STATE OF MINNESOTA

BIM GUIDELINE

State of Minnesota's Facilities Administration Data Capture Plan

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TABLE OF CONTENTS

GENERAL INFORMATION

REQUIREMENTS

DELIVERABLES

GLOSSARY + APPENDIX

GENERAL INFORMATION

BUILDING INFORMATION MODELING (BIM)

What is BIM? Who's using BIM? What are the benefits of BIM?

Building Information Modeling (BIM) is a collaborative effort involving the creation and management of digital, 3D building models and their associated data. BIM and Facility Management (FM) systems form a bi-directional link which allows for immediate information exchange, enhanced data accuracy, and increased productivity

BIM allows various stakeholders to participate in the building construction and management process beginning at design inception and extending all the way to facilities management. As a project develops, detailed asset information is tracked and stored for future reference. BIM can accomplish a wide variety of objectives depending upon the goal and scope of a given project.

Building Information Models (BIMs) are multidimensional; they function in 3D, 4D (time) and 5D(cost). BIMs can be assigned a nearly unlimited range of visual and non-visual building related information. The unique functionality of BIM makes it a very effective interdisciplinary coordination tool. It provides building stakeholders the benefit of seeing a building and its components in a virtual environment prior to physical construction. For additional information on the multitude of BIM applications please see **Exhibit A: BIM Uses.**

Benefits of BIM include but are not limited to:

- A collaborative and integrated approach to design.
- Use of 2D and 3D visualization of the building for marketing materials, and use of 4D (scheduling) and 5D (estimating) process modeling for construction sequencing and planning.
- Faster project delivery through design practicality, integrity and real-time estimating
- Project waste reduction through exact quantity take-offs, model schedule scenarios and site logistic planning.
- Increased construction and public safety through the review of complex structural details and crowd/fire modeling.
- Lifecycle asset management including information on product installation, warranties, serial numbers and preventative maintenance.

PURPOSE OF THIS GUIDE

State's Vision for BIM

The following document is provided to assist in the development of Integrated Lifecycle Management (ILM) strategies through Building Information Modeling (BIM) and Data Management.

The Building Information Modeling (BIM) Guideline represents a BIM pilot program and lifecycle data capture effort by the State of Minnesota. This guideline reflects an effort to enhance the technologies and processes employed by the State and its participating Agencies in the realms of construction and facilities management. The State of Minnesota is committed to adopting BIM as effectively and efficiently as possible.

The State of Minnesota has issued these instructions to aid in the implementation of current and future BIM projects.

Goals of BIM Standardization

The goal is to promote facility management standards and practices by gathering relevant data and documentation from the Architectural, Engineering and Construction (AEC) team for a given project. BIM allows for earlier and more accurate data collection during the construction process and assures that facility information is available in the web-enabled real property management system, Archibus. The State of Minnesota plans to integrate the data present in the Record BIM Model into its communal databases while also employing BIM as a tool for effective construction project management.

Objectives:

- Establish an environment to collaborate and coordinate BIM data and metadata for the life of the project.
- Transfer modeling content from one party to another
- Prepare accurate construction documents derived from the model
- Verify equipment asset attribute data in the model
- Integrate model metadata into the current web-enabled real property management system
- Track manufacturer, commissioning, and maintenance records
- Develop a Record BIM Model for integration into a facility management system
- Control and map metadata into the real property management system

AUTHORING SOFTWARE

The State of Minnesota acknowledges that there are numerous BIM authoring software programs available, but requires all record BIM models to be submitted with Autodesk Revit version 2013. This requirement is due in part to the statewide integration of the facility management software, Archibus.

MODEL + DATA OWNERSHIP

The State of Minnesota retains ownership of all BIMs, Building Data, and electronic CAD files, including, but not limited to, the designs, ideas, and inventions developed within the project. The State of Minnesota shall have ownership of all contents within the BIMs from schematic design to project delivery.

BIM PROJECT MANAGEMENT

BIM Manager

The BIM Manager shall act as the primary contact with the State of Minnesota for all BIM related activity on a given project. This individual will have the necessary experience and knowledge required for successful BIM implementation as it relates to the scope and complexity of the given project.

General Responsibilities:

- Assures development and compliance with State of Minnesota BIM Guidelines.
- Overall Responsibility for the coordination, creation, and implementation of BIM during design and Construction.
- Coordinates and Manages BIM related meetings with Lead BIM developers.
- Manage and maintain all creation of BIM content.

Discipline/Trade Coordination

All parties involved in the creation of a BIM shall communicate changes to the record file in real time. Each discipline or team should elect a BIM Coordinator to serve as a lead technician and communicator to ensure that information is shared in a transparent and timely manner. BIM is a multidisciplinary effort and it is therefore imperative that project teams communicate and coordinate effectively.

BIM Implementation Plan (BIP)

The BIM Implementation Plan addresses the targeted BIM Uses on the project, delineates roles and responsibilities of each company. The BIP defines the detail and scope of information to be modeled and shared, as well as relevant processes, team setup, and rules of engagement. This document is intended to be complimentary to the State of Minnesota BIM Guideline. At any point in time, this document along with the Level of Development (LOD) Matrix, are the governing documents that determine all aspects of BIM Implementations on the project. Changes to the BIM Implementation Plan will be incorporated only after owner and project team reach consensus and will be shared as a new version of this document.

Record Model

The Record Model shall be delivered to the State of Minnesota to depict an accurate representation of the physical conditions, environment, and assets of a facility. The Record Model should contain information relating to the main Architectural and MEP elements in addition to information including equipment and space planning systems to be used for building maintenance and operations. The Record Model contains a true depiction of space and equipment with information such as finishes, serial numbers, warranties and manufacturer of components in the building. The AEC Team shall submit a negotiated LOD Record Revit Model to the State of Minnesota for their Lifecycle Operations and Maintenance process.

REQUIREMENTS

AUTHORING SOFTWARE

Software requirements

The State of Minnesota requires all Record BIM models to be submitted with Autodesk Revit version 2013.

STATE SPACE + DATA STANDARDS

Space Measurement

The State of Minnesota has a standard method of measuring Room Square Footage. A designated party shall be responsible for setting up Area Plans and Area Boundary lines to track tenant areas. The designated party will be responsible for making any updates to these areas until the Record Model is complete. No Additional Room data is required by the Design or Construction Team for Lifecycle Management. Existing parameters at the Room's Instance Level will provide the necessary data. This method is summarized in the table below:

Space Types + Measurement Methodology

Source: State of Minnesota Space Management Background Data Formats & Standards

Space Type	Definition	Comments
Exterior Gross	The Exterior Gross is measured by drawing an area boundary line tracing the outside surface of the exterior wall.	Not used in remaining area calculations
*Interior Gross******	The Interior Gross is measured by drawing a closed area boundary line along the inside finished surface of the exterior wall. If more than 50% of the vertical height of an exterior wall is glass, the area boundary line is drawn along the inside face of the glass.	Area boundary lines to inside face of the building
Vertical Penetrations*****	A Vertical Penetration is measured by drawing area boundary lines around the outside finished surface of its enclosing walls. When the Vertical Penetration is adjacent to another Vertical Penetration, the space is measured to the centerline of the connecting wall.	Any vertical penetration is a location on a floor plate where no floor exists. Space such as stairwells, elevator shafts, mechanical shafts, plumbing chases, atriums, etc
Rentable Area	Internal Gross Area - Tot Vert Pen Area = Rentable Area	Calculation
Service Area*****	Service area is measured to the outside finished surface of its enclosed walls, except when adjacent to a Vertical Penetration. When adjacent to a Vertical Penetration, the Service Area is measured to the inside finished surface of its enclosed walls. When service areas are adjacent to other service areas, the space is measured to the centerline of the connecting wall.	Space that supports building functions such as mechanical rooms, utility closets, janitor closets, and docks or is available to all persons in the building such as corridors and restrooms
Useable Area	Rentable Area – Total Service Area = Usable Area	Calculation
Groups*	Group areas are measured by drawing an area boundary line around the perimeter of offices, workstations and internal circulation areas that are occupied by a single cost center or division. Where workspaces are allocated to different cost centers or	Referred to as Group Area or Chargeable Area Groups may be assigned to a

	divisions, the group line is drawn down the centerline of the wall dividing the allocated areas. Group areas are drawn along the previously drawn area boundary lines for interior gross, vertical penetrations, and service/common areas. No deductions are made for columns, pilasters, or other projections necessary to the building or for interior walls. The sum of all group areas on a floor equals the useable area of a floor. Group areas should be drawn around unallocated space as well, to insure accuracy by identifying Remaining Area.	Division and a Cost Center The remaining area shall be equal to "0" with a tolerance of +/- one (1) square foot.
Remaining Area	Usable Area – The sum of the group areas on a floor = Remaining Area	Calculation
DWS*****	Dead Wall Space is any wall measuring a minimum of 12" thick with an area of four or more square feet or any column or pilaster whose area is equal to or greater than four square feet.	Dead Wall Space is subtracted from a group to determine their useable area.
RPMN Usable Area	Rentable Area – Service – DWS = RPMN Usable Area	Calculation

***** Indicates Space Types used in calculations

Room Numbering Conventions

The State's Room numbers will be assigned to the Room Number Parameter in Revit for each individual room. This process gives the space a Unique Identifier understood by the State of Minnesota while also allowing the developed space to be connected to complex space standards inside the State's Real Property Management System. This serves as the Primary Connector for Room Data between Revit and the System.

Asset Data Standards

Asset Management

Tracking specific Assets during Design & Construction aids the State of Minnesota in more efficient maintenance and operation procedures of a facility. Having data in the model early allows the FM team to start planning for building start up and tracking of building operations, instead of spending time on data entry or searching for O&M documentation. The Shared Parameter file will provide fields to track this data on equipment during the Construction process. All asset naming and definition standards for data capture during construction can be found in ***Exhibit C-Equipment Assets*** *and* ***Exhibit D-Equipment Asset Details.***

The Mark field in Revit is to be coordinated with the State's FM Equipment Use field. This creates a relationship between the names of unique equipment and their associated equipment tags. The Equipment Code serves as the Primary Connecter for Equipment Data between Revit and the State's Real Property Management System, which will be the barcode number authored into the model during Construction by the Construction Manager/Contractor or Sub-trade.

Types of Model Elements

Model elements will be derived from the following sources to include specific Shared Parameters for Room and Equipment:

Manufacturer's Model Elements

Elements created by and acquired from manufacturers often have more information than is prudent to keep in the model; the level of detail as defined in the LOD Matrix should be retained for the design element. However, embedded performance data shall remain for analysis and specification purposes.

Custom Created Model Elements

Custom model elements that are created must utilize appropriate BIM Authoring tool templates. Custom models components need to be assigned as a part and part of a family or group.

Shared Parameters

The required Shared Parameters can be issued by the State of Minnesota as a Revit Template file so those Instance Parameters can be transferred to the Design model. Facilities Data will be entered into these fields in the Construction model and eventually be passed to the Record Model. These Shared Parameters will exist at the Instance Level, not the Family Level. If Parameters requested by the State of Minnesota exist at the Family Level for the Manufacture's Elements or Custom Elements, that data will have to be duplicated at the Instance Level as well. Please refer to ***Exhibit E: Asset Data Mapping Matrix*** for the responsibility of populating the Shared Parameters data.

UNIFORMAT + OMNICLASS CLASSIFICATION

The State of Minnesota classifies and organizes its building components and assets according to the UniFormat and OmniClass systems as defined by the Construction Specifications Institute or CSI. UniFormat is a standard for classifying building specifications based upon system function rather than construction materials or methods. The OmniClass Construction Classification System or OCCS organizes information from other extant systems including UniFormat and MasterFormat into normalized tables.

UniFormat 2010 and OmniClass 2010 as released by the CSI should be referenced when classifying objects within a Building Information Model.

MODEL CONTINUITY

In order to ensure model continuity, the State of Minnesota requires that all models be developed using exclusively object based elements. This means that elements such as windows, doors, floors and roofs shall be associated with parametric information and will not exist as simple geometry. Continuity ensures consistency in the creation and development of a BIM, allowing a single model to be utilized from the conceptual design phase all the way to building operation and maintenance.

MODEL GRANULARITY

Model granularity determines the detail or accuracy with which geometry is represented within a specified Building information Model. The level of development will vary by project and for any given object. It is possible with a low granularity that a BIM will not accurately communicate form, and in turn, design intent; this is important to keep in mind when determining the goal or purpose of a BIM.

It is generally accepted that objects measuring less than 6" x 6" x 6" should not be modeled, but rather represented as a node and assigned the appropriate parametric information. This can be overlooked if a significant goal of a BIM is to provide design visuals or renderings.

LEVEL OF DEVELOPMENT (LOD)

Level of Development articulates the extent to which model elements are developed and their level of reliability. Each LOD prescribes minimum content requirements; these requirements specify detail of representation and attached content. Each model element should only be considered reliable to its prescribed degree. This agreed upon LOD will provide a framework and standard for all parties creating BIMs.

The Level of Development definitions as outlined in the AIA Document E202-2008, Building Information Protocol, are below.

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.

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.

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.

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.

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.

Equipment LOD Specifications
For more information, reference BIMForum's LOD Specifications Document as sited by AIA E202-2008. This document follows current AIA LOD conventions, provides graphic representations and can be downloaded at bimforum.org/lod

BIM IMPLEMENTATION PLAN (BIP)

The State of Minnesota requires a BIM Implementation Plan (BIP) to be completed after a contract has been awarded for any project utilizing BIM technology.

This document is meant to establish goals and coordination efforts of appropriate stakeholders, while outlining the processes, work flows, and management of the BIM. This document is intended to be complimentary to the State of Minnesota BIM Guideline.

The State of Minnesota BIM Guideline defines the expectations that the State has for the final Record Model and data tracking. The Record Model and data tracking will be a collaborative effort between the Design and Construction teams and their consultants. The BIM Implementation Plan addresses the targeted BIM uses on the project, delineates roles and responsibilities of each company, and defines the detail and scope of information to be modeled and shared. Additionally, the BIP defines relevant processes, team setup, rules of engagement, and supporting software.

At any point in time during the project, this document along with the Level of Development Matrix ***(Exhibit E: Asset Data Mapping Matrix)*** is the governing document that determines all aspects of the BIM. Changes to the BIM Implementation Plan will be incorporated only after owner and project team consensus and will be shared as a revised version to the document. ***See Exhibit B: BIM Implementation Plan***

PHASING + INFORMATION EXCHANGE

There is not necessarily a direct relationship between a BIM's LOD and traditional design or construction phases as these systems may develop at differing rates. Information exchanges should be agreed upon by all parties and include BIM development milestones defined in the project's BIM Implementation Plan. These milestones should contain clear objectives, target dates and responsible parties.

SUBMISSION REQUIREMENTS

File Management

Models may be separated by disciplines for design and construction coordination throughout the construction process, but must ultimately be federated as a Record Revit Model.

The Record Model should follow the file naming format below. The first three [3] underscores (_) are used just to separate the section fields for explanation. The file names shall consist of three [3] distinct State of Minnesota sections hyphenated by the discipline and the date issued to the State.

Example Fields: Agency Code Site Code Building ID-Discipline_Published Date.xxx

Final Construction Model Convention:
As-Built Model: G02310100-AsBuilt_YYYYMMDD.nwd
Final Record Model Convention:
Architectural Model: G02310100-ARCH_YYYYMMDD.rvt
MEP: G02310100-MEP_YYYYMMDD.rvt
Structural Models: G02310100-STRL_YYYYMMDD.rvt

*If a Core/Shell and Interiors model both are developed for this Project please contact the State for further direction. In most cases this would just be an additional Architectural model listed as an "Interiors" model in the model naming structure above.

Hand Overs

3D Model files required:

Record Model

A final record model is to be delivered to the State of Minnesota depicting a representation of the physical conditions, environment, and assets of a facility. The Record Model should contain information relating to the main Architectural and MEP elements in addition to information including equipment and space planning systems to be used for maintenance and operations. The Record Model contains a depiction of space and equipment with information such as finishes, serial numbers, warranties and manufacturer of components in the building. The AEC Team shall submit a Record Revit Model of a predetermined LOD to the State of Minnesota for their Lifecycle Operations and Maintenance process.

2D Model files required

Operations + Maintenance Support Information (OMSI)

[The OMSI is in the scope of work of the Contractor and/or Commissioning Agent]

OMSI provides key information produced during the design, construction of new facility acquisition. The OMSI Scope of Work helps ensure that virtually all as-built architectural/engineering, technical product and system information will be available in a standardized, user-friendly format for use over the lifecycle of the facility. The purpose of the work is to provide OMSI manuals that contain detailed, as-built information that describes the efficient, economical and safe operation, maintenance, and repair of the facility. The OMSI manuals are to be factual, concise, comprehensive and formatted to be easily used by operation and maintenance personnel. Descriptive matter and theory must include technical details that are essential for a comprehensive understanding of the operation, maintenance and repair of the system. The Construction Manager/Contractor shall ensure that OMSI manuals reflect changes to systems and equipment made during construction and prepared as outlined in ***Exhibit F-Operations + Maintenance Support Information***.

GLOSSARY

DEFINITIONS + ACRONYMS

AEC
Architectural/Engineering/Construction Team

ARCHIBUS
Software application used for Space Planning and Facilities Maintenance

As-Built Documents
As-built documents are the collection electronic drawings or of paper drawings from the Construction Manager/Contractor that contain mark-ups, annotations, and comments about changes that have been made to the Contract Documents during the construction phase.

Building Information Modeling (BIM)
An integrated process aimed at providing coordinated, reliable information about a building project throughout different project phases—from design through construction and into operations. BIM gives architects, engineers, builders, and owners a clear overall vision of the project—to help them make better decisions faster, improve quality, and increase profitability of the project.

Construction Documents
The Construction Documents are a set of Drawings, that along with the Specifications, Addenda, Construction Change Directives, Change Orders or other written amendment or orders make up the set of documents that includes all pertinent information required for the contractor to price and build the project.

Construction Model
The model used to simulate and analyze the construction of a building.

Design Team
The Design Team is considered to be the Architect and all of the consultants that provide design services for a project. These design services can be rendered at any time during the project.

Design Model
The model used to communicate the design intent of a building.

BIM Implementation Plan (BIP)
BIM Implementation Plan defines BIM roles and responsibilities for Lifecycle Management and Facilities Management data collection during Construction for a project issued.

Integrated Lifecycle Management (ILM)
A management process that improves collaboration and optimizes efficiency between the AEC team and Owner through standardization and refinement of business structures and facility practices into a process that collaboratively optimizes efficiency through all phases of design, fabrication, construction and lifecycle management.

LOD
Level of Development

MEP
Mechanical, Electrical and Plumbing. MEP/FP is Mechanical, Electrical, Plumbing and Fire Protection.

BIM/Model Manager(s)
The project team member(s) responsible for managing the collaboration and sharing of electronic files during the project. Model managers are also responsible for maintaining the integrity of BIM models, which can include gathering, linking, and uploading updated models.

Metadata
The term refers to "data about data". For this document it refers to individual instances of application data, the data content, or "content about content". This content can be authored in a field, stored and managed in one database and transfer to yet another database.

O&M
Operations and Maintenance

OMSI
Operations and Maintenance Support Information

Record Model
Model containing all Contractual and As-Built conditions used to depict an accurate representation of the physical conditions, environment, and assets of a facility. The Record Model contains information relating to the main architectural, structural, and MEP elements, coordinated with the As-Built conditions and Sub-contractor models. It is the culmination of all the BIM Modeling throughout the project, including Operation, Maintenance, and Asset data from the As-Built model. A Record Model is the further development of the Design Model in the Authoring Software Platform for use by the Owner and Facility Management Team. (Also see Section 4.1)

Record Documents
The production of Record Documents is the capturing of the As-Built Documents annotation, comments, and mark-ups in drawing format. This may not include the updating of any models as done purely for 2D documentation and are typically delivered in electronic format.

RVT
An .RVT file is a Revit native file type. It is also the deliverable file format for all projects. This includes all of the Design Team's models.

Schematics
Similar to a Single Line Diagram, a Schematic Diagram illustrates the inter-relationship of components, but incorporates more of a spatial context of the elements, i.e. locations. Generally these are not to scale.

APPENDIX

EXHIBIT A: BIM USES

The following document is provided to assist all project stakeholders understand the multitude of ways they may leverage BIM technologies depending on their needs. This section highlights various applications of BIM for each phase of a project.

EXHIBIT B: BIM IMPLEMENTATION PLAN (BIP)

The following document is provided to assist in the development of the goals and coordination efforts, as well as outline the processes, work flows, and management of the BIM. This document is intended to be complimentary to the State of Minnesota BIM Guideline.

EXHIBIT C: EQUIPMENT ASSETS

The following document is provided to highlight which Equipment Assets are to be tracked for the State of Minnesota. Each project shall determine the required assets to track. Asset details will be collected on the Equipment Assets determined by the project team.

EXHIBIT D: EQUIPMENT ASSET DETAILS

This document lists the metadata parameters to be collected and tracked for all Assets listed in ***Exhibit C: Equipment Assets*** and includes the fields to be collected. Individual fields listed in this Exhibit document reside in the State of Minnesota Revit Template as Instance Parameters.

EXHIBIT E: ASSETS DATA MAPPING MATRIX

This document governs the roles and responsibilities of all BIM stakeholders for capturing asset data throughout the duration of the project.

EXHIBIT F: OPERATIONS + MAINTENANCE SUPPORT INFORMATION

The following exhibit contains OMSI information which should be coordinated with the Equipment being tracked. The OMSI should be provided as PDF files.

EXHIBIT G: REVIT SHARED PARAMETERS

This is an electronic file named *State of Minnesota ARCHIBUS Shared Parameters File Template*. Use this Revit .rte file to transfer Project Standards from the Template File to the Revit MEP Design Model, Revit MEP Construction Model and the Record Revit MEP Model.

EXHIBIT H: REFERENCES + SOURCES

This exhibit is an overview of supplementary information, resources and references used in the State of Minnesota BIM Guideline.

EXHIBIT A: BIM USES

SCHEMATIC DESIGN

Existing Conditions Modeling

A process in which 3D computer modeling software is used to create a model of an existing facility. Methods for capturing existing conditions include conventional surveying techniques or newer 3D laser scanning approaches.

Benefits of Existing Conditions Modeling:

- Capturing proper information and creating a 3D existing conditions model is important for establishing a good foundation for any BIM project.

Cost Estimation

A process in which BIM can be used to generate quantity take-offs in a flexible, dynamic way. This includes cost implications of additions or modifications to the initial design.

Benefits of Cost Estimation:

- Quantity take-offs are generated directly from the BIM resulting in more accurate estimates
- Estimator is able to save time
- Real-time cost implications can aid in design decisions

Phase Planning

A process in which phases are implemented into a BIM via parameter definition. Such planning allows a phased approach to construction and final occupancy. 4D scheduling models allow for clearer visualization and more defined communication strategies throughout the BIM project.

Benefits of Phase Planning:

- Well-defined phasing schedule with the ability to show multiple phasing options
- Integration of occupant, equipment and material scheduling
- Monitoring of project material procurement and status

Programming

Programmatic information furnished by the owner at the beginning of a project can be inputted into a BIM and can be referenced throughout the entire project as a basis for space design and compliance.

Benefits of Programming:

- Embedded programmatic requirements will help ensure the owner's needs are being met.
- Color legends & Excel files can be developed based on an established criteria
- Massing models with accurate square footage quantification can quickly be generated for design review

Site Analysis

A process in which BIM/GIS tools are used to determine the optimal building location and orientation within a given site.

Benefits of Site Analysis:

- Increase building energy efficiency in the envelope and building systems design
- Allow for multiple energy simulations

Design Review

A process in which stakeholders review the initial 3D model and information, and provide feedback on the programmatic design. This may include evaluation of floor and ceiling plans, lighting, acoustics, security, textures, colors, etc.

Benefits of Design Review:

- More efficient design review process
- Instant feedback on programmatic requirements
- Opportunity to review energy, lighting, and design schemes virtually

DESIGN DEVELOPMENT

Design Authoring

A process in which 3D computer modeling software is used to create a Building Information Model and develop the construction documents associated with the BIM. Design authoring is essential for communicating design intent between clients, consultants and other stakeholders. This process is effective when it not only communicates the visual aspects of a building, but also connects the 3D model with a database of properties, quantities, costs and schedules.

Benefits of Design Authoring:

- Design visualization
- Design transparency
- Communication and collaboration between project stakeholders and BIM users
- Design, cost and schedule quality control

Structural Analysis

A process in which an analytical engine is used to evaluate the structural qualities of a Building Information Model. Structural analysis, typically executed by a building engineer, provides architects and other building stakeholders with the assurance that their design is structurally sound and code compliant. These analysis tools provide structural engineers with the ability to do analysis and design better by creating digital models that visualize, simulate and analyze their work.

Benefits of Structural Analysis:

- Increased speed and quality of structural analysis
- Easily communicate structural analyses through 3D representations
- Enhanced model transfer and communication between structural engineers and architects

Lighting Analysis

The integration of real materials and components within a BIM model make it an effective tool for lighting analysis. BIM software can export geometry and component information into secondary lighting analysis programs such as Ecotect and Radiance. These programs use a combination of quantitative and qualitative lighting analyses that provide stakeholders with an accurate projection of the lighting loads and ambiance.

Benefits of Lighting Analysis:

- Understand and quantify both natural and artificial light
- Reduce lighting and cooling loads through effective light analysis and design
- Create renderings with photorealistic lighting effects

Energy Analysis

A process in which an energy simulation program integrates with a Building Information Model to conduct energy assessments. Energy analysis seeks to optimize building energy efficiency by evaluating and proposing changes to spatial configuration and materials.

Benefits of Energy Analysis:

- Improved energy prediction accuracy by referencing BIM component and geometric information
- Optimize design to increased energy efficiency and reduced life cycle cost
- Energy code verification

Mechanical Analysis

A process in which an analytical engine is used to evaluate the mechanical systems present within a BIM. These analytical tools and performance simulators inform designers and engineers of how effectively mechanical systems are meeting building heating, cooling and air quality needs. Understanding mechanical system needs can significantly reduce energy consumption and prevent system overload and failures.

Benefits of Mechanical Analysis:

- Energy consumption reductions
- Accurately size mechanical systems based on building needs
- Communicate mechanical system form and function to project stakeholders

Engineering Analysis

A process in which modeling software uses a Building Information Model to define engineering design specifications. This information is synthesized by designers and engineers to improve facility engineering operability.

Benefits of Engineering Analysis:

- Improve quality and reduce cycle time of engineering design analysis
- Save time and money with automated analysis
- Improve specialized service offered by engineering and design firms

Sustainability Guideline Evaluation

The evaluation of a project based upon LEED, B3 or other sustainability based guidelines. Based on the sustainability guideline, evaluation can happen in any of the primary project phases. Sustainability guidelines are often most effective when they are addressed at a project's conception and are resolved with the creation of an operation plan.

Benefits of Sustainability Guideline Evaluation:

- Accelerate LEED certification
- Improved communication of sustainability guideline metrics
- Optimize building performance
- Track energy use, air quality and material usage
- Create a life cycle analysis of a building's comprehensive impact, identify key changes for increasing project sustainability

Code Analysis

The utilization of code validation software to determine if select Building Information Model parameters meet specific codes. Common code guidelines include the IBC International Building Code and ADA Americans with Disabilities Act.

Benefits of Code Analysis:

- Validate that building design and construction is in compliance with specific codes
- Reduction of code design errors, omissions or oversights that result in costly design and construction changes
- Automatic code validation providing continuous code compliance feedback

CONSTRUCTION DOCUMENTATION

3D Coordination/Clash Detection

The use of Clash Detection software during the construction coordination process in order to reduce the occurrence of systems interference. Integrating all building systems into a comprehensive model allows designers and engineers to effectively coordinate systems and prevents costly change orders.

Benefits of 3D Coordination / Clash Detection:

- Reduce and possibly eliminate field conflicts and need for change orders
- Effectively plan construction sequences, stages and logistics
- Increase productivity on site and decrease overall construction time
- Create more precise as built drawings

Site Utilization Planning

A process in which BIM is used to graphically represent both permanent and temporary facilities on site during multiple phases of the construction process. It may also be linked with the construction activity schedule to convey space and sequencing requirements. Additional information incorporated into the model can include labor resources, materials with associated deliveries, and equipment location. Because the 3D model components can be directly linked to the schedule, site management functions such as visualized planning, short-term re-planning, and resource analysis can be analyzed over different spatial and temporal data.

Benefits of Site Utilization Planning:

- Efficiently generate site usage layout for temporary facilities, assembly areas, and material deliveries for all phases of construction
- Quickly identify potential and critical space and time conflicts
- Accurately evaluate sit layout for safety concerns
- Select a feasible construction theme
- Effectively communicate construction sequence and layout to all interested parties
- Easily update site organization and space usage as construction progresses
- Minimize the amount of time spent performing site utilization planning

Construction System Design

A process in which 3D system design software is used to design and analyze the construction of a complex building system

Benefits of Construction System Design:

- Increase constructability of a complex building system
- Increase construction productivity
- Increase safety awareness of a complex building system
- Decrease language barriers

Digital Fabrication

A process that utilizes machine technology to prefabricate objects directly from a BIM. The model is spooled into appropriate sections and input into the fabrication equipment for production of system assemblies.

Benefits of Digital Fabrication:

- Automate building component fabrication
- Minimize tolerances through machine fabrication
- Maximize fabrication productivity

3D Control + Planning

A process that utilizes information model to layout facility assemblies or automate control of equipment's movement and location. The information model is used to create detailed control points aid in assembly layout. An example of this is layout of walls using a total station with points preloaded and/or using GPS coordinates to determine if proper excavation depth is reached.

Benefits of 3D Control and Planning

- Decrease layout errors by linking model with real world coordinates
- Increase efficiency and productivity by decreasing time spent surveying in the field
- Reduce rework because control points are received directly from the model
- Decrease/Eliminate language barriers

Record Model

Record Modeling is the process used to depict an accurate representation of the physical conditions, environment, and assets of a facility. The record model should, at a minimum, contain information relating to the main architectural, structural, and MEP elements. It is the culmination of all the BIM Modeling throughout the project, linking Operation, Maintenance, and Asset data to the As-Built model (created from the Design, Construction, 4D Coordination Models, and Subcontractor Fabrication Models) to deliver a record model to the owner or facility manager. Additional information including equipment and space planning may be necessary if the owner intends to utilize the information in the future.

Benefits of Record Model:

- Aid in future modeling and 3D design coordination for renovation
- Improve documentation of environment for future uses. E.g. renovation or historical documentation
- Solid understanding of project sequencing by stakeholders leads to reduced project delivery times, risk, cost and lawsuits
- Minimize facility turnover dispute (e.g. link to contract with historical data highlights expectations and comparisons drawn to final product.)
- Ability for embedding future data based upon renovation or equipment replacement
- Provide owner with accurate model of building, equipment, and spaces within a building to create possible synergies with other BIM Uses
- Easily assess client requirement data such as room areas or environmental performance to as-designed, as-built or as-performing data.

OPERATION + MAINTAINENCE

Maintenance Scheduling

A process in which the building structure (walls, floors, roof, etc) and equipment serving the building (mechanical, electrical, plumbing, etc) are maintained over the operational life of a facility. A successful maintenance program will improve building performance, reduce repairs, and reduce overall maintenance costs.

Benefits of Asset Management:

- Plan maintenance activities proactively and appropriately allocate maintenance staff
- Track maintenance history
- Reduce corrective maintenance and emergency maintenance repairs
- Evaluate different maintenance approaches based on cost
- Allow facility managers to justify the need and cost of establishing a reliability centered maintenance program

Structural Analysis

A process in which a BIM Model is used to identify key structural components for testing and analysis. Structural analysis provides building managers the ability to easily assess the structural soundness of an existing structure. It also allows building stakeholders to confirm that building structural components meet the current code.

Benefits of Structural Analysis:

- Increased speed and quality of structural analysis
- Easily communicate structural analyses through 3D representations
- Analyze and record structural system data over time

Building Systems Analysis

A process that measures how a building's performance compares to the design specifications. This includes how the mechanical system operates and how much energy a building uses. Additionally, this analysis includes amongst others, lighting analysis, internal and external CFD airflow, and solar analysis.

Benefits of Building System Analysis:

- Allows design team to select systems that optimize a buildings energy performance, lower operation costs, provide systems with greater potential for high reliability & longer life expectancy
- Allows focus on both Active and Passive design strategies
- Ensures that a building design meets design specifications

Asset Management

A management system provides the State of Minnesota with an efficient tool for the maintenance and operations of its facilities and assets. These assets may include the physical structures, site elements, building systems, and equipment, which must be maintained, operated and upgrade on a consistent basis. By identifying assets and associated data early, the Owner can begin identifying long term and short term planning, scheduling, and facility management solution. BIM asset tracking allows for the elimination of timely data entry and O&M documentation post construction. Asset Management may inform decisions regarding costs related to changing, upgrading, maintaining building's assets.

Benefits of Asset Management:

- Assets Operations, Management, and Equipment Specification Manuals can be stored in the Record Model.
- Provide real time information on facility and equipment data, such as warranties, maintenance history and schedules, costs information, replacements and damages, manufacturer data and more as specified by the Owner.
- Perform and Analyze Equipment and Facility assessments.

Space Management + Tracking

A process in which BIM is utilized to effectively distribute, manage, and track appropriate spaces and related resources within a facility. A facility building information model allows the facility management team to analyze the existing use of the space and effectively apply transition planning management towards any applicable changes. Such applications are particularly useful during a project's renovation where building segments are to remain occupied. Space Management and Tracking ensures the appropriate allocation of spatial resources throughout the life of the facility.

Benefits of Space Management and Tracking:

- Easily identify and allocate space for appropriate building use
- Increase the efficiency of transition planning and management
- Proficiently track the use of current space and resources
- Assist in planning future space needs for the facility

Disaster Planning

A process in which emergency responders would have access to critical building information in the form of a model and information system. The BIM would provide critical building information to the responders that would improve the efficiency of the response and minimize the safety risks. The dynamic building information would be provided by a building automation system (BAS), while the static building information, such as floor plans and equipment schematics, would reside in a BIM model. The BIM coupled with the BAS would be able to display where the emergency was located within the building, possible routes to the area, and any other harmful locations within the building.

Benefits of Space Management and Tracking:

- Provide police, fire, public safety officials, and first responders access to critical building information in real-time
- Improve the effectiveness of emergency response
- Minimize risks to responders

EXHIBIT B: BIM IMPLEMENTATION PLAN

BIP OVERVIEW + GUIDING PRINCIPLES

This document is meant to establish goals and coordination efforts of appropriate stakeholders, while outlining the processes, work flows, and management of the BIM. This document is intended to be complimentary to the **State of Minnesota BIM Guideline**.

The State of Minnesota BIM Guideline defines the expectations that the State has for the final Record Model and data tracking. The Record Model and data tracking will be a collaborative effort between the Design and Construction teams and their consultants. The BIM Implementation Plan addresses the targeted BIM uses on the project, delineates roles and responsibilities of each company, and defines the detail and scope of information to be modeled and shared, relevant processes, team setup, rules of engagement, and supporting software.

At any point in time during the project, this document, along with **Exhibit E: Assets Data Mapping Matrix,** is the governing document that determines all aspects of the BIM. Changes to the BIM Implementation Plan will be incorporated only after owner and project team reach consensus and will be shared as a revised version to the document.

The following information (Goals, Phasing + Scheduling, Roles + Responsibilities, Model Breakdown, Collaboration Plan, LOD, and Technical Guidelines) is intended to act as a guide only. It should be tailored based on project scope and design intent.

BIM PROJECT GOALS

Owner's Goals:
At the completion of the project, the owner would like to have a BIM Model that they can use to manage and maintain facilities. The State desires that the BIM is capable of integrating with Archibus facility management software. This includes the Facility Condition Assessment module, Real Estate Management module, and Building Operations module.

Design Team Goals:
The design team intends to utilize BIM for authoring 2D drawings and coordination of systems throughout design.

Construction Team Goals:
The construction team intends to utilize the model to help understand design intent and to help inform cost estimating exercises. They would also like to utilize BIM to reduce spatial conflicts between trades.

BIM PHASING + SCHEDULING

The Design Team creates Design Models that will be used to produce Construction Documents. Concurrently with issuing signed 100% complete Construction Documents, the Design Models should be provided to the client and the Construction Team for information. The Construction Team will create Construction Models for clash detection, shop drawing production, and fabrication purposes. Changes the Construction Team makes to elements modeled in the Design Model will be communicated back to the Design Team. Incorporating these changes marks the point where the Design Models transition into being the Record Models. Data to be tracked for facilities management (per the State BIM Protocol document) will also be incorporated into the Record Model. This Record Model will be provided to the State at the substantial completion of construction for their use.

Current Conditions Model Creation

The existing conditions can be modeled utilizing various technologies that may include but are not limited to; existing BIMs, laser scans, existing CAD drawings, and site verification. For more information on what will be represented in the model, see section 7: Model Content and Level of Detail.

Schematic Design

Until the current conditions BIM is substantially complete, design work shall progress in 2D AutoCAD drawings and diagrams. This may extend at least through Schematic Design. Schematic design review submittals and final submittal are anticipated to be 2D drawings and diagrams, unless otherwise agreed upon.

Design Development

Utilizing BIM in design development phase and for the construction work will be dependent on having the existing conditions model substantially completed. Once the current conditions model is substantially complete for an area of work, AEC teams will begin to add project specific information to the model.

Quality Control + Quality Assurance Reviews

Prior to the start of development of contractor and/or subcontractor models, the contractor will provide constructability and prefabrication feedback to the design.

After the start of contractor and/or subcontractor modeling, all subcontractors are to ensure that they incorporate constructability into their models while constantly referring to other trade models in the background and ensure their systems are constructible in isolation and in combination with other trades as well. Any constructability related issues that cannot be solved individually by trades or that require the attention of 3 or more trades must be brought to the Contractor's attention so that appropriate meetings can be setup to resolve those issues.

Change Management Process

Construction Phase is defined as the period between issuing Construction Documents and substantial completion of the work.

Intent:

- Necessary Processes will be implemented through the review process so that design and construction models and drawings stay aligned.
- It is critical that this alignment be maintained through the construction phase between the Permit Drawings, Design Models/Drawings and Construction Models. This is critical to ensure alignment between Shop Drawings, Fabrication drawings, Layout Drawings (which are generated from the construction models) and the Permit Drawings (generated from the design drawings and models). This reduces the risk of rework and construction delays that may have occurred because of installation not complying with the permit drawings.

BIM ROLES + RESPONSIBILITIES

All disciplines are responsible for maintaining their BIM throughout the planning, design, and construction of this project. All models used for generating drawings should be updated with any review comments received. The modelers /detailers of all teams producing BIM should follow these responsibilities.

They include, but are not limited to:

1. Develop model content as specified but not limited to what is specified in the *Model Content + Level of Development* section.
2. QA/QC Models for model completeness, accuracy and interoperability.
3. Ensure model delivery meets all schedule dates and milestones.
4. Share model content via collaborative project management system as defined in the *Collaboration Plan* section.
5. Notify the whole team of changes as they happen in their respective models
a. Notification should be compliant of the change management process as described in the *BIM Phasing + Scheduling* section.
6. Minimize interoperability issues by sharing model content in a compatible format.
7. Position model in the authoring software so that they comply with model alignment as specified in the *BIM Technical Guidelines* section.
8. Validate model content during each phase and ensure that the level of detail has been accomplished for each project phase.
9. Participate in model coordination meetings.
10. Communicate/coordinate model related issues with the rest of the team.
11. Monitor file naming conventions as specified in the *BIM Technical Guidelines* section.
12. Ensure model breakdown and file breakdown as specified in the *Model Breakdown* section.
13. Collaboratively analyze software upgrades and get team's approval before upgrading.
14. Purge unused content and optimize file size on a regular basis and before submission to other team members.
15. Suggest and use best BIM technology available in the market for the intended BIM uses as specified in the BIM *Technical Guidelines* section of this document.

Architects

The Architectural design team will be responsible for producing the 3D BIM for Architectural scope of work through 100% DD and eventually to 100% CD level detail. This model will be used as the basis of MEP Coordination from an Architectural Perspective. In case of discrepancies between the Architectural model and the 2D drawings, the 2D drawings will govern provided that any discrepancy is brought to the attention of the design team for review. The A/E will be responsible for directing, developing, and coordinating the work of their consultants, and will ensure that their BIM-based work products are integrated into the project design models and resulting contract documents. The A/E will work closely with the Contractor and Subcontractors to receive and incorporate constructability and fabrication feedback. The architects will produce 2D drawings for the OPR and the OPM to review with the client.

Mechanical and Plumbing Engineers

The Mechanical and Plumbing design team will be responsible for producing the 3D BIM for the Mechanical and Plumbing scopes of work through 100% DD and eventually to 100% CD level detail. This model will be used as the basis of Coordination with other disciplines from a Mechanical and Plumbing Perspective. In case of discrepancies between the Mechanical and Plumbing model and the 2D drawings, the 2D drawings will govern provided that any discrepancy is brought to the attention of the design team for review. The Mechanical and

Plumbing team will be responsible for directing, developing, and coordinating the work of their consultants, and will ensure that their BIM-based work products are integrated into the project design models and resulting contract documents. The Design Engineers will work closely with Contractors and Subcontractors to receive and incorporate constructability and fabrication feedback. The architects will produce 2D drawings for the OPR and the OPM to review with the client.

Electrical Engineers

The Design Team Electrical Engineers will be creating 3D BIM for the Electrical scope of work through 100% DD and eventually to 100% CD level. Concurrently with the Design Team's modeling efforts, the Design Assist subcontractor will model additional items that are not included in the Design Team's modeling scope.

The method in which the final model will be delivered to the client can be completed several different ways. It is recommended that the final delivery include a linked electrical raceway model into the MEP model. This will provide the client with a straight forward way to control the visibility of the electrical raceways. It also combines resources to provide an efficient process.

Structural Engineers

The Design Team will be responsible for creating the 3D BIM for Structural scope of work through 100% DD and eventually to 100% CD level detail. This model will be used for the coordination of MEP systems from a Structural perspective. The Structural model will be considered accurate for coordination purposes. In case of discrepancies between the Structural model and the 2D drawings, the 2D drawings will govern provided that any discrepancy is brought to the attention of the design team for review. The structural engineer will provide a design model (not a construction level model suitable for fabrication).

Fire Protection Systems Engineer

The Design Team will be responsible for producing 2D CAD drawings for the Fire Protection Systems scope of work through 100% CDs. The design team will provide 2D CAD drawings and the BIM model for Architectural, Mechanical, Electrical and Plumbing to the Fire Protection System engineers for coordination purposes throughout the design. To the greatest extent possible the FP Engineers and the subcontractors should coordinate the handoff of 2D drawings to the subcontractors. The subcontractor will be responsible for producing a BIM of the Fire Protection system after the CD phase and prior to systems installation.

Contractor

The Contractor will manage the 3D BIM MEP coordination process collaboratively with the Design Team and the subcontractors. The contractor will designate a BIM Coordinator to manage this process. The role of the BIM coordinator will be to act as a liaison between the subcontractor and design teams. The BIM coordinator will collaboratively create a coordination schedule and manage to this schedule. The BIM coordinator will also manage technical logistics so as to make sure models created by the Design Team and subcontractors are interoperable. The BIM Coordinator along with MEP Coordinators will develop an agreement between the Design Team and Design-Assist subcontractors on the exact scope of their contribution to the process.

Design-Assist Subcontractors

The Design Assist Subcontractors will be responsible for coordinating with the Design team (Architects / MEP Designers / Structural Engineers and their partners) and the Contractor during the Design Development and Construction Document phases. They will be responsible for realizing the MEP design that the Design team has developed and will provide input in terms of equipment sizing, routing, constructability, prefabrication, cost etc. During the preconstruction phase the subcontractor team will collaborate with the Design team and the Contractor to help produce the 2D drawings which will be used to create a review set for the Owner. The Design Assist Subcontractors will create 3D models as necessary for producing shop drawings and fabrication drawings by each of the trade subcontractors to the greatest extent possible.

The specific roles for the MEP subcontractors in this process will be coordinated by the Design Team, and the Contractor BIM Coordinator. Although the Design-Assist subcontractors might use software systems/applications other than Revit, it is our expectation that the subcontractors, the Contractor and Design team should collaboratively figure out the handoffs / interoperability between their software systems/applications, so that the Design-Assist Subcontractors can use the digital models created by Designers as much as possible once they start producing their 3D Construction Models.

All Design Assist trade partners should update their constructions models for any changes made during the preconstruction and construction phases. They should also communicate these changes back to the Design Team so that the changes can also be incorporated into the Design Models.

Design Build Subcontractors

All Design Build Subcontractors will develop 3D BIM for design and construction of their scope of work. They will produce 2D drawings from their 100% CD level coordinated (clash free with the rest of the trades) construction models. During the preconstruction phase, they will provide input in terms of constructability, prefabrication and cost. They will also produce all of their shop drawings and fabrication drawings from the model.

All Design Build trade partners should update their constructions models for any changes made during the preconstruction and construction phases. They should also communicate these changes back to the Design Team so that the changes can also be incorporated into the Design Models.

All trades should ensure 100% compliance of their shop drawings, fabrication drawings and field layout drawings (and any inherent information not derived from the model) with their BIM models produced for their scope of work throughout the preconstruction and construction phase of the project.

MODEL BREAKDOWN

Model software file sizes can often become large, making them slow and cumbersome to work with. In order to manage file size, sometimes buildings are broken down into multiple model files. These models can be linked together (similar to X-refs in CAD). Model divisions are usually related to physical space, such as core & shell vs. interior, construction package physical area, by floor, or by wing.

The Design Team will have separate models per discipline, and each model will utilize work sets to help manage file usability. See the following example of work sets below:

Architectural Model Example (exterior and “backbone” walls)

1) Existing Core & Shell
2) Central Dome (above attic level)
3) Interiors East Wing
4) Interiors West Wing
5) Interiors North Wing & Central
6) Furniture
7) Equipment
8) Major Levels and Grids
9) Minor Levels and Grids

- zLINK – CAD
- zLINK – Civil
- zLINK – MEP
- zLINK – Structure

COLLABORATION PLAN

This section describes how all team members will collaborate on this project to reduce latency in decision making and ensure efficient execution of all BIM processes.

Coordination Meetings

Reoccurring Coordination Meetings should be held a minimum of once a month. These meetings will begin during the modeling of the current conditions. The BIM Manager will initially schedule the BIM Coordination meetings. The Design Team, the Contractor, and Owner will be required to attend these meetings. These meetings will help develop the BIM Implementation plan and resolve model coordination issues.

Once construction begins, the Contractor should schedule the BIM Coordination meetings. The detailer for each trade shall attend, and a project manager's attendance is recommended.

Model Folders Structure:

- Models Example:
  - Design Models
    - Architectural
    - Mechanical
    - Structural
  - Subcontractor Models
    - (Company Name) Ductwork
    - (Company Name) Electrical
    - (Company Name) Fire
    - (Company Name) Piping
    - (Company Name) Plumbing

Model Nomenclature

- Design Models – "Discipline-System/Component-Level/Area"
  - Examples: Arch-Base-01A
    - Arch-Ceilings-01A
    - Struct-Base-01A
    - Mech-Duct-01A
    - Mech-Pipe-01A
- Trade Models – "Company Acronym-Component-Level/Area"
  - Examples: XXX-Duct-01A
    - XXX-Elec-01A
    - XXX-Pipe-01A

Merged Model Folder Structure
Everyone will have individual folders to create their own models for coordination in addition to the models used in the weekly meetings.

Merged Models Example:

- Design Coordination Models
- Contractor Coordination Models
- Subcontractor Coordination Models

Merged Model Nomenclature Example:

- 01 – Level 1 Coordination
- 02 – Level 2 Coordination
- 03 – Level 3 Coordination
- 04 – Level 4 Coordination

Design and Subcontractor Merged Model Nomenclature

- File naming nomenclature is at your discretion.

MODEL CONTENT + LEVEL OF DEVELOPMENT

The following stipulations will be used for the design model content:

- Level of development can be defined by granularity and object information.
- The level of property information in the modeling objects and assemblies depends on the intended BIM use for which the model is being used and the types of analysis that will be performed on the model.

Design models should include all objects with accurate placement, dimensioning (shape and size) and breakdown as needed to convey design intent and analysis.

Please refer to the *State of Minnesota BIM Guideline* for additional information on what will be modeled in the Design Models, Construction Models, and the updates that will be made to the Record model.

The *State of Minnesota BIM Guideline* also outlines the parameters that are required to be incorporated into the Design Model for Facilities Management utilization. These parameters will be incorporated into the Design Models and Record Models.

If any additional special parameters need to be incorporated into the Revit families for scheduling or reporting, they should be identified in a timely manner so as to allow the design teams advance notice to build such parameters into the default family templates.

BIM TECHNICAL GUIDELINES

File Templates

All design model Revit files will be started utilizing the Shared Parameters Revit Template. This will ensure that models coordinate and graphic standards match throughout all models and drawings.

File Naming Structure:

Agency-Site-Building-_ _[discipline designator]-Description.ext

Discipline Designator (may include but not limited to):

Architecture	A
Civil / Site Work	C
Plumbing	P
Electrical	E
Mechanical	M
Fire Protection	FP
Structural	S
Tele/Data	T
Security	SY

.ext = File Type Extension (may include but not limited to):

AutoCAD Web Format File	dwf
AutoCAD Drawing File:	dwg
Industry Foundation Class File:	ifc
Tekla File	db1
Revit Drawing File	rvt

Origin Point
The origin point (0, 0) for all models in their native software applications shall be at the intersection of gridlines A and B, with a coordinated intersection of the project structure.

Units

This Project will utilize the Imperial system of feet and inches for the unit of measure. Fractions of an inch are displayed in fractions, not decimals.

Software Build Versions

All members of the design teams will be working from the same “Build Version” of their associated design application software for their discipline.

Layering Guidelines

Any CAD based drawing files that may be used during the design process should follow the “AIA CAD Layer Guidelines: US National CAD Standards – Version 4”.

Tolerances in BIM

“Model Tolerance” is different from “Field Tolerance” that will vary for different trades based on their specifications.

This model tolerance is a measure of accuracy of the model objects as they are placed in the 3D BIM. Even if the objects in the model are placed to an accuracy of 1/256” in the model but the dimensioned drawings from the model contain dimensions to the level of accuracy of 1/8” of an inch, 1/8” of an inch will be treated as the “Model Tolerance”. Model Tolerance will vary based on objects and existing conditions modeled. The model tolerances shall be discussed and agreed upon by all BIM team members.

Trade Colors

On large projects with multiple trades modeling, it is advantageous to have each trade model their elements in an assigned color. Color assignments to be determined, if necessary.

Current Software Guidelines

Revit Architecture – version 2013
Revit Structure – version 2013
Revit MEP – version 2013
AutoCAD Architecture – version 2011
AutoCAD Civil 3D

BIM Workstation Minimum Spec Recommendation

64 bit workstation
4GB RAM
CPU: Intel Core 2 Duo, T9600 @ 2.8 GHz

KEY PROJECT BIM CONTACTS

Each company on the project will identify a key BIM person who will be responsible for the development and execution of the BIM processes as described in this document to successfully achieve the BIM Goals stated on the project.

Contact Name	Company	Email	Phone

IMPLEMENTATION PLAN TEMPLATE

This template shall act as an outline to identify project goals, execution strategies and sequencing, as well as project roles and responsibilities.

STATE OF MINNESOTA BIM IMPLEMENTATION PLAN TEMPLATE

Project Name & Location:

File Sharing Project Site Location:

Model Origin:

Model Coordinate System:

Project Team:

Discipline/Trade	Consultant	Contact Person
Insert Name Here	Insert Name Here	Insert Name Here

Objective / Goal	Milestone	Timeline + Target Dates		Responsible	Deliverables + Performance Indicators
Strategic Objective/Goal 1: **Description Here**	P = Programming SD = Schematic Design DD = Design Development CD = Construction Documentation	Start		End	
1.1	P:				
	SD:				
	DD:				
	CD:				

EXHIBIT C: EQUIPMENT ASSETS

EQUIPMENT ASSETS

Metadata Fields for All Equipment

Parameters/fields and documentation listed in ***Exhibit C: Equipment Asset Details*** are to be collected on all the Equipment Assets listed below. Individual metadata fields listed in ***Exhibit C: Equipment Asset Details*** will be tracked and authored in Revit by the responsible party as assigned in the **Exhibit D: Assets Data Mapping Matrix.**

This is not a comprehensive list of Equipment Assets for the State of Minnesota. ***Each project shall determine the required assets to track***. If some items mentioned below are not being modeled in the Revit MEP Design &/or Construction models please inform the State of Minnesota and provide the reason. If there are other pieces of Equipment that the AEC Team may consider 'Major HVAC, Electrical or Plumbing Equipment' or are equipment being scheduled on the project please inform the State of those items as well.

Equipment Standards are defined and used by all agencies with the State, the Equipment Standards Code Format is, Category_System_Type_Component

State of Minnesota Equipment Description	Equipment Category	Equipment Standard for Revit Model
Fire System	FIRPR	FIREPR_FIRE_SYSTEM
Fire Pump	FIRPR	FIREPR_PUMP_FIRE
Eyewash	SAFETY	SAFETY_EYEWAS
Security Access Control Panel	SECURE	SECURE_ACCESS_CONTROL_PANEL
Sump Pump	PHYPLT	PHY_TOOLS_PUMP_SUMP
Drinking Fountain	PLUMB	PLUMB_FOUNTAIN_DRINKING
Water Heater	PLUMB	PLUMB_WTR_HTR
Emergency Light	ELEC	ELEC_LIGHTS_INT_EMERGE
Diesel Emergency Generator	ELEC	ELEC_SAFETY-GENEM_DIESEL
Electrical Transformer	ELEC	ELEC_TRNFMR
Breaker Panel	ELEC	ELEC_PANEL_BRK
Condensing Unit	HVAC	HVAC_COND_UNIT
Variable Air Volume Unit	HVAC	HVAC_VAV_UNIT
Air Handler Unit	HVAC	HVAC_AHU
Air Compressor Unit	HVAC	HVAC_AIRCOM_UNIT
Chiller	HVAC	HVAC_CHILL
Expansion Tank	HVAC	HVAC_EXPAN_TANK
Exhaust Fan	HVAC	HVAC_FAN_EXHAUS
Return Air Unit	HVAC	HVAC_FAN_RETURN_UNIT
Chilled Water Pump	HVAC	HVAC_PUMP_WATER_CHILL
Domestic Water Circulation Pump	HVAC	HVAC_PUMP_CIRCUL
Humidifier-Steam	HVAC	HVAC_HUMID_STEAM
Heat Exchanger	HVAC	HVAC_HEATEX

EXHIBIT D: EQUIPMENT ASSET DETAILS

EQUIPMENT ASSET DETAILS DESCRIPTION

Below lists the metadata parameters to be collected and tracked for all Assets listed in ***Exhibit C: Equipment Assets*** and should include the fields listed below. Individual fields listed in this Exhibit document reside in the State of Minnesota Revit Template as Instance Parameters and will be collected as assigned in **Exhibit E: Assets Data Mapping Matrix.** These metadata fields will be mapped from the Record Revit Model into the State's Real Property Management System by the State. For Additional details refer to the Share Parameters Revit Template and ***Exhibit G: Revit Shared Parameters***.

Floor Code
A unique identifier developed by the Owner for each Floor in the IWMS and is associated with the Level in the Record Revit Model.

Room Code
The unique identifier developed by the Owner and entered into the Revit Architectural Design Model by the Architect. These codes should be referenced from the linked Architectural Model coordinating with the Space Names in the Revit MEP model. These Room Codes are the Primary connection between the Record Revit Model and the IWMS for syncing metadata.

Equipment Use*
A field in the IWMS that has been coordinated to associate with the Mark Field in Revit. The Mark field is the unique identifying name in Revit for a piece of equipment that also is associated with Tags on the Plan and Revit Schedules. The State of Minnesota would like a nomenclature for equipment that is in line with their Equipment Standard. Data is to be entered in the Revit field when equipment is initially placed in the Revit MEP Design model, coordinating the Asset Standards with incremental numbering.

Equipment Code
This unique identifier serves as the Primary connector between the Record Revit Model and the IWMS for syncing Equipment data. The actual Equipment Code is the number listed on the Barcode Tag that is attached to the corresponding equipment. So that Barcode number is to be entered into this Revit field for each piece of equipment by the Construction Manager/Contractor or Sub-Trade.

Equipment Standard
This is an identifying Standard grouping all like pieces of equipment. The State of Minnesota has an Equipment Standard for each piece of equipment listed along with the Equipment in ***Exhibit C-Equipment Assets***. The Equipment Standard also has a relationship to the Equipment Use based on its acronym. The appropriate Equipment Standard is to be entered in the Revit field when equipment is initially placed in the Revit MEP Design model.

Manufacturer
Field to place the Equipment Manufacturer name and should be entered into this Revit field for each piece of equipment by the Construction Manager/Contractor or Sub-Trade.

Model Number
Field to place the Equipment Model Number and should be entered into this Revit field for each piece of equipment by the Construction Manager/Contractor or Sub-Trade.

Serial Number
Field to place the Equipment Serial Number and should be entered into this Revit field for each piece of equipment by the Construction Manager/Contractor or Sub-Trade.

Part Number
Field to place any additional Part Number that might be provided by the Manufacturer and should be entered into this Revit field for each piece of equipment by the Construction Manager/Contractor or Sub-Trade.

Classification Code
Field to place the Equipment CSI Uniformat Number and should be entered into this Revit field for each piece of equipment by the Construction Manager/Contractor or Sub-Trade. This should follow Uniformat 2010 nomenclature to the Level 5 classification. Level 5 includes the full Uniformat structure in addition to the CSI MasterFormat Number. For example: Unit Heaters fall under the Heating Systems and Decentralized Heating Equipment in Uniformat so the Level 5 classification would be D3020.70.238239, whereas 238239 is the MasterFormat Number.

Additional Comments
This is a field at the Instance Level in Revit for Equipment; it is not to be used by the Design Team, Construction Manager/Contractor or Sub-Trades.

Cost to Replace
Field to place the estimated Cost to Replace the piece of equipment, this field is for equipment only not labor. Number should be entered into this Revit field for each piece of equipment by the Construction Manager/Contractor or Sub-Trade.

Install Date
Field to place the date in which the piece of equipment was installed in the building. Date should be entered into this Revit field for each piece of equipment by the Construction Manager/Contractor or Sub-Trade.

In Service Date
Field to place the date in which the functional testing/start up occurred and when the equipment was put into use. Date should be entered into this Revit field for each piece of equipment by the Construction Manager/Contractor or Sub-Trade.

Equipment Location
Field to place the information about where the equipment is located in a Room or Space. If in a large open space use the nearest column line intersection and if in a smaller room use a designation referencing a fixed visible component like a door. Location should be entered into this Revit field for each piece of equipment by the Construction Manager/Contractor or Sub-Trade.

Date Warranty Expires
Field to place the date in which the manufacturer's warranty for the piece of equipment will expire. Date should be entered into this Revit field for each piece of equipment by the Construction Manager/Contractor or Sub-Trade.

Life Expectancy
Field to place the estimated Life Expectancy of the piece of equipment. Number, in years, should be entered into this Revit field for each piece of equipment by the Construction Manager/Contractor or Sub-Trade.

Subcomponent of Equipment
Field used to track the Parent-Child relationship of equipment. Parent-Child nomenclature should be entered into this Revit field for each piece of equipment by the Construction Manager/Contractor or Sub-Trade.

The following documents are required for each piece of equipment shown in ***Exhibit C-Equipment Assets***. These documents should be coordinated with the ***Exhibit F: Operations + Maintenance Support Information.***

- Product Data
- O&M Manuals
- Installation Guide
- Warranty Documents
- Submittal Information
- Commissioning Reports
- Start-Up and Shut Down Procedures
- Additional Equipment Testing Documents

EQUIPMENT SCHEMA STANDARDS

Equipment Schema Standards: All equipment entered should follow the following formats.
*Required fields for all equipment.
**Any deviation from this format and the information will not be recognized by the Facilities Management software.

Revit Field Name	Database Field Name	Database Multi-Line Heading	Data Format	Field Size	# of Decimals	Definition	Requirement
Cost To Replace	cost_replace	Cost To Replace	numeri c	12	2	Actual cost to replace equipment based on current market value. Includes labor and materials.	Enter a numeric value no more than 12 characters and no use of special characters or commas.
Classification Code	csi_id	Classification Code	char	16	0	CSI classification code up to level 5 detail	Enter full CSI classification code up to level 5 that best relates to the equipment. Use Uniformat 2010 nomenclature in addition to the CSI MasterFormat #. (Example: D3020.70.238239)
In Service Date	date_in_service	In-Service Date	date	10	0	Date the equipment was first used	Enter the date when the equipment was or is expected to first be in use Format: mm/dd/yyyy
Install Date	date_installed	Install Date	date	10	0	Date the equipment installation was completed	Enter the date when the equipment was or is expected to be installed. Format: mm/dd/yyyy
Date Warranty Expires	date_warranty_exp	Date warranty Expires	date	10	0	Date the equipment warranty expires	Enter the date when the equipment warranty is expected to expire. Format: mm/dd/yyyy
Equipment Code	eq_id	Equipment Code	char	24	0	A unique value for the asset in the table	Equipment ID must be a unique value for every piece of equipment. Equipment code must be entered as a numeric value and be no more than 8 characters. Enter codes in sequential order.

Revit Field Name	Database Field Name	Database Multi-Line Heading	Data Format	Field Size	Number of Decimals	Definition	Requirement
Life Expectancy	eq_life_expct	Life expectancy	date	10	0	End date of the equipment life expectancy	Enter the date when the equipment life expectancy is expected to expire. Format: mm/dd/yyyy
Equipment Location	eq_location	Equipment Location	char	100	0	Short description of the equipment location	Enter a 100 character or less description of where the equipment is located in the building
Equipment Standard	eq_std	Equipment standard	char	50	0	Equipment standards allows equipment categories to be assigned to the equipment	Select the Equipment Standard that best fits from the **eqstd table**. Refer to sheet **eqstd**.
Manufacturer	eqmfr_id	Equipment manufacturer	char	16	0	The manufacturer that manufactured or produced the equipment.	Select the Equipment Manufacturer that best fits from the **eqmfr table**. Refer to sheet **eqmfr**.
Manufacturer Part Number	eqmfr_partnum	Equipment manufacturer part number	char	32	0	Manually entered unique part number as specified by the equipment manufacturer	Enter the manufacturer's part number not to exceed 32 characters
Model Number	eqmodel	Model number	char	100		Manually entered unique model number identifying the piece of equipment	Enter the equipment model number not to exceed 100 characters
Serial Number	num_serial	Serial number	char	32	0	Manually entered unique serial number identifying the piece of equipment	Enter the equipment's serial number. use no more than 32 characters
Subcomponent Of	subcomponent _of	Sub-component of equipment	char	24	0	Manually entered field identifying the specific equipment of which this piece is a subassembly	Enter the eq_id of main piece of equipment this is a subassembly of. Must be no more than 8 characters
Mark	use1	Equipment Use	char	50	0	Required field used to describe the purpose of the piece of equipment within the building	Enter a unique descriptive name for the equipment. Equipment use must not be more than 50 characters

EXHIBIT E: ASSETS DATA MAPPING MATRIX

ASSETS DATA MAPPING MATRIX

This document lays out the roles and responsibilities for capturing data. Below is an example template.

Information Category	Equipment Asset Details	Data Entry Party	Data Authoring Software	Revit Shared Parameters Field
Building Program Data	Site Code	Owner	ARCHIBUS	N/A
Building Program Data	Building Code	Owner	ARCHIBUS	N/A
Spatial Location Data	Floor Code	Owner	ARCHIBUS	Level†
Spatial Location Data	Room Code	Design Team	Both	Room Number†
Asset Data Properties	Equipment Use (Tag on Drawings)	Design Team	Revit	Mark†
Asset Data Properties	Equipment Code (Asset Tag)	Contractor	Revit	Equipment Code*
Asset Data Properties	Equipment Standard	Design Team	Revit	Equipment Standard*
Manufacture Information	Manufacturer	Contractor	Revit	Manufacturer[z]
Manufacture Information	Part Number	Contractor	Revit	Manufacturer Part Number[z]
Manufacture Information	Model Number	Contractor	Revit	Model Number[z]
Manufacture Information	Serial Number	Contractor	Revit	Serial Number[z]
Manufacture Information	Classification Code (CSI Uniformat Number)	Contractor	Revit	Classification Code[z]
Manufacture Information	Additional Comments	Owner	ARCHIBUS	Comments†
Cost Requirements	Cost to Replace	Contractor	Revit	Cost to Replace[z]
Facility Management	In Service Date	Contractor	Revit	In Service Date[z]
Facility Management	Install Date	Contractor	Revit	Install Date[z]
Facility Management	Equipment Location	Contractor	Revit	Equipment Location[z]
Facility Management	Date Warranty Expires	Contractor	Revit	Date Warranty Expires[z]
Facility Management	Life Expectancy	Contractor	Revit	Life Expectancy[z]
Facility Management	Subcomponent of Equipment	Contractor	Revit	Subcomponent Of[z]

†Existing Revit Field *Parameter Created by ARCHIBUS [z]Shared Parameter

EXHIBIT E: OPERATIONS + MAINTENANCE SUPPORT INFORMATION

OPERATIONS + MAINTENANCE SUPPORT INFORMATION (OMSI)

OMSI should coordinated with the Equipment Attachments and be provided as PDF files.

Required Information	Description
Introduction	Facilities Description with outline and structure of O&M content
System Level Description	Description of the system and its purpose, how it operates, and any interfaces it may have
Preventive Maintenance	System-level tables guide maintenance personnel, via fault tree analysis, in a sequential, step-by-step isolation of a system problem to identify faulty equipment. Typical malfunctions, tests or inspections, and corrective actions or recommendations to correct malfunctions are included
Plumbing	Related to domestic water and sanitary waste systems
Fire Protection	Related to wet/dry pipe sprinkler systems
HVAC	Related to systems, including automated controls and exhaust, space heating, and central air systems
Fire Detection & Intrusion Alarms	Related to detection and alarm systems (wet/dry pipe sprinkler)
Electrical	Related to power distribution equipment and backup/emergency electrical (uninterruptible power supply, generator)
Conveying	General information and preventive maintenance for elevators, escalators, wheel chair lifts, conveyors, etc.
Operating Procedures	Controls/Startup/Shutdown/Emergency Over-Ride/Seasonal Changeover: Include equipment configurations for each mode of operation
Manufactures' Literature	Identifies manuals, cut sheets, etc., from equipment manufacturers that amplify information provided within the system-level O&M manual. Manufacturers' literature generally provides procedures to operate, maintain, troubleshoot, and repair specific items at the equipment level. This information is contained in a separate volume of binders, identified by facility/system, for easy reference. Specific material or complete documents can also be electronically scanned for its 'on-line' use, such as linking from the system-level manual
Warranties & Bonds	For Systems, Equipment or Component Parts of Equipment put into service during construction.

REVIT SHARED PARAMETERS

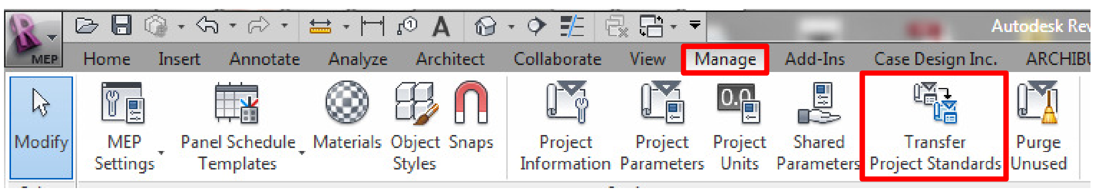
Overview

This is an electronic file named *State of Minnesota ARCHIBUS Shared Parameters File Template*. Use this Revit .rte file to transfer Project Standards from the Template File to the Revit MEP Design Model, Revit MEP Construction Model and the Record Revit MEP Model.

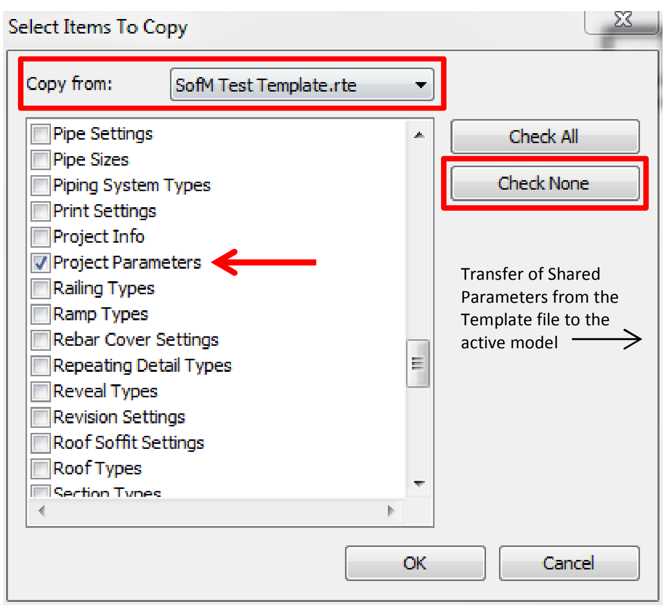
This will create the Instance Parameter fields for metadata requested by the State of Minnesota for MEP Equipment in the project models based on the *Exhibit B: Equipment Asset Details*. Author the requested information into these fields.

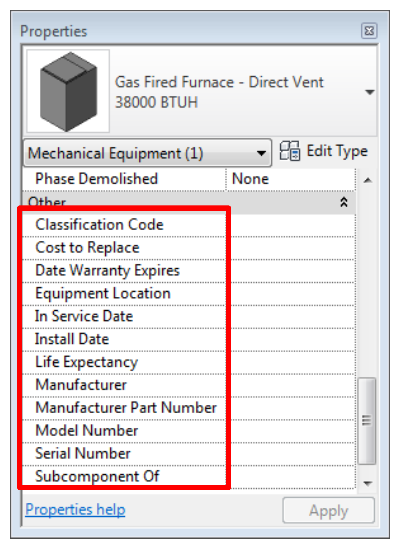
Process

1. Open the *State of Minnesota ARCHIBUS Shared Parameters File Template* while also having one of the MEP files listed above open.
2. Using the model file as the active and open window, go the 'Mange' tab and select 'Transfer Project Standards'.



3. The following 'Select Items to Copy' window will pop up. In the 'Copy from:' drop down select the *State of Minnesota ARCHIBUS Shared Parameters File Template*.
4. Then select the 'Check None' button to deselect all the checked items in the window.
5. Find the 'Project Parameters' field and re-select it.
6. Then click the 'OK' button.





7. At the Instance Level in Revit you will now find these Shared Parameters for MEP Equipment on the project so that metadata required by the State of Minnesota can be authored into these fields.

EXHIBIT G: REFERENCES + RESOURCES

REFERENCES

This is an overview of supplementary information, resources and references used in the State of Minnesota BIM Guideline.

The American Institute of Architects. *Guide, Instructions and Commentary to the 2013 AIA Digital Practice Documents: AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit AIA Document G201™–2013, Project Digital Data Protocol Form AIA Document G202™–2013, Project Building Information Modeling Protocol Form.* 2013 http://www.aia.org/groups/aia/documents/pdf/aiab095711.pdf

BIMForum. *2013 Level of Development Specification*. AIA / AGC, August 22, 2013. http://bimforum.org/wp-content/uploads/2013/08/2013-LOD-Specification.pdf

CIC Research Group, Department of Architectural Engineering, and The Pennsylvania State University. *BIM Project Execution Planning Guide***.** Creative Commons License. 2011.

United States General Services Administration. *GSA Building Information Modeling Guide Series: 03 - GSA BIM Guide of 3D Imaging.* 2012. http://www.gsa.gov/bim

NYC Department of Design and Construction. *DDC BIM Guidelines.* July 2012. http://www.nyc.gov/html/ddc/downloads/pdf/DDC_BIM_Guidelines.pdf

RESOURCES

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