community: A Guide for Local Governments, January 2011 – A guidebook with examples to stimulate ideas for a comprehensive solar plan for communities. http://solaramericacommunities.energy.gov/resources/guide_for_local_governments/

C. John Wiles, Southwest Technology Development Institute (SWTDI), Recommendations for Building Solar Ready Buildings Photovoltaic Systems, 23 June 2009. Attached as Appendix A below

D. L.Lisell, T Tetreault and A Watson, Solar Ready Buildings Planning Guide, NREL Technical Report NREL/TP-7A2-46078, December 2009

12.0 Appendices

Appendix A - Recommendations for Building Solar Ready Buildings Photovoltaic Systems, John Wiles, Southwest Technology Development Institute (SWTDI). June 23, 2009

Appendix B - Structural Calculations

Appendix A – Recommendations for Building Solar Ready Buildings Photovoltaic Systems

d. Initiate and document contact with City of Tucson Zoning and Planning to obtain preliminary requirements.
e. Landscape concept.
f. Cultural Resources - Per Administrative Directives from the City Manager's office, a cultural resource review is required for all Capital Projects. This review is to occur prior to the design of any building projects requiring excavations of any kind. There is a Cultural Resource Clearance request form that needs to be filled out, go to (http://intranet/ad/1-07-7.pdf). Also, you may call the City of Tucson Dept. of Urban Planning and Design; 520-791-4505 for any assistance you may need. The City's PM is responsible for ensuring the Cultural Resources Review is completed. The design consultant is expected to report on the results and their potential project impacts in the SD report.
g. Surrounding Neighborhood – Consider the use of the proposed facility and the possible impact the facility may have on the immediate neighborhood from such changes as increased noise, increased traffic, and other quality of life impacts.
h. Survey - Verify and document property easements and constraints. Note any potential problems. The City's PM is responsible for ensuring the survey is completed by the Architect/Consultant or by others. TEP:(transformer location) get legal description and show on survey if there is an existing transformer and electric service easement. Note new service easement is typically provided during construction and should go through City Real Estate Department to obtain the TEP easement. City's PM is to ensure survey is performed to our requirements. The survey may be under the design consultant's scope or by others.
i. Water Harvesting - Provide a narrative description as to how the project will meet the Tucson code requirements for water harvesting as described in Appendix A of the City of Tucson Water Harvesting Manual, which is available at http://www.dot.ci.tucson.az.us/stormwater/downloads/2006WaterHarvesting.pdf . Consultant is also to provide a cost/benefit analysis of additional water harvesting opportunities. The cost/benefit analysis is not intended to be a detailed study but should provide enough information for the City to make informed decisions whether or not to pursue further water harvesting opportunities on the project.
j. Accessible parking and route.

5. Code Analysis

ACCESSIBILITY – Americans with Disabilities Act (ADA)

Recommendations for Building Solar Ready Buildings Photovoltaic Systems

Executive Summary

Builders considering adding photovoltaic (PV) systems to new buildings after initial construction is completed can save time and money by following new building Solar Ready design guidelines. Solar Ready buildings are designed and built with integrated electrical and mechanical features that streamline the integration of PV systems.

Solar Ready design guidelines are straightforward and impact building design in the following general areas:

- Roof pitch and orientation
- Layout of roof vents, chimneys, etc., to prevent shading
- Roof load bearing specification
- Installation of electrical conduit from main electrical panel location to roof
- Specification of main service panel and circuit breakers
- Space near the main electrical panel for PV inverters and other equipment

Early consideration of these few requirements will ensure the seamless integration of future photovoltaic systems.

1.0 Complete List of Solar Ready design guidelines

Below is the complete list of areas and concerns that must be addressed to configure a Solar Ready building:

- Site and solar resource evaluation
- Roof/array pitch and roof/array orientation
- Roof structure designed to support additional weight of PV array
- Location of roof vents, chimneys, etc., in relationship to PV array
- Location of PV array in relationship to inverter and point of interconnection with the existing utility service
- Specifications and routing of electrical conduit from roof to PV dc disconnect
- Prepare the main electrical panel for PV
- Provide location and adequate spacing for photovoltaic equipment near main electrical panel
- Design for proper panel and main disconnect ratings on the main electrical panel
- Prepare for photovoltaic back-fed circuit breaker in main electrical panel
- Photovoltaic Solar Ready component labeling

The following sections describe each of these requirements in detail. This information is intended as a guide in cases where the PV system design has not been determined. In cases where the design of the future PV system is already known, some of these recommendations can be changed to more specifically and effectively accommodate the system installation. For example, when the type and model of PV modules are known, specific direct current (dc) wiring and disconnects can be sized and installed in advance.

2.0 Descriptions of recommended design guidelines

2.1 Site and solar resource evaluation:

When designing a PV Solar Ready building, a basic design requirement will be to perform a site evaluation of the building's location and orientation to the existing solar resource. This evaluation should take into account the relationship of the building to the path of the sun throughout the year. The location of any existing (or future) foliage that may shade the photovoltaic array should also be considered. It is recommended that the building's landscape design avoid tall trees and other objects that may eventually cast a shadow on the photovoltaic array. Areas to the east, south, and west of the building should be carefully landscaped to avoid shading the array during the corresponding portions of the day.

2.2 Roof/array pitch and roof/array orientation:

Another basic design requirement will be to determine the pitch and orientation of both the roof and the photovoltaic array. The roof surface where the PV array is to be located will, in an ideal case, be oriented directly toward the solar resource. This is generally to the south in the northern hemisphere. Where possible, the pitch of the roof plus the tilt of the array should be slightly less than or equal to the local latitude to provide optimal year round performance.

2.3 Roof structure designed to support additional weight of PV array:

When building a Photovoltaic Solar Ready building, the structural integrity of the roof should be examined to determine that it will carry the added weight of the photovoltaic system and the mounting components. The additional weight of the system will vary greatly depending upon the photovoltaic modules and mounting system used. In general, the roof below the photovoltaic array should be designed to support at least an additional 5 lbs/sq ft of dead weight.

2.4 Location of roof, vents, chimneys, etc., in relationship to PV array:

When designing the layout and location of roof protrusions, special consideration should be given to the location of roof vents, chimneys, gables, or other obstructions that could cast shadows upon the photovoltaic array. The roof design should allow ample clearance for the anticipated photovoltaic array as well as eliminate any shading obstructions along the projected solar path. In general, in the northern hemisphere, any roof protrusions should be located to the north of the planned array location and, depending upon the orientation of the roof surface, other protrusions should be limited to those locations that will limit the amount of shading during the year.

2.5 Location of PV array in relationship to inverter and point of interconnection:

To minimize losses associated with the transmission of dc energy, the distance between PV array output and the inverter should be kept to a minimum. For instance, if the inverter and main electrical panel are to be located in a garage or utility room, a logical location for the PV array would be on the appropriate roof surface directly above the garage or utility room location. This also serves to minimize the amount of electrical supplies, conduit, wire, etc., necessary to complete the connection between the PV array and the inverter.

2.6 Specifications and routing of de conduit from roof to de disconnect location:

A metal conduit is necessary to bring the dc wiring from the PV array output to the location of the dc combiner panel or dc disconnect (depending on the design of the PV system). The size of this conduit should be no smaller than 1" to accommodate the dc wiring.

If the building has an accessible attic space, it is recommended that the conduit be terminated within the attic area to allow for future installation flexibility. The installer will then route the conduit through the attic to the appropriate location before penetrating the roof surface. If the attic is inaccessible, the conduit penetration should be located in a place on the roof as near the anticipated PV array output as possible to minimize the amount of exposed wiring between the PV modules and the input to the conduit.

If the building has a flat roof the dc wiring conduit can be terminated on the inside of a parapet wall or, if necessary, up through the ceiling and roof surface at the appropriate location.

The opposite end of this conduit should be in a location where it can be easily connected to any future component: dc disconnect, dc combiner. Both ends of the conduit should be capped off to keep out water and pests.

2.7 Location and adequate spacing for photovoltaic equipment near main electrical panel:

Adequate space should be available in a readily accessible location for a dc disconnect, inverter, ac disconnect and, if applicable, PV system renewable energy credit (REC) meter and utility required ac disconnect will be mounted. The dimensions required for the location for the PV equipment will largely depend upon the PV system design and equipment choices. In general, a commercial PV system consisting of the equipment mentioned above will require four to five horizontal feet of wall space with adequate clearance above and below the mounting locations. The requirement and location for an additional ac disconnect and PV REC meter is determined by the requirements of the local jurisdiction as well as the local electric company. If this equipment must be located within site of the main electrical disconnect on the exterior of the building, it is recommended that the building design allow two to three feet of space.

2.8 Design for proper bus bar and main disconnect ratings on the main service panel:

The National Electrical Code (NEC) imposes requirements on the size of a PV system that can be added to a specified size of existing electrical service.

The 2005 NEC requires that commercial installations meet the requirements of section 690.64 which covers the point of connection and allows for two types of photo voltaic system interconnection. Section 690.64 (A) allows the output of a photovoltaic power source to be connected to the supply side of the service disconnect. This is often the best option for photovoltaic system retrofits on commercial buildings.

The second option described in section 690.64 (B) is the load side connection. This option requires that the sum of the photovoltaic breaker and the main breaker is less than or equal to the rating of the distribution panel. In the case where the building is constructed with a photovoltaic system in mind, it will be necessary to size the distribution panel, main breaker and photovoltaic breaker appropriately. In the case of series connected panels, the main breaker for each panel is counted in the above calculation.

For instance, an 800-amp main circuit breaker rating along with a 1000-amp panel rating will accommodate up to 200 amps of ac current, which would allow PV systems up to 60 kW in size on a 3 phase 208 Volt service.

In the case of series connected panels, if a 20-amp PV breaker feeds into a 100-amp panel with an 80-amp main then the 80-amp breaker is used to calculate the size of the main breaker in the main panel.

The 2008 NEC Section 690.63 allows commercial buildings to install breakers that when added to the main breaker are less than or equal to 120% of the rating of the distribution panel. The photo voltaic breaker must be installed in the location of the panel farthest from the utility breaker. Also Section 690.63 in the 2008 NEC states that only the PV breaker is counted in the case of series connected panels.

For instance, a 1000-amp main circuit breaker rating along with a 1000-amp panel rating will accommodate up to 200 amps of ac current, which would allow PV systems up to 60 kW in size on a 3 phase 208 Volt service. If the future photovoltaic system will produce more than

20% of the main circuit breaker's rating, then the size of the main electrical panel should be increased, in accordance with NEC 690.64(B).

2.9 Considerations for photovoltaic circuit breaker in main disconnect panel:

If the size of the PV system is unknown, a location (within the main disconnect panel) for the circuit breaker should be labeled as "Future Circuit Breaker From PV System" and left vacant for the installer to specify and connect. This breaker position must be located at the opposite end of the panel from the main utility breaker. This circuit breaker location should allow for a 240-volt breaker which, in turn, will allow the option of a 120-volt system to be installed if this is desired.

2.10 Photovoltaic Solar Ready component labeling:

Proper labeling of the pre-installed components will ensure that a future PV system installation will properly take advantage of the various features of the Solar Ready building. A label detailing specific PV system output limitations is recommended for the main service panel. This label should detail the current limitations and voltage level required to meet the various electrical standards, *NEC*, and local requirements. The PV circuit breaker location should also be labeled as such. It is also recommended that the dc conduit be labeled with appropriate wire size ranges and conduit fill capacities briefly detailed as well.

Prepared by staff of the Southwest Technology Development Institute, New Mexico State University, Las Cruces, NM, June 23, 2009

Appendix B – Structural Calculations

CH2MHILL
Lockwood Greene

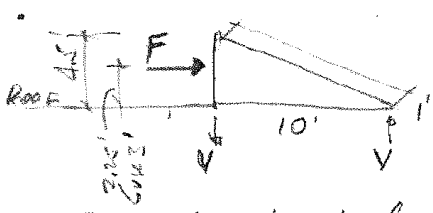
Job Name Tucson Solar Bldg. _____
Subject Task 2 - Building Standard

Job No. 383998.K4
Sheet No. BS-1
Date 8/6/09
Computed By VK
Checked By _____

Loads Specification for new Construction.

1. Non-penetrating ballasted system
Ave. load - 15 psf - based on EC Pueblo installation
to account for local concentrations, use 20 psf DL.
Use 15 psf Seismic mass. non-concurrent with roof live load.

Wind Load: Ref. ASCE7-05, 6.5.15 and 6.5.15.1



$F = q_z G C_f A_f \times 1.9$ (6-28)

$C_f = 1.3$ for $h/D = 1$ Fig. 6.21

Effective Area $= 1.3 \times 1.9\, A_f = 2.47\, A_f$

Per 1 foot of length of the rack:

Effective Area $= 2.47 \times 4.5 \times 1.0 = 11.1$ SF/1 → use 12 SF/1

Uplift $= F \times 2.25/10 = .225\, F$ - use $.25\, F$ - for unballasted system only

2. Non-penetrating, low profile, self-ballasted
3.3 psf - Solyndra
4 psf - Powerguard Roof Tile
Use 5 psf for spec. (Dead load and Seismic mass)

3. Laminate roof membrane - 2 ply roofing system
SIT 1.8 psf use 2 psf

4. Laminate membrane on metal decking:
SIT 1.8 psf + 1 psf steel runners - use 3 psf

IPP1001 6/05

CH2MHILL
Lockwood Greene

Job Name Tucson Solar Bldg. _____
Subject Task 2 - Bldg. Std

Job No. 383903.14
Sheet No. BS-2
Date 8/6/09
Computed By VR
Checked By _____

5. Penetrating System with the racks installed directly on the roof

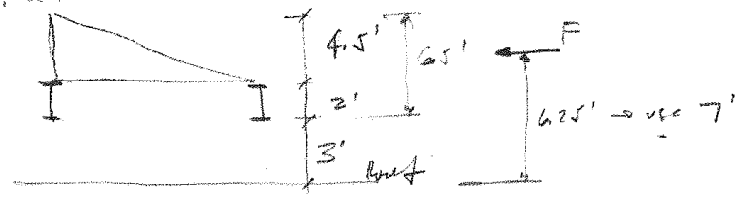
Schletter racks + panels ≈ 3 psf — use 6 psf

Wind load - see Non-penetrating Ballasted system

6. Penetrating System, Racks installed on long-span steel framing elevated above the roof

DL + Seism. Meas. 6 psf racks + panels + 10 psf steel = 16 psf

Wind:



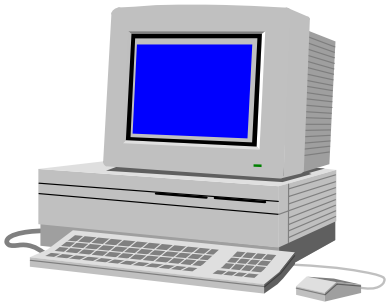
Effective Area = 2.47 × 6.5 × 1.0 ≈ 16 SF/1

IPP1001 6/05

City of Tucson

General Services Department
Architecture and Engineering Division

<u>"AUTOCAD STANDARDS AND GUIDELINES"</u>



Revised: **September 2, 2008**

INTRODUCTION

This notebook is a specification and reference to the City of Tucson, General Services Department, Architecture & Engineering Division's (AED) use of AutoCAD. The specifications describe the standards and procedures for input of drawings into a format acceptable to the AED. Compliance is required where called for in contractual agreements for providing electronic "as-built" ACAD and PDF files to the AED. Only AutoCAD 2006 or later will be accepted. PDF's may be any version of Adobe Acrobat (2000 or later is recommended).

This notebook is a living document. As the division's use of CAD matures and technology advances this notebook changes reflecting the progress. Updated sections are issued frequently. Please direct any comments you may have regarding these AutoCAD Standards to *Octavio A. SantaMaria, Jr.* ***(520) 791-5111 x 331*** *or e-mail* octavio.santamaria@tucsonaz.gov .