APPENDIX 2

Standards and Criteria DSM

LIVE LIFE. TRAVEL WELL.

Design Standards Manual

General Standards and Criteria

Denver International Airport

Airport Infrastructure Management

2016

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Table of Contents

Preface

The Denver International Airport (DEN) Design Standards have been developed to insure a unified and consistent approach to the thematic and technical design for DEN. These standards are for use by the Developer under contract to DEN.

The Standards Manuals are intended to be working documents, which will be revised and updated, as required, to address the general, conceptual, design, and technical standards for all areas of design for the DEN.

This Design Standards Manual for DEN has been prepared for use by competent, professionally licensed architectural and engineering under the direction of DEN Maintenance and Engineering or Tenants of DEN.

The Design Standards shall not be quoted, copied, or referenced in any ~~bidding or~~ construction ~~Contract~~ Documents. All information contained in these standards must be fully explained and shown in all bidding and Contract Documents.

The Developer shall not reproduce, duplicate in any manner, transmit to other consultants or other entities or use in conjunction with other projects without the express written consent of DEN.

Chapter 1 - Administration

Section 100 - Administration

100.1 Title

The DEN Design Standards that are mandatory to this Project, may be cited as such, and are referred to herein as the Standards.

100.2 Purpose

The Design Standard Manuals that are mandatory to this Project define a precise architectural and engineering vocabulary that serves as a basis for making decisions throughout the design and construction process. The Standards provide direction without limiting the creative abilities of those who are governed by them.

100.3 Definitions

BIM	Building Information Modeling
BMS	DEN Business Management Services
BPXP	BIM Project Execution Plan
CDSR	Contract Data Submittal Requirements
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
City	City and Country of Denver
DAR	Design Analysis Report
DEN	Denver International Airport
DSBO	Department of Small Business Opportunity
FAA	Federal Aviation Administration
LEED	Leadership in Energy and Environmental Design
SSI	Sensitive Security Information

100.4 Scope

100.5 The provisions of the Standards apply to the design of any building, structure, or improvement at DEN.Format

Where specific formats are provided or referenced, those formats shall be used by the Developer.

100.6 Procedures

The procedural guidelines contained in these manuals are intended to supplement existing Developer's procedures and to establish a uniform basis for program control for DEN. Where the manuals are silent on a procedural matter, it is incumbent on the Developer to apply its existing corporate guidelines.

100.7 Exclusions

The Standards are not all inclusive and there are areas of the Standards that do not address design requirements. In these instances, the Developer shall use professional design judgment and expertise in preparing a complete system design for those areas within the Developer's Scope of Work (SOW).

Section 101 - Compliance with Codes and Regulations

The Standards are not to be used in lieu of codes or regulations that may be applicable to design or construction work. The user of the Standards shall be solely responsible for the design product compliance with all codes and regulations. In some cases, the Standards contain requirements that are more stringent than codes or regulations.

Section 102 - Pre-work Meeting

A pre-work meeting will be scheduled by the Owner after issuing the Developer's Notice to Proceed. The purpose of this meeting is to introduce the Owner's Representatives to their counterparts in the Developer's organization and to establish lines of communication between these representatives and outline some contract requirements. The Developer's Project Manager and Division of Small Business Opportunity (DSBO) shall attend this meeting.

102.1 Notice of Meeting

The Project Manager will distribute a notice of this meeting, along with an agenda of the subjects to be addressed. Meeting minutes shall be prepared and distributed by the Project Manager.

102.2 Meeting Agenda

A. The Developer will introduce Developer's representatives, and briefly describe each person's responsibilities. The Developer shall provide the following:

1. List of all subconsultants, design disciplines, and a schedule for the first 90 days of work activities unless tasks have not been assigned
2. Office locations, telephone numbers, fax numbers, and e-mail addresses
3. Names of BPXP, LEED, and Design Analysis Report (DAR) coordinators
4. Design administration methods and correspondence control
5. Quality Control Plan
6. Procedures to coordinate the Developer's work with the work of other Contractors and the procedures for sharing access to the worksite

B. The Owner will explain and discuss the responsibilities and authorities of the City's organization. The Owner will provide highlights of the following information at the meeting, as applicable to the project or task:

1. Communications control
2. Security procedures, SSI, and access control/badging
3. DSBO requirements
4. Business Management Services (BMS) - Payment procedures, monthly pay estimate cutoff dates
5. Authorizations and work submittal procedures
6. Scheduling and coordination requirements
7. Quality control/assurance procedures
8. Environmental requirements and permits, protection of property and work in progress, protection of municipal and public service system, protection of streets and roads, protection of drainage ways, protection of the environment, hazardous and explosive materials, archeological and historical discoveries, and buried utilities

Explanations provided by the Owner will not amend, supersede, or alter the terms or meaning of any Contract Document and the Developer shall not claim reliance on such explanations as a defense to any breach or failure by the Developer to perform as specified in the Contract.

Section 103 - Progress Meeting

Progress meetings will be scheduled weekly and more often as necessary by the Owner to promote the competent and timely execution of the contract. The meetings will be held at DEN and will be chaired by the Owner. The Developer shall be available, in person at DEN or, subject to the approval of the Owner, be available via telephone, and/or web conference. The Developer, critical personnel, and/or subconsultants shall be present to assure timely transfer of information. The Project Manager will be responsible for publishing minutes of the meetings within three (3) business days.

Section 104 - Meeting Locations

At the discretion of the Owner, the Developer shall attend any meeting at DEN or via web conferencing.

104.1 Meetings at DEN

The Developer shall attend any meeting at DEN at the request of the Owner. The Developer shall be diligent in meeting planning and allow time for the following:

A. Parking and travel times from probable parking locations

B. Escorting through secure areas

Section 105 - Coordination and Administration

105.1 Procedures

The Developer shall follow the procedures for coordinating and administering activities and for communicating among the Developer and the Owner in accordance with the Contract Documents.

105.2 Coordination

The Developer shall coordinate the services and work provided by all of its subconsultants working on the project. The Developer shall have primary responsibility of the program and processes utilized to eliminate any conflicts and inconsistencies within the final design packages prepared by the Developer and its subconsultants.

105.3 Design Standards

The Developer shall incorporate in design and construction documents, all of the applicable DEN design standards and Owner accepted criteria as specified in the Contract Documents. If the Developer determines that an element of the design should be covered by a Design Standard, but one does not exist for that element, it shall notify the Owner in writing and proceed as directed. If the Developer finds that deviation from any Design Standard may be appropriate, the Developer shall submit in a timely manner any proposed deviations in writing, accompanied by graphic information to the Owner for review and/or acceptance. Development of design for which a Standard modification is required or a new design is required shall not be considered an additional cost to the Owner if considered in the Contract Documents. The Developer shall also fully cooperate with other Consultants performing work at DEN and particularly those Consultants whose work connects or interfaces with the Developer's Scope of Work.

105.4 Communications with the Developer

The Owner will transmit written instructions, responses, or other communications to the Developer. The Developer shall, by a letter to the Owner, designate (by name) one or more assistant managers to receive oral and written communications when the Developer's manager is away from the work site and to act as the Developer's designated representative. During the times that the Developer's manager may be

temporarily absent, an assistant Developer manager shall be authorized to act immediately on orders or instructions issued by the Owner.

105.5 Budget Control

The Developer shall plan and control the work to manage the contract value. Work shall be divided into manageable sub tasks, which represent measurable units of the contract scope each with assigned budgets once established. The Developer's task budgets shall be adhered to unless written authorization is provided by the Owner. The Developer shall include monthly progress of work by task and discipline.

105.6 Design Project Closeout

The Developer shall plan for project closeout from day one. By law and General Conditions of the contract, the Owner requires any set of drawings and specifications in PDF form used to establish pricing or Contract for work be delivered to the Project Manager. Additionally as a part of the design project closeout, the ~~Design~~ Developer shall provide model information outlined in the BIM Project Execution Plan (BPXP) as generated per the *BIM Design Standards Manual.*

The Construction Documents and models will be stored in a document control system and archived by the Project Manager.

End of Chapter

Chapter 2 – Design Phases

Section 200 - Design Phases

200.1 General

The design program shall be sequential by phases. Phases for the Project are shown below. Specific submittal requirements shall be as follows unless documented in the Developer's Contract or by task: For each deliverable, coordinate with the Owner for requirements regarding quantities of documents and quantities of sealed and signed documents to be submitted.

Architectural, Landscape Architecture Signage and Graphics
(Consistent with Technical Requirements I.8.3.3)

1. Schematic Design (30%)
2. Design Development (60%)
3. Construction Documents
   a. 90% submittal
   b. 100% submittal Issued for Review (IFR)
4. Issued for Construction (IFC) Construction Documents
5. Construction
   a. Issue conformed document
   b. Construction overview (administration)
   c. Record documents

Section 201 - ~~Civil/Infrastructure Phases~~

~~This section generally applies to all horizontal work projects, which include paving, roadways, runways, utilities, and utility systems.~~

Section 202 - Architectural, Signage, and Landscape Architecture Phases

This section generally applies to all vertical work projects, which include structures, buildings, landscaping, signage, mechanical, electrical, plumbing, and other disciplines. The projects of this nature may include paving, roadways, runways, utilities, and utility systems associated with the project.

Refer to the Packaging Plan table in Volume 2 of the Technical Requirements.

202.1 Schematic Design Phase

Based upon information and data in the Contract Documents, which will be reviewed periodically by the Owner as it is being prepared, the Developer shall perform certain field investigations and other design services and prepare schematic design documents described below:

A. Engineering surveys and soils investigations, bound separately

B. Schematic drawings indicating design concepts and alternative solutions.

C. Rough, to scale models of areas of the project, if required in the Developer contract or if required to fully demonstrate or describe the project

D. Schematic DAR

E. LEED checklist review

F. Preliminary BIM review

202.2 Design Development Phase

Based upon the schematic design phase and data in the Contract Document design analysis , which will be reviewed periodically by the Owner, the Developer shall prepare design development documents. These documents shall include:

A. Design development drawings

B. Outline Technical Specifications

C. Preliminary DAR

D. LEED checklist review

E. BIM review

202.3 Construction Documents Phases

The Developer shall be required to prepare a minimum of three submittals in the Construction Documents phase, 90% progress CD submittal, an 100% Issued for Review (IFR) submittal, and an Issued for Construction (IFC) submittal, unless otherwise required in the Contract. Each submittal shall be comprised of those elements of the documents begun in the design development and additional documents/reports as necessary or requested. Based upon the accepted design development documents, which have been reviewed by the Owner, the Developer shall prepare:

A. Contract drawings

B. Contract specifications

C. Engineering surveys and soils investigations

D. DAR

E. LEED checklist review

F. LEED design phase submittal for US GBC certification (at Issued for Construction (IFC) only)

G. BIM review

During these phases, the Developer shall also prepare and provide to the Owner technical data or information that is required to complete any permit application, Federal grant application, or any other applications for governmental acceptances associated with the project.

202.4 City Plan Review

For the Issued for Construction (IFC) Construction Documents Phase the Construction Documents shall be completed and checked, sealed, and signed by the Developer. The Developer shall file drawings, specifications, and addenda with the City's Development Services (DBC) for plan review in accordance with instructions received from the Project Manager. The Developer shall attend meetings with Development Services (DBC). Construction Phase

The construction phase shall begin with the Issue for Construction (IFC) submittal.. The number of copies of Construction Documents required shall be established in the Developer's Contract Documents. If not established, quantities as indicated in Chapter 32, Submittals shall apply. Services during the construction phase are identified in Chapter 8, Construction Administration and shall include but are not limited to the following:

A. Attend weekly construction meetings or in accordance with the PMP

B. Visit project site at appropriate intervals; complete observation reports

C. Review and process submittals and RFI's, adhering to standard procedures established by DEN regarding stamping and filing of submittals

D. Interpret Construction Documents

E. Review and evaluate and update Construction Documents

F. Review change orders

G. Assist Owner in final acceptance reviews

H. Prepare LEED construction phase submittal for US GBC certification

I. Complete Record Documents

    1. Refer to Chapter 9, Record Documents

2. Refer to *BIM Design Standards Manual*

End of Chapter

Chapter 3 – Design Analysis Report

Section 300 - Design Analysis Report

300.1 Summary of Work

The Developer shall develop and maintain a Design Analysis Report (DAR). The intent of the report is to present a clear, complete, and concise picture of the design of the facilities and systems. The content and format are defined below. The Developer shall coordinate with the Owner on any additional requirements applicable to the project, which should be included in the design analysis. The design analysis shall be submitted for each required phase of work. The Developer shall prepare DARs, which contain all of the Owner accepted program criteria, parameters, and criteria for each project or task. These manuals (design analysis) shall be periodically reviewed by the Developer. These manuals shall contain, but shall not be limited to, the following information, reviews, and recommendations.

300.2 Quality Control

The Developer shall submit a copy of the Developer's design quality control procedures and a draft quality control submittal log to the Owner for review and comment. The quality control procedures shall be attached as an appendix to each submitted DAR.

Section 301 - Submittals of Design Analysis Report

301.1 Submittal

Submittal of the DARs shall be required as indicated in the Developer's Contract or approved task. If not defined in the Developer's Contract, the Developer shall submit design analysis reports as defined in this chapter and Chapter 32, Submittals shall apply.

301.2 Submittal Format Requirements

All submittals of the DAR shall be submitted in an electronic format in a single PDF file. The DAR format shall include cover sheets shall contain the following:

1. Title of submittal, project title, project number, Developer's name, contract number, and date
2. Material shall be presented in 8 1/2 " x 11" format
3. The file shall carry identification including, volume number, project name, number, Developer name, Developer contract number, date of submittal, and the name of the design phase the submittal addresses
4. Submittals shall be assembled into a single volume if at all possible, except submittals for projects including more than one major facility or distinct part may be assembled into separate volumes, numbered sequentially and indicating total number of volumes
5. Each page of the submittal shall identify the project name, number, and date of submittal

301.3 Table of Contents

The Table of Contents and subsequent division tabs shall divide the reports into the sections outlined in this chapter. Further subdivisions are at the discretion of the Developer.

301.4 Sheet Sizes

Sheets larger than letter size folded to the prescribed size may be utilized when reduction is not feasible. When automated data processing is used, printout material shall be trimmed or reduced to the standard sheet size. All side, top, and bottom margins shall be .75-inch minimum to permit side binding and head-to-head duplication. Folded sheets shall be placed in paper jackets and bound into each report.

301.5 Submittal Quantity

Submit the quantities as indicated in Chapter 32, Submittals

Section 302 - Submittals During Design Phases

302.1 Overview

Submittal of the DAR shall be required at each phase of the design process. The Developer shall maintain and update the DAR on an on-going basis and shall not depend on benchmark or submittal dates for timeliness of formatting and update. Drawings and/or specifications delivered without the DAR may not be accepted by DEN.

302.2 Programming Submittal of Design Analysis Report

The Developer shall submit a programming report addressing all of the items noted in Section 303, Contents and Organization of the Design Analysis Report. The level of completion of the work for each item shall be reviewed with the Owner, at the outset of the project, to assure agreement with the submittal requirements.

302.3 Schematic Design Analysis Report (30%)

The preliminary/schematic DAR contains changes to the programming phase DAR and describes all design criteria, assumptions, design calculations, design coordination, cost estimates, schedules, and other items as itemized below. Appropriate backup material, i.e., product data, drawings, test data shall be included

302.4 Design Development Design Analysis Report (60%)

The Developer shall prepare a design development DAR, which contains,

1. Changes to the schematic design phase and the design criteria
2. Assumptions
3. Relevant design calculations
4. A list of any deviations from the DEN or governmental agency design standards or requirements
5. Design coordination items with technical study reports and appropriate back-up materials, including, but not limited to,
    a. Catalogue cuts
    b. Product data sheets
    c. Specifications data
    d. Systems performance data
    e. Other data or information used to prepare the design development documents
6. List of utilities and their maximum capacities
7. Capacities of these utilities that are required to supply each project
8. Project systems
9. Tenant supplies systems
10. Horizontal and vertical locations where the utilities should enter each project

302.5 Final Design Analysis

The final DAR is a complete document within itself, containing all information from the project inception to the final design of the project. The report summarizes the conclusions of the design, completing and updating design calculations, costs, projected operating and maintenance cost impacts, and other information presented in the previous reports. It is part of the final review submittal due at the end of the Construction Documents phase.

Section 303 - Contents and Organization of the Design Analysis Report

As is appropriate to the project, the content of each section shall be itemized by discipline, i.e., civil, architectural, structural, mechanical, plumbing, fire protection, electrical power, electrical lighting, security systems, paging systems, monitoring systems. Incorporate into the final DAR revisions made because of final review and amendments. The following paragraphs describe the content of each of the report sections.

303.1 Foreword

A. Certification of compliance

The Developer shall provide a written certification that indicates that to the best of the Developer's knowledge, information and beliefs that all deliverables conform to the Contract Documents. All variances from the design standards accepted in writing shall be included. Review all project elements and identify any elements that the Developer recommends variance from the DEN design standards.

B. Program statement

The Developer shall provide a program summary identifying the needs and analysis of the project. This shall include program conclusions and recommendations, and presentation of concepts based on evidence of design influencing factors, ideas, and strategies to accommodate the needs.

C. Logic programs, decision matrices, associative diagrams, functional diagrams, etc.

D. Interviews and meetings

Conduct interviews and prepares meeting minutes of all interviews. The meeting minutes shall be reviewed by and commented on by the Owner prior to any publication or incorporation into the manual.

E. Description of services

A detailed description of engineering services such as soil tests, geo-technical data, surface and subsurface investigations, vibrations analyses, acoustical studies, lighting studies, seismic analyses, line-of-sight studies, vehicular and pedestrian traffic studies, surveys and other technical studies that will be required to design each Project.

F. Limits of Developer work

After consultation and coordination with the Owner, describe agreed upon specific limits for the Developer's SOW for the projects and the work performed by other Consultants who are designing and providing services for portions of DEN that are adjacent to, would be affected by, or which must connect or interface with the Developer's work.

G. Project limits

Define the limits of the construction project by identifying the interfaces of its work with other design work and include the records of correspondence with other Consultants, utility agencies, and code agencies in the coordination of work involving interfaces. Provide a project layout including site plan, improvements, and general sections identifying the scope of the project and limits of work. Include approximate area calculations

H. Design and construction schedule

Provide design and construction schedules for the project that comply with and are in a format accepted by the Owner. See Chapter 31, Construction Schedule for scheduling criteria and format.

I. Summary of actions

Provide a summary of the required actions, acceptances, permits, or additional information from the Owner (including City Building Department), governmental entities, and private entities, (1) which the Developer will require to complete its SOW in accordance with the master schedule and, (2) which the Owner or Developer will require to complete each project.

J. Construction Document packaging

Developer's recommendations for construction document ~~contract bid~~ packaging for each of the projects. The Owner may require the Developer to prepare separate ~~bid~~ packages to achieve the anticipated project delivery budget and schedule.

303.2 Design Requirements

The DAR shall include a written detailed discussion of design solutions, phasing, materials, risk assessment, compatibility with building systems, all building systems, design interfaces, equipment, performance criteria, maintenance considerations, operational compatibility, alternatives, construction scheduling, cost estimates, construction operation, Special Conditions, and other construction-related issues.

The Developer shall present factors considered and provided in the design of the project and project components. Supporting justification, i.e., design calculations, cost estimates and other data. Include discussion, itemized by discipline, at a minimum the following factors as appropriate to the project:

A. General description

The general description identifies and describes the facilities and systems designed by the Developer and their relationship to codes, standards, and the criteria. This shall include the detailed needs of the users and other requirements for a properly functioning facility.

1. Establish spaces, areas, adjacencies, and other relationship requirements including special equipment and systems. Identify existing systems, existing system capacities, and modifications required to those capacities.
2. If relocations are required, provide itemization of components, furnishings, etc., to be relocated to the new location.
3. Include a general review of the economic factors influencing the design alternatives of the systems and materials used in the project shall be provided along with an indication of how the initial and lifecycle costs are considered.

B. Design criteria

Provide a list of general criteria that pertains to all disciplines used in the design, prescribed criteria, specific studies, and minutes of pre-design conference meetings. Specific criteria used by each particular discipline shall be completely documented in the text of that discipline. Such criteria shall be referenced accordingly.

C. ~~Planning study~~

D. Statistical summary

The Developer shall prepare a statistical summary of the designed project areas in comparison to the total Owner approved Tenant programmed project areas, including, but not limited to, the ratio of net designed project area to the gross building area. This statistical summary shall be updated periodically as each project progresses. This summary must accompany each service phase submittal.

E. Major components

Provide a list of all components of the facilities and systems and the categorical systems of the Owner, FAA, CDPHE, and CDOT.

F. Code analysis

Provide a complete code and standards analysis of the project including analysis of impact on adjacent work. The code analysis shall include options of compliance with codes or standards of those jurisdictions governing the work. If the project is to have occupied space, provide a code analysis that includes identification of occupancy types of proposed uses and occupancy types of adjacent uses. Include plan drawings of pedestrian exiting diagrams including contributory loads of various occupied areas, paths of egress with load factor, vertical egress paths with load factors, and opening/corridor size factors.

The code analysis shall also describe fire fighting vehicle access to the site and facility, standpipe coverage, if applicable, fire extinguisher locations, etc.

NOTE: The code analysis shall be a separately bound document and submitted to the building and fire departments with the Design Development package

G. Life safety, security, and communications systems

Identify ALL life safety, security systems, and communications systems including their relationship to existing systems and capacity requirements. Include analysis of required storm shelters, warning systems, barriers, and required separations.

H. Systems load requirements

Identify design load requirements by listing all of the systems associated with a project and their proposed calculated demand and contributing loading requirements.

NOTE: The support data and calculations for this summary shall be located in a separate section or volume of the design analysis. These systems shall include but are not limited to gray water, potable water, storm water (surface and piped), dirty water, fire protection water, sewage conveyance, electrical power, natural gas, communications, fire alarm, paging, security, lightning protection, cathodic protection, roadways, exit corridors, etc.

I. Design alternatives

Define design alternatives in an effort to explore potentials for improvements in the design and/or to accommodate potential future growth, expansion, or upgrade. Prepare a written description and analysis of the design alternatives for all or portions of the facilities and systems of the project. Review and analyze the potential of the following:

1. Alternate layouts, sizes, locations, and geometry
2. Alternate materials with varying sizes and properties
3. Alternate operation and maintenance requirements
4. Alternate design requirements, i.e., code standards and loading criteria
5. Opportunity to provide initial rough-in or substrate to provide for and accommodate future expansion, growth, or upgrade
6. Schedule impacts
7. Cost analysis of alternatives, including lifecycle

J. Costs and budget

Provide cost estimates for the construction project in compliance with Chapter 30, Construction Cost Estimates. Account for discrepancies, and propose design and budget alternatives to reconcile differences between cost and budget.

K. Value engineering

As part of a contract, assist the Owner in completing value-engineering studies as required to evaluate design alternatives by comparing performance criteria with initial and operating costs, scheduling, and load evaluations. If the project is federally funded, the Developer shall adhere to federal value engineering guidelines.

L. List of equipment and long lead items

The Developer shall prepare a list of all long-lead-time items for each project for which procurement activity must be accelerated. In the event that long-lead items are to be procured in advance of completion of Construction Documents for the individual projects, the Developer shall prepare procurement specifications, exhibits, schedules, and contract procurement documents. Included shall be a list and description identifying all major equipment, fixtures, systems, software, or accessories for the project that must be procured. Include any equipment, which the Owner has notified the Developer it will furnish, and any equipment and systems that Tenant has notified the Owner that the Tenant will furnish.

M. Critical construction/request for proposal activities

The Developer shall prepare a list of critical construction and manufacturing activities for the design-build projects that it will observe and monitor during the construction administration phase, which is described in Chapter 8 Construction Administration. These activities shall also be identified in the Construction Documents.

N. Independent testing laboratory report

The Developer shall provide during the design development and the construction document phase a matrix indicating the type, quantity, and quality of tests required by an independent testing laboratory acting as agent of the Developer during construction. The matrix rows shall correlate to technical specification divisions of work. The matrix columns shall identify from left to right the following:

1. Specification division
2. Specification division title
3. System or material to be tested
4. Type of test
5. Quantity of tests

   The quantity of tests is to be identified as actual number of tests, not as a percentage of the work.

O. Contract Data Submittal Report (CDSR)

The Developer shall prepare a CDSR report for each construction and/or procurement Contract Document package prepared. The CDSR shall be provided initially at the preliminary design phase or 60% construction document submittal and with subsequent document submittals up to and including the issue for construction. The CDSR shall identify each submittal and acceptance required, including, but not limited to, required test reports, submittals for the design-build contracts, and analyses by the Developers during the duration of the work from construction notice-to-proceed to final completion. The report format shall include the following in columns from left to right

1. Contract specification section number
2. Paragraph number
3. Submittal description
4. Related sections
5. Number of samples
6. Format of Developer's submittal

P. Cut sheets

Provide the specifications with cut sheets of all specified items and alternates at the end of each section. Annotate at the top right of each cut sheet the paragraph in the specification section where the cut sheet is applicable. The cut sheets shall be current as supplied to the Developer during the design phase. It is the Developer’s responsibility and liability that the items specified (up and until the date of advertisement) are available on the market. Specifications containing specific manufacturer products are not acceptable.

Q. Soils report

The soils report shall be reviewed and commented upon in writing by the Developer and all subconsultants. The final design analysis shall include a written review by the Soils Consultant. This review shall contain geotechnical recommendations applicable to the project.

R. Property loss prevention

FM Global has developed Loss Prevention Data Sheets that are guidelines to help reduce the change of property loss due to fire, weather conditions, and failure of electrical or mechanical equipment. The Developer is not responsible for producing the Loss Prevention Property Loss Prevention Data Sheets

or report, but may need to assist the Owner with some technical product data or calculations to validate applicability to the project.

S. DEN environmental review

Working in conjunction with the DEN Environmental Services Section, the Developer is responsible to insure that design of the project is done in compliance with all federal, state, local, and DEN environmental regulations. The Environmental Services Section shall assist the Developer with design reviews to determine compliance. Following the development of the project parameters, the Developer shall initiate the Environmental Planning Checklist for review and comment by the DEN Environmental Services Section. These comments shall outline Developer's requirements for environmental compliance and design development document compliance.

T. Leadership in Energy and Environmental Design (LEED)

The Developer shall review the current LEED rating system and develop design strategies for maximizing the project's energy efficiency. Following the LEED rating system, the Developer and the City shall determine which level of LEED Green Building Certification is achievable for the project. Following this decision, the Developer shall tailor the design documents to achieve this certification. The LEED rating system document can be obtained at the following website, http://www.usgbc.org

U. Executive Order 123 compliance

Developer shall comply with the terms and conditions of the Contract Documents.

303.3 Calculations

This section of the DAR shall be divided by design discipline. Separate volumes of the DARs may be provided depending on the amount of documentation. This section shall contain copies of all design calculations from which design decisions were made.

A. Identify load capacity requirements for all systems. This shall include the following:

1. Loads of the systems designed for the project
2. Demand or contributory loads of the project systems
3. Provide engineering load requirements, design criteria involved with design work, and assumptions made to determine sizes, capacities, etc., of systems
4. Identify each page with the project title and location
5. Present calculations in clear and legible form incorporating a tabulation showing all design loads and conditions, formulas, and references
6. Explain assumptions and conclusions shall be explained
7. Ensure cross-referencing is clear

When automated data processing is used, indicate the type of software used for the design analysis and include description of design methods, including assumptions, theories, and technical formulas employed. This description shall be sufficient to verify the validity of methods, assumptions, theories, and formulas, but shall not require source code documentation or otherwise compromise proprietary programs.

Submit calculations and designs performed on computers with:

B. Complete input schematic diagrams provided and clearly labeled

C. Complete input data file clearly labeled and defined

D. Complete output data file clearly labeled and defined

E. Provide a CD or DVD of the original computerized input and output data in Microsoft Office format or other electronic format approved by the Project Manager

If a standard design or other design is being site adapted and a design analysis exists, the analysis for the new project shall include appropriate material from the existing analysis modified to incorporate site adaptations and other essential requirements.

303.4 Design Calculations

A. Database

Identify available architectural and engineering data that will be used to design the projects. This shall include a description of all major building systems, including, but not limited to, mechanical, electrical, communications, structural, foundations, plumbing, life safety, FIDS/BIDS, public address, fire protection, security, fire alarm, fiber optics, materials handling, signage, and any other required building systems.

B. General

The following is the guideline for the minimum requirements in developing calculations. Variations due to Special Conditions may be necessary and will be addressed by the Owner when the Developer submits the quality control program for acceptance. The procedure provides a definitive method of preparing, checking, reviewing, controlling, and retaining engineering calculations. The Developer shall have a Quality Control Program in place. All disciplines shall be included in the calculations portion of the DAR.

C. Scope

The accepted procedures shall be used by the Developer for calculations prepared for project use. This procedure applies to calculations that establish design systems, dimensions, or other major parameters used for engineering design output documents prepared by the Developer. This procedure also applies to checking documents to conform to the DEN BIM standards. The calculations shall include but not be limited to:

1. Infrastructure support systems: geometry, loads, and schedules

   Roads

      Traffic patterns and volumes, emergency access, traffic controls, and signaling

   Utilities

      Electrical power, gas, communications, sanitary, storm water, and gray water, storm water flow, snow removal and storage, ground water quality, and environmental controls

2. Civil systems

   Landscaping area, irrigation loads and controls

   Erosion controls

3. Building systems

   Occupancy and area calculations

   Structural load requirements by code

   Hazard area diagrams and calculations

   Code analysis

      Plan drawings indicating new and existing occupancy types, occupancy numbers, exiting directions and load tabulations, egress widths and ratings of separations.

      NOTE: This document shall be submitted to code agencies as a supplement to drawings.

   Soils and structural support analysis

   Structural systems analysis including vibration control

   Mechanical systems analysis including noise and vibration analysis

   Electrical systems analysis including cathodic protection of utilities, heat gains, and harmonics

   Plumbing systems analysis

   Fire protection systems analysis

Communications systems analysis

Horizontal and vertical people movers

Material conveyance systems

303.5 Instructions

Each calculation shall include a list of the basic criteria. These include design assumptions, applicable codes, standards, and references. Major equation sources shall also be listed as well as computer program names and sources used. The source of formula, equation, input data, or assumption and derivation of all uncommon equations should be shown when they are introduced into the calculation.

A. Design assumptions shall be stated so that they may be understood by the checker. Assumptions will be required in the event it becomes necessary to revise calculations or to make them available to outside parties.

B. Established design criteria and previously developed and accepted design methods and solutions should be used as guidelines and identified as the source. The applicability of existing solutions to new problems will be determined before such design methods or solutions are adopted.

C. Calculations shall be orderly and complete with enough sketches and notes so that the work can be understood. Diagrams indicating data (such as loads, flows, voltages, and dimensions) shall be included along with adequate details not considered standard.

D. A flow sample flowchart depicting the preparation and checking of calculations shall be submitted to the Owner prior to the start of calculations.

E. The calculations for each project shall be numbered with respect to the project number system as defined by the Owner.

F. Calculations shall be made on standard 8-1/2" x 11" calculation sheets. The heading of each sheet in the set of calculations shall be completely filled in with the date, designer's name or initials, checker's name or initials, project name, calculations, sheet number, job number, and subject of calculation.

G. When calculations are based upon preliminary data for early implementation of the work, such calculations shall be subjected to the complete review procedure and the responsible engineer/architect shall assure a final calculation check is made as soon as final data are available. Calculations that are the basis for establishing design criteria, dimensions, or other major parameters shall be checked and submitted to the responsible design professional for review and acceptance in accordance with this procedure.

H. The calculations involving computer printouts shall have an accompanying calculation package containing the appropriate information as outlined above. Computer printouts should be cross-referenced to their corresponding calculation package and printouts shall be labeled and filed in the same manner as the hand calculations.

I. Project originated computer programs shall have a flow diagram, sample calculation, and complete description of the program. In those cases where a sample calculation is not practical, other acceptable verification shall be used.

J. The calculation package for a standard computer program output shall consist of a completed cover sheet and a complete outline of the problem, including sketches, if applicable. The user’s manual is the prime source of information.

K. When calculations are based upon preliminary data for early implementation of the work, such calculations shall be subjected to the complete review procedure, and the responsible Engineer/Architect shall assure a final calculation check is made as soon as final input data are available.

303.6 Developer Quality Control of Calculations

The Developer shall have in place a quality control program that includes checking of calculations by independent parties or parties other than the individuals/computers performing the calculations. The responsible designer shall review all design calculations prepared by his group for technical adequacy and conformance with design

requirements. Preliminary calculations shall be reviewed and initialed by the responsible designer and shall clearly be marked **PRELIMINARY**. Final calculations submitted shall carry the stamp, seal, and signature of the respective Consultant. All design calculations shall be checked by a design professional who has a level of design qualifications at least sufficient to originate the calculation. The checker shall not be the originator of the calculations.

A. After verifying the basis of a calculation, the checker has the option of performing a mathematical check of verifying the calculation by an alternate means. Approximation methods may be adequate for checking. The checker shall be responsible for the following activities:

   1. Checking calculations against the design drawing to verify whether they conform to specified configurations, dimensions, and materials.

   2. Checking calculations for assumptions, analytical methods, mathematical accuracy, completeness, compliance with design criteria, and the adequacy of design.

   3. Initial and date each page of the original calculations after they are completely checked and all necessary corrections and additions have been made, or attach initialed alternate calculations, if used.

   4. Sign-off on cover sheet. A Colorado licensed engineer shall seal calculations.

B. The checker shall assure that the following actions are taken for checking computer calculations

   1. Check the calculation package accompanying the computer printout checked in accordance with these procedures.

   2. For project originated computer programs, check the computer listing for assumptions, program theory, compliance with the flow diagram, and overall correctness.

   3. For standard computer programs, check to assure applicability of the program and assumptions made.

   4. Regardless of the computer program used, check all input data for correctness, as well as the application of output data.

   5. Provide checker sign-off on cover sheet. A Colorado licensed engineer shall seal calculations.

   6. Calculations performed by staff personnel, specialist groups, suppliers, and service agencies shall be reviewed and subject to acceptance by the Owner. The Developer is liable for the constructability and the function of the system designed.

C. Revisions to calculations

   1. For revisions to calculations, including superseding calculations, the same checking procedures shall be used for the revised calculations as for the original calculations.

   2. All parts of the complete calculation, which are dependent on the revision, shall be checked and the complete original calculation shall be reviewed to determine which parts are dependent. It is not necessary to recheck parts that are independent of the revision. Results of calculation revisions shall be made known to others who may be affected.

   3. In making revisions, including handling superseded calculations, records shall always be maintained of the original calculations, and they shall be identified as being superseded by being crossed-out and marked **SUPERSEDED**. New calculation sheets shall be prepared for all such superseding calculations. Exceptions may be made to preparing new sheets where the change is minor in nature and where the designer authorizes a cross out by initialing the change. In this case, it shall nevertheless be subject to all other revision procedures, and the change shall be identified with a revision number on the calculation cover sheet.

   4. The originals of the design calculations for each discipline and specialty group shall be kept in a calculation binder that is part of the DAR in each discipline's files that serve as the master project calculation file for reference. Calculations shall be separated into groups: preliminary, final, and superseded. These shall be identified by discipline or specialty group and shall include an index in each one. Pertinent Consultant and supplier calculations, designs, data, and all checks performed shall be kept with the appropriate technical file.

5. Calculations and computer printouts shall not be removed from their binder except when they are revised or reproduced. When calculation binders are removed from files, an **OUT** card shall be inserted in its place indicating what calculations were removed, when, and by whom.

303.7 Appendix

The appendices shall include, if applicable, cost estimates, outline specifications, data reports, product data, conference minutes, and pertinent correspondence relative to the design and referenced in other sections. Each appendix shall be provided with a title page and table of contents (index). Pages shall be numbered consecutively for each appendix and identified in the table of contents. Cross-referencing shall be clear. Assumptions and conclusions shall be explained.

Section 304 - FAA

For projects requiring FAA review, the Developer shall adhere to the following outline when addressing requirements in Requirements of the Final Design Report.

1. Design Analysis

   Airport Layout Considerations
   - Airport Layout Plan (ALP) and Master Plan Conference
   - FAA AGIS Requirements for AIP/PFC Projects
   - FAA AC150/5300-16-1 7-18 for Spatial Data Submittal to FAA
   - Dimensional Standards, FAR Part 77 Clearances

   Soils and Grading
   - Soil Profile and Test Results (Utilize Unified Soil Classification System)
   - Internal Drainage and Frost Conditions
   - Field and/or Laboratory CBR Test Results
   - Cut and Fill, Borrow Considerations, Waste
   - Special Compaction Requirements
   - Expansive Soil Problems

   Drainage
   - Rainfall and Runoff Data
   - Capacity and Structure Design
   - Ponding, Erosion Control, Extraordinary Features

   Pavements
   - Design Loading Basis - Critical Aircraft or Fleet of Aircraft
   - Existing Pavements
   - Material Types and Sources, Joint Design
   - Alternate Construction
   - Cost Comparison
   - Advantages/Disadvantages of Each
   - Recycling of Existing Material
   - Consideration of Fly ash in PCC Pavements
   - Modifications to Standard FAA Specifications
   - Seal Coat Justification
   - Pavement Design Form FAA 5100-1

   Lighting and Navaids
   - Existing Cable and Equipment Conditions Including Circuit Loads and Resistance to Ground Readings
   - Power Supply Sources
   - Counterpoise and Grounding
   - New Equipment, Equipment Housing, New Circuit Loads, Electrical Designs
   - Precision Approach Path Indicators (PAPI) Location and Threshold Crossing Height Calculations

2. Cost Estimates

   Quantities, Unit Costs, and Labor
   Special Considerations (Competition, Labor and Material Availability)

3. Project Schedule

   Time Constraints, Liquidated Damages
   Critical Completion Dates
   Recommended Schedule

4. Proposed Waiver to Standards

End of Chapter

Chapter 4 – Schematic Design Phase (30%)

Section 400 - Schematic Design Phase

Based upon information and data in the accepted design analysis programming submittal (if available), which will be reviewed periodically by the Owner, and/or the project SOW, the Developer shall perform field investigations and other design services and prepare the schematic design.

Section 401 - Engineering Surveys and Soils Investigations

401.1 Site Survey

The Developer shall perform on-site surveys to establish accurate dimensioned location information and to establish existing and proposed facilities. Surveys shall be performed in accordance with DEN survey standards.

401.2 Soils Investigations

The Developer shall conduct engineering surveys and soils investigations, which are required to complete the design of the projects.

Section 402 - Design and Construction Alternatives

Prepare written descriptions, analyses, and evaluations of alternative concepts and/or design/construction methods. Include Developer's recommendations of the alternatives.

402.1 Cost Estimates

Provide cost estimates, if applicable, consistent with requirements as detailed in the Contract Documents.

Section 403 - Schematic Design Documents

403.1 Schematic Design Drawings

The Developer shall prepare drawings, which are in sufficient detail to illustrate design concepts, systems concepts, interfaces, scale, and relationships. The drawings shall identify all project components, systems, circulation, and access, including, but not limited to, site plans, aircraft parking plans, interior elevations, sections, floor plans that include access locations and passenger circulation patterns, mechanical/electrical design concepts, process flow diagrams, schematic space and general arrangement plans, building systems, emergency exiting plans, and building elevations and sections with overall dimensions. Drawings shall illustrate alternate solutions and preferred options.

403.2 Minimum Requirements

At a minimum, the schematic design documents shall define the following:

A. Organization’s functional relationships that effect facility planning

B. Building and site circulation

C. Facility massing and scale

D. Conceptual appearance

E. Project environmental context

F. Basic exterior and interior finish material and product concepts

G. Conceptual structural, mechanical, and electrical systems

H. Circulation/conveying systems, if applicable

403.3 Initial Schematic Design Submittal

The initial submittal should be limited to small-scale block diagrams illustrating basic functional groupings with horizontal and vertical circulation to confirm these fundamental design concepts. If there are repetitive modules, e.g., hotel guestrooms or prototype offices, include a larger-scale ½" per 1' study of the module.

Drawing scales should be small, e.g., the site plan should be at same scale as the survey and single line block diagrams and building sections should be at a 1/32" or 1/16" per 1' scale.

The initial schematic design submittal should include:

A. Site plans

Indicate orientation, site use, demolition, structure's placement, facilities development, circulation and parking, utility systems also showing with existing utilities, landscape and hardscape concepts, and forms.

B. Block diagrams (floor plans)

One for each proposed level; group repetitive levels.

C. Sections

At least two perpendicular to each other at the same scale as the block diagrams to establish vertical control.

D. Exterior elevations

Block outs to illustrate massing and context.

E. Image sketches

Sketches of the site and its overall development.

403.4 Final Schematic Design Submittal

The final schematic design submittal shall establish the conceptual design of the project illustrating the scale and relationship of the project components. This submittal further develops the initial previous submittals.

The final schematic design submittal should include:

A. Site plans shall indicate vehicle circulation for normal and emergency traffic and shall indicate accessible routes.

B. Floor plans shall indicate accessible routes. Provide a plan for each proposed level; repetitive levels may be grouped. Establish horizontal control.

C. Exit plans shall use the same scale as the floor plans.

D. Floor plans of typical repetitive components: At ¼" per 1' scale with their interior elevation studies, (as appropriate) at the same scale.

E. Building sections shall include at least two perpendicular to each other at the same scale as the floor plans. Establish vertical control.

F. Exterior elevations shall use the same scale as the floor plans.

G. Structural framing plans shall use the same scale as the architectural floor plans showing primary vertical and horizontal structure.

H. HVAC plans shall use the same scale as the architectural floor plans showing proposed distribution for primary vertical and horizontal HVAC systems, including shafts and schematic arrangement of primary equipment.

I. Plumbing plans shall use the same scale as architectural floor plans showing primary plumbing risers, chases, fire service risers, roof drains, and overflows with storm water leaders, and proposed primary horizontal distribution, including location and schematic arrangement of primary equipment.

J. Electrical plans shall use the same scale as the architectural floor plans showing vertical and horizontal electrical primary and stand-by power and communication distribution, including locations and schematic arrangement of primary equipment, switchboards, and panel boards.

403.5 Basis of Design

The Developer shall summarize the basis of design in the DAR, which outlines the project opportunities and constraints. The summary shall also describe all applicable zoning regulations and building codes that affect the project. The summary shall outline all record of major design decisions.

The summary basis of design should be formatted as follows:

A. Introduction

A brief description of the project scope and purpose, data sources, and contents

B. Part 1 – Goals

The architect's understanding of the owner's project objectives stated in terms of function, form, quantity, quality, economy, and time

C. Part 2 – Facts

Identify pertinent data, laws, ordinances, regulations, and jurisdictional agency requirements that influence or control the design, permitting, or construction processes. Include site analysis, a summary of planning, zoning, building, mechanical and electrical codes, standards, and environmental and archaeological requirements

D. Part 3 – Concepts

Criteria for implementing or achieving design goals expressed in terms of theme, image amenities, configurations, and operations (e.g., general site planning, functional organization, design, site use and development, movement systems, and the facility's structural, mechanical, and electrical systems.)

E. Part 4 – Needs

Space and functional program requirements, including a reconciliation of programmed and designed spaces at an appendix, schedule requirements, and budget requirements

F. Part 5 – Problem statement

Summary statements identifying unique and essential project design and construction criteria

G. Part 6 – Appendix

Copies of conference reports, owner's directives, relevant correspondence, figures, and graphical data referenced in the text, functional diagrams, space program reconciliation, reconciliation of programmed and designed spaces, reduced submittal drawings, and schedules.

In the preliminary project description, describe major site, architectural, structural, mechanical, plumbing, fire protection, and electrical systems with proposed construction products and materials; include off-site improvements, if applicable.

Prepare a project material product binder based on the design decisions reflected by the schematics, arranged initially into each of the divisions of the DEN Technical Specifications. File all product and material data in the binder as they are selected for the project use.

403.6 Design Analysis

The Developer shall submit a DAR as defined in Chapter 3, Design Analysis Report.

Section 404 - Study Models and Perspectives

Study models and perspectives shall be provided if identified in the approved project or task scope. The Developer shall prepare rough, to-scale models, and/or interior and exterior perspective renderings or isometric views of areas of each project or portions of the project where the Owner and Developer agree that the relationship of building components is difficult to study and to evaluate two-dimensionally.

Section 405 - Submittal Requirements

The Developer shall comply with Chapter 32, Submittals for submittal requirements.

End of Chapter

Chapter 5 – Design Development (60%)

Section 500 - Design Development

Based upon the accepted schematic design documents reviewed and accepted by the Owner, the Developer shall prepare design development documents that establish and describe the size, scope, character, material composition, systems, sequence of operation/control, and other features of each project by means of plans, sections and elevations, typical construction details, three dimensional sketches, study models, and equipment layouts, including specifications that identify major materials and systems and establish in general their quality levels. These Documents shall include DAR for the design development phase, technical specifications, and construction/procurement Construction Documents.

The Developer shall meet with the Owner before the Developer proceeds with design development and review the submittal requirements that apply to each project. These documents, which are described in more detail below, shall be submitted to the Owner for review and acceptance in accordance with the information in Chapter 32, Submittals.

Section 501 - Design Development Drawings/BIM Models

Design development drawings/BIM models shall be developed in sufficient detail to define the location, character, material composition, scope, and size of each project; to identify potential problem areas associated with completing each project; and to describe proposed solutions to the problems. These drawings/models shall provide overall dimensions, code required dimensions and clearances, spot elevations and dimensions of existing and adjacent elements, and shall conform to the DEN design standards. A select sampling to be selected by the Owner of each discipline from the final design development drawings for each project must be submitted in Revit and/or AutoCAD Civil 3D format. Refer to *BIM Design Standards Manual*.

501.1 Plans

Building plans, enlarged partial plans, building sections, enlarged wall sections, exterior and interior details, reflected ceiling plans, elevations, aircraft parking plan, site plan, study perspectives, and study models (non-returnable) showing all building spaces, and relationships. The drawings shall fully illustrate all constructed areas, space planning and component sizes, scope, systems, interfaces, spaces, functions, general materials, and finishes. The Developer shall prepare a set of presentation drawings and material/color sample finish boards of all interior and exterior materials, per the Executive Design Review.. The presentation boards are property of the Owner and shall not be returned to the Developer. The sample boards shall, illustrate as closely as possible, the material in similar ratios, as they would appear to each other, in the project.

In addition to the structural, mechanical, and electrical components, the submittal should also include the same level of information for civil, landscape/hardscape,

Using the approved schematic design documents as a basis for continuing project development, design development decisions, and their documentation would include:

A. All site improvements with building footprints by design discipline, e.g., civil, landscape/waterscape/irrigation, site utilities, and electrical

B. Subdivision of all interior spaces with built-in fixtures and equipment, room names and numbers, wall and partition types, ceiling heights, and all openings, i.e., door, window, and louver

C. Architectural finishes, including preliminary room finish and color schedule (applied colors may be incomplete)

D. Interior and exterior opening schedules, i.e., door, window, window wall storefront, all-glass, interior glazed partitions, and louvers with material and finishes

E. Toilet accessories and their locations (an item-by-item schedule by location) with subschedules (typical plans showing locations and elevations showing mounting heights)

F. Toilet partition types and supports

G. Casework and countertop locations, profiles, configurations, and materials

H. Architectural woodwork locations, profiles, and materials

I. Glass-fiber reinforced concrete and glass fiber reinforced gypsum locations and profiles

J. Building specialties with their locations/configurations, associated equipment/appliances, and furnishings

K. Exterior horizontal and vertical closure and roofing systems

L. Exterior horizontal and vertical waterproofing

M. Foundation drainage and its connection to site drainage systems

N. Foundation, excavation, and backfill criteria

O. Horizontal and vertical circulation, including trash or linen chutes, their fire ratings, and their ancillary and equipment spaces

P. Fire-resistive assemblies and their locations

Q. Sound-rated assemblies, including operable partitions, and their locations

R. Horizontal and vertical structural systems, including sizes and fire-resistive requirements

S. Plumbing fixtures, including trim, and plumbing risers

T. HVAC systems, including their locations, sizes and locations of intakes and discharges, and sizes and locations of individual equipment

U. Electrical fixtures, including trim and allowance fixtures

V. Electrical power systems, including transformers, switch gear, UPS equipment, emergency or stand-by generators, and primary distribution, such as panel board locations.

W. Cable TV, security, communications, fire alarm, smoke control, and sound system, including terminal and equipment locations

X. Symbolic identification of what will not be provided under the construction contract, i.e., what will be owner furnished but Developer installed and what will be owner furnished and owner installed, such as, not-in-contract

Y. All drawing sheets, regardless of discipline, should have the same orientation. Architectural, structural, mechanical, and electrical floor plans should be drawn at the same scale.

Minimum design development submittal items shall include the following:

A. Drawings should be organized for subsequent use as Contract Document drawings. Include title sheets with zoning, building, fire, life safety, plumbing, mechanical and electrical code summaries, and calculations; area and location maps; and a drawing index.

B. Architectural drawings should include abbreviations, symbols, legends, room material code index, and general notes.

C. Architectural site plan with cross-reference notes to work documented by other disciplines

D. Key floor plans

E. Exit plans with exit load calculations

F. Accessible route plans

G. Floor plans with room names, room numbers, room material codes (if used), wall and partition type indications, ceiling heights, openings (i.e., door, window, and louver locations with symbols), plumbing fixture locations, casework, collateral equipment, building specialties, shafts, chases, suspended slab openings, and depressed slab locations

H. Reflected ceiling plans with light fixture locations and ceiling materials; coffers, vaults, domes, and other special construction; and operable partitions

I. Roof plans showing all equipment locations, penetrations, slopes, and drainage

J. Interior elevations

K. Building sections

L. Exterior elevations

M. Exterior wall sections

N. Vertical circulation, including elevator hoistways, escalators, stairs, and chutes

O. Preliminary opening schedules (e.g., door, window, and louver) and all-glass, glazed partition schedules, with sizes, types, construction, finishes, hardware, frame types, and fire ratings

P. Wall and partition schedules

Q. Preliminary architectural finish and color schedules-applied finish colors may be omitted at this phase (If an interior designer is involved, ensure that the architectural room finish schedule differentiates between architecturally selected finishes and interior designer selected finishes; indicate where interior designer finishes are documented.)

R. Conventional and accessible toilet accessory schedules with fixture-related mounting locations and heights

501.2 Civil and Infrastructure

Grading, drainage, paving, fencing, and erosion control plans including existing contours, final contours, horizontal and vertical clearances, storm sewer and water lines, drainage structures, and details of special structures.

Civil drawings (if part of the Developer's services or if coordinated by the Developer) should include:

A. Site development plan (horizontal control)

B. Site grading plan (vertical control)

C. Pavements, parking, and roadways plan

D. Storm water Management Plan (SWMP)

E. Site utilities plan, including above and below ground utilities, points of connection to off-site services, buildings, and facilities. Show existing utilities at halftone-separate sheets by system if the project involves expansion of existing facilities or new construction on an already developed site.

F. Landscape/hardscape/waterscape drawings (if part of the Developer’s services or if coordinated by the Developer) should include site landscape and related plans, including planting, lighting, landscape, hardscape, waterscapes, pump rooms, and related features; street or site furniture; and recreation elements and their supporting facilities.

501.3 Structural Drawings

Structural drawings including, but not limited to foundation plan, caisson plan, excavation details, nominal sizes, types and cross-sections of structural members and systems, critical structural clearances, interfaces, modifications to the base building structural systems, and details necessary to define the structural system.

Structural drawings should include:

A. General notes (do not duplicate information in specifications and vice-versa)

B. Floor plans showing structural foundation systems and sub-slab construction, horizontal and vertical framing systems showing slab (or equivalent) edges, suspended slab openings, depressed slab locations, lateral load cross bracing, and typical construction details; Final structural design criteria; foundation design criteria; preliminary sizing of major structural components; critical coordination clearances; outline specifications or materials list

501.4 Systems Drawings

Systems drawings which define mechanical and electrical systems, including, but not limited to, HVAC, plumbing, fire protection, fire alarm, life safety, security, power, fiber optics, communications, gate facilities distribution, fueling,

lighting, automated materials handling, grounding, lightning protection systems and other special systems which are appropriate for the projects.

Mechanical drawings should include:

A. Floor plans showing major plant equipment sizes and locations, heating and refrigerant supplies and returns, domestic hot and cold water supplies and returns, air-handling equipment locations and air-handling distribution, air-handling supply systems and discharge locations and sizes, air-handling exhaust systems and intake locations and sizes, shafts and chases, plumbing fixture locations with fixtures keyed to plumbing fixture schedule (include fixtures and trim selected by third parties, such as interior designers), and plumbing risers

B. Fire suppression water shut-offs, controls, risers, and horizontal distribution, or zones for horizontal distribution if systems will be design-build

C. Detailed plumbing, HVAC, other plumbing and mechanical systems, and fire suppression systems at typical repetitive elements

D. Site plans showing connection points for water, fire service, sanitary sewer, storm sewer, chilled water supply, and return

E. Additional requirements as outlined in *Mechanical Design Standards Manual*

F. Integration of DEN master system diagrams, e.g., smoke control, fire protection, hydronic flow, electrical one-line, etc.

Electrical systems drawings should include:

A. Floor plans showing major plant equipment locations and sizes; electrical power systems, including transformers, switch gear, UPS equipment, emergency generators, and primary distribution, including panel boards; and cable TV, security, communications, fire alarm and control, and sound systems, including equipment locations and sizes

B. Detailed electrical power, lighting, communication, fire alarm, and sound systems (extensions of/or connections existing fire alarm, sound systems security CCTV, flight information display systems or baggage information display systems must show exact points of connection to the existing systems

C. Vertical and horizontal distribution schematics, including all riser or chase locations

D. Additional requirements as outlined in Chapter 21, Electrical Drawings

The Developer shall prepare site plans showing lighting and site power locations, service locations and sizes, including landscape and lighting locations, if applicable.

501.5 Alternatives

Analyses of alternative building utilities, building automated materials handling systems, and special systems, if applicable. The analyses shall include comparisons of construction and lifecycle costs, and operational and maintenance advantages and disadvantages of the systems.

501.6 Security

Provide plans, operational procedures, and installation details for a complete security system.

501.7 Signage and Graphics

Plans, sections, schedules, elevations, and detail drawings of building public signage and graphics including, but not limited to, Tenant requested changes to base building signage/graphics locations and selective demolition plans.

Signage and graphics (if a part of the Developer's services or to be coordinated by the Developer) should include floor plans and elevations of signage and graphics showing their size, fastenings, and atypical and typical mounting details, illumination/electrical power requirements, etc.

501.8 Interface Drawings

Plans which show system and facility interfaces with related and adjacent projects and which identify the boundaries or contract limits for the Developer's SOW and the work performed by other Consultants and design-build Contractors, who are designing portions of DEN that are adjacent to, interface with, or which would be affected by the Developer's SOW.

Interiors drawings (if part of the Developer's services or if coordinated by the Developer) should include:

A. Floor plans showing floor finishes and patterns and furniture, fixture, and equipment layouts, including special interior features (e.g., flight information display system kiosk, baggage information display system kiosk, electronic ticketing kiosk, built-in and free standing items, such as automated teller machines, internet kiosk, public art pieces.)

B. Interior elevations with finish materials

C. Interior window treatments

D. Interior finish information as required to complete architectural design development documentation

E. Interior decorative lighting, fixture locations, and selection (unless allowance items)

501.9 Standard Drawings

Developer shall include standard drawings, including, but not limited to, those furnished by the Owner, the Owner’s Consultant, the Tenant, or the Tenant's Consultants.

501.10 Demolition

Demolition documents identifying the extent of demolition required prior to, or in conjunction with, the start of construction. Demolition documents shall include all systems demolition or systems to be capped off and abandoned. Demolition safety plan as required by the Project Manager.

501.11 Envelope

The design and location of complete and functional enclosure of all building spaces.

501.12 Art Program

Plans for incorporating the City's Art Program into the project.

In preparing these plans, the Developer shall adhere to the requirements of the City's Art Program, which meets the requirements of Executive Order No. 92, for incorporation of the artist's works that are consistent with design standards for each project. Consideration must be given to lighting, structural systems, power, fire protection systems, finishes, and security. The Developer shall periodically review its design for each project with the City's Art Program Manager.

Section 502 - Preliminary Technical Specifications

The Developer shall prepare a complete set of Technical Specifications for the project in a format accepted by the Owner. An outline of the Division 01 - General Requirements Technical Specifications will be furnished by the Owner and shall be reviewed and commented on by the Developer. Comments shall be submitted to the Owner in written form.

DEN’s Division 1 - General Requirements, as agreed upon by GHP and DEN, will apply for both the O&M Segment and the Non-O&M Segment.

DEN’s Divisions 2-33 of the construction specifications will apply for the Non-O&M Segment.

DEN's Divisions 2-33 will not be mandatory to apply for the O&M Segment unless noted otherwise in Part II of the Technical Requirements.

The Developer shall comply with Chapter 11, Specifications .

Section 503 - Design Development Design Analysis Report

The Developer shall comply with Chapter 3, Design Analysis Report.

Section 504 - Submittal Requirements

The Developer shall comply with Chapter 32, Submittals.

End of Chapter

Chapter 6 – Construction Documents (90% CD and 100% IFR)

Section 600 - Construction Documents

600.1 Intent

The intent of the Construction Documents is to include all items necessary for the proper execution and completion of the construction work. Prior to beginning the Construction Documents phase, the Developer shall completely familiarize all of the team members with the most current version of the *Standard Specifications for Construction, General Contract Conditions* (GCC)*, 2011 edition* published by the City and County of Denver, 2011 including Special Conditions. The individual documents comprising the Construction Documents are all essential parts of the Contract and a requirement occurring in one is binding as though occurring in all. They are complementary, and indicate the construction and completion of the work. Anything mentioned in the technical specifications and not shown on the Contract drawings, or shown on the Contract drawings and not mentioned in the technical specifications, shall be of like effect as if shown or mentioned in both.

Referenced Standards

Material and workmanship specified by the number, symbol, or title of a referenced standard shall comply with the latest edition or revision and amendments and supplements thereto in effect on the date the Contract Documents are executed, except where a particular issue or edition of a publication is indicated.

600.2 Precedence of Construction Documents

A. Technical specifications:

Technical specifications shall be given precedence over Contract drawings. This condition dictates that the Developer not repeat in the drawings, annotations in the specifications. This condition also does NOT relieve the Developer from completely and accurately coordinating dimensional and product profiles/illustration on the drawings. If alternate products are specified, the larger of the acceptable products shall be illustrated on the drawings.

B. Larger scale drawings

Large-scale drawings shall be given precedence over smaller scale drawings, for example: 1" =1' is larger scale than 1"=40' and 1"=1' is larger scale than 1/8"=1'. This requirement in no way relieves the Developer from the liability of accurate coordination of dimensions between small and large-scale drawings.

C. Conflict or inconsistency

In the event of conflict or inconsistency between provisions of the technical specifications, the more stringent shall be given precedence over the less stringent. This requirement in no way relieves the Developer from the liability of coordinating all aspects of the specifications, including Division 01 - General Requirements.

600.3 Scope of Work

The Scope of Work is identified in the Contract Documents.

Section 601 - Trademarks, Copyrights and Patented Devices, Materials, and Processes

See Contract Documents.

601.1 Notification by Developer

If the Construction Documents require the Developer to use any design, device, material, or process covered by letters, patents, copyrights, trademarks, or artists, the Developer shall provide written notification to the Owner of any requirement for such use and shall procure suitable written acceptance with the patentee or patent owner, copyright owner, or trademark owner, which agreement shall provide that there will be no future or continuing royalties or payments by the Developer or by the Owner. For example, the Developer may not publish as part of the Construction Documents, copies of designs, shop drawings or materials by Contractors, designers, or suppliers without written authorization from that Contractor, designer, or supplier.

601.2 Disclosure

If the Construction Documents require use of a particular design, device, material, or process, the Construction Documents shall disclose the existence of any letters, patents, copyrights, or trademarks covering it.

601.3 Liability

The Developer need not indemnify against the negligence of the City, its officers or employees, or against claims for infringement of letters, patents, copyrights, or trademarks required by the Contract but neither disclosed in the Construction Documents nor apparent by virtue of common knowledge in the construction industry.

Section 602 - Construction Documents, Technical Specifications, and Technical Reports

602.1 Construction Documents

Based upon design development documents that have been reviewed by the Owner, the Developer shall prepare complete construction documents and shall provide the following:

A. Agency and utilities applications and permits

B. Final DARs

C. Contract Data Submittal Requirements (CDSR) report

D. Geotechnical study

Section 603 - Submittal Requirements

The Developer shall comply with Chapter 32, Submittals.

Section 604 - System Compatibility

As project systems are refined and operational requirements are defined that require interface between the project and DEN systems. The Developer shall specify system controls that are compatible with existing DEN control systems, including, but not limited to: electrical, lighting controls, mechanical controls, fire protection and detection, surveillance and security. This system compatibility shall include, but not be limited to any and all upgrades to existing systems to handle the increased existing control system responsibilities created by the addition of the systems installed with the project or task. The Developer shall identify all necessary upgrades to existing systems and provide the necessary documentation to accomplish those upgrades within the Construction Documents. The Developer shall identify the requirements for equipment and software compatibility and specify project equipment and software that will facilitate that interface.

End of Chapter

Chapter 7 – Issued for Construction (IFC) Construction Documents

Section 700 - Issued for Construction (IFC) Construction Documents

700.1 Approval

Following Owner review and approval of the (100%) Issued for Review (IFR) construction document phase submittal, and with written notification from the Owner's Project Manager, the Developer shall complete the Issued for Construction (IFC) construction documents and prepare them for distribution to the Building Department for plan review.

Section 701 - Submittal Requirements

The Developer shall comply with Chapter 32, Submittals.

Section 702 - Substitutions

702.1 Materials and Substitutions

The following is the typical language directed to the Developer.

It is often convenient and practical to specify materials and equipment to be incorporated into the work by a proprietary name or by the name of its manufacturer. When so specified and further qualified by the phrases or equal or equivalent, it shall be understood that such specification is not intended to limit the material and equipment selection process. Rather, the specification is intended to indicate a standard of quality and capability, which will be accepted. However, if the Developer desires to use materials other than the specified material, the Developer must obtain the written acceptance of DEN. All such requests for acceptance of equal or equivalent material must be made in writing and, except as hereinafter provided, be submitted to DEN. All requests for acceptance of equal or equivalent material shall contain adequate technical data to clearly demonstrate equivalency. Incomplete submittals will not be reviewed. Requests must be submitted on the form titled **CM-09 Request for Substitution** attached to the Contract Documents. Requests containing inadequate or incomplete information will not be considered.

702.2 Substitution Form

The Contract Documents contain directions and form for the Developer to use in submitting substitutions. The Developer is required to forward to DEN their requests for substitutions. DEN shall, in a timely manner, advise the Developer in writing on the acceptability of substitutions of materials, software, equipment or construction methods, including detailed written reasons for recommending or denying substitutions.

702.3 Acceptance

Acceptance of an **OR EQUAL** by DEN requires that the Developer provide the following:

A. The use of the **OR EQUAL** fulfills the specification requirements contained in the Construction Documents, and

B. The installation of the **OR EQUAL** will not affect the spatial and functional requirements for the work or the scheduling of work performed by the Owner or other Contractors.

End of Chapter

Chapter 8 – Construction and Administration

Section 800 - Inconsistencies in Documents

800.1 Notification

If the Developer, while it performs construction administration services discovers any inconsistencies improper cross-references, omissions or ambiguities in the accepted Issued for construction documents, change directives or change orders in the construction documents it shall make the required revisions to the documents at no cost to the Owner.

Section 801 - Construction and Procurement Meetings

801.1 Pre-construction Conference

Meetings shall be set by the Developer, the Owner is a mandatory invitee. The pre-construction conference is a general review with the Developer of all the Contract requirements.

801.2 Pre-work Meetings

The quality control requirements of the Contract will typically require the Developer to set up pre-work meetings on each phase of work and sometimes on each trade prior to initiation of work for that phase or trade.

801.3 Weekly Meetings

The Developer shall attend weekly construction and procurement meetings and such other construction meetings.

Section 802 - Construction Observation

802.1 Site Visits

The Developer shall conduct the site visits with the Owner or a designated representative and, prior to leaving the site, will verbally discuss with the Owner or an authorized representative any observed defects, deficiencies and other problems and possible solutions to those problems.

802.2 Fabrication and Assembly

The Developer shall visit the project sites and other sites in the Denver metropolitan area where manufacturing, assembly, fabrication, or similar activities are occurring (1) at intervals appropriate to the progress of construction/manufacturing (weekly or more frequently to the project site if necessary or if requested by the Owner), and (2) during critical construction and manufacturing processes. If the Developer's visitation to out of region project sites (Denver Metropolitan area of 5 adjacent counties) is required, the Developer shall notify the Owner of materials and system fabrication testing and shall invite the Owner to each event for observation.

Section 803 - Developer Inspection and Acceptance Reviews

803.1 Preliminary and Completion Observations

The Developer shall participate in observations to establish the completion status of each project. Participate in other observations and testing/start-up, which include completion observations of phases of the work and observations of mockups and equipment startups.

Section 804 - Review of Developer/Construction Submittals

804.1 Construction Submittal Review Process

The Developer shall submit all documents described in the Construction Documents and any other written communications to the Owner as agreed.

A. The Developer shall prepare and keep current, a log of construction submittals indicating status of construction submittals, date received, construction submittal action, and date to DEN. The construction submittal log shall be available at each construction meeting for review. The format of the log shall be as agreed by both parties.

804.2 Developer Review of Submittals

A. The Developer shall review and accept construction submittals required by the Construction Documents for conformance with the design concept of the project and the Construction Documents. These construction submittals include those listed in the Contract Data Submittal Report (CDSR), and all construction submittals shall be submitted to DEN for their information.

B. The reviewed construction submittal shall include the Developer's comments and any corrections or revisions, which are required to obtain its acceptance. Comments shall be on the construction submittal and may not be provided on separate correspondence.

C. The Developer shall not use shop drawings or construction submittals as a vehicle for making changes to the Contractors Scope, correction of design errors and omissions. Completion of the design in the Shop Drawing Process is not acceptable.

804.3 Developer Review Stamp

The Developer and all lower tier subconsultants shall use a review stamp format consistent with the Construction Documents Part I in the language of the review and the marking of the status.

The Developer shall mark, sign, and date the review; the Developer and subconsultant review stamp shall have the following marks: (The marks have the following meanings)

A. Accepted (ACC)

ACC is an acceptance, and means that the illustration and description appears to conform to the respective requirements of the Construction Documents.

B. Accepted as noted (AAN)

AAN is an acceptance, and means that the illustration and description appears to conform to the respective requirements of the Construction Documents after changes in recognition of the reviewer's comments. Construction Submittals so marked need not be resubmitted.

C. Revise and resubmit (R&R)

R&R means that the construction submittal is unacceptable and shall be revised and resubmitted.

D. Rejected (REJ)

REJ means that the construction submittal is not acceptable and that a new construction submittal in accordance with the Construction Documents shall be made.

Review of a separate item will not constitute review of an assembly in which the item functions. Review will not relieve Developer from his responsibility for accuracy of construction submittals, for conformity of construction submittal document to requirements of contract drawings and specifications, for compatibility of described product with contiguous products and the rest of the system, or for protection and completion of the contract in accordance with the contract drawings and specifications.

804.4 Review

The Developer shall review reports of Deficiencies and Non-Conformance Reports (NCRs). The purpose of these written requests is to correct deficiencies in the work.

Section 805 - Interpretation of Construction Documents

805.1 Developer Review and Response

The Developer shall, in a timely manner provide, when requested by the Owner, interpretations of the Construction Documents for the projects. Such interpretations shall be expressed in supplementary drawings or sketches in

Revit/Civil 3-D format, specifications, and instructions that the Developer or the Owner may determine are necessary to provide affected Contractors with sufficient direction to continue their work. All supplementary documents shall be distributed to the Owner in accordance with the Owner's instructions. The Developer shall respond in writing to any questions or comments by the Owner concerning the Construction Documents for the Projects and possible variations in those Documents, which would be accepted in the field to help maintain project progress and project quality.

Section 806 - Developer Substitutions

The Developer shall in a timely manner review, evaluate and make recommendations on all requests for the use of substitutions. The Developer shall then make a substitution request to DEN for review and approval, DEN has 7 calendar days to respond.

806.1 Substitution Requirements

The Developer may ask for substitution of specified material or equipment under the following circumstances:

A. The Developer provides evidence to the Owner which in the Owner's opinion, establishes that an item of specified material is not available or,

B. The Developer provides evidence to the Owner which, in the Owner's sole opinion, establishes that the specified item will have an unreasonable delivery time due to no fault of the Developer.

If any of these circumstances occur, Developer shall request acceptance for a substitution at least 30 days before the material or equipment must be ordered. The request shall describe all features of the requested substitution including any tie-in with other elements of the construction including utilities and controls along with the substitute materials or equipment's size and capacity. The request must be submitted on the form provided by the Owner and shall list all differences from the product described in the technical specifications, include the price of the specified item and the requested substitution, and describe any advantages or disadvantages of the proposed substitution. If the *or equal* material or equipment costs less than that specified, the Developer shall so state it and if the Owner accepts the proposed substitution it may issue a change order to reduce the contract amount by the amount of the direct cost savings to the Developer. If the *or equal* material or equipment is accepted, the Owner may issue a change order to increase the Contract Amount by the direct cost increase to the Developer.

Section 807 - Miscellaneous Services

The Developer agrees to perform the following services whenever they are requested by the Owner:

807.1 Certifications

The Developer shall provide a Developer's certificate which may be required by an applicable Airport bond ordinance or other City ordinance, by any government agency providing funds for the projects or any other local, state or federal agency with jurisdiction over the Projects, so long as it contains terms and conditions which the Developer has a reasonable basis for certifying based on its expertise and experience on the projects.

807.2 Product Records

The Developer shall provide product and equipment record document information in electronic format approved by the Owner that can be entered into the DEN Revit/Civil 3D models.

807.3 Additional Services

Provide other assistance and advice requested by the Owner, which is reasonably related to the work it is required to perform during the construction phase. This assistance shall include, but shall not be limited to, assisting Developers' coordination for work with interfacing Contractors and preparing design modifications required by the Owner to maintain the progress of the work, design intent, and quality of work.

End of Chapter

Chapter 9 – Record Documents

Section 900 - Record Documents

All Documents shall be in a folder dated with the date of project final completion and which be named as **Project Record** in the title block or footer. Cover sheets of Construction Documents shall be titled Project Record. The Developer is responsible for creating a final reconciled Revit/Civil 3D model. Refer to *BIM Design Standards Manual*.

900.1 Record Drawings

Incorporate in Revit/Civil 3D format all changes in the projects and any deviations between the drawings and the work actually performed, no matter how insignificant, including all clarifications made during construction based on marked-up prints, change directives, change orders, request for information, drawings, and other data furnished to the Developer by the Owner (Refer to *BIM Design Standards Manual*). The Developer shall maintain on an ongoing basis from Developer notice to proceed to construction contract final completion the record drawing information. Annotations in the title block shall be removed and a folder named **Project Record with the** date of Functional Area Readiness shall be entered in the title block for each phase shall contain the record documents, with a final complete project record document at final acceptance.

900.2 Specifications

Incorporate all changes in the specifications in the projects and any deviations between the specifications and the work actually performed, no matter how insignificant, including all clarifications made during construction based on marked-up specifications, change directives, change orders, RFI, cut sheets, submittals, other data furnished to the Developer by the Owner. The Developer shall maintain record specification information.

900.3 Final Design Analysis Report (Conformed)

Provide update and any modifications to the final DAR required due to changes made during the course of construction of the project. Submit PDF files in accordance with Chapter 32, Submittals.

900.4 Certification

Include a certification on the cover sheet of drawings and specifications stating that to the best of the Developer's knowledge and belief, the Developer certifies that all construction shown in these record drawings has been completed in substantial conformance with the Construction Documents, and that all changes from the Construction Documents as bid have been noted to the best of its knowledge and belief. The Developer shall include its full business address, phone numbers, and a statement of disclaimers where appropriate.

900.5 Submittal

Refer to Chapter 32, Submittals.

End of Chapter

Chapter 10 – Design Contract Closeout/Task Closeout (Not used - see Contract Documents)

Chapter 11 – Design and Construction Specifications

Section 1100 - Specifications

1100.1 Developer Requirements

The Developer shall provide complete specifications for all projects and/or tasks. Specifications include tables and schedules arranged as noted in this Chapter.

1100.2 Compliance

The Specifications are part of the Construction Documents and shall comply with requirements of Chapter 6, **Construction Documents.**

1100.3 Location

Part II of the Specifications shall include all general requirements, product data sheets (if required), finish/room schedules, door schedules, equipment schedules, hardware schedules, fixture schedules, other appropriate schedules and the Technical Specifications and criteria required to construct or prepare design/build proposals to construct the Projects. Part II of the Specifications shall be prepared by the Developer based upon the Developer's previously accepted preliminary technical specifications. Division 01 - General Requirements technical specifications shall be prepared jointly by the Owner and the Developer.

Section 1101 - Format

1101.1 Style

Use *The Associated Press Stylebook* (available in most bookstores) as a companion writing style guide. It alphabetically lists preferred spelling, standard abbreviations, and numbering styles.

1101.2 Construction Specification Institute (CSI) Format

Follow the CSI Manual of Practice for all definitive requirements of the following:

A. Elements of a Project Manual

B. Specification Writing Techniques

C. Production Techniques

D. Special Applications

1101.3 Construction Specification Institute (CSI) Divisions

The general CSI division breakdown of divisions 1-48 will be followed. The general CSI section format will be followed as the basis for the content and arrangement of the specification sections. Appropriate articles will be utilized to expand on these headings.

- Part 1 General
- Part 2 Products
- Part 3 Execution

Section 1102 - Standard Text Elements

1102.1 General

A Microsoft Word template for creating specifications with all DEN styles outlined in this chapter is available from the Project Manager upon request.

1102.2 Margins

A. Top and bottom margin, 0.5 inches, 0.0 Gutter, 0.5 inches Header and Footer margins.

B. Left and Right Margins are each 1.0-inch.

1102.3 Typeface and Line Spacing

Print text in 10 pt. Arial normal type with 10 pt. Bold Section Titles in upper case, Line spacing is single space unless specified otherwise.

1102.4 Tab Set

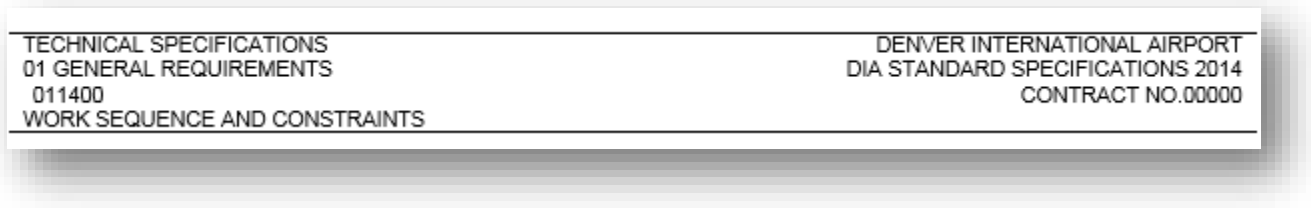
Text formatting will be done by tab spaces. The standard tab is one tab equals 0.5 inches unless otherwise specified.

1102.5 Header

At the top of each text page is a six line flush right and flush left header. Border them on top and bottom. Set three returns below the bottom border. Set margins at standard 1" left and right. Typeface shall be 8 pt. upper case Arial

Line 1:	Flush left	TECHNICAL SPECIFICATIONS
	Flush right:	DENVER INTERNATIONAL AIRPORT
Line 2:	Flush left:	Enter Division number and name
	Flush right:	Enter Construction Contract title (max of 26 Characters)
Line 3:	1 Space from Left:	Enter CSI Section number
	Flush right:	Enter Construction Contract Number (as provided by Owner)
Line 4	Flush left:	Enter Section Name

The following example is reduced in width for clarity. Provide borders as indicated above and below text.

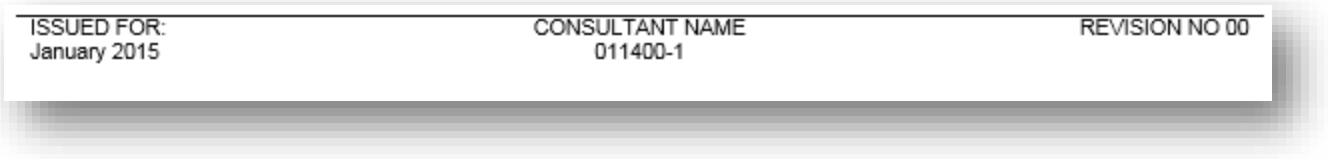


1102.6 Footer

At the bottom of each text page is a six line flush right and flush left header and Section/Page Number Centered. Border them on top. Set three returns above the border. Set margins at standard 1" left and right. All typefaces in the footer shall be 8 pt. lower case Arial bold.

Line 1:	Flush Left:	ISSUED FOR: _____. During the Design Phases and before Issue for Bid, Indicate the Phase such as **Issue for DD Review: 13 March 2015**. At Issue for Construction, enter **Issue for Construction** and the date of the bid opening. At record drawing phase, enter **Project Record** and the date of Final Completion of the Construction or Installation
Line 4:	Centered:	Enter Developer's Name
Line 4:	Flush Right:	Enter Revision Number. At Issue for Bid and Issue for Construction, the number shall be 000. Thereafter, any changes will be sequential in number.
Line 5:	Flush Left	Enter Date of Baseline Spec
Line 5:	Centered:	Enter Section Number. Microsoft Word will automatically update the page number

The following example is reduced in width for clarity. Provide line as indicated above test. Note there is no return after the automatic page number insertion.



Section 1103 - Table of Contents Page and Paragraph Numbering System

1103.1 Location

Table of Contents shall be at the beginning of each manual and volume, and will be designated Table of Contents in the left header and in the footer (TOC). Table of Contents title shall be immediately below the header and centered.

1103.2 Line Spacing

All line spacing shall be Single space.

1103.3 Line Numbering

In general, line numbering is not used at DEN. Upon request of the Project Manager line numbering shall be incorporated into the specifications. The individual pages for the technical shall use automatic line numbering function of the word processing program. In the case of one side or two-sided printing of the specification document, the line numbering must be shown on the right hand margin.

1103.4 Page Numbers

Number the pages in each section beginning with a section number, followed by a hyphen (-), and then the page number. Repeat for each section.

1103.5 Section Title

10 pt. Arial Bold, centered at the top of the page. No returns prior to title entry are required in that the header carries three returns to allow visual spacing in the print out. Section titles correspond to standard forty-eight divisions of CSI Master Format, CDOT and/or the FAA Specifications numbers. Division and number are flush left, followed by a hyphen and division title.

Section 1104 - Text Pages

1104.1 General

These follow many of the same rules as the Table of Contents page. The exceptions follow.

1104.2 Exceptions

The following is the general format to be used (utilize hanging indents)

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Ceiling Type C4.4

1. Tile: White mineral lay-in boards, 24" x 48", 5/8" thick, square edge, NRC rating .5- to .60, Class A fire rating.

a. Acceptable Manufactures:

1.) Celotex Corporation

Section 1105 - Table and Figure Indexes

1105.1 Location

These indexes appear immediately after the Table of Contents and are designated List of Figures and List of Tables under the volume number and title in the page header. In the text, figures and tables are located as closely as possible to the narrative they illustrate.

1105.2 Title

Like the Table of Contents, the titles for these indexes are located 1/2" below the header and centered between the margins. In each case, the title is in 10 pt. upper case bold.

1105.3 Format

A. Divide each index into division. Place division numbers flush left, tab once and begin title.

B. Identify each table or figure by section, part or division and number in series.

C. Table or figure number should be flush with section title.

D. Indent one tab (1/4") and begin graphic title.

E. Print section numbers and title in 10 pt. upper case bold.

F. Print chart or figure number and title in 10 pt. upper case normal.

G. Include section numeral along with page number and place flush left.

Section 1106 - Tables And Charts

1106.1 Location

Tables and charts are located as closely as possible to the narrative they illustrate. The tables and charts may be incorporated into the text in Microsoft Word format. Note that tables and charts used in the specifications must be submitted in magnetic media. Full-page charts or tables immediately follow the page they illustrate. They may be either horizontal or vertical. Always allow 1 inch along the binding edge to assure legibility after reproduction and 3-hole punch.

1106.2 Numbering

Table and chart numbering is by section, part or CSI division and table number (i.e., Division 2, Section 024119, part 8, table number 3 would become Table 024119.8.3) Print in 10 pt., upper/lower case bold.

1106.3 Titles

Titles are centered above the table or charts and printed in 10 pt. uppercase bold.

1106.4 Typeface

Print section title 10 pt. upper case bold. Print abbreviations in 10 pt., uppercase, bold and descriptions in 10 pt. upper/lower case, normal.

Section 1107 - Nomenclature

1107.1 Terminology

Terminology used in all documents shall be in accordance with the terms established in the Standards, be generally accepted throughout the industry, and must be consistent throughout the documents.

1107.2 Abbreviations

Abbreviations shall be avoided unless listed and fully explained in Division 01 - General Requirements or within the specification section in which the abbreviation occurs.

1107.3 Generic Terms

Generic terms shall be used throughout the documents, except that the names of manufacturers, trade names, and model numbers may be specified as described in Section 1108 - Detail Specifications.

Section 1108 - Detail Specifications

1108.1 General Requirements

This portion of the specifications will describe specific project requirements and quality of materials, processes, and workmanship. The detail specifications will include the following items, when applicable:

A. Names of manufacturers - minimum of three (3)

B. Trade names and model numbers of products

C. Type, grade, and quality of materials

D. Alloy of metals

E. Type and grade of finishes

F. Physical properties

G. Required performance, tests, and submittal

H. Methods of fabrication

I. Methods of installation

J. Tolerances

K. Warrantees

1108.2 Standard Technical Specifications

DEN provides and maintains a standard set of DEN specific boilerplate specifications for Divisions 01 - 33. These specifications are to be used on all projects in the Terminal, Concourses, and adjoining areas. The Developer shall obtain a set of the most current specifications from the Project Manager at the start of each project. IN NO CASE SHALL SPECIFICATIONS BE RE-USED ON PROJECTS.

In the event that a specification does not exist, the Developer may develop specifications based on MasterSpec™ or other industry standard technical specifications. Nonstandard technical specifications shall be submitted to the Project Manager for an independent review and acceptance, separate from the standard Contract Document reviews.

1108.3 Products and Materials

Specific products or materials required by these Design Standards Manuals shall be specified, if applicable as described in the Contract Documents to maintain design continuity, engineering efficiency, and ease of maintenance. Those *required* products or materials must be confirmed in writing by the Owner. DEN technical specifications shall be used for all projects. The Developer shall obtain a set of the most current specifications from the Project Manager at the start of each project. IN NO CASE SHALL SPECIFICATIONS BE RE-USED ON PROJECTS.

1108.4 Specifying and Review of Products and Material Submittals

All products, materials, process, etc., which the Developer deems necessary to specify within the project specification, to identify Developer requirements for quality of materials, procedures and processes, and workmanship must require a construction submittal that must be reviewed by the Developer in accordance with the requirements of Chapter 8 Construction Administration. At no time, shall any construction submittals not undergo a Developer review for compliance with the Project specifications.

Care must be taken to assure that information contained in any section is not redundant, in conflict or at variance with the General Conditions, Special Conditions, Detail Specifications, or Drawings.

1108.5 Reference

Each section of the Detail Specifications must list a cross-reference to related work specified in other sections of the detail specifications, to define clearly the limits of the work described in each section.

1108.6 Industry Codes and Standards

Industry codes and standards may be referenced in the detail specifications in order to require compliance with these codes and standards. Such references shall not be used as a means to supersede the design indicated on the project drawings, or to take the place of a complete design.

1108.7 Design Standards

The specifications shall not contain any reference to compliance with the Design Standards by name. The Design Standard Manuals are to be used as a guide to the design of a project and not as a Contract Document for construction.

1108.8 Federal Aviation Administration (FAA) Requirements

If applicable, the Developer shall produce a report, which details the specific Federal Aviation Administration (FAA) requirements for Developer activities during construction on operating airports. This report shall contain copies of the rules, regulations, and advisory circulars that specify Developer activities while constructing the Project. Following the review and acceptance of the report, the Developer shall prepare or modify a Contract Document section, which specifically details Developer requirements for compliance with the FAA rules and regulations.

1108.9 Redline Specifications

All specifications are required to be submitted in redline format at all intermediate submittals of the Construction Documents Specifications and shall be edited in Microsoft Word with the track changes tool enabled (striking out deleted items and adding comment bubbles or bold text of new items). The intent of this step is to identify quickly to DEN Review Staff standard specification items that are being removed and non-standard items that are being added to the spec. This requirement shall not be waived for any project.

Section 1109 - Specifications Requirements Checklist

1109.1 Specifications Requirements Checklist

Following each technical specification section, Division 02 through Division 33, the Developer shall develop and place the Specifications Requirements Checklist (SRC), Table 1 - Specification Requirements Checklist. This checklist is to provide a quick reference for the requirements of the Project's contract specifications. The Developer may determine at which level of project development for submission of the SRC as part of a preliminary specification

submittal. At a minimum, the SRC must be included starting with the 30% Schematic Design Document review submittal.

The Developer shall not use the Specifications Requirements Checklist to identify contract specifications requirements for the construction contract. All specification requirements noted on the Specifications Requirements Checklist must be clearly defined and documented within the text of that particular contract specification section.

Table 1 - Specification Requirements Checklist

Specification Requirements checklist																							
				Shop Drawings																			
Item Number	Specification Item Name	Manufacturers Data	Samples	Plans	Elevations	Details/Calc	Engineer Stamp	Agency Review	Ops and Maint. Manuals	Cert. By Manuf.	Years of Exp. Manuf.	Years of Exp. Installer	System Warranty	Finish Warranty	Ind. Laboratory Test	Construction Testing	Testing Period	Pre-Installation Conf.	Mock Up Req.	Special Testing Requirements	Maintenance Contract	Overstock Materials	Training	Installed and Warranty by Installer outlined in other spec. section

Specification Requirements Checklist Disclaimer: This Contract Specifications Requirements Checklist is provided to supply a summary of the individual requirements for a contract specification section. It is not meant to be an all-inclusive listing of the contract specification requirements. In the event that a conflict exists between Contract Specifications Requirements Checklist and any part of the contract specification, the written requirements of the contract specification shall take precedence over the Contract Specification Requirements Checklist.

Legend

Item Number:	Assign each product called out in a specification, a numerical identifier, i.e., 1,2,3 etc.
Specification Item Name	Call out each product item in a specification, i.e., face brick, flashing, grout, reinforcing, doors, panic hardware, elevators, carpet, etc.
Manufacturers Data	Enter a checkmark in the column if a manufacturer's data submittal is required.
Samples	Enter a checkmark in the column if manufacturer's samples are required.
Plans	Enter a checkmark in the column if plan views are required in the shop drawing submittal.
Elevations	Enter a checkmark in the column if elevation views are required in the shop drawing submittal.
Detail/Calculations	Enter a checkmark in the column if additional details and calculations are required in the shop drawing submittal.
Engineer Stamp	Enter a checkmark in the column if shop-drawing submittals are required to have an engineer's stamp.
Agency Review	Enter a checkmark in the column if an agency review is required, i.e. sign off for elevator installations, etc.
Operations and Maintenance Manuals	Enter a checkmark in the column if operations and maintenance manuals are required.
Certification by Manufacturer	Enter a checkmark in the column if the installer certification is required by the manufacturer of a product.
Years of Experience of Manufacturer	Enter the number of years of experience a manufacturer must have in the manufacture of a product, i.e. 5 , 10 (years), etc.
Years of Experience of Installer	Enter the number of years of experience an installer must have in the installation of a product, i.e. 5 , 10 (years), etc.
System Warranty:	Enter the number of years for the system warranty, i.e. 5, 10 (years) etc.
Finish Warranty:	Enter the number of years for the finishes warranty, i.e. 5, 10 (years) etc.
Independent Laboratory Test	Enter a checkmark in the column if independent laboratory testing is required
Construction Testing	Enter a checkmark in the column if the Developer must perform test in the field, i.e. flood testing a waterproofing system, etc.
Testing Period	Enter the time required for the duration of the test, i.e. 1W = 1 week, 7D = 7 days, 1M = 1 month, etc.
Pre-Installation Conference	Enter a checkmark in the column if a pre-installation/pre-work meeting is required.
Mock Up	Enter a checkmark in the column if a site mock-up is required, i.e. masonry walls, precast panels etc.
Special Testing Requirements	Note any special testing requirements. Notations are not necessary for code required testing, only testing specifically requested by the contract specifications
Maintenance Contract	Enter the number of years of the term for special maintenance service contracts, i.e. elevator/escalator maintenance.
Overstock Materials:	Enter in the column the amount the owner is to receive as overstock materials, i.e. square yards of carpet – 1000 sqyd; boxes of floor tile – 20 B = 20 boxes, etc.
Training:	Enter a checkmark in the column if the Developer is to provide training to the Owner's personnel.
Installed and Warranty by Installer outlined in other Spec Section:	Enter the CSI specification section number for items that are specified in one section but the installation warranty is covered by another specification section, i.e., Section 088000 Glazing, the products are specified in this section, but the systems warranty is specified in Section 084113 Aluminum-Framed Entrances and Storefronts. In this instance, for products described in Section 088000 but warranted in Section 084113, Enter the spec number **0084113** in the column associated with that product.

End of Chapter 11

Chapter 12 - General Drawing Requirements

Section 1200 - General Drawing Requirements

As of 2011, all projects shall be done using Autodesk Revit and/or Civil 3D. Refer to *BIM Design Standards Manual* for detailed procedures and requirements.

Section 1201 - Legacy Projects

In some instances, Autodesk Revit and Civil 3D may not be required. If you have any questions regarding the use of Autodesk Revit and Civil 3D, please contact the Project Manager

End of Chapter 12

Chapter 13 - Phasing and Staging Drawings

Section 1300 - Phasing and Staging Drawings

1300.1 Airport Layout Plan

The Owner will provide Revit/Civil 3D models for Developer use in modifying the Airport Layout Plan (ALP) key plan.

1300.2 Site Access

The Developer shall indicate routes the Developer Personnel and the Developer Delivery shall be required to take in order to access the work site. Included shall be indications of vehicle gates that access the restricted area if the work activity is in the restricted area.

1300.3 Haul Routes

Indicate haul routes for truck movements such as earth fill supply or removal, including borrow and waste locations. Indicate security gate numbers.

1300.4 Trailer Site and Employee Parking

Include in the Key Plan the referenced location for the Developers trailer, employee parking. The Plan for these areas shall be presented in larger scale drawings as part of the drawing set.

Section 1301 - Staging Plan - Vertical Elements And Lighting Restrictions

1301.1 General

Provide large-scale staging plans indicating grade level elevations and allowable height above existing grade that equipment may extend. Include also photometric studies of anticipated site lighting required during Developer execution of the work. This document shall be submitted to the Owner in order to assure conformance with FAA and DEN Operational requirements.

Section 1302 - Staging Plan - General

1302.1 Utility Access

The Developer shall provide documentation of the source of Utilities during construction including quality and capacity of the following: communications, fire protection water, electrical power, potable water, and storage areas.

1302.2 Environmental Controls

Provide documentation locating and defining erosion control, storm water control, temporary drainage, security, spoils areas, and locations of de-watering control areas.

1302.3 Temporary Facilities

Provide documentation locating and defining employee parking, delivery, pedestrian and construction barriers, Developer storage and laydown areas, security requirements, winter protection, signage, trailers, lighting, fencing, and other requirements as directed by the Owner. The Developer shall provide guidelines for temporary structure orientation and appearance.

1302.4 Temporary Traffic Control

Vehicle and pedestrian rerouting, including required temporary signage, signals, etc. Temporary Pavement markings shall be shown at 1"=100' or at a scale as directed by the Owner.

1302.5 Preliminary Plans

Preliminary traffic control modification plans for construction of the Project shall be included in the schematic design submittal. The Developer will consult with the Project Manager and other Airport Operations personnel in developing the staging and phasing plan.

1302.6 Hazard locations

Provide setback of work and constraints.

Section 1303 - Sequencing Plans

1303.1 General

The Developer shall provide construction-sequencing plans where construction sequences must be controlled to assure proper safety and operations at DEN. Include sequencing of pedestrian or vehicular routing, signage, staging areas, etc.

1303.2 Traffic Control

Preliminary traffic control modification plans for construction of the Project shall be included in the schematic design submittal. The Developer will consult with the Owner's personnel and other airport operations personnel in developing this plan.

1303.3 Operating Facility

DEN is an operating air and ground transportation facility. All parties participating in the continuing development of this facility understand that construction will cause disruptions in the normal operations of the facility. However, normal or modified operations must continue at all times. The Developer shall identify the sequencing and staging implications of constructing the Project under the constraints required for maintaining airport operations. The Developer shall prepare construction drawings and specifications to describe the airport operational constraints, which will affect the construction of the Project.

1303.4 Analysis

The Developer shall analyze and quantify the effects of construction sequencing, staging, and constructability on construction cost and schedule and incorporate these effects into its construction estimate and construction schedule. The Construction Documents shall clearly communicate the construction sequencing, staging requirements and airport operational constraints that are necessary for the Developer to understand, prepare the bid and construct the Project.

Section 1304 - Demolition and Site Preparations

1304.1 General

Drawings shall be prepared which clearly indicate altered, discontinued, and removed work where extensive removal and/or demolition operations are required. Demolition drawings shall indicate but not be limited to the following pertinent information.

1304.2 Civil Drawings

Provide at a minimum the following information:

A. Location and size of existing utilities or other elements.

B. Other information to clearly indicate the extent of known conditions and materials and the extent to which these are to be maintained, modified, or removed.

C. Location, size and type of existing vegetation and extent to which existing vegetation is to be removed, pruned or protected and maintained.

D. Location and extent of topsoil on-site or in stockpile, indications of directions for retention, stripping, stockpiling, or spreading of topsoil.

E. Symbols that are used for the demolition work shall be the same as those used on the drawings for new construction.

1304.3 Structural and Architectural

Demolition drawings shall be prepared which clearly indicate altered, discontinued, and removed work where extensive removal and/or demolition operations are required. Demolition drawings shall indicate but not be limited to the following pertinent information:

A. Location and size of structural members

B. Methods of closing openings

C. Other information to clearly indicate the extent of known materials and conditions to be removed.

D. Symbols that are used for the demolition work shall be the same as those used on the drawings for new construction.

E. Allowable loads on existing structures, constraints.

F. Locations allowed for dust or protection barriers, including type of barriers. Include drawings and constraints of barrier construction where protection of existing work is required.

G. Maximum crane height for use during construction is identified.

1304.4 Systems Drawings

A. Fire zone interruption

B. Paging interruption

C. IMPACC system tie in

D. Baggage system interruption

E. Cut off of HVAC and impact on other systems

F. Temporary heating inside occupied areas

G. Freeze protection

H. Ice, snow and wind considerations

I. Emergency features - emergency shut-off locations

J. Emergency lighting and exiting requirements

K. Electrical lockout procedures

L. Lighting and Power systems interruptions

M. Plumbing system interruptions

N. Fueling system interruptions

O. Deicing system interruptions

P. All interruptions to movement or operational activities

End of Chapter

Chapter 14 - Civil Drawings

Section 1400 - Civil Drawings

1400.1 General

Unless otherwise specified in this chapter, the Civil Engineering project drawings shall be completed in Autodesk Civil 3D. The drawings shall indicate complete design.

1400.2 Design Requirement Categories

A. General Civil Notes
B. General Contract Layout Plan
C. Abbreviations and Symbols
D. Contract Quantities Schedules
E. Soil Boring Logs
F. Typical Cross-sections
G. Runway, Taxiway, and Roadway Alignments
H. Alignment Data
I. Site Grading Plans
J. Drainage Plans and Details
K. Utilities Profiles
L. Paving Plans and Details
M. Marking Plans and Details
N. Electrical and Lighting Plans and Details
O. Signing Plans and Details
P. Cross-Sections

1400.3 Bridge Drawings

A. Bridge Plan and Elevation
B. Foundation Plans and Details
C. Structural Plans and Details
D. Drainage/Utilities Plans and Details
E. Marking Plans and Details
F. Lighting/Electrical Plans and Details

NOTE: The actual packages may split these into separate units.

1400.4 Sequence

Construction documents are divided into specific groups per National CAD Standards (NCS). The group number shall always remain the same no matter how large the project. Refer to *BIM Design Standards Manual*.

Section 1401 - Runway, Taxiway, and Roadway Alignment

1401.1 Scale

The upper half of the sheet shall be a plan of appropriate scale. The following scales shall be used unless acceptance to do otherwise is given by the Owner:

A. Runway, taxiway, apron: Horizontal geometry shall be shown at 1"-100', Pavement markings shall be shown at 1"=100', Paving, grading and drainage plans shown at 1"=40', Profile scales shall vary to suit the level of detail to be shown. Maximum horizontal scale 1"=200', Maximum vertical exaggeration shall be 20:1. Minimum vertical exaggeration shall be 4:1.

B. Roadways: Scales shall vary to suit the level of detail to be shown. For roadways with complex geometry and dense utilities, a plan scale of 1"=10' shall be used. Plans of medium complexity shall use 1"=20'. Plans of low complexity shall use 1"=40'. Unpaved roads with no utilities or very simple utilities and which have very little detail to be shown may use scales of 1"=50' or 1"=100'.

C. Profiles shall generally be shown at the same horizontal scale as the plan views except that the horizontal scale need not exceed 1"=20' (1"=10' shall not be used). A vertical scale: 1"=5' shall be used.

It is assumed that those roads with plan scales of 1"=50' up to 1"=100' shall not require profiles. If profiles are required, they shall be drawn with a horizontal scale of 1"=50'.

1401.2 Stationing

Stationing shall be indicated in relation to the scale as follows:

Scale	Station At
1" = 50'	Each 100 ft
1" = 100' or greater	Each 500 ft.

The station shall be identified by a tick mark 1/8" long. The numerals shall be 3/32" high. Station equalities shall be shown as a 1/8" open square. The equation shall be shown on a fine line drawn perpendicular to the stationed line.

1401.3 Legend

Refer to DEN Standards legend families provided with site models.

1401.4 Roadways

Where perimeter roads, access roads, etc., are to be constructed, they shall be solid lines defining the edges of the proposed alignment. Where applicable, the centerline of roads or structures shall be shown.

1401.5 Utilities

When a set of plans is to be prepared, the plan and profile sheets shall show utilities that have an effect on the runways, taxiways, roadways, or structures. Underground Utilities: Underground utility layouts shall be shown on the appropriate paving, grading or drainage plans. Profiles shall be shown at the same scales as the plan sheets. Vertical profiles shall be 1"=5'.

1401.6 Match Lines

Each sheet shall bear match lines at each end, drawn perpendicular to the alignment, preferably at a full station. The lines shall be made up of a long dash 3/4" long and short dashes 1/8" long; the pattern repeats. The match lines shall be labeled, **MATCH LINE-STA #+00** in letters and numbers approximately 3/16" high.

1401.7 Profile Grid

The horizontal scale shall be the same scale as the plan. The horizontal/vertical scale ratio shall be a maximum of 1/10 or a minimum of 1/5, as appropriate. Elevations shall be indicated at 10 ft. intervals. Stations shall be shown along bottom of profile grid at 4" spacing. Numbers shall be approximately 3/16" high.

1401.8 Runway and Roadway Profiles

The profile shall be shown by a single solid line. The top edge of this line defines the grade line profile of the runway or roadway. Significant points designating changes in grade shall be shown by an open circle of 1/8" diameter. These points shall be identified by a fine vertical line drawn to the circle showing the station and pertinent abbreviation.

Profile tangent intersections shall be identified by open triangles 1/8" on a side. A fine vertical line shall be drawn to the triangle and the station, abbreviation (PIVC), and the elevation shall be shown. Reference CADD Symbols in the *BIM Design Standards Manual.*

A. Ground Line: The profile of the existing ground along the centerline of the runway, road, etc., shall be shown by a freehand style broken line and shall be labeled **EXISTING GROUND**.

B. Utilities: Where they cross the runways, taxiways, or roadways, utility lines shown in plan shall also be shown in profile.

1401.9 Profile Match Line

Match lines shall be designated as in Section above describing Match lines. In addition, the elevation of the profile grade shall be shown.

1401.10 Alignment Data

These sheets shall be arranged in tabular form showing all horizontal points. The tables shall be arranged by runway, taxiway, etc., and read from the top to the bottom of the page. Table headings are as follows:

Station Point	Y	R	I	L	E	T	LS	AS

Y and X = coordinates
R = radius of curvature
I = intersection
L = total curve length
E = super elevation in feet
T = length of tangent
LS = length of spiral
AS = spiral intersection angle

1401.11 Roadway and Runway Sections

A. Nomenclature

Runway sections, including earthwork sections, shall be referred to as cross-sections.

B. Identifying Symbols and Titles

Road and runway sections shall be indicated on the plan by a section symbol and shall be identified by station below the section detail.

C. Orientation

Cross-sections shall be taken looking ahead on line. When more than one cross-section is drawn on one sheet, they shall be oriented so that the section station increases from the bottom to the top of the sheet.

D. Typical cross-sections

Typical cross-sections shall be shown at appropriate points along the runway or roadway. They shall include the runway or roadway, shoulders and other miscellaneous typical details.

E. Special Cross-sections

Special cross-sections shall be provided in areas where they will be useful in clarifying construction details.

1401.12 Typical Details

Typical details may eventually become Airport standards. They shall include runway, taxiway, apron, roadway, and miscellaneous civil details.

1401.13 Drainage

Drainage layout sheet shall include detailed layout information for all utilities. These depictions shall be plan and profile sheets with horizontal scale (1" = 50'). Sheets shall be referenced by number to the layout index.

1401.14 Utility Lines

The location shall be shown by lines and identifiers as described in the *BIM Design Standards Manual*.

1401.15 Drainage Details

These details may include typical and special details and may become Airport standards.

End of Chapter

Chapter 15 - Landscape Drawings

Section 1500 - Landscape Drawings

1500.1 Contents

The drawings shall present all information relative to the size, form, location, and arrangement of the landscape components and systems of the project. The drawings shall indicate complete design. Prior written acceptance is required of any design-build components. The following shall be included on the landscape architectural drawings, when applicable to the specific project:

A. Location of materials, assemblies, products, and accessories.

B. Size, thickness, and significant dimensions of all landscape elements.

C. Separation details of adjacent dissimilar materials.

D. Soil boring or test pit logs including locations.

E. Irrigation drawings shall present all necessary information to show location and/or routing of all landscape irrigation system components. Drawings shall indicate at a minimum the following items as applicable to the specific area irrigation system:

1. Spray and rotor heads
2. Non-pressure (lateral) piping
3. Drip tubing
4. Electric control valves
5. Air relief valves
6. Quick coupling valves
7. Isolation gate valves
8. Pressure regulating valves
9. Pressure (mainline) piping
10. Effluent distribution piping
11. Backflow preventer
12. Master valves
13. Water meters
14. Point of connection and service line
15. Field controllers
16. Chemical/fertilizer injection assemblies
17. Sleeving

F. Separate drawings shall be prepared indicating power source wiring diagrams, controllers, point of connection, and service lines.

Section 1501 - Sequence

1501.1 Numbering

Construction documents are divided into specific groups per National CAD Standards (NCS). The group number shall always remain the same no matter how large the project. Refer to *BIM Design Standards Manual*.

Section 1502 - Plans

1502.1 Landscape Plans

Plan view drawings shall present the following minimum information:

A. North direction arrow, located in accordance with drawing format requirements

B. Floor elevation of adjacent structures using survey datum elevations and reference elevations if applicable

C. Cross reference symbols or notations to sections, elevations, detailed plans, details or other related information continued in the drawings so these drawing elements can be readily located

D. Extent and location of all proposed materials, patterns, and finishes for all landscape elements shall be clearly indicated

E. Topographic Drawings indicating existing conditions – contours, existing utilities, and drainage

F. Topographic Drawings indicating contours and drainage of proposed plan

G. Topographic Drawings indicating Construction Staging, Developer access, and environmental control requirements during construction

1502.2 Irrigation Plans

Irrigation plans shall present the following minimum information.

A. Location and size of all system components including controllers

B. Routing and sizing of all piping

C. Description of requirements for points of connection

D. Description of requirements for field controller installation including electrical source and controller size

E. Separate plans indicating power, controllers, and signaling/control wiring. Plans shall be dimensioned. All locations of all buried devices shall be fully dimensioned

1502.3 Irrigation Schedule

Schedule shall be structured in columns showing from left to right, the component or piping symbol, manufacturer, model number, description of item, and appropriate detail numbers.

A. Model number, manufacturer, and nozzle size for all spray and rotor heads

B. Class of schedule and material type for all piping

C. Manufacturer and model number of all system components

1502.4 Key Symbols

A. Electric control valves shall be labeled with hexagon symbol indicating valve size, controller, station number, and designed flow rate in gallons per minute

B. Pressure setting of all regulating valves

C. Location of all evergreen trees located within irrigated turf area

D. Specific irrigation notes as required to clearly communicate design and installation intent

E. Location and description of existing components, piping or conditions

F. Construction notes describing any special irrigation conditions

G. Designed static water pressure

H. Drip emitter schedule for specific size and type of plant material

1502.5 Sections

Sections and elevations shall be provided to indicate the correct vertical relationships, size, and location of the landscape components.

1502.6 Details

Construction details shall be provided which illustrate the intent of installation of all landscape components and systems including irrigation systems and components. Details shall clearly identify all required assembly parts, sizes, and dimensions. Details shall be numbered and appropriately keyed with overall landscape and irrigation plans, detailed plans and schedules.

1502.7 Continuation

Drawings shall indicate, where applicable, any continuation from one drawing to another, and where plans and system layouts are continued on another drawing. The location of the drawing on which the continuation appears shall be noted at the point of break in the plans.

1502.8 Demolition and Site Preparation

Drawings shall be prepared which clearly indicate altered, discontinued, and removed work where extensive removal and/or demolition operations are required. Demolition drawings shall indicate, but not be limited to, the following pertinent information:

A. Location and size of existing utilities or other elements

B. Other information to clearly indicate the extent of known conditions and materials and the extent to which these are to be maintained, modified, or removed

C. Location, size and type of existing vegetation and extent to which existing vegetation is to be removed, pruned or protected and maintained

D. Location and extent of topsoil on-site or in stockpile, indications of directions for retention, stripping, stockpiling, or spreading of topsoil

E. Symbols that are used for the demolition work shall be the same as those used on the drawings for new construction

End of Chapter

Chapter 16 - Architectural Drawings

Section 1600 - Architectural Drawings

1600.1 Contents

The drawings shall present all information relative to the size, form, location, and arrangement of the project components. The drawings shall indicate complete design. Prior written acceptance from the Owner is required for any design-build component. The following items shall be included on the architectural drawings, when applicable to the specific project:

A. Location of materials, assemblies, products, and accessories

B. Size, thickness, and significant dimensions of all building elements

C. Gauges, except for prefabricated and assembled units

D. Diagrams of specially fabricated connections

E. Relationships of adjacent dissimilar materials

F. Soil boring or test pit logs including locations

1600.2 Design Requirements

Refer to *Architectural Design Standards Manual* for detailed requirements of architectural design, details, and specifications.

1600.3 Sequence

Construction documents are divided into specific groups per National CAD Standards (NCS). The group number shall always remain the same no matter how large the project. Refer to *BIM Design Standards Manual*.

Section 1601 - Plans

1601.1 Floor Plans

Plan view drawings shall present the following minimum information:

A. North direction arrow located in accordance to drawing requirements and at top of drawing where feasible

B. Floor elevation - The floor elevation shall be keyed to DEN NAVD-88 Datum in at least one location on each floor plan. The elevation shall be clearly defined as finish floor or elevation of structural floor.

C. Identify and indicate the correct horizontal relationship, size, and location of all components. Avoid repeating dimensions that are to be found on large-scale drawings.

D. Cross-reference symbols or notations to sections, elevations, insert plans, larger scale plans, diagrams, and other drawing details so these drawing elements can be readily located.

1601.2 Reflected Ceiling Plans

Reflected ceiling plan drawings shall clearly delineate all systems including but not limited to materials, soffits, ceilings, partitions, exterior walls, columns, lighting, sprinklers, monitoring devices, diffusers, grilles, registers, signage, and furring elements. The reflected ceiling plans shall carry the same minimum information as itemized above.

1601.3 Large Scale Plans

Where large-scale plans are presented, critical dimensions for code compliance shall be identified. Enlarged plans are required at each gate and shall accurately depict all equipment (PCA, GPU, PWC, etc.) with required access clearances and the relationship to aircraft and airline ground support equipment (GSE).

Sections shall be included when loading bridges serve multiple sizes of aircraft to ensure loading sill height does not negatively affect gate equipment.

1601.4 Precedence

There is no precedence; plan drawings of the same areas that are presented at different scales shall not deviate.

1601.5 Roof Plans

Provide roof plans that indicate all components of other disciplines including, but not limited to lightning protection, mechanical, electrical, plumbing, access systems and communications systems. Indicate traffic pads from all access points to and around roof mounted equipment or areas requiring maintenance and access. Show storm water flow directions, crickets, flashings, and materials.

Section 1602 - Sections

1602.1 Precedence

There is no precedence; section drawings of the same areas that are presented at different scales shall not deviate.

1602.2 Sections

Sections shall be provided to define completely the character of construction elements. Above or below grade elevations shall be keyed to the DEN NAVD-88 Datum. Notes such as **similar to** shall not be acceptable. Developer shall provide design of each type of detail.

Section 1603 - Elevations

1603.1 Exterior Elevations

Exterior elevations shall be provided for all exterior planes of new or modified construction, and shall include all other systems including, but not limited to civil, mechanical, electrical, plumbing, fire protection, lighting, communications, lightning protection, fences, and access systems. Indicate the correct vertical relationships, size, and location of the components.

1603.2 Interior Elevations

Interior elevations shall be provided for all interior planes of new or modified construction, and shall include all other systems installed in or on the surfaces.

1603.3 Material Definition

Different materials shall be delineated to define clearly separation of materials.

Section 1604 - Demolition Drawings

1604.1 General

Demolition drawings shall be prepared which clearly indicate altered, discontinued, and removed work where extensive removal and/or demolition operations are required. Demolition drawings shall indicate, but not be limited to, the following pertinent information:

A. Location and size of structural members

B. Methods of closing openings

C. Other information to clearly indicate the extent of known materials and conditions to be removed

D. Symbols that are used for the demolition work shall be the same as those used on the drawings for new construction

E. Complete design and detailing of systems interruptions and protection of adjacent or affected systems and operations from damage due to interruptions and/or construction activities.

Section 1605 - Egress Plans

The Developer shall provide floor plans indicating safety egress from the facilities that shall include blocks of occupancy types, calculated quantity of occupants, and calculated egress widths. This shall include block diagrams indicating the egress schemes.

End of Chapter

Chapter 17 - Structural Drawings

Section 1700 - Structural Drawings

1700.1 Definition

A structural drawing delineates the various portions of the overall structural system. All construction materials shall be defined with dimensions, sizes, and locations in the structure. The drawings shall indicate complete design. Prior written acceptance from the Owner is required for any design-build component. Structural drawings shall be coordinated with other disciplines and shall include penetrations and other accommodations required.

1700.2 Sequence

Construction documents are divided into specific groups per National CAD Standards (NCS). The group number shall always remain the same no matter how large the project. Refer to *BIM Design Standards Manual*.

Section 1701 - Foundation Plans

Foundation plans show location, size and type of foundations, which support the building. Plan views locate supported columns, grade beams, basement walls (if any), location, and size of piles, equipment pedestals, and any other items, which are part of the foundation. Cross sections and details shall be provided to show dimensions and shapes of all concrete items not completely defined in plan. Show number and location of foundation elements along with type, size, and length. Show reinforcing bars, anchor bolts and other embedded items, joints and penetrations. Define material properties for concrete, reinforcing steel and all other parts of foundations. Indicate on foundation plans all required penetrations and references for any modifications to reinforcing or structure required for penetrations.

Section 1702 - Floor Plans

1702.1 Structural Steel Framing

Show framing for each floor level, and elevations (top of steel) for all members. Locate all beams with respect to column lines and give sizes. Locate all support points for equipment, posts, hangars, stairs, etc. Sections referring to structural steel details shall be required.

Define by notes all grades of steel used, types and sizes of connections (with details as required) and refer to all standard drawings, charts, tables, notes, etc. for information required to construct a safe and complete floor system.

1702.2 Floor Plans

Show all plan dimensions of floor. Define outer limits, location, and size of openings, elevations for all areas, floor types (concrete, grating, floor plate, etc.) and thickness, equipment supports, and any other items to be incorporated in the floor construction. Cut sections and indicate details shown on same or other sheets to show edge details, equipment pedestals, reinforcement, anchor bolts, and miscellaneous embedments.

Define reinforcement grades and sizes, bar grating or floor plate sizes, and details; locate all floor construction joints, reinforcement lap/splices as required. Define and locate all penetrations. Define steel decking wherever used as concrete form or otherwise shall be defined. Define material properties required for all concrete, steel, floor topping, or other materials used.

1702.3 Roof Plans

Define all plan dimensions and openings as for floors. Define top of steel elevations, sizes, and locations of all beams, purlins, and joists. Define roof type (concrete, steel deck, etc.) Provide framing as required around openings. Define loading requirements for steel deck roofs, such as live load, wind uplift, and attachment to framing for diaphragm action. Define roof slope and locate drains. Locate support points for all roof-mounted equipment such as HVAC equipment, tanks, etc.

Section 1703 - Elevations And Wall Sections

1703.1 General

Show all columns, beams, bracing on column lines. Size all columns and bracing. Define connections or show loads for connections to be designed by Developer. Give size for all struts and beams not shown on floor plans. Show framing at doors, windows, etc. Provide details for any non-standard connections.

On exterior walls, show girt system. Show sizes, spacing, and locate sag rods. Detail special girts, parapet construction, framing around openings, etc. Types and sizes of siding shall be coordinated with architectural drawings.

Section 1704 - Standard Drawings, Schedules, Tables, and Details

1704.1 Drawings

In lieu of detailing repeated identical items on all views where they occur, detail on standard drawings and refer to them by letter or number designations. The drawings include, but are not limited to, the following:

A. General Notes and Details:

Include references to pertinent codes and standards. Give design criteria and loads as required. Show standard details for treatment of concrete edges, joints, penetrations, and anchor bolts. Detail standard handrails and ladders and their anchorage to structure.

B. Column Schedules:

Show location and size of columns used. Detail splices and base plates, showing shear bars, anchor bolts, grout, and any other required features.

C. Bracing Connections:

Show typical details for diagonal bracing. List all combinations of vertical, horizontal, and diagonal connections between braces, beams and columns and reference by letter or number designations to plans and elevations.

D. Standard Beam and Joist End Connections:

Detail typical connections, showing required tolerances, edge distances, pitch, gage, etc. Show manner of designating connections on plans. If standard connections are used for given beam sizes, list.

E. Non-standard Connections:

Detail as required except where shown on plan or elevation drawings.

F. Stair Details:

Show plan and elevations for all stairs, with riser and tread dimensions. Show reinforcing for concrete stairs. For steel stairs, show all member sizes, connections, bracing and supports.

G. Girt Details:

Show all girt bracket types, sag rods, and joints between girt sections and all connections. Detail special built-up girt sections.

H. Miscellaneous Details:

Show details for all welded girders, trusses, built-up members, and assemblies used. Show all necessary views of crane girders, crane columns, and brackets and attachment to building, crane stops, clearance requirements, and dimensions relative to building column lines and elevations. Provide details for fabrication of floor plates, floor bracing, and all other miscellaneous items to be installed by the Developer.

End of Chapter

Chapter 18 - Mechanical Drawings

Section 1800 - Mechanical Drawings

1800.1 Definitions

A mechanical drawing delineates equipment, materials, components, ductwork, piping, and accessories to convey liquids, and gases for the construction of mechanical systems. Mechanical systems include HVAC, plumbing, fire protection, building automation and any process system requirements. The drawings shall indicate complete design. Prior written acceptance is required for any design-build component.

1800.2 General Requirements

These drawings establish the requirements for construction of the facility design, including pertinent services, equipment, and other features required for the performance of the mechanical equipment. These drawings shall incorporate dimensions, symbols, reference to codes, conventions, schedules, diagrams, etc., in describing the size and routing of pipes, material to be used, equipment criteria, duct sizes and shapes, amount of flow and the temperature of material in pipes and ducts, valve types and location, floor and wall penetrations, tank construction, equipment, piping insulation, and other facets of mechanical design as are required.

1800.3 Design Requirements

Refer to *Mechanical Design Standards Manual* for detailed requirements of mechanical design, details, and specifications.

Section 1801 - Sequence

1801.1 Numbering

Construction documents are divided into specific groups per National CAD Standards (NCS). The group number shall always remain the same no matter how large the project. Refer to *BIM Design Standards Manual*.

1801.2 Demolition

Demolition drawings of mechanical systems shall call out all ductwork, insulation, piping, and associated controls to be removed. Controls shall be called out to be removed in the programming of that system. Abandoned-in-place piping and ductwork is not allowed unless authorization is obtained in writing from the Project Manager.

Section 1802 - Flow Diagrams

1802.1 Schematic Illustrations

Flow diagrams are schematic illustrations of piping or duct circuits including equipment, components, and instruments involved in the mechanical system. The purpose of flow diagrams shall be to define a mechanical system with respect to flow directions, component sizes, control functions, operational and flow balances.

1802.2 Key Drawings

Flow diagrams are key drawings, which form a basis for detail design drawings, maintenance, operator training, and construction. Because of the definitive nature of flow diagrams, they shall be developed prior to the commencement of construction document phase piping drawings or any detail design drawings, which may be affected by the flow diagrams.

1802.3 Flow Diagrams

Flow diagrams shall be required to illustrate the following:

A. HVAC airflow, all HVAC systems, and relative pressurization of spaces.

B. Chilled water piping systems.

C. Cooling tower water and/or condenser water systems.

D. Process systems; chemical feed systems.

E. Heating water piping systems.

F. Plumbing waste, grease waste, and storm drainage systems: diagrams shall be provided and show calculated fixture unit counts on all sections and equipment.

G. Plumbing hot and cold water supply systems: diagrams shall be provided and show calculated fixture unit counts on all sections and equipment.

H. Automation; temperature controls, process controls, life safety controls, etc. Diagram shall depict all components in control of equipment and interface with DEN EMS system(s)

I. Standpipe systems and fire risers.

J. Smoke Pressurization and exhaust.

K. Gas piping systems. Gas piping systems shall include calculations of inches of water and shall note the demand loads of all equipment to be connected to the gas system.

L. Fuel systems.

Existing flow diagrams shall be modified to show new work and modifications to any equipment represented in the diagram. The need for additional flow diagrams shall be determined on a project-by-project basis by the Design Engineer, the DEN Mechanical Engineer, and the DEN Project Manager. The need for additional flow diagrams shall be based on the complexity of piping in the mechanical system. Flow diagrams shall define all contributory loads and demand loads of existing systems or systems to be provided by others.

Section 1803 - Flow Diagram and Control Requirements

1803.1 General Requirements

All piping, ductwork, and equipment shall be represented on flow diagrams in schematic form. Accurate depiction of physical relationships is essential for clarity, e.g., a pressure vessel with nozzles located on top, bottom, and sides should appear on the flow diagram with nozzles shown in approximately the same relationship. Piping specialties and special features shall bear a reasonable resemblance to the actual items or installations.

Flow and controls may be shown on a single diagram. For complex or very large control and flow diagrams, they may be requested to be separate by the DEN Mechanical Engineer.

1803.2 Flow Direction

A flow direction arrow shall appear at each line junction or change of direction in order to illustrate the flow direction clearly.

1803.3 Limits of Construction

Purchased equipment packages, which are pre-assembled or pre-piped, shall be so designated with a dashed line to outline the limits of the vendor-supplied portion.

1803.4 Instruments and Controls

Instrument Society of America (ISA) symbols shall be used to represent instruments and control loops. Instruments shall be identified by a tag number inside a circular balloon, in accordance with ISA standards. Tag numbers shall be permanently affixed to each instrument.

Flow diagram shall completely identify all devices, mechanisms of control (i.e., pneumatic, electric) and interface points. Level of detail documents can be provided upon request through the DEN Mechanical Engineer.

1803.5 Set Points

Set points for relief valves, limit switches, control valves, dampers, and operating temperatures shall be indicated. Normal and failure positions shall be called out for control valves and dampers (fail open, fail closed, normal open,

normal closed, etc.). Other instrument set points or operating control points shall be called out as appropriate to aid design and construction.

1803.6 Logic/Control

For complex systems and/or those systems controlled by Direct Digital Control (DDC), or those connecting to the DEN EMS, a written logic description shall be added to the flow diagrams or included in the project technical provisions of the Specifications.

A. Instrument Society of America (ISA) symbols shall be used to represent control devices, instruments and control loops.

B. All components shall be identified by a tag number inside a circular balloon, in accordance with ISA standards. Tag numbers shall be permanently affixed to each instrument.

1803.7 Operating Controls

Consideration shall be given to all anticipated operating conditions, including start-up and shutdown. Flow diagrams shall show bypasses, start-up lines, shutdown lines, and any valves, controls, etc., required for any anticipated operating condition.

1803.8 Identification Tags

Facilities management identification tag numbers and basic design parameters shall be shown on the flow diagrams. Engineer shall obtain equipment tag numbering from the Project Manager.

1803.9 Existing System Tie-in

When new mechanical systems are to be connected to existing systems or systems being designed by others, each tie-in shall be identified on the drawings by a hexagon symbol bearing a unique tie-in number. The designer shall include a list of tie-ins on the drawings as required for a project. The tie-in schedule shall note the tie-in number, piping, ductwork, or other service, and the extent of interruption required to affect each tie-in. This schedule shall be used to help coordinate construction with normal operations in order to minimize unscheduled down time.

1803.10 Symbols

Symbols used on flow diagrams for valves, instruments, and accessories shall conform to standards established by the legend.

1803.11 Gravity Drainage

When a specific service requires positive gravity drainage, arrows and notes on the flow diagram shall illustrate the slope required. Plans shall indicate starting and ending invert elevations.

1803.12 Space Pressurization Diagrams

Space pressurization diagrams are required to show how air is intended to move throughout the facility and required pressurization aspects of many space types (i.e., restrooms under negative pressure). Diagrams shall be in block form and depict as clearly and simply as possible all HVAC & Life Safety systems. Diagrams shall show:

1. All equipment (AHU, EF, VAV, FCU, etc.) serving each space/area with appropriate unit tags
2. Total airflow rates of pressurized systems in each space (each diffuser is not required unless a VAV serves many individual spaces)
3. Paths of transfer air in each space with anticipated airflow rate
4. Path of return air in each space with anticipated airflow rate
5. Path of smoke control and airflows in each space
6. Room names of each space
7. Single or double line presentation of ductwork system flow

Section 1804 - Drawings For Mechanical Systems

1804.1 General

Piping drawings shall delineate the components required to convey the fluids. Drawings shall be completely coordinated with other disciplines and existing systems to ensure no conflicts occur in the documents. Drawings shall include but not be limited to such items as the supply and distribution of potable water, sanitary water and waste, storm waste, chilled water, systems for fire protection, drainage, fuel supply to boilers and heating water. Piping drawings shall delineate the material, system, size, and routing of pipe, hose and tubing, the associated vessels and equipment, and other facets of mechanical design by incorporating dimensions, symbols, codes, conventions, schedules, and diagrams.

1804.2 Flow Diagrams

When flow diagrams are required, they shall be completed prior to commencement of detail piping drawings. Enlarged plans are required at each gate and shall accurately depict all equipment (PCA, GPU, PWC, etc.) with required access clearances and the relationship to aircraft and airlines ground support equipment (GSE).

Sections shall be included when loading bridges serve multiple sizes of aircraft to ensure loading sill height does not negatively affect gate equipment.

1804.3 Enlarged Plans

When adequate detail cannot be shown on arrangement plans, enlarged plans shall be provided.

1804.4 Drawing Delineation

The following rules shall be followed in the delineation of piping drawings:

A. Exposed pipe shall be shown as a single thick line, and hidden or buried pipe shall be shown as a thick dashed (hidden) line; however, in order to delineate clearances and special conditions, 6" and larger pipe shall be shown using a double line, drawn to scale shown, the actual pipe dimensions, and pipe centerline.

B. When new and existing piping, ductwork and/or equipment are shown on the same drawing, existing pipe, ductwork and equipment shall be shown using a light or shaded line. New equipment shall be drawn with darker lines than main piping.

C. All ductwork shown on plans hall be shown using a double line, drawn to scale shown, the actual duct dimensions, and round duct centerline. Single line representation shall only be used for flexible ductwork to diffusers/grilles.

D. Pipe shall be identified as to size and service code (fluid in pipe).

E. Valve stems, hand wheels, etc., even though shown symbolically, shall be drawn to scale where a clearance problem may exist or where removal or operation may be critical.

F. The scale used for Mechanical drawings shall be as follows:

1. General site routing plans – 1/10" to 1/20" = 1'-0"
2. Piping plans (including double line piping) – 1/8" to 1/4" = 1'-0"
3. Enlarged plans, sections and details – 1/4" to 3/4" = 1'-0"

G. Pipe and ductwork mains and branches shall be dimensionally located from the facilities structure, such as column lines, walls, ceiling, equipment, supports, etc., or from recognized bench marks; as required or justified by complexity or space constraints.

H. Pipes and ductwork shown in elevation or section shall have their centerline or bottom of pipe/duct elevations given above or below grade or floor elevation to a reference datum plane. All pipe/duct elevations shall be identified on the drawings and coordinated with other items vertically.

I. When draining of horizontal piping is required or drip stations are called for, the slope in lines shall be called out by an arrow placed adjacent to the applicable line.

J. The slope shall be indicated in fraction of an inch per foot or the elevation given at both ends of the slope. Invert elevations shall be given at the start point of the first bend, and obstruction clearance, at tie-ins to existing piping and/or when the continuation of the piping is covered by another discipline.

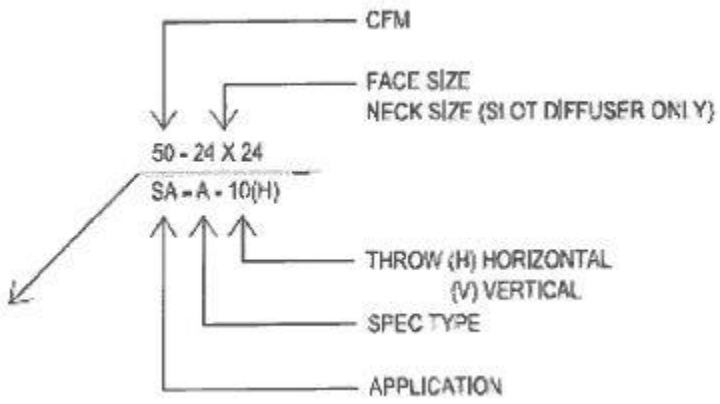
K. When more than one system or service is delineated on the drawing, line designations shall be used.

L. When pipe or tubing runs are grouped close together, the line designations shall be called out.

M. Guides, anchors, and expansion compensators shall be located and described.

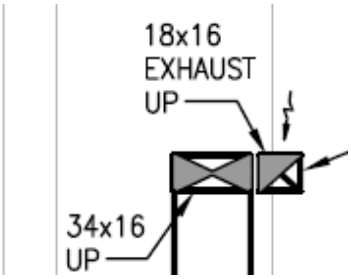
N. All new and existing diffusers, registers, and grilles shall be called out with a minimum face size or neck size, design airflow, specification type, and maximum pressure drop or maximum throw at 100 fpm. Presentation shall be identified with a single callout.

1. Refer to the following example of the Air Distribution Device Identification:



O. Ductwork and piping callouts shall be labeled in the direction of fluid flow and indicate equipment service.

1. In the example below, the exhaust air is labeled correctly and the supply air is labeled incorrectly. It should read **34 x 16 from above** or better **34 x 16 from AHU-CX**



Section 1805 - Heating, Ventilating, Air Conditioning

1805.1 General

Heating, ventilating, and air conditioning drawings delineate the components required to supply or move air by natural or mechanical means. Such air may or may not be conditioned (i.e. filtered, tempered, and/or humidified). These drawings shall establish procedures for construction of the facility design, including pertinent services, equipment, and utilities. The delineation for these drawings shall incorporate dimensions, symbols, codes, conventions, schedules, diagrams, etc., in describing the ducts blowers, filters, heating or cooling coils, roof exhausts, grilles, dampers, air conditioning units, pumps, and controls, ducts, and equipment. The drawings shall be completely coordinated with all other design disciplines to assure that there are no designed conflicts and that the systems can be installed as delineated.

1805.2 Combined Drawings

HVAC Systems and piping systems for HVAC systems may be combined on the same set of drawings where practical and prior written acceptance form the Owner has been issued.

1805.3 Drawing Delineation

The following rules shall apply when detailing these drawings:

A. Drawings shall be prepared showing routing of ducts and piping and location of ducts, grilles, and required ventilation, exhaust, and/or air conditioning equipment. The preferred scale for arrangements is 1/4" = 1'-0". (To aid in checking drawings and resolving potential interferences among other components, such as piping, electrical, architectural, etc., the heating, ventilation, and air conditioning drawing shall be prepared to the same scale as these other drawings, where feasible).

B. Duct layouts shall include grille sizes, CFM, splitters, outlet control dampers, elbows, access doors, branches, volume control dampers, louver openings, booster heating equipment, test holes, and other miscellaneous components equipment and controls.

C. When duct sizes are given, the first dimension is the side shown, for example, 20x12. The 20" dimension is the width and the 12" dimension is the depth where the duct is shown in plan.

D. Material for ducts, gauge of metal, type and spacing of joints and reinforcements, type and spacing of hangers, angle, or change in size transitions, and cross bracing shall be covered in the specifications.

E. Direction of flow shall be indicated by an arrow.

F. All parts such as coils, fans, dampers, filters, housings, compressors, and miscellaneous items shall be called out on the drawing. A schedule may be employed for this purpose. A schedule lists the type, size, capacity, speed, pressure, type enclosure, fins per inch and rows, and other pertinent components in tabular form. Deviations from the standard schedules shall be approved by the Project Manager prior to use.

G. Automatic control diagrams for ventilation, heating, and air conditioning systems shall show:

1. All controllers, sensors, thermocouples, valve and damper operators, relays, and accessories necessary to illustrate the functions and sequence of operation of all principal components in the system.
2. The set point and throttling range of all controllers.
3. The normally open or closed position of all valves and dampers.
4. A list or matrix of inputs and outputs.
5. The sequence of operation of the system through a complete winter-summer cycle, including the off and fire alarm conditions shall be provided in the specifications.

End of Chapter

Chapter 19 - Plumbing Drawings

Section 1900 - Plumbing Drawings

1900.1 Definitions

A plumbing drawing delineates equipment, materials, components, ductwork, piping, and accessories to convey liquids, and gases for the construction of mechanical systems. Mechanical systems include HVAC, plumbing, fire protection, building automation and any process system requirements. The drawings shall indicate complete design. Prior written acceptance is required for any design-build component.

1900.2 General Requirements

The drawings establish the requirements for construction of the facility design, including pertinent services, equipment, and other features required for the performance of the mechanical equipment. These drawings incorporate dimensions, symbols, reference to codes, conventions, schedules, diagrams, etc., in describing the size and routing of pipes, the kind of material to be used, equipment criteria, duct sizes and shapes, amount of flow and the temperature of material in pipes and ducts, valve types and location, floor and wall penetrations, tank construction, equipment, piping insulation, and other facets of mechanical design as are required. Drawings shall be completely coordinated with other disciplines to ensure there are no conflicts and that the systems can be installed as delineated.

1900.3 Design Requirements

Refer to *Mechanical Design Standards Manual* for detailed requirements of plumbing design, details, and specifications.

Section 1901 - Sequence

1901.1 Numbering

Construction documents are divided into specific groups per National CAD Standards (NCS). The group number shall always remain the same no matter how large the project. Refer to *BIM Design Standards Manual*.

1901.2 Demolition

Demolition drawings of plumbing systems shall call out all insulation, piping and associated controls to be removed. Controls shall be called out to be removed in the programming of that system. Abandoned-in-place piping is not allowed unless written authorization is obtained in writing from the Project Manager.

Section 1902 - Flow Diagrams

1902.1 Schematic Illustrations

Flow diagrams are schematic illustrations of piping or duct circuits including equipment, components, and instruments involved in the mechanical system. The purpose of flow diagrams shall be to define a mechanical system with respect to flow directions, component sizes, control functions, operational and flow balances.

1902.2 Key Drawings

Flow diagrams are key drawings, which form a basis for detailed design drawings, maintenance, operator training, and construction. Due to the definitive nature of flow diagrams, they shall be developed prior to the commencement of construction document phase piping drawings or any detailed design drawings, which may be affected by the flow diagrams.

1902.3 Requirements

Flow diagrams shall be required to illustrate the following:

A. Process systems; chemical feed systems.

B. Hot water piping systems.

C. Plumbing waste and storm drainage systems: diagrams shall be provided and show calculated fixture unit counts on all sections and equipment.

D. Plumbing hot and cold water supply systems: diagrams shall be provided and show calculated fixture unit counts on all sections and equipment.

E. Automation; temperature controls.

F. Standpipe systems and fire risers.

G. Gas piping systems. Gas piping systems shall include calculations of inches of water and shall note the demand loads of all equipment to be connected to the gas system.

H. Fuel systems.

The need for additional flow diagrams shall be determined on a project-by-project basis by the Design Engineer and Project Manager. The need for additional flow diagrams shall be based on the complexity of piping the mechanical system.

Section 1903 - Flow Diagram Requirements

1903.1 General

Piping and equipment shall be represented on flow diagrams in schematic form. Accurate depiction of physical relationships is essential for clarity (i.e. a pressure vessel with nozzles located on top, bottom, and sides should appear on the flow diagram with nozzles shown in approximately the same relationship). Piping specialties and special features shall bear a reasonable resemblance to the actual items or installations.

1903.2 Flow

A flow direction arrow shall appear at each line junction or change of direction in order to illustrate the flow direction clearly.

1903.3 Limits of Construction

Purchased equipment packages, which are pre-assembled or pre-piped, shall be so designated with a dashed line to outline the limits of the vendor-supplied portion.

1903.4 Instruments

Instrument Society of America (ISA) symbols shall be used to represent instruments and control loops. Instruments shall be identified by a tag number inside a circular balloon, in accordance with ISA standards. Tag numbers shall be permanently affixed to each instrument.

1903.5 Set Points

Set points for relief valves, limit switches, control valves, dampers, and operating temperatures shall be indicated. Failure positions shall be called out for control valves and dampers (fail open, fail closed). Other instrument set points or operating control points shall be called out as appropriate to aid design and construction.

1903.6 Controls

For complex systems or those systems controlled by Direct Digital Control (DDC), a written logic description shall be added to the flow diagrams or included in the project technical provisions of the Specifications.

1903.7 Operating Conditions

Consideration shall be given to all anticipated operating conditions, including start-up and shutdown. Flow diagrams shall show bypasses, start-up lines, shutdown lines, and any valves, controls, etc., required for any anticipated operating condition.

1903.8 Identification Tags

Facilities management identification tag numbers and basic design parameters shall be shown on the flow diagrams in a neat format along the top or bottom of each drawing.

1903.9 Exiting System Tie-in

When new plumbing systems are to be tied into existing systems or systems being designed by others, each tie-in shall be identified on the drawings by a hexagon symbol. The designer shall include a list of tie-ins on the drawings as required for a project. The tie-in schedule shall note the tie-in number, piping, ductwork, or other service, and the extent of interruption required to affect each tie-in. This schedule shall be used to help coordinate construction with normal operations in order to minimize unscheduled down time.

1903.10 Symbols

Symbols used on flow diagrams for valves, instruments, and accessories shall conform to standards established by the legend.

1903.11 Gravity Drainage

When a specific service requires positive gravity drainage, arrows and notes on the flow diagram shall illustrate the slope required.

Section 1904 - Drawings For Piping

1904.1 General

Piping drawings shall delineate the components required to convey the fluids. Included shall be such items as the supply and distribution of potable water, sanitary water and waste, storm waste, chilled water, systems for fire protection, drainage, fuel supply to boilers and heating water. Piping drawings, or a set of piping drawings, delineate the kind, size, and routing of pipe, hose and tubing, the associated vessels and equipment, and other facets of mechanical design by incorporating dimensions, symbols, codes, conventions, schedules and diagrams.

1904.2 Flow Diagrams

When flow diagrams are required, they shall be completed prior to commencement of detail piping drawings.

1904.3 Drawing Delineation

The following rules shall be followed in the delineation of piping drawings:

A. Exposed pipe shall be shown as a single thick line, and hidden or buried pipe shall be shown as a thick dashed (hidden) line; however, in order to delineate clearances and special conditions, 6" and larger pipe shall be shown using a double line, drawn to scale shown, the actual pipe dimensions , and pipe centerline.

B. When new and existing pipe and/or equipment are shown on the same drawing, existing pipe and equipment shall be shown using a hidden line. New equipment shall be drawn with lighter lines than main piping.

C. Pipe shall be identified as to size and service code (fluid in pipe).

D. Valve stems, hand wheels, etc., even though shown symbolically, shall be drawn to scale where a clearance problem may exist or where removal or operation may be critical.

E. The scale used for piping drawings shall be as follows:

1. General site routing plans – 1/10" to 1/20" = 1'-0"
2. Piping plans (including double line piping) – 1/8" to 1/4" = 1'-0"
3. Enlarged Plans, Sections and details – 1/4" to 3/4" = 1'-0"

F. Pipe mains and branches shall be dimensionally located from the facilities structure, such as column lines, walls, ceiling, equipment, supports, etc., or from recognized bench marks; as required or justified by complexity or space constraints.

G. Pipes shown in elevation or section shall have their centerline or bottom of pipe elevations given above or below grade or floor elevation to a reference datum plane. All pipe elevations shall be identified on the drawings and piping coordinated with other items vertically.

H. Piping callouts shall be labeled in the direction of fluid flow and indicate equipment service.

I. When draining of horizontal lines is required or drip stations are called for, the slope in lines shall be called out by an arrow placed adjacent to the applicable line.

J. The slope shall be indicated in fraction of an inch per foot or the elevation given at both ends of the slope.

K. When more than one system or service is delineated on the drawing, line designations shall be used.

L. When pipe or tubing runs are grouped close together, the line designations shall be called out.

M. Guides, anchors, and expansion compensators shall be located and described.

Section 1905 - Plumbing

1905.1 General

Plumbing drawings delineate the components required to supply domestic hot and cold water to plumbing fixtures and then to remove this water after use through a sanitary drainage and vent system. These drawings shall establish procedures for construction of the plumbing system design, including pertinent utility connections, plumbing fixtures and piping. The delineation for these drawings shall incorporate dimensions, symbols, codes, conventions, schedules, diagrams, etc., in describing the plumbing system design.

1905.2 Detailing Requirements

The following rules shall apply when detailing these drawings:

A. Drawings shall be prepared showing routing of domestic cold, hot, and re-circulating hot water piping. Sanitary drainage and vent piping shall also be shown. The preferred scale for arrangements is 1/4" = 1'-0". (To aid in checking drawings and resolving potential interferences among other components, such as ductwork, electrical equipment, etc.). The plumbing drawing shall be prepared to the same scale as the drawings of the other disciplines, where feasible.

B. Plumbing drawings shall include pipe sizes and routing, design fixture unit counts or design flow rates, direction of flow, clean-out locations, plumbing fixture schedule, invert elevations for sanitary drainage piping, and locations for vent piping roof penetrations.

C. Materials for piping, insulation, and equipment such as water meters, water heaters, water hammer arresters, infrared sensing devices for automatic valve control and plumbing fixtures, shall be covered in the technical specifications.

D. An isometric diagram to five feet outside the buildings shall be provided for the domestic hot and cold-water piping, with re-circulation hot water piping included on the isometric where applicable. Indicate water heater location, valves and tie-in location for connection to water utility service. Indicate all water meters as necessary.

E. An isometric diagram shall be provided for the sanitary drainage and vent piping to five feet outside the building, with pertinent invert elevations indicated.

F. An isometric diagram shall be provided for the following additional plumbing systems:

1. Gas piping systems
2. Storm water systems (primary and secondary)
3. Grease waste and vent systems
4. Acid waste and vent systems

G. All plumbing fixtures shall be itemized in schedules on the drawings. The schedule shall list the type of fixture, and connection sizes of hot, cold, sanitary and vent piping. Water heaters may be scheduled in cases where several are required.

H. Automatic (infrared) lavatory valve operators and flush valves shall be coordinated with the electrical engineer/electrical drawings and shown on the plumbing drawings.

1905.3 Service Diagrams

On all projects requiring natural gas service, compressed air or other types of pressured systems, provide as part of the construction documents flow diagrams indicating demand loads. An example may be a flow diagram indicating gas service with regulator size, and inches of water demand calculations for each element or devices to be served by the gas service. Include identification at each device the range of pressures acceptable for start-up, testing, and operation of the device.

End of Chapter

Chapter 20 - Fire Protection Drawings

Section 2000 - Fire Protection Drawings

2000.1 Definitions

A fire protection drawing delineates equipment, materials, components, piping and accessories to convey liquids, and gases for the construction of fire protection systems. The drawings shall indicate complete design. Prior written acceptance from the Project Manager is required for any design-build component. These drawings establish the requirements for construction of the facility design, including pertinent services, equipment, and other features required for the performance of the mechanical equipment. These drawings incorporate dimensions, symbols, reference to codes, conventions, schedules, diagrams, etc., in describing the size and routing of pipes, the kind of material to be used, equipment criteria, duct sizes and shapes, amount of flow and the temperature of material in pipes and ducts, valve types and location, floor and wall penetrations, tank construction, equipment, piping insulation, and other facets of mechanical design as are required. Drawings shall be complete and coordinated with other disciplines to ensure there are not conflicts and that the systems can be installed as delineated.

2000.2 Design Requirements

Refer to *Mechanical Design Standards Manual* for detailed requirements of fire protection design, details, and specifications.

Section 2001 - Sequence

2001.1 General

Construction documents are divided into specific groups per National CAD Standards (NCS). The group number shall always remain the same no matter how large the project. Refer to *BIM Design Standards Manual*.

Section 2002 - Flow Diagrams

2002.1 Schematic

Flow diagrams are schematic illustrations of piping or duct circuits including equipment, components, and instruments involved in the mechanical system. The purpose of flow diagrams shall be to define a mechanical system with respect to flow directions, component sizes, control functions, operational and flow balances.

2002.2 Key Drawings

Flow diagrams are key drawings, which form a basis for detail design drawings, maintenance, operator training, and construction. Because of the definitive nature of flow diagrams, they shall be developed prior to the commencement of construction document phase piping drawings or any detail design drawings, which may be affected by the flow diagrams.

2002.3 Requirements

Flow diagrams shall be required to illustrate the following:

A. Standpipe systems and fire risers

B. Gas piping systems

C. Fuel systems

The need for additional flow diagrams shall be determined on a project-by-project basis by the Design Engineer and Project Manager. The need for additional flow diagrams shall be based on the complexity for piping of the fire protection system.

Section 2003 - Flow Diagram Requirements

Flow diagram requirements shall conform to requirements in Chapter 20, Plumbing Drawings Protection Drawings.

Section 2004 - Drawings For Piping

2004.1 General

Fire Protection Drawings shall delineate the components required to convey the fluids. Piping drawings shall delineate the material, size, and routing of pipe, hose and tubing, the associated vessels and equipment, and other facets of mechanical design by incorporating dimensions, symbols, codes, conventions, schedules, and diagrams.

Systems shall never be shown to be supported by slab on grade without flex connections.

Where systems require structural penetration for clearances of other project elements, provide a complete design including required penetration sizes. Completely coordinate with the Structural Engineer all penetrations sizes and locations.

2004.2 Flow Diagrams

When flow diagrams are required, they shall be completed prior to commencement of detail piping drawings.

2004.3 Delineation

The following rules shall be followed in the delineation of piping drawings:

A. Exposed pipe shall be shown as a single thick line and hidden or buried pipe shall be shown as a thick dashed (hidden) line; however, in order to delineate clearances and special conditions, 6" and larger pipe shall be shown using a double line, drawn to scale shown, the actual pipe dimensions.

B. When new and existing pipe and/or equipment are shown on the same drawing, existing pipe and equipment shall be shown using a hidden line. New equipment shall be drawn with lighter lines than main piping.

C. Pipe shall be identified as to size and service code (fluid in pipe).

D. Valve stems, hand wheels, etc., even though shown symbolically, shall be drawn to scale where a clearance problem may exist or where removal or operation may be critical.

E. The scale used for piping drawings shall be as follows:

1. General site routing plans – 1/10" to 1/20" = 1'-0"
2. Piping plans (including double line piping) – 1/8" to 1/4" = 1'-0"
3. Sections and details – 1/4" to 3/4" = 1'-0"

F. Pipe mains and branches shall be dimensionally located from the facilities structure, such as column lines, walls, ceiling, equipment, supports, etc., or from recognized bench marks; as required or justified by complexity or space constraints.

G. Pipes shown in elevation or section shall have their centerline or bottom of pipe elevations given above or below grade or floor elevation to a reference datum plane. All pipe elevations shall be identified on the drawings and piping coordinated with other items vertically.

H. When draining of horizontal lines is required or drip stations are called for, the slope in lines shall be called out by an arrow placed adjacent to the applicable line.

I. The slope shall be indicated in fraction of an inch per foot or the elevation given at both ends of the slope.

J. When more than one system or service is delineated on the drawing, line designations shall be used.

K. When pipe or tubing runs are grouped close together, the line designations shall be called out.

L. Guides, anchors, and expansion compensators shall be located and described.

Section 2005 - Fire Protection

2005.1 Drawings

Fire protection drawings delineate the components required to provide fire protection to the facility. This includes all methods of fire protection including, but not limited to: wet-pipe, dry-pipe, deluge systems, carbon dioxide systems, Halon systems, foam systems, pre-action systems, fire extinguishers, fire hoses, and standpipes. These drawings shall establish procedures for construction of the fire protection system design, including water connections to the fire main, sprinkler heads, piping, alarms, valves, etc. The delineation for these drawings shall incorporate dimensions, codes, conventions, schedules, diagrams, etc., in describing the fire protection system design.

2005.2 Detailing

The following rules shall apply when detailing these drawings:

A. Drawings shall be prepared showing routing of fire protection piping. The preferred scale for arrangements is 1/4" = 1'-0".

B. To aid in checking drawings and resolving potential interferences among other components, such as ductwork, electrical equipment, etc. The fire protection drawings shall be prepared to the same scale as the drawings of the other disciplines.

C. Fire protection drawings shall include pipe sizes and routing, direction of flow, test connection points, riser diagrams showing valves and alarms, fire extinguisher and hose locations.

D. Materials for piping, valves, sprinkler heads, alarm devices, and fire department connections shall be covered in the technical specifications.

E. Density and remote square footage requirements shall also be indicated.

End of Chapter

Chapter 21 - Electrical Drawings

Section 2100 - Electrical Drawings

2100.1 General Information and Requirements

The electrical drawings described in this chapter shall be prepared as applicable, depending upon the characteristics and complexity of the particular projects involved. These drawings shall be provided when essential in planning, procurement, construction, evaluation, recording, and use of the particular projects. The drawings shall indicate complete design. Prior written acceptance is required for any design-build component.

2100.2 Definition

Facility electrical drawings are graphic representations of facilities electrical design requirements.

2100.3 Design Requirements

Refer to *Electrical Design Standards Manual* for detailed requirements of electrical design, details, and specifications.

Refer to *BIM Design Standards Manual*.

2100.4 Completeness

Facility electrical drawings, when interpreted in association with the construction specifications, shall:

A. Furnish sufficient information to permit installation of manufactured equipment that requires electrical service WITHOUT CONFLICT WITH WORK OF OTHER DISCIPLINES.

B. Furnish sufficient information to manufacture equipment that is of special design, made exclusively to meet the requirement of the project. Components and systems shall be UL listed.

C. Describe items so that they may be procured.

D. Furnish sufficient information to permit planning, construction, evaluation, recording, repair, and maintenance of facilities.

E. Furnish the above in sufficient completeness for accomplishment without the need of assistance from the Consultant.

2100.5 Sequence

Construction documents are divided into specific groups per National CAD Standards (NCS). The group number shall always remain the same no matter how large the project.

2100.6 Electrical and Electronic Symbols

Electrical and electronic symbols, when used, shall be in accordance with American National Standards Institute (ANSI). Other symbols, if devised by the Developer, shall be shown in the **ITEM** column and explained in the **DESCRIPTION** column of the LEGEND with indication **FOR THIS PROJECT ONLY**.

2100.7 Symbols for Other Functional Disciplines

Symbols for functional disciplines other than electrical shall be as specified in the respective sub-sections of this manual.

2100.8 Functional Designations

Functional designations, when used, shall be in accordance with Section - Function Designations.

2100.9 Delineation Types

Electrical drawings shall generally include, as required, the following types of delineations:

A. Block diagrams
B. One-line diagrams
C. Schematic diagrams
D. Connection diagrams
E. Facility electrical power distribution plans
F. Facility lighting plans. (Outdoor and indoor)
G. Facility communications plans and risers
H. Facility grounding plans and risers
I. Facility security plans and risers
J. Facility lightning protection plans
K. Fire alarm plans and risers
L. Panel, circuit and other schedules
M. Detail drawings

The number of delineation drawings for a project shall be kept to a minimum, consistent with clarity for constructability.

2100.10 Delineation Drawings

Subject to Owner acceptance, the drawings for projects need not contain all delineation types. For example, projects consisting only of a single building and a relatively simple electrical system may not need a block diagrams or single-line diagrams if the information normally found in them is effectively conveyed by other delineation types. Different and various combinations of delineation types may be shown on the same drawing, except that lighting and power shall always be on separate plans. Each delineation shall be identified by its type below the area where it is displayed, e.g., SCHEMATIC DIAGRAM. These delineations shall not be included on architectural, structural, civil, or mechanical drawings. If delineation drawings are different from outlined herein, then the Drawing Index shall clearly show combination of delineation.

2100.11 Legend

Electrical drawings shall contain a legend of symbols. The symbols as used in accordance with Section Symbols for Electrical Drawings shall be considered standard for application to electrical drawings. If a nonstandard symbol is not fully described by supplementary notation where it is shown, it should be: a) Contained in the **LEGEND,** b) Explained in the notes to eliminate possibility of misinterpretation if paragraph (a) is insufficient, c) Noted **FOR THIS PROJECT ONLY**.

2100.12 Specification Relationship

Specifications, which are a portion of a contract package, shall include an electrical section. The electrical drawings, together with the specifications shall specifically describe all the electrical design requirements of the project. Vendor information drawings may be included as reference drawings subject to written approval from the Manufacturer. Electrical drawings, which may form a part of a purchase specification drawing, may be included as reference drawings. The Developer by submitting the documents for Bid ensures that space allocations for equipment specified is adequate and compliant with all code requirements, including clearance requirements and free of conflicting space requirements of all other trades.

Section 2101 - Electrical Plans

2101.1 Definition

Electrical plans consist of scaled delineations and line symbology arranged to depict circuits and electrical equipment installation. Diagrams and the specifications supplement the plans to present the required information for facilities. The following types of plans are included:

A. Electrical equipment arrangement
B. Facility electrical power distribution, including underground distribution
C. Facility grounding
D. Facility lighting, indoor and outdoor
E. Facility security
F. Facility lightning protection
G. Facility communications
H. Fire alarm

2101.2 Symbols

Electrical symbols used shall be in accordance with Section - Symbols for Electrical Drawings. Electrical items such as wire, conduit, cable, electrical equipment, etc., shall be delineated by line work distinguishable from line work used to depict items shown for reference or orientation. Lines between boxes on power and lighting circuit plans shall indicate cable, conduit, duct, and wire runs. Separate lines for wires within these carriers are generally not shown except by symbol. Conduit runs shall generally be indicated by straight lines run parallel to building lines, walls, floors, ceilings, etc.

Circuitry not depicting conduit routing shall be generally depicted by curved lines. When these lines are used without additional qualification, they may be interpreted as permitting the most direct, non-interfering route compliant with codes and workmanship standards. This system may ONLY BE USED BY THE DESIGNER IF the designer has professionally designed the system to guarantee no interference to the route during construction. It is the Developer's responsibility to design the project. When a specific routing of conduit, wire, and cable run is required, the routing of these runs shall be dimensioned and/or covered by note. Specific routing location run shall be required when routing is buried, to be placed in concrete, or to be routed through penetrations to prevent conflict or to assure clearances. Dimensional locations of routing shall be shown.

Circuit designation shall be shown for feeders, such as,

- A = Alarm Circuit
- C = Control Circuit
- L = Lighting Circuit
- D = DC Circuit

2101.3 Future Space

When space is specifically set aside for the possible future installation of equipment such as a transformer, such space shall be indicated in dashed lines, dimensioned, and labeled.

2101.4 Spares

Spare wires, cables, conduits, terminals, circuit breakers, etc., shall be shown and identified as spares.

2101.5 Cross-reference

Applicable drawings, including other discipline drawings, shall be referenced. Reference to vendor information drawings shall not be used. Reference made shall be to specific vendor equipment drawings only when equipment is known or received.

2101.6 Arrows On Wires

The use of arrowheads on lines, which depict wire, cable, or conduits, shall be limited to the indication of *home runs* (home runs are those returning, without interruption, to the local panel board). Location and elevation of wire ways, electrical bus, and cable trays shall be shown.

2101.7 Completeness

The completeness of the drawings shall be such that additional drawings need not be made in the field to interpret the design. The drawings shall permit the development and analysis of applicable vendor information drawings. Unless included in the specification, the following items shall be included on the drawings:

A. Extent of utilization of National Testing Laboratory acceptance of items

B. Compliance, as applicable, to the National Electrical Code

C. Marking or tagging requirements, i.e., Underwriter's labels, wire sizes, fuse ratings, etc.

D. Labeling of circuits and equipment

2101.8 Load Balancing

The plans shall be so delineated that the proximity to balance load conditions can be ascertained.

2101.9 Special requirements

Special requirements such as those indicated below shall be included on the drawings:

A. Number, size, and location of building expansion joints

B. Construction details, such as when a conduit passes from a floating floor to a rigid structure

2101.10 Details

Details depict features, which require delineation in addition to that provided on the basic plan or elevation.

2101.11 Devices

Devices, which have different energized and de-energized appearance, shall be shown in the de-energized condition.

2101.12 Scale

Scales 1/8"=1'0" and larger shall generally be used. Drawings shall be the same scale as the architect's drawings, unless a larger scale is required. Drawing North orientation shall be the same as the architect's drawings. Building areas shall be the same as the architect's drawings and presented in the same order.

Section 2102 - Facility Electrical Power Distribution Plans

2102.1 Definition

Facility electrical power distribution plans depict primary and secondary power distribution, control and grounding, excluding lighting, and communications. Plans shall show equipment arrangements, configuration, and information to locate, position, and mount electrical equipment.

2102.2 Primary Supply

The primary supply cables to, and the secondary feeder cables or busways from, service entrance equipment shall be shown.

2102.3 Secondary Circuits

Connections of secondary circuits to utilization points and associated equipment such as panel boards, distribution transformers, converting equipment, etc., shall be shown.

2102.4 Panelboard Schedules

Power panelboard schedules shall be shown. The total connected load (KVA) and the estimated demand load (KVA), including the demand factor used, and shall be shown on the schedule with phases balanced.

2102.5 Panelboard Drawings

Panelboards, existing and new, shall be delineated in plan and elevation, showing all equipment adjacent to the installation dimensionally. New and existing equipment shall be indicated to scale. If optional panelboard manufacturers are specified, the LARGEST panel shall be shown, and the code-required clearances shall be indicated on the drawings. Delineation of the equipment shall be provided to the extent that its orientation with surroundings clearly depicts correct top-to-bottom and front-to-back positioning. Plan views shall be oriented the same as architectural plan views. Surrounding equipment and areas shall be identified. Door swings, clear areas required for placement of parts, etc., shall be shown.

2102.6 Delineation

Equipment shall be dimensionally located from column lines, walls, ceilings, etc.

2102.7 Grounding

Grounding design shall comply with DEN cathodic protection requirements and shall be delineated on the drawings including detailing of the grounding bars. Grounding paths shall be shown whether made through wires, buses, conduit, ducts, rods, or other items serving as ground conductors. Bonding information shall be included, unless covered in specification. Grounding conductor sizes and locations shall be delineated.

2102.8 Raceways

Raceway systems and components (cable tray, conduit, pull boxes, wireway, etc.) shall be dimensionally located and described. Coordination of locations with other building systems is the responsibility of the Developer. The Developer shall ensure there are not conflicts with work to be performed by other disciplines.

2102.9 Equipment

Equipment shall be identified by notes or in a material list. Equipment shall be delineated indicated dimensions of the largest (or equal) manufactured equipment. Access clearances for equipment shall be delineated on the drawings. Provide concrete housekeeping pads for floor-mounted electrical equipment.

2102.10 Emergency Power

Standby or emergency power systems shall be included and identified.

2102.11 Transformers

Heat load of the transformers shall be documented on the drawings and shall be addressed in the HVAC cooling calculations.

2102.12 Receptacles

Receptacles shall be defined by symbol and home run circuit number. Note mounting height when different from typical. The panel for the home run shall be indicated on the drawings, and shall be keyed by room number as well as panel number. Intermediate pull boxes shall be designated on the drawings and shall be coordinated with all other building systems to assure access.

Section 2103 - Facility Lighting Plans

2103.1 Definition

Facility lighting plans are electrical plans, which depict the lighting circuits, lighting control circuits, fixtures, and accessories within a facility. Facility lighting plans delineate the installation of the lighting system beginning with the power source at the service entrance equipment or the lighting transformer and panelboards and extending to the light fixtures.

2103.2 Circuits

Lighting circuits shall generally be shown separate from other circuits. Lighting circuits may include feeders, transformers, panelboards, wires, cables, raceways, switches, lamps, outlets, emergency lighting batteries, relays, etc.

2103.3 Delineation

Delineation for systems shall include runs from the service entrance equipment through the lighting control panelboards and conductors to the lights. Size, material, etc., shall be given for wire, conduit, and special fittings.

2103.4 Panels

Panelboard connection details shall be shown; a panelboard schedule shall be used. The mounting height shall be given by note or in elevation if not covered in the specification. Panel schedules shall describe equipment and its location (room number).

2103.5 Symbols

The lighting symbols shall include light fixture type number or letter code within or adjacent to them with their home run branch circuit number, and a lower case letter indicating switches by which they are controlled. Note height if different from typical. Night-lights or security lighting circuits shall be distinguishable from the other lighting.

2103.6 Layout and Location

Coordinate lighting layouts with location of mechanical and other electrical equipment. Mounting height for fixtures shall be given by note or shown on elevations. The mounting height of switches shall be given by note or in elevation unless covered in the specification.

2103.7 Emergency Lighting

Emergency battery-powered lighting units, which are activated by power failures, shall clearly indicate the lighting circuits to which they are connected and that they are connected on the line side of all switches per applicable code.

Section 2104 - Facility Communications Plans

2104.1 Definition

Facility communication plans are electrical plans that depict the interconnecting electrical circuits between devices such as telephones, closed-circuit television, intercoms, public address, etc., as well as the various alarm or signaling systems such as fire detection and alarm, energy management and control system and security alarm, etc.

2104.2 Locations

The location of the communication equipment shall be shown or noted. The interconnecting wiring and/or cabling shall be shown. When more than one system is shown on a plan, each shall be made clearly discernible. Raceway systems and components (cable tray, pull boxes, conduit, wireway, etc.) shall be located and described as required. Communication systems may be integrated together into common data communication links.

Section 2105 - Diagrams - General

2105.1 Definition

An electrical diagram is a graphic explanation of the manner in which an electrical installation or system performs its intended function. It depicts the characteristics and relationships of items within a specified area or functional system by the use of symbols and lines. Diagrams, depending upon the type, shall show flow, function, or physical connections.

2105.2 Layout

The layout of electrical diagrams shall be such that the main features are prominently shown. The parts of the diagram shall be spaced to provide an even balance between blank spaces and lines. A sufficient blank area should be provided near symbols to avoid crowding of notes. Provide blank spaces for planned additions.

A. Diagram line work shall be of medium line width except where otherwise specified in the respective paragraph for a particular diagram type.

B. A set of electrical drawings shall include either a one-line diagram, schematic diagram, or both. Drawing titles shall include the delineation type, as follows, when the drawing contains only a single delineation.

1. Block diagram
2. Single-line diagram
3. Schematic diagram
4. Connection diagram

C. When combinations of electrical delineation types are included on the same drawing, the entry for the type of drawing in the title block shall be selected to adequately define the drawing content. Typically, if a drawing combines all of the delineation types, the entry in the title block shall be ELECTRICAL DIAGRAMS. Facilities diagrams shall consist of the following types as required by project:

1. Block diagram
2. Single-line diagram
3. Schematic diagram
4. Connection diagram

D. When a circuit contains parts, which need to be shown grouped, the grouping shall be indicated by means of a boundary line enclosure.

E. All lines between blocks or symbols shall be vertical or horizontal, with the use of diagonal lines restricted.

F. Lines shall be as direct and short as possible without the use of diagonal lines. Lines shall have a minimum number of turns and crossings, crossings shall be looped.

G. The nomenclature or other designations used for identification of blocks, symbols, equipment, etc., shall be in accordance with the device, equipment marking, or the standards established for the facilities.

H. Interface reference for flow lines, etc., that are from or to features not included on the drawing shall have a direction arrow.

I. Notes concerning physical or functional information shall be used, as required, when it is necessary to have an accompanying description to clarify the graphic presentation.

J. More than one type of diagram may be included on one drawing; however, they should usually be kept separate from plan drawings.

K. Connecting lines should preferably be drawn horizontally or vertically and with as few bends and crossovers as possible. When connecting lines are drawn parallel, the spacing between lines after fifty percent (50%) reduction shall be legible.

L. A specific diagram type may include supplementary information beyond the requirements outlined in its descriptive text. For example, a block diagram or connection diagram may include schematic information, while a schematic diagram may include wiring information. The combination of information on a specific diagram type is dependent upon increasing the utility of the diagram. The entry for the type of drawing in the title block shall be selected based upon the major purpose of the drawing.

Section 2106 - Block Diagrams

2106.1 Definition

A block diagram describes the concepts and/or organization of an equipment or facility by the use of rectangular blocks, representing functions or groups of functions. Interconnecting lines establish the relationships between blocks and indicate the direction of information flow. A block diagram is used to give a quick over-all picture of a system and the general interrelationships between components of that system. It may be used for general arrangement studies, functional explanations, systematization of facilities, or for design discussion purposes.

2106.2 Requirements

A. Diagrams

1. A block diagram shall be presented in as simple a form as possible. Rectangular blocks shall be used to represent functional electrical systems or parts thereof and/or major elements of an electrical system or circuit. Various other symbols may be used as supplementary information to increase the utility of the diagram.
2. Identifying nomenclature shall be included within the blocks.
3. Block diagrams may be made for any level of project activity. For example, a block diagram at the highest level may be made for a complete project, or any lower-order stage.
4. Related mechanical, electro-mechanical, or optional apparatus may also be included on block diagrams in rectangular form.
5. Mechanical connections between such elements shall be illustrated with dashed lines connecting the applicable blocks.
6. If the form of the circuit involves multiple sources and common or similar circuits, or variations thereof, tabulations may be used.
7. If a block diagram must be divided and placed on more than one drawing, the division of the circuit should be made in a logical manner, that will avoid confusion and at a point of minimum information transfer.

B. Connecting Lines

1. Lines connecting blocks shall indicate relationships, direction of flow of the system, sequence of operation, etc. The arrangement of lines and blocks shall show action or energy flow in functional sequence from top to bottom and/or left to right of the diagram, starting at the top left or top center and ending at the bottom right of the diagram.
2. Connection lines shall be labeled, where necessary, to make the meaning clear and unmistakable. When dashed lines are used for more than one purpose on a block diagram, these purposes shall be made clear by label, legend, or note.
3. Connecting lines may include arrows to further define the circuit flow.

Section 2107 - One-Line Diagrams

2107.1 Definition

A single-line diagram shows, by means of single lines and graphic symbols, the course of an electrical/electronic circuit or system of circuits and the component devices or parts used therein. The principal objective of the single-line diagram is to record a maximum of significant information in a minimum of space. Facilities single-line diagrams are most useful in representing power distribution and communication systems. It may be used in the study and explanation of the facilities. A single-line diagram conveys basic information about the operation of a circuit or system of circuits. It omits much of the detailed information usually shown on schematic or connection diagrams. A single-line diagram delineates, in more detail than a block diagram, information, which will subsequently be shown on other diagrams.

2107.2 Requirements

The requirements specified in Chapter 4, Schematic Design Phase (30%) shall apply in addition to the following:

A. Only one phase of a multiphase system and one polarity of a dc system shall be used to simplify the circuit and to include the necessary essentials.

B. Descriptive nomenclature, when used, shall be placed above or to the right of the subject element or connecting line unless other placement has a distinct advantage for the particular application.

C. All symbols shall be of the single-line type.

D. A single-line diagram is termed functional if various line widths are used to separate categories of circuits. When this type of diagram is made, the line widths shall be defined. No more than two widths of lines shall be used. Heavy-width lines represent power circuits and medium-width lines represent control and measurement circuits.

E. Nominal voltages shall be used for supplementary information in the designations of systems.

F. Power transformer impedance shall be indicated on the drawing.

G. Transformer voltage representation shall use the symbols dash (-) and slant (/) as follows:

H. The dash (-) is used to separate the voltage ratings of separate windings on a transformer, e.g., 13.8 KV -480V.

I. The slant (/) is used to separate multiple voltages or indicate taps of the same winding, e.g., 208Y/120.

J. Transformation ratios shall use the slant (/) as the separation between the values.

K. A one-line diagram may show only the power circuits or be extended to include secondary and control circuits in the simplified form.

L. The one-line diagram may include pertinent rating information about its items; for example voltages of potential transformers, ampere rating of current transformers, fault current, interrupting capacity, breaker frame and trip ratings of circuit breakers, motor horsepower ratings, load estimates, bus ampere and voltage rating.

M. A one-line diagram may also include wire and cable information, and further descriptions of elements; i.e., element categories, models, drawing numbers, functional designations, length of cable.

N. Indicate distribution equipment, power, control, and metering, and protective relay circuits from the incoming feeder to ultimate motor lighting panel or other load, including item names.

O. Winding connection symbols shall be used adjacent to the symbols for the transformer windings.

P. The quantity of a particular device may be indicated on a single-line symbol when it is necessary to define its quantity in relation to the graphical symbol. The numeral indicating quantity is placed adjacent to the symbol. The number 3 adjacent to the magnetic overload device indicates that there are three circuits like the one shown.

Q. A note shall be included with the legend or notes indicating the function of the quantity numeral, e.g., **THE NUMERAL ADJACENT TO RELAYS DENOTES QUANTITY**.

R. Device lists shall be incorporated on the drawings and included as part of the legend, when functional designations per Section - Connection Diagrams are used. In addition, the meaning of each suffix used with a device function number should be listed if it is not included with a complete device function number. The following illustrates a device list.

1. Examples of device function numbers

- 1A Master Element
- 1M Master Element
- 23 Temperature Control Device
- 38 Bearing Protective Device
- 43 Manual Transfer Switch

- 47 Phase Sequence Voltage Relay
- 49 Machine Thermal Relay
- 51 AC Time Overcurrent Relay
- 51N AC Time Overcurrent Relay (Neutral)
- 52 AC Circuit Breaker
- 52X Auxiliary Relay for 52
- 86 Locking-out Relay

S. Protective relays may be included along with an indication by operator dash lines on the device upon which the relay acts

T. Electrical values and other functional information shall be included as necessary to allow analysis of the circuit.

Examples of some types of information that may apply are as follows:

A. Current, voltage, and interrupting rating of circuit breakers

B. Primary and secondary voltages and kVA ratings of power transformers

C. Voltage and kVA or kW rating of generators

D. Voltage and HP rating and type of motors

E. Rating and type of load on feeder circuits

F. Ratings of power and control sources

G. Circuit breaker frame trip and interrupting current

H. Switches ampere rating

I. Ratings of instrument transformers, fuses, resistors, capacitors, and Developers, motor starters

J. Resistance to ground, inductance, and temperature ratings

K. Voltage and current waveforms

L. Bus amperage, voltage, and fault current capacity

Section 2108 - Schematic Diagrams

2108.1 Definition

A schematic diagram shows, by means of lines and graphic symbols located in sequence of function, an electrical/electronic circuit, or system circuits. A schematic diagram is particularly useful where the electrical relationships or circuits and device elements are the principal considerations. It may be used in systematization and/or circuit analysis. A schematic diagram emphasizes the device elements of a circuit, as distinguished from the physical arrangement of conductors, devices, etc., of a circuit system. The circuit layout follows the signal or transmission path from input to output, left to right, or in the order of functional sequence without regard to the actual physical shape, size, or location of the device. They show, in straight-line form, all circuits and items within a defined area or portion thereof.

2108.2 Symbols

Electrical item symbols shall be shown in their de-energized state unless otherwise noted on the drawing. In general, terminal symbols may be omitted unless required for clarification.

A. The diagram shall be arranged so that the drawing user can follow the functional relationships (input to output, source to load, order of potential utilization, etc.). Layout should be such that the path of energy flows from left to right, top to bottom, or a combination thereof.

B. Items of the circuit shall be assigned functional designations. The designations shall be placed adjacent to their symbols, preferably above or to the right of the symbol.

C. Descriptive nomenclature shall be used to label all inputs and outputs of the schematic diagram. Physical operating label nomenclature (for example, PUSH TO TEST) should be placed adjacent to the push-button switch that will have such a label.

D. For interrupted single lines, the line identification may also serve to indicate destination. In general, identification practice for interrupted single lines shall be the same as for grouped and bracketed lines described in the paragraph on interrupted grouped lines. When interrupted lines are grouped and bracketed, line identifications shall be shown. Bracket destinations or connections may be indicated either by means of notations outside the brackets or by means of a dashed line. When the dashed line is used to connect brackets, it shall be drawn so that it will not be mistaken for a continuation of one of the bracketed lines. The dashed line shall originate in one bracket and terminate in no more than two brackets. Letters, numbers, abbreviations, or other identifiers for interrupted lines shall be located as close as possible to the point of interruption.

E. The relation of switch position to circuit function shall be shown on schematic diagrams. For simple toggle switches, it may be sufficient to identify position with notations such as ON-OFF. For complex switches, position-to-function relations may be shown either near the switch symbol or at a more convenient location on the drawing. When rotary switches perform involved functions, a tabular form of presenting supplementary information is preferred, such as a selector switch contact development table.

F. When parts of rotary switches are designated S1A, S1B, S1C, etc., the suffix letters A, B, C, etc., shall start from the knob or actuator end and then be assigned sequentially away from this position. Each section of the switch shall be shown viewed from the same end. When both sides of a rotary switch section are used to perform separate switching functions, the front (knob or actuator end) and rear symbols should be differentiated by appropriately modifying the reference designation, for example, S1A FRONT and S1A REAR.

G. When portions of connectors and terminal boards are separated on the diagram for drawing convenience, the words **PART OF** shall precede their designation labels or each individual terminal shall be labeled with its reference designation. When the separation of portions of connectors or terminal boards on the same drawings, becomes extensive, the separated parts may be identified as individual terminals. If individual terminals from different parts, such as connectors, are intermixed, mechanical connecting lines shall be omitted.

H. When mechanical functions are closely related to certain electrical functions, the mechanical components shall be linked to the applicable graphic symbols of the schematic diagram.

I. Connecting points of lines should not be purposely laid out to represent actual physical arrangement of wires. This type of information will be provided by connection diagrams.

J. Terminal identifications may be added to graphic symbols to indicate actual physical markings, which appear on or near item terminations.

K. When terminals or leads of multi-lead items are identified on the item by a wire color, code, letter, number, or geometric symbol, this identification shall be shown on or near the connecting line adjacent to the symbol.

L. When rotary-type, adjustable resistors are shown on schematic diagrams; it is desirable to indicate the direction of rotation with respect to an arbitrary reference point. It is customary to refer to the rotary motion as clockwise or counterclockwise when rotation is viewed from the knob or actuator end of the control.

M. Subdivisions of items may be identified by adding a suffix letter to the designation of the part. For example, CB1A and CB1B identify electrically separate sections of a dual circuit breaker designated CB1. In cases where multiple items are physically integral but are shown separately they shall be identified by suffix letters. Where they are shown together within an enclosure, the assignment of suffix letters is optional.

N. Portions of multi-item components may be shown at different locations on the schematic diagram. In such cases, suffix letters added to reference designations will indicate the relationships of the subdivisions to the whole components.

O. In schematic diagrams for switching circuits, reference designations may be aligned along one edge of the circuit instead of being shown at the symbol. Mechanical linkage lines of multi-item switching devices and reference designations for individual contacts may be omitted when the association of parts is clear.

P. Explanatory information in the form of notes, that describe sequence of operations or the dependence of a circuit upon other actions, may be located adjacent to the particular related device, schematic delineation, or with the notes of the drawing.

Section 2109 - Connection Diagrams

2109.1 Definition

A connection diagram shows the general physical arrangement and electrical connections of a unit or of its component devices or parts. It may cover internal or external connections, or both, and contains such detail as is needed to make or trace the connections on the equipment. An interconnection diagram is a form of connection diagram, which shows the external wiring connections between different units of an equipment or different equipment of a system. Connection diagrams are used as a guide for installation of wire or cable. They are used for circuit tracing but not for circuit analysis. They serve the following purposes:

A. Furnish information showing electrical connections for an installation in diagram form.

B. Facilitate determination of electrical connection adequacy.

C. Terminals shall be named, spare terminals indicated.

D. Facilitate maintenance of equipment.

Supplement schematic and single-line diagrams by relating circuit information with the actual wiring and relative location of items. Connection diagrams are classified as either lineless or line types. The line type classification includes two subtypes: the point-to-point and the cable (or highway) type. The point-to-point diagram shall be used when the quantity of connections is small. The cable or highway type, as well as the lineless type, shall generally be used for a complex connection diagram.

2109.2 Common Requirements

A. The physical arrangement of device terminals and connections thereto are generally pictorially shown.

B. All connections shall be listed or all lines and symbols required to fully represent wire, cable, and circuit items and their connections within a defined area shall be depicted.

C. Point-to-point wire and/or cable types, connection information, and specific terminal identifications shall be shown.

D. System items, whenever feasible, shall be represented by rectangles and/or circles. Other geometric shapes, which approximate the outline of the item, and are simple in form, may be used. These outlines may encompass portions of their internal circuits in single-line or schematic form where more rapid understanding of the drawing will result, e.g., fuses, circuit breakers, switches, etc.

E. Terminations on items shall be represented by attached lines, rectangles, or circles. They shall be identified by letters, numbers, pigtail colors, or other nomenclature. This identification shall agree with actual marking on the item, when possible, and shall be compatible with other designations of the same item within the drawing set.

F. Item symbols shall be identified with the functional designations or other nomenclature assigned to them on single-line and/or schematic diagrams of the facility.

G. Rating and circuit function information, which is indicated, on single-line and/or schematic diagrams shall not be duplicated on connection diagrams. However, polarities and phase indications shall be included.

H. To avoid possible damage to equipment by improper connections, every consideration shall be given to indicating proper phasing. The diagram shall specify wires, which must be grouped in conduits as well as the proper identification of the wires and conduits. If conduits are not used, the wires must be grouped in a convenient manner to facilitate identification.

I. Pre-wired connections are those made by the equipment or item manufacturer. Pre-wired connections may be indicated by drawing notes directed to the connecting line indicating that the connection is pre-wired.

J. Connections shown with solid lines outside of the symbol outline indicate connections, which are required to be made by those making the installation.

K. The item symbols may be arranged in the manner, which provides the simplest, most diagrammatic form of representation. They may also be arranged to approximate their actual physical relationship with each other.

L. Information notes may be included for clarification and explanation as required.

2109.3 Requirements for Line-Type Connection Diagram

A. Continuous lines to represent conductors between the terminals of one item and the terminals of another item shall be shown.

B. The lines shall be drawn horizontal or vertical wherever possible and as direct as practical. Double crossovers should be avoided.

C. Wire sizes shall be indicated in terms of American Wire Gage numbers. Insulation and cable composition shall be defined by the drawing note, which may call for the applicable specification. When a number of wires are the same size, it is recommended that a general note such as the following be included:

D. ALL WIRES 12AWG (SPECIFICATION NO.) UNLESS OTHERWISE SPECIFIED.

E. Multi-conductor cables shall utilize ICEA/NEMA method 1 (CEA S-19-81 Table 5-2) color coding utilizing colored insulation and contrasting tracers for 127 positive conductor codings. Spare wire shall be indicated.

F. Wire colors shall be indicated for wire other than that which is part of cable assembly information included on another drawing or specification. It is preferred that color designations be shown above the line to which they belong. Wire color designations shall be placed at both ends of a connection line unless the connection shown is short, in which case a single indication is sufficient. Wire colors shall be indicated by showing abbreviations shown below in Table 2 - Wire Color Abbreviations. Shielded wire shall be indicated.

Table 2 - Wire Color Abbreviations

Abbreviation	Color
BK	Black
W	White (Neutral Conductor Only)
R	Red
G	Green
OR	Orange
BL	Blue
Y	Yellow
BR	Brown

2109.4 Requirements for Highway Line-Type Connection Diagram

A. The highway line-type connection diagram is the same as the point-to-point line-type diagram with the exception that groups of inter-item connecting lines are merged into paths called highways instead of being shown for the entire run as individual lines.

B. From the device or component terminals, short lines or feed line are drawn perpendicular to the cable or highway line. The junction of the feed line with the highway line shall be indicated with an inclined or curved line. The curved or inclined line indicates the run direction in joining the cable or highway line.

C. Crossing of lines shall be avoided. If this is not possible, they should be looped at 90° with respect to each other.

D. Wire data on feed lines shall include wire destinations, color and wire type.

E. Feed-line destinations may be indicated by specifying function or other designations and terminal number of the component to be connected.

F. Wires which must be segregated for electrical reasons from other wires, or which are otherwise critical, shall be shown separately or run directly from terminal to terminal.

G. More than one cable or highway line may be used to facilitate indication of wire runs or to indicate grouping of particular wires into cable or harness assembles. A drawing note with the aid of a symbol, if necessary, shall identify the highways as being part of the same or different cable assemblies.

H. Wire groupings may be shown as in interrupted line, identified with a symbol, and the destination grouping with the same symbol and letters or numbers.

2109.5 Requirements for Lineless-Type Connection Diagram

A. Continuous connecting lines between items are omitted. Short spur lines from connectors, terminals, terminal boards, etc., shall be used in conjunction with item and item terminal designations to convey the connection information.

B. Destinations shall be indicated in terms of designators or other nomenclature established on the single-line and schematic diagrams and referred to in or near item symbols on the connection diagram.

C. These designations shall be followed by a dash numbers or letters to indicate to what terminal, connector, pigtail, lead, etc., they are to be connected. If the item description nomenclature is too long, it may be abbreviated.

D. One end of each wire or cable shall specify the wire size and type and be placed, preferably, above one of the spur lines, unless otherwise indicated by note.

E. One end of each wire shall include its color code in the terms specified by Section 1910.3 and be placed above the spur line unless it may be better indicated by note.

F. If the wires for mating between item connections are furnished with items, they shall be labeled PGT (pigtails). In such cases, the wire size and type may be omitted.

Section 2110 - Function Designations

2110.1 Definitions

Functional designations are words, abbreviations, or meaningful number or letter combinations, usually derived from the function of an item, and used on drawings, equipment, and instructional material to identify items of a complete control system or equipment in terms of function.

2110.2 General Requirements

Switchgear and control device designations shall be applied as outlined under definitions. In general, on one complete drawing or set of drawings, only one system of designations shall be used. When using functional designations on an individual equipment, supplementary letters or numbers shall have one meaning only and the meaning shall be clearly designated in a device list on the drawing.

2110.3 Switchgear Designations

Switchgear designations are numbers that describe the functions performed by electric devices in switching circuits used in the generation, transmission, and distribution of electric power. Supplementary letters and numbers are used with the basic designation to permit positive identification of an item.

A device function number, with appropriate suffix letter or letters where necessary, shall be used to identify the function of each device in all types of partial automatic and automatic, and in many types of manual, switchgear. These numbers shall be used on drawings, in publications, and in specifications. In addition, for automatic switchgear, the number shall be placed on or adjacent to each device in the assembled equipment so that the device may be readily identified. Designations shall be in accordance with designations for Electric Power Switchgear Devices and Industrial Control Devices.

2110.4 Control Device Designations

Control device designations are letters used to identify the function of electric control devices on power utilization equipment. Suitable prefix numbers and letters are added to the basic designation to distinguish between devices performing similar functions.

The assignment of designations to devices on a specific equipment is governed solely by the function or functions performed by each device on a particular equipment and not by the type or nature of the device or its possible use for other functions in other equipment. Thus, the same type of device may perform different functions in different equipment or even in the same equipment. Therefore, it may be identified by different designations. Designations shall be in accordance with ANSI/IEEE C37.2 -1979, Electrical Power System Device Function.

Section 2111 - Symbols For Electrical Drawings

2111.1 Definition

Electrical/Electronic Symbols for Diagrams are graphical symbols providing coverage for electrical and electronic diagrams. Correlation of symbols with parts lists, descriptions, or instructions may be established by means of reference and functional designations. Symbols shall be in accordance with ANSI Y32.2, Graphical Symbols for Electrical and Electronics Diagrams. Notify the Owner of any inconsistency between the DEN Design Standard Symbols and the ANSI Standards.

It should be noted that letter combinations used as part of graphical symbols are not abbreviations. Functional designations shall be assigned in accordance Section - Functional Designations.

2111.2 Symbols

Symbols for Electrical Plans are graphical symbols that provide coverage for architectural and electrical layout drawings. Functional electrical and electronic symbols should be used to provide full coverage for these drawings. Symbols shall be in accordance with ANSI Y32.9, Graphic Symbols for Electrical Wiring and Layout Diagrams used in Architecture and Building Construction.

2111.3 Labels

Labels for panelboards and electrical equipment shall designate the source location (fed from), voltage, and ampacity. The prefixes to be used for panelboard numbers shall be compliant with Table 3 - Electrical Panel Naming Conventions.

Table 3 - Electrical Panel Naming Conventions

Naming Electrical Panels For Grounds and Outlying Buildings

Use DEN utility map for main and secondary grids

Example: **L-13F4TDEH1-A**

L-13	Utility map book page location choices: **A** through **FF** (West to East) and **1** through **31** (South to North)
F4	Location grid on above page choices: **A** through **J** (West to East) and **1** through **10** (North to South)
T	Indicates TENANT panel if appropriate choices: **T** [TENANT] or blank [no space] if DEN

D Indicates distribution panel if appropriate choices: **D** [DISTRIBUTION] or blank [no space] if NOT DISTRIBUTION

E Indicates panel feeder function choices: **E** [EMERGENCY or ESSENTIAL POWER] or **U** [UPS origin]

H Panel voltage choices: **H** = 600 or 480Y/277 or **L** = 208Y/120 or 240/120

1 Sequence number of this panel supplied from this source choices: **1…N**

-A Sub-fed panel suffix, if appropriate choices: **-A** …as required

Naming Electrical Panels for Concourse Buildings and Tunnel System

Example: **B-AW1TDEL1-A**

B- Concourse letter choices: **A** through **C** (South to North)

A Floor choices: **T** [tunnel] or **B** [basement] or **A** [apron] or **C** [concourse] or **M** [mezzanine] or **4** [fourth floor] or **5** [fifth floor] or **R** [roof]

W1 Core area choices: **CE** [center core east side] or **CW** [center core west side} or **E1 … E3** [sub-core number east of center core] or **W1 … W3** [sub-core number west of center core]

T Indicates TENANT panel if appropriate choices: **T** [TENANT] or blank [no space] if DEN

D Indicates distribution panel if appropriate choices: **D** [DISTRIBUTION] or blank [no space] if NOT DISTRIBUTION

E Indicates panel feeder function choices: **E** [EMERGENCY or ESSENTIAL POWER] or **U** [UPS origin]

L Panel voltage choices: **H** = 600 or 480Y/277 or **L** = 208Y/120 or 240/120

1 Sequence number of this panel supplied from this source choices: **1…N**

-A Sub-fed panel suffix, if appropriate choices: **-A** …as required

Naming Electrical Panels for Terminal, AOB, and Parking Structures

Example: **6-11CTDEL2-A**

6- Floor choices: **T** [tunnel] or **1** through **11**, depending on building

11C Module designation (see Architectural designation) choices: **01** through **15** and **A** through **D**

T Indicates TENANT panel if appropriate choices: **T** [TENANT] or blank [no space] if DEN

D Indicates distribution panel if appropriate choices:
D - [DISTRIBUTION] or blank [no space] if NOT DISTRIBUTION
E - Indicates panel feeder function choices: **E** [EMERGENCY or ESSENTIAL POWER] or **U** [UPS origin]

L Panel voltage choices: **H** = 600 or 480Y/277 or **L** = 208Y/120 or 240/120

2 Sequence number of this panel supplied from this source choices: **1…N**

-A Sub-fed panel suffix, if appropriate choices: **-A** … as required

End of Chapter

Chapter 22 - Communications\Electronic Systems

Section 2200 - Communications\Electronic Systems

2200.1 General Information and Requirements

This chapter provides engineers, and designers performing design work for DEN with systems overviews, configurations, and specific design requirements. Communications and Electronic Systems addressed in this chapter include:

A. Security Card Access System (SCAS)

B. Closed Circuit Television System (CCTV)

C. Fire Alarm System (FAS)

D. Voice Paging System (VPS)

E. Public Affairs Television System (PATV)

F. Premise Wiring Distribution System (PWCS)

G. Parking/Ground Transportation Revenue Control System (PGTS)

H. Flight and Baggage Information Display System (FIDS/BIDS)

I. Data Acquisition and Control System (DACS)

Section 2201 - Drawings

2201.1 Drawings

The communications and electronic systems described in this chapter shall be designed and drawings shall be prepared as applicable, based upon the characteristics and complexity of the particular projects involved and as determined by each system narrative contained in these design standards. Drawings shall be provided when essential in planning, procurement, construction, evaluation, recording, and use of the particular projects. All drawings shall indicate complete design.

2201.2 Definition

Facility communications and electronic systems drawings are graphic representations of facilities design requirements.

2201.3 Completeness

Facility communications and electronic systems drawings, when interpreted in association with the construction specifications, shall:

A. Furnish sufficient information to permit installation of manufactured equipment that satisfies the design requirements.

B. Furnish sufficient information to manufacture equipment that is of special design, made exclusively to meet the requirement of the project. Components, assemblies, and systems shall be UL listed.

C. Describe items so that they may be procured.

D. Furnish sufficient information to permit planning, construction, evaluation, recording, repair, and maintenance of facilities.

E. Furnish the above in sufficient completeness for accomplishment without the need of assistance from the Developer.

2201.4 Drawing Sequence

Construction documents are divided into specific groups per National CAD Standards (NCS). The group number shall always remain the same no matter how large the project. Refer to *BIM Design Standards Manual*.

2201.5 General Notes, Drawing Index, Symbols, and Abbreviations

These sheets shall contain Notes that are applicable (or general) to all sheets in the set of drawings and in addition contain the drawing symbology as required in Section 2201.14, Communications and Electronic Systems Symbols. These sheets shall also contain a complete drawing index for the document set.

2201.6 Site Plan

The site plan shall identify, where applicable, all site facilities required in support of the specified communications and electronic systems including conduits and their interconnection to existing conduits (ductbanks), resources, and cabling systems. In addition, the site plan shall indicate all existing utilities and all communications and electronic systems devices and conduits that are located external to the building and indicate connections (penetrations methods) to internal systems. Where applicable, external devices and equipment e.g., towers, antennas etc., shall be shown including all internal and external connections. Keyed symbology shall be shown which directs the Developer to specific installation, provisioning, and configuration details that shall be included in the detail sheets. All required connections to the grounding system shall be indicated.

2201.7 Floor Plans/Roof Plans

Plan drawings shall be provided which indicate all communications and electronic systems devices and equipment locations and include conduit interconnection between devices. All device locations shall be coordinated with all disciplines including architectural finishes and features. Keyed symbology shall be shown which directs the Developer to specific installation, provisioning and configuration details which shall be included in the detail sheets.

When more than one system is shown on a plan, each shall be made clearly discernible by system. Conduits indicated on the plans shall either be shown as routed to their specific termination location (Equipment or Terminal cabinet) or be indicated by schedule for termination location. All conduits shall be coordinated with the requirements of the conduit riser diagram. Devices indicated on plans shall be coordinated with the requirements as indicated in point-to-point diagrams.

2201.8 Equipment Rooms Layouts and Elevations

Coordinated equipment room layouts and wall elevations shall be provided which indicate scaled layout of the equipment room and all Communications and Electronic Systems and facilities co-located within the equipment room. Equipment rooms and layouts shall provide sufficient detail that permit coordinated construction and include the following elements:

A. Interconnection between equipment

B. Conduit terminations

C. Grounding connections

D. Electrical connections and grounding bars

E. Floor mounted and wall hung equipment placement

F. Cable tray configurations

G. All penetration and fire sealant/safing details

H. Clearance zones for servicing equipment

I. Locations and sizing of cooling equipment required.

Where new equipment and/or facilities are specified/required for installation in an existing equipment room, layouts shall be provided that coordinate the placement of new equipment with existing equipment. Detail provided shall be as indicated above. New equipment shall be delineated by a different line type from existing equipment so that positive identification between new and existing equipment is assured.

2201.9 Functional Block Interconnection Diagrams

A block diagram describes the concepts and/or organization of an equipment or facility by the use of rectangular blocks, representing functions or groups of functions. Interconnecting lines establish the relationships between blocks and indicate the direction of information flow. A block diagram is used to give a quick over-all picture of a system and the general interrelationships between components of that system. It may be used for general arrangement studies, functional explanations, systematization of facilities, or for design discussion purposes.

A. Diagrams

1. A block diagram shall be presented in as simple a form as possible. Rectangular blocks shall be used to represent functional electrical systems or parts thereof and/or major elements of an electrical system or circuit. Various other symbols may be used as supplementary information to increase the utility of the diagram.
2. Identifying nomenclature shall be included within the blocks.
3. Block diagrams may be made for any level of project activity. For example, a block diagram at the highest level may be made for a complete project, or any lower-order stage.
4. Related mechanical, electro-mechanical, or optional apparatus may be included on block diagrams in rectangular form.
5. Mechanical connections between such elements shall be illustrated with dashed lines connecting the applicable blocks.
6. If the form of the circuit involves multiple sources and common or similar circuits, or variations thereof, tabulations may be used.
7. If a block diagram must be divided and placed on more than one drawing, the division of the circuit should be made in a logical manner, that will eliminate confusion and at a point of minimum information transfer.
8. When abbreviations or symbols are used on any drawing, provide on that same drawing keynote, abbreviation, and symbol legend.

B. Connecting Lines

1. Lines connecting blocks shall indicate relationships, direction of flow of the system, sequence of operation, etc. The arrangement of lines and blocks shall show action or energy flow in functional sequence from top to bottom and/or left to right of the diagram, starting at the top left or top center and ending at the bottom right of the diagram.
2. Connection lines shall be labeled, where necessary, to make the meaning clear and unmistakable. When dashed lines are used for more than one purpose on a block diagram, these purposes shall be made clear by label, legend, or note.
3. Connecting lines shall include arrows to further define the circuit flow.

2201.10 Point-to-Point Wiring Diagrams

Point-to-point wiring diagrams describe the detailed wiring configuration and arrangement of the specific system utilizing lines connected to specific equipment terminals and equipment pieces. Point-to-point wiring diagrams indicate the required system color-coded interconnection details at the component level. Point-to-point wiring diagrams shall be required at the design level only for those electronic and communications systems where interconnection to existing equipment is required. Point-to-point shall be provided only for the specific interface location and configuration. In the cases where new systems are designed and do not require interconnection to existing systems, system concepts and intent shall be conveyed through the functional block diagram, riser diagrams, floor plans, elevations, and the project specifications. When required, point-to-point wiring diagrams shall contain the following detail.

A. All wiring by type and size required between all system components

B. Indicate wire color coding

C. Indicate terminal strip numbers and positions

D. Indicate current, signal, and data flow

2201.11 Systems Riser Diagrams

Communications and electronic systems riser diagrams indicate the distribution of major systems components, wiring systems, and their interconnection requirements. Riser diagrams shall always be provided for cabling systems and indicate:

A. Equipment rooms

B. Cable quantities

C. Cable types

D. Termination locations

E. Keyed reference to related details

F. In multi-floor facilities, riser diagrams shall be organized by level

For simpler designs not containing cabling distribution systems specific riser diagram information, (e.g. major component location information may be incorporated into the Functional Block Diagram).

2201.12 Conduit/Cable Tray Riser Diagrams

Conduit riser diagrams are provided to indicate the configuration, location, quantity, and size of the conduit/cable tray infrastructure required in support of the specified communications or electronic system. In multi-level facilities, conduit riser diagrams shall be organized by level. All conduit riser diagrams shall indicate the following information:

A. Equipment rooms (or conduit termination locations)

B. Conduit quantities

C. Conduit sizes

D. Conduit identification schemes

E. Interfaces to cable trays

F. Grounding and bonding requirements

G. Cable tray systems

Conduits, which are specified or scheduled for installation of fiber optic cables, shall be configured with appropriate bending radii and bend requirements. All conduit and cable tray systems shall be installed in compliance with applicable codes and DEN Standards. Conduit shall have not more than 270 degrees of bend between pull locations and shall have a minimum of 1” size. Review sizing and bends with Project Manager at Design Development Phase.

Terminal cabinets, equipment backboards, and other conduit termination facilities and locations are considered part of an integrated conduit riser diagram and shall be shown on the conduit riser diagram. Branch conduits installed in support of devices need not be shown on the conduit riser diagram.

The conduit riser diagram shall be coordinated with the system riser diagram, such that cross-reference between systems cables and conduit/tray infrastructure are achievable. All conduit and cable tray systems shall be configured and suitably sized to permit the segregation of cables by conduit/tray segment by signal level as follows:

A. Less than 10V

B. 10V - 70.7V

C. Greater than 70.7 volts

D. Telecommunications cabling (voice and data) cables shall never be mixed with dissimilar resources.

2201.13 Systems Details

Systems details are provided to indicate specific installation techniques and systems configurations. System details shall be provided in support of the design and installation intent indicated on other sheets, and call attention to the specific conditions and requirements necessary to ensure that the installed system configuration is compliant with

the design intent and requirements. Details shall be provided for all conditions where specific direction cannot be properly conveyed or is indicated on other sheets.

2201.14 Communications and Electronic Systems Symbols

Communications and Electronic Systems and electronic symbols, when used, shall be in accordance with ANSI standards, in accordance with Section 2201.14, Communications and Electronic Systems Symbols. Other symbols, if devised by the Developer, shall be shown in the **ITEM** column and explained in the **DESCRIPTION** column of the LEGEND with indication **FOR THIS PROJECT ONLY**.

2201.15 Symbols for Other Functional Disciplines

Symbols for functional disciplines other than Communications and Electronic Systems shall be as specified in the respective sub-sections of this manual.

2201.16 Functional Designations

Functional designations, when used, shall be in accordance with Section 2110 - Function Designations.

2201.17 Drawing Delineation Types

Communications and Electronic Systems drawings shall generally include the following types of delineations:

A. Block diagrams

B. One-line diagrams

C. Schematic diagrams

D. Connection diagrams

E. Facility communications and electronic systems power requirements plans

F. Facility communications plans and risers

G. Facility grounding plans and risers

H. Facility security plans and risers

I. Facility lightning protection plans

J. Fire alarm plans and risers

K. Panel, circuit, and other schedules

L. Detail drawings

The number of delineation drawings for a project shall be adequate to describe the entire system including existing system and device locations, demolition of systems, reuse of systems or devices, and new work.

2201.18 Delineation Drawings

Subject to Project Manager acceptance, the drawings for projects need not contain all delineation types. For example, projects consisting only of a single building and a relatively simple communications and electronic systems may not need block diagrams or single-line diagrams if the information normally found in them is effectively conveyed by other delineation types. Each delineation shall be identified by its type below the area where it is displayed, e.g., SCHEMATIC DIAGRAM. These delineations shall not be included on architectural, structural, civil, mechanical, or electrical drawings. If delineation drawings are different from outlined herein, then the Drawing Index shall clearly show combination of delineation.

2201.19 Specification Relationship

Specifications that are a portion of a contract package shall include communications and electronic systems technical specifications sections. Each communications or electronic system section shall have its own General Requirements section, which is specifically tailored to the requirements of the electronic and communications system requirements. The communications and electronic systems drawings, together with the specifications, shall describe specifically and adequately all the communications and electronic systems design requirements of the

project. Vendor information drawings may be included as reference drawings subject to written approval from the manufacturer. Communications and electronic systems drawings that may form a part of a purchase specification drawing may be included as reference drawings. Prior written acceptance is required for any design-build component.

Section 2202 - Security Card Access System (SCAS)

2202.1 System Description

The security environment at DEN FAA is Federal Aviation Regulation 107.14 compliant and is comprised of two (2) specific secure areas:

A. Sterile area

Sterile areas are those areas in the terminal, concourses, and other facilities where the occupants have been screened.

B. Restricted area

The restricted area is comprised of the Airport Operating Area (AOA). Individuals with badged access to the restricted area must enter or leave the AOA environment through an access control door.

Access control doors are required at all points that provide access from public or sterile locations to the AOA regardless of building type or location.

2202.2 Administrative Access

A third Administrative access control area is defined at DEN. Administrative areas are those areas where access control is required by DEN, rather than by the FAA. These areas and requirements shall be defined by the Project Manager.

2202.3 Security Card

The Security Card Access system at DEN interfaces to two (2) external systems. These include the Closed Circuit Television System (CCTV), and an interface to an audio system that provides 2-way communications between certain door types and the airport operation center.

2202.4 SCAS

The SCAS at DEN is an airport-wide integrated system. All access control doors and the systems-related functionality are maintained from a single system. The SCAS utilizes multiple door type configurations that require different conduit rough-in schemes and doorframe and door hardware configurations. DEN Planning and Development maintains a library of the various conduit rough-ins, doorframe types, and hardware configurations.

2202.5 Developer Design and Contract Document Requirements

Whenever a Developer’s design scope meets the criteria for FAR 107.14, administrative requirements, or external system interface, and the addition of a security door is required, the Developer shall be required to initiate a meeting with the DEN Planning and Development Project Manager and DEN Access Services to review the specific access requirements. Design decisions with respect to access control door types, quantities, and interfaces will be made. In support of the Developers design activities, DEN maintains a comprehensive set of as-built documentation, which upon request will be made available to the Developer for review in the development of the design. The Developer shall be responsible for coordination of, specifying, and drawing preparation of the following design elements, which will comprise a functional extension of the SCAS.

A. Security door conduit rough-in details

The applicable details to be used shall be provided to the Developer by the Owner once the specific details are identified. The appropriate CADD files of the details shall be given to the Developer for inclusion into the construction documents.

B. Security doorframe details

The applicable details to be used shall be provided to the Developer by the Owner once the specific details are identified. The appropriate details shall be given to the Developer for inclusion into the construction documents.

C. Door hardware

The applicable hardware types and details to be used shall be provided to the Developer by the Owner once the specific details are identified. An appropriate hardware list shall be given to the Developer for inclusion into the construction documents.

D. SCAS interconnecting conduits

Conduits and raceways that tie the new access control doors or devices to the existing system shall be required. The Developer shall be required to conduct a building and site investigation to establish the exact inner/inter-building and/or site conduit configuration. All conduit specifications provided by the Developer for SCAS work shall be suitably sized for the cabling to be installed. Where installation of fiber optic cables is indicated by DEN, the Developer's specifications shall be representative of those requirements.

E. External systems interconnecting conduits

Where identified by DEN and tie-ins to external systems are required, the Developer shall be required to include in the design all necessary conduit systems and wires. These requirements shall be coordinated with the Project Manager.

All other SCAS components including electronic interfaces to external systems, wiring, and software shall be installed by DEN Maintenance unless the Project Manager requires the Developer to design and specify this work. Verify with the Project Manager the scope requirements during the Programming Phase of Design. The Developer shall require in the door hardware specifications that a coordinated commissioning test of all SCAS doors installed as part of the work be jointly tested by the Contractor supplying the door hardware system, and DEN Maintenance. This will ensure proper hardware/electronic systems interface and operation. This testing shall be coordinated by the DEN Planning and Development Project Manager.

Section 2203 - Closed Circuit Television System

2203.1 System Description

The CCTV system is utilized for general surveillance throughout DEN and for SCAS door monitoring. The system is comprised of a 2040 input American Dynamics (AD) cross point switcher with audio follow. More than 675 inputs are connected to the system. All camera video is transported between the camera and AD headend via 62.5um fiber optic cable using fiber options fiber optic multiplexers. A variety of camera configurations are utilized including indoor and outdoor, fixed, and remote controllable types

2203.2 Specific Requirements

Quantity and general location of CCTV cameras shall be provided by the Project Manager on a project-by-project basis. The Developer shall be required to review the requirements provided by the Project Manager to validate the functionality and direction provided by the Project Manager. The Developer shall be responsible for the design and specification of all CCTV system components, wiring systems (both coaxial and fiber optic as applicable), and interfaces to the headend system. Final system connection and system software programming at the headend shall be completed by the DEN Maintenance Division.

2203.3 Infrastructure

DEN has in place an extensive site, intra-building, and inner building copper and fiber optic infrastructure that is utilized in the transport of various signals (including CCTV) throughout DEN. This infrastructure is maintained by US West under a maintenance agreement with the Management Information Division at DEN. The Developer's design shall be coordinated with those resources and include all work required (including costs) by US West to implement transport of signals between CCTV cameras and the system headend.

2203.4 Installation Details and Parts

DEN Planning and Development maintains a library of CCTV installation details and parts lists that are utilized at DEN. The Developer shall be responsible for initiating a meeting with the Project Manager to obtain appropriate details to ensure that all designs provided are compliant and compatible with existing systems and components. In support of the Developer's design activities, DEN maintains a comprehensive set of as-built documentation, which upon request will be made available to the Developer for review in the development of the design.

2203.5 Specifications

The design specifications shall require that an integrated CCTV system test be conducted by the installing Contractor and the DEN Maintenance Division. This test will be conducted to ensure proper operation of Contractor supplied and installed equipment and work performed by the DEN Maintenance Division. Under no circumstances shall the Developer's specifications and project requirements allow the Developer to make connections to existing equipment without direct supervision by DEN Maintenance.

Section 2204 - Fire Alarm System

2204.1 System Description

The Fire Alarm System (FAS) at DEN is a point addressable type and is operational. FAS requirements vary throughout the airport based upon the facility location and type. In contiguous facilities, specifically:

A. Terminal building

B. Concourses A, B, and C,

C. AGTS/baggage tunnel

D. Airport Office Building

2204.2 System Compatibility

All equipment installed in the above-referenced facilities shall match the equipment type presently installed and are UL listed for operation with the equipment presently installed. All equipment installed in contiguous facilities shall be manufactured by Edwards System Technology (EST) unless otherwise directed by the Project Manager. This is considered the main system at DEN. Remote buildings located throughout DEN shall utilize one of the approved equipment manufacturers.

2204.3 Assurance Review

The DEN Maintenance Division is solely responsible for the maintenance of all fire alarm systems located within Owner owned facilities at DEN. Any and all plans developed for implementation at the airport shall be submitted to the Project Manager for review by the Maintenance Division. The Developer is responsible for procuring written acceptance by DEN Maintenance.

The Developer may encounter four potential design conditions at DEN. These include:

A. The expansion or addition to the main system within contiguous facilities

The designer shall specify a functional extension of the existing system.

B. The expansion or addition of an existing fire alarm system in a remote facility

The designer shall specify a functional extension of the same type as the existing system.

C. Remodel or modification to existing facilities.

D. A new standalone facility to be constructed that is remote from the main system.

The designer may specify one of the following system manufacturers.

1. Simplex
2. Pyrotronics
3. Edward Systems Technology (EST)

4. Notifier

DEN has standardized on these manufacturers to minimize to the maximum extent possible the requirements for maintenance training and spare parts inventory.

2204.4 Additions to the Main Fire Alarm System

When additions to the main fire alarm system are required, the Developer shall be required to perform a comprehensive site investigation and conduct interviews to determine the configuration of the existing system in the area to be modified or constructed. During this site investigation, the Developer shall:

A. Determine the requirements for the need of additional equipment. If additional equipment is required, the Developer shall be required to determine:

1. Signaling line capacity within the construction area
2. Capacity of initiating circuit within the construction area
3. Required device locations
4. Interface point for both signaling and initiating circuits
5. The impact on the existing smoke zones within the construction area
6. The impact on the sprinkler zones within the construction area

In support of the Developers investigative activities, DEN maintains a set of as-built documentation provided by fire alarm installers, which upon request will be made available to the Developer for review in the development of the design. The accuracy of such information must be field verified.

The Developer shall be responsible for the design of all notification, initiation, control devices, raceways, and modifications required for the complete expansion to the existing fire alarm system in compliance with the requirements of NFPA, Denver Fire Prevention Bureau, and DEN Life Safety Team. Plans shall be compliant with the design standards and include all devices and their locations. All conduits shall be indicated with interconnection to the existing system.

The Developer shall define the sequence of operation in both written form and single line diagram. The single line diagram shall indicate all fire alarm devices and all devices to be monitored, controlled, or activated by the FAS. This includes but is not limited to fire/smoke dampers, HVAC units, exhaust/pressurization fans, fire doors, flow switches, tamper switches, pressure switches, pre-action panels, low air switches, and fire pumps.

Fire Alarm system support devices such as power boosters and panels shall be located in secured electrical rooms.

All raceways and conductors shall be in compliance with the Technical Specifications.

2204.5 Expansion or Addition of an Existing Fire Alarm System in a Remote Facility

When the Developer's Scope of Work requires that a functional extension of an existing operational fire alarm system located in a noncontiguous building be designed, the requirements identified above under additions to the Main Fire Alarm System shall apply.

2204.6 Standalone Facility

When the Developer's Scope of Work requires that a new fire alarm system be installed within a new facility, the Developer shall observe the requirements for the accepted manufacturers' systems as indicated above. In addition, when a standalone fire alarm system is installed in a non-contiguous facility, a remote tie-in to the main system is required. This remote tie-in is comprised of two (2) monitor points including alarm and trouble. These auxiliary contacts/points are in addition to the remote/off-site system signaling (Central Station) requirements of NFPA and shall be demarked at the telephone board located with the facility. Demarcation shall be in a 6" x 6" x 4" box on a terminal strip. The FAS remote outputs/monitor points shall be terminated on the left side of the terminal strip. Terminations shall be labeled indicating function. Provisioning of the FAS for two (2) additional remote outputs, all conduit and wiring between the fire alarm system and the demarcation point, and equipment at the demarcation shall be specified in the design documents.

2204.7 Code Compliance

All FAS designs shall be compliant with national, state, and local codes. Under no circumstances shall the Developer's specification and project requirements allow the Developer to make connections to existing equipment without direct supervision by the DEN Life Safety Team.

2204.8 Testing

Equipment shall be installed and pretested prior to request for DFD testing. Five working days' notice shall be provided to the DEN Life Safety Team and the DFD for testing. The request for testing shall include itemization of devices and systems to be tested in the format as required by DFD. The Developer shall be present at tests.

Section 2205 - Voice Paging System (VPS)

2205.1 System Description

The voice paging system at DEN is a fully functional system that is utilized for passenger and emergency paging. The system is only located within contiguous facilities, specifically the Terminal building; Concourses A, B, and C; the AGTS tunnel; and the Airport Office Building. The system provides coverage throughout all public and non-public (back of house) areas of these facilities.

The system is comprised a four (4) computer controlled distributed headends interconnected by fiber optic cables. Remote amplification and processing equipment racks distribute paging signals via a 70.7-volt medium and are located throughout all of the contiguous facilities. The system electronics are manufactured by Innovative Electronic Designs (IED). All expansions to the system shall utilize equipment manufactured by IED, which is of the same type or fully compatible with installed equipment at DEN. DEN has standardized on all other system components including speakers, backboxes, speaker grills etc. The Developer, when specifying these components, shall observe those manufacturers with whom DEN has standardized.

2205.2 System Expansion

The system provides emergency paging to all areas of the airport. Therefore, design modifications and new construction areas must be evaluated for proper coverage. When coverage deficiencies for both general and emergency sources are identified, it shall be the responsibility of the Developer to design and specify a functional extension of the VPS to ensure adequate coverage of general and emergency pages.

Expansion of the system can take several forms including:

A. Where additional speakers only are required, and a branch speaker circuit has sufficient capacity to absorb additional speakers without compromising spare capacity and headroom adjustments, addition of additional speakers to an existing circuit shall be permitted.

B. Where insufficient capacity is not available as described above and a new speaker circuit is required, the Developer's design shall include all facilities including conduit, wiring, and electronic equipment to satisfy the requirements.

C. If additional paging stations are required, the Developer's design shall include conduit and wire from the proposed station locations to the nearest VPS equipment room. In addition, the paging station shall be specified and supporting electronics components when spare capacity is not available shall be included in the Developer's design.

In support of the Developer's design activities, DEN maintains a comprehensive set of as-built documentation, which upon request will be made available to the Developer for review in the development of the VPS design.

2205.3 Site Investigation

All VPS system programming and maintenance is conducted by DEN Maintenance. Prior to design work, the Developer shall request a meeting with the Maintenance Division through the Project Manager. A comprehensive site investigation of the area shall be conducted. During the site investigation, the Developer shall determine:

A. Available circuit capacity in the design area (if applicable)

B. Requirements for paging stations

C. New speaker circuit requirements (if required)

D. New paging zone requirements (if required)

E. Additional hardware (processing, amplification, and miscellaneous equipment if required)

F. Points of interface

The Developer shall be required to design and specify a complete extension of the existing VPS system. Included in the Developers design shall be all conduit, terminal cabinets, wire, and paging system hardware, and components that match existing equipment types used throughout the facility. Where connections to existing circuits and equipment are required, all work shall be coordinated with DEN Maintenance. Under no circumstances shall the Developer's specification and project requirements allow the Developer to make connections to existing equipment without direct supervision by DEN Maintenance. When the final system connections are completed, the DEN Maintenance Division shall make any necessary programming and balancing adjustments.

Where the Developer's work is within a Tenant area, DEN permits the use of standalone background music systems. Standalone systems however must be interfaced to the DEN paging system such that in the event of an emergency page situation the DEN system has priority override capabilities. To achieve this goal, when Tenant areas are equipped with standalone systems, they must be equipped with a 600 ohm balanced input for audio and a control (mute) input. The sources for these signals are provided by DEN and are located throughout the contiguous facilities. The project requirements shall include all conduit and wiring between the standalone system and the DEN interface point. Actual location of the nearest interface point shall be determined during the site investigation. DEN will not provide general paging audio to a standalone system.

Section 2206 - Public Affairs Television System (PATV)

2206.1 System Description

The Public Affairs television system is a 600 Mhz forward pass broadband system operating over fiber optic and .500 hardline cable. The system distributes video signals throughout the contiguous and remote facilities at DEN. Telecommunications Company Inc. TCI provides subscriber services over this system. In addition, DEN originated services are distributed over select channels allocated for DEN services. Passive devices (8 port taps) are located in the majority of Communications and electronic systems equipment rooms throughout all contiguous facilities and several remote facilities. No additions or modifications to the PATV system shall be permitted to accommodate a design requirement. The only interface permitted to the system is the addition of a new television outlet (conduit and outlet box) within a space. Refer to conduit requirements below.

A. When a Developers design scope identifies a requirement for the addition of a television outlet, the Developers design shall include conduit and pull string between the nearest equipment room containing a passive device and the outlets location. Wiring and outlet commissioning shall be arranged between the Tenant/occupant and DEN.

B. All conduits specified for the installation of PATV facilities shall comply with the following requirements.

1. Conduit size: 1" minimum

2. Outlet box size: 4" square x 2-1/2" deep equipped with a 2 gang device ring

3. Looping between PATV outlets shall not be permitted

4. Gathering of PATV conduits to an intermediate (Large) box and extending a single larger conduit to the nearest communications room containing a passive device shall not be permitted.

5. When a conduit is extended to an existing cable tray it shall be secured (clamped) and properly bonded to the tray system

6. All conduit ends shall be equipped with a plastic bushing

7. Where new cable tray is specified in a Developers design, its type size and configuration shall comply with the requirements as indicated in the electrical specification.

8. Proper sealing of all openings (penetrations) created or resulting from the installation of PATV conduits

9. DEN's cable tray system is subdivided into segments, where services are subdivided by service type and signal level. In those cases where extension PATV facilities which include a cable tray segment between the outlet and the serving communications room, the Developer shall be mindful of and coordinate the conduit termination requirements into the proper cable tray segment to ensure code, signal level and service type compliance.
10. Installation of a conduit to the cable tray system shall be made so as not to interfere with the future installation of cabling systems.

Section 2207 - Parking and Ground Transportation Automatic Revenue Control System (PGTS)

2207.1 System Description

The Parking and Ground Transportation Automatic Revenue Control System consists of several individual elements' which when integrated comprise a fully functional system. The elements that make up this system include:

A. The public parking revenue control system
B. License Plate Inventory (LPI) system
C. Access control system for employee parking
D. Automatic Vehicle Identification System (AVI)

The public parking revenue control system is a distributed PC based system. Review the requirements with the Project Manager

Section 2208 - Flight and Baggage Information Display System (FIDS/BIDS)

2208.1 System Description

The Flight and Baggage Information Display System at DEN is a distributed PC based system that provides flight schedule and baggage location text information to video monitors throughout the terminal and concourses. The system signals are distributed throughout the facilities on the FDDI network and are 802.3 compliant network. Signals between the system servers and the data to video converters (DVCs) utilize RS422 signal protocol. After conversion to a video format at the DVCs, which are located within the FIDS/BIDS display kiosks, coaxial cables are extended to the individual display monitors.

DEN has in place a service and maintenance agreement that is utilized in day-to-day system maintenance, implementation of system configuration changes, and system expansions. Therefore, when a Developer's scope includes the addition, deletion, or modification to the existing system, the Developer's scope is limited to the specification of the correct physical characteristics and facilities in support of the installation of equipment and facilities by others. The Developer shall be responsible for the correct specification and configuration of kiosks and millwork, communications conduit systems, electrical provisions, and cooling and ventilation requirements.

Because the FIDS/BIDS system utilizes the Premise Wiring and Communications System (PWCS) and infrastructure as the transportation media for system signals, all conduit and infrastructure components specified for the FIDS/BIDS system shall be typical of those requirements identified below for the PWCS system.

Section 2209 - Premise Wiring and Communications System

2209.1 System Description

The Premise Wiring Communications System (PWCS) at DEN is a universal structured wiring system consisting of multiple cable types that are service location oriented and transmission electronics including SONET, FDDI, and 802.3 compliant networks. The PWCS utilizes Category 5 Unshielded Twisted Pair (UTP), Category 5 Shielded Twisted Pairs (STP), single and multimode fiber optic strands, composite category 5 STP/UTP copper and fiber optic cable construction types, and coaxial cable for broadband video applications. All cables are extended to their end locations via conduit and/or cable trays. All structured wiring system cables are terminated on universal wall plates that support modular connectivity of all cable types identified above.

All cabling additions (provisioning, configuration, and installation of) to the existing infrastructure to satisfy local, site, and inter-building connectivity requirements must be performed by the DEN PWCS Maintenance Contractor.

The PWCS Contractor for DEN is US West. A Tenant requiring cable installation is directed to contact the Help Desk to order services.

2209.2 Addition of Telecommunications Facilities

When a Developer's scope requires the addition of telecommunications outlets as part of a design, the Developer's scope shall include the following elements.

A. Location and specification of the outlet locations and quantities

B. Specification of conduit and outlet box size with pull string (refer to conduit requirements below)

C. Extension of outlet conduit to the nearest communications room or cable tray providing access to the nearest communications room

Note: This room may vary depending upon the available resources within the nearest communications room. The Developer is required to coordinate with DEN Planning and Development to establish the proper conduit termination location.

D. Proper sealing of all openings (penetrations) created or resulting from the installation of telecommunications conduits

2209.3 Conduit Requirements for Electronic and Telecommunications Systems

The following text describes the minimum requirements for conduit sizing and configuration to be utilized in the installation of telecommunications facilities.

2209.4 Telecommunications Outlet

A telecommunications outlet is defined as a voice, data, fiber, or television outlet. The telecommunications outlet is wall mounted, typically at the same height as an electrical outlet and serves desktop devices.

A. Conduit size: 1" minimum

B. Outlet box size: 4-11/16" x 2-1/2" deep equipped with a 2-gang device ring. This conduit shall be extended to the nearest telecommunications cable tray. Where tray is not present, the addition of tray shall be required or extension of the conduit to the nearest Intermediate Distribution Frame (IFD) (Communications Room)

C. Junction boxes in a conduit run shall be a minimum of 6" square

D. Looping between telecommunications outlets shall not be permitted

E. Gathering of telecommunications conduits to an intermediate (Large) box and extending a single larger conduit to the nearest communications room shall not be permitted unless submitted to and approved by DEN telecommunications.

F. When a conduit is extended to an existing cable tray it shall be secured (clamped) and properly bonded (grounded) to the tray system

G. All conduit ends shall be equipped with a plastic bushing

H. Where a new cable tray is specified in a Developer's design, its type, size, and configuration shall comply to the requirements as indicated in the electrical specification for cable trays, 260536.

I. The DEN cable tray system, which is utilized for telecommunications, is subdivided into segments, where services are subdivided by service type and signal level. In those cases where telecommunications facilities that include a cable tray segment between the outlet and the serving telecommunications room, the Developer shall be mindful of and coordinate the conduit termination requirements into the proper cable tray segment to ensure code, signal level, and service type compliance

J. Installation of a conduit to the cable tray system shall be made so as not to interfere with the future installation of cabling systems

K. All conduit installation shall comply with National Electric Code (NEC) for number of bends (in degrees) between pull boxes and distances between pull boxes

L. Telecommunications conduits may contain fiber optic cable; therefore, the specified bending radius of a telecommunications conduit shall be 2" ID minimum

M. Any deviation from these requirements is not acceptable without written approval of the DEN telecommunication department

2209.5 Telecommunications Outlet – Wall-Mounted Telephones

Wall-mounted telephone outlets typically serve above-counter single line sets, courtesy phones, and serve as the rough in for pay stations. Typical mounting height is 54" AFF. In all cases, the final height must be coordinated with the architect based upon function.

A. Conduit size: 3/4" minimum

B. Outlet box size: Single-gang x 1-7/8 D with a single-gang device ring. This conduit shall be extended to the nearest telecommunications cable tray. Where a tray is not present, the addition of a tray or an extension of the conduit to the nearest Intermediate Distribution Frame (IFD) (Communications Room) may be required

C. Junction boxes in a conduit run shall be a minimum of 4" square

D. All of the requirements as indicated in items D – K above in Telecommunications Outlet shall apply to wall-mounted telephone outlets

E. Wall-mounted telephone outlets will not receive fiber optic cable; therefore, the minimum bending radius required in item 1, l. above does not apply.

2209.6 Modular Furniture

Because of the varying connection configurations of modular furniture and the quantities of units that may be fed from a single communications source point, a standard physical interface is not provided. The Developer, when specifying/designing spaces that contain modular furniture, shall be required to initiate a coordination meeting with DEN Telecommunications to develop an interface that supports the connectivity requirements of the space.

2209.7 Building Service Conduits

A. Conduit size: 4" minimum

B. Conduit quantity: The quantity is dependent on the size and functionality of the facility. The Developer shall be required to coordinate with DEN Telecommunications to establish the exact quantities of telecommunication service conduits required.

C. Bending radius

D. Pull boxes

E. Distance between pull boxes

F. Burial depth

2209.8 Duct Bank Systems

A. Conduit size: 4” minimum

B. Conduit quantity: The quantity is dependent on the size and functionality of the facility. The Developer shall be required to coordinate with DEN Telecommunications to establish the exact quantities of telecommunication service conduits required.

C. Burial Depth

D. Marker tape

E. Ground

F. Conduit bending radius

2209.9 Manholes

As-built documentation for all systems: All as-built documentation shall comply with the requirements identified in *BIM Design Standards Manual*.

Section 2210 - Radio Frequency Site/Operational Standards

2210.1 General Technical Standards

These technical standards, as may be amended periodically by the AIM Director, are intended to apply to all cases where transmission of signals of any type are contemplated by the Licensee or Tenant. There is no intent whatsoever to limit the scope of application of this chapter to Radio Technologies presently known or available. DEN reserves the right to review any and all proposed technologies and to reject any or all proposed installations if, in its own judgment, a proposed Tenant's use or activity would limit, restrict, interfere with, prevent, or otherwise damage any present or proposed telecommunications use by DEN or Tenants. These standards are intended to include all of the known electromagnetic radiation spectrum. Technologies not contemplated at the date of this instrument and including non-radio frequency bands (e.g., light wave, infrared, laser, etc.) are all subject to DEN's approval and must be demonstrated to be free of all harmful interference and to pose no threat to people, equipment, or activities of DEN and its other Tenants. At its discretion, DEN may require testing of Tenant's equipment to determine compliance with these standards, or to determine a source of interference.

2210.2 Operational Standards

A. Pre-installation standards: All users shall furnish the following to the DEN Site Manager prior to installation of any equipment:

1. Executed lease, license agreement, or site access permit
2. Copy of FCC license, construction permit, or application, as appropriate
3. Accurate block diagrams showing operating frequencies, all system and interface components including active or passive with gains and losses in dB, along with power levels
4. Antenna type and mounting arrangements, DEN shall determine the equipment location for all potential Tenants
5. Payment of all costs associated with any intermodulation (IM) interference study or co-site interference study as may be required by the AIM Director or the designated representative.

An IM interference study shall be required at the discretion of DEN before execution of a lease. In such cases, the IM study will be performed by DEN or its approved Consultant. Results of the IM study will determine whether a potential transmitter is allowed on the site, or whether additional interference protection devices are required.

Tenant will make no alterations, changes, or modifications to the installation in terms of the number of transmitters, type of equipment, antennas or antenna height, frequencies used, or power output of transmitters,. Tenant will not alter any other technical parameters without written approval from DEN.

A. Tenant maintenance

Tenant's equipment on the Property shall be properly maintained in accordance with the manufacturer's specifications in such a manner as to prevent it from becoming a source of interference or from becoming a safety hazard.

B. Identification tags

Tenant's equipment cabinets and/or relay rack shall have visible identification labels attached that show the Tenant's corporate identity; the licensee's name, address, call sign, and frequency, and the telephone number of the person and organization responsible for maintenance work.

C. Disputes between Tenants

DEN will be the final authority between Tenants in the interpretation of these technical requirements. DEN has final authority with respect to technical parameters, including equipment placement, antenna location, as well as installation workmanship. DEN's recommendations shall be binding.

D. Building regulations

All areas in and around Tenant's equipment and work area shall be kept clean and neat at all times. In addition, exterior areas on the Property including roads and parking lots shall be kept clean. Each Tenant's trash and other unused materials shall be removed immediately from the property and not stored on the premises in any manner.

1. Tools, test equipment, and work materials shall be stored only in areas approved by DEN. It shall be the Tenant's responsibility to secure stored materials against theft and vandalism. All stored material other than small tools and parts are to be tagged with owner's name.
2. Food and drink will be permitted on the premises; however, all trash related to same shall be removed. Care shall be taken not to spill or litter equipment on the premises with food or drink.
3. No alcoholic beverages shall be taken on the premises by Tenant, its agents, or employees.
4. Tenants shall not use or permit the use of the premises for lodging or sleeping.
5. Smoking, open flame, or welding will not be permitted inside the building.
6. Tenants shall not allow or authorize entry into the premises for any purpose whatever, to any person not performing maintenance work for the Tenant without prior permission of DEN.
7. In the event any Tenant fails to comply with all building regulations, DEN shall have the right, after due written warning, to cancel Tenant's lease, and require his equipment to be removed from the building and tower.
8. DEN reserves the right to amend this document. Tenant shall cooperate fully with DEN in regards to all of the above, as well as to future rules and regulations pertaining to the Property

2210.3 Site Technical Standards for Radio Installations

A. The following information must be posted on or near the cabinet:

1. Copy of FCC license
2. Identifier card with the following information:

   Transmit and receive frequencies

   Type of emission

   Authorized output power and ERP

   Antenna model number

   Transmission line model number and type

   Name of licensee

   Name and telephone number of responsible technician or engineer

Identifier cards will be furnished by DEN. They must be attached as soon as received. Unidentified equipment will be considered unauthorized and will be removed immediately.

A. Changes

Notify DEN immediately in writing of any approved changes to frequencies, antennas, equipment configuration, etc. Update the identification card accordingly.

B. Mobile radio and paging transmitters

At a minimum, each transmitter shall employ a dual-stage isolator followed by a single cavity bandpass filter. All transmitters must have external harmonic (low pass) filters. Low pass filters will attenuate the second harmonic by at least 60 dB and the third harmonic by at least 50 dB. The following minimum specifications apply:

30-76 MHz

Isolators - minimum of 60 dB
TX cavity - minimum of 20 dB rejection at + 1 MHz

130-174 MHz

Dual Stage Isolators - minimum of 60 dB
TX cavity - minimum of 25 dB rejection at + 1 MHz

406-512 MHz

Dual Stage Isolators - minimum of 60 dB
TX cavity - minimum of 25 dB rejection at + 1 MHz

851-940 MHz

Dual Stage Isolators - minimum of 60 dB
Tx cavity - minimum of 20 dB rejection at + 5 MHz

Cellular, PCS, and 220 MHz combiners: These systems required special consideration. Plans must be submitted to the Telecommunications Committee.

The bandpass filter should follow the isolator because ferrite isolators are nonlinear and can create harmonics. Please note that most bandpass cavity filters will pass odd harmonics of the tuned frequency, so an external low-pass filter is required. Transmitter combiners will be considered on a case-by-case basis. Please provide all combiner technical information to the site manager.

2210.4 Additional Protective Devices

The specifications listed above for mobile radio and paging transmitters are minimum requirements. Additional protective devices may be required based upon evaluation of the following additional information:

A. Theoretical TX mixes, particularly second and third order mixes
B. Antenna location and type
C. Combiner/multicoupler configurations
D. Transmitter specifications
E. Receiver specifications
F. Historical problems
G. Transmitter to transmitter isolation
H. Transmitter to antenna isolation
I. Transmitter to receiver isolation
J. Calculated and measured level of IM products
K. Transmitter output power
L. Transmitter ERP
M. Spectrum analyzer measurements
N. VSWR measurements
O. Existing cavity selectivity
P. Antenna to antenna proximity

2210.5 Mobile Radio Receivers

DEN has high RF levels in all mobile radio bands. Receiver amplifiers must be robust to work in the DEN environment. The receiver must have good IM rejection, a high compression point, and a high third order intercept. If interference is encountered and DEN finds the receiver is not performing in a state-of-the-art manner, DEN may require receiver improvements before other Tenant equipment or configurations must be changed.

Filters are required for mobile radio receivers. Single receivers must employ a minimum of a single cavity bandpass filter with a rejection curve corresponding to 1 dB insertion loss or better. Additional filter isolation may be required in special cases. Receiver multicouplers must use a bandpass filter prior to the multicoupler.

2210.6 Antennas

Select antennas designed to minimize passive intermodulation generation. Unless the antenna is configured for simplex or duplex operation, transmit and receive antennas should be separated vertically on the tower or other support structure. If the tower is owned by DEN, DEN designates antenna locations. Antennas must be DC grounded to the tower.

2210.7 Transmission Lines

Coaxial cable should be grounded at the top and the bottom of the run with an Andrew ground kit or approved equivalent. Ground conductors must run straight down with no sharp bends (bends increase the impedance of the line; low impedance is required for good lightning protection). DEN also requires that the line be marked so it can be identified, as needed. DEN requires bands of colored electrical tape at the bottom, middle, and top of the run (similar to a resistor color code). A Polyphasor (or equivalent) coaxial surge arrestor must be installed at the bulkhead. All exterior transmission lines must have solid outer conductors. Receive and transmit lines should be separated by at least one foot from cabinet to antenna.

2210.8 Connectors

Connectors are often sources of RF leakage and passive IM. UHF connectors (PL259) are not allowed. 7/16 DIN connectors should be used at 800 MHz and above, but N connectors are authorized at 800 MHz. Connectors using dissimilar metal contacts or ferrous materials (e.g., nickel plating) are not allowed. The preferred connector uses a silver plated body with gold plated inner conductor. Brass bodies and silver or brass inner conductors are also authorized.

2210.9 Grounding- General

Equipment grounding and bonding should be accomplished in accordance with Mil Std 188-124 and Military Handbook 419. Contact the DEN Electrical Engineer for guidance on grounding and bonding for a particular facility.

2210.10 Shielding

RF interference can get directly into the electronics of a receiver or transmitter. Cabinet shielding must be in place and maintained to the manufacturer’s specifications.

2210.11 Power Limits

Cellular, ESMR, and licensed PCS/PCN facilities operating at cell sites on DEN property shall limit their effective radiated power (defined as antenna input power times the gain of the transmitting antenna in dB relative to a dipole) to 25 Watts per RF channel (for wideband systems, such as CDMA, this power limit applies to the equivalent RMS power over the entire band occupied by the CDMA RF channel).

2210.12 Installation/Construction Standards

Installations shall be accomplished in a professional manner, by qualified technical personnel, and are subject to the approval of DEN prior to rendering any system operational.

2210.13 Cabinets

All RF devices including duplexers, isolators, cavities, and switches, etc., shall be located inside grounded cabinets. Properly shielded devices may be mounted on grounded relay racks with permission of DEN. The cabinets shall comply with the following at a minimum:

A. All cabinets must be bonded together and to the ground system with at least #6 copper wire or 1" copper strap

B. All doors must be on and closed

C. All non-original holes larger than 1" must be covered with copper screen or solid metal plates

D. Cabinets will be spaced with no less than 2' of front and back clearance for maintenance access, unless a cabinet does not require rear access

E. Cabinets may be fastened to the concrete floor with hardware through the bottom of the cabinet if desired by the Tenant

2210.14 Cabling

A. All antenna cables must be jacketed Heliax (or equivalent). No kinked or cracked cable will be permitted. No single-braided cable will be permitted. Antenna cables must be tagged at building entry and exit with a weatherproof tag identifying Tenant. An additional tag is required in the equipment room if the building entry/exit point is not in the equipment room. Any unused cable must be terminated.

B. All antenna transmission lines shall be grounded at tower top and bottom, and at the building entrance with appropriate grounding kits.

C. All coax shall be individually attached to the tower legs or wave-guide hangers. This location will be assigned by DEN. Attachment of coax will be by insulated stainless steel clamps and hangers or ultraviolet-stabilized nylon ties spaced a maximum of three feet apart.

D. All transmit interconnecting cables/jumpers must be solid copper outer conductor (superflex or equivalent), or double-braided silver (RG/9 or equivalent).

E. All receiver intercabling must be 100% shielded coax or double-shielded silver cable.

F. All rooftop cable must be run on antenna mounting structure.

G. All inside cable must be run in troughs where provided.

H. All AC line cords must be 3-conductor with grounding plugs.

I. Where no troughs or cable trays exist, all cable must be tied at 3' or closer intervals.

J. Power and phone line cables shall be protected by grommets where they enter cabinets. Cable shall not be wrapped with black tape.

K. Lightning protection must be provided for antenna, power, and control lines.

L. Cable between an equipment cabinet and building exit must be an uninterrupted, continuous length without splices or adapters.

2210.15 Connectors

A. Connectors must be 50-ohm type, including chassis/bulkhead connectors. No UHF connectors will be allowed.

B. Connectors must be properly fabricated (soldered if applicable) if field installed.

C. Connectors must be taped and coated with a sealing agent at least 4" onto jacket if exposed to weather.

D. Male pins must be proper length. Female contacts may not be spread.

E. Connectors must be plier tight as opposed to hand tight.

F. Connectors must be silver-plated or brass.

G. Connectors must be electrically and mechanically equivalent to OEM connectors.

2210.16 Antennas and Mounts

Tenant may not weld antenna mounts to tower. All antenna mounts or supporting structures will be stainless steel or hot-dipped galvanized steel. Any hot dipped galvanized pipes or brackets that have been field cut must be sprayed with a minimum of two coats of cold galvanizing paint or stainless steel paint. All antennas should be fiberglass enclosed. Exposed metal antennas will not be permitted on the site unless treated by chromate conversion (iridite). All antennas that become corroded or damaged must be replaced in a timely fashion.

2210.17 Prevention of Passive Intermodulation

To help prevent passive intermodulation, the following practices shall followed at DEN sites

A. At 800 MHz and above, use 7/16 DIN connectors instead of Type N (for new systems)

B. All connectors should be non-ferrous (no nickel). Silver plated bodies with gold plated inner conductors are best.

C. Do not use UHF connectors (PL259) at any frequency

D. All coaxial cables should be solid shield (e.g., Heliax, Flexwell, or equivalent)

E. Transmission lines should be grounded at the top and bottom of each run

F. Ensure that all bonds are clean, tight, free of corrosion, and have no dissimilar metals

G. Bonds should have large surface areas. Sharp points are sources of IM

H. Separate transmit lines from receive lines as much as possible

I. Use antennas designed to preclude passive intermodulation 2211.4.6 RF Distribution Interface: Tenants will be responsible for equipment necessary to interface with the RF Distribution System (RFDS). Input to the RFDS downlink (base-to-mobile) is a type N connection with a maximum input of +20 dBm per carrier. Output of the RFDS uplink (mobile-to-base) will provide -86 dBm (or greater) per carrier via type N connection. The -86 dBm level is the worst case figure based on a 1 Watt mobile in the defined areas of coverage.

Installations requiring the RFDS connections to couple signals from antenna lines must provide adequate isolation between the RFDS and antennas. Downlink couplers must have a minimum directivity of 20 dB. Uplink coupling or summing devices must have 20 dB minimum port-to-port isolation.

2210.18 Procedures for Adding New or Modifying Existing Systems at DEN

Users who propose to add channels to an existing radio system, change the configuration of an existing radio system, or construct new radio systems at DEN must file a formal application with the DEN Telecommunications Committee. The application should contain, at a minimum, the following information.

2210.19 Application for System Operation at DEN

A. Frequency band and specific frequencies

The applicant must specify the frequency band or bands within which the system will operate, as well as the specific Transmit and Receive frequencies to be used.

B. Transmitter output power

The applicant must specify either the actual transmitter output power that will be used, or the transmitter power (if any) and effective radiated power specified in its FCC license for the proposed facility.

C. Transmission line and antenna information

The applicant must specify the type and length of transmission line to be used and the type of connectors that will be used. The transmission line can be specified as a specific manufacturer's type number, or generically (e.g., 1/2 inch solid outer conductor foam dielectric line). Antenna type (omnidirectional or directional), manufacturer and model number, and gain relative to a dipole should be specified for both transmitting and receiving antennas. Directional antennas should include the orientation of the pattern maximum lobe.

D. Modulation/multiple access method

The applicant must specify the type of modulation used in the system (e.g., AM, SSB, FM, ACSSB, CDMA, TDMA, etc.). For digital modulation techniques, such as TDMA and CDMA, the channel bandwidth occupied by the system should also be specified.

E. Coverage Requirements

The application must contain a general description of the coverage area required for the system to distinguish between systems that require wide area coverage over much of the airport and systems that require coverage only in limited areas, such as in the immediate vicinity of the Concourses.

1. Underground coverage

   The applicant must include requirements for underground coverage, if any, so that the addition of the proposed system to the Radio Frequency Distribution System (RFDS) can be evaluated.

2. Proposed TX/RX sites

   The application should include a description of the site or sites requested for transmitting and receiving antennas. In cases where specific antenna mounting locations are available at a site (e.g., on a tower at the antenna farm or on the roof of a building), the specific mounting location and methods will be specified by DEN, based on the results of the interference study performed on the applicant's system.

F. Description of methods to be used to comply with DEN technical standards

The applicant shall describe isolators, filters, and other additional equipment to be installed to assure compliance with DEN installation and technical standards.

2210.20 Assuring Compliance with Site Standards and DEN Architectural and Engineering Standards

Each application shall be reviewed to assure that it complies with DEN radio system installation and site standards, as well as any DEN Architecture, Engineering, or other standards that apply to the system.

2210.21 Co-site Interference Study to Assure Lack of Interference From New Users

New systems, or changes to existing systems (such as physical reconfiguration or the addition of new channels) will be evaluated to determine their potential to cause interference to existing systems at DEN. The scope of this analysis will vary, depending upon the type and complexity of the new system being installed. The installation of a new simplex VHF air-to-ground system would be relatively simple to evaluate, while the installation of a new multi-channel trunked system would be more involved.

2210.22 Testing and Inspection

New or changed systems will be inspected by a DEN representative after installation to assure that they comply with installation and technical standards, and tested to demonstrate proper operation of filters and other protective devices installed in the system.

A. Interference definition

Interference is not based solely on degradation of the radio frequency performance of existing systems. Interference will normally be based upon the requirements embodied in FCC rules and on the voice quality standards for long distance telephone lines contained in the Bell System Practices. These standards provide a consistent and well-defined means of evaluating the degradation of the audio quality over a voice channel, whether it is a wire channel or a radio channel.

B. Third-party evaluation of interference complaints

For disputes regarding the cause or resolution of specific interference problems, the interference complaint may be evaluated by an independent third party who is competent to evaluate the potential causes of the interference and the measures required for its resolution.

C. Procedures for modification of existing systems

If the channel capacity at a proposed site (or sites) is limited by potential interference considerations, physical space limitations, or radio frequency radiation exposure limits, some means of evaluating different distributions of channel capacity among the various service providers operating at the site must be used to assure that capacity is distributed equitably.

1. Capacity limitations for each provider operating at a particular transmitter/receiver site may be imposed by:

   Non-ionizing electromagnetic radiation limits

   Physical space limitations for antennas or base station equipment

   Potential for interference from additional users or from additional channels

Requirements for maintenance of space for future users

2. Providers may be required to submit verifiable traffic data demonstrating a need for increased capacity before a request for more space at a site is evaluated. DEN may collect this type of information on a regular basis from the providers, since it will provide a picture of wireless traffic patterns at the airport as well as a means of evaluating requests for additional capacity.

End of Chapter

Chapter 23 - Signage and Graphics Drawings

Section 2300 - Signage and Graphics Drawings

2300.1 General Design Requirements

Signs shall comply with all federal, state, and local codes and the Technical Requirements.

Dynamic FIDS, BIDS, and GIDS monitors are addressed in Chapter 22, Communications\Electronic Systems.

2300.2 Sign Construction

Signs that frequently change must be made of local, readily available materials. All message changes must be streamlined in order to update changes overnight if necessary. Signs that historically change most frequently at DEN are Tenant listings and parking signs.

2300.3 Flexibility

Frequently updated signs must be easily maintained and not require sole sourced parts. Include spare panels for frequently revised sign faces for DEN Graphic Shop use. Spare panels allow the changes to be made in the shop and changed out in the field. Unique custom signs are not acceptable.

Section 2301 - Drawings

2301.1 Content

The drawings illustrate and provide all necessary sign information relative to the size, form, location, attachment, and arrangement of the static and dynamic signage components and systems. The following shall be included in the static and dynamic signage and graphics drawings, where applicable. Tracing or copies of manufactured drawings is copyright infringement and is not acceptable.

A. Manufacturer locations of materials, assemblies, products, and accessories

B. Size, thickness, and significant dimensions of all signage elements

C. Gauges, except for prefabricated and assembled units

D. Details of specially fabricated connections

E. Relationship of adjacent dissimilar materials

F. Soil boring or test pit logs including locations for foundations supporting exterior signs

G. Sign location plans shall present all necessary information of all signage system components. Drawings shall indicate, at a minimum, front and back panel designations, sign type, unique sign numbers, and concealed attachment methods.

2301.2 Static and Dynamic

Signage and graphics drawings are divided into two sections identified as, Static Signage and Dynamic Signage. All static signs are required to have a unique sign number identified on all location plans.

2301.3 Static Signage Drawings

Construction documents are divided into specific groups per National CAD Standards (NCS). The group number shall always remain the same no matter how large the project.

2301.4 Dynamic Signage Drawings

Construction documents are divided into specific groups per NCS. The group number shall always remain the same no matter how large the project.

2301.5 Minimum Requirements

Sign location plans shall present the following minimum information:

A. Unique sign number and sign type symbol

B. Front panel designation

C. Back panel designation

D. Sign type

2301.6 Sections and Interior Elevations

Sections and interior elevation drawings show typical sign elevations and their relationship, size, mounting dimensions, and location to interior architectural elements.

2301.7 Details

Detail drawings for both static and dynamic signage showing sign unit elevations, mounting conditions, sizes, graphic layouts, and construction details of each sign and display unit type.

2301.8 Continuation

Drawings shall indicate, where applicable, any continuation from one drawing to another and where plans and system layouts are continued on another drawing. The location of the drawing on which the continuation appears must be noted at the point of break in the plans.

Section 2302 - Structural Requirements

Structural requirements shall be designed by a licensed Colorado Structural Engineer. The Structural Engineer shall:

A. Confirm existing structure can support anticipated signage loads.

B. Verify imposed loads on signs including seismic, wind, thermal, and impact. For signs designed to be free standing in interior public spaces, the load shall be a minimum of the load required for handrails or guardrails and inclusive of seismic, maintenance, and thermal loads. For exterior sign wind load requirements, refer to current CDOT standards.

C. Design foundations, beam supports, and attachments

D. Document and verify the design accommodates thermal movement from heat sources.

Section 2303 - Mechanical Requirements

For sign assemblies not provided by the sign manufacturer, include necessary mechanical requirements designed by a licensed Colorado Mechanical Engineer. The Mechanical Engineer shall:

A. Confirm heat loads developed by internal and external lighting

B. Design ventilation systems both active and passive

C. Document and verify heat loads contributed to the surrounding space.

D. Design any modifications required by fire protection systems.

Section 2304 - Electrical Requirements

Electrical requirements shall be designed by a licensed Colorado Electrical Engineer. The Electrical Engineer shall:

A. Establish load studies for points of connection for new services

B. Design raceways, panels, and transformers to support the installation

C. Design electrical systems within the sign and assure application for UL listing prior to Bid Advertisement.

2304.2 Building/Structure (Exterior) Numbering

Each building or structure shall have at least one sign located on the exterior structure. Review of the building and site plan must be completed with DFD to confirm location and quantity of the signs. Contact the Project Manager for assignment of the building identifier number.

End of Chapter

Chapter 24 - Specialty Systems

Section 2400 - Specialty Systems

Section 2401 - Baggage and Material Handling Systems

Design criteria shall be provided by the Owner.

Section 2402 - Aircraft Support Systems – Passenger Loading Bridges, PC Air, 400 Hertz

Design criteria shall be provided by the Owner. Refer to *Mechanical Design Standards Manual* for PCA requirements.

Section 2403 - People Movers - Trains

Design criteria shall be provided by the Owner.

End of Chapter

Chapter 25 - GIS/CADD Requirements

Section 2500 - GIS/CADD Requirements

As of 2011, all projects shall be done using Autodesk Revit and Civil 3D.

Section 2501 - Legacy Projects

In some instances, Autodesk Revit and Civil 3D may not be required by the Project Manager. If you have any questions regarding the use of Autodesk Revit and Civil 3D, please contact the Project Manager.

End of Chapter

Chapter 26 - Surveys

Section 2600 - Surveys

2600.1 General

This chapter covers the procedures and accuracy requirements for survey services for layout of work and field measurement related to design surveys. Prior to beginning any field survey work, the Developer shall meet with the DEN Survey Office to coordinate survey and reporting requirements.

2600.2 Notice of Survey

Before commencing any layout of work and surveys, the Developer shall give the Owner forty-eight (48) hours written advance notice so that the Owner may witness such work. Developer is responsible for obtaining DEN related survey guidance, survey points, calibration files, and training materials from the DEN Survey Office prior to beginning design survey work.

2600.3 Field Measurements

Field measurements will be performed by the Developer to verify existing conditions unless this activity is specifically excluded from the Developer's Scope of Work. Field measurements generally fall into two categories:

A. As-built measurements of vertical work

Provide field verification of measurements of existing facilities to verify and/or create accurate as-built drawings to be used for Project base data. These measurements shall be completed using proper Surveying Equipment that will deliver accurate Survey results, based on specifications listed in current Construction Documents.

B. Field verification of horizontal work

As-built measurement for items that will be hidden or visible including all civil, mechanical, electrical, control work, and all utilities that are placed in concrete, earth, or behind walls shall be made by and under the direction of a Colorado licensed surveyor while the work is exposed and the measurements submitted to the Project Manager. Unless noted otherwise, the measurements shall show the final location within tolerance of current requirements, written in design contract. Items located within or five feet beyond a building shall be referenced to building column lines and finish floor elevations. Special attention shall be paid to items requiring service, sensors, and items with moving parts, access points, and locations of junctions, elevation changes, and directional changes. Survey notes must be supplied to the Project Manager prior to covering up the work. Survey notes must be supplied to the DEN Survey Office in an electronic format that can be read in AutoCAD 2010 or earlier version.

1. As-built surveys are required to conform to *BIM Design Standards Manual* and Technical Specifications Division 01 for data collection. Failure to provide acceptable layers, feature collection, attribution, and metadata will render the survey defective. As-built surveys encompassing the entire project scope must be supplied upon completion of construction to the Project Manager prior to project close out. Acceptable formats as established in *BIM Design Standards Manual* and Construction Plan Manual Technical Specifications Division 01 - General Requirements. If a design survey project alters any natural (including topography) or fabricated feature that was not specifically addressed in the project scope of work, the is responsible for collecting the change in the features affected by the project and supplying those affected features in the final as-built survey.
2. As-built survey BIM Models, DEN ESRI GIS File Geodatabase, or Building Information Models (BIM) provided to the Project Manager will be sent to the DEN AIM Development Division for final airport quality control. DEN will undergo accuracy check and conformance to the following requirements:

   Spatial conformance with DEN LDP

DEN ESRI File Geodatabase Layer, attribute, metadata conformance with DEN *BIM Design Standards Manual* and Construction Plan Manual Technical Specifications Division 01 -General Requirements.

Completeness of the project as-built BIM models as required in the contract

3. The Developer is responsible to supply as-built BIM models, photographs (JPG), raw point clouds, TIN models, DEM data, point files, to the Project Manager when the Developer is ready to supply the as-built project documentation.

4. Should the submitted as-built drawing or model fail a quality control check, the Developer is responsible for correcting the as-built survey in compliance with airport standards.

The DEN Survey Office has the right to enter any surveying site, at any time, and request from the Developer any:

Survey field notes

Airport survey control points used

Survey measurement files used in data collection

Inspect survey equipment used by Developer

The DEN Survey Office may also check site survey work with their survey instruments to ensure survey work is within tolerance requirements. Any problems found by the DEN Survey Office during site inspections will be reported to the DEN Project Manager.

Section 2601 - Site Work Design Surveys

The DEN Survey Office will provide information at a Pre-Survey meeting with Developer, and his surveyor, for location of NGS Control points on DEN Property, and help with conversion to current Coordinate System. The Developer must accurately transfer the survey control information to the points of application to insure that all elements of the work are correctly located. The Developer should verify that all Geodetic information in pre design plans is correct, by consulting with DEN Survey Office.

If Developer disturbs a DEN Control point, after being made aware of its location, they will be responsible for reestablishment of point. If the Developer is aware that a DEN Control Point is to be destroyed, they must contact DEN Survey Office within 48 Hours of point's destruction.

Should the original reference points that DEN provided be obliterated or dislodged by operations that the Developer controls, the Developer will be responsible for replacement and all costs associated with replacement. The cost of the re-surveys to replace obliterated or dislodged monuments will be paid for **by Developer.**

Section 2602 - Preservation of DEN Control Points and Land Corners.

Throughout the work site there exists an extensive system of Airport Control Points installed for maintaining the LDP coordinate system. If the Developer destroys or obliterates any such Airport Control Points or section corner, the Developer shall be required to pay for all labor, materials, and equipment costs of replacing these Airport Control Points.

Section 2603 - Reference And Coordinate Points

2603.1 Control Points

DEN control points and section corners must be protected and preserved. Coordinates shown on the drawings are based upon current values. Prior to August 1, 2011, DEN utilized a coordinate system called DIA GRID Coordinate System. Drawings may be found that use this legacy coordinate system; however, these drawings must not be used for reference purposes. All DEN Airport Control Points are cataloged at www.ngs.noaa.gov website. The DE Survey Office will provide current coordinates of the Airport Control Points based upon project site location. Developer must meet with DEN Survey Department, prior to doing any design surveying work.

2603.2 Geodetic Control

All airport project surveys must tie to DEN Current Coordinate values.

2603.3 Temporary Control

When the Developer establishes temporary control stations for DEN project work, they must follow FAA guidelines. All project temporary control stations must be referenced to the National Spatial Reference System (NSRS) using the 1) National Geodetic Survey (NGS) Online User Positioning System (OPUS) or 2) DEN Survey Control Points provided by the DEN Survey Office. The only two acceptable means to establish temporary geodetic control for airport construction are as follows:

A. Temporary control must be established under close cooperation with the DEN Survey Office following the procedures outlined in AC150/5300-16 General Guidance and Specifications for Aeronautical Surveys: Establishment of Geodetic Control shall be required according to information below:

   1. A large airport airfield construction project that significantly changes the airport geometry and would trigger the need to acquire new digital stereo imagery following AC 150/5300-17 General Guidance and Specification for Aeronautical Survey Airport Imagery Acquisition and Submission to the National Geodetic Survey. Examples include a new runway and taxiway complex, significant modification of the existing runway or taxiway system, development of a new outboard deice pad complex, or establishment of new mi- airfield concourse and terminal complex.
   2. Construction that establishes a new ILS CAT II/III Operations
   3. New instrument development procedure
   4. New airport layout plan survey update
   5. New airport obstruction chart update
   6. New airport mapping database

B. Excluding large airport airfield construction projects, as listed above, the Developer may use temporary control points on their project site. These temporary control points must be referenced to the nearest DEN control points provided by the DEN Survey Office. All surveyors must obtain permission to establish temporary control points from the DEN Survey Office prior to beginning fieldwork. The temporary points will have DEN current-coordinate values only, along with current elevations.

In all cases, Developers must protect and preserve all DEN Control Points and section corner monuments associated with their reference points. Coordinates shown on the drawings are based on DEN LDP coordinate system. Before establishing any permanent reference points, control points, and benchmarks, contact Den Survey Office.

2603.4 Protection

Protect and preserve DEN Control Points and Section Corners.

2603.5 Damaged or Destroyed Points

Report damaged or destroyed Airport Control Points and section corners to the Project Manager and the Airport Survey Manager.

A. If any section corner monuments are damaged or destroyed during construction activities, such points shall be re-established pursuant to *Laws of the State of Colorado Regulating the Practice of Land Surveying* by a Professional Land Surveyor registered in the State of Colorado. This work is to be done under supervision of DEN Survey Manager.

B. If Airport Control Points are damaged, moved, altered, or destroyed by the Developer, the Developer will be responsible for all replacement costs.

C. The Owner will not be responsible for any increased costs or delays to the Developer relating to reference points, DEN Control Points which are damaged, moved, altered or destroyed by

the Developer or its subcontractors, suppliers, agents or employees or other Contractors working on the site.

2603.6 Errors

A. Report alleged errors in Airport Control Points, promptly to the Project Manager and to the DEN Survey Manager.

B. Discontinue using any DEN Control Points, alleged to be in error, contact the DEN Survey Section, or Project Manager.

C. Claims for extra compensation for alteration or reconstruction allegedly due to errors in Airport Control Points will not be allowed unless original still exists or substantiating evidence proving error is furnished by the Developer, and unless the Developer has reported such errors to the Project Manager and to the DEN Survey Manager as specified herein.

2603.7 Limitations of Existing Information

A. The following are limitations and additional information on DEN Control Points.

1. The DEN current Horizontal and Vertical Survey Data must be shown on the Contract Drawings. NGS data files and coordinates for NGS Horizontal points will be provided during the mandatory survey meeting.

2. The DEN Airport Control Points include Current elevations and current coordinate data. The values as listed on the contract drawings or listed in the specifications are the only approved coordinate points and elevations for design surveying.

3. The use of control points for design surveying other than those shown on the contract drawings or furnished by the Airport Survey Office is prohibited.

4. Elevations are based on current DEN values.

5. The X, Y, Z data for temporary control points listed on the contract drawings or in the specifications is the only approved data to be used for design surveys. The Developer is required to validate these points before any design surveying begins. This data will only be available on DEN Control Points.

6. The Airport Survey Office will provide the Developer with current Horizontal and Vertical Values.

Section 2604 - Construction Lines And Grades

2604.1 Reference Points

Current DEN coordinate points will be provided by DEN, for specific areas of the project.

2604.2 Developer Surveys

The Developer shall make surveys and layouts, as necessary, to delineate the work. The Developer shall make the surveys for the proper performance of the work. As a part of such surveys, the Developer shall furnish, establish, and maintain in good order DEN control points. The Developer shall be responsible for any lines, grades, or measurements that do not comply with specified or proper tolerances, or which are otherwise defective, and for any resultant defects in the work. The Developer will be required to conduct re-surveys or check surveys to correct errors, found by DEN Survey review of Electronic data files.

The Owner shall have the right to check surveys and layouts made by the Developer prior to accepting any of the work. The Developer shall give advance notice of not less than forty-eight (48) hours to the Owner to enable such checking prior to placing any work. The Developer shall furnish assistance as may be required for checking purposes when so requested by the Owner. The Owner may draw the Developer's attention to errors or omissions in lines or grades, but the failure to point out such errors or omissions shall not give the Developer any right or claim nor shall in any way relieve the Developer of his obligations according to the terms of the Developer’s Contract.

2604.3 Quality Control

The Developer shall furnish skilled labor, instrument platforms, ladders, and such other temporary structures, as may be necessary for making and maintaining points and lines in connection with the surveys required. The Developer's instruments and other survey equipment shall be accurate, suitable for the surveys required in accordance with recognized professional standards, and in proper condition and adjustment at all times. Design Surveys shall be performed under the direct supervision of a Colorado licensed surveyor. All correspondence sent to DEN Survey or Project Managers, by the Developer pertaining to Survey issues, must be reviewed and stamped by a PLS, licensed in the State of Colorado.

2604.4 Field Notes

A. The Developer must collect data using electronic methods, for any submitted survey design work. Electronic data files must be sent to Project Manager and the DEN Survey Manager.

All editing of computer records will be done on a copy of the original with all changes initialed. Electronic data from data collectors shall be provided in a format in accordance with *BIM Design Standards Manual*, and Construction Plan Manual Technical Specifications Division 01 - General Requirements. These will be used to supplement field books and will be supplied to the Project Manager and Airport Survey Manager on digital media. The same method of data collection used by the Developer at the beginning of the contract must be used throughout the contract duration.

B. If the Project Manager or DEN Survey Office finds errors in the field notes, or in submitted electronic data files, the information will be returned to the Developer for correction and resubmission. This review does not relieve the Developer from the responsibility of maintaining accurate survey data.

End of Chapter

Chapter 27 - Testing Agency Reports

Section 2700 - Testing Agency Reports

2700.1 Testing Requirements

Unless specifically excluded in the Developer's Contract, the Developer shall provide testing services and analysis in the locations and quantities to satisfy data and analysis information required so the Developer can provide a complete and accurate design.

A. These surveys and testing programs shall include but not be limited to all soils tests and any other investigations of surface or subsurface conditions, which would be required to design the Projects. The scope of such surveys, tests, and investigations shall be submitted to the Owner for its review and acceptance before the surveys or investigations are commenced. The Scope shall include Developer's consideration of information, which the Owner has provided such as topographic maps, site preparations drawings, and the results of available soils investigations. All surveys shall conform to the DEN LDP Coordinate System established by the Owner and shall be coordinated with the DEN Survey Office. The Developer shall perform any and all surveys and soils investigations required by any governmental agencies, regulatory bodies, and authorities having jurisdiction before they will issue construction acceptances for any Project. The Developer shall be solely responsible for contact and coordination with all utility companies for establishment of utility locations prior to site investigations.

2700.2 Testing Agency

Laboratory and field-testing will be conducted by an independent testing laboratory retained by the Developer. The Owner may request additional testing beyond the minimum requirements of the Construction Documents.

Section 2701 - Testing Agency

2701.1 General

The Developer shall employ the services of an independent testing agency consistent with the Technical Requirements.

2701.2 Control of Measuring and Test Equipment

The testing laboratory shall select the measuring and test equipment in such a manner as to provide proper type, range, accuracy, calibration, and tolerance for determining compliance with specified requirements. Measuring and test devices shall be calibrated, adjusted, and maintained at prescribed intervals prior to use, based upon equipment stability and other conditions affecting measurement. Provisions shall be made for the proper handling and storage of equipment. Calibration shall be accomplished using certified standards that have a known traceable relationship to the National Institute of Standards and Technology. Every calibrated measuring and test device shall show the current status, date of last calibration, and the due date for the next calibration. Calibration records shall be maintained as quality records and shall be made available for inspection upon request of the Project Manager.

2701.3 Surveillance of Inspections

When the laws, ordinances, rules, regulations, or orders of any public agency having jurisdiction require the Owner's surveillance of inspections or tests, the Developer shall notify the Owner of the place, date, and time forty-eight (48) hours prior to the inspection/test operation.

2701.4 Retain tested materials and data

The Developer shall be responsible for maintaining tested materials and testing data until Final Completion of the Project or Construction Contract, or at such time as the Owner notifies the Developer in writing. Tests

and tested materials shall be available at time of Bid and during the Bidding process for review by proposers.

Section 2702 - Soils Testing Precautions

2702.1 General

A Colorado Licensed Surveyor shall layout and locate all test pit locations for soils tests. Thirty (30) days prior to beginning soils testing, a geometry study showing vertical clearance and lighting requirements must be submitted to DEN AIM Planning and DEN Operations for review. Protection of Property and Work In Progress.

The Developer shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury, or loss to the following:

A. Property at the work site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction

B. The Developer shall give all notices and comply with all applicable laws, ordinances, rules, regulations, and lawful orders of any public authority bearing on the safety of property or its protection from damage, injury, or loss and further, shall cooperate and keep the Owner and other Contractors informed of all of the Developer's precautions for the protection of the work.

C. If any of the Developer's operations destroy or damage any real or personal property, public or private, the Developer shall promptly repair or replace such property before the Owner will accept the work performed under this Contract. This paragraph applies unless written release is provided by Airport Legal Services.

2702.2 Protection of Municipal and Public Service System

Before any work is started, the Developer shall communicate with all governmental agencies and private entities that have jurisdiction over municipal or other public service systems that might be affected by the work. After work is begun, the Developer shall perform in a manner designed to reduce to a minimum the potential for disrupting the operations of municipal and other service systems. In particular, when a municipal or other public service system can be affected by work done by the Developer, the Developer is required to contact the agency responsible for operation of that system for instructions on how best to proceed.

2702.3 Protection of Drainage Ways

The Developer shall be responsible for the preservation and protection of storm water collection systems and drainage ways, which may be affected by the Developer’s work. This municipal service system is operated by the Wastewater Management Division, and the Developer is required to notify the Director of the Wastewater Management Division and Owner when the work may diminish the system's capabilities or may redirect water flows. This notification process does not relieve the Developer of the responsibility for damage to persons and property, which may result from changes to that system caused by the Developer's operations.

2702.4 Protection of the Environment

The Developer shall comply with the following:

A. The Developer shall comply with all applicable federal, state, and local environmental protection rules, laws, and regulations and accept responsibility for compliance with all environmental quality standards, limitations, and permit requirements promulgated there under, including but not limited to the City's noise control ordinance, federal and state air quality standards for fugitive dust control, prevention of surface and groundwater contamination, and hazardous and other waste disposal practices and procedures.

B. If the City, as owner, is determined by any federal, state, or local government agency, department, board, or commission, or in any judicial proceeding to have violated any such environmental protection rules, laws, or regulations as a result of the Developer's acts or omissions, the Developer agrees to indemnify and hold harmless the City from any and all

prosecutions, payment of any and all fines or penalties, and the cost of abatement and remediation.

2702.5 Hazardous and Explosive Materials

The Developer shall exercise the utmost care and caution in the storage or use of hazardous materials required for the performance of the work. Activities related to the purchase, storage, use, removal, treatment, and disposal of such hazardous materials shall at all times be the sole responsibility of the Developer and shall be supervised and carried out by personnel properly qualified to perform such activities. However, in no circumstances shall activities requiring the purchase, storage, use, removal, treatment, or disposal of hazardous materials be started without first notifying the Owner in writing of the proposed activity and receiving the Owner's written acceptance of that action. The use and storage of explosives will not be allowed on site.

2702.6 Archeological and Historical Discoveries

The Developer is required to inform the Owner of any evidence which might suggest to a layperson that archaeological or historical materials or human remains may be present in the work area. Upon making such a discovery, the Developer shall do whatever is necessary to avoid disturbing that work area. This could require that the Developer's activities be redirected or stopped until the Owner determines how to proceed.

Section 2703 - Documentation

2703.1 Submittal

The Developer shall submit reports of testing and testing analysis to the Owner.

2703.2 Document Control

All records and documents, which are quality related shall be prepared, identified, and maintained by the Developer and shall be submitted to the Owner. Records shall be protected from damage, deterioration, or loss. Retention time for all quality records shall be not less than three (3) years from date of final payment.

2703.3 Test Results

Test results shall be submitted to the Owner after completion of inspections/tests and prior to incorporation of the items into the work unless the test or inspection must be done after installation. Field density and moisture tests shall be reported in draft form immediately at the test site with typed/printed final test results given with 48 hours. If the DEN inspector is not present for the actual test, the draft results shall be given to the Owner at the end of the shift. All other inspection and test results shall be submitted within forty-eight (48) hours of the inspection or test. Test reports shall include worksheets showing any and all calculations used in obtaining the test results. All test results must be reviewed and signed by a registered licensed engineer in the state of Colorado. The signature represents that the test procedures used are in strict conformance with the applicable testing standard, the calculated data are true and accurate, the tools and equipment used were in calibration, the sample was not contaminated, and the persons running the test were qualified.

In addition, the testing laboratory shall prepare and submit to the Owner a Monthly Summary Report each month, which summarizes the activities and results for the quality control tests and inspections conducted during that period. The Monthly Summary Report shall consist of both graphics and text and at a minimum shall identify all test types, test locations, testers, test results, any calculations used, specifications, whether the test passed or failed, and the material supplier, installer, and Developer. Material performance trends shall include a statistical evaluation of each type of test, results of which shall be clearly stated in an overview for each Monthly Report.

2703.4 Records

Records (reports) of inspection and test activities are quality records and shall be maintained, in a manner that provides integrity of item identification, acceptability, and traceability. Reports shall identify the following:

A. Developer's name

B. Contract number and title

C. Testing laboratory name

D. Name of items inspected/tested including a physical description and as applicable, model and make

E. Quantity of items

F. Inspection/test procedure used. If national standards are used, any deviation from these standards.

G. Date the samples were taken and the date the test was made.

H. Where tests were performed including environmental condition where applicable.

I. Name of inspector/tester.

J. Observations/comments.

K. Specified requirements in the contract that the item must meet.

L. Acceptability.

M. Deviations/nonconformance.

N. Corrective action.

O. Evaluation of results.

P. Signature of authorized evaluator.

Q. Where the material was installed.

End of Chapter

Chapter 28 - Planning Study

Section 2800 - Planning Study

Scope of Work was previously provided by the Owner in the Request for Proposals.

End of Chapter

Chapter 29 - Codes and Compliance

Section 2900 - Codes and Compliance

2900.1 Developer Responsibility

The Developer shall be responsible for ensuring that all designs are complete and are compliant with all building code regulatory requirements.

The Developer shall schedule a series of project familiarization meetings with applicable building code and fire prevention officials to review project development. The Developer and all applicable subconsultants shall attend these meetings to discuss code issues and design direction.

The Developer shall submit documents in a timely manner to all required review agencies in order to ensure that permits are available at the time. This shall include intergovernmental agreements and acceptances to tap water and sewer lines. The Designer is responsible for submitting the specifications and drawings to the City's Building Inspection Division for the division's plan review and receiving acceptances thereon sufficient to allow the Developer to obtain the necessary building permits so as not to cause any delay.

2900.2 Compliance

The codes contain specific references that define the Engineer of Record's responsibility for reviewing of Developer submittal for compliance to the code, establishing construction acceptance criteria, special inspections requirements and procedures, and the engineer's review of Developer-engineered items. As a requirement of its contract responsibilities, the Developer is responsible for the development of all code-required items, which are directed by the applicable project regulations and codes and reviewing of all Developer submittals for compliance to the building codes applicable to the project.

2900.3 Variances

Section 2901 - All requests for code and compliance variances must be accepted by the City prior to requesting a formal variance from any code agency.Agencies

The following is a partial listing of agencies that have jurisdiction over projects at DEN.

2901.1 Building Code

All design and construction work shall be governed by the amendments to the International Building Code for the City, latest edition. Particular attention shall be directed to Appendix N of this code, which addresses the construction of airport buildings and structures.

Review and acceptance of all construction documents for compliance to the Denver Building Code as it applies to DEN.

City and County of Denver
Denver Development Services
201 West Colfax Avenue, Department 205
Denver, Colorado 80202

2901.2 Denver Fire Department

Review and acceptance of plans for compliance with the DFD's requirements as it applies to DEN.

Denver Fire Department
201 West Colfax Avenue, Department 205
Denver, Colorado 80204

2901.3 Department of Health and Hospitals

The enforcement of the Denver Health Code, latest edition, is under the jurisdiction of:

City and County of Denver
Department of Environment Health

201 West Colfax Avenue, Department 1009
Denver, Colorado 80204

2901.4 Wastewater Management Division

Review and acceptance of plans for compliance with Chapter 56 of the Revised Municipal Code and enforcement of the Rules and Regulations Governing Sewer Charges and Fees and Management of Wastewater.

City and County of Denver
Department of Public Works
Wastewater Management Division
2000 West 3rd
Denver, Colorado 80223

2901.5 Denver Zoning Administration

Review and acceptance of plans for compliance with the Denver Zoning Ordinance as it applies to DEN.

City and County of Denver
Denver Zoning Administration
201 West Colfax Avenue, Department 205
Denver, Colorado 80202

2901.6 FAA Requirements

Design and construction shall be in accordance with the requirements of the Federal Aviation Administration Design Standards criteria, as set forth in applicable FAA advisory circulars. The Developer shall submit FAA submittals to DEN Maintenance and Engineering, not directly to the FAA. The following Federal Aviation Administration Standards govern the height and location, with respect to runways and taxiways, of all DEN structures:

A. FAR Part 77, "Objects Affecting Navigable Airspace"

B. AC 150/5300-13, "Airport Design"

C. AC 150/5370-2D/E, “Operational Safety on Airports During Construction”

D. AC 70/7460-1K, “Obstruction Marking and Lighting

E. Latest edition Advisory Circulars may be obtained from Federal Aviation Administration U.S. Department of Transportation, 5440 Roslyn Street, Suite 300, Denver, Colorado 80216-6026, (303) 286-5538; U.S. Department of Transportation, Subsequent Distribution Section, M-4943, Washington, D.C. 20590; Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, or other FAA regional offices.

2901.7 U.S. Customs Service (USCS)

The Customs Service, Department of the Treasury, is authorized to control the entrance and clearance of aircraft arriving in and departing from the United States and to inspect the crews, passenger, baggage, stores, and cargo carried thereon (Tariff Act of 1930 and Section 1109 of the Federal Aviation Act of 1958). Customs enforces approximately 400 different laws for forty other agencies in protecting the borders of the United States.

Commissioner of Customs
U.S. Customs Service
1301 Constitution Avenue N.W.
Washington, D.C. 20229
Attention: Chief, Space Management Branch
(202) 566-5471

2901.8 Immigration and Naturalization Service (INS)

The Immigration and Naturalization Service, Department of Justice, examines all persons arriving in the United States to determine their admissibility under the provisions of the Immigration and Nationality Act

(66 Statute 163). Section 239 of the Act (Title 8, U.S. Code 1229) and Part 239, Title 8, Code of Federal Regulations, pertain specifically to aircraft and airports of entry.

Associate Commissioner, Management
Immigration and Naturalization Services
425 I Street N.W.
Washington, D.C. 20536
Attention: Chief, Facilities, and Engineering Branch
(202) 633-4448

2901.9 Public Health Service (PHS)

The Assistant Secretary for Health, Department of Health and Human Services, is authorized to make and enforce such regulations that are necessary to prevent the introduction, transmission, or spread of communicable diseases from foreign countries into the United States or its possessions (Section 361, Public Law 410, 78th Congress).

Director, Division of Quarantine
Public Health Service
Center for Prevention Services
Centers for Disease Control
Atlanta, Georgia 30333
Attention: Chief, Program Operations Branch
(404) 639-2574

2901.10 Animal and Plant Health Inspection Service (APHIS)

APHIS provides inspection services for all aircraft, crew, passengers, stores, and cargo arriving from foreign countries into the United States, its territories and possessions or departing from Hawaii, Puerto Rico, and the U.S. Virgin Islands destined for the U.S. mainland. The purpose is to protect American agriculture by preventing the introduction of injurious plant and animal pests and diseases not previously known to occur in the United States (Plant and Animal Quarantine Acts - 21 U.S. Code 111, 7 U.S. Code 151 et seq.).

Plant Protection and Quarantine Programs
Animal and Plant Health Inspection Service
Federal Building
Hyattsville, Maryland 20782
Attention: Chief, Port Operations
(301) 436-8295

End of Chapter

Chapter 30 - Construction Cost Estimates

Section 3000 - Construction Cost Estimates

The Developer shall submit a verifiable cost estimate for completing the construction of each project or task in compliance with the Contract Documents.

Section 3001 - Submittal Format

Submittals shall be prepared in letter size (8.5 x 11). Each page of each cost estimate shall identify the following: Developer Name and Contract Number, Owner Construction Contract or Package Number, Date, Construction Contract tracking item (change notice, construction change request, RFI, change directive, etc.)

End of Chapter

Chapter 31 - Construction Schedule

Section 3100 - Construction Schedule

The Developer shall provide the Owner with a construction schedule including design process information. The schedule data and information shall be prepared and submitted in accordance with the following requirements. The construction schedule is an integral part of the design process and serves to edify the design. Staging, sequencing, work constraints, and submittal requirements per the Technical Requirements must be coordinated and integrated into the construction schedule. The Developer is responsible for delivery of a design that can be completed and that has been coordinated to assure that work can be prosecuted in given timeframes. Incomplete and poorly coordinated documents may result in project delays.

Section 3101 - Schedule Requirements

The Developer shall prepare a detailed Project Schedule following the requirements set forth in the Technical Requirements and Division 1 Section 013210 “Schedule”.

Section 3102 - Submittal Format

Schedule shall be submitted electronically in PDF format.

End of Chapter

Chapter 32 - Submittals

Section 3200 - Submittals

3200.1 General Information and Requirements

This chapter addresses the minimum requirements for submittal of documents during the progress of design and construction. Unless otherwise stated in the Developer's contract or approved task, at a minimum, the Developer shall deliver the following submittals to the Owner. The Developer shall submit to the Owner progress review submittals of design and Construction Documents, cost estimates, design-build phasing plans, and schedules as described in the Contract Documents. These submittals shall contain the information that the Owner requires to monitor the Developer's progress and to monitor compliance. The Owner will provide the Developer with its written comments, recommendations, instructions, and assistance after it has reviewed these submittals.

3200.2 Submittal Certification

Each required submittal shall be accompanied by written certification by the design contract signatory that the submittal is complete and in compliance with the Construction Documents. The Developer is solely responsible for completion and coordination of work by subconsultants. Any deviation shall be so noted in the certification and shall be accompanied by a copy of the written authorization of deviation by the Owner.

3200.3 Review by DEN

Review and comments by DEN do not relieve the Developer from liabilities of providing complete design services and is not an acceptance of any errors or omissions that may be contained in the documents. Review by DEN shall NOT be construed by the Developer as replacing the Developers quality control program. Submittals by the Developer must be reviewed by the Developer and corrected PRIOR to submittal to DEN.

The Owner reserves the right to reject any submittals, as applicable per the Contract Documents, described below when the Owner determines they do not adequately represent the required level of completion, do not include all relevant design disciplines, systems, approved Tenant requirements or do not include all the required documents. Partial or incomplete submittals will be accepted by the Owner for review purposes only when the Owner requires them for a specific purpose or has otherwise authorized their submittal. Such partial submittals to the Owner shall not relieve the Developer of its commitments to meet schedule and budget requirements contained in the Contract Documents.

3200.4 Schedule of Review of Submittals by DEN

Review timeframes shall be consistent with the agreed upon or contract design schedule.

3200.5 Submittal to Code Agencies

The Developer is solely responsible for acquiring acceptance from review agencies. The Developer shall identify is its design schedule submittal its scheduled submittals to code agencies to ensure that the documents are in compliance with all required code agency requirements.

Section 3201 - Typed Submittals – Specifications, Tables, Estimates, Design Analysis

3201.1 Format

All typed submittals shall be in hard copy form and in Microsoft Word for Windows 2000® or other previously authorized format. These electronic submittals shall be on CD-ROM or DVD. Each disc must be labeled clearly according to DEN guidelines. At a minimum, each disc shall be labeled with the construction project number and title, design contract number, disc number, and date of submittal. The files shall not be protected. Files shall contain the text, illustrations, tables, schedules, and exhibits contained in the document. Package the submittal in a PAPER jacket pocket including a hard copy of the disc directories. The files shall contain the illustrations, tables, and exhibits contained in the document.

3201.2 Specifications

The Developer shall use the uniform format established in these standards for all reports, Construction Documents, and technical specifications. Technical specifications and reports shall be provided on reproducible copy and in Microsoft Word for Windows 2000® format unless otherwise specified in the Developer contract. Electronic submittal shall be on CD-ROM or DVD clearly labeled according to Owner guidelines. Files shall not contain macro language, nor shall files be protected. Package the submittal in a PAPER jacket pocket including a hard copy of the disc directories. The files shall contain the illustrations, tables, and exhibits contained in the document.

Specifications magnetic files organized, as one document with sections shall include a hard copy directory of the sections with the correlative title of the sections within the doc. file.

3201.3 Data and Product Cut Sheets

The Developer shall submit copies of specifications that incorporate behind each specification section sheets cut sheets, product data sheets and back-up materials for the items specified in the respective section. Cut sheets and product date shall identify system or item performance criteria, size, weight, and color. If color selection is requested of the Owner, original manufacturer color samples shall be included. Selected products shall be marked or noted in BLACK to facilitate reproduction. This submittal shall be provided at the 60% construction document submittal and at the 100% construction document submittal. Each specification volume shall be submitted electronically.

Section 3202 - Submittal Format - Drawings

Drawings shall be submitted in the format and size as required by the Owner. The Developer shall contact the Owner in writing prior to each submittal for clarification of the drawing size to be submitted (full size, half size, or reduced size).

Section 3203 - Building Information Management (Revit)

3203.1 Submittal Schedule

Refer to *BIM Design Standards Manual*.

3203.2 Electronic Submittal Requirements

3203.3 Labeling of Media

Developers must label media with the following information:

A. Developer name

B. Contract number

C. DEN project number

D. Submittal date

E. Submittal level

F. Contact phone number

Additionally, a hard copy file list must accompany the submitted disc.

Section 3204 - PDF Submittal Requirements

3204.1 Specifications

In addition to other formats required, specifications shall be submitted as a single PDF file. The file shall be an Adobe Acrobat, PDF file version 6 or later containing all pages in each submittal. This PDF file shall contain all pages rotated to correct orientation. The PDF file shall be delivered to DEN in the unlocked, security-free state. All sections shall have a bookmark. All bookmarks shall be subdivided by discipline and specification number-title, as shown in Figure 1 - Specification Bookmark. As much as it is possible, documents shall be directly converted to PDF format. Scanning of files to PDF is acceptable only with written permission from the Project Manager. Additionally, all pages within or printed from the PDF file must

match the pages submitted. Single PDF files of each separate specification section are only acceptable with written permission of the Project Manager.

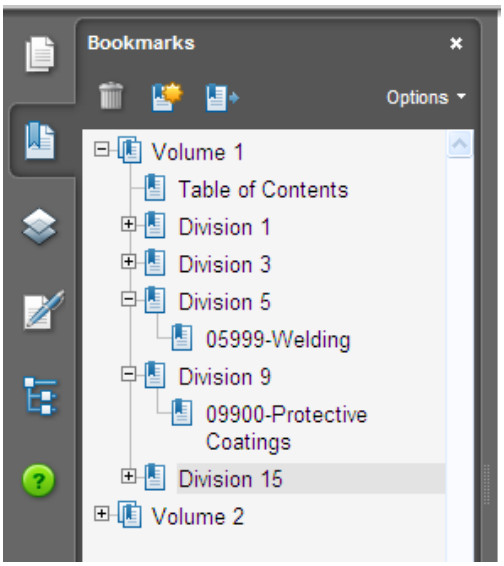


Figure 1 - Specification Bookmark

3204.2 Drawings

In addition to other formats required an Adobe Acrobat, PDF file version 6 or later containing all sheets in each submittal or Volume submitted together with the CADD files at each submittal level. This PDF file shall contain all sheets rotated to correct orientation and plotted to full extents for to-scale printing. The PDF file shall have and be delivered to DEN in the unlocked state. All bookmarks shall be subdivided by discipline and drawing number-title for drawings, as shown in Figure 2 - Drawing Bookmark. As much as it is possible, be directly converted to PDF format. Scanning of files to PDF is acceptable only with written permission Project Manager. Additionally, all sheets within or printed from the PDF file must match the drawings submitted. Single PDF files of each separate drawing are only acceptable with written permission of the Project Manager.

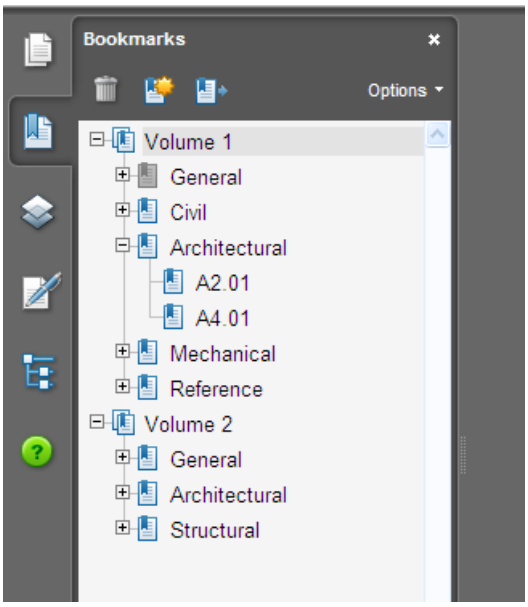


Figure 2 - Drawing Bookmark

3204.3 Reports

In addition to other formats required, reports shall be submitted as a single PDF file. The file shall be an Adobe Acrobat, PDF file version 6 or later containing all pages in each submittal. This PDF file shall contain all pages rotated to correct orientation. The PDF file shall be delivered to DEN in the unlocked, security-free state. All sections shall have a bookmark. All bookmarks shall be subdivided by chapter/title and subchapter numbers/headings. As much as it is possible, documents shall be directly converted to PDF format. Scanning of files to PDF is acceptable only with written permission from the Project Manager. Additionally, all pages within or printed from the PDF file must match the pages submitted.

3204.4 Calculations

In addition to other formats required, calculations shall be submitted as a single PDF file. The file shall be an Adobe Acrobat, PDF file version 6 or later containing all pages in each submittal. This PDF file shall contain all pages rotated to correct orientation. The PDF file shall be delivered to DEN in the unlocked, security-free state. All sections shall have a bookmark. All bookmarks shall be subdivided by discipline and equipment/system number-title. As much as it is possible, documents shall be directly converted to PDF format. Scanning of files to PDF is acceptable only with written permission from the Project Manager. Additionally, all pages within or printed from the PDF file must match the pages submitted.

Section 3205 - Schematic Design Phase (30%)

3205.1 General

The Developer shall deliver schematic design documents to the Owner in accordance with the project schedule accepted by the Owner. This submittal shall be approximately 30% complete and shall include all of the requirements set forth in Chapter 4, Schematic Design Phase. The Developer shall schedule a meeting with the Owner to review its preliminary schematic design in accordance with the individual project schedules accepted by the Owner. At this preliminary review meeting, the Developer shall present drawings and documents in sufficient detail to illustrate concepts, issues, problems, and proposed solutions.

The percentage does not mean 30% of the drawings. EACH drawing required for the schematic design package shall be 30% complete, including but not limited to title block, background annotations, object placements, annotations, key note development, key plan development, schedules if approved by City, etc. This submittal is a step beyond the typical cartoon or mock-up of a package. All CADD layering, annotation, and line systems shall be in place. This submittal shall be reviewed and commented on by the City for:

A. Compliance with CADD standards. Refer to *BIM Design Standards Manual*.

B. Compliance with DEN standards

C. Compliance with Construction Document requirements

3205.2 Schematic Design Submittal

The objectives of the pre-design programming and schematic design are to define the project criteria, formulate the design philosophy, and to develop design solutions, including alternate schemes for the project. During programming, the Developer shall provide the Client data and documentation that will assist in establishing the validity of the overall program, schedule, limitations, and other requirements that serve as the basis in the development of the schematic design and identifying issues that may require adjustments to the program. During the schematic design effort, the Developer shall develop a design solution to the program and alternative schemes and associated site development plans.

These drawings and/or models shall illustrate the general scope, compatibility with FAA Part 77 guidelines, scale, and relationship of project components for conceptual or schematic approval by the Client. The schematic design submittal shall include information that is sufficient in detail to define and quantify system requirements and interrelationships, and shall comprise drawings, list of specification sections, cost estimates, and design reports for alternative design solutions as required by the SOW.

A. Drawings

1. The schematic design submittal drawings shall define site, utility, and floor layouts; floor and building heights and elevations; structural and mechanical systems; overall

electrical, utility, and other system requirements; and provide overall dimensions of major systems and elements. The submittal will generally include the following drawings for each alternative:

- Cover sheet, drawing index
- Survey of existing conditions
- Site layout, civil and utility plans and requirements
- Floor plans
- Architectural sections and elevations
- Structural drawings, soil analysis if available
- MEP drawings
- Perspective sketches and study models

2. At the end of the schematics design stage, upon selection of accepted alternatives, the Developer shall provide to the Client a list of expected construction document drawings.

B. Specifications

The Developer shall prepare a list of proposed Construction Specifications Institute (CSI) Specification Sections that will eventually be incorporated into the Construction Documents and furnish a brief outline description of all major systems selected by each discipline.

C. Cost Estimates

The schematic cost estimate will be used to validate the project budget. The cost estimates for the schematic submittal shall be conceptual in nature, based on systems and unit costs of the work developed. Allowances may be applied to work that is known, but not yet detailed. The estimate submitted at this stage of the work need not be in CSI format.

D. Calculations

By the completion of the schematic design the Developer shall size major systems for disciplines, determine total load requirements, and shall furnish all calculations for the establishment of those quantities.

E. Design Report

The design report shall address all major design characteristics; summarize all major design issues, confirm project criteria, design assumptions, field findings. Provide floor area calculations, spatial and functional relationships, and describe how the design meets or differs from the requirements of the SOW. In the design report the Developer shall include a description of all systems for each discipline and specialty Contractors/suppliers, including analysis of those and alternative system attributes. The design report shall provide information on the preliminary geotechnical report and data. As part of the design report, the Developer shall explain building code requirements and compliance issues and provide a building code analysis and an egress analysis of all structures covered by the international building code (IBC) and Denver amendments. At a minimum, the analyses shall state the type of construction; use group; occupancy load for all parts of the building; live load for each floor; any special stipulations, conditions, and/or modifications to the IBC; and a schematic diagram indicating corridors, exits, and maximum travel distances to the outside of the building. The code analysis shall contain the analyses for all disciplines, included but not limited to architectural, structural, plumbing, EMCS, and electrical.

F. Schedule

As part of this submittal, the Developer shall update the design schedule and provide a broad scope construction schedule defining overall construction times and phasing requirements.

Section 3206 - Design Development (60%)

3206.1 Design Development

The Developer shall deliver design development documents to the Owner in accordance with the project schedule accepted by the Owner. This submittal shall be approximately 60% complete and shall include all of the requirements set forth in Chapter 5, Design Development. Design Development Submittal

Upon receipt of Client comments and approval of the schematic design submittal, the Developer shall commence with preparation of the design development documents. The objective of the design development phase is to refine and further develop the information attained during schematic design that provides detailed information for the execution of the work. The design development submittal shall represent the continuation of the schematic design submittal, incorporating review comments, and shall be in the defined format for the design development documents. The design development submittal, at a minimum, shall comprise the following documents:

A. Drawings

Drawings should be organized for subsequent use as Contract Document drawings. Include title sheets with zoning, building, fire, life safety, plumbing, mechanical and electrical code summaries, and calculations; area and location maps; and a drawing index.

B. Specifications

The Developer shall prepare a complete set of Technical Specifications for the project in a format accepted by the Owner. An outline of the Division 01 - General Requirements Technical Specifications will be furnished by the Owner and shall be reviewed and commented on by the Developer. Comments shall be submitted to the Owner in written form.

C. Cost Estimates

The design development cost estimate will be used to validate the project budget. The cost estimates for the design development submittal shall be based on systems and unit costs of the work developed. Allowances may be applied to work that is known, but not yet detailed. The estimate submitted at this stage of the work need not be in CSI format. The construction cost contingency at this level should not exceed 20%. A section of the estimate shall include a budget reconciliation detailing major variances between the total amount of the current construction estimate and that of the schematic design submittal.

D. Calculations

By the completion of the design development, the Developer shall furnish calculations for all disciplines that are necessary to determine the initial requirements and configuration of all parts of all systems required for the execution of all construction work.

E. Design Report

The design report shall address how the information gained from the schematic design review has been carefully coordinated, cross-referenced, and incorporated into the design development documents, how the design development address's further developments in design characteristics, code compliance issues, and description of how the design meets or differs from the requirements of the SOW. In the design report the Developer shall include a description of all systems for each discipline and specialty Contractors/suppliers, including analysis of those and alternative system attributes. The design report shall provide information on the geotechnical report and data. As part of the design report, the Developer shall explain building code requirements and compliance issues and provide a building code analysis and an egress analysis of all structures covered by the international building code (IBC) and Denver amendments. At a minimum, the analyses shall state the type of construction; use group; occupancy load for all parts of the building; live load for each floor; any special stipulations, conditions, and/or modifications to the IBC; and a plan indicating corridors, exits, and maximum travel distances to the outside of the building. The code analysis shall contain the analyses for all disciplines, included but not limited to architectural, structural, plumbing, EMCS, and electrical.

F. Schedule

The Developer shall furnish a revised design schedule and updated probable construction schedule, including consideration of all major systems and long-lead items. The probable construction schedule shall contain a level of detail necessary to identify individual portions of the work.

G. Spare Parts and Long Lead Items List

During the design development phase, the Developer shall begin to evaluate the requirements for spare parts and long lead items by identifying the spare parts and their quantities. The Developer is required to coordinate the spare parts requirements with Engineering and Maintenance at each respective airport and to prepare specifications to accomplish these goals. Provide an initial list of all items that may need to be purchased in advance by the Client or the Developer to meet the construction schedule.

Section 3207 - Construction Documents - 90% Progress

3207.1 General

An in-progress submittals of the Construction Documents shall be scheduled by the Developer when the Construction Documents are approximately 90% complete. If the Owner determines that major items of work have been omitted in this submittal, the Owner may reject the submittal.

The Developer shall deliver an in-progress submittal of specific packaging Construction Documents to the Owner in accordance with the project schedule accepted by the Owner. Each submittal will be a standalone package for a specific area or discipline. Each submittal shall be approximately 90% complete and shall include all requirements set forth in Chapter 6, Construction Documents.

3207.2 Construction Documents – 90% Progress Submittals

Upon receipt of Client comments and approval of the design development submittal, the Developer shall commence with preparation of the construction documents. The objective of the construction document phase is to refine and further develop the information attained during design development that provides detailed information for the execution of the work. The construction documents comprise drawings, specifications, and contractual information that define in detail all materials, quantities, systems, interrelationships, work methods and limitations, and contractual requirements for the execution of the project. The construction documents must be completely coordinated with the solicitation provisions, special provisions, and contract provisions of the Client. The 90% Progress Submittals shall represent the continuation of the design development submittal, incorporating review comments, and shall be in the final format of the Issued for Construction (IFC) construction documents. The 90% Progress submittals, at a minimum, shall comprise the following documents:

A. Drawings

The drawings shall include all required sheets of the final construction working drawings defined by the drawing list, each at least to the 90% level of completion, with sufficient information included for the preparation of a detailed cost estimate.

B. Specifications

The specifications shall be in the final format in the most recent edition of the MasterSpec© format and shall address all applicable subdivisions, and shall contain adequate technical information to supplement the drawings to quantify sizes, capacities, and qualify grade, strength, workmanship finishes, and other characteristics of applicable materials and equipment. Provide a list of sole-source items included in the design document and provide sole-source justifications for all items not on the pre-approved list.

C. Calculations

The Developer shall furnish calculations for all disciplines that are necessary to determine the final requirements and configuration of all parts of all systems required for the execution of all construction work.

D. DAR

The design report shall address how the information gained from the design development review has been carefully coordinated, cross-referenced, and incorporated into the construction documents, how the construction documents address further developments in design characteristics, code compliance issues, and description of how the design meets or differs from the requirements of the SOW. The design report shall be in its final format and shall include, at a minimum, the following data:

1. Executive summary
2. Existing site conditions
3. Utilities
4. Developer access and facilities
5. Potential coordination conflicts/phasing issues
6. Overall design philosophy and criteria by disciplines
7. Floor area calculation and allocations
8. Material descriptions and properties
9. Equipment description and properties
10. Coordination of maintenance and operational issues
11. Code report and compliance issues

E. Schedule

The Developer shall furnish a revised design schedule and updated probable construction schedule, including consideration of all major systems and long-lead items. The probable construction schedule shall contain a level of detail necessary to identify individual portions of the work. An electronic medium of a compressed back up shall be provided on CD or DVD with each submittal.

F. Spare Parts and Long Lead Items List

During the 90% Progress Submittal, the Developer shall evaluate the requirements for spare parts and long lead items by identifying the spare parts and their quantities. The Developer is required to coordinate the spare parts requirements with Engineering and Maintenance at each respective airport and to prepare specifications to accomplish these goals. Provide a list of all items that may need to be purchased in advance by the Client or the Developer to meet the construction schedule.

Section 3208 - Construction Documents, Issued for Review – 100% (IFR)

3208.1 General

Issued for Review (IFR) Submittals of the Construction Documents shall be scheduled by the Developer when the Construction Documents are 100% complete or substantially complete. If the Owner determines that major items of work have been omitted in this submittal, the Owner may reject the submittal. The Developer shall provide a separate written report addressing comments and direction provided the Developer by the Owner after the 90% Progress Submittals.

3208.2 Construction Documents - Issued for Review - 100% (IFR) Submittal

The IFR submittals shall incorporate the comments and information gained from the 90% Progress submittals and is a comprehensive and complete Construction Document, suitable for construction. The

documents shall be 100% complete, pending any work for only minor corrections to resolve discrepancies discovered during the final review and for the incorporation of final Client comments.

A. Certification

The Developer shall certify in writing that all of the Construction Documents are in conformance with the DEN design standards, all code agency requirements, and that the documents are complete. This certification will be forwarded to the FAA for acceptance, as necessary, when AIP funding is to be used for the projects. On federally funded projects, these documents will be submitted to the appropriate federal agency for review.

B. Drawings

The drawing set shall include all required construction working-drawing sheets completed to 100% level of completion.

C. Specifications

Specifications shall be complete, comprehensive, and fully coordinated with the working drawings between disciplines and with the contract and special provisions. Specifications shall comply with Chapter 11, Detail Specifications requirements including the Data and Product Submittal. Part I and Part II Specifications shall be complete. The specifications shall include the following contract requirements:

1. Supplemental conditions
2. Division 01 - General Requirements
3. Division 02 through Division 33: All other technical specification sections

D. Calculations

All calculations shall be finalized; incorporating all resolved comments and corrections of the 90% Progress Submittals.

E. DAR

The Design Report shall be finalized by carefully coordinating, cross-referencing, and incorporating all resolved comments and corrections of the 90% Progress Submittals and the contents of all previously submitted design reports and revised to reflect the final design.

F. Soils reports

The Developer shall bind separately soils investigations performed by the Developer to establish design criteria for the project. This report shall be issued as an information attachment to the bid documents.

3208.3 Construction Documents, Issued for Construction (IFC) Submittal

The final construction documents shall be comprehensive, clear, and suitable for the purposes of procurement, contracting, and construction, and shall incorporate the final, client-approved solicitation provisions, contract provisions, special provisions, conditions of the contract, and general requirements

The final submittal of the Issued for Construction (IFC) Documents shall incorporate all Owner comments developed by the IFR submittal, with all outstanding actions resolved. Deliverables shall include the following documents:

A. Developer annotated responses to the design review comments from the IFR submittal.

B. Final drawings

C. Final specifications

D. Final Calculations

E. Final DAR

F. Progress project schedule

G. Spare parts and long lead items list

At the IFC submittal phase, the Developer shall have finalized the requirements for spare parts and long lead items.

H. An original letter signed and sealed by the Developer and addressed to the Owner providing a list of the special inspections required by the Universal State Building Code (USBC) for the proposed work.

I. An original letter signed and sealed by the Developer and addressed to the Owner certifying that the design as submitted is in accordance with prevailing and applicable codes. Letter shall include a list of such codes used in the design.

J. An original letter signed and sealed by the Developer and addressed to the Owner for the temporary Support of Excavation (SOE) system, when applicable.

K. A complete list of all drawings submitted for final code review.

L. The final construction submittal schedule, listing all submittals required of the Developer by specification section.

3208.4 Certification Requirements

Final construction documents, including drawings, specifications, and calculations shall be sealed and signed by the appropriate Professional Registered Architect or Engineer-of-Record. Plans and specifications prepared for asbestos abatement, hazardous materials remediation, wetland delineation or other environmental activities shall be signed and sealed in accordance with federal and state regulations.

3208.5 Building Department Review

Upon completion of the Issued for Review (IFR) review by the Owner, incorporation and/or resolution of the IFR review comments, and acknowledgement of agreement on comment resolution by the designated signatory (Program Manager), the Developer shall complete the Issued for Construction (IFC) submittal and bind them so they are ready for distribution to the Building Department for plan review. Issued for Construction (IFC) submittal shall be completed, reviewed, checked, signed, and sealed by the Developer. The Owner's comments and approved Tenant comments from previous reviews shall be incorporated in the Issued for Construction (IFC) submittal and all outstanding issues shall be resolved to the satisfaction of the Owner.

The Developer shall deliver the Issued for Construction (IFC) submittal to the Building Department for review and notify the Project Manager of the Building Department log number and provide a weekly update of the review status. The Developer shall address all Building Department issues at no additional cost to the project.

Section 3209 - Submittals Concurrent to the Issued for Review (IFR) Submittal

3209.1 Agency and Utilities, Applications and Permits

A. Identify all design or construction related governmental permits, licenses or other acceptances that are required to complete each project.

B. Prepare and submit to the Owner technical data and information required to prepare any federal grant application and any State of Colorado or federal permit application. These submittals shall include the number of copies of contract drawings and specifications, which any State of Colorado, utility, and/or regulatory body requires in connection with their review and acceptance of the individual applications. The Owner shall submit these applications to the appropriate agency, utility, and/or department.

C. During all phases of work, prepare and submit technical data and information to all government agencies, regulatory bodies, and public utilities necessary to obtain the required permits or acceptances to design and construct each project. A copy of this information shall be sent to the Owner. The Developer shall either:

1. Obtain, on behalf of the Owner, and deliver to the City's Building Inspection Division prior to publication of the Notice for Invitation to Bid, the permits and acceptances described above, or

2. Confirm that these permits and acceptances have been obtained and all other requirements including the Building Division requirements have been satisfied by delivery to the City, a letter signed by the Building Division and other authorized representatives of each government agency or regulatory body stating that the necessary building and other permits are ready to be issued to successful proposers for each construction contract.

The Developer shall not be responsible for paying any construction permit fee unless the Developer is performing construction work or the activities of the Developer during testing require code agency reviews and permits.

D. The Developer shall also during the construction phases of this Project submit to the government department, agency, regulatory body and/or public utilities technical data or information contained in addenda, change requests, change directives, and/or change orders, which those agencies, departments, regulatory bodies, or utilities need to issue any new or modified permits or acceptances and shall obtain those permits and acceptances on behalf of the City and deliver them to the Building Division.

E. Incorporate in the Construction Documents submitted all revisions necessary to obtain the governmental permits and licenses or other acceptances.

F. Document all discussions relating to permits, licenses, and acceptances with City, State, and Federal agencies, regulatory bodies, departments, and with public utilities. Within 24 hours of meetings or discussions, provide the City with copies of all meeting minutes and all serialized correspondence sent to and received from such agencies, departments, and public utilities relating to permits or acceptances, including copies of the permits, licenses, and acceptances.

Section 3210 - Other In Progress Submittals

The Owner may require in-progress submittals at any time during the term of this Contract Documents. These submittals may be required to address specific questions or issues related to matters such as interface problems or other issues associated with work performed by other Consultants, Tenants, design-build Contractors, and Contractors, and any special problem areas that are identified by the Owner. The Owner shall provide the Developer with its requirements for in-progress submittals with reasonable advance notice to allow the Developer to schedule and prepare the submittal.

Section 3211 - Record Document Submittal

3211.1 General

Submit in compliance with Chapter 9, Record Documents.

MINIMAL SUBMITTAL REQUIREMENTS AND QUANTITIES

This table indicates the quantities of sets of design and construction documents to be submitted during each phase

Phase	Submittal	Report	Full size Prints	Half size Prints	PDF files
EW	Schematic Design Package - 30% Design Analysis Report – SD - 30%	5	1	5	3
EW	Other Early Design Work (multiple package)	5	1	5	3
DD	Design Development Package - 60% Design Analysis Report – DD – 60%	5	1	5	3
CD[1]	All Construction Documents – 90% Progress Submittals: number and name of packages based on Developer packaging schedule (multiple packages)	5	1	5	3
CD[1]	All Construction Documents - Issued for Review - 100% (IFR) Submittal	5	1	5	3
CD[1] CD[2]	All Construction Documents -Issued for Construction (IFC) Submittal	5	1	5	3
CD[2]	Design Analysis Report CD[2]	5	1	5	3
CD[1]	All Submittals issued for Governmental Approvals (agency utilities, grant applications)	5			
CD[1]	All Construction Documents -Issued for Governmental Approval (IFC)		2		
CA	Record Document BIM (per BIM DSM)		2		

End of Chapter

Chapter 33 - Quality Control Plan

Section 3300 - General

3300.1 General Information and Requirements

The Developer shall develop, implement, and regularly utilize a document Quality Control Plan (QCP) for the project Construction Documents. The objective of the QCP is to achieve the following objectives for the production of the Construction Documents:

A. The design is capable of being constructed with minimal/critical design modifications.

B. The drawings and specifications accurately define the work to be performed.

C. The drawings and specifications are produced without negligent errors or omissions.

D. Drawings and specifications conform to the standards and criteria presented in this Design Standards Manual.

E. Construction can be accomplished in accordance with drawings and specifications and will result in functional systems that meeting the owner's intended use.

The Construction Documents QCP established herein is to provide a consistent framework for review and communication between the architectural/engineering team disciplines. This framework is not intended to describe the full extent of the Developer's quality control efforts or the complete development of a checklist specific to the project. The Developer shall review this checklist and matching its level of detail, develop a similar checklist of applicable systems, materials, procedures, etc. of the project that are necessary for the complete development and proper functioning of the project and which are not identified in the checklist. These additional systems, materials, procedures, etc. shall be defined during the programming phase of the project and the quality control checklist developed accordingly.

During the design development phase, the Developer shall start the document quality control checklist process. At a minimum, each successive submittal during the design development and construction documents phases shall contain a completed Quality Control Checklist. The submittal shall provide evidence that a formal process of verification of quality, accuracy, and coordination of the project Construction Documents was taken place within the context of the Developer's overall quality assurance process.

Section 3301 - Quality Control Plan

3301.1 General

The Developer is responsible for making sure that each project discipline establishes and adheres to a quality control plan. The Developer shall actively monitor each disciplines use of the plans procedures and that the checklist is being utilized to monitor the development of the document packages. Each member of the project team is responsible for the finished quality of all designs and documents produced by them.

At a minimum, the Developer's quality control plan shall achieve the following:

A. All disciplines define their quality control approach detailed form

B. Complete and thorough information is shown, checked and reviewed

C. Contents are without negligent errors and omissions

D. CADD standards conform to the standards presented in *BIM Design Standards Manual*.

E. Drawings and specifications conform to the standards presented in this Design Standards Manual.

F. Conflicts between documents; whether between different discipline drawings, electronic media, or between the plans and specifications; minimized.

G. Issuance of drawings and specification conform to the standards presented in this Design Standards Manual.

H. The Construction Documents quality control plan provides evidence that the Developer will check the quality, accuracy, and coordination of the project's Construction Documents. All documents will be checked using a formal procedure.

3301.2 Quality Control Checklist

The following quality control checklist is provided to establish a minimum level of thoroughness for the development of a project specific document quality control checklist. The Developer shall review this checklist and based upon the specifics of the project, modify this checklist to meet the specific need for document quality control for its design. The quality control checklist is to be submitted with each design development and construction document submittal as defined in this standard presented in this Design Standards Manual.

Table 4 - Quality Control Checklist

Check list Item	Yes	No	N/A
GENERAL ITEMS			
1. Developer name shown on the drawings and is the same as that used on the specifications and the Owner/Architect agreement.	☐	☐	☐
2. Verify the name and location of project corresponds with plans. Include ALP with Project identified.	☐	☐	☐
3. Verify Bidding/Bidder requirements with the Project Manager	☐	☐	☐
4. Verify that the unit price bidding is clear, if applicable.	☐	☐	☐
5. Verify alternate bidding is clear.	☐	☐	☐
6. Verify insurance requirements with Owner.	☐	☐	☐
7. Verify legal conditions of Project Manual, i.e., General Conditions, Contract, Bond, Insurance, etc.	☐	☐	☐
8. Verify that the zoning application has been submitted and the project approved	☐	☐	☐
9. Geo-Tech recommendations were followed.	☐	☐	☐
10. Independent testing lab reports results immediately to Developer.	☐	☐	☐
11. Rain water will be collected and divert to appropriate storm water systems	☐	☐	☐
12. Civil field engineering, staking in the Contract or performed by others.	☐	☐	☐
13. Uniform Building Code Special Inspections - who performs what?	☐	☐	☐
14. Identify below grade waterproofing location and limits material.	☐	☐	☐
15. Identify below grade water drainage is directed to appropriate storm water drainage systems	☐	☐	☐
16. Crack control - control joints located for all conditions; expansion joints located and waterproofed. Note: building not air conditioned, i.e., schools closed during summer must have additional crack control.	☐	☐	☐
17. Skylight and window wall; Developer used, engineered, waterproofed and expansion provided.	☐	☐	☐
18. Structural connection engineered to develop member loads.	☐	☐	☐
19. Through the wall flashing provided with weeps.	☐	☐	☐
20. Concealed gutters waterproofed and expansion provided; connected to roof drains.	☐	☐	☐
21. OSHA requirements are identified.	☐	☐	☐
22. Retaining walls, miscellaneous site items are engineered.	☐	☐	☐
23. Controls, fire alarm, HVAC are coordinated, installation and performance.	☐	☐	☐
24. Roof drains, routed, located, detailed and overflow provided.	☐	☐	☐
25. Walls, roof, and floor engineered for vapor protection, prevent mildew.	☐	☐	☐
26. General Conditions of Construction Documents	☐	☐	☐
27. Verify underpinning - support of existing structure during demolition and construction.	☐	☐	☐
28. Verify exterior platforms, aprons are sloped to drain substructure, waterproofed and flashed. Provided control and expansion joints.	☐	☐	☐
29. Machinery vibration, air, and noise control are defined and accounted for.	☐	☐	☐
30. Verify site service condition with the different utilities, i.e., gas, water, electric, telephone, cable, etc.	☐	☐	☐

Check list Item	Yes	No	N/A

ADMINISTRATION

1. Verify coversheet information and spelling corresponds to Project Manual.	☐	☐	☐
2. Verify stamping and signing by professionals of the different disciplines.	☐	☐	☐
3. Verify Index Sheet corresponds to drawings and titles.	☐	☐	☐
4. Verify Abbreviations and Symbols correspond with abbreviations and symbols in the documents.	☐	☐	☐
5. Verify conformance of Building Codes, Life Safety, Fire Protection, LEED, Zoning, EPA, or other Governmental authority. Obtain written approval for any variance.	☐	☐	☐

CIVIL

1. Verify existing conditions, i.e., surveys, topographies, zoning, utilities, easements, etc.	☐	☐	☐
2. Verify that existing to remain power/ telephone conduits, drainage inlets, manholes, valve boxes, street signs, cathodic protection, etc. do not interfere with new site improvements or landscaping.	☐	☐	☐
3. Verify that new power/ telephone utilities, grease traps, fuel tanks, etc., do not interfere with new site improvements, existing conditions or landscaping.	☐	☐	☐
4. Verify site limits of construction, i.e., clearing, grading, landscaping, utilities, building, etc.	☐	☐	☐
5. Verify profile sheets with utilities, building, topography, etc.	☐	☐	☐
6. Verify civil specification coordination with plans.	☐	☐	☐
7. Verify demolition disposal, borrow sites, waste is clear for disposition and coordinated.	☐	☐	☐

LANDSCAPE

1. Verify that the sprinklers, lighting, hardscape, etc. correspond with the site limits, including the building and civil plans.	☐	☐	☐
2. Verify that the maintenance and landscape is coordinated in the Project Manual.	☐	☐	☐

ARCHITECTURAL

1. Verify site property lines and existing conditions match with survey or civil.	☐	☐	☐
2. Verify building location meets all set back requirements, zoning codes.	☐	☐	☐
3. Verify building limits match with civil, plumbing, and electrical on site plans.	☐	☐	☐
4. Verify locations of columns, bearing walls, gridlines, and overall building dimensions match structural.	☐	☐	☐
5. Verify locations of expansion joints, all floors, match with structural.	☐	☐	☐
6. Demolition to remove is clear vs. what remains	☐	☐	☐
7. Verify building elevations match floor plans.	☐	☐	☐
8. Verify building sections match elevations, plans, and structure.	☐	☐	☐
9. Verify building plans match lines, with structural, mechanical, plumbing, and electrical.	☐	☐	☐
10. Verify structural member locations are commensurate with architectural.	☐	☐	☐
11. Verify elevation points with structural.	☐	☐	☐
12. Verify chases match with structural, mechanical, plumbing, and electrical.	☐	☐	☐
13. Verify section and detail callouts are proper and cross-referenced.	☐	☐	☐
14. Verify large-scale plans and sections match small-scale plans and sections.	☐	☐	☐
15. Verify reflected ceiling plans with architectural, mechanical, and electrical plans.	☐	☐	☐
16. Verify Room Finish Schedule information matches plans, elevation, sections	☐	☐	☐
17. Verify door schedule information matches plans, elevations, fire rating	☐	☐	☐
18. Verify cabinets or millwork will fit in available space.	☐	☐	☐

Check list Item	Yes	No	N/A
19. Verify flashing through the wall and weep holes where water may penetrate the outer material.	☐	☐	☐
20. Verify flashing material, gauges	☐	☐	☐
21. Verify fire rated walls and ceiling match with fire and smoke dampers.	☐	☐	☐
22. Verify miscellaneous metals detailed	☐	☐	☐
23. Verify equipment room or areas are commensurate with mechanical, electrical, or plumbing.	☐	☐	☐
24. Verify the limits, types and details of waterproofing	☐	☐	☐
25. Verify the limits, types and sizes of insulation	☐	☐	☐
26. Verify the limits, types and details of roofing	☐	☐	☐
27. Verify skylight structures with the structural.	☐	☐	☐
28. Verify skylight expansion and weeps are provided.	☐	☐	☐
29. Verify masonry expansion and crack control is provided.	☐	☐	☐
30. Verify floor and wall tile expansion and crack control is provided.	☐	☐	☐
31. Verify walls, partitions and window walls are not inadvertently loaded through deflection.	☐	☐	☐
32. Verify that all miscellaneous items, i.e., stairs, stud walls, catwalks are engineered.	☐	☐	☐
33. Verify all window walls, expansions and weeps are provided.	☐	☐	☐
34. Verify all handicapped requirements coordinate with plumbing and electrical	☐	☐	☐
35. Verify architectural space requirements are commensurate with ductwork, conduit, piping, light fixtures and other recesses.	☐	☐	☐
36. Verify architectural space requirements are commensurate with elevators, escalators and other equipment.	☐	☐	☐
37. Verify dew point in walls, roof, and provide vapor barrier as required.	☐	☐	☐
38. Verify concealed gutters are properly detailed, drained, waterproofed and expansion provided.	☐	☐	☐
39. Verify grading around perimeter of building with Civil.	☐	☐	☐

STRUCTURAL

1. Verify that the design load conditions meet or exceed the Building Codes and the Design Standards.	☐	☐	☐
2. Verify Geo-Tech Developer recommendations were followed without deviation.	☐	☐	☐
3. Verify that column grid lines and column orientation on the structural and architectural drawings match.	☐	☐	☐
4. Verify that load bearing walls and column locations match with the architectural drawings.	☐	☐	☐
5. Verify that slab elevations match the architectural drawings.	☐	☐	☐
6. Verify that depressed or raised slabs are indicated and match the architectural drawings.	☐	☐	☐
7. Verify that the limits of slabs on the structural drawings match with the architectural drawings.	☐	☐	☐
8. Verify that the expansion joints through the building on structural drawings match with the architectural drawings.	☐	☐	☐
9. Verify footing depths and coverage with existing final grades.	☐	☐	☐
10. Verify that foundation piers, footings, grade beams are coordinated with the Schedules.	☐	☐	☐
11. Verify footing and pier locations with new and existing utilities, trenches, tanks for location.	☐	☐	☐
12. Verify underpinning - support of existing structure during demolition where required.	☐	☐	☐
13. Verify foundation wall elevations with the architectural drawings.	☐	☐	☐
14. Verity that the location of floor and roof framing column lines and column orientation match the foundation plan column lines and column orientation.	☐	☐	☐
15. Verify that the structural perimeter floor and rooflines match the architectural drawings.	☐	☐	☐

Check list Item	Yes	No	N/A
16. Verify that the Section and Detail callouts are proper and cross-referenced.	☐	☐	☐
17. Verify that the columns, beams, and slabs are listed in Schedules and are coordinated.	☐	☐	☐
18. Verify that the column length, beam, and joist depths match with the architectural drawings.	☐	☐	☐
19. Verify that the structural dimensions match the architectural drawings.	☐	☐	☐
20. Verify that the drawing notes do not conflict with the specifications.	☐	☐	☐
21. Verify that the exterior platforms, decks, and patios that are sloped to drain match the architectural drawings.	☐	☐	☐
22. Verify the architectural construction and rustication joints.	☐	☐	☐
23. Verify the structural openings with architectural, mechanical electrical and plumbing drawings.	☐	☐	☐
24. Verify the structural joist and beam location with water closets, floor urinals, floor drains, and chases.	☐	☐	☐
25. Verify the structural design roof and floors for the superimposed loads, including the HVAC, boilers, glass walls, etc.	☐	☐	☐
26. Verify cambers, drifts, and deflections with the architectural drawings.	☐	☐	☐
27. Verify the concentrated load points on joists by other disciplines, i.e., large water lines or fire main lines.	☐	☐	☐
28. Verify that horizontal and vertical bracings, ladders, stairs and framing do not interfere with doorways, piping, ductwork, electrical, equipment, etc.	☐	☐	☐

MECHANICAL

1. Mechanical plans match architectural and reflected ceiling plans.	☐	☐	☐
2. HVAC ducts are commensurate with architectural space and not in conflict with conduit, piping, etc.	☐	☐	☐
3. Mechanical equipment fits architectural space with room for access, safety, and maintenance.	☐	☐	☐
4. Verify mechanical openings match architectural and structural.	☐	☐	☐
5. Verify mechanical motor sizes match electrical schedules.	☐	☐	☐
6. Verify thermostat locations are not placed over dimmer controls.	☐	☐	☐
7. Verify building pressure will allow exterior doors to close.	☐	☐	☐
8. Verify equipment schedules correspond to a manufacturer and Project Manual.	☐	☐	☐
9. Verify mechanical requirements to special equipment, i.e., kitchen, elevator, telephone, transformer, etc.	☐	☐	☐
10. Verify fire damper location in ceiling and firewalls.	☐	☐	☐
11. Verify vibration, air and noise control for mechanical.	☐	☐	☐

PLUMBING

1. Verify plumbing plans match architectural, mechanical, and structural.	☐	☐	☐
2. Verify plumbing fixtures match plumbing schedules and architectural locations.	☐	☐	☐
3. Verify site piping limits interface with building piping.	☐	☐	☐
4. Verify roof drain locations with roof plan.	☐	☐	☐
5. Verify subsurface drains located and detailed.	☐	☐	☐
6. Verify roof drain overflows are provided.	☐	☐	☐
7. Verify piping chase location matches architectural and structural.	☐	☐	☐
8. Verify all cold (chilled) and hot water piping is insulated.	☐	☐	☐
9. Verify piping is commensurate with architectural space and not in conflict with conduit, duct, and structure.	☐	☐	☐
10. Verify sprinkler head locations with room and reflected ceiling plan.	☐	☐	☐
11. Verify piping openings match architectural and structural.	☐	☐	☐
12. Verify plumbing equipment and piping requirements with structural.	☐	☐	☐

Check list Item	Yes	No	N/A
13. Verify plumbing equipment schedules correspond to a manufacturer in specification.	☐	☐	☐
14. Verify floor drains match architectural and kitchen equipment plans.	☐	☐	☐
15. Verify site water and gas service requirements with supplying utility.	☐	☐	☐
16. Verify floor openings, i.e., drains, water closets, etc. do not conflict with structural beams, joists, or trusses.	☐	☐	☐
17. Verify limits and confines where piping may be run.	☐	☐	☐

ELECTRICAL

1. Verify electrical plans match architectural, mechanical, plumbing, and structural.	☐	☐	☐
2. Verify location of light fixtures, speakers, etc. match with reflected ceiling plans.	☐	☐	☐
3. Verify equipment have electrical connections, i.e., mechanical motors, heat strips, etc., architectural, overhead doors, stoves, dishwashers, etc.	☐	☐	☐
4. Verify location of panelboards, transformers, with architectural, mechanical, and plumbing plans.	☐	☐	☐
5. Verify conduit chase locations match architectural and structural.	☐	☐	☐
6. Verify conduit and light fixtures are commensurate with architectural space and not in conflict with duct, piping, or structure.	☐	☐	☐
7. Verify electrical equipment structural requirements.	☐	☐	☐
8. Verify electrical equipment room fit architectural space with clearance for safety and maintenance.	☐	☐	☐
9. Verify electrical Hp, voltage, phasing for all motors, lights and heating match mechanical and architectural.	☐	☐	☐
10. Verify fixtures, speakers, clocks, etc., schedules correspond to a manufacturer and Project Manual.	☐	☐	☐
11. Verify light fixture spacing and location to eliminate dark spots.	☐	☐	☐
12. Verify location of duplex outlets, telephone, fire alarms, clock outlets, etc. with architectural millwork and finishes.	☐	☐	☐
13. Verify the limits and confines of where conduits may he run.	☐	☐	☐
14. Verify site electrical and telephone service requirements with supplying utility.	☐	☐	☐

SPECIFICATIONS

1. Verify nomenclature on plans corresponds with Project Manual.	☐	☐	☐
2. Verify the name and location of project corresponds with plans.	☐	☐	☐
3. Verify bidding requirements with Owner.	☐	☐	☐
4. Verify Finish Schedule items are specified.	☐	☐	☐
5. Verify unit price bidding is clear.	☐	☐	☐
6. Verify alternate bidding is clear.	☐	☐	☐
7. Verify items of equipment are specified.	☐	☐	☐
8. Verify that all specification sections are in the index and that cross-referenced specification sections exist.	☐	☐	☐
9. Verify insurance requirements with Owner.	☐	☐	☐
10. Verify legal conditions of Project Manual, i.e., General Conditions, Contract, Bond, Insurance, etc.	☐	☐	☐
11. Verify specified items exist in the project.	☐	☐	☐

3301.3 Architectural Quality Control Checklist

Table 5 - Architectural Quality Assurance Checklist

Check List Item	Yes	No	N/A
A. Drawing organization cartoon set	☐	☐	☐
B. Project specific CAD manual (as required)	☐	☐	☐

Check List Item	Yes	No	N/A
C. Organization of drawings - all disciplines	☐	☐	☐
D. Drawing numbering system and organization	☐	☐	☐
E. Code research/analysis covering the following areas:	☐	☐	☐
a. Construction type; occupancy type	☐	☐	☐
b. Travel distances	☐	☐	☐
c. Exit widths and location	☐	☐	☐
d. Stair widths and location	☐	☐	☐
F. Handicapped requirements:			
a. Toilet stall dimensions	☐	☐	☐
b. Toilet turn arounds	☐	☐	☐
c. Toilet entrance doors and circulation	☐	☐	☐
d. Toilet fixtures	☐	☐	☐
e. Toilet mirrors	☐	☐	☐
f. Drinking fountains	☐	☐	☐
g. Stairs	☐	☐	☐
h. Hand and guardrails	☐	☐	☐
i. Ramps	☐	☐	☐
j. Elevator access to upper floors	☐	☐	☐
k. Handicapped fixture count	☐	☐	☐
l. Elevator controls	☐	☐	☐
G. Requirements for Rated Construction:			
a. Wall ratings	☐	☐	☐
b. Floor ratings	☐	☐	☐
c. Door ratings	☐	☐	☐
d. Structural frame ratings	☐	☐	☐
e. Chase/shaft ratings	☐	☐	☐
H. Room Ratings:			
a. Janitor	☐	☐	☐
b. Storage	☐	☐	☐
c. Mechanical	☐	☐	☐
d. Stairs	☐	☐	☐
e. Trash rooms	☐	☐	☐
f. Boiler rooms	☐	☐	☐
g. Exit ways	☐	☐	☐
h. Electrical	☐	☐	☐
i. Communications	☐	☐	☐
I. Smoke partitions.	☐	☐	☐
J. Area separation	☐	☐	☐
K. High-rise requirements	☐	☐	☐
L. Stair Requirements:			
a. Stair nosings and tread/riser dimensions	☐	☐	☐
b. Stair run distance between landings	☐	☐	☐
c. Hand and guard rail heights and spacings	☐	☐	☐
M. Drinking fountain count	☐	☐	☐
N. Toilet fixtures count.	☐	☐	☐
O. Trash chute requirements	☐	☐	☐
P. Trash room hose bib and sprinklers	☐	☐	☐
Q. Health code requirements	☐	☐	☐
a. Kitchens	☐	☐	☐
R. Material/product cut sheets	☐	☐	☐
S. Project manual			
a. List of major materials and systems (SD)	☐	☐	☐
b. Outline specification (products only) (DD)	☐	☐	☐

Check List Item	Yes	No	N/A
c. Technical specification (full CSI format) (CD)	☐	☐	☐
d. General Conditions (CD)	☐	☐	☐
T. Plans			
a. Proper scale for project and phase	☐	☐	☐
b. Proper dimensioning techniques are included.	☐	☐	☐
c. Proper referencing - no duplication techniques included.	☐	☐	☐
d. Extent of materials within a space are identified and limits defined	☐	☐	☐
e. Paving joints in additive materials to structure are located over structural	☐	☐	☐
f. Plans are coordinated between disciplines.	☐	☐	☐
g. Column numbers correlate between disciplines	☐	☐	☐
h. Rated partitions are identified (either here or on a separate plan).	☐	☐	☐
i. Partition types are identified.	☐	☐	☐
j. All spaces are assigned room numbers.	☐	☐	☐
k. Plumbing fixture locations are coordinated with plumbing.	☐	☐	☐
l. Floor drains and clean-outs are shown and coordinated with plumbing. Finish is appropriate for project.	☐	☐	☐
m. Double drains are provided at cast or set exterior paving materials.	☐	☐	☐
n. Chases located above beams are sufficient in size to allow MEP items to pass beams.	☐	☐	☐
o. All doors and framed openings are assigned door numbers.	☐	☐	☐
p. Openings scheduled (windows and relites).	☐	☐	☐
q. Floor elevations are called out (based on a 0.00 ref. Elev.).	☐	☐	☐
r. Casework is scheduled.	☐	☐	☐
s. Millwork elevations are referenced.	☐	☐	☐
t. Proper depressions for inset tile, stone applications, etc. are provided.	☐	☐	☐
u. North arrow and graphic scale	☐	☐	☐
v. Match lines as indicated.	☐	☐	☐
U. Roofs			
a. Sloped as required for system	☐	☐	☐
b. Roof drain locations in relationship to beams and cambers.	☐	☐	☐
c. Provisions for emergency overflow drain system.	☐	☐	☐
d. Window wall/building skin maintenance davit system.	☐	☐	☐
e. Roof walk locations and materials for window/building skin and mechanical equipment access.	☐	☐	☐
f. Guard rails if roof is accessible to public.	☐	☐	☐
g. Roofing material control joint spacing and locations	☐	☐	☐
h. Roof details referenced.	☐	☐	☐
i. Expansion joint interface with parapet and other intersecting structures.	☐	☐	☐
j. Roofing and flashing material indicated.	☐	☐	☐
k. Insulation type and value indicated.	☐	☐	☐
l. Quantity of roof drains is adequate.	☐	☐	☐
m. Blocking at insulation perimeter and roof expansions/ control joints.	☐	☐	☐
n. Cant material indicated.	☐	☐	☐
o. Curb and flashing heights	☐	☐	☐
p. Roof penetration structures, i.e., skylight support walls are structurally sound.	☐	☐	☐
q. Roof penetrations are flashed in accordance with NRCA and are minimum of 2'-0" from adjacent vertical elements.	☐	☐	☐
r. North arrows are provided.	☐	☐	☐
s. Slopes are defined with spot elevation or percentage slope from a control elevation.	☐	☐	☐
V. Reflected Ceilings			
a. Room numbers are provided for all spaces and correspond to floor plans.	☐	☐	☐
b. Proper referencing techniques are included.	☐	☐	☐
c. Extent of materials within a space are identified and limits defined (dimensioned if necessary).	☐	☐	☐
d. Lighting fixture locations are coordinated with electrical.	☐	☐	☐
e. Mechanical diffuser locations are coordinated with mechanical,	☐	☐	☐

Check List Item	Yes	No	N/A
f. Column grids and numbers are indicated.	☐	☐	☐
g. Electrical items on ceilings are shown, i.e., smoke detectors and speakers.	☐	☐	☐
h. Soffit materials and other non-scheduled exterior materials are called out.	☐	☐	☐
i. Location of control and expansion joints are shown.	☐	☐	☐
j. Partitions above ceilings are indicated.	☐	☐	☐
k. Rated ceilings are indicated when more than one material/rating is scheduled within a space.	☐	☐	☐
l. Show direction of directional ceiling system, i.e., linear metal/wood systems and rectangular lay-in.	☐	☐	☐
m. Locate access panels.	☐	☐	☐
n. Location of sprinkler heads when location is aesthetically a concern.	☐	☐	☐
o. Extent of soffit or ceiling thermal or special acoustical treatment is indicated.	☐	☐	☐
p. Type of ceilings used are appropriate:	☐	☐	☐
i. a. Wet areas	☐	☐	☐
ii. b. Circulation and assembly areas (type)	☐	☐	☐
iii. c. Office and similar areas (type)	☐	☐	☐
iv. d. Toilets - accessibility to valves	☐	☐	☐
v. e. Rated assemblies - do they meet code?	☐	☐	☐
q. Ceiling mounted mechanical, electrical and plumbing devices - show and dimension locations.	☐	☐	☐
i. a. Diffusers	☐	☐	☐
ii. b. Return air grilles	☐	☐	☐
iii. c. Slot diffusers - coordinate length shown with length provided by mechanical.	☐	☐	☐
r. Ceiling shapes, sizes and proportions at drywall are appropriate (rectangles; with 1 x 2 ratio preferred).	☐	☐	☐
s. Soffit perimeter drip joints.	☐	☐	☐
t. Ceiling height changes shown and detailed.	☐	☐	☐
u. Condition at soffit and wall perimeters (thermal and seismic movement).	☐	☐	☐
v. Exterior ceiling material types are noted and extent is clear.	☐	☐	☐
w. Details are referenced for all conditions.	☐	☐	☐
x. Extent of existing conditions are clear.	☐	☐	☐
y. Equipment, catwalks, etc. above ceilings are shown. (May require separate plan.)	☐	☐	☐
z. Underside of stairs are shown (not treads).	☐	☐	☐
aa. Toilet fixtures, counters, and doors are not shown (if shown, they are screened).	☐	☐	☐
bb. Skylights pattern is shown.	☐	☐	☐
cc. Furring or closure panels above casework/millwork are shown.	☐	☐	☐
dd. Match line references as indicated.	☐	☐	☐
ee. North arrow and graphic scale.	☐	☐	☐
W. Exterior Elevations			
a. Show column lines and numbers.	☐	☐	☐
b. Reference building sections.	☐	☐	☐
c. Reference large-scale typical bays if applicable.	☐	☐	☐
d. Show extent of materials.	☐	☐	☐
e. Call out typical materials on exterior elevations or large-scale elevations, whichever is applicable.	☐	☐	☐
f. Call out floor elevations (based on a 0.00 reference or established by DEN).	☐	☐	☐
g. Reference individual details to show the extent of materials and construction assembly if not covered with plan or section references - do not duplicate information.	☐	☐	☐
h. If elevations are used for scheduling openings, then glass types and references should be provided if a typical bay condition or conditions system cannot be used.	☐	☐	☐
i. Building expansion joints are shown.	☐	☐	☐
X. Building Sections			
a. Referenced to details if scale is adequate.	☐	☐	☐
b. References to larger scale wall sections if building section scale is smaller than 1/4 inch to a foot.	☐	☐	☐

Check List Item	Yes	No	N/A
c. Floor elevations (based on a 0.00 reference or established by DEN).	☐	☐	☐
d. Column lines.	☐	☐	☐
e. Typical materials called out - do not duplicate information shown elsewhere.	☐	☐	☐
Y. Large Scale Wall Sections			
a. Reference to details	☐	☐	☐
b. Dimensions	☐	☐	☐
c. Typical materials not covered by details are identified - do not duplicate information shown elsewhere.	☐	☐	☐
d. If large-scale elevations relating to wall sections are provided, call out materials.	☐	☐	☐
e. Extent of thermal and acoustical insulation is shown.	☐	☐	☐
Z. Interior Elevations			
a. Elevations are only shown to reflect extent of more than one material on a wall and for location of products - both architectural and engineering.	☐	☐	☐
b. Typical mounting heights for devices and toilet room accessories	☐	☐	☐
c. Elevations of millwork scheduled.	☐	☐	☐
d. Casework that is scheduled is elevated on casework schedule.	☐	☐	☐
e. Details of pertinent items are referenced.	☐	☐	☐
f. Dimensions showing extent of materials is provided.	☐	☐	☐
g. Detail references for complicated wall construction are shown if not referenced from other documents or scheduled in wall type schedule.	☐	☐	☐
AA. Interior Partition Construction			
a. Masonry:	☐	☐	☐
i. Spacing of control joints	☐	☐	☐
ii. Reinforcing - vertical and horizontal	☐	☐	☐
iii. Control joint materials in rated walls	☐	☐	☐
iv. Clearance around building structural frame	☐	☐	☐
v. Bracing at head of wall	☐	☐	☐
vi. Wall spans vertical and horizontal			
vii. Thickness required for span	☐	☐	☐
viii. Thickness and block material related to code requirements	☐	☐	☐
ix. Lintel and precast for openings	☐	☐	☐
x. Header block provisions	☐	☐	☐
b. Metal studs with gypsum board:	☐	☐	☐
i. Stud spacing - specifications	☐	☐	☐
ii. Sizes relative to span	☐	☐	☐
iii. Basic detail assembly of support system	☐	☐	☐
iv. Wall Details and corner protection details	☐	☐	☐
v. Location of control joints	☐	☐	☐
vi. Type of finish wall panels relative to location	☐	☐	☐
vii. Type of gypsum board relative to locations	☐	☐	☐
viii. Wall rating locations and construction	☐	☐	☐
ix. Wall acoustical locations and construction	☐	☐	☐
BB. Partition Type Schedule			
a. Combination of wall composition and extent of wall heights, i.e., closes to ceiling, above ceiling or to bottom of structure.	☐	☐	☐
b. Rating of wall construction (if not called out elsewhere in the documents)	☐	☐	☐
c. Wall types meet code requirements - specifically at chases.	☐	☐	☐
CC. Door Type Schedules			
a. Elevation of all door types, i.e., single leaf, double leaf and with or without panels	☐	☐	☐
b. Ratings only (if not on door schedule; do not duplicate).	☐	☐	☐
c. STC rating only (if not on door schedule; do not duplicate).	☐	☐	☐
d. Style sizes if not specified.	☐	☐	☐
e. Louver location and detail reference.	☐	☐	☐
f. Louver sizes (if not scheduled in the door schedule).	☐	☐	☐
g. Door materials.	☐	☐	☐
DD. Window/Opening Schedules			
a. Schedule provided.	☐	☐	☐

Check List Item	Yes	No	N/A
b. Dimensions.	☐	☐	☐
c. Glass type.	☐	☐	☐
d. Code compliance of glass types.	☐	☐	☐
e. Detail references.	☐	☐	☐
EE. Door and Room Finish Schedules			
a. All rooms, alcoves, vestibules, and similar spaces are scheduled.	☐	☐	☐
b. All doors and cased openings receiving frames and/or hardware are scheduled.	☐	☐	☐
c. Fire ratings of doors in minutes.	☐	☐	☐
d. STC rating of doors.	☐	☐	☐
e. Door types.	☐	☐	☐
f. Reference to door and frame type schedule within documents.	☐	☐	☐
g. All door head, jamb, and sills are properly referenced.	☐	☐	☐
h. Frame materials are scheduled.	☐	☐	☐
i. Glass types are scheduled and in compliance with code and project usage.	☐	☐	☐
FF. Door/Window Frame Type, Schedule			
a. Materials are called out.	☐	☐	☐
b. Dimensions are shown.	☐	☐	☐
GG. Glazing Schedule	☐	☐	☐
a. Referenced on windows and doors.	☐	☐	☐
b. Specifies type and thickness of glass (also construction of insulating glass).	☐	☐	☐
HH. Details			
a. Material usage is appropriate for projects budget, location, and needs.	☐	☐	☐
b. Details address waterproofing and removal of water.	☐	☐	☐
c. Exposed sub-structures are sloped 1/4 inch per foot.	☐	☐	☐
d. Drainage mat is provided under terrace paving.	☐	☐	☐
e. Proper sealant material for use is specified.	☐	☐	☐
f. Thermal and seismic movement is considered in details.	☐	☐	☐
g. Material joints, i.e., flashing, spacing, and method has to be addressed.	☐	☐	☐
h. Extent of thermal and acoustical insulation is shown.	☐	☐	☐
i. Insulation is always located on the exterior side of structural slabs.	☐	☐	☐
j. Vapor retarders are shown.	☐	☐	☐
k. Intake louvers are drained.	☐	☐	☐
l. Cavity construction with sealant in the exterior skin has the sealant vented and weeped.	☐	☐	☐
m. Details are organized in categories of location, i.e., exterior versus interior, and materials, i.e., precast versus stucco.	☐	☐	☐
n. Fully adhered single ply systems if used.	☐	☐	☐
o. Details are dimensioned to face of structure or centerline of building grid - not both.	☐	☐	☐
p. Details do not duplicate information provided by other disciplines, i.e., structure edge of slab to column grid line.	☐	☐	☐
q. Building expansion joint size, configuration and locations are coordinated with structure.	☐	☐	☐
r. Edge of slabs - All conditions are coordinated with structure.	☐	☐	☐
s. Toilets, mechanical, elevator equipment rooms and other areas requiring acoustical treatment are provided with appropriate sound deadening and absorbing materials.	☐	☐	☐
t. Exterior doorsill elevation changes are coordinated structure.	☐	☐	☐
u. Overhead doors have system to support door hoods. Twenty-two sliding fire doors have access to reset doors.	☐	☐	☐
v. Schedule dimensions correspond with schedule dimension locations (i.e., doors and windows).	☐	☐	☐
w. Schedule dimension locations are identified in details or door/window frame details.	☐	☐	☐
x. Rod stock is provided behind all sealant.	☐	☐	☐
y. Means to retain rod stock is provided.	☐	☐	☐
z. Below slab thermal insulation is provided in northern climates.	☐	☐	☐

Check List Item	Yes	No	N/A
aa. Bollards or other protection details are shown.	☐	☐	☐
bb. Sun control is provided - especially in Middle Eastern, tropical, and southwestern project locations.	☐	☐	☐
cc. Details are constructable.	☐	☐	☐
II. Material Usage			
a. Exterior walls - masonry:			
i. Reinforcing - vertical and horizontal has been provided.	☐	☐	☐
ii. Cavity width			
iii. Cavity waterproofing and damp-proofing has been provided.	☐	☐	☐
iv. Locations of brick expansion joints and block control have been shown.	☐	☐	☐
v. Exterior sealer – block	☐	☐	☐
vi. Tie system	☐	☐	☐
vii. Ledger angle material finish and spacing	☐	☐	☐
viii. Type of base wall head and jamb/end termination waterproofing	☐	☐	☐
ix. Weep holes or rope weeps sizes and spacing (check specification)	☐	☐	☐
x. Coursing - vertical and horizontal	☐	☐	☐
xi. Code requirements on thickness	☐	☐	☐
xii. Location of building expansion joint	☐	☐	☐
xiii. Locate mechanical, electrical, plumbing items	☐	☐	☐
xiv. Structural design of walls for code and local conditions	☐	☐	☐
xv. Openings course out vertically and horizontally	☐	☐	☐
xvi. Clearance around building structural line	☐	☐	☐
xvii. Parapet construction reinforcing/thru wall flashing	☐	☐	☐
b. Metal panels:			
i. Design of support system	☐	☐	☐
ii. Size of panels match industries standard	☐	☐	☐
iii. Integration with other materials and systems d. Finish	☐	☐	☐
iv. Joint system	☐	☐	☐
v. Trim of panels	☐	☐	☐
vi. Detailing of system at all conditions	☐	☐	☐
vii. Spacing and detailing of panel joints color can affect allowable lengths	☐	☐	☐
viii. Interior finish if exposed	☐	☐	☐
ix. Locations of building expansion joints	☐	☐	☐
x. Sizing of support system, erection tolerance and deflection	☐	☐	☐
xi. Locate mechanical, electrical, plumbing items	☐	☐	☐
c. Architectural concrete:			
i. Tie hole locations and spacings	☐	☐	☐
ii. Samples prepared using local or desired materials	☐	☐	☐
iii. Formwork	☐	☐	☐
iv. Sealer	☐	☐	☐
v. Tie hole method of finish - expressed or filled	☐	☐	☐
vi. Post tension pull point locations and details	☐	☐	☐
vii. Column forms	☐	☐	☐
viii. Sample of sandblasting or other finishing technique desired	☐	☐	☐
ix. Locations and spacing of rustication joints in relationship to form material size limitations	☐	☐	☐
x. Configurations of rustication joints	☐	☐	☐
d. EFIS	e.	f	g
i. Type and finish	☐	☐	☐
ii. Location and spacing of control joints	☐	☐	☐
iii. Location of building expansion joints	☐	☐	☐
iv. Support system	☐	☐	☐
v. e. Lath type	☐	☐	☐
vi. f. Location of light fixtures and other mechanical, plumbing equipment	☐	☐	☐
vii. g. Thermal protection	☐	☐	☐
viii. h. Control joint and subframe detailing	☐	☐	☐
h. Precast concrete - faced and unfaced:			

Check List Item	Yes	No	N/A
i. Facing thickness	☐	☐	☐
ii. Bond breaker between precast and facing	☐	☐	☐
iii. Size of facing material related to material limitations	☐	☐	☐
iv. Spacing and width of joints between panels to allow for thermal movement, construction and fabrication tolerances	☐	☐	☐
v. Anchor material for facing	☐	☐	☐
vi. Thickness of precast in relationship to span, loading and availability of structure for horizontal loading g. Provisions for structural support of precast	☐	☐	☐
vii. Configuration constructability			
viii. Ability to ship and erect specified panel sizes	☐	☐	☐
ix. Method of application of insulation and interior finish materials	☐	☐	☐
x. Samples reflecting desired mix and finish	☐	☐	☐
i. Window/Curtain walls:	j.	k	l.
i. Frame size in relationship to span	☐	☐	☐
ii. Secondary support member use and locations where span exceeds frame limitations	☐	☐	☐
iii. Glass size - material manufacturing limitations	☐	☐	☐
iv. Location of safety glass related to code requirements	☐	☐	☐
v. Frame and glass wind loaded design parameters	☐	☐	☐
vi. Seismic design considerations	☐	☐	☐
vii. Reflective treatment related to glass type	☐	☐	☐
viii. Weep hole locations and spacings	☐	☐	☐
ix. Integration with surrounding materials	☐	☐	☐
x. Quantity of glazing related to project energy requirements	☐	☐	☐
xi. Window washing system	☐	☐	☐
xii. Window details	☐	☐	☐

End of Chapter