DENVER INTERNATIONAL AIRPORT

DESIGN STANDARDS MANUAL

Digital Facilities & Infrastructure

Design, Engineering and Construction

Revised: Q4 2023

Printed in the United States of America

Table of Contents

Table of Figures

This page is intentionally blank.

Table of Tables

This page is intentionally blank.

Summary of Revisions

The following tables list the revisions to the Digital Facilities and Infrastructure Design Standards Manuals (DSM).

2023 Revisions

Fourth Quarter

Reference	Revision Description
Throughout	Minor punctuation and grammar changes
1.3.1.2 Strategic Objectives	Added definition of DEN's DFI and Asset Management strategies
1.4.1.3 Level of Development and the Digital Facilities and Infrastructure Matrix	Added BIMForum Levels of Development
Table 2-6: Asset Data: 60 and 90 Percent Design	Updated Data Type, Civil Attribute, and Data Description of Name/Mark
2.4.3 Add Object Data Tables	Updated information
2.4.3.1 Add Data to AutoCAD Object in the Drawing	Updated information
2.4.3.2 Edit Object Data to Populate Data Fields	Updated instructions and added Data Types
2.4.3.3 FAA Object Data Tables	Updated table requirement information
2.7.2.6 Autodesk Drawing Migration Tool	Added section
3.1.11 Model Delivery	Added information on including a BIM Data Transmittal
Table 3-2: Model Review Critical Items	Updated information
3.2.12.2 Room and Space Numbering	Updated information
Table 3-4: Asset Data: 60 and 90 Percent Design	Updated Revit Attribute for Asset Type
Table 3-5: Asset Data: Administrative	Updated and added new Data Type information
3.7.1.2 Quality Control	Update information
3.8.5 As-Built Contract Drawings	Added new section
Table 5-1: Appendix A- DEN Asset Types	Updated Table Titles

2022 Revisions

Fourth Quarter

Reference	Revision Description
Throughtout	Minor punctuation and grammar changes
Table 1-4: BIM Team Software	Changed BIM 360 Design to AutoDesk Construction Cloud (ACC)
1.1.4.7 Security Sensitive Information Model	Updated information
2.1.3.2 Data Reference Files	Updated information
2.1.3.3 Reference Files	Updated information
2.1.5.1 DEN Low Distortion Projection System	Updated information
2.3.3 AEC Object Naming	Updated information
Table 2-7: Asset Data: Administrative	Changed Attribute column header
3.0.2 DEN Common Data Environment	Changed BIM 360 Design to AutoDesk Construction Cloud (ACC)
3.1.2 Template Files	Updated information
3.1.4 Phasing	Removed information
3.1.7.1 Use of CAD Files and other Non-native File Formats	Updated information
3.1.11 Model Delivery	Updated information
3.2.7.5 Family Naming	Updated information
3.2.10 Systems and Connectivity	Added electrical circuiting information
3.2.12 Rooms, Spaces, and Doors	Updated information
Table 3-4: Asset Data: 60 and 90 Percent Design	Updated information
Table 3-5: Asset Data: Administrative	Changed Attribute column header

Fourth Quarter

Reference	Revision Description
Throughout	Minor punctuation and grammar changes
3.2.7.5 Family Naming	Updated description, added Annotation section, and updated description for Asset Type

2021 Revisions

Fourth Quarter

Reference	Revision Description
3.4.5.2 Template Schedules	Updated description
3.4.5.3 Schedules: Mechanical Schedules	New paragraph
3.4.5.4 Schedules: Door and Frame Schedules	Updated requirements
Table 4-1 - Appendix A - DEN Asset Types	Added naming reference

Second Quarter

Reference	Revision Description
Throughout	Heading and body text appearance changes. Notation style for revisions updated from colored text to lines in margin. Minor grammatical changes.
1.1.4.3 Project BIM Team Software	Revit version number removed. Updated instructions.
3.1.3.3 DEN Project Identifier	Updated naming convention
3.1.4 Phasing	Updated phasing requirements
3.1.9 Shared Coordinates	Updated LPD version
3.1.10 Model Levels	Updated requirements
3.1.12.4 Critical Items	Updated table
3.1.12.7 Interim Reviews	Updated requirements
3.2.2 Model Accuracy and Tolerances	Removed table, added accuracy requirements
3.2.4.3 Existing Assets	Added requirements
3.2.5.1 General- Applicable to All Disciplines	Revised modeling requirement for piping
3.2.7.2 Outside Content Sources	Updated contact
3.2.12.2 Room and Space Numbering	Added information, updated table
3.2.14 Reconciled Model	Added reference
3.3.4.2 Asset Data- 90 Percent Design	Added description/requirements
3.4.5.2 Template Schedules	Added requirement
Chapter 4- BIM Tenant Standards	Tenant-specific standards reorganized. Chapter now provides standards by reference to other chapters/sections and exceptions thereto.

2020 Revisions

Second Quarter

Reference	Revision Description
2.4.2 Asset Identification	Clarified asset data requirements for interim design submittals
Table 3-3: Codes for Specialty Areas within Rooms, Table 3-4: Codes for Specialty Areas within Rooms	Updated code for Roof
3.3.4.2 Asset Data- 90 Percent Design	Updated requirement
Table 3-5: Asset Data- 60 and 90 Percent Design	Clarified Description
4.3.3 Asset Data	Updated requirements
Table 4-9: Appendix A- DEN Asset Types	Added, deleted, and updated asset types

Revision Notation: Revisions made to this Manual during this revision cycle are annotated as shown in the example below:

A vertical line in the left-hand margin is used to annotate paragraphs that have been added or revised in the current publication. Revisions may include items such as new requirements, clarification of existing requirements, or removal of requirements that no longer apply to projects. Revision annotation is applied to each publication individually; revisions made in past publications are not annotated in subsequent publications.

Purpose of Design Standards Manuals

The DEN Design Standards have been developed to ensure a unified and consistent approach to the thematic and technical design for DEN. These standards are for use and strict implementation by all consultants under contract to DEN, to tenants, and all other consultants under contract to any other entity for the design of projects at DEN.

The Standards Manuals are 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 DEN.

This Design Standards Manuals (DSM) for DEN has been prepared for use by competent, professionally licensed architectural and engineering consultants 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. Content contained in this Manual shall not be copied in any bidding or construction documents, except where specifically instructed to do so. All information contained in these standards must be fully explained and shown in all bidding and contract documents.

The Design Standards Manuals are intended to be used as a whole, as each manual is complimentary to the other DSMs. To understand the overall thematic and design standards for DEN, the applicable manuals must be utilized together and not separated from the Design Standards Manuals.

The Consultant 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.

NOTE: This document is optimized for duplex (double-sided) printing.

VARIANCE FROM DEN DESIGN STANDARDS MANUALS

Requests for non-conformance or variance from DEN Design Standards manuals, for any DEN or Tenant Projects, must be formally submitted using the online DSM Variance Request form at the following website:

DEN DSM Variance Request Form

Variance requests may or may not be approved by DEN and response will be communicated to the requestor.

This page is intentionally blank.

Chapter 1 - Introduction and Overview

1.0 Introduction and Overview

1.0.1 Introduction and Overview

This document lists the Digital Facilities and Infrastructure (DFI) requirements for any DEN project or operation, whether created in-house or by external consultants. The DEN DFI Design Standards Manual (DFI DSM) is both a stand-alone document for staff and consultants to understand the DEN DFI-specific requirements for starting projects, as well as a resource used to inform a project execution plan.

DFI encompasses the use of Building Information Modeling (BIM) and Civil Information modeling (CIM) tools and processes and their integration with Asset Management (AM) through the delivery and operational phases of the lifecycle of DEN assets and/or properties.

Requirements established here are minimum requirements for all DFI projects at DEN. Any of these requirements may be superseded by the project the project contract.

1.0.1.1 Target Audience

This document is intended for:

A. External service providers (design and construction) supplying BIM Data to DEN
B. DEN Executives and Project Managers

1.0.1.2 Civil/Infrastructure/Facilities/Buildings Projects

All Civil projects, Airside or Landside, and Facilities/Buildings projects shall comply with the requirements outlined in this Design Standards Manual.

1.0.1.3 Tenant/Concessions Projects

All tenant projects shall comply with the Tenant Guidelines outlined in.

1.0.1.4 Purpose

The goal of the DEN DFI and Asset Management programs is to integrate BIM, Civil Information Modeling (CIM), and Asset Management from the cradle to grave as a process and deliverable into the DEN organizational and planning structure. This enables DEN to utilize the information created during design, construction, and operations to enhance and feed into existing and future facilities and infrastructure operations and processes.

1.0.2 Document Layout

This document provides staff and consultants with detailed information on how to comply with DEN's Information Management Process:

A. Chapter 1- Introduction and Overview – Identifies reference documents, definitions, associated documents, and the Information management Process and Information Requirements.
B. Chapter 2- CADD Procedures– All Civil, Airside, or Landside projects shall comply with the requirements outlined in this Design Standards Manual.
C. Chapter 3- Facilities BIM Requirements – All Facilities/Buildings projects shall comply with the requirements outlined in this section of the Design Standards Manual.
D. Chapter 4- BIM Tenant Standards – Applicable to all tenant projects, including concessions, retail, airline, and other tenant project types, shall comply with the requirements outlined in this section of the Design Standards Manual.

1.0.3 Reference Documents

1.0.3.1 Industry Reference Documents

UNIFORMAT 2010

1.0.3.2 BIM Reference Documents

BIMForum Level of Development Specification 2021

ISO 19650-1:2018

ISO 19650-2:2018

1.0.3.3 FAA Reference Documents

A. AC150/5300-16 Geodetic Control AC 150/5300-16A- General Guidance and Specifications for Aeronautical Surveys: Establishment of Geodetic Control and Submission to the National Geodetic Survey.
Explains the specifications for establishing geodetic control on or near an airport. It also describes how to submit the information to the National Geodetic Survey (NGS) for approval and inclusion in the National Spatial Reference System (NSRS) in support of aeronautical information surveys.

B. AC 150/5300-17C- Standards for Using Remote Sensing Technologies in Airport Surveys
Provides guidance on the use of remote sensing technologies in the collection of data describing the physical infrastructure of an airport. This version is a substantial rewrite and includes new sections on remote sensing technologies other than aerial imagery (primarily LIDAR) for collecting airport data.

C. AC 150/5300-18B- General Guidance and Specifications for Submission of Aeronautical Surveys to NGS: Field Data Collection and Geographic Information System Standards.
Provides the specifications for the collection of airport data for the FAA Airport Surveying – GIS Program. Also explains how to submit data to the FAA, which will forward the safety-critical data to the National Geodetic Survey (NGS) for independent verification and validation. The standards covered in this document provide critical information for the operation and safety of the National Airspace System (NAS) and are classified as critical by the ICAO. ICAO Annex 15 defines data as critical when,

There is a high probability when using corrupted critical data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe.

The information furnished under these standards covers the spectrum of the FAA's airport data requirements.

1.0.3.4 Federal Aviation Administration Regulatory Requirement for Local Compliance

Under the Airport Improvement Program (AIP), DEN and County of Denver (CCD) has an obligation to comply with FAA standards and policies concerning AC150/5300-16, 17 and 18 (current version). In accepting AIP funds CCD has agreed to specific Federal obligations, including the obligation to,

Carry out the project in accordance with policies, standards, and specifications approved by the Secretary including but not limited to the Advisory Circulars.[1]

Under Federal law, this obligation runs in perpetuity. Failure to comply with Federal grant assurances may result in the FAA issuing an order terminating eligibility for grants pursuant to 49 U.S.C. 47106(e) and 7111(d), an order suspending the payment of grant funds, an order withholding approval of any new application to impose a Passenger Facility Charge pursuant to Section 112 of the FAA Act of 1994, 49 U.S.C. 47111(e), or any other compliance order issued by the Administrator to carry out the provisions of the Acts, including possible repayment of prior Federal grant money.

1. AIP Grant Assurance No. 34

1.0.4 Terms and Definitions

The terms and acronyms provided in this section are used throughout this DSM.

Table 1-1: Abbreviations and Acronyms

Acronym	Meaning
AC	Advisory Circular
AGIS	Airports Geographic information system
AIM	Airport Infrastructure Management Division
AIP	Airport Improvement Program
BIM	Building Information Modeling/Management
BIMPxP	BIM Project Execution Plan
CADD	Computer Aided Design and Drafting
CCD	City and County of Denver
CDOT	Colorado Department of Transportation
CIM	Civil Information Modeling
CM	Construction Manager
DEN	Denver International Airport
eALP	Electronic Airport Layout Plan
FAA	Federal Aviation Administration
GIS	Geographic Information System
HDS	High-Definition Scanning
LDP	Low Distortion Projection
NCS	National CAD Standard
PM	Project Manager
QA	Quality Assurance
QC	Quality Control
TSA	Transportation Security Administration

Table 1-2: ISO General, Project and Asset Terms

Term	Definition
Asset	Item, thing, or entity that has potential or actual value to an organization

Table 1-2: ISO General, Project and Asset Terms (Continued)

Term	Definition
Delivery Phase	Part of the life cycle, during which an asset is designed, constructed, and commissioned
Delivery Team	Lead appointed part and their appointed parties
Operational Phase	Part of the life cycle during which an asset is used, operated, and maintained
Project information	Information produced for, or utilized in a specific project
Responsibility Matrix	Chart that describes the participation by various functions in completing tasks or deliverables
Task Team	Individuals assembled to perform a specific task.

Table 1-3: Information Managements Terms

Term/Acronym	Definition
Asset Information Model (AIM)	Information model relating to the operational phase (ISO)
Asset Information Requirement (AIR)	Information requirements in relation to the operation of an asset (ISO)
Building Information Modeling (BIM)	Use of a shared representation of a built asset to facilitate design, construction, and operation processes to form a reliable basis for decisions. (iso)
Common Data Environment (CDE)	Agreed source of information for any given project or asset for collecting, managing, and disseminating each information container through a managed process (ISO)
Exchange Information Requirement (EIR)	Information requirement in relation to the agreed instruction for the provision of information concerning works, goods, or services (ISO)
Federation	Creation of a composite information model from separate information containers (ISO)
Information	Reinterpretable representation of data in a formalized manner suitable for communication, interpretation, or processing (ISO)
Information Model	Set of structured and unstructured named persistent sets of information retrievable from within a file, system, or application storage hierarchy (ISO)
Information Requirement	Specification for what, when, how, and for whom information is to be produced (ISO)
Level of Development (LoD)	LoD is the degree to which the elements geometry and attached information has been thought through the degree to which project team members may rely on the information when using the model. This base definition is further defined in the “Level of Development Specification,” 2021 by BIM Forum.

Table 1-3: Information Managements Terms (Continued)

Term/Acronym	Definition
Organizational Information Requirement (OIR)	Information requirements in relation to organizational objectives (ISO)
Project Information Model (PIM)	Information model relating to the delivery phase (ISO)
Project Information Requirement (PIR)	Information requirement in relation to the delivery of an asset (ISO)
Published state	
Shared state	
Status Code	Metadata describing the suitability of the content of an information container (ISO)
Work in progress state	

1.0.5 Policy Updates

This policy will be eligible to be updated and enhanced on a quarterly basis. Recommended additions and suggested changes are to be directed to DEN Asset Management.

1.1 Organizational DFI Strategy for DEN

This overview provides a summary of the overall strategy of DFI at DEN. It is to be used as a reference for all DEN facilities, infrastructure, and tenant projects and as a reference document for the internal departments involved in the use of BIM, CIM, or Asset Management at DEN.

At DEN, BIM and CIM is not just a design tool; it is a business decision made by the senior executives knowing the impact on all levels of DEN building projects, from design, documentation, and construction to operations and maintenance. DFI provides integration and coordination amongst project stakeholders throughout all aspects of design, construction, and occupation.

1.1.1 BIM Provides Graphical Coordination

The initial Design direction of BIM is to provide a graphical coordinated document set of all trades of a building. BIM provides a three-dimensional graphical database that allows the spatial coordination of document sets of multiple Design Disciplines and the phasing of the project for construction logistics.

Depending on the design discipline, DEN requires all graphical models to be created using either Revit or Civil 3D.

1.1.2 BIM Provides Data Coordination

The *I* for *Information* in Building Information Modeling is what sets BIM apart; the components within a BIM are more intelligent than 2D CAD elements. For example, a BIM HVAC unit has embedded data fields (*parameters*) that can control its size, airflow, cost, maintenance schedule, and O&M data. These components are mini databases within the larger graphical database.

1.1.3 BIM Links Bi-directionally to Facilities Management/Geospatial Information Systems

The BIM platform and process allows the design and construction data to better coordinate with each other as well as to link bi-directionally to the DEN Facilities Management (FM) and Geospatial Information System (GIS) platforms. The accessibility of the BIM data allows the FM and GIS programs to be more productive with the overall

management and preventive maintenance of the facility. This, in turn, allows exposure to other management benefits, including improvement of building sustainability, schedulable maintenance, lifecycle costing, and overall predictive behavior of the facility. Implementation.

1.1.4 Implementation

1.1.4.1 Project Delivery

The project delivery method must be determined at the initial stage of the project so that BIM can be properly structured and managed to support the delivery strategy. The delivery method defined for a project will have a significant impact on downstream processes and coordination.

1.1.4.2 Data Reuse, Ownership, Rights of Data

DEN shall have the title and all intellectual and other property rights in and to all phased and final project models and all data used in the development of the same, including the results of any tests, surveys, or inspections at the project site, and all photographs, drawings, drafts, studies, estimates, reports, models, notes and any other materials or work products, whether in electronic or hard copy format, created by the Consultant pursuant to this document, in preliminary and final forms and on any media whatsoever, whether the project for which the documents were created is executed or not. The Consultant shall identify and disclose, as requested, all such documents to DEN.

1.1.4.3 Project BIM Team Software

Table 1-4: BIM Team Software

BIM Team Software	Comments
Autodesk Revit	Required development and deliverable file format for all BIM PIMs within less than 5 feet of the building envelope. Request current Approved Version from DEN.
Autodesk AutoCAD Civil 3D	Required development platform for PIMs more than 5 feet outside the building envelope.
Autodesk Construction Cloud (ACC)	DEN's ACC environment shall be used as the CDE for non-SSI models for all projects. ACC is also populated with all project Assets. Asset data must be populated for Assets in accordance with responsibility matrix. The DEN ACC platform is also available for additional functionality.
Autodesk Recap	All point cloud deliverables must be delivered to DEN on the DEN LDP coordinate system, in a format compatible with Autodesk Recap.

1.1.4.4 Additional Software and Plugins

Additional plugins for Revit and Civil 3D may be acceptable for use on a case-by-case and project-by-project basis. Acceptance on a prior project does not assure acceptance on additional projects, as DEN DFI continuously assesses the impacts of additional plugins and software. Requests for the use of additional software or plugins shall be submitted to DEN DFI for acceptance.

1.1.4.5 DFI Responsibilities

DFI authoring tools, data integration, and collaborative team workflow environments shall be used to develop and produce project information and documentation as required for submittals.

It is the responsibility of all consultants and contractors to have or obtain, at their cost, the trained personnel, hardware, and software needed to implement BIM successfully for the project and to develop the PIMs to a LoD, as defined in DEN DFI Matrix and approved BIMPxP.

Equipment used by the subcontractors during the on-site coordination meetings must meet the requirements of the software being implemented so as not to cause delays in modeling and redrawing. All technical disciplines shall be responsible for their data integration and data reliability of their work and coordinated BIMs.

1.1.4.6 Collaborative Workflow and the DEN Common Data Environment

PIMs shall be live in a work-in-progress state on the DEN CDE set up for the PIMs and pushed to a shared state on a weekly basis. Infrastructure PIMs may be live on the DEN CDE and, if not, shall instead be posted to the CDE in a shared state on a weekly basis.

PIMs shall be posted to the CDE in a published state for each deliverable package.

PIM archiving is handled automatically by the CDE.

1.1.4.7 Security Sensitive Information Model

All Security Sensitive Information (SSI) information will be kept in a separate and distinct model from the project BIM and must be handled in accordance with all DEN SSI requirements as set forth by DEN Security.

1.2 Information Management Process

1.2.1 Information Management Process Compliance Policy

1.2.1.1 Policy

To support diverse DEN initiatives and requirements, including DEN Asset Management, DEN maintenance, DEN operations, FAA Airport GIS (also known as eALP), and the latest versions of FAA Advisory Circulars AC150-5300-16-17-18 DEN requires that all airport staff, consultants, and contractors comply with the Information Management Process (IMP) requirements/standards detailed in the documents listed in 1.0.3 Reference Documents and throughout this DSM.

Compliance is required for efficient airport owner coordination and collaboration with internal and external organizations, including federal, state, and municipal governments and the private sector.

1.2.1.2 Applicability

This policy applies to all personnel responsible for the creation, collection, and maintenance of incoming and outgoing spatially referenced model, vector, and raster data. Spatially referenced data includes both collected or produced (derived) data, as well as associated attributes and metadata from CAD, BIM, CIM, or HDS.

1.2.2 Information Management Process Defined

The IMP is a set of standards for controlling the collection and transfer of electronic asset information between organizations both inside and outside of DEN through information models. Information collected as part of the Information Management Process is collected to meet a set of information requirements: Organizational Information Requirements (OIR), Asset Information Requirements (AIR), Project Information Requirements (PIR), and Exchange Information Requirements (EIR).

1.3 Information Requirements and Information Models

1.3.1 Organizational Information Requirements (OIR)

1.3.1.1 Scope

This section sets out the Organizational Information Requirements (OIR) of DEN in line with ISO 19650. These OIRs are developed in conjunction with the Asset Information Requirements (AIR), Project Information Requirements (PIR), and Exchange Information Requirements (EIR). See Figure 1-1: Hierarchy of Information Requirements from ISO 19650-1:2018.

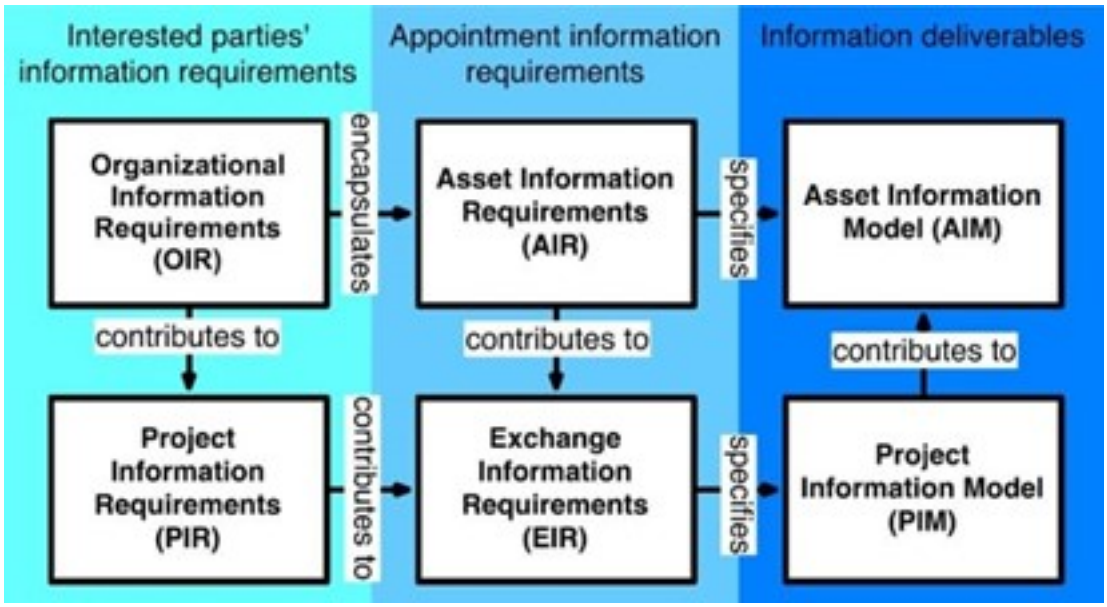

Figure 1-1: Hierarchy of Information Requirements

The OIR defines the information required to meet the needs of the DEN asset management program and other organizational functions including but not limited to airport operations, maintenance, finance, and development.

1.3.1.2 Strategic Objectives

The overall strategy for the management of DEN DFI is underpinned by the DEN Strategic Asset Management Plan. At the heart of this strategy is the promotion of innovation and development in asset management including the use of digital data management workflows, the development of structured data sets and building information modeling (BIM) standards to facilitate informed, rational decision making. The use of digital data management workflows and building information modeling supports the overall goal of DEN asset management, including the development of asset information models of existing DEN assets to inform the ongoing operational and delivery processes. DEN strategic objectives are outlined as follows:

DEN's DFI and Asset Management strategies are in support of Vision 100 which is DEN's strategic plan that will enable DEN to prepare for and reach 100 million annual passengers. The strategic plan will serve as a blueprint to align decision-making and enable accountability so together we can thoughtfully prepare to serve 100 million passengers.

DEN's strategic plan is centered around the four pillars of Vision 100 and under each pillar are strategic objectives, which are goals for the next 3-5 years. The four pillars are:

1. Empowering Our People - DEN's success relies on its people and partners.
2. Growing Our Infrastructure - We must continue to invest and grow our facility.
3. Maintaining What We Have - We must continue to take care of what we currently have.

4. Expanding our Global Connections- Grow our air network to provide more options for our passengers.

1.3.1.3 OIR Contributors

DEN's OIR is informed by input and feedback from stakeholders across the organization as well as organizational partners including but not limited to:

A. Project sponsors
B. Project Managers
C. Asset Managers
D. Maintenance Planners
E. Maintenance personnel
F. FM Managers
G. Building users/employees
H. Authorities Having Jurisdiction
I. Consultants

1.3.1.4 OIR Activities

To meet organizational strategic objectives identified in 102.4.2, DEN has identified a range of activities in support of those objectives and has identified how the information that is to be collected and processed is to be used. These are developed with processes informed by ISO 19650-1:2018 and DEN's own asset management activities.

A. To optimize the asset management strategy and optimize / prioritize the asset management plan
B. To promote the use and development of consistent industry, national, and international standards
C. To form part of the organizational information resource – an institutional asset
D. To develop a digital asset model to support operational decision making
E. To support informed and justified decision making for operational, developmental, and maintenance activities
F. To develop a common data environment in which asset information can be accessed by all departments/stakeholders
G. To validate legacy data and identify knowledge gaps
H. Produce data where gaps exist, such as survey data
I. Assess the value of defect liabilities for funding and budgeting purposes
J. Assess priorities for the forward planning of operational, developmental, and maintenance activities
K. To undertake on-going identification, assessment, and mitigation of risks to operations
L. To reduce the duplication of work and produced information, make information available to a wider audience, promote collaboration and improve efficiencies
M. To provide a visual / graphical summary of asset related data
N. To facilitate the production of data driven reports for a range of uses / stakeholders
O. To facilitate detailed, component level data management
P. To meet statutory and regulatory obligations
Q. To support quality assurance and performance management activities
R. Modelling the asset to support operational decision making
S. Identifying expiration of warranty periods
T. Determining the end of an asset's economic life, e.g., When the asset related expenditure exceeds the associated income
U. Determining the cost of specific activities (activity based costing), e.g., The total cost of maintaining a specific asset(s)/asset system

V. Obtaining/calculating asset replacement values
W. Innovation and change management
X. Data, information, and knowledge management
Y. Maintenance, inspection, condition, and performance monitoring
Z. Contingency planning and emergencies
AA. Energy efficiency and environmental aspects, e.g., Renewable resources, recycling, waste management, air purity, hygiene
AB. Risk assessment and management
AC. Safety, health, and environmental management

1.3.2 Asset Information Requirements (AIR)

1.3.2.1 AIR Scope

This section lays out the DEN Asset Information Requirements (AIR) in line with ISO 119650-1:2018 as a sub-set of the OIR.

ISO 19650-1:2018 states that an Asset Information Requirement (AIR) document shall be produced defining the information (in the form of Data, Documents and Geometry) that is required in the Asset Information Model (AIM). The AIM is then used by the Asset Management teams to inform the systems utilized for the operations and maintenance of the building. This AIR guidance section sets out the requirements for information to meet the needs of DEN asset management systems and other organizational functions.

1.3.2.2 AIR Activities

To prepare the content required to answer the Organization Information Requirements (OIR) will require the collection, aggregation, and manipulation of multiple pieces of asset information. To do so requires identifying what pieces of information are needed to respond to each OIR. Refer to. These pieces of information are the Asset Information Requirements (AIR). Asset Information Requirements are the detailed pieces of data and information about the asset that when placed in context can answer the questions raised in the OIR. Typical events that might require the retrieval of this data include:

A. Receiving information during a capital improvement project
B. Managing asset information
C. Evaluating performance of an asset
D. Planned or reactive maintenance work
E. Minor works (repairs, component replacements)
F. End-of-life works (decommissioning, mothballing)
G. Change in regulations relating to the asset
H. Change in organizational requirements for the asset
I. Change in owner, operator, or maintainer

1.3.2.3 AIR Contributors

Section in Development

1.3.2.4 AIR Classification System and Maintainable Assets List

Section in Development

1.3.3 Project Information Requirements (PIR)

Section in Development

1.3.4 Exchange Information Requirements (EIR)

Section in Development

1.3.5 Project Information Model (PIM)

Section in Development

1.3.6 Asset Information Model (AIM)

Section in Development

1.3.7 Information Delivery

Section in Development

1.4 Execution Plan, Matrices, and Worksheets

1.4.1 DEN BIMPxP

DEN based its BIMPxP Template package on a plan created from the building SMART alliance™ (bSa) project "BIM Project Execution Planning" as developed by The Computer Integrated Construction (CIC) Research Group of The Pennsylvania State University.

DEN's BIMPxP Template and associated worksheets, definitions and instructions are part of the DEN Kit of Parts.

The original template package includes several worksheets and a separate guide-instructions document. Like the original, the DEN BIMPxP includes instructions and worksheets that have been modified from the original CIC/Penn State template.

1.4.1.1 BIMPxP Requirement

Completion of a BIMPxP for a project is recommended for all projects and is required for all projects with a projected budget over $10 million.

1.4.1.2 BIM Uses

Section in Development

1.4.1.3 Level of Development and the Digital Facilities and Infrastructure Matrix

LoD for all modeled content is broken out by Uniformat 2010 in the DFI Matrix which is included in the DEN Kit of Parts and shall meet the definitions in the 2021 BIMForum Level of Development Specification.

Applications of modeled object types and layer assignment shall be as outlined in the DFI Matrix unless prior approval is received from DEN through an LoD Exceptions Worksheet as part of the BIMPxP and approved by DEN.

DEN interprets the BIMForum Levels of Development as below:

1.4.1.3.1 LOD 100

The Model Element may be graphically represented in the Model with a symbol or other generic representation, but does not satisfy the requirements for LOD 200. Information related to the Model Element (i.e. cost per square foot, tonnage of HVAC, etc.) can be derived from other Model Elements.

DEN Interpretation: LOD 100 elements are not geometric representations. Examples are information attached to other model elements or symbols showing the existence of a component but not its shape, size, or precise location. Any information derived from LOD 100 elements must be considered approximate. (No Change from BIMForum Interpretation).

1.4.1.3.2 LOD 200

The Model Element is graphically represented within the Model as a generic system, object, or assembly with approximate quantities, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.

DEN interpretation: At this LOD elements are generic placeholders. They may be recognizable as the components they represent, or they may be volumes for space reservation. Any information derived from LOD 200 elements must be considered approximate. (No Change from BIMForum Interpretation.

1.4.1.3.3 LOD 300

The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.

DEN interpretation: The quantity, size, shape, location, clearances, and orientation of the element as designed can be measured directly from the model without referring to non-modeled information such as notes or dimension callouts. The project origin is defined, and the element is located accurately with respect to the project origin.

1.4.1.3.4 LOD 350

The Model Element is graphically represented within the Model as a specific system, object, or assembly in terms of quantity, size, shape, location, orientation, and interfaces with other building systems. Non-graphic information may also be attached to the Model Element.

DEN interpretation. Parts necessary for coordination of the element with nearby or attached elements are modeled. These parts will include such items as penetrations, supports, clearances and connections. The quantity, size, shape, location, and orientation of the element as designed can be measured directly from the model without referring to non-modeled information such as notes or dimension callouts.

1.4.1.3.5 LOD 400

The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the Model Element.

DEN interpretation. An LOD 400 element is modeled at sufficient detail and accuracy for fabrication of the represented component. The quantity, size, shape, location, and orientation of the element as designed can be measured directly from the model without referring to non-modeled information such as notes or dimension callouts. (No Change from BIMForum Interpretation).

1.4.1.3.6 LOD 500

The Model Element is a field verified representation in terms of size, shape, location, quantity, and orientation. Non-graphic information may also be attached to the Model Elements.

DEN interpretation. LOD 500 represents a progression from whatever modeling level was specified in the preceding deliverable in regard to field verification of size and location. Additional modeled detail is not required.

Example - Light Fixture:

LOD 100 cost/sf attached to a room element
LOD 200 light fixture, generic/approximate size/shape/location
LOD 300 Design specified 2x4 troffer, specific size/shape/location/asset information
LOD 350 Actual model, Lightolier DPA2G12LS232, specific size/shape/location/asset information
LOD 400 As 350, plus special mounting details, as in a decorative soffit.
LOD 500 Design specified 2x4 troffer, field verified size/shape/location/asset information.

1.4.1.4 LoD Exceptions Worksheet

Section in Development

1.5 Process Summary, Objectives, and Application

This section provides a summary of a typical DEN BIM project process. These requirements are organized using the traditional Design-Bid-Build delivery method. This section does not dictate delivery method and may not be applicable to any particular project. It is intended to establish a common vocabulary as a starting point for DEN BIM projects and is not to be considered comprehensive.

1.5.1 General

The following requirements apply to all phases of the project:

A. All models shall comply with the full DSM standards as laid out here and in other sections at all phases of work. Modeling shall conform, by project phase, to the LoD Matrix as developed at project kickoff.

B. To allow the most flexibility in delivery methods, the term project BIM team is used in this section to delegate responsibility in general to the project BIM team as identified by the BIMPxP. Specific roles and responsibilities are determined by that document.

1.5.1.1 RFP Process

DEN may make available any existing BIM models, proposed design models, laser scans, surveys, or as-built CAD files of the project area for the RFP process in some cases.

1.5.1.2 Contract Negotiation

BIMPxP and LoD shall be developed and finalized as addenda to the contract. DEN will make available any existing BIM models, proposed design models, laser scans, surveys, or as-built CAD files of the project area available as soon as possible once a proposer is selected.

1.5.1.3 Project Kickoff

Once the project is awarded and the Notice to Proceed (NTP) is issued, the BIMPxP is developed with DEN and all consultants (and contractor, if available). The BIMPxP draft is submitted within 30 days of NTP. DEN will respond within 14 days. A project setup model for each planned model with draft BIMPxP must be submitted. This is a project file from the DEN templates with all available background files linked and the DEN LDP shared coordinate system integrated.

1.5.1.4 Existing Conditions

The project team shall model all existing conditions needed to explain the extent of the construction work for alterations, additions projects, and new projects that interface with existing facilities. The extent of modeling beyond the affected areas and the level information to be included will be determined based on project needs. These requirements may be stated in the project program or discussed during the project kickoff meeting. The BIMPxP shall define the agreed upon scope of the modeling effort.

All project teams shall verify with DEN the existence and accuracy of as built models.

Existing models provided by DEN shall be used for reference only.

1.5.1.5 Pre-Design (Conceptualization) Phase

Project BIM team may use any method to begin the process. The project team is encouraged to use electronic programming and planning tools that integrate into their BIM authoring software to capture early cost, schedule, and program information during this phase.

BIM deliverables to be determined by the BIMPxP.

A. Data
B. Programmatic spaces

   Early use of Preliminary Programmatic Spaces is encouraged

C. Energy

   A BIM that will provide an accurate volume representation of spaces and a gbXML compliant model is encouraged for lateral and downstream use.

1.5.1.6 Schematic Design (Criteria Design)

Project BIM team may use any method to begin the design process but shall be using a BIM authored models by completion of this phase. All information needed to describe the schematic design shall be graphically or alphanumerically included in and derived from these models. DEN expects the project BIM team to use analysis tools, static images, and interactive 3D to describe the design concepts.

A. Data
B. Programmatic spaces

   a) All rooms in the architectural and/or MEP BIM model.

   b) Programmatic Spaces must be linked to rooms by final submittal of this phase.

C. Sustainability
D. Energy- As called for by BIMPxP Preliminary Energy modeling data included:

   a) Detailed electric and fuel rates as defined by the local service provider

   b) Building function and occupancy

   c) Preliminary Building operating schedules

   d) Preliminary estimates of building construction types

E. Clearance- Clearances will be built into families to allow visual display of:

   a) Building code clearances

   b) Access clearances

   c) Maintenance clearances

F. BIM Rooms/Spaces- Rooms are to be enclosed and bounded by walls or room separation lines, separated by use. Floors shall be room bounding, Ceilings (GWB, ACT, etc.) shall not be room bounding.

1.5.1.7 Design Development Phase (Detailed Design)

The project BIM team shall continue development of their BIM. Parametric links shall be maintained within the models to enable automatic generation of all plans, sections, elevations, custom details, and schedules as well as 3D views. All information needed to describe the detailed design shall be graphically or alphanumerically included in and derived from these models only, except for the Specifications. Documentation of the models or design documents shall not happen outside of the BIM authoring software.

A. Data
B. Programmatic spaces

   All rooms in the architectural and/or MEP BIM models

C. Sustainability
D. Energy design- As called for by BIMPxP Preliminary Energy modeling data included

a) Detailed electric and fuel rates as defined by the local service provider

b) Building function and occupancy

c) Building operating schedules

d) Building construction types

E. Equipment (data)- All equipment in model will be registered in the project equipment library

F. Equipment considerations- MEP vs. DEN infrastructure vs. Secure (screening equipment)

G. BIM Rooms/Spaces- Rooms are to be enclosed and bounded by walls or room separation lines, separated by use. Floors shall be room bounding, Ceilings (GWB, ACT, etc.) shall not be room bounding.

1.5.1.8 Construction Documents Phase

The project BIM team shall continue development of the models created in the Design Development Phase. Maintain parametric links within the respective models to enable automatic generation of all plans, sections, elevations, custom details, schedules, and 3D views. All information needed to describe the execution documents shall be graphically or alphanumerically included in and derived from these models only. Specifications are not required to be linked within the models.

Revit and Civil 3D models to be submitted at 30, 60, 90, and 100 percent construction documents with LoD matching those laid out in the LoD Matrix. Include families in use that were not part of DEN library for review. DEN will review models and families within 14 days and schedule meeting with the project team to discuss.

A. Data

B. Programmatic spaces- All rooms in the architectural and/or MEP BIM model shall conform to DEN naming, numbering and categorization requirements

C. Sustainability

D. Energy- As called for by BIMPxP Preliminary Energy modeling data included:

a) Detailed electric and fuel rates as defined by the local service provider

b) Building function and occupancy

c) Building operating schedules

d) Building construction types

E. Equipment (data)- All equipment in model will be registered in the project equipment library

1.5.1.9 Bidding Phase

The project BIM team shall update the models with all addendum, accepted alternates and/or value enhancement proposals.

1.5.1.10 Contractor Bidding

As delivery method allows contractors who are bidding on this project are to review the BIMPxP, and these DEN BIM Requirements before bidding. Contractor will follow the guidelines and requirements as set forth by the BIM Execution Plan.

DEN will make the project BIM available with appropriate disclaimers to the contractor at bidding.

1.5.1.11 Construction Phase (Design Team)

The project BIM team is expected to continuously maintain and update the design intent models with changes made from official Construction Change Directives and construction mark-ups maintained on site by the Contractors during construction. At an interval that is decided within the BIMPxP or at minimum, once a month

during construction the updated design intent models will be published in Revit and Civil 3D formats (Current Version) and posted to the DEN project site for the project.

1.5.1.12 Construction Models

Contractor shall model conditions, as they will be built in the field. These models could include fabrication models, coordination models, or shop drawing models. These models will now be referred to as the Construction Models. Construction models shall be made available to the project BIM team throughout the project process.

1.5.1.13 Concurrent Record Model (Design Team)

The project BIM team shall submit a plan to the Owner for review, prior to the start of construction that outlines the process for concurrent record documentation. Design Team will incorporate changes from Requests for Information (RFIs), Change Orders, Addenda, and other CA revisions into their models as they are issued. Concurrency is mandated. Methods for recording and communicating construction information are left to the discretion of the contractor.

Potential options for concurrency include:

A. Traditional methods
B. Periodic laser scanning of completed or partially completed primary systems coordinated with the sequence of construction.
C. Integration of model changes in RFI, Change Order approval processes. Responsibility of the modeling updates is determined by the BIMPxP.

Primary systems include, but may not be limited to structural framing, primary HVAC duct runs, primary fire protection main runs, primary electrical conduits (2 inches plus tolerance), ceiling grids layouts, any elements or systems indicated as Assets in the LoD Matrix.

Once Contractor model is completely coordinated, Design Team shall reconcile differences between the Contractor and Design models.

1.5.1.14 Commissioning Requirements

Commissioning data including but not limited to design intent, performance criteria and operations data shall be recorded and/or linked to the REVIT or Civil 3D model as commissioning occurs throughout the project. It shall be the project Team's responsibility to coordinate the information sources and integrate this information into the REVIT or Civil 3D model for transfer at the completion of the project.

1.5.1.15 Project Close-out

The project BIM team shall update their respective models with contractor recorded changes (record documents). Republish record documents in paper and PDF formats.

In addition to any submissions required per DEN professional services contract (deliverables sections) and the DEN As-Builts requirement documents, the project BIM team will submit a record model prior to close out.

1.5.1.16 Record Models

Record models shall be submitted in .rvt and Civil 3D .dwg format and shall be cleaned of extraneous *scrap* or *working* views, stories, abandoned designs, object creation and testing places, and other content typically produced in BIM production.

Record models shall be modeled to the LoD noted in the DFI Matrix with any Assets updated to reflect actual location, size, shape, and orientation of installed Assets.

1.5.2 General Terms and Acronyms

Table 1-5: General Terms and Acronyms

Term	Definition
AEC Objects	AEC Objects are custom objects created by Civil 3D for use in Civil 3D only. Object enablers are built into AutoCAD and related verticals beginning in version 2012.
Airport Feature	An airport feature is limited to those aspects of the airport that are outside in the physical space not occupied by a manufactured structure. Anything that can be seen using a satellite image of the airport property falls under airport feature. For example, changes made to the inside of a building cannot be seen by a satellite image and thus do not fall under the definition of an airport feature. Airport features are only those manufactured and natural elements on airport property that are covered by the civil engineering discipline. The only exception to this is subsurface utilities that are also defined by an airport feature.
Airport GIS	The Airports Surveying-GIS Program defines the FAA process for the collection and maintenance of airport and aeronautical data required to meet the demands of the Next Generation National Airspace System. Guided by the program advisory circulars, the airport sponsor/proponent becomes a key link in the airport and aeronautical information chain.
Airport Spatial Data	Any data representing manufactured or natural features that have geometry (size, location, elevation/depth, etc.) and have specific attributes associated with them. The coordinates of a point are the most obvious example of spatial data, but spatial data also incorporates projection systems, line and polygon attributes, and other information. There are two main classes of spatial data: vector and raster.
Attributes	Characteristics of a geographic feature (manufactures or natural) described by numbers, characters, and images, typically stored in a tabular format, and linked to a geographic feature by an identifier within some form of database (GIS, MS Access, CADD, BIM). A column in a database table can contain an attribute field covering the same type of data class for a variety of geographically disperse features.
AutoCAD Objects	Objects in a DWG file that are not AEC objects and produced by AutoCAD commands. These objects are often referred to as native AutoCAD objects.
BIM Project Execution Plan (BIMPxP)	The record document and attachments of the BIM Project Execution Planning process.

Table 1-5: General Terms and Acronyms (Continued)

Term	Definition
BIM Project Execution Planning (BPIM)	A process that allows consensus decisions to be made by all shareholders in the PBIM. Used to identify Model Element Authors (who is creating the model elements) as well as the level of detail and BIM Uses (who is consuming Data from the PBIM, when and what LoD is needed by them).
Building Information Modeling/Management (BIM)	(VERB) An integrated process built around coordinated, reliable information about a project from design through construction and into operations. BIM gives architects, engineers, builders, and owners a clear overall vision of the projects and contributes to the ability to make better decisions faster, helping raise the quality. (NOUN) The aggregate of files used to record the building information. Applications and Formats included but not limited to .rvt, .dwg, .pdf, .dwf, .nwc, mdb, and sql databases.
Data Reference Files (DREF)	DREFs are model files containing the original Civil 3D AEC objects that have been published as data shortcuts.
Data Shortcuts	A set of tools in Civil 3D that allow a file containing a Civil 3D object to be referenced into another DWG file.
DEN CADD Standard	A manual defining process and content for the production of design documentation, 3D models, and data for BIM
Design Documentation	The traditional set of 2D plans for construction of physical infrastructure or documentation of existing conditions.
Drawing Template File	A DWG file with the file extension .DWT
Horizontal Disciplines	Horizontal Disciplines have their design work located outside of buildings. Horizontal Disciplines produce the following types of drawings. • C - Civil Drawings • E - Electrical Drawing • F - Fueling Drawings • G - Signing Drawings • L - Lighting Drawings • S - Structural Drawings • U - Utility Drawings This is not a complete list. Some disciplines listed are limited to that portion of their work positioned 5' or more beyond the outside of a building

Table 1-5: General Terms and Acronyms (Continued)

Term	Definition
Level of Development (LoD)	LoD is the degree to which the elements geometry and attached information has been thought through – the degree to which project team members may rely on the information when using the model. This base definition is further defined in the "Level of Development Specification," 2021 by BIM Forum.
Metadata	Information about data, describing the quality (e.g., accuracy, last revised, originator, etc.) of that data being examined by a user, to manage user expectations for proper application of that data. Security level restrictions for the use of a certain data are also part of its metadata.
Model Files	DWG files where drawing content is only created in modelspace
Modelspace	The drawing editor accessed through the Model tab. Objects are drawn at a 1:1 scale representing real world dimensions.
Object enablers	Object enablers are built into AutoCAD 2012.
Paperspace	The drawing editor environment accessed through Layout tabs and scaled for plotted dimensions to fit various paper sizes.
Project BIM Team	The project stakeholders who are either contributing to or using the PBIM.
Project Building Information Model (PBIM)	Used in this document to specify the aggregate of files used to record the building information for a specific project. It is recognized that a project may have more than a single model to complete the delivery. The term BIM is used in this document to represent all modeling and database files holding data for a specific project.
Sheet Files	DWG files containing external references in modelspace and Sheet specific drawing objects in paperspace.
Sheet Set Data File	A file with a .DST file extension used with Sheet Set Manager in Auto-CAD. It contains custom properties for managing title block content.
Spatial	Relating to, occupying, or having the character of physical three-dimensional space
Spatial Data Standards for Facilities Infrastructure and Environment (SDSFIE)	The SDSFIE is an American National Standard Institute (ANSI) standard detailing the data structure and organization of CADD-GIS graphic fea-tures and corresponding attributes constituting a base map.
Team	The terms Design Team, Construction Team, and Design/Construction Team, and project BIM team have been used in this document to assist in defining which group the guidance applies to. However, because the project delivery methods can define risk differently, for some projects the responsibility will shift to either the A/E or Contracting entity, or both. The DEN Contract and BIMPxP shall properly define the duties of the parties before BIM modeling begins.

Table 1-5: General Terms and Acronyms (Continued)

Term	Definition
XREF	Externally Referenced File inserted in the current drawing using the ATTACH command in AutoCAD.

1.5.3 Policy Updates

This policy will be eligible to be updated and enhanced on a quarterly basis. Recommended additions and suggested changes are to be directed to DEN Asset Management.

End of Chapter

Chapter 2 - CADD Procedures

2.0 Introduction

2.0.1 Introduction

DEN uses AutoCAD® Civil 3D® software as the Building Information Modeling (BIM) solution for civil engineering design and documentation. This information is for anyone authoring CADD/Civil 3D® models for DEN. This includes DEN staff, as well as external service providers. The reader is assumed to have a basic knowledge of CADD, Civil 3D®, and the workflows and terms common to the industry. This document presents baseline requirements for all civil BIM projects at DEN.

2.0.1.1 Purpose

This document establishes the procedures for CADD/Civil 3D® submittals to DEN and organization of CADD/Civil 3D® data within DEN. The procedures are necessary to ensure efficient electronic data exchange between DEN and its consultants, contractors, and local, state, and federal government agencies, including CCD, Colorado Department of Transportation (CDOT), FAA, TSA, and law enforcement agencies.

The presented procedures are designed to enforce commonality amongst data required throughout the lifecycle of DEN airport facilities as well as ensure the compatibility of CADD/Civil 3D® data with the FAA's AGIS database, GIS standards, and metadata standards. CADD/Civil 3D® submittals from consultants are the basis of most Engineering/GIS data referenced by DEN. These procedures assist DEN in receiving and producing data that conforms to FAA Advisory Circular (AC) 150/5300/18B and best practices in planning/design/construction. By organizing data for better accessibility and maintainability, these CADD/Civil 3D® procedures are critical to supporting DEN infrastructure throughout its life cycle.

2.0.2 Scope

This document provides procedures for the use of the DEN Civil 3D template as well as management of files, naming conventions, layers, colors, linetypes, and other CADD related properties. The DEN CADD procedures are based on the National CAD Standards (NCS) Version 4, FAA AC 150/5300-18B, and CDOT standards. This document and associated template are intended to provide DEN consultants the baseline for creation of design drawings to be submitted to DEN. The consultant shall follow the procedures provided in this manual and utilize the layering format in the DEN CADD/Civil 3D® template.

A comprehensive set of layers is included in the CADD/Civil 3D® template to represent features typical for Airport projects and include layers provided in the CDOT and FAA AC 150/5300-18B standards. The layers provided in the CADD/Civil 3D® template will be used to define objects and other data required by the FAA as well as additional layers typically used for design purposes. It is the responsibility of the Consultant/User to choose the appropriate layers and ensure that all data required by the FAA is submitted to DEN in the proper format.

2.0.3 Proposing Revisions

This standard is intended to be updated and enhanced as deemed necessary by DEN over time. Recommended additions and suggested changes are to be directed to DEN Asset Management.

2.1 General Setup and Delivery

2.1.1 Introduction

This section deals with general setup for project Civil 3D files, resources within the DEN Kit of Parts, and requirements for delivery of Civil 3D BIM files.

2.1.2 DEN Kit of Parts

The DEN Kit of Parts is updated on an ongoing basis and the most current version must be requested from the DEN BIM team before each project. The DEN Kit of Parts folders are not project data folders but contain sharable libraries of Civil 3D templates, content, and files for configuration purposes. This enables the standardization of AutoCAD applications in a multi-user environment by having this folder structure available in a shared folder on a network accessible by all CAD users who need a DEN-compliant environment.

Within the BIM Kit of Parts, you will find the following folders to be useful:

2.1.2.1 Blocks

The 03_Libraries\02_Templates\Civil_3D\Blocks folder contains DWG files with block definitions arranged in logical groups similar to the AutoCAD Sample folder. Additional blocks shall be submitted to the project BIM Coordinator for review and inclusion.

2.1.2.2 DEN-C3D-TEMPLATE

The 03_Libraries\02_Templates\Civil_3D\DEN-C3D-TEMPLATE folder contains Civil 3D specific content including DEN C3D Master Template 20##.dwg, DEN C3D Master Template 20##.dwt, and DEN C3D Master Template 20##.dws, for use with the standards checker.

2.1.2.3 DEN-SHEETSETS

The DEN-CADD-STANDARD-TEMPLATE folder contains the DEN Sheet Set Master.dst file and the DEN Sheet Set Master.dwt file. Both can be found in the 03_Libraries\02_Templates\Civil_3D\DEN-CADD-STANDARD-TEMPLATE\DIA-SHEETSETS folder.

2.1.2.4 Docs

The 05_Reference\04_C3D folder contains potentially useful reference documents, such as Sheet Set Manager Tips and NCS Discipline Codes.

2.1.3 File Organization and Structure

The file types discussed in this section are used for developing project data. Configuration files such as drawing templates are discussed in the Workstation Configuration section.

2.1.3.1 Design Files

A design file contains the digital representation of the physical components of an existing or proposed site (e.g., roads, drainage structures, terrain models, buildings, etc.). Design files are drawn at full scale, representing plans, profiles, sections, etc. A model file can contain both 2D and 3D objects. Model files can be generated either by adding AutoCAD or Civil 3D objects or from BIM model extractions.

2.1.3.2 Data Reference Files

Data Reference Files (DREFs) are model files containing the original AEC objects produced by Civil 3D for sharing data across multiple design files. Data shortcuts are the Civil 3D mechanisms utilized to share this data. Creating a reference is the action taken to establish the link between the host and the source files for a specific AEC object. All data reference files must be transmitted to DEN at all deliverables.

2.1.3.3 Reference Files

Reference files, also known as Xrefs, are model files. Reference files can be DWG, DGN, PDF, DWF, and all image file formats supported by Civil 3D. Reference files provide background information for a model file or design information for a sheet file. Model files can be externally referenced into sheet files. Sheet files are never used as Xrefs.

The XREF type shall always be *Overlay* and locked in place. The XREF manager should be checked in all drawings so that all information is transmitted to DEN. Missing, unloaded, and not found XREFs are not permitted.

2.1.3.4 Sheet Files

A sheet file is synonymous with a plotted CAD drawing file. A sheet file is a selected view or portion of referenced model files within a border sheet introduction.

2.1.4 Deliverables and Delivery Method

Current, complete Civil 3D files must be submitted at each deliverable and at the same time as the rest of the deliverable.

2.1.4.1 BIM Data Transmittal Document

The BIM submittal must include a BIM data transmittal that outlines date, project number, project title, submittal level, points of contact, description of files in a .pdf format along with responses to the last model review.

2.1.4.2 Data Transmittal

Use eTransmit command in Civil 3D to create a zip file of the current drawing, its reference files and data reference files. eTransmit is the only acceptable submittal method for Civil 3D files.

Include a BIM Data Transmittal containing a list of files and any comments that will help the recipient understand what is being delivered and how to use it.

See the best practices section (2.7.2) to ensure that the etransmit is fully complete.

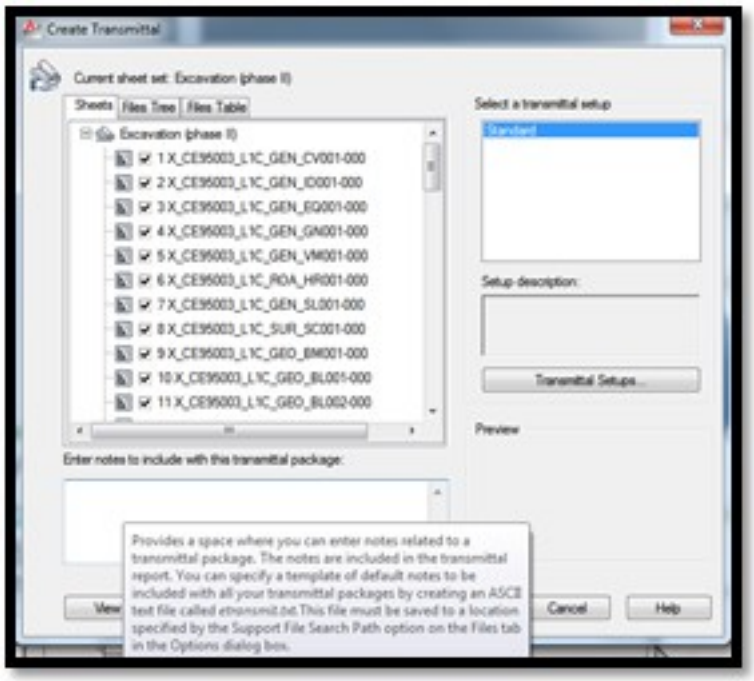

Figure 2-1: BIM Data Transmittal

2.1.5 Coordinate Systems

2.1.5.1 DEN Low Distortion Projection System

All design files submitted in CADD format must be produced and submitted using the DEN Low Distortion Projection 2018 (LDP) system. This coordinate system is coded into the DEN template. When using the template for the first time on your computer, you will be asked if you want to add the DEN LDP 2018 coordinate system to your Library. To set up the coordinate system on your machine, click yes.

2.2 Design Files

2.2.1 Introduction

This section deals with file setup for C3D model files, naming, and layer standards. Each design drawing (model file) shall be in model space (with nothing in paper space) and shall have no other drawing files externally referenced in it.

2.2.2 DEN Model Template

The most current DEN C3D model file template must be used on all projects. The file is available in the DEN Kit of Parts with the most recent template being, DEN C3D Master Template.dwg.

2.2.3 DEN File Naming Components – Model Files and Reference Files

The DEN file naming system for model files and external reference files conforms to the NCS Uniform Drawing System (UDS) and DEN legacy standards. The DEN external reference file naming system consists of three standard components and two optional components, as follows:

LLNNNNN	-	L	LLL	LL	-	LNLN
(1)		(2)	(3)	(4)		(5)

2.2.3.1 File Naming Conventions

These conventions standardize the naming and numbering of all project documents. All CADD documents shall contain a numbering system according to the criteria outlined below.

2.2.3.2 Project Identifier

This is the DEN contract number provided by the DEN Project Manager. If the project has multiple tasks, denote which task with a decimal point and task number, e.g., ce95003.01.

ce95003	-	A	1	-	GRA	-	SC

2.2.3.3 Level 1 Feature Group Designator:

This component identifies the FAA Feature Group contained within the file. A given design file shall not have content from more than one FAA Feature Group. For example, a file with AIRFIELD information in it is denoted with an A after the hyphen and shall not have information within the file from the Feature Groups for CADASTRAL, ENVIRONMENTAL, UTILITIES, etc.

Refer to Table 2-2: Level 2 Discipline Designators for FAA Feature Group designators and FAA AC 150/5300-18B for FAA Feature Group content breakdown.

ce95003	-	A	1	-	GRA	-	SC

2.2.3.4 Level 2 Phase Designator

This component identifies the file as having been generated by the design team with a 0, or by the surveyor with a 1.

ce95003	-	A	1	-	GRA	-	SC

2.2.3.5 Level 3 Discipline Designator - Optional

This optional, user-defined component further specifies the type of model discipline, as needed. For example, in the civil grading model file a GRA is added to the C designation. Use – if this option is not needed.

Refer to Table 2-2: Level 2 Discipline Designators for level 2 discipline designators.

ce95003	-	A	1	-	GRA	-	SC

2.2.3.6 Model Type Designator

The example of the 2-character model type designator shows an SC, denoting a Section. The example file name denotes the Civil Grading Section for contract ce95003.

Refer to Table 2-3: Model Type Designators for standard model type designators.

ce95003	-	A	1	-	GRA	-	SC

2.2.4 Additional Designators (Optional)

If additional designators or levels are needed, a request may be submitted to the DEN BIM team on a project-by-project basis.

2.2.5 DEN File Naming Components – Identifiers

The following tables provide the identifiers and their descriptions for use in naming project plan files and external reference files.

Table 2-1: Level 1 Feature Group Designators

Discipline	Description	Discipline	Description
A	Airfield	M	Man Made Structures
C	Cadastral	N	Navigational Aids
E	Environmental	S	Surface Transportation
G	Geospatial	U	Utilities

Table 2-2: Level 2 Discipline Designators

Identifier	Description	Identifier	Description
AER	Aerial	KEY	Key Map
AVD	AVI Details	LID	Lighting Detail
AVN	AVI Notes	LIN	Lighting Notes
AVP	AVI Plans	LIP	Lighting Plan
BLD	Boring Log Data	LOP	Sheet Layout Plan
BLM	Boring Log Map	MSC	Miscellaneous Sheets
BMP	Benchmark Plan	MSL	Overall Milestone Layout Plan
CFG	Conceptual Foundation Grading	PEN	Pavement Elevations Notes
COV	Cover/Title Sheet	PHM	Potholing Map
CRS	Cross Sections	PMN	Pavement Marking Notes
CST	CDOT Standard Plans List	PVE	Pavement Elevations Plan/Det
DET	Detail Sheets	PVM	Pavement Marking Plans/Pvmt Details
DMN	Demolition Notes	QTB	Quantity Tabulations
DMP	Demolition Plan	QTY	Summary of Approximate Quantities
DPP	Drainage Plan and Profile	RDT	Roadway Details
DRD	Drainage Details	RPL	Roadway Plan
DRL	Drainage Profiles	RPP	Roadway Plan and Profile
DRN	Drainage Notes	SCD	Structural Caisson Details
DRP	Drainage Plan	SCL	Structural Caisson Layout
ECD	Erosion Control Details	SCN	Structural Construction Layout
ECN	Erosion Control Notes	SED	Structural Excavation/Backfill Details
ECP	Erosion Control Plan	SEG	Structural Engineering Geology
EES	Excavation Earthwork Summary	SGL	Structural General Layout
ELD	Electrical Details	SGN	Structural General Notes
ELN	Electrical Notes	SLD	Structural Slab Reinforcing Details
ELP	Electrical Layout Plan	SMD	Structural Miscellaneous Details
FCD	Fence Details	SPD	Structural Panel Details
FCP	Fence Plans	SSD	Structural Details
FIO	For Information Only	STY	Structural Typical Section

Table 2-2: Level 2 Discipline Designators (Continued)

Identifier	Description	Identifier	Description
FSM	Fill Settlement Markers	SUR	Survey Control Plan
GED	Geometry Data	TDT	Track/Platform Details
GEN	Geometry Notes	TOP	Topography
GEP	Geometry Plan	TPL	Track/Platform Details
GNN	General Notes Sheet	TPP	Track/Platform Plan and Profile
GRA	Grading Plan	TTB	Title Block
GRN	Grading Notes	TYP	Typical Sections
GUT	General Utilities	UTD	Utility Details
HRT	Haul Route	UTN	Utility Notes
IMG	Images	UTP	Utility Plans
IND	Index of Drawings	UTX	Utility Text (Base)
INF	Infrastructure/Site	VMS	Vicinity Map Sheet
JTD	Joint Layout Details	WDT	Retaining Wall Details
JTN	Joint Notes	WGL	Retaining Wall General Layout
JTP	Joint Layout Plan	WTY	Retaining Wall Typical Section

Table 2-3: Model Type Designators

Identifier	Description	Identifier	Description
3D	Isometric/3D	PP	Phasing Plan
CP	Construction Plan	PR	Profile
DG	Diagrams	QP	Equipment Plan
DP	Demolition Plan	RP	Roof Plan
DT	Detail	SC	Section
EL	Elevation	SH	Schedules
EP	Enlarged Plan	SP	Site Plan
ER	Erosion and Sediment Control Plan	XP	Existing Plan
FP	Floor Plan	01, 02, 03	Sequence
GP	Grading Plan		

2.2.6 Model File Breakout

All modeled content shall be delivered to DEN broken out into model files by FAA Feature Group. A design file that contains Utilities as broken out by the FAA Feature Group may not contain Airfield, Environmental, Geospatial, or other Feature Group information except as reference files. There may be multiple design files for each Feature Group.

2.2.6.1 CAD Layering Standards

The DIA CADD Template contains layers commonly used in the development of design drawings for Aviation/Airport projects. The DEN Template includes FAA AGIS layers for use on all Airfield projects inside the DEN fence as well as all landside projects outside the DEN fence.

A full list and description of FAA AGIS layers is provided in AC 150/5300-18B.

2.2.6.2 Abbreviations

The following table contains the abbreviations used in the CADD FAA layer list.

Table 2-4: CADD FAA Layers

Identifier	Description
1M	1MM
3D	3D Line
C	Continuous
DS	Dashed Spaced
FT	Featured Type
L	Line
LT	Linetype
LW	Line weight
P	Point
PG	Polygon

2.2.6.3 Layer Groups

The DEN C3D Master Template.dws file contains layer filter groups.

2.2.6.4 FAA AGIS Layers

FAA AGIS Layers were created utilizing the samples provided in AC 150/5300-18B. In certain instances, layers were either added or revised to better correspond with NCS guidelines, provide the level of detail typical for design drawings, and/or minimize uncertainty when determining what data is required by the FAA.

The FAA layers are arranged similarly to the NCS Layers in that the layers are filtered according to the FAA feature group. Each feature group filter (e.g., Airfield) contains several additional filters for the appropriate feature class (e.g., Airfield Light) within the group.

Each feature class filter contains the layers used to represent the airport features associated with the class. When preparing a drawing for submittal to the FAA, objects on layers within each feature class will be converted to the FAA AGIS layer for that class, which is typically the feature class name.

2.2.6.5 Layer Naming

Layers may not be added nor renamed or appended except in accordance with the requirements of AC 150/5300-18B. The first three designators must conform to the requirements of the circular but may add a fourth or further modifying designators, with additional layers continuing to comply with the requirements for the first three designators and additional modifiers for further differentiation.

2.3 Model Content

2.3.1 Overview

Every drawing must be in the world UCS with the origin at 0,0,0. Use the same coordinate system (DEN LDP 2018) as the base map provided by DEN. It is important to maintain an accurate coordinate system to allow the exchange of design information among the project team and allow information from different design groups to be displayed together easily. Each design drawing (model file) shall be in model space (with nothing in paper space) and shall have no other drawing files externally referenced into it. As you are working on your drawing, you will have the base and other design drawings externally referenced during your drawing session, but when you are complete, it is important to unload but not detach all external references.

2.3.2 Model All Designed Elements

3D Models shall be created that include all geometry, physical characteristics and product data needed to describe the design and construction work to within 5 feet of building envelope. Drawings and schedules required for assessment, review, bidding, and construction shall be extractions from this model.

In all cases, model infrastructure systems to a level that allows the team to verify clearances, analyze conflicts/clashes and properly coordinate the work with all other aspects of the project. The project BIM team shall follow the guidelines and requirements detailed in this document and the BXP for BIM related services.

The LoD defined for elements in design models for Civil/Site work are the minimum required and shall be modeled to the specific LoD as represented by the LoD Matrix and BIM Forum LoD specification.

2.3.2.1 General – Applicable to All Disciplines

The Civil/Site model shall be delivered in Civil 3D to include the following:

A. Site Utilities

   All proposed site utilities within the project boundary of the project footprint are to be modeled in three dimensions and accurately represented with AEC Object elements as outlined below:

B. Wet Utilities

   Storm, Sanitary and Water Lines: Model all proposed, replaced, or relocated installations including all structures and related appurtenances in the form of AEC Civil 3D pipe network objects.

C. Dry Utilities

   Piping/Conduit/Duct banks: Model all proposed installations 2 inches or greater in the form of AEC Civil 3D pipe network objects, smaller piping in ganged runs may be modeled as a mass.

D. Abandoned in Place

   Any existing utilities which are abandoned in place must be identified and labeled appropriately as abandoned during design and modeled as surveyed for As-Builts.

E. Demolished/Removed Utilities

Can be delivered as AutoCAD primitive data (3D Polylines, Arcs, Blocks etc.)

F. Existing Utilities to remain

Existing utility data not normally modelled in Civil 3D can be delivered as AutoCAD primitive data (3D Polylines, Arcs, Blocks, etc.) for design and must be modeled as surveyed for As-Builts.

G. Horizontal site development

Model all proposed paved surfaces, roadways and site grading as Civil 3D TIN surfaces utilizing a combination of AEC Civil 3D feature lines, assemblies, corridors, alignments, and profiles.

H. Airfield Panels

Model each designed airfield panel as AEC Civil 3D feature lines and apply elevations to all panel vertices.

2.3.2.2 Structural

The following stipulations will be used for structural model elements:

A. All cast-in-place concrete, including all penetrations and openings identified in the construction documents, will be modeled. Slab camber will not be modeled. Chamfers at corners will not be modeled (but will be detailed).
B. Edges of all slabs and penetrations of structural systems will be accurately located in the model.
C. All primary and secondary structural steel members will be modeled, including standard steel member sizes, gusset plates, braces, kickers, and equipment supports. Reinforcing steel and imbeds will not be modeled.
D. Metal, wood, and concrete decks will be modeled as the overall thickness of the slab; ribs in metal decks will not be modeled.
E. Bolts, clip angles, etc. will not be modeled.
F. Miscellaneous metals such as elevator hoist beams, rails and intermediate rail support steel for the elevator will be modeled.
G. Identify reinforcing or penetration
H. *no-fly* zones as applicable.

2.3.2.3 Utilities

Utilities within the project boundary of the project scope are to be modeled in three dimensions and accurately represented with model elements. The Civil/Site model shall be modeled in Civil 3D.

A. Utility trench excavation surfaces
B. Excavation lift models of proposed daily progress of mass excavation and utility trenches
C. Shored walls/surfaces
D. MSE walls
E. Bridge soffit surfaces – Pre-camber and post-camber
F. Bridge bents
G. Bridge top deck surfaces – Pre-camber and post-camber
H. Bridge hinge keys
I. Electrolier bases on bridges
J. Bridge barriers
K. Piping/Conduit/Duct banks

Model all proposed installations including but not limited to:

a. Piping
b. Joints

c. Sump basins
d. Storage tanks
e. Free draining material wraps or bedding around piping
f. Pipe networks *part properties* shall be populated with relevant geometric and analytic data pertaining to; *Geometry, Resize Behavior, Hydraulic Properties, and Part Data*

L. Excavation and vertical underground elements

Model all temporary and permanent shoring, and areas of excavation including affected lay back areas, with appropriate sloped surfaces.

M. Horizontal site development

Model all temporary roadways required for potential phasing including but not limited to:

a. Perimeter barriers (jersey barriers, k-rails)
b. Paving surface relocations
c. Storm drainage requirements
d. Snow storage areas
e. First responders' site and perimeter access roadways

N. Site areas of impact

Provide model elements to indicate the following:

a. Areas of influence
b. Sterile area boundaries
c. AOA boundaries
d. Stakeholder access zones

Civil 3D deliverable files shall be accompanied by a LandXML 1.2 file of alignments /profiles/surfaces and points, and an IFC if possible.

2.3.2.4 Civil 3D Styles and Settings

The Civil 3D drawing template contains the pre-configured command settings and style definitions compliant with the DEN CAD Standard. Begin all model files using this Civil 3D template. The Civil 3D drawing template provided in this Standard contains the Description Key Set defining the Survey Descriptor Codes.

Additional styles are the responsibility of the design consultant.

2.3.3 AEC Object Naming

Coordinate with DEN BIM for numbering of airfield panels. DFI will provide an approved bank of numbers to use for new panels being provided in design.

Storm and Sewer manhole name/number should be coordinated with DEN at or prior to the 90% design level.

2.3.4 Spatial Coordination

Design Consultants shall ensure that their design work is coordinated with existing and designed systems. If designed content is not sufficiently coordinated as judged by DEN BIM, the design team may be required to participate in a Spatial Coordination process.

2.3.5 Model Reconciliation

2.3.5.1 Model Management

Design Consultants shall provide updates/maintenance of Electronic Data/3D Model throughout construction that modify the design intent and/or special coordination to the design model to include but not limited to:

A. Incorporation of RFIs.

B. Incorporation of ASIs, CDs, CCDs, MODs.
C. Submittal comments and revisions on approved shop drawings.
D. Implementation of modifications to the project Building Information Models due to RFI responses will be the responsibility of the Model Element Author in primary control of the affected Model Element at the RFIs initiation.

2.3.5.2 As-Built Model

Designers shall provide updated As-Built model files and sheet files which reflect contractor field changes and survey data.

2.3.6 GIS Data Workflow

All drawings submitted for satisfying FAA or DEN GIS standards must conform to the general geometric standards for GIS data. The FAA has established a system of feature classes representing the various areas of an airport (Airfield, Airspace, Man Made Structure, etc.) and feature types representing elements within each feature class. GIS compatible drawings submitted to the DEN must conform to the geometric requirements and topological integrity required for GIS compatibility.

Table 2-5: GIS Data Terms and Acronyms

Term	Definition
Attributes	Tabular data associated with graphical objects such as points, link, or polygons.
Layer	In GIS, a layer refers to a data layer comprised of either points, links, or polygons.
Point	XYZ location with a unique identifier as an attribute.
Link	A linear object defined by points at the beginning coordinate and ending coordinate of the line.
Polygon	A collection of links forming a closed 2D area.
AutoCAD Primitives	Native AutoCAD object including point, line, polyline, circle, block, insert, text, mtext.
AutoCAD Civil 3D AEC Objects	Custom objects created by Civil 3D commands in the form of Points, alignments, Surfaces, Pipe Networks, Corridor Models and more.
Object Data	Object data is attribute data that is attached to individual objects and stored in tables in the drawing.

2.4 Assets

2.4.1 Introduction

This section discusses the collection and entry of data on assets as required by DEN for FAA and DEN maintenance purposes.

2.4.2 Asset Identification

What DEN defines as an Asset is broken down and specified by DEN Asset Type and DEN Functional Area in Appendix A- Asset Types must be identified by the 60 percent deliverable. In general, these asset types include but are not limited to:

A. Airfield panels
B. Electrical equipment/runway lighting
C. Manholes, drainage, and conveyance structures
D. Mechanical equipment and fixtures
E. Plumbing equipment and fixtures
F. Water line equipment and fixtures

2.4.2.1 Asset Data

Asset data is generated throughout the project process by multiple parties. When a party adds new data, they are also responsible for validating the existing data associated with that Asset. Below are the fields required for the successful population and execution of the DEN Asset Management program.

2.4.2.2 Asset Data – 60 Percent Design

At 60 percent Deliverable and beyond, all DEN assets, new and existing within the scope of design and demolition, must be modeled and identified.

2.4.2.3 Asset Data – 90 Percent Design

By the 90 percent Deliverable and beyond, all DEN assets, new and existing within the scope of design and demolition, must have the information shown in Table 2-6: Asset Data: 60 and 90 Percent Design entered by the design team in the DEN OD table spreadsheets contained within the Kit of Parts using the fields required in the DSM. This information must be maintained as current through the remainder of the project.

Table 2-6: Asset Data: 60 and 90 Percent Design

Data Type	Civil Attribute	Data Description
Name/Mark	Name/Mark	Asset identifier, e.g., VAV-13, FSD-12, SDG12900, SAG3400
Asset Type	ASSET_TYPE	DEN Asset Type, e.g., Fan Power VAV. Refer to Appendix A-Asset Types.
Asset	ASSET	Indicating the element is an asset. If it is a DEN asset, set to Yes; otherwise, No.

2.4.2.4 Asset Data - Construction

During construction and prior to Substantial Completion, the installer is responsible for populating the information shown in Table 2-7: Asset Data: Administrative data for all Assets using the DEN OD table spreadsheets, as well as validating existing data

.

Table 2-7: Asset Data: Administrative

Data Type	ACC Attribute	Data Description
Purchase Price	PURCHASE PRICE	Asset purchase price, not installation cost.
Warranty End Date	Warranty End Date	Date Warranty is set to expire

2.4.3 Add Object Data Tables

Per FAA all project feature data shall satisfy the requirements as detailed in the AC 150/5300-18B. Objects for each feature type shall be categorized under its applicable feature group, feature class and feature type utilizing the FAA specific data tables MS (Excel) available in the project ACC environment.

2.4.3.1 Add Data to AutoCAD Object in the Drawing

Every element in the drawing package that requires data per the FAA and this DSM must have a unique name/mark assigned. The name can be applied via block attribute or a property set definition methods.

2.4.3.2 Edit Object Data to Populate Data Fields

After Assigning a name/mark to an element in the drawing, populate values in the corresponding MS Excel File for each type of asset. Ensure that all tabs within the MS Excel file are completed.

Example Data Sheets:

Data Types
Airfield light
Airfield Sign
Manhole
Utility Line
Utility Point
Runway Element
Taxiway Element
CCTV
Electric Panel
Ground Power Unit
Lighting Control
Lighting Circuit
Airfield
Cadastral
Environmental
Geodetic
Jurisdictional
Navigation Aides
Security
Structure
Surface Transportation

Utilities

2.4.3.3 FAA Object Data Tables

Completing all MS Excel files fully satisfies the object data table requirement.

2.5 Sheet Files

2.5.1 Introduction

This section covers sheet file setup, naming, and conventions for all Civil 3D work at DEN.

The Plan Production techniques introduced herein are considered best practices for automating processes for producing nearly complete sheets in very few steps. Training is strongly recommended to acquire skills needed to utilize these tools effectively. DEN submittals are to follow the Plan Production process to minimize large submission packages of multiple files.

Plan Production is the process of creating individual Sheets for inclusion in a plan set. The result of several possible Plan Production processes is a set of plans either plotted on paper or contained in a pdf file.

The Plan Production process can be as simple as creating Layouts manually and using the PUBLISH command to plot drawings. Another method employing a little more automation involves creating layouts, creating a Sheet Set and manually adding layouts. Using Sheet Set Manager, you can batch plot drawings. You can use plain AutoCAD for both these techniques.

The most automated technique uses the Plan Production Tools found in Civil 3D. You can create Plan Sheets, Plan and Profile Sheets, or Section Sheets using Civil 3D's Plan Production Tools.

2.5.2 DEN Sheet File Template

The DEN Kit of Parts includes drawing templates (.DWT) and a Sheet Set data file (.DST) ready to use with the Plan Production Tools.

2.5.3 Sheet File Naming

The components used to identify a file depend on the complexity and requirements of the project. The DEN file naming system consists of seven standard components and two optional components, as follows.

_	NNNNNNNN	-	L	N	L	LLL	-	N	NN	-	LNN
(1)	(2)		(3)	(4)	(5)	(6)		(7)	(8)		(9)

L = alphabetical character

N = numerical character

2.5.3.1 FAA Airport Improvement Program (AIP) Number – Used/Not Used

The FAA issues AIP numbers to track projects that have applied for FAA funding. If an AIP number is issued, it shall be entered into the drawing title block for identification and tracking. The two entries used for this identifier include the following:

A. A = AIP Number associated with project

B. _ = No AIP Number associated with project

_	95003001	-	1	C	GRA	-	1	01

2.5.3.2 Project Identifier

A project number assigned by DEN Project Manager. For projects with multiple Tasks, such as on call contracts, separate the project identifier from the task number with a decimal point, e.g., task 1 would be 95003001.01

_	95003001	-	1	C	GRA	-	1	01

2.5.3.3 Volume Number

The volume number is a single-digit identifier (1 through 9) that denotes individual volumes of a drawing set. The volume number allows for the splitting of individual sub-sets as required to properly detail an area of the project, i.e., Volume 1 for runway, Volume 2 for taxiway, etc.

_	95003001	-	1	C	GRA	-	1	01

2.5.3.4 Level 1 Discipline Designator

This component identifies the subject matter in the file. For example, a civil sheet is denoted with a C.

Refer to Table 2-1: Level 1 Feature Group Designators for discipline designators.

_	95003001	-	1	C	GRA	-	1	01

2.5.3.5 Level 2 Discipline Designator

This optional component further identifies the subject matter. For example, a civil grading sheet is denoted with a **GRA**, while a demolition plan is denoted with a **DMP**. These designators are not identified in any table included in this document.

Refer to Table 2-8: Sheet Type Designators for level 2 discipline designators.

_	95003001	-	1	C	GRA	-	1	01

2.5.3.6 Sheet Type Designator

This is a single-digit sheet type designator. The 1 in this example denotes a Plan Sheet (horizontal views).

Refer to Table 2-8: Sheet Type Designators for a list of sheet type designators.

_	95003001	-	1	C	GRA	-	1	01

2.5.3.7 Sheet Sequence Number

This component identifies sheet sequence in the set. The example denotes the first sheet of the 90 percent submission for project 95003001, Volume 1, Civil Grading Plan.

_	95003001	-	1	C	GRA	-	1	01

2.5.4 Additional Designators (Optional)

If additional designators or levels are needed, a request may be submitted to the DEN BIM team on a project by project basis.

2.5.5 DEN File Naming Components – Identifiers

The following tables provide the identifiers and their descriptions for use in naming project plan files and external reference files.

Table 2-8: Sheet Type Designators

Sheet Type	Description	Sheet Type	Description
0	General	5	Details (Misc.)
1	Plans	6	Schedules/Diagrams/Qtys Table
2	Elevations/Profiles	7	3D Representations
3	Sections/Cross Sections	8	User-Defined
4	Large-Scale Views/Vicinity Maps	9	User-Defined

2.5.6 Sheet Numbering and Naming

Sheet numbering and naming shall be per NCS standards.

2.5.7 Titleblock Information

Information in sheet titleblocks must be complete, correct, and current for all sheet files.

2.6 Annotation

2.6.1 Introduction

The following section covers annotating sheet drawings for documentation to DEN.

2.6.2 Standard Text and Dimension Styles

DEN uses AutoCAD default text and dimension styles. All text shall be UPPERCASE and easily readable on half-size prints. Plotted text heights are provided in table below.

Table 2-9: DEN Text Heights

Height	Item
3/32"	Normal Text, Notes, Dimensions
1/8"	Sub-Headings
5/32"	Headings

2.6.3 Standard Symbols Palette

The DEN Tool Palette includes standard blocks, symbols, linetypes, hatch patterns, etc. according to DEN legacy standards. Where linetypes, hatch patterns, etc. are not specified, use standard AutoCAD linetypes, hatch patterns, etc. DEN Palettes, e.g., the *DIA Standard Symbols* Palette Group and others, are loaded from the DEN template file. The symbols are arranged by a major discipline. The individual discipline palettes are arranged into tabs located on the side of the tool palette.

The *DIA Master Symbols* drawing is not to be modified unless permission is received from the DEN BIM Manager.

Whenever possible, project must use the elements provided in the tool palette in the creation of all drawings.

2.6.4 Standard Linetypes, Colors, Lineweights

DEN uses AutoCAD default line types and hatch styles unless otherwise required and specified by FAA requirements.

DEN uses the following line weights on drawings unless otherwise required and specified by the FAA requirements.

Table 2-10: Standard Linetypes, Colors, Lineweights, and Hatch Styles

Color	AutoCAD Number	Pen #	Inches	MM
Red	1	7	0.03	0.7
Yellow	2	7	0.02	0.5
Green	3	7	0.02	0.5
Cyan	4	7	0.015	0.35
Blue	5	7	0.015	0.35
Magenta	6	7	0.01	0.25
Black/White	7	7	0.01	0.25
Peach	11	7	0.05	1.2
Gray	253	253	0.01	0.25
Light Gray	254	254	0.01	0.25
Brown	12	7	0.005	0.127

2.6.5 Civil 3D Labels

Automatic labeling capabilities are found throughout Civil 3D. Label Styles control the behavior and content of these labels. Civil 3D Label Styles and Settings are located under the Settings Tab within the Toolspace palette. The Civil 3D drawing template, DEN Civil 3D Master Template.dwt, contains the Label Styles for use on DEN projects.

To view a list of just label styles, choose the drop-down list on the Settings tab of the Toolspace and select Labels Only View.

2.7 Quality Assurance/Quality Control and Best Practices

2.7.1 Introduction

This section covers Quality Assurance/Quality Control (QAQC) and DEN best practices for Civil 3D procedures.

2.7.2 Civil 3D Best Practices

2.7.2.1 Miscellaneous

A. In Profile Views, do not use a clipped grid.
B. For Pipes in Profiles, use the boundary option rather than the model option.

C. Label Styles- Create a No Label style to enable the option of turning off labels without deleting the label.
D. For Point Label Styles put all text components in a single component instead of separate components.
E. Surfaces
F. Deliver TIN surfaces to DEN, not DEM surface
G. Use external ASCII point files rather than point objects in the drawing.
H. Create a surface snapshot after sampling the point file. FIle size increases but the rebuild times improve.
I. Adding contour data- Understand the settings for Minimizing Flat Areas.
J. Avoid Surface Editing- Filling gaps and adding points is much faster than swapping edges. In addition, you have no evidence for what has been altered.
K. Minimize points used to create surfaces.
L. Surface Simplification is an Editing tool that decimates points without affecting accuracy.
M. Display of triangles and contours can slow down the display. Minimize displayed data when appropriate.
N. Use an outer boundary to reduce data processed in the surface.
O. Use Data Clipping instead of Masking the surface.
P. Cropped Surfaces are linked to a parent surface but process a smaller portion of the data.
Q. Query GIS Data to create a surface.

2.7.2.2 Corridor Models

A. In Subassembly styles, use solid fills instead of hatch patterns.
B. Turn off Rebuild Automatic.
C. Isolate Regions so you are not processing the entire corridor.
D. Reduce Cross Sections in the corridor drawing during preliminary design.
E. Externally references the corridor into a separate drawing and sample sections in that drawing. Use a data shortcut for the alignment.

2.7.2.3 AutoCAD Best Practices

A. Layoutregenctl is best set to 1.
B. Proxy Graphics shall be turned off until you are ready to share your drawing with other non-civil 3D users.
C. Turn off Tool Tips and Event Viewer if not needed.

2.7.2.4 Data Management Methods

A. Using one drawing is best suited for small projects.
B. Using Data Shortcuts is best for sharing data across multiple drawings.
C. Using Data Management Server applies the same principals as Data Shortcuts but has the requirement of a Server Component that may be undesirable for teams without adequate IT support.

2.7.2.5 Stationing

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

Table 2-11: Stationing Scale

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

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

2.7.2.6 Autodesk Drawing Migration Tool

The Autodesk Drawing Migration Tool can be used to validate the quality and completeness of the etransmit created by Civil 3D. The tool can be found in the Autodesk App store. The tool must be used in conjunction with Autodesk Desktop Connector (version 16.5.0.2083 or later). It is recommended to run the tool to determine if all references have been included. If the tool finds issues investigate the missing references (downloadable report available in csv format) to diagnose and resolve file issues.

2.7.2.7 Drawing Standards Check

The DEN Drawing Standards file (CADD Check Template) has been included in the DEN CADD Standard to ensure conformance with DEN CADD Procedures. All CADD production drawings must be checked for conformance prior to submission to DEN.

2.7.2.8 Use Drawing Cleanup Tools

As a best practice, use the Drawing Cleanup Tools to check and correct drafting errors. Following the rules of geometry for Topologies will give you the best results. You can perform the following cleanup actions:

A. Delete duplicate objects
B. Erase short objects
C. Break crossing objects
D. Extend undershoots
E. Extend to apparent intersections
F. Snap clustered nodes
G. Dissolve pseudo nodes
H. Erase dangling objects (overshoots)
I. Simplify objects
J. Delete zero-length objects
K. Weed 3D polyline vertices

2.7.3 Geometry

Generate all geometry in AutoCAD Civil 3D using 3D Polylines, Lines, Arcs, Polylines, and Blocks as required.

Data that represents objects that are normally not modeled as AEC Objects using Civil 3D commands. These objects could be existing utilities, easements, fences, parking spaces, or light poles for example.

2.7.4 Model Reviews

Model Reviews will be conducted by the DEN BIM staff at each submittal and will be returned within 10 business days of the submission, unless noted otherwise in the BIMPxP.

2.7.4.1 Model Review Form

The DEN Civil 3D Model Review form follows the general format of the DFI DSM document. Each line item is identified and assigned a grade. Critical Items are identified in the Model Review form.

2.7.4.2 Line Item Scoring

Table 2-12: Line Item Scoring

P	Pass	Standards are being followed	100%
C	Caution	Standards are mostly followed, with some errors	50%
F	Fail	Standards are mostly not followed	0%

Note: Starting with 90 percent model review and later, no cautions will be issued, either the requirement is being followed completely, or it is a Fail

2.7.4.3 Scoring, Tracking, and Reporting

To pass a DEN BIM Model Review and be in conformance with DEN requirements, each file must meet 100 percent of the identified Critical line items and a 90 percent Overall score. Anything less is considered to have failed to meet DEN requirements.

Each submission is tracked and reported to DEN project managers (PMs) and leadership on performance.

Model scores for a project or submission are not available to non-DEN staff except the consultant performing the work and any lead consultant they may be sub-consultant to.

2.7.4.4 Critical Items

Of the 41 line items in the C3D model review form, 27 are Critical items. A Caution or Fail on a Critical item is a fail for the submission.

2.7.4.5 Resubmittal

Resubmittal of CAD within 5 working days of receipt of the Model Review may be reviewed to supersede the prior submittal score. Original grades will continue to be tracked for trend analysis.

2.7.4.6 Interim Reviews

A consultant may at any time request an interim review of their files, interim review scores are not tracked by DEN and are for the consultant's benefit only.

2.7.4.7 Failure to Submit

Failure to submit content as part of a project submission will result in a grade of 0 (zero) percent for that project submission.

2.7.4.8 Model Review Form

The current Model Review Form can be found within the DEN Kit of Parts for reference.

End of Chapter

This page is intentionally blank.

Chapter 3 - Facilities BIM Requirements

3.0 Introduction and Overview

3.0.1 Introduction

DEN uses Autodesk Revit® software as the Building Information Modeling (BIM) solution for building and facilities design and documentation. This information is for anyone authoring Revit® models for DEN. This includes DEN staff, as well as external service providers. The reader is assumed to have a basic knowledge of Revit® and the workflows and terms common to the industry. This document presents baseline BIM requirements for all new facilities and facility renovation projects at DEN.

3.0.1.1 Requirements

All consultants and sub-consultants (architecture, structure, MEP, fire protection, BHS, etc.) will create a BIM model and produce 2D construction documents natively using Autodesk Revit (current approved version). The Revit design files shall be 100 percent Revit, and all designed equipment and systems shall be modeled. The Revit file shall not contain any imported or linked AutoCAD, Bentley, or other CAD or graphic files. This file shall include the model, families, and 2D documentation.

3.0.1.2 Target Audience

This document is intended for:

A. External service providers (design and construction) supplying BIM Data to DEN
B. DEN executives and Project Managers

3.0.1.3 Proposing Revisions

This standard is intended to be updated and enhanced as deemed necessary by DEN over time. Recommended additions and suggested changes are to be directed to DEN Asset Management.

3.0.2 DEN Common Data Environment

DEN uses the Autodesk Construction Cloud (ACC) environment as its Common Data Environment (CDE) for model information.

The Facilities Project Information models (PIMs) shall be live in a work-in-progress state on the DEN CDE set up for the PIMs and pushed to a shared state (Published) on a weekly basis. The published models shall include a published 3D view for each phase of the project that includes all linked models, as well as a complete set of drawing Sheets from the most recent package submittal. After 100% submittal, all Publishes should include all 100% CD drawings with any revisions.

PIMs shall be posted to the CDE in a published state for each deliverable package.

PIM archiving is handled automatically by the CDE.

3.1 Revit BIM Setup

This section discusses the initial setup of a DEN Revit BIM file utilizing DEN base files and the DEN Kit of Parts. It also covers file naming, phasing, worksets, use of linked file content, and other general setup standards.

3.1.1 DEN Kit of Parts (BIM)

The DEN BIM Kit of Parts holds the DEN-generated BIM library. This content is the baseline from which all projects will begin. As project-specific content is developed, reviewed, and accepted, this content will be added to the Kit of Parts. The library structure is defined with Custom folders and folders with a CSI MasterFormat naming convention.

A. 01_Reference – Repository for BIM and general Reference Materials
    a. 00_DEN
    b. 01_Masterformat
    c. 02_UNIFORMAT
    d. Etc.
B. 02_Templates –Templates for Revit and Civil 3D
    e. Civil_3D
    f. Revit_Family_Templates
C. 03_Libraries
    g. 01_Containers – Revit container files that hold libraries of system families such as walls, floors, ceilings, roofs, etc.
    h. 02_Details
    i. 03_Titleblocks – DEN titleblocks for Revit and Civil 3D
    j. 04_Hatch_Patterns- .pat and .dxf files for Civil 3D
    k. 05_Revit_Families
D. 04_Support
    l. 01_Shared Parameters – DEN Revit Shared Parameter file
    m. 02_Keynotes – DEN Revit Keynote file
    n. 03_ImportLineweightsDWG – Civil 3D lineweights
    o. 04_ExportLayersDWG – Civil 3D layer info
E. 05_Scripts

3.1.2 Template Files

All projects must use the most current DEN BIM templates. These are Revit project files, not Revit template files, for which cannot have worksets created as standard with a single template for all disciplines. These are available in the standard content, 02_Templates, folder: DEN_Revit_Template_YYYY.rvt.

Inherent in the Revit project template files are graphic standards and organization of the views, legends, schedules, and sheets.

Consistency in Worksets, Phases, Design Options, and other built-in characteristics of organization and use has a great impact on the ability for diverse teams to be able to effectively utilize the model.

Because the models will become part of the facilities, maintenance, and operations tools, it is essential that the base set of standards established by the DEN templates be maintained through the design and construction process.

3.1.3 Naming: Revit Project Files

This section outlines the DEN naming convention for Revit project (.RVT) file naming. Naming is divided and group formatted into three sections as follows:

A. <Building Identifier>_<BIM team/model identifier>_<DEN Project Identifier>_Central.rvt
B. TML_DEN-A_20110930_Central.rvt

Fields within the general categories are delimited with a hyphen if needed.

3.1.3.1 Building Identifier (assigned by DEN)

<Bldg ID Abbreviation>, e.g., TML (Terminal)

3.1.3.2 BIM Team and Model Identifier

<Office of Origin>< dash ><Discipline>, e.g., DEN-A (Denver International Airport, Architecture)

Note: Refer to the Office of Origin document in Kit of Parts for list of assigned abbreviations. Additional abbreviation may be assigned by DEN on request

3.1.3.3 DEN Project Identifier

A. <DEN Project Number & Task Number>, e.g., 20110930 – If project number is not available, consult DEN BIM Staff.
B. TML_DEN-A_20110930_Central.rvt

3.1.4 Phasing

Phases shall be set up as coordinated with DEN BIM and must be uniform across all models within the project. Most projects will have an Existing phase and a single new phase for design work.

If the project has multiple phases or packages, the model shall accurately reflect those phases or packages in phase naming and phased model content as coordinated with the DEN DFI team.

3.1.5 Worksets

Worksets are Revit's way of allowing multiple people to work on the same project. All DEN project files must have worksharing enabled.

3.1.5.1 General Standards

The BIM Leader for the project is responsible for creating and maintaining the worksets of the project. Do NOT use worksets like layers. For new content created within an existing DEN base model, the consultant shall create separate Worksets to allow for the definition and separation of new content from existing.

3.1.5.2 Standard Worksets

All workset enabled projects will have at least the default worksets Shared Levels and Grids and Workset 1 which shall be renamed as appropriate for the primary UNIFORMAT 2010 Level 2 group below. As project complexity increases, worksets are added from the following list. This list is not exclusive. Projects may have other worksets, but at the end of the project, the models must be submitted using the workset names and guidelines below.

A. Primary List
    a. A10 Foundations
    b. B10 Superstructure
    c. B20 Exterior Closure
    d. B30 Roofing
    e. C10 Interior Construction
    f. C20 Staircases
    g. C30 Interior Finishes
    h. D10 Conveying systems
    i. D20 Plumbing
    j. D30 HVAC
    k. D40 Fire Protection
    l. D50 Electrical
    m. E10 Equipment
    n. E20 Furnishings
    o. F10 Special Constructions
    p. G10 Site
B. _LINKED CAD

This workset will be created OFF by default in all views and is never set as the active workset. Link a DWG to all views, and then change its property to assign it to this workset. Use Visibility Graphics as needed per view to turn this workset on then isolate the individual drawing using the Imported Categories tab.

C. _COORD-[DISCIPLINE]

This workset shall contain elements that are contained in the model solely for spatial coordination, system connectivity or that are copy monitored, e.g., Mechanical equipment is copy/monitored to an electrical model for system connectivity purposes, or light families that exist in architecture for coordination. These worksets may only be added with DEN approval.

D. _LR<DISCIPLINE INITIAL>- For Linked Revit Files.

Create one workset per linked Revit model discipline. These worksets will appear in ALL workset files where another Revit file is linked. This allows users to use Visibility Graphics to turn off a linked Revit model or to use the worksets dialog box to set this to Opened=No, e.g., _LR<DISCIPLINE> such as _LRA for Architecture, _LRS for structure etc.

3.1.6 Correct Project Information

Project Information must be completed as it becomes available, including: consultant name and address, design contract number, project issue date, package submittal, project address, and project name.

3.1.7 CAD and Linked Files

3.1.7.1 Use of CAD Files and other Non-native File Formats

If CAD files or other non-native file formats (e.g. image files, .pdfs, .skp, etc.) are needed in a linked or imported use case, approval must be received from the DEN BIM Manager. When approved, CAD files must be linked. Linked CAD files must always be placed on the correct Workset _LINKED CAD.

CAD files must never be imported or exploded.

3.1.7.2 Linked Revit Files

Linked Revit files must be linked and located using Shared Coordinates, must be pinned in place, and must be placed on the corresponding Worksets. Linked Revit files shall be linked as Overlays using Relative pathing.

3.1.8 Design Options

Design Options allow the creation of studies of multiple alternates within the Revit file.

Unless specifically approved by DEN, design options shall be eliminated from the model file prior to submission at 90 percent submittals or later.

3.1.9 Shared Coordinates

The current Shared Coordinate system is known as LDP 2018. All projects must use the DEN LDP 2018 coordinate system.

3.1.10 Model Levels

Levels are to be restricted to occupiable floor levels and shall be labeled numerically and in ALL CAPS, e.g., LEVEL 01, LEVEL 02, LEVEL 03.

When using levels that exist in provided DEN models, match the naming of those levels.

If surveyed elevations do not match the elevation of existing levels in the model, contact DEN for direction.

Levels shall not be created for intermediate spaces, such as landings, or delineation of upper limits, such as the top of the parapet. Reference Planes and Elevation annotation may be used for such conditions. New levels must be approved by DEN.

3.1.11 Model Delivery

Models must be delivered at each submittal at the same time as the rest of the contract deliverables for that package. Models shall be delivered through the DEN CDE as a Transmittal sent to the DEN DFI BIM Project Manager and the DEN Project Manager. Include a BIM Data Transmittal containing a list of files and a quality assurance statement indicating that the deliverables are in compliance with DEN's standards. A copy of the Transmittal must be submitted as well through the appropriate DEN System of Record, typically Unifier or Aconex.

3.1.12 Model Reviews

Model Reviews will be conducted by the DEN BIM staff at each submittal and will be returned within 10 business days of receipt, unless agreed otherwise in the BIMPxP. A sample copy of the Model Review form can be found in the Kit of Parts in 01_Reference>00_DEN.

3.1.12.1 Model Review Form

The DEN Model Review form follows the general format of the DFI DSM document. Each line item is identified and assigned a grade. Critical Items are identified in the Model Review form.

3.1.12.2 Line Item Scoring

Table 3-1: Line Item Scoring

P	Pass	Standards are being followed	100%
C	Caution	Standards are mostly followed with some errors	50%
F	Fail	Standards are mostly not followed	0%

Note: Starting at the 90 percent model review and later, no cautions will be issued, either the requirement is being followed completely, or it is a Fail.

3.1.12.3 Scoring, Tracking, and Reporting

To pass a DEN BIM Model Review and be in conformance with DEN requirements, each file must meet 100 percent of the identified Critical line items and a 90 percent Overall score. Anything less is considered to have failed to meet DEN requirements.

Each submission is tracked and reported to DEN PMs and leadership on performance.

Model scores for a project or submission are not available to non-DEN staff except the consultant performing the work and any lead consultant they may be sub-consultant to.

3.1.12.4 Critical Items

Of the 47 line items in the BIM model review form, 18 are Critical items. A Caution or Fail on a Critical item is a fail for the submission. Those Critical items are listed below with line item references to the BIM Model Review document.

Table 3-2: Model Review Critical Items

Item	Title
1.1	DEN Template Used
1.3	Phasing
1.6	Approved CAD files must be LINKED; never imported or exploded
1.11	Project Location - LDP Coordinates
1.12	Model Levels
1.13	Model Delivered On-Time via DEN CDE
2.1	Model all designed elements
2.2	Existing Assets Modeled to LOD 200
2.3	All modeled elements tagged correctly Door number/mark information correct
2.5	Meets Revit Family File naming conventions
2.6	No Unapproved In-Place Models
2.7	No unapproved Generic Models
2.10	All rooms/space placed/Enclosed/numbered -OR- ASSET LOCATION data complete
3.1	All Assets Identified
3.2	Existing Assets Identified & Information Complete
3.3	Asset Design Information Complete
3.4	Asset Sheet
4.4	Schedules natively generated (no drafting views, links, imports, or detail groups)

3.1.12.5 Review Responses

An in-line response to all failed line items is required within five working days from the issuance of the model review.

3.1.12.6 Resubmittal

Resubmittal of files within 10 working days of receipt of the Model Review may be reviewed to supersede the prior submittal score. Original grades will continue to be tracked for trend analysis.

3.1.12.7 Interim Reviews

A consultant may at any time request an interim review of their files, interim review scores are not tracked by DEN in any way and are for the consultant's benefit only. DEN may also perform an interim review at any time to ensure quality and data integrity. Interim reviews do not require a response from the project team unless specifically requested by DEN.

3.1.12.8 Failure to Submit

Failure to submit content as part of a project submission will result in a grade of 0 (zero) percent for that project submission.

3.1.13 Project Termination and Closeout

In the event a project is terminated prior to completion, all models shall be turned over to DEN with all content in full compliance with the DFI DSM as appropriate for the project phase.

3.2 Modeling Standards

3.2.1 Introduction

This section covers basic modeling standards for all DEN Revit projects, including model accuracy, model content, and other modeling requirements.

3.2.2 Model Accuracy and Tolerances

Models shall include all appropriate dimensioning as needed for design intent, analysis, and construction. Level of detail and included model elements are provided in the Information Exchange Worksheet. Design documents shall be accurate to +/- [1/16”] of design size and location unless otherwise dictated by the element in question needing a higher level of accuracy for design or placement.

3.2.3 Modeling Guidelines and Requirements – Design

3.2.3.1 Design Team

All consultants and sub-consultants (architecture, structure, MEP, fire protection, BHS, etc.) will create a BIM model and produce 2D construction documents natively using Autodesk Revit (current approved version). The Revit design files shall be 100 percent Revit, and all designed equipment and systems shall be modeled. The Revit file shall not contain any imported or linked AutoCAD, Bentley, or other CAD or graphic files. This file shall include the model, families, and 2D documentation. Civil design will be designed and executed in Autodesk Civil 3D.

3.2.3.2 Extent of Model

The Building Information Model (in plan view) shall typically extend to five feet beyond the exterior walls of the buildings or rooms being modeled. Vertically, the model shall extend from the lowest extent of the rooms or buildings, which may include foundations or lowest underground utility up through (and including) the roof of the topmost floor or highest overhead utility or adjacent structure. To the extent that the scope includes building systems, those systems will be included to the full horizontal and vertical extents of the model, including underground utilities and rooftop-mounted items.

Model scope also includes relevant faces/masses of buildings and encroachment zones (FAA Part 7460) adjacent or across the street. Existing conditions will be modeled at level 300 when directly adjacent (within 5') to new construction. Otherwise, existing conditions shall be modeled as level 200.

3.2.4 Existing Conditions

3.2.4.1 Existing Model

In the event of a renovation or addition, a base model of the existing facility based on prior record documents may be available on request. When possible, DEN will provide a project model using the DEN template of the project scope sliced from the DEN facility model for project use.

3.2.4.2 Laser Scanning

High-definition laser scanning and existing conditions surveying may be available from the DEN survey services group on request, given enough lead time. When LIDAR scans are delivered to DEN, they shall be delivered in a format readable by the most current version of Autodesk ReCap. Laser scans delivered to DEN shall be broken up into files no larger than a single mod of a single level. Requests for exceptions shall be submitted to the DEN DFI team.

3.2.4.3 Existing Assets

Any existing equipment that falls under the Asset Types identified in Appendix A that is being either connected to or demolished as part of a project scope must be modeled to level 200 and identified as required in section 3.3.4 Asset Data.

Existing Assets that are being demolished shall be identified using the schedule ASSET IDENTIFICATION- *PHASE NAME* DEMO and included on a sheet in the demolition drawings for that discipline, with the schedule being filled out as completely as possible.

3.2.5 Systems Modeled and Level of Development

The minimum level of detail defined for elements in the Design models shall be as set by the DEN BIM LoD Matrix in Appendix D except as amended by approved attachment to the BIMPxP. LoD shall be as defined by the 2021 BIM Forum LoD Specification.

3.2.5.1 General – Applicable to All Disciplines

A. All equipment is to be modeled as solid objects to their overall height, width, and depth and Level of Detail as outlined in, “BIM Matrix Worksheet and LoD Definitions.”
B. All designed elements shall be included as fully connected and closed systems.
C. No-fly and access zones around equipment above control panels shall be modeled as 50 percent transparent solids for access issues, code issues, and/or constructability.
D. MEP Spaces will be modeled as coordinated with Architectural Rooms.
E. Piping and Conduit 3/4 inch or greater shall be modeled, and smaller piping or conduit in ganged runs of three or more shall be modeled as a mass or as piping or conduit.
F. Fire Alarm Zones, Fire Sprinkler Zones, and Communications Speaker zones shall be modeled as solid, transparent Revit Masses with appropriate asset information assigned.
G. Signage modeling requirements in the BIM Model shall be limited to Way Finding and Room Identification required by Code.
H. Life safety – Identify UL rating and Fire Ratings of doors, walls, and enclosures, and identify fire stairs.

3.2.5.2 Diagrams

A. Electrical One-Lines shall be drafted in the Electrical Revit model on drafting views (scale 12"=1'-0") and placed on sheets using the one-line detail families provided in the DEN template. Existing one-lines are available in the DEN Electrical facility model.
B. Mechanical and Plumbing Diagrams shall be created in Revit. Use the diagrams provided in the DEN Master Diagram models as the starting point for all system diagrams.

3.2.6 Tagging

3.2.6.1 Model Content Tagging

All modeled elements must be identified using Revit’s built-in tagging functionality. Use of the Text tool to identify rooms, doors, walls, pipes, ducts, equipment, etc., is not permitted.

Tags and Symbols approved by DEN are available in all templates and the Kit of Parts and can be found in the legend: SYMBOLS.

3.2.7 Content and Family Library

3.2.7.1 Model Content from DEN Library

Revit family content from the DEN Kit of Parts shall be used whenever possible.

3.2.7.2 Outside Content Sources

Content from non-DEN sources may only be utilized with prior review and approval from the DEN DFI Team.

3.2.7.3 Proposed Content Guidelines

If new families are needed, the design team shall create them from the family templates in the DEN Kit of Parts and adhere to the following guidelines:

A. Simple geometry meets design intent and spatial coordination needs.
B. Dimensions shall be flexible and parametric.
C. Clearances.
D. Symbolic lines in plan/rcp.
E. System connections are included and flexible in placement and size.
F. Flexible without being complicated.
G. No nested/grouped geometry or content.
H. The proposed content must be named according to the DEN Family Naming requirements with an additional prefix of “NA_.” Incorrectly named content will not be reviewed.

3.2.7.4 Proposed Content Submittal

The proposed content must be submitted to DEN for approval as a single .zip file, along with a spreadsheet listing the family name and justification for creation. The proposed content must be submitted no less than two weeks before each package submittal.

3.2.7.5 Family Naming

This section outlines the naming format for DEN Revit family files. Naming is divided and formatted into 4 sections as follows:

<Origin><underscore><Annotation><underscore><CSI Identifier><underscore><Asset Type><dash> <Description>

A. Origin: 3 Characters (Required)

   Designator for author of the family. All families from DEN Kit of Parts shall be DEN. Additional assigned designators are listed in the Kit of Parts in 01_Reference\00_DEN. Further designators or adjustments may be requested from DEN DFI.

B. Annotation: 2 Characters (Required for Annotations, Detail Items, and Profiles Only)

   Designator for elements that are not three dimensional. If the Family is an Annotation Symbol, Detail Item, or Profile then add the identifier below as appropriate.

   TB – Titleblocks

   TG – Tags

   SY – Symbols

   AN – Other Annotation families

DT – Detail Items

PR – Profiles

For other Categories, omit this designator and the preceding underscore shall be omitted.

C. CSI Identifier: 6 Digits (Required)

The DEN standard Spec sections CSI 2018 format 6-digit identifier is used, no spaces.

a. 08 71 13 Automatic Door Operators = 087113

For conditions where conflicts occur, just first two characters are significant. For example, a wood door (081416) in hollow metal frame (081113) leads to just 080000.

Annotation elements not associated to a CSI specification shall use 000000.

D. Asset Type: 6 Characters, ALL CAPS (Required)

For Assets, this field is Required and shall indicate the Asset Type abbreviation, refer to Appendix A- Asset Types. For non-Assets this field and the preceding underscore shall be omitted.

E. Description: 18 Characters Max, CamelCase (Required)

General description of the family.

Do not use spaces, special characters, or dimensions. Dimensions should be identified in the Family Type when needed.

Manufacturer or model number is not allowed in family or type naming, e.g., DEN_087113_DOORAU-InteriorSlidingDoorMtlFrame.rfa

3.2.8 In-Place Families

In-Place Families are not permitted except with prior approval from DEN BIM. In-Place families, when permitted, must be named using the DEN family naming convention with an initial prefix of IP-. Existing equipment to be removed may be modeled schematically as In-Place families.

3.2.9 Generic Models

Generic Model category families are not permitted except with prior approval from DEN BIM. Generic Model types are permissible for Escalators and Passenger Boarding Bridges.

3.2.10 Systems and Connectivity

All designed elements shall be included as fully connected and closed systems using the built-in System tools and System Browser in the required version of Autodesk Revit. All parts of a system must also have the *System* parameter populated with the correct system identifier.

As electrical circuiting must be done in one phase if a project has multiple phases, the electrical circuiting should be completed in the final phase of the project. The electrical designer may also propose alternate approaches for DEN consideration.

3.2.11 Model Groups

Model groups should be avoided and must be ungrouped for model submissions at 90 percent and later.

3.2.12 Rooms, Spaces, and Doors

3.2.12.1 Room and Space Placement

All areas within the project design scope shall have Rooms in the Architecture models and Spaces in other discipline models placed, enclosed, and numbered per DSM requirements. Disciplines other than architecture may forego placing Rooms or Spaces in their model if they meet two conditions. First, rooms or spaces in another project

model must be shown, tagged, and identified correctly in model views and on sheets (no plain text in place of Room Tags), AND any Assets in that discipline's model must have the ASSET_LOCATION parameter filled out completely and accurately.

If a project has multiple phases, the final phase of the project shall include all of the new rooms for the project, including new rooms that were created on previous phases of the project and existing rooms to remain in the project scope area.

All rooms must identify Number, Name, Security level (Public, Sterile, Secure), and Occupancy Type.

3.2.12.2 Room and Space Numbering

Room and door identification must be coordinated to assure maximum compatibility with all downstream DEN uses including, Maximo, Public Safety, and GIS applications. Each of the values illustrated below will be a separate parameter that may be modified in Revit. Proposed Room numbers will be reviewed at each submittal, starting at 30%, and comments must be incorporated into the project model and documents.

<Building><underscore><Level><underscore><Module and Direction Code><underscore><Room>

A. Building – Three- four-character designator of the building, assigned by DEN. e.g., TML
B. Level – Two-digit indicator of the level assigned by DEN. e.g., 02
C. Module – Two-character designator of the building module and direction, e.g., 3W is module 3 West
D. Room – Three- four-character rooms are numbered clockwise within a single module as established by the Building Module/Direction outlined above. Room Codes will be three digits except as noted below.

Elevators, stairs, and other vertical shafts shall have a room created at each floor level. Instead of a three-digit room code, stairs, elevators, corridors, mechanical shafts, and gate areas will have a prefix noted below and then a two-digit room number. These must be coordinated with existing room numbers for the building, level, and module.

Table 3-3: Codes for Specialty Areas within Rooms

Code	Area Type	Code	Area Type
CR	Corridor	RF	Roof
EL	Elevator	ST	Stairs
GT	Gate Hold Room		

Where renovations occur, reuse the room number if the room configuration does not change. Do not reuse a room number if the configuration does change; instead, find the highest room number in that module and level, add ten, start numbering from there, and submit to DEN for review.

These parameters are built into the tags available in the DEN Revit Templates.

Example Room: ARF_03_5E_EL05- Aircraft Rescue and Firefighting, Level 03, in 5th module east, Elevator, room 05 in this building module/grid.

Stair numbering must be approved by DEN as numbering relates to other existing stairs.

Each Gate must have a dedicated Hold Room identified in the interior of the building. Hold Room numbering relates to the Gate the hold room serves; e.g., GT35 is for the Hold Room at Gate 35. Each Gate shall also have an exterior Gate area associated with it on the Apron and numbered accordingly. The mod location for the Gate Hold Room and the Gate Apron location may be different. e.g., CCA_02_4W_GT25 is the Hold Room, and CCA_01_5W_GT25 is the Apron location for Gate 25 on Concourse A.

Corridors and shafts shall be numbered sequentially, beginning at 01 in a clockwise manner, starting in the SW corner on a module-by-module basis.

New building models will require a new building designator to be assigned by the DFI Project Manager. The default module for the building shall be 1C. Additional Modules should be used if the size of the structure requires the floor plans to be separated onto multiple sheets. If this is necessary, consult the DFI Project Manager for direction.

3.2.12.3 Door Numbering

Door numbering shall match the number of the room being entered. Multiple doors to a room shall have an alphabetical suffix rotating clockwise from the lower left corner of the room.

Example Door: ARF_03_5E_EL05B

Same room, second door in that room. If more than one door is in a room, the first room will be A.

3.2.12.4 Areas and Spaces

Areas and Spaces will use the same naming and numbering convention as Rooms unless created for special purposes such as code/egress diagrams, leasing areas, or take-offs of spatial regions per project.

Plenum Spaces will be defined by the inclusion of the prefix *P* before the name. Plenum spaces that cross over multiple rooms will take the name of the room that the space first crosses over in the lower left-hand corner.

3.2.13 BIM Spatial Coordination Procedure Outline – Design Model

3.2.13.1 Design Team

The Design team will provide a Revit model as a 3D background model or, upon request, export 2D drawings from the model into an AutoCAD DWG format to be used by Contractor, structural, MEP+FP, FA, and special consultants.

2D and 3D updated backgrounds will be posted regularly as per the BIMPxP.

3.2.13.2 Represented in these Assigned Colors as a Guideline

Recommended trade colors for Spatial Coordination:

A. Fire Protection: red
B. Plumbing: magenta
C. HVAC Duct: blue
D. HVAC Pipe: lime green
E. Electrical: cyan
F. Pneumatic Tube: dark green
G. Concrete: grey
H. Structural Steel: maroon
I. Architectural: white

3.2.13.3 Spatial Coordination Procedure

Design Consultants shall be prepared to participate in regular coordination meetings beginning prior to 60 percent design deliverable to resolve model conflicts. A schedule of those meetings shall be submitted to DEN for review and acceptance prior to the 60 percent of design deliverables.

A. The Design Team will provide a clash detection report in advance of each coordination meeting. The reports will be generated using a platform and format proposed by the Design Team and approved by DEN.

B. The clash reports will be run for all disciplines. A clash analysis report will be generated by the Design BIM Coordinator that involves inspection of each individual clash and documentation by saving the appropriate viewpoints.
C. Design Consultants shall review the clash detection report prior to the weekly meeting and arrive prepared to address the unresolved clashes in a constructive manner.
D. Clashes shall be kept to a minimum and will be evaluated for acceptable tolerance by DEN.
E. Design Consultants are required to post updated models to the DEN-approved project collaboration site at least once per week, prior to the clash detection analysis run by the Design BIM lead as per the BIMPxP.
F. Design Consultants are required to collaborate with each other consultant to resolve basic clashes outside of the weekly Coordination meetings. The weekly Coordination meetings are held to address difficult areas that are not able to be coordinated between the multiple disciplines themselves.
G. Models that are to be used for Clash Detection shall be exported from a 3D Export view in each discipline model showing all content to be coordinated and show the project in its final state when phasing is used.
H. Coordination model shall include, at a minimum: The modeling elements per modeling requirements specified by this document and the LoD.
I. Resolutions to BIM clashes must be incorporated into the model in less than 10 business days.

3.2.13.4 Model Management

Design Consultants shall provide updates/maintenance of Electronic Data/3D Model throughout construction that modify the design intent and/or special coordination to the design model to include but not limited to:

A. Incorporation of RFIs
B. Incorporation of ASIs, CDs, CCDs, MODs
C. Submittal comments and revisions on approved shop drawings.
D. Implementation of modifications to the project Building Information Models due to RFI responses will be the responsibility of the Model Element Author in primary control of the affected Model Element at the RFIs initiation.

3.2.14 Reconciled Model

Once the Contractor model is completely coordinated, Design Team shall reconcile differences between the Contractor and Design models as they relate to DEN identified Assets under the guidance of the DEN BIM Manager. Refer to the “Standards and Criteria DSM – Chapter 9: Record Documents” for additional requirements that should be incorporated into the Reconciled Model.

3.3 BIM Data and Parameters

3.3.1 BIM Data

This section covers the required BIM and Asset Management data. The collection of asset data in BIM by the appropriate parties throughout the project process is critical to the success of the BIM, Asset Management, and Maintenance programs at DEN.

3.3.2 Shared Parameters

DEN maintains a master shared parameter file for all projects. This is not contained in the shared Revit Content Library, but the parameters are available in the DEN templates. If new, shared parameters are required by a project, they must be approved by the DEN BIM manager in advance.

DEN maintains a single master Shared Parameters file; DEN_Shared Parameters.txt. It is in the 04_Support\02_Shared Parameters folder in the Kit of Parts.

Use of appropriate DEN Shared Parameters is CRITICAL to the Asset Management program. Failure to conform to these standards will result in automatic failure of a submittal review.

3.3.3 Asset Identification

Asset Data delivery and integrity are essential to the DEN Asset Management and maintenance programs.

3.3.3.1 Asset Identification and Types

What DEN defines as an Asset is broken down and specified by DEN Asset Type and DEN Functional Area in Appendix A- Asset Types. Assets must be identified by the 60 percent deliverable by using the _Asset Yes/NO and _Asset Yes/No – Mass – Zones schedules built into the DEN templates. In general, these asset types include but are not limited to:

A. Doors (Power Actuated and/or Overhead)
B. Baggage Handling Equipment
C. Electrical Equipment
D. Life Safety Systems/Zones
E. Mechanical Equipment
F. People Movers
G. Plumbing Equipment and Fixtures
H. Security Equipment
I. Existing Assets

3.3.4 Asset Data

Asset data is generated throughout the project process by multiple parties. When a party adds new data, they are also responsible for validating the existing data associated with that Asset. Below are the fields required for the successful population and execution of the DEN Asset Management program.

3.3.4.1 Asset Data – 60 Percent Design

By the 60 percent Deliverable, all DEN assets, new and existing within the scope of design and demolition, must be modeled and identified using the Asset Yes/No schedule and Asset Yes/No- Mass- Fire Alarm Zones.

3.3.4.2 Asset Data – 90 Percent Design

By the 90 percent Deliverable, all DEN assets, new and existing within the scope of design and demolition, must have the following information entered by the design team in the BIM model using the fields required in the DSM. The DEN template model has a sheet set up with an Asset schedule pre-placed on it. This must be filled in completely for submittals at 90% and beyond. Any modifications to the schedule formatting must be approved by DEN. This information must be maintained as current through the remainder of the project. This data can be checked in the Revit models using the DEN Revit template in the Schedule _Asset Data Checker- 03 DESIGN and _Asset Data Checker- 03 DESIGN-Zone Masses.

Table 3-4: Asset Data: 60 and 90 Percent Design

Data Type	Revit Attribute	Data Description
Mark	Mark	Asset equipment identifier per discipline DSMs including conveyances.
Asset Type	ASSET_ASSETTYPE	DEN Asset Type, e.g., TRANSFORMER. Refer to Appendix A- Asset Types.
Location	ASSET_LOCATION	Associated room/space number, e.g., CCA_01_1W_CR101*
Asset	ASSET	Indicating the element is an asset. If it is a DEN asset, set to **Yes**; otherwise, **No**.

**Asset locations that fall outside of defined Rooms shall be brought to DEN's attention for location assignment. e.g. located on roofs or outside of the building.*

3.3.4.3 Asset Data - Construction

During construction and prior to Substantial Completion, the installer is responsible for populating the following data for all Assets using the Autodesk Construction Cloud platform, as well as validating existing data.

Table 3-5: Asset Data: Administrative

Data Type	ACC Attribute	Data Description
Manufacturer	MANUFACTURER	Manufacturer of installed asset
Model	MODEL NUMBER	Model number of installed asset
Serial Number	Serial Number	Manufacturer serial number of asset
Purchase Price	PURCHASE PRICE	Asset purchase price, not installation cost
Install Date	Install Date	Actual installation date of asset (not facility activation date), e.g., 2/2/16.
Status	Status	This value should be updated to "Installed" as the Asset is installed
Warranty End Date	Warranty End Date	Date Warranty is set to expire
Vendor	VENDOR	Company that purchased the Asset on DEN's behalf e.g., ABC GENERAL CONTRACTING
Bar Code	Barcode	Asset Tag (QR Code) Number; labels provided by DEN

3.4 Views

3.4.1 Model Views

The following conventions apply to all views in the project regardless of the view type; plan section, legend, or schedule.

3.4.1.1 Original Views

Once section and elevation marks have started to be placed in the project, do not delete the original Level plan views. This is important as DEN utilizes the *Referenced From* parameter. Deleting the original views will create problems with this system.

3.4.1.2 Creating New Views

When creating a new view/sheet by duplicating or creating new from scratch, always open the view properties and fill in the element properties that are used by your project for view sorting and organization.

3.4.1.3 Level Names

Level Names, once set by the project BIM Lead, may not be changed. This means that the names that appear in elevations/sections shall not be changed.

3.4.1.4 Duplication of Section Mark Types

Section-Detail types may not be duplicated.

3.4.1.5 Duplication of Drafting View Types

Drafting view TYPES may be duplicated in a project to help organize 2D details in projects. In large projects, the view's browser driving parameters shall be used.

3.4.1.6 View Organization Parameters

Most view types (Plans, Sections, Elevations, Detail and Drafting views) have two custom parameters, Category, and Sub-Discipline, which are used with two default Revit view parameters, Discipline, and Associated Level, to sort and organize the default views provided in any template.

A. Discipline refers to the design discipline for the documents being generated, such as Architectural, Structural, Mechanical, Electrical, etc.

B. Category is used per the National CAD Standard sheet ordering system to group similar view types together, e.g., 100-PLANS, 150-RCP, 200-ELEVATIONS, 300-SECTIONS, 500-DETAILS, 900-3D, etc.
    a. Plans and RCP – For floor plans and reflected ceiling plans. Associated to a level.
    b. Elevations- Design elevations are intended to be used for color presentations. Sheet elevations are for construction documents.
    c. Sections and Detail Views – Created with the section tool. The type determines the look of the mark as well as where the view appears in the project browser.
    d. Drafting views- Used for generating standard 2D details that can be imported across projects.

C. Sub-Discipline- Sub Discipline is used by the project browser to organize the plan views into different categories based on how the view will be used in the project. Additional Sub Disciplines may be added for specific project needs.
    p. Design views- Used for Presentation views. May include color, shading/shadow, and other Conceptual and/or Schematic Design information.
    q. Export views- Set up for exporting to other formats.
    r. Sheet views- Make up the construction document set. They contain final annotation and dimensions.
    s. Working views- Used for day-to-day modeling. These views are never placed on sheets.
    t. Temporary working views- Generated to create a view at a different scale or visibility graphic settings when a working view is in use by another member of the team. If you create one of these views, it is their responsibility to delete it when you are through with it.

3.4.2 View Counts

Keep the number of views to a minimum. Delete old and unused views.

3.4.3 View Naming

All Views, Schedules, and Legends shall be named in ALL CAPS if going on sheets. Informational or working legends, which are not placed on sheets, are named in all lowercase letters.

3.4.3.1 Legends

Legends are broken into two general categories.

A. Notes Legends- Include General Notes and Code Analysis views.
B. Symbol Legends- Includes the list of DEN-approved default Fill Patterns and the DEN Symbols reference.

3.4.3.2 Schedules

Key in a schedule name indicates the scheduling of Revit Keys rather than building components.

3.4.4 Browser Organizations for Views

The DEN templates have six standard view organizations. Each organization definition sorts and/or filter views in the project browser. For example, in the 01 ALL organization, views are sorted first by Discipline, then by Category, Sub discipline, and then by their Associated Level.

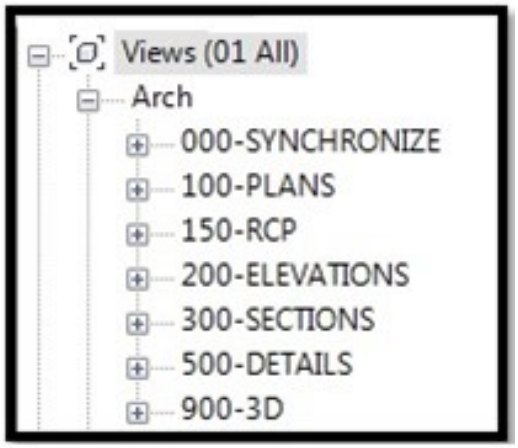

Figure 3-1: Browser Organization for Views

All views will be listed, and groups of view types are packaged together. A consultant could create a Sub Discipline called Schematic Presentation and place all the Schematic Design views into that package. Those views will remain with the project but will be separate from the rest of the DD and CD views.

3.4.4.1 Template Browser Organizations: DEN Standards (Numbered)

These are standard DEN browser organizations and shall not be modified or deleted.

A. 01 All- Views are ordered in a structure similar to the National CAD Standard
    a. Order: Discipline > Category > Sub discipline > Associated Level
    b. Filter: None Applied
B. 02 Design Views
    a. Order: Discipline > Category > Sub discipline > Associated Level
    b. Filter: Sub Discipline = Design

C. 03 Sheet Views - Only Sheet views are shown in the project browser
    a. Order: Discipline > Category > Sub discipline > Associated Level
    b. Filter: Sub Discipline = Sheet

D. 04 Working Views - Only Working views are shown in the project browser
    a. Order: Discipline > Category > Sub discipline > Associated Level
    b. Filter: Sub Discipline = Working

E. 05 Export Views - Only Export views are shown in the project browser
    a. Order: Discipline > Category > Sub discipline > Associated Level
    b. Filter: Sub Discipline = Export

F. 06 Details Order - Only Detail views are shown in the project browser
    a. Discipline > Category > Sub discipline > Associated Level
    b. Filter: Category = 500-Details

3.4.5 Schedules

3.4.5.1 Schedule Creation

Schedules must be created using Revit's built-in scheduling tools. Use of drafting views, CAD, text tools, drafting lines, or other workarounds is not permitted.

3.4.5.2 Template Schedules

The DEN template contains many customized schedules. They are created to facilitate project data entry and documentation in a manner that is consistent with the needs of DEN's stakeholders both during and after the project.

Whenever possible and appropriate DEN Template schedules shall be utilized for documentation.

This section outlines the custom schedules available in the DEN templates and container files.

3.4.5.3 Schedules: Mechanical Schedules

Use of DEN's Mechanical schedules is required for all applicable mechanical equipment. No substitution or modification is permitted without authorization from the DEN Systems group and the DEN DFI Project Manager for the project.

Existing DEN Mechanical Schedules may be renamed to remove the M- prefix.

The DEN standard mechanical schedules are listed below.

A. M-ABBREVIATIONS
B. M-AHU SCHEDULE (1/2)
C. M-AHU SCHEDULE (2/2)
D. M-AIR SOLID SEPARATOR SCHEDULE
E. M-CABINET UNIT HEATER SCHEDULE
F. M-CRAH SCHEDULE
G. M-DAMPER SCHEDULE
H. M-DEDICATED OUTDOOR AIR UNIT SCHEDULE (1/2)
I. M-DEDICATED OUTDOOR AIR UNIT SCHEDULE (2/2)
J. M-DEDICATED OUTDOOR AIR UNIT SCHEDULE COMPLETE
K. M-DIFFUSER, REGISTER, AND GRILLE SCHEDULE

L. M-EQUIPMENT SOUND SCHEDULE
M. M-EXPANSION TANK SCHEDULE
N. M-FAN COIL UNIT SCHEDULE
O. M-FAN SCHEDULE
P. M-HEAT EXCHANGER SCHEDULE
Q. M-INFRARED RADIANT HEATER (NATURAL GAS) SCHEDULE
R. M-LOUVER SCHEDULE
S. M-MAKEUP AIR UNIT SCHEDULE
T. M-PLENUM BOX SCHEDULE
F. M-RADIANT MANIFOLD SCHEDULE
U. M-UNIT HEATER SCHEDULE
V. M-VAV SCHEDULE

3.4.5.4 Schedules: Door and Frame Schedules

The DEN template contains a series of door schedules for easy reference. Use of these Schedules is optional at this time.

Table 3-6: Door and Frame Schedules

Door and Frame Schedule	Schedule intended for plotted set drawings.
Door and Frame Schedule 01 Materials Key	Key schedule. Holds full information for the materials and finishes assigned to the frame and panel in the DOOR AND FRAME SCHEDULE
Door and Frame Schedule 02 Detail Key	Key schedule. Holds head, Jamb and Sill detail references for specific typical wall conditions to populate DOOR AND FRAME SCHEDULE.
Door and Frame Schedule 03 Hardware Key	Hardware Sets are described in the specifications; edit this Key Schedule to correspond to the specifications to populate DOOR AND FRAME SCHEDULE.

A. _abbreviations
Customized schedules to be used to record or plot the standard abbreviations for the project. This schedule is a key schedule that holds values in the Revit Internal Point Loads parameters.

3.5 Sheets

3.5.1 Sheets

Sheets, like views, have their own parameters that are used for sorting and organizing the sheets in the project browser. The same parameters used to sort and organize the sheets in the project browser are used to organize the sheets in the Drawing Index schedules. For general Sheet naming, numbering, and layout standards, refer to the National CAD Standards v6.0.

3.5.2 Title Blocks

Standard Titleblocks are provided in the Kit of Parts. DEN's standard Titleblock is 34x44. The Titleblock family shall not be modified without approval from DEN DFI and the DEN Project Manager. All consultants and sub-consultants on a project shall use the same Titleblock.

3.5.3 Sheet Parameters

Sheet Parameters are used to organize the project browser and the drawing lists for document sets. The following section documents to which elements the parameters are assigned. Similar to the view browser organizations, these are set in the template as a base set of schedules and browser organizations. This base set may be added to any project.

A. Volume Number- Used for Drawing Index schedule to sort construction document sheets by volume if needed. Volume is also used in the browser organization: 02 Architectural Set by Volume.

B. Sheet Sort Order- Allows the Drawing Index schedules and Browser Organizations to be organized in a non-alphabetical manner. The sheet sort order number is organized by the National CAD standard Discipline Designator with a two-digit numerical prefix, e.g., 00-GENERAL, 07-ARCHITECTURAL.

C. Category- In theproject browser used for browser organization, this is the Sheet Type Designator as defined by NCS, e.g., 100-PLANS, 200-ELEVATIONS, etc.

Table 3-7: Sheet Parameters

Abbreviation	NCS	Revit Sheet Sort Order
G	General	00
H	Hazardous Materials	01
V	Survey/Mapping	02
B	Geotechnical	03
C	Civil	04
L	Landscape	05
S	Structural	06
A	Architectural	07
I	Interiors	08
Q	Equipment	09
F	Fire Protection	10
P	Plumbing	11
D	Process	12
M	Mechanical	13
E	Electrical	14
T	Telecommunications	15
R	Resource	16
X	Other Disciplines	17
Z	Contractor/Shop Drawings	18
O	Operations	19
PL	Planning and Urban Design	20
		21

Table 3-8: Sheet Type Designators

Abbreviation	NCS
000	General (Symbols, legends, notes, etc.)
100	Plans (Horizontal Views)
200	Elevations (vertical views)
300	Sections (sectional views, wall sections)
400	Large-Scale Views (Enlarged plans, elevations, stair sections, or sections that are not details)
500	Details
600	Schedules and Diagrams
700	Assets (user defined by DEN)
800	User Defined
900	3D Representations (Isometrics, perspectives, photographs)

3.5.4 Sheet Browser Organization

Like the views, the project browser allows for the organization of sheets. These organization definitions only affect the project browser and not the drawing list schedules. However, the same parameters are used to drive the browser organization as well as the drawing list schedules.

3.5.4.1 Template Browser Organizations: DEN Standards (Numbered)

DEN templates have three customized browser organizations built-in. These are standard DEN browser organizations and shall not be deleted or changed. Any project may add to this set for project-specific organizations. If possible, use parameters already in use by the other browser organizations.

A. 01 By NCS- All sheet views are shown
    a. Group by: Volume Number > Sheet Sort Order > Category
    b. Sort by: Sheet Number
    c. Filter: No Filter applied
B. 02 Architectural Set by Volume- All printed views are shown. Any sheet that is a placeholder (for drawing index) is not shown.
    a. Group by: Volume Number
    b. Sort by: Sheet Number
    c. Filter: Category Not Equal to 999-PLACE HOLDERS
C. 03 Architectural Set- All printed views are shown. Placeholder sheets for drawing index are not shown.
    a. Group by: Category
    b. Sort by: Sheet Number
    c. Filter: Category Not Equal to 999-PLACE HOLDERS

3.6 Annotation

3.6.1 General Annotation

Section in Development

3.6.2 Standard Text Styles

All Revit text will be in Arial font. The DEN standard text types as provided in the DEN Revit templates:

A. Headings: 5/32 inch- Used for any headings, such as on legends Notes Headings, etc.
B. Sub-Headings: 1/8 inch- Sub-Headings that need to be hierarchically beneath Headings such as Schedule headings.
C. Notes: 3/32 inch- This text is the default and is used in all use cases in a project not covered specifically by the preceding types.
D. Notes- Transparent: 3/32 inch- This text is where a transparent background may be necessary for Notes.

3.6.3 Standard Dimensions

DEN templates have one linear dimension type available. Any additional types must be removed prior to each submittal:

A. Standard: Standard dimension type is to be used for all construction document purposes.

3.6.4 Sheet Notation

Annotation shall follow the National CAD Standards current version (As of this writing, current version 6.0) Uniform Drawing System Module 7 Notations. Please refer to that document for complete text on any of the topics in this section.

There are five types of notes: general notes, general [discipline] notes, general sheet notes, reference keynotes, and sheet keynotes. General notes, general [discipline] notes, and general sheet notes do not directly correspond to a graphic representation and are not directly linked by the symbol (or other identifier) to other drawings or specifications. Should these three types of notes appear on the same sheet, they are listed in the following hierarchical order:

A. General Notes
B. General [Discipline] Notes (such as General Architectural Notes)
C. General Sheet Notes

3.6.4.1 General Notes

General Notes are located within the G-Series, General Drawing's sheet types.

3.6.4.2 General [Discipline] Notes

General [Discipline] Notes appear on the first or 0-Series sheets within a particular design discipline and apply to all subsequent sheets within that discipline. For example, general architecture notes appear on sheet A-001 and apply to all architecture sheets within the drawing set.

3.6.4.3 Sheet Notes

General Sheet Notes are used to communicate sheet-specific information or instructions. General sheet notes are tabulated sequentially within the note block. General Sheet Notes follow the other types of general notes (general notes or general [discipline] notes) and precede any reference keynotes that may appear in the note block. Refer to the following illustrations. General Sheet Notes shall be written in the imperative mood and in a streamlined format similar to the preferred specification language presented in The Project Resource Manual—CSI Manual of Practice (PRM).

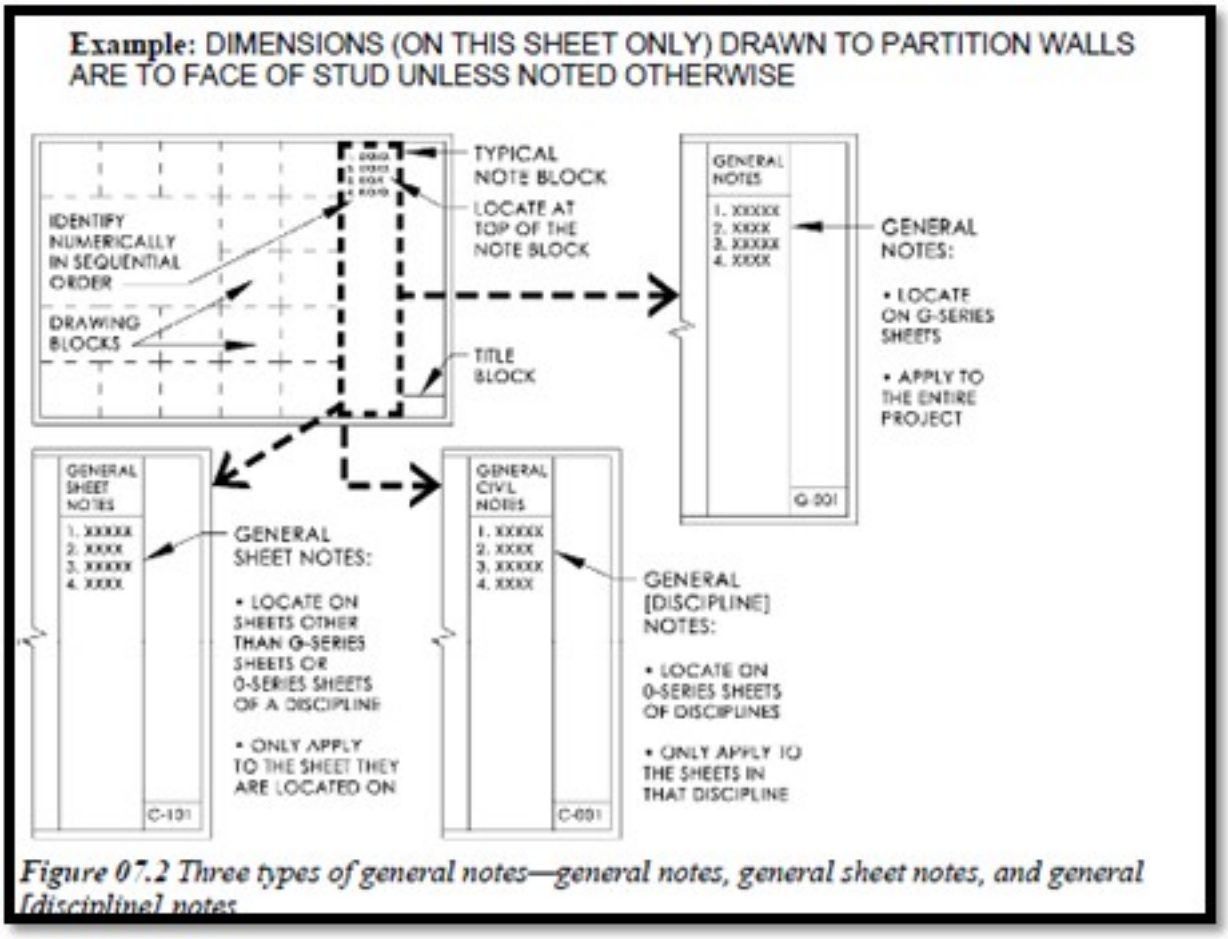

Figure 3-2: Sheet Notes: Dimension Examples

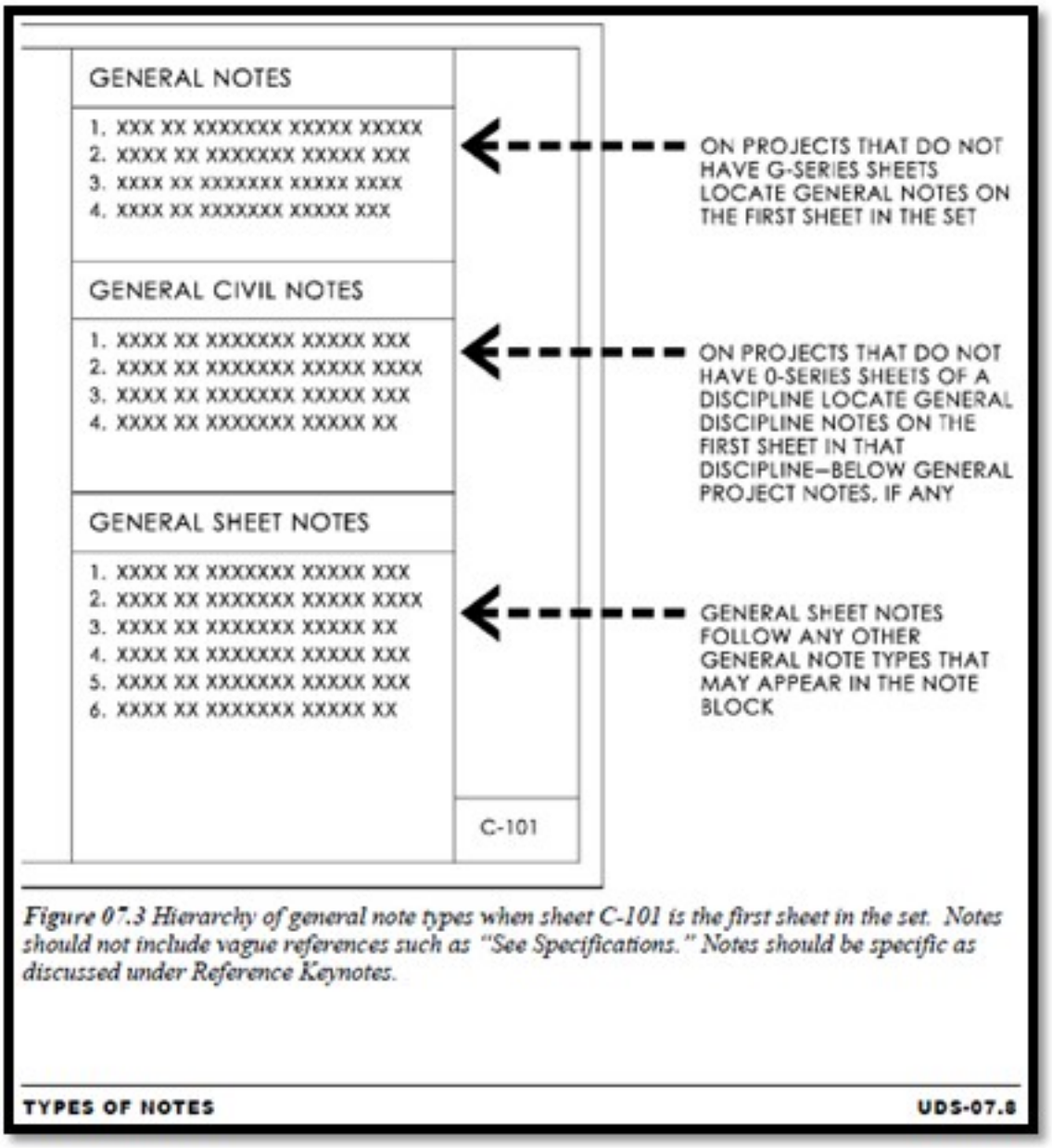

Figure 3-3: Sheet Notes: General Note Examples

A. Sheet Notation General Rules

When placing notes on the drawing, place the note directly next to the noted object, using complete text within the drawing area. Revit Keynote functionality may also be used for sheet notation where possible and appropriate.

If you cannot put the full text of the note within the drawing area, it will become either a Reference Keynote or a Sheet Keynote.

To allow the most flexibility for all firms and disciplines working with DEN, the following Revit components have been identified to fill the roles established by the National CAD Standard for Reference Keynotes and Sheet Keynotes:

d. Sheet Keynotes are more generic and may use the Revit Keynote tools or Generic Annotations and Note block schedules.
e. Reference Keynotes refer to specific specification sections within the project and utilize the Revit Keynote tools.

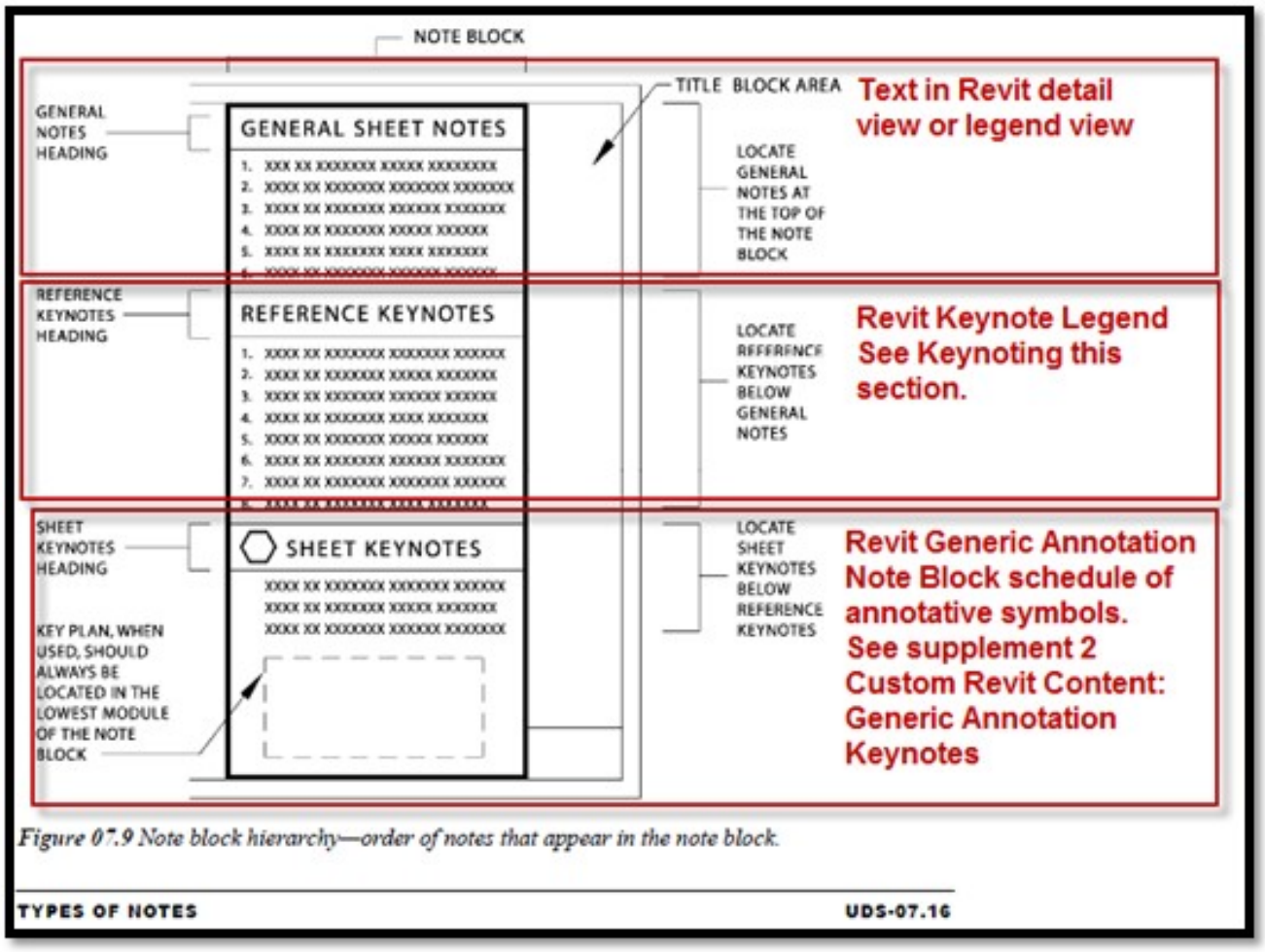

Figure 07.9 Note block hierarchy—order of notes that appear in the note block.

Figure 3-4: Sheet Notation: General Rules

3.6.5 Keynotes

The Revit Keynoting feature links data in a text file to the elements and/or materials within the Revit model. If one material or element type is linked to a keynote, all future keynotes placed on that same material or element within other views will display the same value.

DEN maintains a single master keynote file; DEN_RevitKeynotes_Imperial_2004.txt. It is located in the DEN Kit of parts in the 04_Support>03_Keynoting folder.

3.6.6 Sheet Notes

3.6.6.1 Family: Annotation: 000000 <Use> SheetNote-GA

Each family is separated by use. Alt notes, Demo notes, Plan Notes, and Elev notes are provided in the base template. If needed, save this family from the template for different uses.

A. 000000-PLAN-Sheet Note-GA
B. 000000-ELEV-Sheet Note-GA

3.6.6.2 Types

Types are used to designate the number of the sheet note; e.g., Note 2 on A floor plan would use 000000-PLAN-Sheet Note-GA:2.

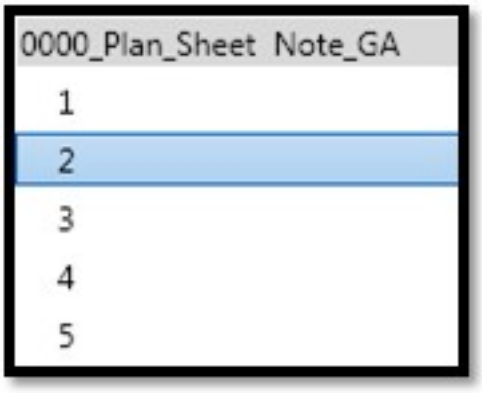

Figure 3-5: Sheet Note: Types

3.6.6.3 Symbol

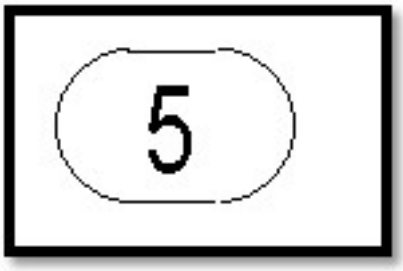

Figure 3-6: Sheet Note: Symbols

3.6.6.4 Parameters

B. Instance Parameters

Figure 3-7: Sheet Note: Instance Parameters

Sheet No is used to filter the note block schedules for placing on individual sheets.

C. Type Parameters

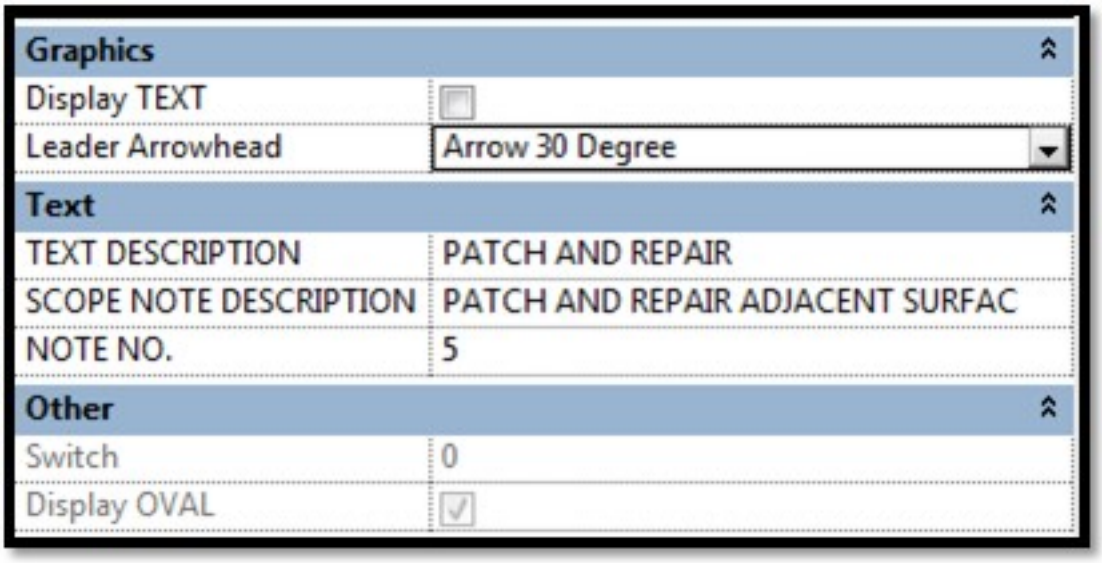

Figure 3-8: Sheet Note: Type Parameters

f. Scope Note Description

Longer text that appears in note block schedule placed on sheet (Sheet Notes).

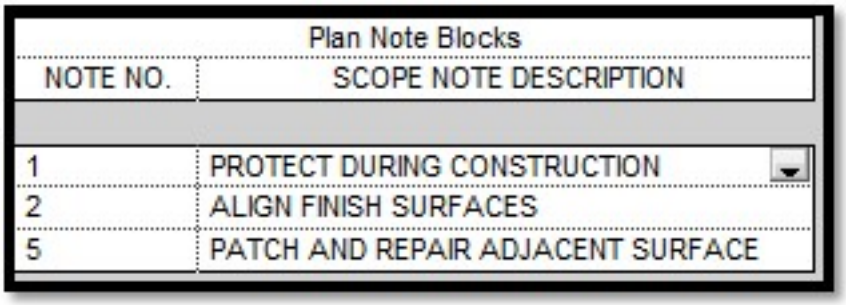

Figure 3-9: Scope Note Description

The text associated with any number will match the same number used on other sheets.

g. Note No

Used for note block schedule. Duplicates Type Name.

3.6.7 Line Patterns and Styles

Line styles and patterns approved by DEN will be available in all templates and can be found in the legend: Line Types.

The Medium, Wide, and Thin lines shall not be used (however, they cannot be purged from the templates).

DEN Line Styles shall be named according to their thickness and their color, and line pattern if they are not Solid Black.

Table 3-9: Line Pattern and Style Examples

O2	A solid black line with thickness 2

Table 3-9: Line Pattern and Style Examples (Continued)

O2 Red	A solid red line style with thickness 2
O2 Hidden Red	A red line, thickness 2 with the Hidden line pattern

3.6.7.1 Line Patterns

Line patterns are documented in the templates in the schedule, Line Patterns for Drafting.

3.7 Quality Management

3.7.1 Quality Management

3.7.1.1 General

This section outlines required best-use practices that affect the health and/ or organization of the project.

A. Opening Files
    a. Open selective worksets for larger files as appropriate.

3.7.1.2 Quality Control

All models shall be reviewed by the BIM Lead for each model author for compliance with the DEN BIM requirements prior to submitting to the BIM Project Coordinator. The BIM Project Coordinator shall review each model for compliance with DEN standards prior to each model submission. By submitting models for DEN review, the BIM Leads and BIM Project Coordinator assert that the submitted models meet all DEN BIM requirements.

3.7.1.3 Run Purge Unused

Remove unused families, types, and other content as appropriate prior to submittals. Use discretion whether this is a manual process from the project browser or using the Purge Unused tool.

3.7.1.4 Remove Unused Links

Remove unused links, CAD, or Revit, throughout model development as appropriate and before every deliverable.

3.7.1.5 Review and Fix Warnings

Warnings shall be fixed on a daily or as-created basis. Warnings have a significant adverse effect on model performance. Prioritize warnings for model-based elements (i.e., system connection issues, model elements overlapping, etc.) over annotation or mark type conflicts (the line is at a slight angle, door/room/elements share the same mark, etc.)

3.7.2 References

This part has been inspired and assembled from many sources, including:

A. IU_BIM_Guidelines_and_Standards.pdf
B. VA-BIM-Guide.pdf
C. State of Wisconsin BIM Guidelines and Standards.pdf
D. BIM_Guidelines_Book_191109_lores.pdf

3.8 Construction Modeling Guidelines and Requirements

3.8.1 Modeling Guidelines and Requirements – Construction Team

3.8.1.1 Origin Point

All models must be in the correct location in 3D Space (x, y, and z coordinates) using the current approved DEN coordinate system.

3.8.1.2 Tolerances

Models and Model Elements must be within 1/8 inch of theoretical dimensions. Tolerances for specific items and systems will be determined as necessary. Model tolerances are not to be construed as construction tolerances.

3.8.1.3 Units

Imperial units: One (1) unit in the model equals 0 feet-1 inch.

3.8.1.4 Model Completeness

Models must be 100 percent complete for the current building, level, and phase. This includes, but is not limited to:

A. Piping and conduit that is larger than 1/2-inch diameter.
B. Model all equipment and panels to scale with required clearance zones included.
C. Identify all service and access areas.
D. Show size and thickness of housekeeping pads.
E. Show all sleeved or cored hole penetrations.
F. Model all
G. *no-fly zones* for access, maintenance clearance, elevator shaft, code issues, and constructability with solid objects.
H. Any item which may impact coordination with other disciplines
I. Penetrations through building systems such as cast-in-place concrete and CMU walls shall be identified in the Trade Contractor's model by means of a modeled sleeve (w/ defined tolerance).
J. All model elements (families) are to have identity codes or CSI codes attached as defined in the data normalization requirements.
K. All model elements are to have DEN-required parameters and their values included for As-Built submission. CM/GC will ensure the collection and data population of DEN required parameters from all subcontractors and vendors.

3.8.1.5 Systems Modeled and Level of Detail

The minimum level of detail defined for elements in the Construction/Fabrication models shall be level 350 as defined by the 2021 BIM Forum LoD Specification except as defined otherwise by the LoD Matrix attached to the BIMPxP for that project. The Contractor will determine the effect on the Models and scope and propose the appropriate response to accommodate the noted Model development and/or coordination issue.

3.8.2 Systems Modeled and Level of Detail – Construction Model

The Contractor shall provide modeling to accurately represent the scope of the work contracted for and shall provide separate model iterations to reflect the proposed stages of work for periods no less than one-month duration or snapshots in time at significant milestones within the schedule. Project model elements shall conform, at a minimum, to the requirements established in the *Standards and Criteria Design Standards Manual*, specifically including but not limited to the Phasing and Staging Drawings and Planning Study chapters.

All model elements are to have DEN-required parameters and their values included for As-Built submission.

3.8.3 Clash Coordination – Construction Phase

3D Computer coordination as it relates to Mechanical, Electrical, Plumbing, Fire Protection, Fire Alarm, Baggage Handling System, and Special Systems during the construction modeling phase.

3.8.3.1 Trade Contractor

Will deliver a 3D computer model that is complete based upon DEN standards in their native, Revit compatible file format and in NavisWorks Document Format (.NWD) and Revit (.rvt). Any elements not included will become the Trade Contractor's responsibility to coordinate in the field and at no additional cost. All 3D model elements shall include DEN-required parameters and their associated values included for deliverable submission.

Trade Contractor will provide a list of minimum typical clearances for all model components (Clash rule criteria).

3.8.3.2 Represented in these Assigned Colors as A Guideline

Suggested Trade Colors for Spatial Coordination:

A. Fire Protection: red
B. Plumbing: magenta
C. HVAC Duct: blue
D. HVAC Pipe: lime green
E. Electrical: cyan
F. Pneumatic Tube: dark green
G. Concrete: grey
H. Structural Steel: maroon
I. Architectural: white

3.8.3.3 Coordination Procedure

A. Design team BIM/3D models: Current Architectural, Structural, MEP, BHS, and Security and IT models shall be made available to the Trade Contractor; each trade is required to download and use these files to create their system models by sequence or geographic area (Schedule WBS, Work area, etc.).
B. Trade Contractor shall be prepared to accommodate bi-weekly meetings to resolve model conflicts within the project schedule and sign off on a Master Model to be considered the basis for construction on an area and floor-by-floor basis consistent with the project schedule.
C. Contractor will provide clash detection reports to accommodate the above utilizing approved software platforms.
D. Each Trade is required to review the clash detection report generated by the Contractor BIM Coordinator before the weekly meeting and arrive at the meeting prepared to address the unresolved clashes in a constructive manner. Subcontractors are responsible for coordinating and resolving most of the clashes prior to a meeting so that the meeting time can be used efficiently to focus on the issues that require all participants to resolve.
E. Coordination model shall include, at a minimum: The modeling elements, associated parameters, and their data per modeling requirements specified by this document and the LoD and MPS.
F. Models to be purged of all non-essential information; only 3D information shall remain in the file.
G. Each Trade is required to run the clash detection analysis for their respective trade systems against the Architectural/Structural design models to ensure that there are no conflicts between the architectural/structural elements and their systems prior to submittal.
H. Each Trade is required to post to the DEN CDE updated drawings/models at least once per week prior to the clash detection analysis run by the BIM Coordinator. The day and time of the posting are per the BIMPxP. This will continue until the area is completely coordinated.

3.8.3.4 Master Model

Following 100 percent coordination and agreement on a Master Model, the Trade Contractor agrees and signs off to be responsible for locating their respective components within an agreed tolerance based on the 'Master Model.'

A. Any variation beyond the agreed tolerance must be coordinated with Contractor first and approved by the Designer and Owner.
B. Items not included in the coordination model will be installed in the field; after all, coordinated elements are in place.
C. Components that are installed in conflict with model layout and create obstacles or additional work for other disciplines shall require one of the following: a) removal and reinstallation per model at no cost to other parties, or b) monetary compensation to the affected party and owner.

3.8.3.5 Documentation of Coordination

The following will be included as a zipped file and posted by Contractor for all subs and design team.

A. A record of the Original BIM data used for Sign-off documentation.
B. A NavisWorks (NWD) Published file that includes the final Clash reports and Comments.
C. PDF files of above reports.
D. Each Trade is required to maintain and provide the 3-Dimensional Model with respect to generating As-Built Drawings/Models. It is the responsibility of each trade to update their respective 3-Dimensional Model throughout construction to reflect field conditions to accurately document As-Built conditions.
E. Each Trade is required to submit an electronic copy containing the 3-Dimensional As-Built models, once all issues are addressed from above. This deliverable shall contain As-Built models in Revit (.rvt), Postscipt Digital File (.pdf), NavisWorks (.NWD) format and the other original authoring files in the native format of the program that created the models. Owner reserves the right to request additional file formats as the needs of the client or project require.

3.8.3.6 Model Management

A. Trade Contractors shall provide updates/maintenance of Electronic Data/3D Model throughout construction to include but not limited to:
B. Incorporation of RFIs, Bulletins, Change Orders, etc.
C. Submittal comments and revisions on approved shop drawings.
D. As-Built field modifications updated daily.
E. Trade Contractor to provide Contractor with an updated model on a bi-monthly (2x per month) basis throughout the installation of the Work.

3.8.4 Utilization of BIM for the RFI/Change Order/Bulletin Process

Trades that have worked directly affected by RFI, Change Orders, or Bulletins shall submit updated models no later than 10 business days after execution of the Change Order. Implementation of modifications to the project Building Information Models due to Change Orders will be the responsibility of the Model Element Author in primary control of the affected Model Element at the Change Order's initiation. The contractor BIM Coordinator will audit and report the clashes that are local to the area affected by the change documents.

3.8.5 As-Built Contract Drawings

In accordance with DENVER GENERAL CONTRACT CONDITIONS 403.2 the Contractor shall maintain a .pdf of the as-built Contract Drawings on DEN's project deployment of ACC. Within five business days of handover of any phase or area for substantial completion, temporary occupancy, or beneficial use the Contractor shall deliver as-builts for the scope of that phase or area to DEN.

End of Chapter

Chapter 4 - BIM Tenant Standards

4.0 Introduction and Overview

4.0.1 Introduction

This chapter provides guidance on standards for any tenant improvement project at DEN. DEN uses Autodesk Revit® software as the BIM solution for building and facility design and documentation. This information is for anyone authoring Revit® models for DEN. This includes DEN staff, as well as external service providers. The reader is assumed to have a basic knowledge of Revit® and the workflows and terms common to the industry. This document presents baseline BIM requirements for all new facilities and facility renovation projects at DEN.

4.0.1.1 Target Audience

This document is intended for:

A. External service providers (design and construction) supplying BIM Data to DEN (4).
B. DEN executives and Project Managers (4).

4.0.1.2 Proposing Revisions

This standard is intended to be updated and enhanced as deemed necessary by DEN over time. Recommended additions and suggested changes are to be directed to DEN Asset Management.

4.0.1.3 Requirements

All consultants and sub-consultants (architecture, structure, MEP, fire protection, BHS, etc.) will create a BIM model and produce 2D construction documents natively using Autodesk Revit (current approved version). The Revit design files shall be 100 percent Revit and all designed equipment and systems shall be modeled. The Revit file shall not contain any imported or unapproved linked CAD, 3D, or graphic files. This file shall include the model, families, and 2D documentation and shall follow all standards in Chapter 3 of this DSM, with allowances made for any exceptions noted in the following section.

All civil designs will be designed and executed in Autodesk Civil 3D following the standards in Chapter 2 of this DSM, with allowances made for any exceptions noted in the following section.

4.0.2 Tenant Civil Exceptions

Civil tenant work done on DEN property shall follow all standards outlined in Chapter 2 of this DSM, with the exception of sections identified below.

4.0.2.1 Exceptions

No Tenant Civil Exceptions have been identified at this time.

4.0.3 Tenant Facilities Exceptions

Facilities tenant work done on DEN property shall follow all standards outlined in Chapter 3 of this DSM with the exception of sections identified below.

4.0.3.1 Exceptions

The sections below have been determined to be Not Applicable to Tenant Facilities projects at DEN.

- 3.1.13 Project Termination and Closeout
- 3.2.7.2 Outside Content Sources
- 3.2.7.4 Proposed Content Submittal
- 3.2.13 BIM Spatial Coordination Procedure Outline – Design Model

End of Chapter

Appendix A - Asset Types

The following table lists the DEN Asset Types and their abbreviations.

Table 5-1: Appendix A - DEN Asset Types

Asset Type Revit Parameter ASSET_ASSET TYPE	Abbreviation For Revit Family Naming & LOD Matrix	Naming Reference
Actuator	ACT	DEN Mechanical DSM Ch 1.2-1.3
Air Compressor	AIRCOM	DEN Mechanical DSM Ch 1.2-1.3
Air Conditioning Unit	ACU	DEN Mechanical DSM Ch 1.2-1.3
Air Curtain	AIRCUR	DEN Mechanical DSM Ch 1.2-1.3
Air Dryer	AIRDRY	DEN Mechanical DSM Ch 1.2-1.3
Air Handling Unit	AHU	DEN Mechanical DSM Ch 1.2-1.3
Air Solid Separator	AIRSS	DEN Mechanical DSM Ch 1.2-1.3
Airfield Lighting Circuit	AIRLC	
Airfield Lighting Control & Monitoring	ALCAMS	
Auto Transfer Switch	ATS	
Backflow Preventer	BFP	DEN Mechanical DSM Ch 1.2-1.3
Boiler	BOILER	DEN Mechanical DSM Ch 1.2-1.3
Call Box	CALLBX	
Camera	CAMERA	
Card Reader	CARDRD	
Chiller	CHILL	DEN Mechanical DSM Ch 1.2-1.3
CKT Selector Switch	CKTSS	
Combination Air Vent	COMBAV	DEN Mechanical DSM Ch 1.2-1.3
Constant Current Regulator	CCR	
Controller (Fire/Jockey Pump)	CONTRL	DEN Mechanical DSM Ch 1.2-1.3
Cooling Tower	COOLTW	DEN Mechanical DSM Ch 1.2-1.3
Door, Automatic	DOORAU	DEN DFI DSM
Door, Fire Rated	DOORFI	DEN DFI DSM
Door, Overhead	DOOROH	DEN DFI DSM
Duct Heater	DUCHTR	DEN Mechanical DSM Ch 1.2-1.3

Table 5-1: Appendix A - DEN Asset Types (Continued)

Asset Type Revit Parameter ASSET_ASSET TYPE	Abbreviation For Revit Family Naming & LOD Matrix	Naming Reference
ECS/Microphones	ECSMIC	
ECS/Paging	ECSPAG	
Electrical Panel	EPANEL	DEN Electrical DSM Ch 2.1
Elevator	ELEVAT	DEN Conveyance Administrator
Energy Management Control System	EMCS	DEN Mechanical DSM Ch 1.2-1.3
Escalator	ESCALA	DEN Conveyance Administrator
Expansion Tank	EXPTNK	DEN Mechanical DSM Ch 1.2-1.3
Facial Recognition Reader	FACRDR	
Fan Coil Unit	FCU	DEN Mechanical DSM Ch 1.2-1.3
Fan, Exhaust	FANEXH	DEN Mechanical DSM Ch 1.2-1.3
Fan, Relief	FANREL	DEN Mechanical DSM Ch 1.2-1.3
Fan, Return	FANRET	DEN Mechanical DSM Ch 1.2-1.3
Fan, Smoke Control	FANSMK	DEN Life Safety DSM Ch 5.8
Fan, Supply Air	FANSUP	DEN Mechanical DSM Ch 1.2-1.3
Fire Damper	FIRDAM	DEN Life Safety DSM Ch 5.8
Fire Sprinkler Zone	FIRZON	DEN Life Safety DSM Ch 1.5
Flow Meter	FLWMTR	DEN Mechanical DSM Ch 1.2-1.3
Gas Detection System	GASDET	DEN Mechanical DSM Ch 1.2-1.3
Generator	GENER	DEN Fleet Series Classification Guide
Ground Power Unit	GPU	
Heat Exchanger	HTEXCH	DEN Mechanical DSM Ch 1.2-1.3
Hoist	HOIST	
Humidity Control Equipment	HUMCTL	DEN Mechanical DSM Ch 1.2-1.3
Incinerator	INCIN	
Interceptor, Grease	INTRGR	DEN Mechanical DSM Ch 1.2-1.3
Interceptor, Sand Oil	INTRSO	DEN Mechanical DSM Ch 1.2-1.3
Lighted Sign	SIGNLT	
Lighting Control	LITCTL	
Makeup Air Unit	MUAU	DEN Mechanical DSM Ch 1.2-1.3

Table 5-1: Appendix A - DEN Asset Types (Continued)

Asset Type Revit Parameter ASSET_ASSET TYPE	Abbreviation For Revit Family Naming & LOD Matrix	Naming Reference
Meter	METER	DEN Mechanical DSM Ch 1.2-1.3
Motor Cont Ctr	MCC	
Motorized Dampers	DAMPER	DEN Life Safety DSM Ch 5.8
Moving Walk	POWWLK	
Packaged Compressor Condenser	PAKCOM	DEN Mechanical DSM Ch 1.2-1.3
Passenger Loading Bridge	PLB	
PATV	ECSVIS	
PCA Plant	PCAPLT	DEN Mechanical DSM Ch 1.2-1.3
Potable Water Cabinet	PWC	DEN Mechanical DSM Ch 1.2-1.3
Pre Conditioned Air, Dx	PCADX	DEN Mechanical DSM Ch 1.2-1.3
Pre Conditioned Air, Hydronic	PCAHYD	DEN Mechanical DSM Ch 1.2-1.3
Pump, Boiler Feedwater	PUMPBL	
Pump, Centrifugal Fire	PUMPFI	DEN Fleet Series Classification Guide
Pump, Domestic Water	PUMPDW	DEN Mechanical DSM Ch 1.2-1.3
Pump, Domestic-Water Packaged	PUMPBO	DEN Mechanical DSM Ch 1.2-1.3
Pump, Facility Fuel	PUMPFF	DEN Mechanical DSM Ch 1.2-1.3
Pump, Facility Packaged Sewage	PUMPST	DEN Mechanical DSM Ch 1.2-1.3
Pump, Fuel-Oil	PUMPFO	DEN Mechanical DSM Ch 1.2-1.3
Pump, Heat Recovery	PUMPHR	DEN Mechanical DSM Ch 1.2-1.3
Pump, Hydronic	PUMPHY	DEN Mechanical DSM Ch 1.2-1.3
Pump, Pressure-Maintenance	PUMPPM	DEN Mechanical DSM Ch 1.2-1.3
Pump, Sanitary Sewerage	PUMPSW	DEN Mechanical DSM Ch 1.2-1.3
Pump, Specialized Liquid	PUMPSL	DEN Mechanical DSM Ch 1.2-1.3
Pump, Sump	PUMPSU	DEN Mechanical DSM Ch 1.2-1.3
Pump, Vertical-Turbine Fire	PUMPVT	DEN Fleet Series Classification Guide
Radiant Heater	RADHTR	DEN Mechanical DSM Ch 1.2-1.3
Radiant Slab Manifold	RADMAN	DEN Mechanical DSM Ch 1.2-1.3

Table 5-1: Appendix A - DEN Asset Types (Continued)

Asset Type Revit Parameter ASSET_ASSET TYPE	Abbreviation For Revit Family Naming & LOD Matrix	Naming Reference
Receiver	RECVR	
Rooftop Unit	RTU	DEN Mechanical DSM Ch 1.2-1.3
Sand Filter	SNDFLT	DEN Mechanical DSM Ch 1.2-1.3
Security Gate	SECGAT	
Solvent Tank	SOLTNK	DEN Mechanical DSM Ch 1.2-1.3
Switchgear	SWITCH	
Surface Condition Analyzer	SCAN	
Transformer	TRANSF	
Unit Heater	UNTHTR	DEN Mechanical DSM Ch 1.2-1.3
UPS	UPS	
Valet Baggage Lift	BAGLFT	
Valve, Control	VLVCTL	DEN Mechanical DSM Ch 1.2-1.3
Valve, Ball	VLVBAL	DEN Mechanical DSM Ch 1.2-1.3
Valve, Butterfly	VLVBUT	DEN Mechanical DSM Ch 1.2-1.3
Valve, Check	VLVCHK	DEN Mechanical DSM Ch 1.2-1.3
Valve, General	VLV	DEN Mechanical DSM Ch 1.2-1.3
Valve, Globe	VLVGLB	DEN Mechanical DSM Ch 1.2-1.3
Valve, Mixing	VLVMIX	DEN Mechanical DSM Ch 1.2-1.3
Valve, Plug	VLVPLG	DEN Mechanical DSM Ch 1.2-1.3
VAV	VAV	DEN Mechanical DSM Ch 1.2-1.3
Vehicle Charging Station	VEHCS	
Vent Smoke Control Fan	VSCF	
VFD	VFD	DEN Mechanical DSM Ch 1.2-1.3
VFD/Bypass Switch	VFDSWT	
Waste Grinder	WASGRN	DEN Mechanical DSM Ch 1.2-1.3
Water Bottle Filling Station	WTRBTL	DEN Mechanical DSM Ch 1.2-1.3
Water Treatment System	WTRTRT	DEN Mechanical DSM Ch 1.2-1.3

End of Appendix

This page is intentionally blank.

Appendix B - Object Types

The following table identifies the object types and their abbreviations identified in the DEN DFI Matrix. These are the Object Types that shall be used when modeling elements in Revit or Civil 3D to represent designed elements. Note that some object types may include other Object Types within them as part of a system.

Table 6-2: Appendix B - Object Types

Object Type	Abbreviation	Notes
Revit Object Types		
Air Terminals	AIRT	
Cable Tray Fittings	CTRF	Part of CTRA
Cable Tray Runs	CTRR	Part of CTRA
Cable Trays	CTRA	Includes Cable Tray, Cable Tray Runs and Cable Tray Fittings
Casework	CASE	
Ceilings	CLNG	
Columns	CLMN	
Communication Devices	CMDV	
Conduit Fittings	CONF	Part of SYSC
Conduit Runs	CONR	Part of SYSC
Conduits	COND	Part of SYSC
Conduit System	SYSC	Includes Conduits, Conduit Runs, Conduit Fittings
Curtain Systems	CWSY	
Data Devices	DTDV	
Detail Items	DTLS	
Doors	DOOR	
Duct Accessories	DUCA	Part of SYSD
Duct Fittings	DUCF	Part of SYSD
Duct Insulations	SYSD	Part of SYSD
Duct Linings	DUCL	Part of SYSD
Duct Systems	SYSD	Includes Ducts, Flex Ducts, Duct Lining, Duct Insulation, Duct Fittings, Duct Accessories
Ducts	DUCT	Part of SYSD
Electrical Equipment	ELEQ	
Electrical Fixtures	ELFX	

Table 6-2: Appendix B - Object Types (Continued)

Object Type	Abbreviation	Notes
Fire Alarm Devices	FADV	
Flex Ducts	FLXD	Part of SYSD
Flex Pipes	FLXP	Part of SYSP
Floors	FLOR	
Furniture	FURN	
Furniture Systems	FUSY	
Generic Models	GENM	
Gutters	GUTR	
Lighting Devices	LIDV	
Lighting Fixtures	LIFX	
Mass	MASS	
Mechanical Equipment	MEEQ	
Model Groups	MGRP	
Nurse Call Devices	NCDV	*unused*
Pads	PADS	
Parking	PKNG	*unused*
Pipe Accessories	PIPA	Part of SYSP
Pipe Fittings	PIPF	Part of SYSP
Pipe Insulations	PIPI	Part of SYSP
Pipe Placeholders	PIPP	Part of SYSP
Pipes	PIPE	Part of SYSP
Piping Systems	SYSP	Includes Pipes, Flex Pipes, Pipe Accessories, Pipe Fittings, Pipe Insulation, Pipe Placeholders
Planting	PLTG	*unused*
Plumbing Fixtures	PBFX	
Property Lines	PROP	
Railings	RAIL	
Ramps	RAMP	
Roofs	ROOF	
Roof Soffits	ROFS	*unused*
Security Devices	SCDV	

Table 6-2: Appendix B - Object Types (Continued)

Object Type	Abbreviation	Notes
Site	SITE	
Specialty Equipment	SPEQ	
Sprinklers	SPRK	
Stairs	STRS	
Structural Beam Systems	STBS	
Structural Columns	STCO	
Structural Foundations	STFO	
Structural Framing	STFR	
Structural Rebar	STRB	*unused*
Structural Trusses	STTR	
Switch Systems	SYSW	
Telephone Devices	TLDV	
Walls	WALL	
Windows	WNDW	
Wires	WIRE	*unused*
Shaft Openings	SHAF	
Wall Sweeps	WALS	
Civil 3D Object Types		
3D Polyline	3DPOL	
AEC Pipe	AECPI	
AEC Pipe Network	AECPN	
AEC Structure	AECST	
AEC Structure Junction	AECJC	
Corridor	CORDR	
Feature line	FLINE	
null	NULLS	
Point	POINT	
POLYGON	POLYG	
Polyline	POLYL	
Surface	SURFA	
Utility Line	ULINE	

Table 6-2: Appendix B - Object Types (Continued)

Object Type	Abbreviation	Notes
Utility Point	UPOIN	
Utility Polygon	UPGON	

End of Appendix

Digital Facilities and Infrastructure

Appendix C - Object Types

The following table, broken out by Uniformat 2010, lists the DEN standard Model Object, Layer Name, Asset Types, and LoD by deliverable level.

Table 7-3: Appendix C - DEN DFI Matrix

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
A				**SUBSTRUCTURE**										
A	10			**Foundations**										
A	10	10		**Standard Foundations**										
A	10	10	.10	Wall Foundations	STFO			100	200	300	300	300	350	350
A	10	10	.30	Column Foundations	STCO			100	200	300	300	300	350	350
A	10	10	.90	Standard Foundation Supplementary Components	DTLS, WALL			100	200	300	300	300	350	350
A	10	20		**Special Foundations**										
A	10	20	.10	Driven Piles	STFO			100	200	300	300	300	350	350
A	10	20	.15	Bored Piles	STFO			100	200	300	300	300	350	350
A	10	20	.20	Caissons	STFO			100	200	300	300	300	350	350
A	10	20	.30	Special Foundation Walls	STFO			100	200	300	300	300	350	350
A	10	20	.40	Foundation Anchors	DTLS			100	200	300	300	300	350	350
A	10	20	.50	Underpinning	DTLS, STFO			100	200	300	300	300	350	350
A	10	20	.60	Raft Foundations	FLOR, STFO			100	200	300	300	300	350	350
A	10	20	.70	Pile Caps	STFO			100	200	300	300	300	350	350
A	10	20	.80	Grade Beams	STBE			100	200	300	300	300	350	350
A	20			**Subgrade Enclosures**										
A	20	10		**Walls for Subgrade Enclosures**										
A	20	10	.10	Subgrade Enclosure Wall Construction	WALL			100	200	300	300	300	350	350
A	20	10	.20	Subgrade Enclosure Wall Interior Skin	WALL			100	200	300	300	300	350	350
A	20	10	.90	Subgrade Enclosure Wall Supplementary Components	WALL			100	200	300	300	300	350	350
A	40			**Slabs-on-Grade**										
A	40	10		**Standard Slabs-on-Grade**	**FLOR**			100	200	300	300	300	350	350
A	40	20		**Structural Slabs-on-Grade**	**FLOR**			100	200	300	300	300	350	350
A	40	30		**Slab Trenches**	**DTLS**			100	200	300	300	300	350	350
A	40	40		**Pits and Bases**	**DTLS**			100	200	300	300	300	350	350
A	40	90		**Slab-On-Grade Supplementary Components**										
A	40	90	.10	Perimeter Insulation	DTLS, FLOR			100	200	300	300	300	350	350
A	40	90	.20	Vapor Retarder	FLOR			100	200	300	300	300	350	350
A	40	90	.30	Waterproofing	FLOR			100	200	300	300	300	350	350
A	40	90	.40	Mud Slab	FLOR			100	200	300	300	300	350	350
A	40	90	.50	Subbase Layer	FLOR			100	200	300	300	300	350	350
A	60			**Water and Gas Mitigation**										
A	60	10		**Building Subdrainage**				100	200	300	300	300	350	350
A	60	10	.10	Foundation Drainage	DTLS, SYSP			100	200	300	300	300	350	350
A	60	10	.20	Underslab Drainage	DTLS, FLOR, SYSP			100	200	300	300	300	350	350
A	60	20		**Off-Gassing Mitigation**				100	200	300	300	300	350	350
A	60	20	.10	Radon Mitigation	DTLS			100	200	300	300	300	350	350
A	60	20	.20	Maethane Mitigation	DTLS			100	200	300	300	300	350	350
A	90			**Substructure Related Activities**										
A	90	10		**Substructure Excavation**	**n/a**			100	200	300	300	300	350	350

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
A	90	20		**Construction Dewatering**	**n/a**			100	200	300	300	300	350	350
A	90	30		**Excavation Support**				100	200	300	300	300	350	350
A	90	30	.10	Anchor Tiebacks	DTLS			100	200	300	300	300	350	350
A	90	30	.20	Cofferdams	n/a			100	200	300	300	300	350	350
A	90	30	.40	Cribbing and Walers	n/a			100	200	300	300	300	350	350
A	90	30	.60	Ground Freezing	n/a			100	200	300	300	300	350	350
A	90	30	.70	Slurry Walls	DTLS			100	200	300	300	300	350	350
A	90	40		**Soil Treatment**	**Polyline**	**H-STOR-HAZM-, H-STOR-HAZW-**		100	200	300	300	300	350	350
B				**SHELL**										
B	10			**Superstructure**										
B	10	10		**Floor Construction**										
B	10	10	.10	Floor Structural Frame	CLMN, STBS, STCO, STFR			100	200	300	300	300	350	350
B	10	10	.20	Floor Decks, Slabs, and Toppings	FLOR, PADS, SHAF			100	200	300	300	300	350	350
B	10	10	.30	Balcony Floor Construction	FLOR, PADS, STBS, STFR			100	200	300	300	300	350	350
B	10	10	.40	Mezzanine Floor Construction	FLOR, PADS, STBS, STFR			100	200	300	300	300	350	350
B	10	10	.50	Ramps	FLOR, RAMP, STFR			100	200	300	300	300	350	350
B	10	10	.90	Floor Construction Supplementary Components	DTLS, FLOR			100	200	300	300	300	350	350
B	10	20		**Roof Construction**										
B	10	20	.10	Roof Structural Frame	STBS, STCO, STFR, STTR			100	200	300	300	300	350	350
B	10	20	.20	Roof Decks, Slabs, and Sheathing	PADS, ROOF, SHAF			100	200	300	300	300	350	350
B	10	20	.30	Canopy Construction	ROOF, STFR			100	200	300	300	300	350	350
B	10	20	.90	Roof Construction Supplementary Components	ROOF			100	200	300	300	300	350	350
B	10	80		**Stairs**										
B	10	80	.10	Stair Construction	STRS			100	200	300	300	300	350	350
B	10	80	.30	Stair Soffits	CLNG, WALL			100	200	300	300	300	350	350
B	10	80	.50	Stair Railings	RAIL			100	200	300	300	300	350	350
B	10	80	.60	Fire Escapes	GENM			100	200	300	300	300	350	350
B	10	80	.70	Metal Walkways	GENM			100	200	300	300	300	350	350
B	10	80	.80	Ladders	GENM			100	200	300	300	300	350	350
B	20			**Exterior Vertical Enclosures**										
B	20	10		**Exterior Walls**										
B	20	10	.10	Exterior Wall Veneer	WALL			100	200	300	300	300	350	350
B	20	10	.20	Exterior Wall Construction	WALL			100	200	300	300	300	350	350
B	20	10	.30	Exterior Wall Interior Skin	WALL			100	200	300	300	300	350	350
B	20	10	.40	Fabricated Exterior Wall Assemblies	WALL			100	200	300	300	300	350	350
B	20	10	.50	Parapets	WALL, WALS			100	200	300	300	300	350	350
B	20	10	.60	Equipment Screens	SPEQ, WALL			100	200	300	300	300	350	350
B	20	10	.80	Exterior Wall Supplementary Components	DTLS, WALL			100	200	300	300	300	350	350
B	20	10	.90	Exterior Wall Opening Supplementary Components	DTLS, WALL, WALS			100	200	300	300	300	350	350
B	20	20		**Exterior Windows**										
B	20	20	.10	Exterior Operating Windows	WNDW			100	200	300	300	300	350	350
B	20	20	.20	Exterior Fixed Windows	WNDW			100	200	300	300	300	350	350
B	20	20	.30	Exterior Window Wall	CWSY			100	200	300	300	300	350	350
B	20	20	.50	Exterior Special Function Windows	CWSY, DTLS, WNDW			100	200	300	300	300	350	350

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
B	20	50		**Exterior Doors and Grilles**										
B	20	50	.10	Exterior Entrance Doors	CWSY, DOOR		Door, Automatic;	100	200	300	300	350	350	500
B	20	50	.20	Exterior Utility Doors	DOOR			100	200	300	300	300	350	350
B	20	50	.30	Exterior Oversize Doors	DOOR		Door, Overhead;	100	200	300	300	350	350	500
B	20	50	.40	Exterior Special Function Doors	DOOR			100	200	300	300	300	350	350
B	20	50	.60	Exterior Grilles	DOOR			100	200	300	300	300	350	350
B	20	50	.70	Exterior Gates	DOOR			100	200	300	300	300	350	350
B	20	50	.90	Exterior Door Supplementary Components	CWSY, DOOR			100	200	300	300	300	350	350
B	20	70		**Exterior Louvers and Vents**										
B	20	70	.10	Exterior Louvers	AIRT			100	200	300	300	300	350	350
B	20	70	.50	Exterior Vents	AIRT			100	200	300	300	300	350	350
B	20	80		**Exterior Wall Appurtenances**										
B	20	80	.10	Exterior Fixed Grilles and Screens	RAIL, SPEQ, WALL			100	200	300	300	300	350	350
B	20	80	.30	Exterior Opening Protection Devices	SPEQ			100	200	300	300	300	350	350
B	20	80	.50	Exterior Balcony Walls and Railings	RAIL, WALL			100	200	300	300	300	350	350
B	20	80	.70	Exterior Fabrications	CLMN, SPEQ, WALL, WALS			100	200	300	300	300	350	350
B	20	80	.80	Bird Control Devices	DTLS, SPEQ			100	200	300	300	300	350	350
B	20	90		**Exterior Wall Specialties**				100	200	300	300	300	350	350
B	30			**Exterior Horizontal Enclosures**										
B	30	10		**Roofing**										
B	30	10	.10	Steep Slope Roofing	ROOF			100	200	300	300	300	350	350
B	30	10	.50	Low Slope Roofing	ROOF			100	200	300	300	300	350	350
B	30	10	.70	Canopy Roofing	ROOF			100	200	300	300	300	350	350
B	30	10	.90	Roofing Supplementary Components	DTLS, ROOF			100	200	300	300	300	350	350
B	30	20		**Roof Appurtenances**										
B	30	20	.10	Roof Accessories	GENM, SPEQ, WALS			100	200	300	300	300	350	350
B	30	20	.30	Roof Specialties	DTLS, SPEQ			100	200	300	300	300	350	350
B	30	20	.70	Rainwater Management	GUTR, SPEQ, SYSP			100	200	300	300	300	350	350
B	30	40		**Traffic Bearing Horizontal Enclosures**										
B	30	40	.10	Traffic Bearing Coatings	GENM, ROOF			100	200	300	300	300	350	350
B	30	40	.30	Horizontal Waterproofing Membrane	ROOF			100	200	300	300	300	350	350
B	30	40	.50	Wear Surfaces	GENM, ROOF			100	200	300	300	300	350	350
B	30	40	.90	Horizontal Enclosure Supplementary Components	DTLS, ROOF			100	200	300	300	300	350	350
B	30	60		**Horizontal Openings**										
B	30	60	.10	Roof Windows and Skylights	WNDW			100	200	300	300	300	350	350
B	30	60	.50	Vents and Hatches	AIRT, SPEQ		Vent Smoke Control Fan;	100	200	300	300	350	350	500
B	30	60	.90	Horizontal Openings Supplementary Components	DTLS			100	200	300	300	300	350	350
B	30	80		**Overhead Exterior Enclosures**										
B	30	80	.10	Exterior Ceilings	CLNG			100	200	300	300	300	350	350
B	30	80	.20	Exterior Soffits	CLNG, ROOF, WALL			100	200	300	300	300	350	350
B	30	80	.30	Exterior Bulkheads	CLNG, ROOF, WALL			100	200	300	300	300	350	350
C				**INTERIORS**										
C	10			**Interior Construction**										
C	10	10		**Partitions**										

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
C	10	10	.10	Interior Fixed Partitions	WALL			100	200	300	300	300	350	350
C	10	10	.20	Interior Glazed Partitions	CWSY			100	200	300	300	300	350	350
C	10	10	.40	Interior Demountable Partitions	FUSY			100	200	300	300	300	350	350
C	10	10	.50	Interior Operable Partitions	SPEQ			100	200	300	300	300	350	350
C	10	10	.70	Interior Screens	FUSY			100	200	300	300	300	350	350
C	10	10	.90	Interior Partitions Supplementary Components	WALL			100	200	300	300	300	350	350
C	10	20		**Interior Windows**										
C	10	20	.10	Interior Operating Windows	WNDW			100	200	300	300	300	350	350
C	10	20	.20	Interior Fixed Windows	WNDW			100	200	300	300	300	350	350
C	10	20	.50	Interior Special Function Windows	WNDW			100	200	300	300	300	350	350
C	10	20	.90	Interior Window Supplementary Components	WNDW			100	200	300	300	300	350	350
C	10	30		**Interior Doors**			**Door, Fire;**	100	200	300	300	350	350	500
C	10	30	.10	Interior Swinging Doors	DOOR			100	200	300	300	300	350	350
C	10	30	.20	Interior Entrance Doors	CWSY, DOOR		Door, Automatic;	100	200	300	300	350	350	500
C	10	30	.25	Interior Sliding Doors	CWSY, DOOR			100	200	300	300	300	350	350
C	10	30	.30	Interior Folding Doors	DOOR, SPEQ			100	200	300	300	300	350	350
C	10	30	.40	Interior Coiling Doors	DOOR		Door, Overhead;	100	200	300	300	350	350	500
C	10	30	.50	Interior Panel Doors	DOOR			100	200	300	300	300	350	350
C	10	30	.70	Interior Special Function Doors	DOOR			100	200	300	300	300	350	350
C	10	30	.80	Interior Access Doors and Panels	DOOR, SPEQ			100	200	300	300	300	350	350
C	10	30	.90	Interior Door Supplementary Components	CWSY, DOOR, SPEQ			100	200	300	300	300	350	350
C	10	40		**Interior Grilles and Gates**										
C	10	40	.10	Interior Grilles	DOOR			100	200	300	300	300	350	350
C	10	40	.50	Interior Gates	DOOR			100	200	300	300	300	350	350
C	10	60		**Raised Floor Construction**										
C	10	60	.10	Access Flooring	FLOR			100	200	300	300	300	350	350
C	10	60	.30	Platform/Stage Floors	FLOR			100	200	300	300	300	350	350
C	10	70		**Suspended Ceiling Construction**										
C	10	70	.10	Acoustical Suspended Ceilings	CLNG			100	200	300	300	300	350	350
C	10	70	.20	Suspended Plaster and Gypsum Board Ceilings	CLNG			100	200	300	300	300	350	350
C	10	70	.50	Specialty Suspended Ceilings	CLNG			100	200	300	300	300	350	350
C	10	70	.70	Special Function Suspended Ceilings	CLNG			100	200	300	300	300	350	350
C	10	70	.90	Ceiling Suspension Components	CLNG			100	200	300	300	300	350	350
C	10	90		**Interior Specialties**										
C	10	90	.10	Interior Railings and Handrails	RAIL			100	200	300	300	300	350	350
C	10	90	.15	Interior Louvers	AIRT			100	200	300	300	300	350	350
C	10	90	.20	Information Specialties	GENM		Lighted Sign;	100	200	300	300	350	350	500
C	10	90	.25	Compartments and Cubicles	SPEQ			100	200	300	300	300	350	350
C	10	90	.30	Service Walls	WALL			100	200	300	300	300	350	350
C	10	90	.35	Wall and Door Protection	SPEQ			100	200	300	300	300	350	350
C	10	90	.40	Toilet, Bath and Laundry Accessories	SPEQ			100	200	300	300	300	350	350
C	10	90	.45	Interior Gas Lighting	LIFX			100	200	300	300	300	350	350
C	10	90	.50	Fireplaces and Stoves	MEEQ, SPEQ			100	200	300	300	300	350	350
C	10	90	.60	Safety Specialties	SPEQ			100	200	300	300	300	350	350

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
C	10	90	.70	Storage Specialties	SPEQ			100	200	300	300	300	350	350
C	10	90	.90	Other Interior Specialties	SPEQ			100	200	300	300	300	350	350
C	20			**Interior Finishes**										
C	20	10		**Wall Finishes**										
C	20	10	.10	Tile Wall Finish	DTLS, WALL			100	200	300	300	300	350	350
C	20	10	.20	Wall Paneling	DTLS, WALL			100	200	300	300	300	350	350
C	20	10	.30	Wall Coverings	DTLS, WALL			100	200	300	300	300	350	350
C	20	10	.35	Wall Carpeting	DTLS, WALL			100	200	300	300	300	350	350
C	20	10	.50	Stone Facing	DTLS, WALL			100	200	300	300	300	350	350
C	20	10	.60	Special Wall Surfacing	DTLS, WALL			100	200	300	300	300	350	350
C	20	10	.70	Wall Painting and Coating	DTLS, WALL			100	200	300	300	300	350	350
C	20	10	.80	Acoustical Wall Treatment	DTLS, WALL			100	200	300	300	300	350	350
C	20	10	.90	Wall Finish Supplementary Components	DTLS, WALL			100	200	300	300	300	350	350
C	20	20		**Interior Fabrications**	**CLMN, DTLS, SPEQ, WALL**			100	200	300	300	300	350	350
C	20	30		**Flooring**										
C	20	30	.10	Flooring Treatment	FLOR			100	200	300	300	300	350	350
C	20	30	.20	Tile Flooring	FLOR			100	200	300	300	300	350	350
C	20	30	.30	Specialty Flooring	FLOR			100	200	300	300	300	350	350
C	20	30	.40	Masonry Flooring	FLOR			100	200	300	300	300	350	350
C	20	30	.45	Wood Flooring	FLOR			100	200	300	300	300	350	350
C	20	30	.50	Resilient Flooring	FLOR			100	200	300	300	300	350	350
C	20	30	.60	Terrazzo Flooring	FLOR			100	200	300	300	300	350	350
C	20	30	.70	Fluid-Applied Flooring	FLOR			100	200	300	300	300	350	350
C	20	30	.75	Carpeting	FLOR			100	200	300	300	300	350	350
C	20	30	.80	Athletic Flooring	FLOR			100	200	300	300	300	350	350
C	20	30	.85	Entrance Flooring	FLOR			100	200	300	300	300	350	350
C	20	30	.90	Flooring Supplementary Components	FLOR			100	200	300	300	300	350	350
C	20	40		**Stair Finishes**										
C	20	40	.20	Tile Stair Finish	STRS			100	200	300	300	300	350	350
C	20	40	.40	Masonry Stair Finish	STRS			100	200	300	300	300	350	350
C	20	40	.45	Wood Stair Finish	STRS			100	200	300	300	300	350	350
C	20	40	.50	Resilient Stair Finish	STRS			100	200	300	300	300	350	350
C	20	40	.60	Terrazzo Stair Finish	STRS			100	200	300	300	300	350	350
C	20	40	.75	Carpeted Stair Finish	STRS			100	200	300	300	300	350	350
C	20	50		**Ceiling Finishes**										
C	20	50	.10	Plaster and Gypsum Board Finish	CLNG			100	200	300	300	300	350	350
C	20	50	.20	Ceiling Paneling	CLNG			100	200	300	300	300	350	350
C	20	50	.70	Ceiling Painting and Coating	CLNG			100	200	300	300	300	350	350
C	20	50	.80	Acoustic Ceiling Treatment	CLNG			100	200	300	300	300	350	350
C	20	50	.90	Ceiling Finish Supplementary Components	CLNG			100	200	300	300	300	350	350
C	20	90		**Interior Finish Schedule**				100	200	300	300	300	350	350
D				**SERVICES**										
D	10			**Conveying**										
D	10	10		**Vertical Conveying Systems**										
D	10	10	.10	Elevators	SPEQ		Elevator	100	200	300	300	350	350	500
D	10	10	.20	Lifts	SPEQ			100	200	300	300	300	350	350

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
D	10	10	.30	Escalators	GENM		Escalator	100	200	300	300	350	350	500
D	10	10	.50	Dumbwaiters	SPEQ			100	200	300	300	300	350	350
D	10	10	.60	Moving Ramps	GENM			100	200	300	300	300	350	350
D	10	30		**Horizontal Conveying**										
D	10	30	.10	Moving Walks	SPEQ		Powered Walk;	100	200	300	300	350	350	500
D	10	30	.30	Turntables	SPEQ			100	200	300	300	300	350	350
D	10	30	.50	Passenger Loading Bridges	SPEQ		Passenger Loading Bridge;	100	200	300	300	350	350	500
D	10	30	.70	People Movers	GENM, SPEQ			100	200	300	300	300	350	350
D	10	50		**Material Handling**										
D	10	50	.10	Cranes	SPEQ			100	200	300	300	300	350	350
D	10	50	.20	Hoists	SPEQ		Hoist;	100	200	300	300	350	350	500
D	10	50	.30	Derrecks	SPEQ			100	200	300	300	300	350	350
D	10	50	.40	Conveyors	GENM, SPEQ			100	200	300	300	300	350	350
D	10	50	.50	Baggage Handling Equipment	GENM, SPEQ		Valet Baggage Lift;	100	200	300	300	350	350	500
D	10	50	.60	Chutes	SPEQ, SYSD			100	200	300	300	300	350	350
D	10	50	.70	Pneumatic Tube Systems	SPEQ, SYSP			100	200	300	300	300	350	350
D	10	80		**Operable Access Systems**										
D	10	80	.10	Suspended Scaffolding	SPEQ			100	200	300	300	300	350	350
D	10	80	.20	Rope Climbers	SPEQ			100	200	300	300	300	350	350
D	10	80	.30	Elevating Platforms	SPEQ			100	200	300	300	300	350	350
D	10	80	.40	Powered Scaffolding	SPEQ			100	200	300	300	300	350	350
D	10	80	.50	Building Envelope Access	SPEQ			100	200	300	300	300	350	350
D	20			**Plumbing**										
D	20	10		**Domestic Water Distribution**										
D	20	10	.10	Facility Potable-Water Storage Tanks	MEEQ			100	200	300	300	300	350	350
D	20	10	.20	Domestic Water Equipment	MEEQ		Pump, Domestic-Water Packaged Booster; Pump, Domestic Water; Potable Water Cabinet	100	200	300	300	350	350	500
D	20	10	.40	Domestic Water Piping	MEEQ, SYSP			100	200	300	300	300	350	350
D	20	10	.60	Plumbing Fixtures	PBFX, SYSP		Water Bottle Filling Station;	100	200	300	300	350	350	500
D	20	10	.90	Domestic Water Distribution Supplementary Components	SYSP		Backflow Preventer;	100	200	300	300	350	350	500
D	20	20		**Sanitary Drainage**										
D	20	20	.10	Sanitary Sewerage Equipment	MEEQ		Interceptor, Grease; Interceptor, Sand Oil; Pump, Facility Packaged Sewage Pumping Stations; Pump, Sanitary Sewerage;	100	200	300	300	350	350	500
D	20	20	.30	Sanitary Sewerage Piping	SYSP			100	200	300	300	300	350	350
D	20	20	.90	Sanitary Drainage Supplementary Components	SYSP		Combination Air Vent; Flow Meter; Meter;	100	200	300	300	350	350	500
D	20	30		**Building Support Plumbing Systems**										
D	20	30	.10	Stormwater Drainage Equipment	MEEQ		Pump, Sump;	100	200	300	300	350	350	500
D	20	30	.20	Stormwater Drainage Piping	SYSP			100	200	300	300	300	350	350
D	20	30	.30	Facility Stormwater Drains	PBFX, SYSP			100	200	300	300	300	350	350
D	20	30	.60	Gray Water Systems	MEEQ, SYSP			100	200	300	300	300	350	350
D	20	30	.90	Building Support Plumbing System Supplementary Components	MEEQ, SYSP			100	200	300	300	300	350	350

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
D	20	50		**General Service Compressed-Air**	**SYSP**		**Air Compressor; Air Dryer;**	100	200	300	300	350	350	500
D	20	60		**Process Support Plumbing Systems**										
D	20	60	.10	Compressed-Air Systems	MEEQ, SYSP			100	200	300	300	300	350	350
D	20	60	.20	Vacuum Systems	MEEQ, SYSP			100	200	300	300	300	350	350
D	20	60	.30	Gas Systems	MEEQ, SYSP			100	200	300	300	300	350	350
D	20	60	.40	Chemical-Waste Systems	MEEQ, SYSP		Solvent Tank;	100	200	300	300	350	350	500
D	20	60	.50	Processed Water Systems	MEEQ, SYSP			100	200	300	300	300	350	350
D	20	60	.90	Process Support Plumbing System Supplementary Components	SYSP			100	200	300	300	300	350	350
D	30			**HVAC**										
D	30	10		**Facility Fuel Systems**										
D	30	10	.10	Fuel Piping	SYSP			100	200	300	300	300	350	350
D	30	10	.30	Fuel Pumps	MEEQ		Pump, Facility Fuel; Pump, Fuel Oil;	100	200	300	300	350	350	500
D	30	10	.50	Fuel Storage Tanks	MEEQ			100	200	300	300	300	350	350
D	30	20		**Heating Systems**	**MEEQ, SYSD, SYSP**									
D	30	20	.10	Heat Generation	MEEQ, SYSP		Boiler; Heat Exchanger; Pump, Boiler Feedwater; Sand Filter;	100	200	300	300	350	350	500
D	30	20	.30	Thermal Heat Storage	MEEQ			100	200	300	300	300	350	350
D	30	20	.70	Decentralized Heating Equipment	MEEQ		Air Curtain; Cabinet Unit Heater; Fan Coil Unit; Radiant Heater; Radiant Slab Manifold; Unit Heater;	100	200	300	300	350	350	500
D	30	20	.90	Heating System Supplementary Components	SYSD		Expansion Tank; Valve, Control; Valve, Ball; Valve, Butterfly; Valve, Check; Valve, General; Valve, Globe; Valve, Plug;	100	200	300	300	350	350	500
D	30	30		**Cooling Systems**	**MEEQ, SYSD, SYSP**									
D	30	30	.10	Central Cooling	MEEQ, SYSP		Air Conditioning Unit; Chiller; Cooling Tower; Packaged Compressor Condensor; PCA Plant; Sand Filter;	100	200	300	300	350	350	500
D	30	30	.30	Evaporative Air-Cooling	MEEQ			100	200	300	300	300	350	350
D	30	30	.50	Thermal Cooling Storage	MEEQ			100	200	300	300	300	350	350
D	30	30	.70	Decentralized Cooling	MEEQ		Air Conditioning Unit; Pre-Conditioned Air, DX; Pre-Conditioned Air, Hydronic;	100	200	300	300	350	350	500

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
D	30	30	.90	Cooling System Supplementary Components			Valve, Control; Valve, Ball; Valve, Butterfly; Valve, Check; Valve, General; Valve, Globe; Valve, Plug;	100	200	300	300	350	350	500
D	30	50		**Facility HVAC Distribution Systems**				100	200	300	300	300	350	350
D	30	50	.10	Facility Hydronic Distribution	MEEQ, SYSP		Pump, Hydronic; Pump, Specialized Liquid; Solvent Tank;	100	200	300	300	350	350	500
D	30	50	.30	Facility Steam Distribution	MEEQ, SYSP			100	200	300	300	300	350	350
D	30	50	.50	HVAC Air Distribution	AIRT, MEEQ. SYSD		Air Handling Unit; Duct Heater; Fire Damper; Humidity Control Equipment; Makeup Air Unit; Damper; Rooftop Unit; VAV;	100	200	300	300	350	350	500
D	30	50	.90	Facility Distribution Systems Supplementary Components	SYSD		Valve, Control; Valve, Ball; Valve, Butterfly; Valve, Check; Valve, General; Valve, Globe; Valve, Plug;	100	200	300	300	350	350	500
D	30	60		**Ventilation**										
D	30	60	.10	Supply Air	AIRT, SYSD		Fan, Supply;	100	200	300	300	350	350	500
D	30	60	.20	Return Air	AIRT, SYSD		Fan, Return;	100	200	300	300	350	350	500
D	30	60	.30	Exhaust Air	AIRT, SYSD		Fan, Exhaust; Fan, Relief; Fan, Smoke;	100	200	300	300	350	350	500
D	30	60	.40	Outside Air	AIRT, SYSD			100	200	300	300	300	350	350
D	30	60	.60	Air-to-Air Energy Recovery	MEEQ			100	200	300	300	300	350	350
D	30	60	.70	HVAC Air Cleaning	MEEQ		Air Solid Separator;	100	200	300	300	350	350	500
D	30	60	.90	Ventilation Supplementary Components	SYSD			100	200	300	300	300	350	350
D	30	70		**Special Purpose HVAC Systems**										
D	30	70	.10	Snow Melting	SYSP			100	200	300	300	300	350	350
D	40			**Fire Protection**										
D	40	10		**Fire Suppression**			**Fire Zone;**	100	200	300	300	350	350	500
D	40	10	.10	Water-Based Fire-Suppression	MEEQ, SPRK, SYSP		Backflow Preventer; Pump, Fire; Pump, Pressure Maintenance; Pump, Vertical-Turbine Fire;	100	200	300	300	350	350	500
D	40	10	.50	Fire-Extinguishing	SPRK, SYSP			100	200	300	300	300	350	350
D	40	10	.90	Fire Suppression Supplementary Components	SYSP, MASS			100	200	300	300	300	350	350
D	40	30		**Fire Protection Specialties**										
D	40	30	.10	Fire Protection Cabinets	SPEQ			100	200	300	300	300	350	350
D	40	30	.30	Fire Extinguishers	SPEQ			100	200	300	300	300	350	350
D	40	30	.50	Breathing Air Replenishment Systems	SPEQ			100	200	300	300	300	350	350

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
D	40	30	.70	Fire Extinguisher Accessories	SPEQ			100	200	300	300	300	350	350
D	50			**Electrical**										
D	50	10		**Facility Power Generation**										
D	50	10	.10	Packaged Generator Assemblies	ELEQ		Generator; UPS;	100	200	300	300	350	350	500
D	50	10	.20	Battery Equipment	ELEQ, ELFX		UPS;	100	200	300	300	350	350	500
D	50	10	.30	Photovoltaic Collectors	ELEQ			100	200	300	300	300	350	350
D	50	10	.40	Fuel Cells	ELEQ			100	200	300	300	300	350	350
D	50	10	.60	Power Filtering and Conditioning	ELEQ		Constant Current Regulator; VFD; VFD/Bypass Switch	100	200	300	300	350	350	500
D	50	10	.70	Transfer Switches	ELEQ		Automatic Transfer Switch;	100	200	300	300	350	350	500
D	50	10	.90	Facility Power Generation Supplementary Components	ELEQ, SYSC		Energy Management Control System;	100	200	300	300	350	350	500
D	50	20		**Electrical Service and Distribution**										
D	50	20	.10	Electrical Service	ELEQ		Switchgear; Transformer;	100	200	300	300	350	350	500
D	50	20	.30	Power Distribution	CTRA, ELEQ, SYSC		CKT Selector Switch; Electrical Panel; Ground Power Unit; Motor Control Ctr;	100	200	300	300	350	350	500
D	50	20	.70	Facility Grounding	ELEQ, SYSC			100	200	300	300	300	350	350
D	50	20	.90	Electrical Service and Distribution Supplementary Components	CTRA, ELEQ, SYSC			100	200	300	300	300	350	350
D	50	30		**General Purpose Electrical Power**										
D	50	30	.10	Branch Wiring System	CTRA, ELEQ, SYSC			100	200	300	300	300	350	350
D	50	30	.50	Wiring Devices	ELFX, LIDV, SYSW			100	200	300	300	300	350	350
D	50	30	.90	General Purpose Electrical Power Supplementary Components	CTRA, ELEQ, SYSC			100	200	300	300	300	350	350
D	50	40		**Lighting**										
D	50	40	.10	Lighting Control	ELEQ, LIDV, SYSW		Lighting Control;	100	200	300	300	350	350	500
D	50	40	.20	Branch Wiring for Lighting	CTRA, ELEQ, LIDV, SYSC			100	200	300	300	300	350	350
D	50	40	.50	Lighting Fixtures	LIFX			100	200	300	300	300	350	350
D	50	40	.90	Lighting Supplementary Components	CTRA, SYSC			100	200	300	300	300	350	350
D	50	80		**Miscellaneous Electrical Systems**										
D	50	80	.10	Lightning Protection	ELEQ, SYSC			100	200	300	300	300	350	350
D	50	80	.40	Cathodic Protection	ELEQ, ELFX, SYSC			100	200	300	300	300	350	350
D	50	80	.70	Transient Voltage Suppression	ELEQ			100	200	300	300	300	350	350
D	50	80	.90	Miscellaneous Electrical Systems Supplementary Components	CTRA, ELEQ, SYSC			100	200	300	300	300	350	350
D	60			**Communications**										
D	60	10		**Data Communications**	**SYSC**									
D	60	10	.10	Data Communications Network Equipment	CMDV, DTDV			100	200	300	300	300	350	350
D	60	10	.20	Data Communications Hardware	DTDV			100	200	300	300	300	350	350
D	60	10	.30	Data Communications Peripheral Data Equipment	CMDV, DTDV			100	200	300	300	300	350	350
D	60	10	.50	Data Communications Software	n/a			100	200	300	300	300	350	350
D	60	10	.60	Data Communication Program and Integration Services	n/a			100	200	300	300	300	350	350
D	60	20		**Voice Communications**	**SYSC**									

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
D	60	20	.10	Voice Communications Switching and Routing Equipment	CMDV			100	200	300	300	300	350	350
D	60	20	.20	Voice Communications Terminal Equipment	TLDV		Call Box;	100	200	300	300	350	350	500
D	60	20	.30	Voice Communications Messaging	n/a			100	200	300	300	300	350	350
D	60	20	.40	Call Accounting	CMDV			100	200	300	300	300	350	350
D	60	20	.50	Call Management	CMDV			100	200	300	300	300	350	350
D	60	30		**Audio-Video Communication**	**SYSC**									
D	60	30	.10	Audio-Video Systems	CMDV, MASS			100	200	300	300	300	350	350
D	60	30	.50	Electronic Digital Systems	CMDV, DTDV		Lighted Sign;	100	200	300	300	350	350	500
D	60	60		**Distributed Communications and Monitoring**	**SYSC**									
D	60	60	.10	Distributed Audio-Video Communications Systems	CMDV, MASS		ECS/Microphone; ECS/Paging; PATV;	100	200	300	300	350	350	500
D	60	60	.30	Healthcare Communications and Monitoring	CMDV, NCDV			100	200	300	300	300	350	350
D	60	60	.50	Distributed Systems	CMDV			100	200	300	300	300	350	350
D	60	90		**Communications Supplementary Components**	**SYSC**									
D	60	90	.10	Supplementary Components	CMDV, CTRA, SYSC			100	200	300	300	300	350	350
D	70			**Electronic Safety and Security**										
D	70	10		**Access Control and Intrusion Detection**										
D	70	10	.10	Access Control	SCDV, SYSC		Card Reader;	100	200	300	300	350	350	500
D	70	10	.50	Intrusion Detection	SCDV, SYSC			100	200	300	300	300	350	350
D	70	30		**Electronic Surveillance**										
D	70	30	.10	Video Surveillance	SCDV, SYSC		Camera;	100	200	300	300	350	350	500
D	70	30	.50	Electronic Personal Protection	SCDV, SYSC			100	200	300	300	300	350	350
D	70	50		**Detection and Alarm**										
D	70	50	.10	Fire Detection and Alarm	FADV, MASS, SYSC			100	200	300	300	300	350	350
D	70	50	.20	Radiation Detection and Alarm	FADV, SYSC			100	200	300	300	300	350	350
D	70	50	.30	Fuel-Gas Detection and Alarm	FADV, SYSC		Gas Detection System;	100	200	300	300	350	350	500
D	70	50	.40	Fuel-Oil Detection and Alarm	FADV, SYSC		Gas Detection System;	100	200	300	300	350	350	500
D	70	50	.50	Refrigeration Detection and Alarm	FADV, SYSC			100	200	300	300	300	350	350
D	70	50	.60	Water Intrusion Detection and Alarm	FADV, SYSC			100	200	300	300	300	350	350
D	70	70		**Electronic Monitoring and Control**										
D	70	70	.10	Electronic Detention Monitoring and Control	SCDV, SYSC			100	200	300	300	300	350	350
D	70	90		**Electronic Safety and Security Supplementary Components**										
D	70	90	.10	Supplementary Components	CTRA, SYSC			100	200	300	300	300	350	350
D	80			**Integrated Automation**										
D	80	10		**Integrated Automation Facility Controls**			**Actuator;**	100	200	300	300	350	350	500
D	80	10	.10	Integrated Automation Control of Equipment	DTDV			100	200	300	300	300	350	350
D	80	10	.20	Integrated Automation Control of Conveyances	DTDV			100	200	300	300	300	350	350

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
D	80	10	.30	Integrated Automation Control of Fire-Suppression Systems	DTDV, FADV			100	200	300	300	300	350	350
D	80	10	.40	Integrated Automation Control of Plumbing Systems	DTDV			100	200	300	300	300	350	350
D	80	10	.50	Integrated Automation Control of HVAC Systems	DTDV			100	200	300	300	300	350	350
D	80	10	.60	Integrated Automation Control of Electrical Systems	DTDV			100	200	300	300	300	350	350
D	80	10	.70	Integrated Automation Control of Communication Systems	CMDV, DTDV			100	200	300	300	300	350	350
D	80	10	.80	Integrated Automation Control of Electronic Safety and Security Systems	DTDV, SCDV			100	200	300	300	300	350	350
D	80	10	.90	Integrated Automation Control of Supplementary Components	CTRA, DTDV, SYSC			100	200	300	300	300	350	350
E				**EQUIPMENT & FURNISHINGS**										
E	10			**Equipment**										
E	10	10		**Vehicle and Pedestrian Equipment**										
E	10	10	.10	Vehicle Servicing Equipment	SPEQ		Vehicle Charging Station;	100	200	300	300	350	350	500
E	10	10	.30	Interior Parking Control Equipment	SPEQ			100	200	300	300	300	350	350
E	10	10	.50	Loading Dock Equipment	SPEQ			100	200	300	300	300	350	350
E	10	10	.70	Interior Pedestrian Control Equipment	SCDV, SPEQ			100	200	300	300	300	350	350
E	10	30		**Commercial Equipment**										
E	10	30	.10	Mercantile and Service Equipment	SPEQ			100	200	300	300	300	350	350
E	10	30	.20	Vault Equipment	SPEQ			100	200	300	300	300	350	350
E	10	30	.25	Teller and Service Equipment	CMDV, SPEQ			100	200	300	300	300	350	350
E	10	30	.30	Refrigerated Display Equipment	SPEQ			100	200	300	300	300	350	350
E	10	30	.35	Commercial Laundry and Dry Cleaning Equipment	SPEQ			100	200	300	300	300	350	350
E	10	30	.40	Maintenance Equipment	SPEQ, SYSP			100	200	300	300	300	350	350
E	10	30	.50	Hospitality Equipment	SPEQ			100	200	300	300	300	350	350
E	10	30	.55	Unit Kitchens	MGRP			100	200	300	300	300	350	350
E	10	30	.60	Photographic Processing Equipment	SPEQ			100	200	300	300	300	350	350
E	10	30	.70	Postal, Packaging and Shipping Equipment	SPEQ			100	200	300	300	300	350	350
E	10	30	.75	Office Equipment	CMDV, SPEQ, TLDV			100	200	300	300	300	350	350
E	10	30	.80	Foodservice Equipment	AIRT, MEEQ, PBFX, SPEQ			100	200	300	300	300	350	350
E	10	40		**Institutional Equipment**										
E	10	40	.10	Educational and Scientific Equipment	AIRT, MEEQ, PBFX			100	200	300	300	300	350	350
E	10	40	.20	Healthcare Equipment	SPEQ			100	200	300	300	300	350	350
E	10	40	.40	Religious Equipment	CASE, SPEQ			100	200	300	300	300	350	350
E	10	40	.60	Security Equipment	SPEQ			100	200	300	300	300	350	350
E	10	40	.70	Detention Equipment	SPEQ			100	200	300	300	300	350	350
E	10	60		**Residential Equipment**										
E	10	60	.10	Residential Appliances	SPEQ			100	200	300	300	300	350	350
E	10	60	.50	Retractable Stairs	SPEQ			100	200	300	300	300	350	350
E	10	60	.70	Residential Ceiling Fans	LIFX, SPEQ			100	200	300	300	300	350	350
E	10	70		**Entertainment and Recreational Equipment**										

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
E	10	70	.10	Theater and Stage Equipment	SPEQ			100	200	300	300	300	350	350
E	10	70	.20	Musical Equipment	SPEQ			100	200	300	300	300	350	350
E	10	70	.50	Athletic Equipment	FURN, SPEQ			100	200	300	300	300	350	350
E	10	70	.60	Recreational Equipment	SPEQ			100	200	300	300	300	350	350
E	10	90		**Other Equipment**										
E	10	90	.10	Solid Waste Handling Equipment	MEEQ, SPEQ		Incinerator;	100	200	300	300	350	350	500
E	10	90	.30	Agricultural Equipment	SPEQ			100	200	300	300	300	350	350
E	10	90	.40	Horticultural Equipment	SPEQ			100	200	300	300	300	350	350
E	10	90	.60	Decontamination Equipment	SPEQ			100	200	300	300	300	350	350
E	20			**Furnishings**										
E	20	10		**Fixed Furnishings**										
E	20	10	.10	Fixed Art	FURN, WALL			100	200	300	300	300	350	350
E	20	10	.20	Window Treatments	GENM, WNDW			100	200	300	300	300	350	350
E	20	10	.30	Casework	CASE			100	200	300	300	300	350	350
E	20	10	.70	Fixed Multiple Seating	FURN, FUSY			100	200	300	300	300	350	350
E	20	10	.90	Other Fixed Furnishings	FURN, SITE			100	200	300	300	300	350	350
E	20	50		**Movable Furnishings**										
E	20	50	.10	Movable Art	FURN, GENM			100	200	300	300	300	350	350
E	20	50	.30	Furniture	FURN, FUSY			100	200	300	300	300	350	350
E	20	50	.40	Accessories	FURN, SPEQ			100	200	300	300	300	350	350
E	20	50	.60	Movable Multiple Seating	FURN, FUSY			100	200	300	300	300	350	350
E	20	50	.90	Other Movable Furnishings	FURN, SITE			100	200	300	300	300	350	350
F				**SPECIAL CONSTRUCTION & DEMOLITION**										
F	10			**Special Construction**										
F	10	10		**Integrated Construction**										
F	10	10	.10	Building Modules	MGRP			100	200	300	300	300	350	350
F	10	10	.50	Manufactured/Fabricated Rooms	MGRP			100	200	300	300	300	350	350
F	10	10	.70	Modular Mezzanines	MGRP			100	200	300	300	300	350	350
F	10	20		**Special Structures**										
F	10	20	.10	Fabric Structures	GENM, SPEQ, STFR			100	200	300	300	300	350	350
F	10	20	.20	Space Frames	STFR			100	200	300	300	300	350	350
F	10	20	.30	Geodesic Structures	GENM, SPEQ, STFR			100	200	300	300	300	350	350
F	10	20	.40	Manufactured-Engineered Structures	MGRP			100	200	300	300	300	350	350
F	10	20	.60	Manufactured Canopies	GENM, STCO, STFR			100	200	300	300	300	350	350
F	10	20	.65	Rammed Earth Construction	n/a			100	200	300	300	300	350	350
F	10	20	.70	Towers	n/a			100	200	300	300	300	350	350
F	10	30		**Special Function Construction**										
F	10	30	.10	Sound and Vibration Control	DTLS, GENM, SPEQ			100	200	300	300	300	350	350
F	10	30	.30	Seismic Control	DTLS, GENM, SPEQ			100	200	300	300	300	350	350
F	10	30	.50	Radiation Protection	DTLS, GENM, SPEQ			100	200	300	300	300	350	350
F	10	50		**Special Facility Components**										
F	10	50	.10	Pools	MEEQ, SPEQ, SYSP			100	200	300	300	300	350	350
F	10	50	.20	Interior Fountains	MEEQ, SPEQ, SYSP			100	200	300	300	300	350	350
F	10	50	.30	Interior Water Features	PBFX, SPEQ			100	200	300	300	300	350	350
F	10	50	.40	Aquariums	SPEQ			100	200	300	300	300	350	350
F	10	50	.50	Amusement Park Structures and Equipment	SPEQ			100	200	300	300	300	350	350

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
F	10	50	.60	Ice Rinks	MEEQ, SPEQ, SYSP			100	200	300	300	300	350	350
F	10	50	.70	Animal Containment	SPEQ			100	200	300	300	300	350	350
F	10	60		**Athletic and Recreational Special Construction**	**SPEQ**			100	200	300	300	300	350	350
F	10	80		**Special Instrumentation**										
F	10	80	.10	Stress Instrumentation	SPEQ			100	200	300	300	300	350	350
F	10	80	.20	Seismic Instrumentation	SPEQ			100	200	300	300	300	350	350
F	10	80	.40	Meteorological Instrumentation	SPEQ			100	200	300	300	300	350	350
F	10	80	.60	Earth Movement Instrumentation	SPEQ			100	200	300	300	300	350	350
F	20			**Facility Remediation**										
F	20	10		**Hazardous Materials Remediation**	**n/a**									
F	20	10	.10	Transportation and Disposal of Hazardous materials				100	200	300	300	300	350	350
F	20	10	.20	Asbestos Remediation				100	200	300	300	300	350	350
F	20	10	.30	Lead Remediation				100	200	300	300	300	350	350
F	20	10	.40	Polychlorinate Biphenyl Remediation				100	200	300	300	300	350	350
F	20	10	.50	Mold Remediation				100	200	300	300	300	350	350
F	30			**Demolition**										
F	30	10		**Structure Demolition**	**n/a**	**Utilize phasing for element being demoed.**								
F	30	10	.10	Building Demolition				100	200	300	300	300	350	350
F	30	10	.30	Tower Demolition				100	200	300	300	300	350	350
F	30	10	.50	Bridge Demolition				100	200	300	300	300	350	350
F	30	10	.70	Dam Demolition				100	200	300	300	300	350	350
F	30	30		**Selective Demolition**	**n/a**	**Utilize phasing for element being demoed.**								
F	30	30	.10	Selective Building Demolition				100	200	300	300	300	350	350
F	30	30	.30	Selective Interior Demolition				100	200	300	300	300	350	350
F	30	30	.50	Selective Bridge Demolition				100	200	300	300	300	350	350
F	30	30	.70	Selective Historic Demolition				100	200	300	300	300	350	350
F	30	50		**Structure Moving**	**n/a**									
F	30	50	.10	Structure Relocation				100	200	300	300	300	350	350
F	30	50	.30	Structure Raising				100	200	300	300	300	350	350
G				**BUILDING SITEWORK**										
G	10			**Site Preparation**										
G	10	10		**Site Clearing**	**n/a**	**0**								
G	10	10	.10	Clearing and Grubbing	N/A	N/A		100	200	300	300	300	350	350
G	10	10	.30	Tree and Shrub Removal and Trimming	N/A	N/A		100	200	300	300	300	350	350
G	10	10	.50	Earth Stripping and Stockpiling	N/A	N/A		100	200	300	300	300	350	350
G	10	20		**Site Elements Demolition**	**0**	**See respective layer for element being demoed, use -DEMO as fourth designator**								
G	10	20	.10	Utility Demolition		See respective layer for element being demoed, use -DEMO as fourth designator		100	200	300	300	300	350	350
G	10	20	.30	Infrastructure Demolition		See respective layer for element being demoed, use -DEMO as fourth designator		100	200	300	300	300	350	350

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
G	10	20	.50	Selective Site Demolition		See respective layer for element being demoed, use -DEMO as fourth designator		100	200	300	300	300	350	350
G	10	30		**Site Element Relocations**	0	0								
G	10	30	.10	Utility Relocation	See utility type	See utility type		100	200	300	300	300	350	350
G	10	50		**Site Remediation**										
G	10	50	.10	Physical Decontamination	POINT/POLYGON	C-POLL-CONC-, C-POLL-POTN-		100	200	300	300	300	350	350
G	10	50	.15	Chemical Decontamination	POINT/POLYGON	C-POLL-CONC-, C-POLL-POTN-		100	200	300	300	300	350	350
G	10	50	.20	Thermal Decontamination	POINT/POLYGON	C-POLL-CONC-, C-POLL-POTN-		100	200	300	300	300	350	350
G	10	50	.25	Biological Decontamination	POINT/POLYGON	C-POLL-CONC-, C-POLL-POTN-		100	200	300	300	300	350	350
G	10	50	.30	Remediation Soil Stabilization	POINT/POLYGON	C-POLL-CONC-, C-POLL-POTN-		100	200	300	300	300	350	350
G	10	50	.40	Site Containment	POINT/POLYGON	C-STOR-HAZM-, C-STOR-HAZW-		100	200	300	300	300	350	350
G	10	50	.45	Sinkhole Remediation	N/A	N/A		100	200	300	300	300	350	350
G	10	50	.50	Hazardous Waste Drum Handling	POINT/POLYGON	C-STOR-HAZM-, C-STOR-HAZW-		100	200	300	300	300	350	350
G	10	50	.60	Contaminated Site Material Removal	POINT/POLYGON	C-STOR-HAZM-, C-STOR-HAZW-		100	200	300	300	300	350	350
G	10	50	.80	Water Remediation	N/A	N/A		100	200	300	300	300	350	350
G	10	70		**Site Earthwork**										
G	10	70	.10	Grading	SURFACE	C-TOPO-MAJR-, C-TOPO-MINR-		100	200	300	300	300	350	350
G	10	70	.20	Excavation and Fill	SURFACE/POLYGON	C-TOPO-MAJR-, C-TOPO-MINR-		100	200	300	300	300	350	350
G	10	70	.30	Embankments	SURFACE	C-TOPO-MAJR-, C-TOPO-MINR-		100	200	300	300	300	350	350
G	10	70	.35	Errosion and Sedimentation Controls	UTILITY POLYGON	C-STRM-EROS-, C-STRM-CHUT-		100	200	300	300	300	350	350
G	10	70	.40	Soil Stabilization	POINT/POLYGON	C-STRM-EROS-		100	200	300	300	300	350	350
G	10	70	.45	Rock Stabilization	POINT/POLYGON	C-STRM-EROS-		100	200	300	300	300	350	350
G	10	70	.50	Soil Reinforcement	POINT/POLYGON	C-STRM-EROS-		100	200	300	300	300	350	350
G	10	70	.55	Slope Protection	POINT/POLYGON	C-STRM-EROS-		100	200	300	300	300	350	350
G	10	70	.60	Gabions	POLYGON	C-STRM-CHUT-		100	200	300	300	300	350	350
G	10	70	.65	Riprap	POINT/POLYGON	C-STRM-EROS-		100	200	300	300	300	350	350
G	10	70	.70	Wetlands	POLYGON	V-TOPO-WETL		100	200	300	300	300	350	350
G	10	70	.80	Earth Dams	POLYGON	C-STRM-CHUT-		100	200	300	300	300	350	350
G	10	70	.90	Site Soil Treatment	N/A	N/A		100	200	300	300	300	350	350
G	20			**Site Improvements**										
G	20	10		**Roadways**										
G	20	10	.10	Roadway Pavement	CORRIDOR/SURFACE/3D POLYLINE	C-ROAD-OTLN-		100	200	300	300	300	350	350
G	20	10	.20	Roadway Curbs and Gutters	POLYGON	C-ROAD-CURB-		100	200	300	300	300	350	350
G	20	10	.40	Roadway Appurtenances	POINT	C-ROAD-POIN-	Lighted Sign;	100	200	300	300	350	350	500
G	20	10	.70	Roadway Lighting	POINT	C-POLE-UTIL-		100	200	300	300	300	350	350
G	20	10	.80	Vehicle Fare Collection	N/A	N/A		100	200	300	300	300	350	350
G	20	20		**Parking Lots**										
G	20	20	.10	Parking Lot Pavement	FEATURE LINE/3D POLYGON	C-PKNG-OTLN-		100	200	300	300	300	350	350
G	20	20	.20	Parking Lot Curbs and Gutters	FEATURE LINE/3D POLYGON	C-ROAD-CURB-		100	200	300	300	300	350	350
G	20	20	.40	Parking Lot Appurtenances	FEATURE LINE/3D POLYGON	C-PKNG-ISLD	Lighted Sign;	100	200	300	300	350	350	500
G	20	20	.70	Parking Lot Lighting	POINT	C-POLE-UTIL-		100	200	300	300	300	350	350
G	20	20	.80	Exterior Parking Control Equipment	POLYLINE/POINT	C-SITE-GATE-		100	200	300	300	300	350	350
G	20	30		**Pedestrian Plazas and Walkways**										
G	20	30	.10	Pedestrian Pavement	FEATURE LINE/3D POLYGON	C-SITE-WALK-		100	200	300	300	300	350	350
G	20	30	.20	Pedestrian Pavement Curbs and Gutters	FEATURE LINE/3D POLYGON	C-ROAD-CURB-		100	200	300	300	300	350	350
G	20	30	.30	Exterior Steps and Ramps	FEATURE LINE/3D POLYGON	C-SITE-WALK-		100	200	300	300	300	350	350

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
G	20	30	.40	Pedestrian Pavement Appurtenances	FEATURE LINE/3D POLYGON	C-SITE-WALK-		100	200	300	300	300	350	350
G	20	30	.70	Plaza and Walkway Lighting	POINT	C-POLE-UTIL-		100	200	300	300	300	350	350
G	20	30	.80	Exterior Pedestrian Control Equipment	N/A	N/A		100	200	300	300	300	350	350
G	20	40		**Airfields**										
G	20	40	.10	Aviation Pavement	POLYGON	C-RUNW-SEGM-, C-APRN-OTLN-, C-TAXI-OTLN-, C-AIRF-AHOA		100	200	300	300	300	350	350
G	20	40	.20	Aviation Pavement Curbs and Gutters	FEATURE LINE/3D POLYGON	C-ROAD-CURB-		100	200	300	300	300	350	350
G	20	40	.40	Aviation Pavement Appurtenances	POINT	C-APRN-SIGN-, C-PVMT-SIGN-, C-RUNW-SIGN-, C-TAXI-SIGN-, V-LITE-SIGN-, E-SPCL-TRAF-	Lighted Sign;	100	200	300	300	350	350	500
G	20	40	.70	Airfield Lighting	POINT	C-LITE-APPR-, C-LITE-DIST-, C-LITE-LANE-, C-LITE-OBST-, V-LITE-RUNW-, V-LITE-TAXI-, V-LITE-THRS-, V-LITE-RUNW-TDZN, C-LITE-RUNW-EDGE, C-LITE-TAXI-CNTL, C-LITE-RNWY-GARD, C-LITE-TAXI-EDGE, C-LITE-RUNW-PTGS1	Airfield Lighting Circuit;	100	200	300	300	350	350	500
G	20	40	.80	Airfield Signaling and Control Equipment	POINT	C-LITE-SIGN-		100	200	300	300	300	350	350
G	20	50		**Athletic, Recreational, and Playfield Areas**	**N/A**	**N/A**								
G	20	50	.10	Athletic Areas				100	200	300	300	300	350	350
G	20	50	.30	Recreational Areas				100	200	300	300	300	350	350
G	20	50	.50	Playfield Areas				100	200	300	300	300	350	350
G	20	60		**Site Development**										
G	20	60	.10	Exterior Fountains	N/A	N/A		100	200	300	300	300	350	350
G	20	60	.20	Fences and Gates	POINT/POLYLINE	C-DETL-FENC-, C-SITE-FENC-,C-SECU-FENC-, C-SITE-GATE-		100	200	300	300	300	350	350
G	20	60	.25	Site Furnishings	N/A	N/A		100	200	300	300	300	350	350
G	20	60	.30	Exterior Signage	POINT	C-PVMT-SIGN-	Lighted Sign;	100	200	300	300	350	350	500
G	20	60	.35	Flagpoles	POINT	C-AIRS-OBST-PPNT		100	200	300	300	300	350	350
G	20	60	.40	Covers and Shelters	POINT	V-SITE-STRC-		100	200	300	300	300	350	350
G	20	60	.45	Exterior Gas Lighting	N/A	N/A		100	200	300	300	300	350	350
G	20	60	.50	Site Equipment	N/A	N/A		100	200	300	300	300	350	350
G	20	60	.60	Retaining Walls	POLYLINE	C-SITE-FENC-		100	200	300	300	300	350	350
G	20	60	.70	Site Bridges	POLYGON	C-SITE-BRDG-, V-SITE-STRC-		100	200	300	300	300	350	350
G	20	60	.80	Site Screening Devices	N/A	N/A		100	200	300	300	300	350	350
G	20	60	.85	Site Specialties	N/A	N/A		100	200	300	300	300	350	350
G	20	80		**Landscaping**										
G	20	80	.10	Planting Irrigation	AEC PIPE	C-IRRG-PIPE-		100	200	300	300	300	350	350
G	20	80	.20	Turf and Grasses	POINT	C-DETL-GRAS-		100	200	300	300	300	350	350
G	20	80	.30	Plants	POINT	C-PLNT-PLTS-		100	200	300	300	300	350	350
G	20	80	.50	Planting Accessories	POINT	C-PLNT-CTNR-		100	200	300	300	300	350	350
G	20	80	.70	Landscape Lighting	N/A	N/A		100	200	300	300	300	350	350
G	20	80	.80	Landscaping Activities	N/A	N/A		100	200	300	300	300	350	350
G	30			**Liquid and Gas Site Utilities**										
G	30	10		**Water Utilities**										
G	30	10	.10	Site Domestic Water Distribution	AEC Pipe	V-UTIL-WATR-		100	200	300	300	300	350	350
G	30	10	.30	Site Fire Protection Water Distribution	AEC Pipe	C-AFFF-PIPE-, C-WATR-PIPE-, C-SPRN-PIPE		100	200	300	300	300	350	350

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
G	30	10	.50	Site Irrigation Water Distribution	AEC Pipe	C-IRRG-PIPE-		100	200	300	300	300	350	350
G	30	20		**Sanitary Sewerage Utilities**										
G	30	20	.10	Sanitary Sewerage utility Connection	AEC Structure	C-SSWR-FTTG-, C-SSWR-JBOX-		100	200	300	300	300	350	350
G	30	20	.20	Sanitary Sewerage Piping	AEC Pipe	C-SSWR-MAIN-, C-SSWR-SERV-		100	200	300	300	300	350	350
G	30	20	.40	Utility Septic Tanks	AEC Structure	C-SSWR-TANK-		100	200	300	300	300	350	350
G	30	20	.50	Sanitary Sewerage Structures	AEC Structure Junction/null	C-SSWR-FTTG-, C-SSWR-JBOX-, C-SSWR-DEVC-		100	200	300	300	300	350	350
G	30	20	.60	Sanitary Sewerage Lagoons	Polygon	C-SSWR-LAGN-, C-SSWR-LEAC-, C-SSWR-NITF-		100	200	300	300	300	350	350
G	30	30		**Storm Drainage Utilities**										
G	30	30	.10	Storm Drainage Utility Connection	AEC Structure	C-STRM-FTTG-, C-STRM-MHOL-		100	200	300	300	300	350	350
G	30	30	.20	Storm Drainage Piping	AEC Pipe	C-STRM-MAIN-		100	200	300	300	300	350	350
G	30	30	.30	Culverts	AEC Pipe	C-STRM-CULV-, C-STRM-CHUT-		100	200	300	300	300	350	350
G	30	30	.40	Site Storm Water Drains	AEC Structure	C-STRM-INLT-, C-STRM-STRC-		100	200	300	300	300	350	350
G	30	30	.50	Storm Drainage Pumps	AEC Structure	C-STRM-PUMP-		100	200	300	300	300	350	350
G	30	30	.60	Site Subdrainage	AEC Pipe	C-STRM-SUBS-, C-STRM-SERV-		100	200	300	300	300	350	350
G	30	30	.70	Storm Drainage Ponds and Reservoirs	Polygon	C-STRM-LAGN-, C-STRM-AFFF-		100	200	300	300	300	350	350
G	30	50		**Site Energy Distribution**										
G	30	50	.10	Site Hydronic Heating Distribution	AEC Structure	V-HTCW-HTPL-, V-HTCW-HTPS-		100	200	300	300	300	350	350
G	30	50	.20	Site Steam Energy Distribution	AEC Structure	C-HTCW-STML-, C-HTCW-STMS-, C-STEM-PIPE-		100	200	300	300	300	350	350
G	30	50	.40	Site Hydronic Cooling Distribution	AEC Pipe	V-HTCW-CHLL-, V-HTCW-CHLS-		100	200	300	300	300	350	350
G	30	60		**Site Fuel Distribution**										
G	30	60	.10	Site Gas Distribution	AEC Pipe	C-NGAS-MAIN-		100	200	300	300	300	350	350
G	30	60	.20	Site Fuel-Oil Distribution	AEC Pipe	C-FUEL-FOIL-		100	200	300	300	300	350	350
G	30	60	.30	Site Gasoline Distribution	AEC Pipe	C-FUEL-FGAS-		100	200	300	300	300	350	350
G	30	60	.40	Site Diesel Fuel Distribution	AEC Pipe	C-FUEL-MAIN-		100	200	300	300	300	350	350
G	30	60	.60	Site Aviation Fuel Distribution	AEC Pipe	C-FUEL-MAIN-		100	200	300	300	300	350	350
G	30	90		**Liquid and Gas Site Utilities Supplementary Components**										
G	30	90	.10	Supplementary Components	POINT	C-FUEL-DEVC-, C-NGAS-DEVC-		100	200	300	300	300	350	350
G	40			**Electrical Site Improvements**										
G	40	10		**Site Electric Distribution Systems**										
G	40	10	.10	Electrical Utility Services	Utility Line	C-PRIM-OVHD-, C-PRIM-UNDR-, C-SECD-OVHD-, C-SECD-UNDR-		100	200	300	300	300	350	350
G	40	10	.20	Electric Transmission and Distribution	Utility Line	C-PRIM-OVHD-, C-PRIM-UNDR-, C-SECD-OVHD-, C-SECD-UNDR-		100	200	300	300	300	350	350
G	40	10	.30	Electrical Substations	Utility Point	C-ELEC-SUBS-		100	200	300	300	300	350	350
G	40	10	.40	Electrical Transformers	Utility Point	C-TRAN-PADM-, C-TRAN-POLE-		100	200	300	300	300	350	350
G	40	10	.50	Electrical Switchgear and Protection Devices	Utility Point	C-LITE-PANL-, C-POWR-PANL-		100	200	300	300	300	350	350
G	40	10	.70	Site Grounding	Utility Point	C-GRND-EQUI-, C-GRND-REFR-		100	200	300	300	300	350	350
G	40	10	.90	Electrical System Instrumentation	Utility Point	C-POWR-PANL-		100	200	300	300	300	350	350
G	40	50		**Site Lighting**										
G	40	50	.10	Area Lighting	POINT	C-POLE-UTIL-		100	200	300	300	300	350	350
G	40	50	.20	Flood Lighting	POINT	C-POLE-UTIL-		100	200	300	300	300	350	350
G	40	50	.50	Building Illumination		N/A		100	200	300	300	300	350	350
G	40	50	.90	Exterior Lighting Supplementary Components		N/A		100	200	300	300	300	350	350
G	50			**Site Communications**										

UNIFORMAT 2010 LEVEL								DESIGN MODEL LOD AT PACKAGE DELIVERABLE					CONSTRUCTION MODEL	
1	2	3	4	ELEMENTS	OBJECT TYPE	LAYER NAME	Asset Types	30-59% LOD	60-89% LOD	90-99% LOD	100%-IFC LOD	Record Model	Fabrication Model	As-Built Model
G	50	10		**Site Communications Systems**										
G	50	10	.10	Site Communications Structures	Utility Polygon	C-COMM-VALT-		100	200	300	300	300	350	350
G	50	10	.30	Site Communications Distribution	AEC Pipe Network	C-CABL-FIBR-, C-COMM-OVHD-, C-COMM-UNDR-		100	200	300	300	300	350	350
G	50	10	.50	Wireless Communications Distribution	Point	C-COMM-ANTN-, C-EQPM-OTHR-, V-COMM-EQPM-	RECVR	100	200	300	300	350	350	500
G	90			**Miscellaneous Site Construction**										
G	90	10		**Tunnels**										
G	90	10	.10	Vehicular Tunnels	Polygon	C-SITE-TUNL-		100	200	300	300	300	350	350
G	90	10	.20	Pedestrian Tunnels	Polygon	C-SITE-TUNL-		100	200	300	300	300	350	350
G	90	10	.40	Service Tunnels	Polygon	C-SITE-TUNL-		100	200	300	300	300	350	350
G	90	10	.90	Tunnel Construction Related Activities	Polygon	C-SITE-TUNL-		100	200	300	300	300	350	350