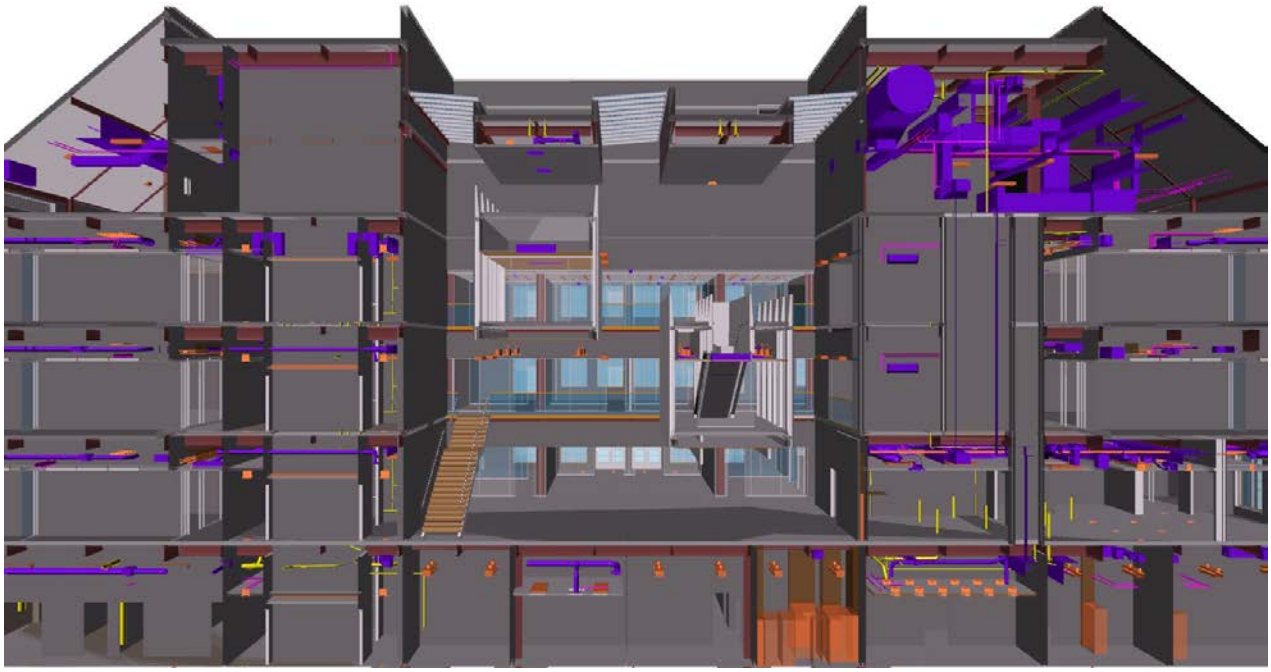
UNC CHARLOTTE



INTEGRATED LIFECYCLE MANAGEMENT

BIM/VDC REQUIREMENTS

IMPLEMENTATION PLAN

Manual for VDC, BIM/VDC and Lifecycle Data for design and construction projects at UNC Charlotte.

February 2018

February 1, 2018

Integrated Lifecycle Management (ILM) helps Owners manage the project and post-project related information with these five goals: ***Communication***, ***Centralization***, ***Documentation, Standardization*** and ***Automation***.

This document is to assist in the development of Lifecycle Management through BIM, the VDC process and Data Management resources.

To achieve this vision, The University of North Carolina Charlotte (UNC Charlotte) has issued these guidelines to be a required part of the contract for all campus design and construction projects.

Throughout the design and construction, various UNC Charlotte departments will review the BIM/VDC, Project Metadata and associated documentation for verification, accuracy and delivery. These departments and their involvement are as follows:

- **UNC Charlotte FO BIM/VDC Manager**
  - Coordinate development of BIM and Metadata within various UNCC departments.
  - Receives, reviews and is the final sign-off on BIM Execution Plan-Design (BXP-D) and BIM Execution Plan-Construction (BXP-C).
  - Provide UNC Charlotte Capital Project Manager with Site Code and Building ID for Revit project information.
  - Provide UNC Charlotte Capital Project Manager with Revit Template and Digital Management Exchange Guidelines Structure.
  - Ensures that BXP-D and BXP-C are adhered to for the duration of the project.
  - Provide access to Project Collaboration Cloud.
  - FO defines FM metadata, documentation, clearances to mechanical equipment and equipment naming standards. They will also verify that the systems and zones are defined correctly.

- **UNC Charlotte Facilities Information Systems (FIS)**
  - Specifies nomenclature for data to be collected, see Exhibit 5.
  - Specifies IT data collection tools, i.e. BIM 360 Field.

- **UNC Charlotte 3rd Party Consultants**
  - Any 3rd party viewer in conjunction with the above listed UNC Charlotte departments to validate models, documentation, deliverables and overall BIM/VDC requirements.

If you have any questions about the BIM/VDC Requirements Implementation Plan please contact the Capital Project Manager and they will route all inquiries to appropriate University personnel for response.

Update Schedule

Release	Date	Brief Update Description
1	10/2013	Initial public release
2	1/2018	Full plan revision #1, v2.0

Table of Contents

Glossary

AEC
Architectural/Engineering/Construction

ARCHIBUS
IWMS used for Space Planning and Facilities Maintenance

As-Built Documents
As-built documents are the collection of 2D hard copy documents and/or electronic drawing files from the Contractor/CM that contain markups, annotations, and comments about changes that have been made to the Contract Documents during the construction phase.

As-Built Model
This is a collection of models that have been collected and updated throughout the construction process by the Construction Manager/Contractor. These changes and updates have been communicated from the Contractor and Sub-Contractors through comments, annotations, markups and design changes; model showing how a building is actually assembled and delivered. (Also see Section 7.6.3)

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 the profitability of the project.

BIM Execution Plan (BXP)
The BXP helps to define the BIM roles and responsibilities for the Design and Construction Team during the project.

Cx
Commissioning Agent

Clash Detection
The process of checking for clashes and interferences in one or more BIM models. May also be referred to as model coordination.

Construction Documents
The Construction Documents are a set of written and graphic documents prepared for communicating the project design for construction and administering the construction contract." They consist of the drawings, specifications, contracting requirements, procurement requirements, modifications and addenda, and resource drawings.

Construction Model
The model used during construction to simulate and analyze the construction of a building for constructability, pricing, etc. within an authoring software. (Also see Section 7.6.1)

Coordination Model
A federated model created from two or more models used to show the relationship of multiple building disciplines such as architectural, civil, structural, and MEP (mechanical, electrical, and plumbing) for constructability and coordination. (Also see Section 7.6.2)

Core Collaboration Team
The group of people—which should include someone from each party working on the project, such as the owner, architect, contractor, consultants and trade contractors—responsible for completing a BIM and Building Energy Simulation (BES), creating the document management file folder structure and permission levels in the collaborative project management system, and enforcing the action plan set out in that document throughout design and construction of the project.

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 as is the single source for construction document development.

.DWF
.DWF is a file type that was developed by Autodesk to be locked file for drawing sheets and model data. It can be used as a file transfer for estimating data, markups, and other third party software. It can be a combination of 3D and 2D information within the same file.

FM
Facility management is a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology.

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

Integrated Workplace Management System (IWMS)
A workplace management system characterized by an enterprise-class software platform that integrates five key components of functionality operated from a single technology platform and database repository: real estate management, project management, facilities and space management, maintenance management, and environmental sustainability.

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

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. Data necessary to allow a repository to manage information objects, such as when, how and by whom a resource was created and how it can be accessed.

Model Manager
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.

Navisworks
Navisworks is software that allows for the viewing of multiple model formats. This ability to "view" these files also allows for Navisworks to simulate the interaction between model files. That includes collision reporting, time lining, and coordination.

NWC
This file is a Cache File that is used by Navisworks to quickly read many other file types.
These files can only be read in Navisworks and Navisworks cannot export out or be saved as an NWC. NWC is the format that is typically created (exported) from products like Revit and AutoCAD, and also is created automatically when Navisworks opens up a DWG directly.

NWD
This is the equivalent of a DWF or PDF. Typically the project file NWF is published to NWD which removes all links and keeps everything in the NWD. This allows the ability to share a project with someone externally without having to send all of the linked/appended files. An NWD can be opened with any Navisworks program, specifically Freedom Viewer.

NWF
This is the project file. The NWF contains all of the Navisworks data and pointers to the files that are loaded. The content that is saved in an NWF are things like red lines, saved viewpoints, materials, etc. Project/working file used daily to update info and reload updates from the linked/appended files.

O&M
Operations and Maintenance

Operations and Maintenance Support Information (OMSI)
Comprehensive data to properly operate, maintain and repair the facility and its systems. OMSI, also referred to as "Technical Operating Manuals," provides a process and a product that captures and organizes key information produced during the design, construction and final acceptance of new facility acquisition or major rehabilitation. The OMSI Scope of Work helps ensure that virtually all as-built architectural and technical product and system information will be available in a standardized, user-friendly format for use over the life cycle of the facility.

Parametric
The relationships among and between all elements of a model that enable coordination and change management. These relationships are created either automatically by the software or manually by users as they work.

Record Drawings
The capturing of As-Built Document's annotation, comments, and markups into an updated drawing set. This is a collection of 2D hard copy documents and/or electronic drawing files from team members assigned to producing and providing the documentation to the Owner.

Record Model
A model containing all Contractual and As-Built conditions used to depict an accurate representation of the physical conditions, environment, and assets of a facility within an authoring software. (Also see Section 7.6.3)

.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.

Single Line Diagrams
A 2D simplified diagram illustrating the inter-relationship of pieces of a system or other elements. These are not to scale.

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

Virtual Design and Construction (VDC)
The management of integrated multidisciplinary performance models and metadata of design-construction projects, including the product (i.e., facilities), work processes and organization of the design-construction-operation team in order to support explicit and public business objectives

End of Glossary

1.1 Objectives

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

This BIM/VDC (Building Information Modeling /Virtual Design and Construction) Requirement and its corresponding guidelines are intended to act as the standard for the AEC Team to follow and develop their Project Execution Plans. Project Plans written to execute these guidelines should allow the facility to be compliant with UNC Charlotte's BIM/VDC and Lifecycle Data requirements. All drawings, schedules, simulations, and services required for assessment, review, and construction shall be extractions from the model and support electronic data and metadata. Moving this collected design and construction data into an Integrated Workplace Management System (IWMS) is critical to UNC Charlotte meeting its intended Lifecycle requirement.

UNC Charlotte's BIM/VDC Requirement is a living document and will continually be reviewed for applicability with current methods and technology. Also, review section 01 78 23-Digital Management Exchange Guidelines (DMEG) in the Project Manual for information associated with these requirements. UNC Charlotte welcomes feedback from the AEC Teams and internal staff regarding the performance of these processes is critical to keeping it relevant.

1.2 BIM/VDC Vision

UNC Charlotte understands that BIM/VDC represent both an enhanced technology and process change for the architecture-engineering-construction-facilities management industry. UNC Charlotte is committed to moving both the organization and its service providers to BIM/VDC as efficiently as possible, and to integrate BIM/VDC process methodologies into its delivery requirements. The information model shall include geometry, physical characteristics and metadata needed to describe the project, its construction and provide UNC Charlotte with needed Facilities Management Data.

UNC Charlotte will describe in this BIM/VDC Requirement how the modeling requirements need to be developed and how they can be used by their internal teams during and after construction. These requirements are split into the following categories

- Model use during design
- Construction requirements for modeling
- Metadata and data use after project completion

Modeled elements shall be of a Level of Development described within to support an integrated design process that coordinates critical systems for proper building function, performance and IWMS integration.

1.3 Lifecycle Vision

UNC Charlotte's goal is to maximize lifecycle building performance with detailed facility information and metadata, electronic building data improves the design and management across the lifecycle. This should occur from concept design through construction and beyond into operations and eventually to renovations and/or salvage and demolition.

To achieve this, UNC Charlotte has looked internally to its own workflows and processes to strategically align them with a BIM/VDC workflow. Changes have been made to assets and other electronic information within their IWMS system to better match BIM/VDC processes from the AEC industry. Therefore, UNC Charlotte is asking all AEC providers to use compliant BIM/VDC authoring tools for all major construction and renovation projects over $500,000. This requirement shall apply to design and construction by the architects, engineers, other consultants, and other contractors hired for UNC Charlotte projects.

1.4 General Responsibilities

BIM/VDC authoring tools, data integration, and collaborative team workflow environments shall be used to develop and produce project information and documentation as required for completion of construction. Both geometry and data information from BIM/VDC is to be used to maximize project reviews, decision support, design analysis, and quality assurance during all phases of the project.

It is the responsibility of all AEC Team members to provide the hardware, and software needed to successfully use BIM/VDC and Data Management processes for the project. The use of BIM 360 can be purchased using UNC Charlotte's license. A quote will be provided upon request and payment can be made directly to the software provider.

1.5 Goals

UNC Charlotte has set the following goals for the use of BIM during the design phase, construction phase and Handover/Facilities Operation.

Design

- Space Requirements
- Early Energy Information Modeling (EIM)
- START data entry for equipment

Construction

- Clash Detection & Resolution
- Model Integrity Checks (Depends on BIM Assure purchase per contract)
- Document equipment data & CONTINUE data entry
- Place Barcode on installed equipment

Handover/Facilities Operations

- Develop preventive maintenance procedures before building handover
- As-built model and data, such as O&M Manuals
- Push data into Archibus

1.6 Reuse

It is important for UNC Charlotte to own, reuse, and properly manage building data throughout the facility lifecycle. Consequently, UNC Charlotte will place significant importance on the accurate creation, management, and stewardship of building information during project creation and expects that data created during design and construction to be reused throughout construction and into facility management. Record Model(s) in the authoring software shall be provided at the end of construction to further the lifecycle and development efforts.

--- END OF SECTION ---

BIM/VDC Execution Planning

UNC Charlotte requires a BIM/VDC Execution Plan (BXP) developed to provide a master information/data management plan and assignment of roles and responsibilities for model creation and data integration at project initiation. The BXP shall align the project needs and requirements from this BIM/VDC Requirement with the Design and Construction team skills, capabilities, and technology maturity.

For Design-Bid-Build or GMP projects, a separate BXP for Design and Construction shall be developed and submitted to UNC Charlotte with specific attention to model and data handover from the design team to the construction team to Facilities. If a Construction Team is involved during Design and information is available during the design phase, a single BXP can address both Design and Construction activities.

2.1 Design BXP (BXP-D)

The Design Team shall submit to UNC Charlotte's BIM/VDC Manager their BXP-D during schematic design. Within thirty [30] days of submission, the BXP-D will be reviewed for approval by UNC Charlotte. BXP-D should identify the entire Design Team including all consulting engineers and specialty consultants, roles and responsibilities of the team(s), even if that party has not yet been identified, should be included in the BXP-D. The BXP-D will be a part of the final contract documents. This document will be due to the UNC Charlotte BIM Manager at Schematic Design deliverable.

See Exhibit – 1 BIM Execution Plan-Design for more details.

2.2 Construction BXP (BXP-C)

The Construction Team shall submit to UNC Charlotte's BIM/VDC Manager their BXP-C within sixty [60] days of pre-construction contract award for CMR firms and within thirty [30] days from bid award for General Contractors. The BXP-C shall outline the strategy and schedule for utilizing BIM/VDC Technology to execute construction related activities and project coordination. Within thirty [30] days of submission, the BXP-C will be reviewed for approval by UNC Charlotte. BXP-C should identify the entire Construction Team, subcontractors and specialty trades and design team. Roles and responsibilities of the team(s), even if that party has not yet been identified, should be included in the BXP-C. The BXP-C will be a part of the final contract documents and to make this a collaborative process the Construction Team needs to involve the Design Team in their VDC workflow when creating their BXP-C. This document will be due to the UNC Charlotte BIM Manager 90 days after the contract has been signed.

See Exhibit – 1 BIM Execution Plan-Construction for more details.

2.3 Information Exchange

UNC Charlotte Facilities Management (FM) is working to develop Digital Management Exchange Guidelines (DMEG) to eliminate hard-copy drawings, DWG electronic files, boxes of specs and basic electronic documents turned over to the Owner at close-out. It is evolving into an ongoing information delivery exchange process integral to the entire Team. UNC Charlotte seeks to advance the quality, timeliness and cost- effectiveness of the collection, input and maintenance of that facility information. Further aiding this process is a deliverable standard that produces all design & construction documentation in a consistent format the Owner understands and receives on all projects. This electronic workspace is established for efficient and timely exchange of documents, models and database files.

UNC Charlotte will provide the Contractor/CM with a template file structure to populate all Record Documentation for the Owner during construction. This folder structure has a direct relationship to the Digital Management Exchange Guidelines outlined in the appendix. UNC Charlotte will utilize a cloud based document management process for collecting the required deliverables listed in the appendix.

--- END OF SECTION ---

Process Responsibilities

3.1 General Responsibilities

The AEC Team should involve the owner's key personnel as directed by the UNC Charlotte Capital Project and BIM Manager to provide information during design and construction as needed. Their involvement should continue all the way through commissioning & close out. The UNC Charlotte BIM Manager will perform Model Health Checks at each milestone during the design process.

Documentation reviews at the end of all Design Phases will be performed paperless via a Bluebeam Studio Session set up by the UNC Charlotte Project Manager or the Architect of Record. The free viewer Bluebeam Vu can be downloaded for access and markup of files. All comments, markups, and suggestions for documentation and design changes should be made with this session as part of the contract. All markups need to be reviewed by each parties' respective lead prior to changes being made to the documents.

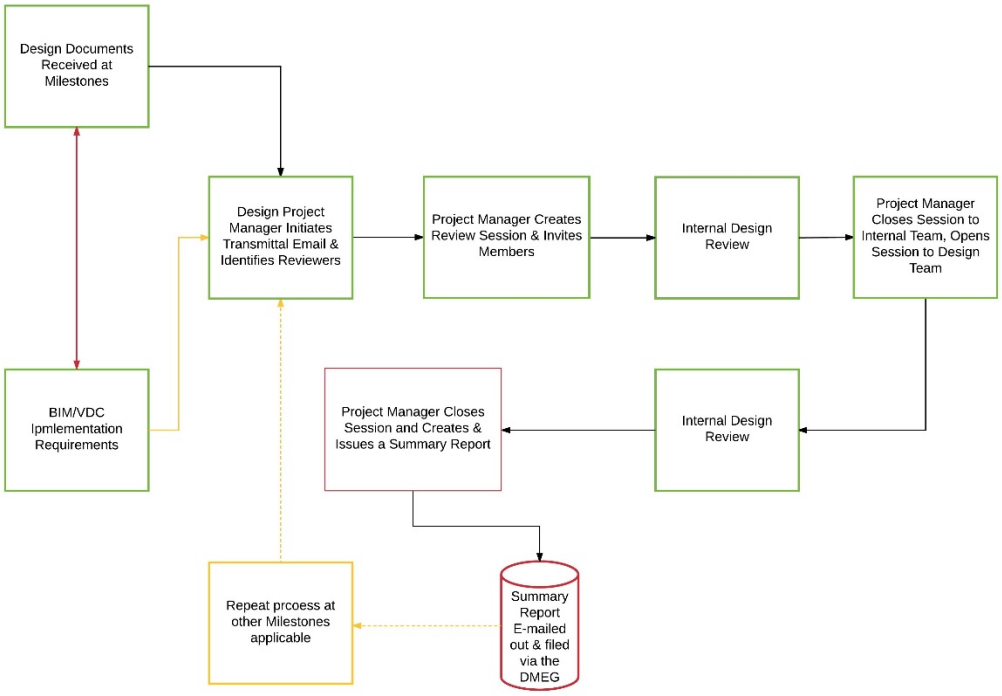
Tracking markups and/or comments during design or construction documents review:

Mark Color	Description
Black	Original Document
Red	Corrections to documents. Edits in this color provide direction for revisions, additions, or deletions to the documents that are to be included in the updated documents.
Blue	Notation from document editor. Edits in this color provide direction that is NOT to be specifically added or deleted from the documents.
Green	Questions from design team members picking up markups or comments back to the originator. This is to seek clarification or direction. (Note: utilize this work method only when comment originator is not available for immediate clarification)
Orange	Reviewers Acceptance to marks and comments in the document. This is for the Markups list color only
Yellow	Corrections to documents have been incorporated and design team has back checked their work. This can be highlighted in the document, but should also be added as a reply to the markup in the markups list.

During construction, updated Documentation sheets and information should be made in accordance to the BXP-C and unincorporated markups and revised sheets will be transferred to the latest sheet. The BXP-C will be maintained by the construction team in a Bluebeam Studio Session during construction.

During construction, updated Documentation sheets and information should be made in accordance to the BXP-C and unincorporated markups and revised sheets will be transferred to the latest sheet. The BXP-C will be maintained by the construction team in a Bluebeam Studio Session during construction.

Please see the flow diagram on the next page.



3.2 BIM/VDC Leads

As part of the execution of the BXP-D and BXP-C, the Design and Construction Team shall assign an individual to the role of Design Team and Construction Team BIM/VDC Manager. The individual shall have sufficient BIM/VDC experience for the size and complexity of the project and shall have relevant proficiency in the proposed BIM/VDC authoring and coordination software. The individual shall serve as the main point of contact for UNC Charlotte and the Design/Construction Team for BIM/VDC related issues.

3.3 Schematic Design

UNC Charlotte encourages the Team to take advantage of data exchanges and/or validations with BIM/VDC during Schematic Design, especially when it comes to Program and Space validation. The design team can start providing a spatial design based on input from the Pre-Design phase; provide an initial design for building systems and attributes including architectural, structural, and MEP; identify initial coordination issues among building systems. All information needed to describe the schematic design can be graphically or alphanumerically included in and derived from BIM/VDC by the end of Schematic Design. The Architectural model can show the general design and layout of the building structure and act as the baseline for all other subsystem designs, such as MEP and Structural models. The subsystem designs can be used to show the layout of building components with the combined model showing the spatial relationship of the Architectural model and subsystem design models. UNC Charlotte will require the design teams to upload any Schematic Design models to a specified location for QA/QC checks by the UNC Charlotte BIM/VDC Manager.

3.4 Design Development

Development of BIM/VDC should commence with an increased Level of Development (LoD) based on an approved Model Development Specification (MDS) and building systems. The model should now include parametric links to enable automatic generation of all plans, sections, elevations, custom details and schedules as well as 3D views. The Architectural model should continue to act as the baseline for all other subsystem designs. The subsystem designs will be modified accordingly to represent the enhanced design. The combined Design model will continue to show the spatial relationship of the Architectural model and consultant models. During Design Development

and for the remainder of the Design Phase the Design Team is to use BIM/VDC for conflict checking and the coordination of individual and specialized Design models. The conflicts report should be developed and show any outstanding coordination issues between the Design Team members as resolved.

UNC Charlotte's BIM/VDC Manager will require the design teams to upload their Design Development models via a specified process for QA/QC checks. Items being checked will be the use of the UNC Charlotte Revit Template, UNC Standards around Room and Equipment Naming, Finish and Equipment Scheduling, Level of Development (LoD) and general model health checks.

3.5 Construction Documents

During the Construction Document phase, the design should be finalized for the building and all building systems while preparing documentation for code review. All information needed to describe the "Contract Documents" shall be included in and derived from these models only. At this point, no documentation of the models should happen outside of the BIM/VDC Authoring software. As described later in this BIM/VDC Requirements document all model elements should be modeled and to their required Level of Development (LoD) outlined in the teams Model Development Specification (MDS).

It is the Design Team's responsibility to conduct and manage an adequate and thorough Clash Detection process so that all major interferences between building components will have been detected and resolved at the completion of Construction Documents.

3.6 Construction

The Design Team shall continue development of their BIM/VDC(s) throughout construction in conjunction with the Contractor/CM based on submittals, RFIs, or owner-directed changes. Maintaining the model based on construction activities and coordinating all updates for the individual and specialized models and databases will ensure completeness and accuracy of the overall project model. All information needed to describe the ongoing "detailed design" shall be graphically or alphanumerically included in and derived from these models only. Documentation of the models shall not happen outside of the BIM/VDC Authoring software.

By direction of the Design Team Lead the Consulting Engineers' models shall also be revised throughout construction based on submittals, RFIs, or owner-directed changes. The models shall always reflect the revised contract documents. At an agreed upon interval, and outlined in the BXP-C, during construction the updated design models shall be published in the approved collaboration format and posted for the Contractor/CM's coordination. If native authoring model files are needed by the Contractor/CM, separate copies of each technical disciplines model in the original format shall be provided.

Contractor/CM will have the Design Model(s) available at the start of construction to update and house data as established by the bid documents and specifications as necessary to support construction and UNC Charlotte's facility management objectives. Regardless of the Legal status of the model (Binding, Informational, Reference, Reuse), these electronic files are provided to the Contractor/CM solely for the uses related to this project. In the event of a conflict between the Contract Documents and the Electronic Model Files, the CMR shall immediately contact the architect to get clarification and make no assumption on which version might be correct.

It is the Contractor/CM's responsibility to assure that all major trades are modeled and used for clash detection, construction phasing, and installation coordination. Fabrication models shall be coordinated with the design model and any conflicts need to be resolved prior to fabrication and construction. Those conflicts shall be reported to the Design Team in the form of a Request for Information (RFI). Minor changes that have not been officially executed in the design models and that are considered As-Built changes will be documented by the Contractor/CM during construction. As listed in the BXP-C, those Mark-Ups shall be shared and coordinated with the Design Team so the changes can be incorporated into the Design model(s). All changes in the authoring software shall be published to the Contractor/CMs collaboration model to keep them up to date.

If the Contractor/CM uses Concurrent Construction Modeling in authoring software they should submit an action plan to UNC Charlotte and the Design Team for review prior to the start of construction that outlines the process for concurrent As-Built documentation and outline this process in the BXP-C.

3.7 Commissioning

Commissioning data including but not limited to design intent, performance criteria and operations data shall be recorded in Electronic form within the described Field Management or UNC Charlotte approved application. Unlike traditional paper-based systems, an electronic application for mobile Commissioning can capture systems and equipment information electronically, right in the field, which saves time, reduces errors and develops Real-Time Data Capture. This should reduce the time required for commissioning, improve the speed of re-commissioning and validate requirement or deliverables related to equipment issues or documentation. Dynamic reporting can show the statuses of all systems and equipment, enabling commissioning agents and other responsible parties to better manage project status and workflows. It shall be the Contractor/CM and Commissioning Agents responsibility to coordinate the information sources and integrate this information into the electronic application into a format for transfer at the completion of the project, or before.

If Commissioning is to reside in the Contractor/CM's electronic platform, the Commissioning Agents shall provide the Contractor/CM with their traditional documentation that would be used for Commissioning Construction Checklists, Pre-Commissioning, Functional Testing and any other documentation typically used by the Commissioning Agent. The Construction Manager/Contractor or UNC Charlotte BIM/VDC Manager will, in turn, create that documentation in an electronic version inside their system for Commissioning and Sub-trade coordination.

During the building commissioning processes, Facilities Operations (FO) staff shall be involved and coordinated through the Capital Projects CM to see how all building systems are designed to function and that they are being installed, balanced and verified to perform as designed. There should be an orientation and training program for FO staff to review the contents of the O&M manuals for major systems and equipment, including building mechanical, automation controls, plumbing, electrical, fire detection and protection, security, elevators, systems, etc. Any specialized training in building automation software should not be 'generic training' but should be performed using the actual project building graphics, controls sequences and data. All OMSI required documentation that is filed per the Digital Management Exchange Guidelines (DMEG) in the appendix should be reviewed for compliance by the Commissioning Agents.

--- END OF SECTION ---

Coordination & Collaboration

The success of an ILM enabled project is highly dependent upon the level at which the entire Design/Construction Team can communicate and work collaboratively for the duration of the project and with UNC Charlotte. This section documents collaboration procedures for effectively managing this process.

4.1 Kickoff Orientation

After award of the project, the Contractor/CM, shall facilitate a Project Kickoff Orientation Meeting, which will review all UNC Charlotte BIM/VDC and data requirements and answer questions from the Project Team. While reviewing the Primary Systems in BIM/VDC, the BXP-D should be reviewed and coordinated while developing the BXP-C.

Primary Architectural Systems include, but may not be limited to:
Partition systems with structure, flooring systems, partition systems with bulkheads, partition systems with expansion control, vertical transportation systems with primary engineering systems, millwork and casework systems with power and data outlets, horizontal ceiling systems with window openings, bulkheads, partitions, lighting, fire protection and HVAC outlet locations, exterior skin systems with window openings, structure, roof edge conditions, parapets, roof penetrations, and equipment locations.

Primary Engineering Systems include, but may not be limited to:
Structural framing, primary HVAC duct runs, primary fire protection main runs, primary electrical conduits, ceiling grids layouts, primary data, audio visual, security and communication distribution systems (cable trays, etc.).

4.2 Consultants/Sub-trades

Prior to installation, the Contractor shall hold trade coordination meetings with subcontractors and review clashes and report them back to the team. The coordinated model will be used to review and optimize scheduling and field installation. Sub-trades should be expected to have individuals attend who can actively engage in the subcontractor coordination process and make schedule commitments.

This collaborative process is to ensure that the deep knowledge and associated efficiencies of the fabricator are embedded into the Construction Model(s). The following construction trades (at a minimum) should provide 3D fabrication models:

- Structural Steel
- Mechanical System Duct MEP subcontractors (incorporate vendor models if available)
- Curtain Wall
- Building Envelope Systems (rain screens, pre-cast panels, glazing systems)
- Casework and furniture systems
- Additional fabrication models generated by subcontractor

4.3 Clash Issues

The Contractor/CM is required to coordinate models between design team disciplines, subcontractors and specialty trades to perform clash detection in order to assure constructability and help reduce RFI and Change Order submissions before construction begins. Contractor/CM shall require subcontractors, fabricators, suppliers, and manufacturers to submit all models to the contractor as outlined in the BXP-C. These model(s) should be updated after each project coordination meeting or as changes occur in the field during construction.

- On a multistory project, the models may need to be split on a level-by-level basis for MEP/F coordination. If a floor is particularly large, it may also need to be split into zones to reduce file size. Typically, 3D clash detection/coordination continues on a single floor until building systems are fully coordinated, and then continues on the next floor up.

- The team shall review the model and the Clash Reports in coordination meetings outlined in the BXP-C
- Internal Clash Resolution – Design Consultants and Subcontractors who are responsible for multiple scopes of work are expected to coordinate the clashes between those scopes prior to providing those models to the Construction BIM/VDC Manager for overall spatial and system coordination.
- Spatial Coordination Verification: Verification and tracking of resolved conflicts of all trade coordination issues which could result in change orders or field conflicts shall be provided to UNC Charlotte during project milestone dates, and should be fully resolved before build out.

Collision Reports
Collision reports can be published in a standard XML, HTML, or Text format. These reports shall include the following information at a minimum:

- Description of Collision Report
- Date of Collision Report Run
- List of all Collisions detected their status and their proposed solution

Contractor/CM shall submit a Collision Report schedule to the UNC Charlotte BIM Manager and Design Team as outlined in the BXP-C for further reference or clarification if needed. Static Coordination Model files should be created at all critical coordination milestones; this model should be archived with the date of the clash report at each instance, providing a record document at this point and time during construction.

4.4 Field Management

Field Management applications and their connected web-based workflow for in field point-of-construction data solutions, Issues Tracking and Punchlist is to be utilized by the Contractor/CM in conjunction with the Design Team, Sub-trades and UNC Charlotte for project coordination and data entry. Linked documents, photographs and model data between BIM and the Field Management application can be utilized to collaborate during construction and in preparation for data exchange to UNC Charlotte. Commissioning tests and checks, as-installed data, O&M manuals and start-up procedures are some of the items the Field Management application can be used to track, test and validate during construction. UNC Charlotte highly recommends utilizing BIM 360 Filed for the Equipment Asset Registry at minimum by the Contractor/CM.

--- END OF SECTION ---

5.1 Authoring Software

All architects, engineers, and specialty consultants are required to use the following design authoring software. Projects will remain on the same software release throughout the life of the project unless approved by the entire team and University. This should be outlined and coordinated in the BXP-D and BXP-C for UNC Charlotte's BIM Manager to review.

- Autodesk Revit (.rvt)
- AutoCAD MEP* (on the trade side only if necessary due to fabrication, equipment naming and tagging must be carried over from the original model)
- Review Specialty Sub-Trade modeling applications with UNC Charlotte's BIM/VDC Manager

Architectural, Structural, M.E.P., Energy, Life Safety and Fire Protection Models – These Autodesk Revit (.rvt) Model(s) are Central Revit Files with Worksets enabled. If there will be more than one model per discipline and/or Interior models please outline and describe in the BXP-D.

*AutoCAD MEP and propriety software add-ons are welcomed to develop, coordinate and fabricate the project. Where modeling for coordination and constructability is done outside of Revit or recreated as an entirely new model, all the Equipment, System and Zone Naming conventions developed in the Design model must be imported over to these models for data integrity and reliability. Changes made through these platforms; be it placement, geometry or metadata must make its way back into the original authoring software model and Record Model.

5.2 Coordination Software

Coordination software shall be used for assembling the various design models to electronically identify, collectively coordinate resolutions, and track and publish interference reports between all disciplines. The technical disciplines shall be responsible for updating their models to reflect the coordinated resolution. All internal and external model coordination and conflict detection are required to use the following software in its native file format in its current version. Confirm version with UNC Charlotte in the BXP-C for the project.

- Autodesk Navisworks Manage (.nwd)
- Autodesk BIM/VDC 360 Glue (optional)

5.3 Field Asset Management

A Secure, cloud-based, web and mobile Field Asset Management application that delivers a complete field management solution shall be used. This system will electronically enable workflows for quality, commissioning and document management processes in the field and in the office; proven to reduce rework, delays and eliminate paper. Modules required by the UNC Charlotte on their projects are Issues, punch-list, commissioning and equipment tracking.

- Autodesk BIM 360 Field
- KTrack

5.4 Additional BIM/VDC Tools

The Design and Construction Teams are encouraged to explore options to use the BIM/VDC and other electronic tools to enhance the project quality and delivery times, including quantity take-offs, cost estimating, overall project scheduling, subcontractor coordination, off-site fabrication, and other BIM/VDC benefits. UNC Charlotte is interested in fostering and supporting innovation and encourages bold steps toward trying new ways to improve business process efficiency, design, and project outcomes.

Following are some of the discretionary areas that UNC Charlotte may support for further development and the use of BIM/VDC; other ideas may also be proposed by the AEC Teams:

- 5D – Material take-offs & cost estimating
- Integrating information, e.g., electronic specifications that are tied to the BIM/VDC
- Achieving automated code checking
- Repeatable prefabrication components to speed construction erection time
- Off-site fabrication

Virtual Mockups

The contractor may want to utilize this process to which software is used to design and analyze the construction of a complex building system (e.g. curtain wall, form work, design element, tie-backs, etc.) in order to increase awareness and planning. Any physical mock-ups listed in the specifications can first be developed virtually, but without written approved authorization from UNC Charlotte, the Virtual Mockups do not take the place of the Physical Mockups per the specifications.

Energy Requirements

The Design Team may also establish an energy modeling method including local weather data within the BXP-D that will detail how energy modeling will be accomplished for the project.

Potential software to perform the energy modeling for the project may be: Insight 360, Sefaira and eQuest

--- END OF SECTION ---

Model Format & Data Collection

The models shall consist of objects and elements that represent the actual dimensions of the building elements and the building equipment that will be installed on the project. Before modeling begins, the Contractor/CM and Subcontractor BIM/VDC Managers will work with the Design Team to develop the model, and model view extraction structure for all the construction document files to assure coordination between disciplines. This structure shall be provided to UNC Charlotte so that the models can be reconstructed at a later date. BIM/VDC coordination requires the following model structure and features:

- The Architect's BIM/VDC Manager shall establish the floor elevation protocol so that the Technical Discipline/Trade BIM/VDCs will be modeled at the correct elevation.
- Clearance Reservations: All models shall include required clearances for all mechanical equipment for repair, maintenance, and replacement, light fixture access, overhead cable tray access, etc.
- All 3D model files submitted for clash detection shall be "clean;" all extraneous 2D references and/or 3d elements must be stripped from the model files.
- Revit deliverables should not have imported or linked 2D AutoCAD files associated with them.

6.1 General Requirement

6.1.1 Origin Point

All models must be in the correct location in 3D Space (x, y, and z coordinates). Models should be inserted by Auto-Origin to Origin. All models should contain their own grids and levels as a QC method to assure correct location. The correct insertion point is critical and ensures that each model will align properly without modification when linking and coordinating.

6.1.2 Tolerances

Model(s) must be within construction tolerances of the element in question – use 1/16" if unsure. Tolerances for specific items and systems will be determined as necessary. Set precision to 1/256". Globally set the precision to 1/256" and look for odd dimensions, the intent is to model at the highest accuracy as not to start out with errors built in.

6.2 Model Structure

All elements of the building must be coordinated into one file and should be modeled by their specific trade.

Examples:

- Architectural models should not include any of the structural elements contained in the structural model.
- Lights should be modeled by the electrical engineer, and not be the architect
- Plumbing Fixtures should be modeled by the Plumbing Engineer and not the Architect
- Architectural ceilings should contain information for openings for lights, registers, etc. as required by design
- All models should include 3D representations of required clearances and/or access requirements for equipment

Models will be separated by the following disciplines for design and construction coordination by all project participants throughout the construction process.

- Architectural -Deliverable-
- Mechanical -Deliverable- (This may coordinate into a single MEP model)
- Electrical -Deliverable- (This may coordinate into a single MEP model)
- Plumbing -Deliverable- (This may coordinate into a single MEP model)
- Structural -Deliverable-

- Construction Based on Contractor/CM authoring capabilities
- Coordination Required during Construction, only Clash Reports are a required deliverable.
- As-Built -Deliverable-
- Record -Deliverable-

6.3 File Naming

Model deliverables should have a file name that consists of three [3] distinct sections delineated by the following format: Facility ID _Discipline _Published Date.xxx

Final As-Built Model:

As-Built	Facility ID _AsBuilt_YYYYMMDD.nwd

Final Record Model:

Architectural Model(s)	Facility ID_ARCH_YYYYMMDD.rvt
Interiors/Furniture Model(s)	Facility ID_FURN or INTR_YYYYMMDD.rvt
MEP Model(s)	Facility ID _MEP or [DISCIPLINE]_YYYYMMDD.rvt
Structural Model(s)	Facility ID_STRL_YYYYMMDD.rvt
Life Safety and Fire Protection	Facility ID_LSFP_YYYYMMDD.rvt

6.4 Data Modeling Requirements

6.4.1 Room Name & Numbers

Use the Room Numbering convention outlined by UNC Charlotte in their Design Manual for all new construction projects, coordinate existing Room Numbers with UNC Charlotte. This system provides a consistent method for identifying and managing building space and shall be adhered to unless approval is documented in writing by the UNC Charlotte. This Room Numbering structure will be reviewed and approved at the end of Design Development and cannot be changed without written approval from UNC Charlotte - Capital Projects, FIS, and Space Management.

The Room Numbers shall be assigned to the Number Parameter in Revit for each individual room or space. This process gives the room/space a Unique Identifier understood by UNC Charlotte while also allowing the developed space to be connected to complex space standards and regulations inside UNC Charlotte's IWMS once connected. This serves as the Primary Connector for Room Data between Revit and the IWMS.

6.4.2 Room Finishes

Using the UNC Charlotte Revit Template a base Room Finish Schedule has been prepared so finishes can be tracked at the individual Room. This will provide detailed metadata to UNC Charlotte's Facilities Maintenance software on the type of finishes used in each Room. The means in which to populate this schedule is up to design team, but the finish data required per the template must end up residing at the Room level as well as a schedule produced in the documentation process.

Built in Revit Finishes should be used for the Room Finish Material for floor, base, wall and ceiling. Additionally the Finish Code, Color and Manufacturer need to be filled in for each Room as well as the Ceiling Height.

6.4.3 Room Category

All Rooms are assigned a Room Category and listed in *Exhibit 3-Space Asset Codes*. An additional Shared Parameter of Room Category will be assigned to Rooms and will be available once transferring the Project Standards from the *UNCC ARCHIBUS Shared Parameters File Template*. Populate this field when placing a Room with the Category assigned to that Room Type per the Exhibit provided in this document.

6.4.4 Occupancy

UNC Charlotte has two fields relating to Occupancy they would like populated. The first one being the Standard Room field of "Occupancy" which is the maximum number allowed per code. Second is the additional "Fixed Occupancy" field for those spaces that have fixed seating or built in work stations within the space.

6.4.5 Area Calculation

UNC Charlotte has a fundamental method of measuring Room Square Footage that synchronizes in a practical way with their IWMS. The area bound by the inside faces of surrounding walls, minus the area bound by the outside faces of contained full height columns will be the net area of a space. Revit should automatically delineate this based on the footprint of surrounding walls.

6.4.5 Equipment Category

All UNC Charlotte defined Equipment Assets should be assigned one of ten available Equipment Categories in the MEP Design Model, you can find these listed in *Exhibit 5-Equipment Asset Naming*. A Shared Parameter field for Equipment Category will be assigned to MEP Equipment and will be available once transferring the Project Standards from the *UNC_C VDC-BIM/VDC Lifecycle Revit Template*. Populate this field when placing a piece of Equipment in the Design Model with the Standards provided in the attached Exhibit.

6.4.6 Equipment Type

All UNC Charlotte defined Equipment Assets should be assigned an Equipment Type at the Family Level in the MEP Design Model, you can find these listed in *Exhibit 5-Equipment Asset Naming*.

6.4.7 **Equipment ID** (Unique Project ID)

Developing Asset Management during Design aids during Construction and UNC Charlotte in more efficient maintenance and operation procedures of a facility. By having data in the model early, it allows the FM team to start planning for building startup and tracking of building operations instead of spending time doing data entry or trying to find O&M documentation.

Each individual piece of building equipment shall include the following attributes and be maintained throughout Design and Construction. The Mark field in Revit serves as the Projects Unique Identifier and is a derivative of UNC Charlotte's Portfolio based Equipment Code. Those associated equipment tags shown on the documents lend a relationship to the metadata collected elsewhere in the VDC process. The Equipment Code will serve as the Primary Connector for Equipment Data between Revit and UNC Charlotte's IWMS and is to be authored in the model during Design when the equipment is placed. Those Equipment Codes can be found in *Exhibit 5-Equipment Assets*.

6.4.8 **Equipment Code** (Unique Portfolio ID)

All UNC Charlotte defined Equipment Assets are to be assigned an Equipment Code in the MEP Design Model, you can find these listed in *Exhibit 5-Equipment Asset Naming*. A Shared Parameter field for Equipment Code will be assigned to MEP Equipment and will be available once transferring the Project Standards from the *UNC_C VDC-BIM/VDC Lifecycle Revit Template*. Populate this field when placing a piece of Equipment in the Design Model with the Standards provided in the attached Exhibit.

Using the UNC Charlotte Revit Template a base Equipment Schedule has been prepared so all Equipment can be tracked in a single schedule for QA/QC purposes. This provides metadata to UNC Charlotte's Facilities Maintenance software using its required data structures. Data developed from items 6.4.5-6.4.7 are tracked in that boiler plate schedule.

6.4.9 Equipment Standard

After or during the equipment submittal process all UNC Charlotte defined Equipment Assets are to be assigned an Equipment Standard during construction in the Field Equipment Registry software, you can find

the data structure described in *Exhibit 5-Equipment Asset Naming*. The Equipment Standard is driven from the portfolio level, these are multiple quantities of like Equipment Components. The Equipment Standard is associated with the Category, Manufacturer and Model Number level allowing for bulk lookup or updates to equipment data.

6.4.10 CSI MasterFormat Number

All Equipment in the MEP Design Model is to be assigned its equivalent MasterFormat Level 3, and when available Level 4, CSI Number. An additional Shared Parameter for CSI Number will be assigned to MEP Equipment and will be available once transferring the Project Standards from the *UNC_C VDC-BIM/VDC Lifecycle Revit Template*. Populate these fields when placing a piece of Equipment in the Design Model with the appropriate number.

6.4.10 Doors

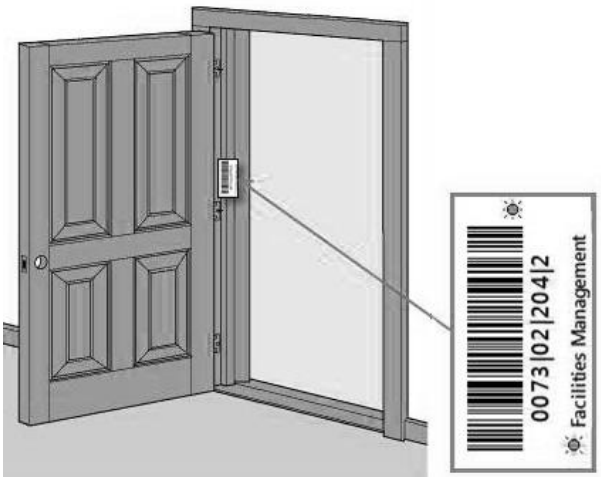
Door types are to be created to accurately reflect each kind of door in regards to type, size and information. The door symbol is a result of the view that is created from the model. Because of this, 3-D doors shall be used throughout the construction documents process and be built into the door schedule and parameters. Each door is also to receive a barcode over the second (middle) hinge of each door frame.

Door Details Tracked in Model during Design

- Door Number (Mark)
- Door Width
- Door Height
- Door Thickness
- Door Hand (Shared Parameter)
- Door Material
- Frame Material
- Frame Type
- Fire Rating
- Side Light or Transom
- Emergency Egress
- Hardware Code (Shared Parameter)

Door Details Tracked During Construction

- Interior or Exterior
- Lock Brand
- Lock Design
- Lock Finish
- Lock Back Set
- Cylinder Brand
- Cylinder Part Number
- Cylinder Material
- Cylinder Finish



Barcode information:

- Example barcode ID: 0055|02|232|2
- ID Breakdown: Building ID|Floor ID|Room ID|Door ID
- Barcodes are to face the door they are associated with.
- Doors are associated with Rooms by the following rules:
    - The lock faces opposite of the room that the door is associated with. Example: When you unlock a room 120 from hallway 100, the door is associated with room 120.

- If the panic hardware is installed on a door then the direction the panic hardware is facing is the room the door is associated to.
- In the instance of a corridor where both doors swing in either direction, it's the discretion of the installer to decide which room the doors are associated with.

6.4.11 Wall Partitions

A different Partition type is to be created for each type of wall used in the project per UNC Charlotte approval and constructed in 3-dimensional form. These will be based on University standards opposed to project standards. The Fire Rating, Fire Rating UL# and STC Rating # all need to be Parameters associated with each Partition type.

Partition Type Mark/Tag Example: G5a

G=Partition Type
5=Sequence Number
a=Fire/Smoke Rating

Partition Types:
C = Concrete
E = Exterior
S = Shaft
F = Furring
G = Gypsum
D = Demountable

Fire Ratings:
G5 = No Rating
G5a = Smoke Rated
G5b = 1 Hour Fire Rating
G5c = 1 Hour Fire and Smoke Rated
G5d = 2 Hour Fire Rated
*Continue progression as needed above 2 hours+.

6.5 Types of Model Elements

Model elements should be derived from inherent Parameters and specific Shared Parameters for Room and Equipment. The Spared Parameters will be issued by the UNC Charlotte via a Revit Template file so those Instance Parameters can be transferred to the Design and Construction models. Facilities Data will need to be entered into these fields during Design and Construction and eventually be passed to the Record Model. These Shared Parameters will exist at the Instance Level, not the Family Level. So if data requested by the UNC Charlotte exist at the Family Level for the Manufacturer's Elements or Custom Elements, that metadata will have to be duplicated at the Instance Level as well. Please refer to the attached Exhibits for the Shared Parameter fields being added.

- Manufacturer's Model Elements - elements created by and acquired from manufacturers often have more information than is prudent to keep in the model; the *appropriate* level of detail 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/VDC Authoring tool templates to create custom elements. Custom models components need to be assigned as a part and part of a family or group.

6.6 Model Systems and Components

- BIM/VDC shall be used for all building systems design, development, and analysis, including but not limited to architectural, structural, mechanical, and electrical, plumbing, and fire suppression, etc.
- During Concepts, SD and DD Phases, BIM/VDC technology shall be used to develop and establish building performance and the basis of design in accordance with UNC Charlotte standards.
- Elements, objects and equipment shall be tagged with unique identifiers Globally Unique Identifier (GUIDs).

6.6.1 Architectural Systems

Model the following architectural elements to a level that defines the design intent and accurately represents the design solution.

- Architectural Site plan
- Exterior wall systems
- Interior wall systems
- Fire rated walls
- Architectural floor slabs
- Roofing systems
- Equipment including owner provided equipment
- Reflected ceiling plans
- Vertical circulation – including elevators, stairs, escalators, and railings
- Doors and door frames
- Glazing – windows, interior glazing, curtain wall, and storefront
- Millwork and Casework
- Finishes – Including all room paint codes, flooring codes, and other finish items
- Toilets and accessories
- Toilet Partitions
- Specialties
- Must meet BOMA Standards
- Furnishings, fixtures, and equipment if not provided by others and integrated into the architectural model for coordination and document generation.
- Specialty equipment (food service, etc.)
- Clearance zones for access, door swings, service space requirements, gauge reading, and other operational clearance must be modeled and checked for conflicts with other elements. These clearance zones should be modeled as invisible solids within the object.

6.6.2 Structural Systems

Model the following structural elements.

- Foundations, including foundation walls
- Columns, beams, and joists
- Column grid
- Load bearing structural walls
- Brace frames and shear walls
- Structural slab
- Specialties
- Misc. structural components.
- Miscellaneous Steel
    - Angles for openings, deck bearing, etc.
    - Channels for mechanical units coordinating between mechanical
    - Lintels (unless considered a major member)

- These items may be modeled at the Design Team's option:
  - Steel reinforcing in concrete
  - Embeds in concrete

6.6.3 HVAC Systems

Model the following HVAC elements at a minimum. Model all HVAC components into Supply Air, Return Air and Exhaust Air Systems. Create Zones and assign all Rooms served to its corresponding Zone.

Systems should be named as followed: Category-System-Component, i.e. HVAC-SupplyAir-AHU1
Zones should be named as followed: Equipment Type-Rooms in Zone, i.e. VAV1-100,102,103

- Equipment
  - Fans, VAV's, compressors, chillers, cooling towers, air handlers etc.
- Distribution
  - Supply, return, exhaust, relief and outside air ductwork modeled to outside face dimension or duct insulation (whichever is greater)
  - Duct Joints
  - Diffusers, grilles, louvers, hoods, radiant panels, perimeter units, wall units
- Pipes sized at and over 3/4" diameter, include any insulation in model
- Clearance zones for access, door swings, service space requirements, gauge reading, and other operational clearance must be modeled as part of the HVAC equipment and checked for conflicts with other elements. These clearance zones should be modeled as invisible solids within the object.

6.6.4 Electrical systems

Model the following electrical elements at a minimum. Model all Electrical components into Lighting, Power, Telecommunications and Fire Alarm Systems.

- Power and Telecommunications
  - Interior and exterior transformers, emergency generators, and other equipment
  - Main and distribution panels and switchgear including access clearances
  - Main IDF's
  - Feeders and conduit at and over 1"diameter, and all large conduit bundles
  - Outlets, Switches, Junction Boxes
- Light Fixtures
- Lighting Controls
- Fire Alarm and Security Systems
  - Input devices
  - Notification devices
  - Associated equipment and access clearances
  - Permanently mounted fixtures
- Building Controls
- Clearance zones for access, door swings, service space requirements, gauge reading, valve clearances and other operational clearance must be modeled as part of the electrical equipment for collision checking. These clearance zones should be modeled as invisible solids within the object.

6.6.5 Plumbing and Fire Protection Systems

Model all Plumbing components into Domestic Hot Water, Domestic Cold Water, Sanitary and Sprinkler Systems. Sprinkler Systems are divided into multiple styles of suppression, these suppression systems must be identified.

- Model the following plumbing and fire protection elements at a minimum.
- Waste and Vent Piping sized at and over 2" diameter, includes any insulation in model
- Roof and floor drains, leaders, sumps, grease interceptors, tanks, water treatments and other major items.
- Supply Piping sized at and over 3/4"diameter, includes any insulation in the model.
- Domestic Booster Pumps
- Fixtures (sinks, toilet fixtures, water tanks, floor sinks, etc.)
- All fire protection Sprinkler lines
- Sprinkler heads, Fire Protection Pumps
- Stand pipes, wall hydrants, fire department connections, risers, including valve clearances
- Clearance zones for access, service space requirements, gauge reading, valve clearances and other operational clearance must be modeled as part of the plumbing and fire protections system and checked for conflicts with other elements. These clearance zones should be modeled as invisible solids within the object.

6.6.6 Specialty Consultants

- Specified or provided equipment by consultants should be outlined in the BXP-C.
- If questionable, pose to UNC Charlotte for further direction.

6.6.7 Civil & Site

- Grading, contours (proposed and existing), site structures to nominal dimensions, all new utilities will be modeled.
- Existing utilities and points of connection, only as applicable and available from existing owner as-built information. Include all structures and utilities to be demolished.
- Pads and other accommodations for buildings will be modeled. Floor slabs, decks and other structural surfaces will be modeled by the architecture team.
- Landscape items, benches, etc. will be modeled by the architecture team to the extent that they are required for overall project coordination.

6.7 Construction Modeling

6.7.1 Construction Model

Objective: Construction Models are the models being developed during construction in an authoring software package (i.e. Revit, AutoCAD MEP, Sprinkler CAD) by the Contractor/CM and/or Sub-trades. Depending on the Contractor/CM and the BXP-C, model authoring by the Contractor/CM may not occur but is required by the Sub-trades for coordination. Any Construction Modeling should reflect the exact geometric properties of the materials and/or systems being submitted. In addition to the items mentioned in Section 7, these models could include fabrication, shop drawing and other models for coordination. Once federated with all the Design, Construction, Sub-trade, etc. models this is to be referred to as the Coordination Model.

Responsibilities: The Contractor/CM's BIM/VDC Manager will work with the Design Team and Sub-trades to answer the RFIs and submittals and adjust the Construction Models accordingly while also using it for constructability analysis. If so determined in the BXP-C the Contractor/CM's Construction Model may replace the Architect's Design model during construction and within the Coordination

Model. Sub-trade models are to be analyzed based on the Design and be incorporated into the Coordination Model.

6.7.2 Coordination (Federated) Model

Objectives: Update Coordination based on submittals, RFIs, or owner-directed changes; maintaining the model during construction based on construction activities and developed to reflect the actual fabrication of the building. These models are to include fabrication, shop drawing and other models developed during coordination and constructability reviews. The model is to always reflect the revised contract documents and can be used for scheduling analysis, construction sequencing if so desired.

Trade Constructability/Coordination Colors:

HVAC Pipe: Lime Green	Electrical: Cyan
Lights: Yellow	HVAC Duct: Blue
Fire Sprinklers: Red	Plumbing: Magenta
Ceilings: Orange	Framing: Purple
Steel: Maroon	Concrete: Gray

Responsibilities: The Architect's BIM/VDC Manager will work with the Architect's Consultants to answer the RFIs and submittals and adjust the Design model accordingly. The Contractor's BIM/VDC Manager will update this model throughout construction with the supplier and sub-trade models.

6.7.3 As-Built (Federated) Model

Objectives: The As-Built model serves as the final model based on updated Coordination models including all field changes and data requirements and represents the actual assembly of the building. These models will be issued per floor of the building at the close of construction as both a Navisworks NWD file and PDF file.

Responsibilities: The Contractor/CM's BIM Manager will work with all Consultants and Sub-trades to finalize this Coordination Model into an As-Built model. This model will then be handed over to the Design Team. Designer should take the model from the contractor, including any hand-written notes or other material, and produce a record model and specifications for the project. Original as-built mark-ups should be given to UNC Charlotte.

6.7.4 Record Model

Objective: Record models shall be provided for the project. Two files should be made available for each drawing. One file type should be the authoring software file and the other is IFC, for the owner to use as a basis for future project drawings. Model in the original authoring software format 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 to match that of the As-Built model conditions as well as the Sub-trade models. It is the culmination of the BIM process for the project including As-Built conditions back into the Authoring Software Platform for use by the Owner and Facility Management Team.

Responsibilities: The Design Team is responsible for providing UNC Charlotte this Record Model deliverable. These Revit RVT file models are to be delivered to the University within 90 days of Substantial Completion.

6.7.5 Closeout Documents

Objective: The closeout documents, required upon acceptance of the project, should be provided to the UNC Charlotte by the designer. All closeout documents should be provided within 60 days of project acceptance, unless required earlier by the contract. The UNC Charlotte BIM Manager will verify that all required closeout documents have been uploaded and approved prior to authorizing final payment to the Designer.

Responsibilities: The Contractor/CM is responsible for providing UNC Charlotte closeout documents. All closeout documents should be provided within 60 days of project acceptance, unless required earlier by the contract.

6.8 Level of Development (LoD)

UNC Charlotte intends to make final deliverable building information models available for integration into a Lifecycle Management solution. To meet that objective, it is important that UNC Charlotte's model is delivered following a LoD specified by the Universities BIM/VDC Manager in an approved MDS.

UNC Charlotte' welcomes the use of the Level of Development for BIM/VDC deliverables as defined by the 2017 Level of Development Specification by BIM/VDC Forum. As UNC Charlotte specific information will be added to the Design and Construction Models, the Record Model will consist of many LoD 350 components. This number refers to a LoD 300 for those items defined in the MDS and delivered at the Construction Document Phase. The 50 represents the more specific supplemental equipment and facilities metadata and As-Built construction changes that may have been included in the Record Model. Supplemental metadata during construction is required to be entered via the approved Field Asset Management application. The Contractor/CM shale coordinate this process with UNC Charlotte in the BXP-C.

During Construction and Coordination modeling the Contractor/CM and Sub-trades should use LoD 400 on elements requiring a high level of spatial coordination or constructability review. For questions related to LoD please review the latest BIM/VDC Forum/AIA Level of Development Specification for additional information.

6.9 Model Quality

Discussions regarding processes and best practices to ensure Quality should be reviewed at the Kickoff Orientation as a project team. At project milestones mentioned earlier in these requirements, the model and metadata will be reviewed to confirm that each model and its corresponding metadata/documents are being developed in accordance with the UNC Charlotte's intended use. The goal is to support each team member and verify that the processes are being followed throughout the timeline of the project, that there are no unresolved issues during construction and that there are no issues that may result in a significant loss of metadata upon exchange of information.

The Team shall establish and use in-house modeling quality control guidelines and exchange protocols. Good BIM/VDC practices may include but are not limited to:

- Use of element and component objects that embed the best practices of the firm.
- Maintenance of parametric linkages within the model at all times.
- Dynamic Search Sets as opposed to Static Selection Sets
- Use of UNC Charlotte defined nomenclature from the Equipment Standards Matrix.
- Use appropriate and interoperable viewing, checking, and output file formats.
- Review of a random 15% of model components, metadata and documentation for compliance.

UNC Charlotte will provide Issue Reports back to the Design and Construction Teams when variations or incorrect modeling and/or data collection procedures are not followed per these requirements.

--- END OF SECTION ---

7.1 Integrated Workplace Management System (IWMS)

The Computer Aided Facilities Management (CAFM) portion of the application helps UNC Charlotte improve space efficiency and evaluate the true costs associated with space usage. The reports resulting from a space management analysis will reveal how each square foot of space is being allocated which can enable a highly granular chargeback process. This can, in turn, improve reimbursement rates from third parties who require accurate and defensible space allocation and occupancy reports. With Space Management, organizations can easily satisfy these needs and better plan for current and future space needs across the organization.

The Computerized Maintenance Management System (CMMS) portion of the application allows UNC Charlotte to cost-effectively manage on demand or preventive maintenance (PM), improve internal and outsourced service provider performance, and simplifies forecasting and budgeting. Building Operations Management puts all of those capabilities—and more—easily within reach so the organization may gain more control over workload.

UNC Charlotte intends to integrate the final deliverable Record Model into a Lifecycle Management solution. In order to meet that objective, it is important that the data guidelines presented in this document be followed so it can be validated by the Owners IWMS. The integration of the Record BIM/VDC data into an IWMS is critical to UNC Charlotte's O&M procedures. Electronic data already in the model allows the FM team to start planning for building start up and tracking building operations; instead of spending time "catching-up" with data entry after taking control of the building. Any additional BIM/VDC advice or data collection opportunities that the AEC Team might be aware of or can be provided during the process are welcomed.

7.2 IWMS Construction Data Collection

Field Asset Management applications enable users to leverage Equipment and their attributes (i.e. name, type and manufacturer). Using a mobile device in the field as well as web-based applications that are dynamically updated as work and operations progress allowing the entire team to review the project at any time. Users do not need to see the BIM/VDC while entering data as part of this workflow.

Equipment related metadata should be uploaded to the Field Asset Application as made available during construction so the information can be reviewed by the AEC Team, Cx Team Members and the Owner's Facilities Maintenance team. The purpose is to create a more collaborative team approach and to collect equipment data and documentation throughout construction, not just at the end of the project. Metadata within the Field Asset Application is to be utilized to manage equipment during construction in preparation for Lifecycle Management. These documents and metadata inside the Field Asset Application can then be mapped to UNC Charlotte's IWMS for Lifecycle Management and Operations and Maintenance creating a Real-Time Data Collection Process.

Tracking of the materials and equipment are identified in the attached Exhibits, these assets have components and metadata to be tracked across all stages of the construction process. The Contractor/CM will be responsible for coordinating with the Owner and any other Consultants to ensure all custom metadata fields needed for Facilities O&M metadata are produced per these requirements. The QA/QC of models and metadata as well as the metadata mapping integrations is the responsibility UNC Charlotte's BIM/VDC Manager.

Tracking electronic information by barcoding is part of UNC Charlotte's business and usual process and the University is now extending that into the Construction and VDC process as well. Using Owner supplied barcodes the Contractor/CM is required to track materials and assets with the Field Asset Management Application throughout the installation and into building handover. By attaching barcodes to the Equipment Assets, the team will track and update the progress and metadata of these components and can directly access information about the asset. This process further prepares the database for Lifecycle Management tracking for UNC Charlotte.

7.3 Barcoding Requirements

The proper scheduling and association during the construction project is key to a successful process of allowing the barcode to be utilized in all phases of construction as well as O&M. Two areas of importance to focus on throughout the process is the individual placement of the tag and when the association with the tag begins. Installing generic barcodes, provided by the University, by the installer during the asset's installation has the best return on investment. A member of that same Trade Partners team or someone from the CM/GC team can then come through and quickly associate the barcode to the asset record, and/or model and collect additional information required. A good validation review during this process is for the Commissioning Agent to review when checking and commissioning the equipment.

A team meeting to review a label location standard for equipment is recommended because multiple people from the Trade Partner or CM/GC may be applying these labels. Without such standards each individual will determine what they think is best, leaving the owner to figure out that logic and search for labels each time they approach a piece of equipment. One universal standard set by UNC Charlotte is to not install the barcode label on a cover plate or any other type of removable cover. During construction and O&M, removable plates get lost, relocated and switched out, leaving an asset with no label or a label from another similar piece of equipment.

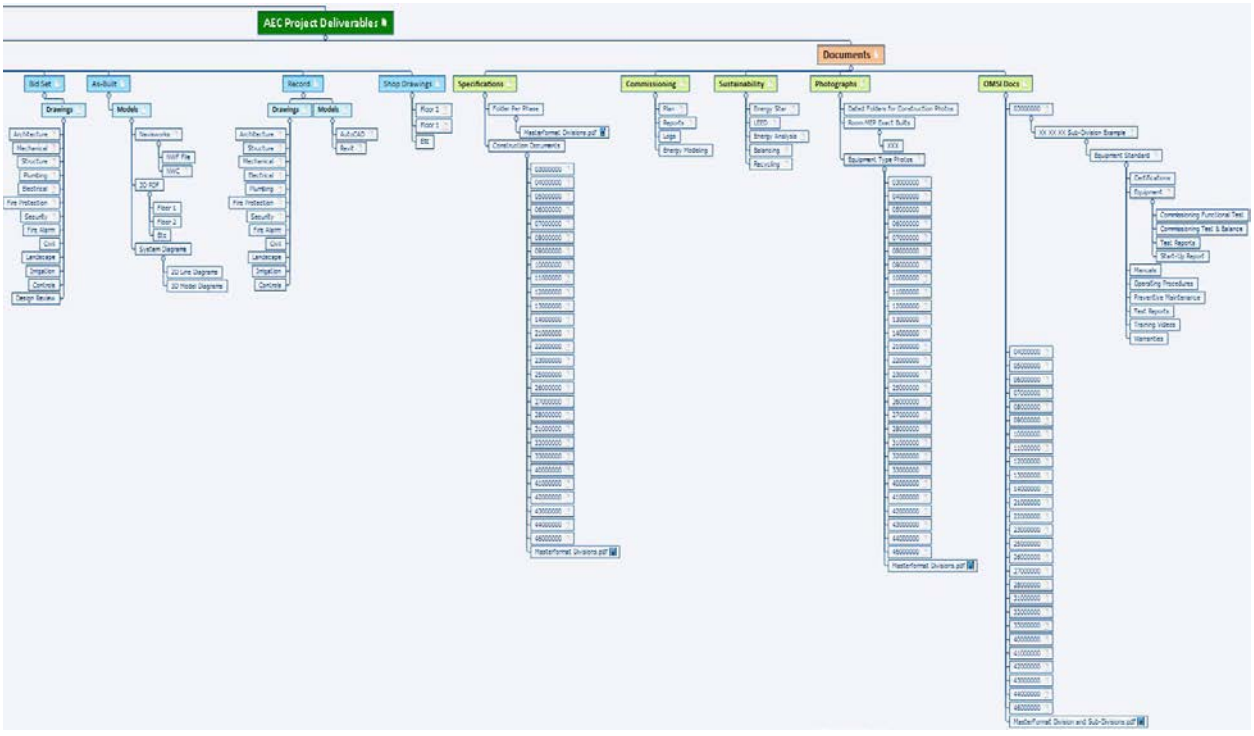
On a monthly basis, at a minimum, the Contractor/CM shall include UNC Charlotte and all BIM/VDC Managers in a coordination established for the purpose of assessing and/or executing FM data reviews and/or transfers from the construction process. Data transfers shall be coordinated with the UNC Charlotte BIM/VDC Manager and other project BIM/VDC Managers (when feasible) and be based on the FM objectives as defined. The Contractor/CM will be responsible for coordinating with the UNC Charlotte BIM/VDC Manager to ensure all custom metadata fields needed for Facilities O&M data are produced in the Field Asset Management Application. It will be UNC Charlotte's responsibility to integrate systems so that metadata is transferred to UNC Charlotte's IWMS and the attached asset documentation to the Digital Management Exchange Guidelines (DMEG).

--- END OF SECTION ---

Digital Management Exchange Guidelines (DMEG)

A Digital Management Exchange shall be established for the purpose of efficient and timely transfer of model, metadata and document files in an electronic process. Also, reference the 01 78 23 Spec Section in the Project Manual for additional information. UNC Charlotte's Capital Projects deliverables have advanced beyond hard copy deliverables. UNC Charlotte seeks to advance the quality, timeliness and cost- effectiveness of the collection, input and maintenance of the facility information and be as paperless as possible in doing so. Further aiding this process is a deliverable standard that produces all design & construction documentation in a consistent format the Owner understands and receives on all projects. This electronic workspace is established for the purpose of efficient and timely transfer of information and a standard structure for deliverables to reside. The Contractor/CM is to obtain, file and store this data from the entire AEC Team based on UNC Charlotte's required structure. For this process, UNC Charlotte will leverage a Cloud based platform for the design and construction team to file electronic documents per the DMEG. The contractor will have full administrative access to this cloud based project for their team and UNC Charlotte will only have read-only capabilities until building handover. If the contractor would like to leverage their own Cloud based document management tool the Contractor/CM will need to request this exception in their BXP-C. If so granted UNC Charlotte's BIM/VDC Manager will provide the Contractor/CM with a template folder structure for the document exchange process. This folder structure has a direct relationship to the DMEG and should be exchanged with UNC Charlotte at the close of the project based on the process agreed on by the Contractor/CM and Owner outlined in the BXP-C.

2D documentation for the purposes of assembling a design or construction set shall be derived from the models. All BIM/VDC information shall be fully parametric so that all applicable information regarding fixtures and/or elements can be generated for the schedules. Also, refer to *Exhibit 8-Digital Management Exchange Guidelines*.



(Exert from the DMEG Folder Structure)

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Appendix