BUILDING INFORMATION MODELING

(BIM)

GUIDELINES and STANDARDS for

ARCHITECTS and ENGINEERS

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Facilities Planning Department

Brigham Young University

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Building Information Modeling (BIM)

Guidelines and Standards for Architects and Engineers

This BIM Guideline and Standard applies to BYU Architecture and Engineering contracts executed after January 1, 2010 for the following projects:

- *Required on all new construction with total project funding of $1M or greater*
- *Required on all building additions and remodels with total project funding of $2M or greater*
- *Encouraged but not required on all other projects*

1. Requirements

1.1 Architects and structural engineers shall use BIM authoring software (see section 1.4). Building information models shall be created that include all geometry, physical characteristics and product data needed to describe the design and construction work. All drawings and schedules required for assessment, review, bidding and construction shall be extractions from this model. A/E (Architect/Engineer) shall follow the guidelines and requirements detailed in this document for BIM related services. Deliverable requirements are as specified in the *BYU Instructions to Architects and Engineers*.

1.2 Mechanical, electrical, plumbing, fire protection and civil engineers shall use BIM authoring software or discipline specialty 3D software approved by owner. Models shall be created that include all geometry, physical characteristics and product data needed to describe the design and construction work. Drawings and schedules required for assessment, review, bidding and construction shall be extractions from this model. Software shall be capable of interfacing with the Architects' and Structural Engineers' BIM authored software. In all cases, model building and infrastructure systems to a level that allows the team to verify clearances, analyze conflicts/clashes and properly coordinate the work with all other aspects of the project. A/E shall follow the guidelines and requirements detailed in this document for BIM related services. Deliverable requirements are as specified in the *BYU Instructions to Architects and Engineers.*

1.3 Specialty Consultants including but not limited to: food service planning, medical planning, library planning, audiovisual/communications, exhibit design, safety and security planning, interior design shall use BIM authoring software or discipline specialty 3D software approved by owner. Models shall be created that include all geometry, physical characteristics and product data needed to describe the design and construction work. Drawings and schedules required for assessment, review,

bidding and construction shall be extractions from this model. Software shall be capable of interfacing with the architect's BIM authored software. In all cases, model components to a level that allows the team to verify clearances, analyze conflicts/clashes and properly coordinate the work with all other aspects of the project. Deliverable requirements are as specified in the *BYU Instructions to Architects and Engineers.*

1.4 BIM Authoring Software

A/E shall use the following ***BIM*** authoring software for BYU projects: AutoDesk Revit Architecture, Structure, MEP and Civil 3D. The specific software version used must be approved by the owner.

1.5 IFC Compliance

BIM authoring software shall be compliant with the latest release of the Industry Foundation Classes (IFC) as certified by the buildingSMART Alliance. http://www.iai.hm.edu/how-to-implement-ifc/certification/ifc2x3-certification-results

1.6 Open Standards for Interoperability

BYU has adopted open standards for data exchange. A/E is encouraged to use products based on or using open standards for greatest interoperability between consultants and BYU.

1.7 Geo-reference / Coordinate System

A/E shall geo-reference site plans and building models to the BYU Survey Control Network (BSCN) coordinate system.

1.8 Project Collaboration Tools

A/E is encouraged to use electronic project collaboration tools such as document management and file sharing sites, reviewing tools and project communication websites.

2. Process

2.1. Model Quality

A/E shall establish and use in-house modeling quality control guidelines and exchange protocols. This may include but not be limited to:

- Use of element and component objects that reflect the best practices of the firm.
- Maintain parametric linkages within the model at all times.
- Do not use disconnected 2D files except as reference only and remove before project delivery. Extract all drawing views from your model.
- Use correct object definitions for modeling: i.e. use a table object for a table – do not "fudge it" with slab commands. It may *look right* but will not *be right* for scheduling, analysis or interoperability with other software.

- Practice efficient and accurate modeling, i.e. eliminate object overlap, correctly close wall intersections, etc. The model needs to *look right* and *be right*. Inaccurately modeled items WILL become a problem.
- Creation and adherence to A/E's own in-house standards.
- Creation and use of BIM planning procedures.
- Use industry-accepted or BYU-defined nomenclature for objects and spaces.
- Use appropriate and interoperable viewing, checking, and output file formats.
- Use of model-checking tools to confirm the validity and accuracy of files and adherence to modeling standards before submission.
- Use of Open Standards and IFC compliant software.
- Where intelligent objects are not available, these items may be modeled as a "concept object" conforming closely in length, width, height and properly located.

2.2 Work Effort and Compensation Schedule

BYU will consider fee allocation within the stated BIM work effort limits. This decision will be based on A/E's BIM capabilities, scope of the project and adherence to work effort descriptions.

BYU Project Phases	***Description of A/E BIM Work Effort***	***BIM Work Effort***
Schematic Design	Defines the optimum design solution meeting program, budget and schedule.	15% 15% total
Design Development	Facility design is fully developed, coordinated and validated. Cost and Schedule established with high level of precision.	30% 45% total
Construction	Detailed design is fully annotated and	

Documents (100% review)	graphically clarified for accurate bidding, scheduling and construction purposes.	30% 75% total
Bid set	Above plus inclusion of review comments into model(s)	In above
Bidding	Clarify document intent by addendum; update model.	5% 80% total
Construction and Closeout	Maintain building model during construction and incorporate record documents, change orders and other appropriate close-out submittals into the model(s).	20% 100% total

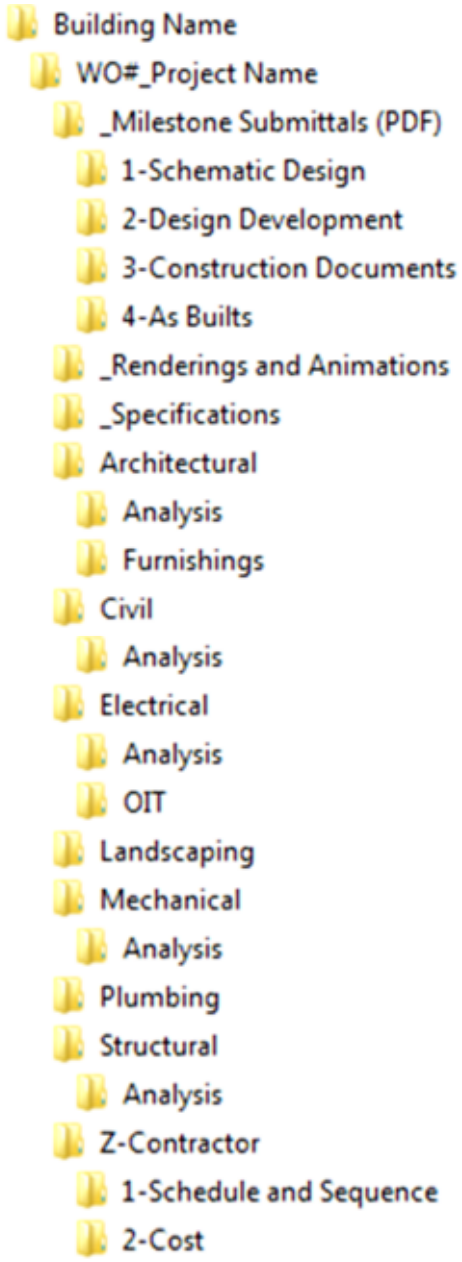
2.3 Model Submittal

With submittal of closeout documentation, the A/E shall submit the final model(s) in native application's format and validated IFC. Any future changes to, or extractions from the model will be the responsibility of the party making the changes.

A/E shall make all submittals per *BYU Instructions to Architects and Engineers*.

2.4 Project Folder Structure

Maintaining consistent file naming and structure is critical for referenced (linked) files to function properly across project teams and for end users such as facilities managers, to be able to retrieve files quickly once the project is complete. For this reason, BYU has developed a filing structure to organize project files and other deliverables for the duration of the project.



3. Objectives and Application

3.1 Schematic Design Phase

3.1.1 A/E may use any method to begin the design process but shall use a BIM authored or 3D model(s) by completion of this phase. All information needed to describe the schematic design shall be graphically or alphanumerically included in and derived from these models. BYU expects A/E to use analysis tools, static images and interactive 3D to describe the design concepts.

Deliverables are required as stated in *BYU Instructions to Architects and Engineers* and as noted below.

3.1.2 Topographic Surveying

Detailed requirements of what is to be included in the surveying deliverables is managed by BYU staff in consultation with the A/E on a project-by-project basis. The Engineer/Surveyor (E/S) performing the topographic survey shall use the BSCN coordinate system.

Survey data shall be provided in the deliverable Civil 3D model drawing(s) (see Section 3.2.9). The E/S must also provide a separate electronic text file in the PNEZD comma-delimited (*.csv) format. (Point number., Northing, Easting, Elevation, Description)

3.1.3 Existing Conditions

A/E shall model all existing conditions needed to explain the extent of the construction work for addition and remodel projects. The extent of modeling beyond the affected areas and the level of information to be included will be determined based on project needs.

3.1.4 Comparative Cost Analysis

A/E shall extract quantity information using BIM authoring software and other BIM integrated tools to support comparative costs analysis of options studied. Analysis and options may include: building perimeter, square foot zones by cost type, exterior envelope area, construction type, envelope materials, and/or others appropriate to the project. Outputs shall be converted to spreadsheets and submitted as part of the design solution justification at the end of this phase.

3.1.5 Comparative Energy and Sustainability Analysis

A/E shall use early energy modeling tools integrated with the BIM Authoring software to develop comparative energy analysis. Variables shall include site location, orientation, massing, form, sun controls, wall construction, natural ventilation, area of glass, day-lighting heating, cooling systems, natural and artificial light studies, insulation options, appropriate window-to-wall ratios and other factors appropriate to decision making. Modeling parameters shall be based on local climate data and actual site conditions. Output format shall

clearly communicate and be appropriate to project needs and submitted as part of the design solution justification at the end of this phase.

3.1.6 Program and Space Validation

A/E shall use the BIM authoring software or other analysis tools to compare and validate stated program requirements with the actual design solution. The following shall be developed automatically from the building information model:

- Assignable Areas (ASF) and Non-assignable Areas (NaSF) measured to inside face of wall objects.
- Gross Square Footage (GSF) measured to the outside face of wall objects.

Outputs may be converted to a standard space tabulation spreadsheet format and submitted as part of the design solution at the end of this phase.

3.1.7 Conflict Checking

A/E is encouraged to use automated conflict-checking software for this phase of the work.

3.1.8 Planning Tools

A/E is encouraged to use electronic programming and planning tools that integrate into BIM authoring software to continue project development at this phase.

3.2 Design Development Phase

3.2.1 General

A/E shall continue development of its Building Information Model (or 3D models for specialty consultants) created in the "Schematic Design Phase", Parametric links shall be maintained within the models to enable automatic generation of all plans, sections, elevations, custom details and schedules as well as 3D views. All information needed to describe the "detailed design" shall be graphically or alphanumerically included in and derived from these models only, except for the Specifications.

Deliverables shall be as stated in the *BYU Instructions to Architects and Engineers.*

3.2.2 Architectural Systems

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

- Architectural Site plan (also see Section 3.2.9 Civil Engineering):

  Paving, grading, sidewalks, curbs & gutters, utilities, site amenities and other elements typically included on enlarged scale site drawings in vicinity of building.

- Existing conditions to the extent required by 3.1.3.
- Demolished items to the extent required by 3.1.3
- New interior and exterior walls including:

  Doors and window openings

  Veneers, insulation and other vertical elements thicker than ½" (may be part of a composite element or assembly)

  Interior and exterior soffits, overhangs, sun control elements

  Parapets, screening elements

  Architectural precast

- Floor, ceiling and roof systems including:

  Appropriate structural items listed below if not provided by the structural engineer and integrated into the architectural model for coordination and document generation.

  Insulation, ceiling systems, floor tiles and other horizontal elements ½" or thicker (may be part of a composite element or assembly)

  Roof, floor and ceiling slopes, if needed, shall be modeled

- Elevators, stairs, and ramps – including railing systems
- Casework, shelving, cabinets and other interior architectural elements

- Furnishings, fixtures and equipment if not provided by others and integrated into the architectural model for coordination and document generation:

  Specialty equipment (food service, medical, etc.)

  Model mechanical, electrical and plumbing items that require architectural space (toilets/sinks/etc.) or require color/finish selection (louvers, diffusers, etc.) or affect 3D visualization (lighting fixtures, fire alarms, thermostats, etc.) unless provided by engineers.

- Clearance zones for access, door swings, service space requirements, gauge reading, and other operational clearance must be modeled as part of all equipment and checked for conflicts with other elements.

- These items may be modeled at A/E option:

  Exterior and interior wall trim

  Sheet metal or other thin elements

  Hardware

  Finishes unless stated above

3.2.3 Interior Design Systems

Model the following interior design elements to a level that defines the design intent and accurately represents the design solution:

- Wall finishes: Paint, wall covering, wood paneling, etc.
- Floor and base finishes: carpet, wood, tile, resilient flooring, VCT, etc.
- Window treatments: blinds, drapes, etc.
- Moveable wall panels
- Toilet partitions
- Furniture with associated finishes, model numbers and fabrics

It is desirable that the BIM model render each of the above products and provide associated product specifications and color choices.

3.2.4 Structural Engineering

Model the following structural elements:

- Foundations such as:

  Spread

  Caisson

  Pile

  Mat

  Wall

- Framing such as:

  Steel columns (with correct shape and size)

  Steel floor C-Joists

  Open web joists

  Steel beams and purlins (with correct shape and size)

  Blocking and Bracing members

  Precast concrete elements (hollow core plank may be modeled as a slab)

  Cast-In-Place concrete elements (chamfers and embeds may or may not be modeled)

  Floors including overall extents and openings (cast-in-place, precast, wood, composite, etc.)

  Wood posts/column

  Wood joists and rafters

  Wood trusses

  Solid wood or laminated beams

- Wall types including openings:

  Load bearing walls (masonry, concrete, cold-formed steel, wood)

Model overall thickness of cold-formed steel and wood stud walls (individual members may be modeled at A/E option)

Structural foundation walls including brick ledges

- These items may be modeled at A/E option:

Steel reinforcing in concrete

Embeds in concrete

Connection steel (gusset plates, bolts, clip angles, etc.)

Miscellaneous steel

Angles for openings, deck bearing, etc.

Channels for mechanical units

Lintels (unless considered a major member)

Miscellaneous wood

King studs

Headers (unless considered a major member)

3.2.5 HVAC Systems

Model the following HVAC elements:

- Equipment
- Fans, VAV boxes, compressors, pumps, coils, chillers, etc.
- Ductwork
- Supply, return, exhaust, relief and outside air ductwork including insulation and fittings
- Air Terminals
- Diffusers, grilles, louvers, hoods
- All piping, including insulation, fittings, valves, etc.

- 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.

  Specify the appropriate properties for all modeled elements. The following is an example list of elements and appropriate properties:

- Air Terminals
  Manufacturer, model number, neck size, flow
- VAV Box
  Manufacturer, model number, inlet size, flow, minimum flow
- Fan or Pump
  Manufacturer, model number, connection sizes, flow, external static pressure, electrical voltage, phase & amps, motor horse power, weight
- Large Coil
  Manufacturer, model number, connection sizes, air flow, water flow, materials, number of rows, number of fins per inch, finned height, finned length, air temperatures (in & out), water temperatures (in & out)
- Centrifugal Chiller
  Manufacturer, model number, connection sizes, chilled water flow, condenser water flow, cooling capacity (BTUH), water temperatures (in & out), electrical voltage, phase & amps, motor horse power, weight

Create systems and assign all modeled objects to their appropriate systems
- Supply Air, Exhaust Air, HW, ChW, etc.

Specify system properties
- System Type, Fluid Type, Fluid Temperatures, Flow, Static Pressure, etc.
  Define all building areas as spaces
- Specify space instance properties (Occupiable, Condition Type, Space Type, People, Electrical Loads, Temperature Set Points, etc.) for each space.
- Typically spaces are defined by the faces of the walls, floor, and ceiling bounding an area.
- A separate space must be defined for the plenum space above the ceiling.
- If there are different space properties within one physical area then the area must be modeled as two separate spaces.
- Spaces must be checked for accuracy before performing an energy analysis. Ensure that there are no missing spaces, no spaces that overlap, and no gaps between spaces and their bounding elements.

Create HVAC zones
- Assign all spaces to an appropriate HVAC zone

3.2.6 Electrical systems

Specify the appropriate properties for all modeled elements. Create systems and assign all modeled objects to their appropriate systems.

The following is an example list of elements and appropriate properties:

1. Power

   Exterior and interior transformers

   Manufacturer, model number, primary and secondary voltage, phase, KVA rating and impedance.

   Main and distribution panel and switchgear

   Manufacturer, model number, voltage, phase, bus material, quantity of spaces, circuit breakers in panel and all access clearances.

   Feeders and conduits

   Show all feeder and conduits 2" ID and larger.

   Receptacles, switches, junction boxes

   Show the dimensions and mounting heights of each box.

   Identify the devices (if applicable) in each box. Include type of device, color, system, etc. as necessary.

   Devices (Power)

   Identify type of device, i.e., number of poles, voltage, amperage ratings, NEMA type etc.

   Identify wire size

2. Lighting

   Lighting fixtures (Permanent mounted fixtures)

   Show manufacturer, model number, dimensions, voltage, wattage, lamp type, number of lamps, color, lens type

   Light fixtures (Moveable or plug-in fixtures)

   Moveable, plug-in fixtures need not be modeled as part of the electrical package.

   Show manufacturer, model number, dimensions, voltage, wattage, lamp type, number of lamps, color, lens type

   When specified, include power load (in watts) for receptacle where the fixture will be located/installed.

3. Fire Alarm

   Main and subpanels

   Show manufacturer, model number, dimensions and mounting height of all panels.

   Devices

Show manufacturer, model number, dimensions. Show location and dimensions of device on wall/ceiling.

4. Security System
   Main and subpanels
   Show manufacturer, model number, dimensions and mounting height of all panels.
   Devices
   Show manufacturer, model number, dimensions. Show location and dimensions of device on wall/ceiling.

5. CCTV (Close Circuit Television)
   Main and subpanels
   Show manufacturer, model number, dimensions and mounting height of all panels.
   Cameras
   Show dimensions and mounting height of all cameras.

6. Tele/Data
   Equipment racks
   Show the dimensions of all equipment racks.
   Show the interface with the room cable trays.

7. Cable Tray
   Show the dimensions and mounting height of all cable trays.

3.2.7 Plumbing and Fire Protection

Model the following plumbing and fire protection elements:

1. Waste and Vent

   All piping, including fittings, insulation (roof drains), valves, etc.

   Roof and floor drains, leaders, sumps, grease interceptors, tanks, water treatments, etc.

2. Supply (water, compressed air, gasses, etc.)

   All piping, including insulation, fittings, valves, etc.

3. Fixtures

Sinks, toilet fixtures, water tanks, floor sinks, faucets, etc.

4. Fire protections

   All sprinkler lines, including fittings, valves, etc.

   Sprinkler heads

   Stand pipes, wall hydrants, double check valves, fire department connections, risers, including valve clearances

5. 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.

6. Specify the appropriate properties for all modeled elements.

7. Create systems and assign all modeled objects to their appropriate systems
- DCW, DHW, Waste, etc.

8. Specify system properties
- System Type, Fluid Type, Fluid Temperatures, Flow, Static Pressure, etc.

3.2.8 Specialty Consultants

Model the following specialty consultant elements to correct size and location:

- Equipment provided or specified by said consultants
- Rough-in connections points for power, data, communications, water service and waste, gas, steam, or other needed utilities
- Extent of specialty consultant modeling shall be coordinated with the prime A/E
- Clearance zones for access, door swings, service space requirements, controls, gauge reading, and other operational clearance must be modeled as part of the equipment and checked for conflicts with other elements.

3.2.9 Civil Engineering

The following should be included in the Civil 3D Model drawing(s):

- SURFACES: Topographic Surface Models (3D digital terrain model - DTM) showing one or two foot contours intervals as determined by owner and/or A/E.
    - Existing Site Surface
    - Proposed Site Surface
- POINTS: Topographic Survey Points of Existing Site include in POINT GROUPS.
- Site Plan - Existing & Proposed:
    - Existing and Proposed Building Foot Prints within project boundaries. Include all new site improvements and utilities.
    - Site Elements: Curbs & gutters, sidewalks, walls, planters, asphalt, concrete, fences, and stairs.
    - Landscaping Elements: Trees, shrubs and planting areas, such as raised planting beds and berms, parking islands, pools/ponds/other water features, terraces and other landscape grading features.
    - Utilities Elements (Public & Private): Identify utility type, size, location and elevations (rim and inverts) for storm drainage, sewer, gas, domestic water, chilled water, high temp water, power and communications underground and overhead and all their appurtenances. Including but not limited to transformers, power poles, light poles, junction boxes, valve boxes, manholes, vaults, hydrants, catch basins, storm grates, etc.

All models must be geo-referenced such that all elements can be viewed as an overlay in the building information model or in drawings that use the BSCN coordinate system.

3.2.10 Energy Modeling

During design development, energy modeling allows the A/E to conduct parametric analyses on the selected design. Parametric analyses allow the A/E to determine the relative impact of design modification to various building systems and sub-systems, such as changing window types, insulation values, HVAC system configuration, control strategies, etc. By determining the relative impact of modifying these parameters, the most desirable design option may be selected. After design options are selected perform a detailed energy analysis and estimate the final design energy performance.

Provide energy modeling and reporting per current Instructions to Architects and Engineers. Specify all information necessary to perform energy analyses, such as building type, building construction, ground plane, operating schedules, local weather data, utility rates, etc., in the BIM model. A/E shall use appropriate software that uses the BIM model to perform all analyses, rather than manually creating the data.

3.2.11 Conflict Checking

A/E shall use conflict checking software to resolve clashes between all disciplines and specialties included on the project. Hard clashes between the various elements and soft clashes between an element and a required clearance shall be identified and resolved prior to submittal.

Submit the report generated by the checking software showing conflicts have been resolved.

3.2.12 Program and Space Validation

A/E shall use the methodology described in 3.1.6 described above.

3.2.13 Other Analysis and Checking Tools

A/E is encouraged to analyze the design using software that interacts with the model in order to refine day-lighting, natural ventilation (as directed by owner), acoustics, code issues and design issues.

3.2.14 Quantity Take-off and Cost Control

A/E is encouraged to use quantity take-off features of the BIM and 3D tools coupled with unit costs to assist in construction cost control.

3.3 Construction Documents Phase

A/E shall continue development of the BIM (or 3D Models for Specialty Consultants) created in the "design development phase". Maintain parametric links within the respective models to enable automatic generation of all plans, sections, elevations, custom details, schedules and 3D views. All information needed to describe the "building design and construction" shall be graphically or alphanumerically included in and derived from these models only. Specifications are encouraged to be linked to the BIM model.

Deliverables shall be as stated in the BYU Instructions to Architects and Engineers.

3.4 Bidding Phase

A/E shall update the models with all addendum, accepted alternates and/or value enhancement proposals.

3.5 Construction Phase

A/E is expected to continuously maintain and update the model(s) with changes made during construction.

3.6 A/E Contract Close-out

A/E shall update their respective models with contractor recorded changes. Republish record documents. Also submit full model with all needed objects and reference drawings, in original authored software and in IFC format. Submit all documents per BYU Instructions to Architects and Engineers.

4.0 Design Team BIM Software Requirements

Authoring Software

The Design Team is required to use parametric BIM Authoring software for this project. All architects, engineers, and specialty consultants are required to use the following design authoring software in its current version:

- Autodesk® Revit® Architecture
- Autodesk® Revit® MEP
- Autodesk® Revit® Structure
- Autodesk® Civil 3D

Coordination Software

All final internal and external model coordination and conflict detection are required to use the following software in its native file format in its current version:

- Autodesk® Navisworks® Manage

All project revisions between AE teams should be documented using the following software in its native file format in its current version:

- Autodesk Design Review

All AE teams should be able to use the following software in its native file format in its current version for communication with Owner:

- Bluebeam PDF

4.1 Construction Team BIM Software Requirements

1. *General Contractor's Name* uses Autodesk® Revit® Architecture to author logistics models and to manage model deliverables from the Design Team.
2. Autodesk® Navisworks® Manage will be used to compile the system models and execute a comprehensive clash detection study.
3. Sub-contractors will author their three-dimensional shop drawings and as-built models in a platform compatible with Autodesk® Navisworks® Manage.
4. Autodesk® Revit® verticals will be used throughout the life of the project.

5.0 Hardware Requirements

Design and Construction Team members shall utilize computer hardware that is sufficient to efficiently handle single model files of up to 500 MB and aggregate models of up to 1.5 GB.

6.0 Existing Conditions

6.1 Modeling of the existing conditions is to be performed by the Design Team based on *Project Name* provided as-built information.

6.2 Before project starts, all Design Teams to perform a field survey of the site and to validate and document the accuracy of the as-built information

6.3 All Design Teams to exchange the field survey data affecting each other design.

6.4 MP and Electrical Design Teams to verify the extent of the demolition work and to update Architects with necessary changes.

7.0 Project Setup

7.1 *Architect Firm Name* to provide a cartoon set of the project.

7.2 Project documents to be prepared on 30x42 paper size

7.3 *Architect Firm Name* to provide a Title Block for the project.

7.4 *Architect Firm Name* to provide a key plan

7.5 *Architect Firm Name* to illustrate a typical way of setting up a floor plan views (overall and partial).

7.6 Grids and levels are to be placed on the workset "Shared Levels and Grids".

7.8 *Architect Firm Name* to provide architectural sheet index (for reference).

8.0 Naming Format

8.1 Design File Naming Format

Files for exchange/final models should be formatted as follows:

1. Architectural
2. Architectural-TI
3. Structural
4. Mechanical
5. Plumbing
6. Electrical

8.2 Construction File Naming Format

1. The file naming convention enforced *General Contractor Name* will consist of the following syntax:

   a) **DDDD_LvX.XXX** where **DDDD** represents to the project discipline, **LvX** stands for level, and **XXX** is the file extension.
   b) For example, the plumber would name their files **Plumbing_Undg.rvt, Plumbing_Lv1.rvt** and **Plumbing_Lv2.rvt** etc.
   c) The naming convention for construction models should not differ from the design convention with the exception of the level identifier.

2. It is imperative once the file naming structure is in place that it does not change and that we have full compliance to this standard by all parties involved. Variance from this standard will not be tolerated.

3. If a file is modified or updated, it is to be saved as the exact same file name as the previous version and uploaded to the appropriate directory. Archived versions will be saved.

9.0 Design Model Files Setup

1. All design models to be central files.
2. Each discipline to acquire the shared coordinates, grid lines, levels, and project north from the Architectural model. Refer to 11.1 for Project Base Point and True North.
3. Preliminary models with acquired shared coordinates to be sent to the *Architect Firm Name* team for verification.
    1. Verified models only to be used for design.
4. The final model will be the SITE file.
5. During the project, files of different disciplines could be interlinked as necessary as overlays.
6. Shared Design Models are to be cleaned up per #15.0 of this plan.
7. At the end of the project, separate model from each discipline are to be directly tied to the SITE, without any additional levels of Revit or CAD links.
8. No DWG files to be linked to exchanged or final submitted Revit files.

9.1 Project Base Point Coordinates and Angle to True North

(Insert reference image)

9.2 Construction Model Files Setup/Coordination with Design Models.

1. The project grid lines established in the Architectural model will serve as the origin for all subsequent models. *General Contractor Name* will create a Revit family of 3D grids and labels and provide the .dwg export to each participant for reference.
2. The intersection of grid lines XX and XX at 0'0" will serve as our 0,0,0 reference throughout the project.
3. The coordination will take place level by level and thus the model files will be cropped or represent a single level. The following table represents the range of each level:

Level	Base constraint	Top Constraint	Total Height
Underground			
Level 1			
Level 2			
Level 3			
Level 4			

10.0 Model elements rules: General

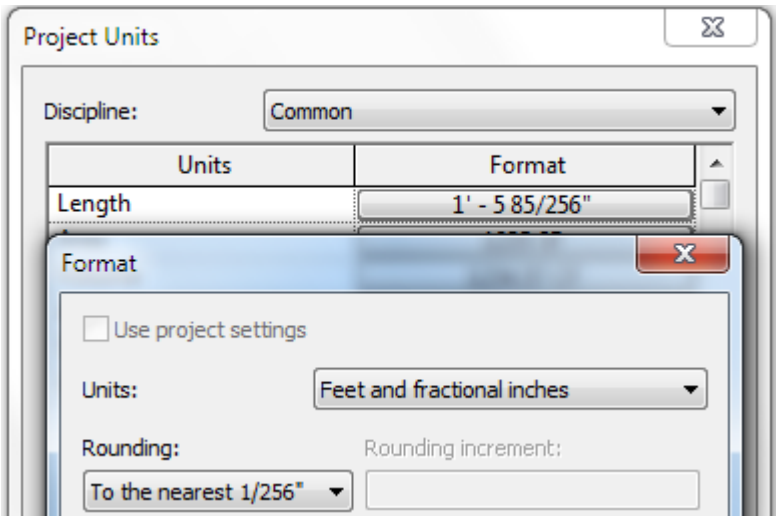
1. Completeness of design

All physical building elements within the project are to be modeled (except those clearly defined and excluded in the MEA Table) and are to represent the full and complete design of each level and element of the building. For example, if a single level of a building is identical to another level, each level is to be distinctly and completely represented in the Design and Construction models. Same applies to the identical partial floor layouts.

2. Model property data

Both the Design and Construction Models are to accurately represent the geometric properties of the building elements and/or systems in the model.

3. Model precision:
Project units should be rounded to the nearest 1/256".



10.1 Design Model elements rules: General

1. Modeled elements must never be deleted (unless required by design changes).
2. Roof to be profiled by Architect and modeled by Structural Engineer

10.2 Design Model elements rules: Structural

1. Framing

a) Columns will be accurately located and sized.

b) Beams and girders will be accurately located and sized.

c) Foundations will be accurately located and sized.

d) Concrete walls will be accurately located and sized.

2. Existing

a) Existing beams and columns are places based on the best of the Design Team knowledge given the as-built drawings.

10.3 Design Model elements rules: Architectural

1. Rooms

a) Rooms are to be accurately bounded, completely enclosed, and not overlapping with other rooms.

b) Rooms are to be used for MEP spaces

c) Rooms are to contain property data with the correct name and number.

d) Rooms will contain property data assigning it to the correct space, department, area, and level.

e) Rooms are to be continuous spaces with the height of the space corresponding to the ceiling height.

2. Closure and Adjacency

a) Rooms, spaces, departments etc. shall be properly enclosed using floors, walls, and ceilings that are touching, but not overlapped.

b) Adjacent model elements shall be touching and not overlapping.

3. Walls

a) Existing wall are to be generic

b) New walls are to be of the correct wall types.

c) Walls shall be modeled to the correct height based on wall type.

4. Doors

a) Doors are to be associated with the correct level.

b) Doors are to contain the correct door type as property data.

10.4 Design Model elements rules: Mechanical

1. HVAC Equipment

AHUs, Fans, VAV boxes, and other major equipment within the building project boundaries are to be modeled.IM

2. HVAC Distribution

Air distribution ducts for supply, return, ventilation and exhaust ducts, fire smoke dampers, registers, diffusers, grilles and louvers are to be modeled to outside face dimension. Duct hangers and supports and seismic bracing shall be modeled by the mechanical contractor. Controls systems will not be part of the Revit model.

3. Mechanical Piping

All piping 3/4" diameter and greater within building footprint and within five feet from building shall be modeled to outside diameter of pipe or pipe insulation, whichever is greater.

4. Equipment Clearances
   Clearances shall be modeled for use in clash detection process and maintenance access requirements.

10.5 Design Model elements rules: Plumbing

1. Fixtures
   Piping of plumbing fixtures, sinks, toilets, tubs, shall be modeled in the pluming model unless otherwise specified in the BIM execution plan. Plumbing fixtures will be modeled in the Architectural model.

2. Equipment
   Carriers, floor and roof drains, leaders, sumps, booster pumps, grease interceptors, sediment separators and other major equipment shall be modeled.

3. Piping
   Plumbing piping within building footprint and within five feet from building, including hot and cold water piping, sewer piping, storm drain piping, gas piping, compressed air piping, mains and branch valves and cleanouts shall be modeled. Piping shall be modeled to outside diameter of pipe or pipe insulation, whichever is greater. Pipe hangers, pipe supports, seismic bracing, fixture isolation and angle stop valves will not be part of the design model, they shall be added detailing and development of the contractor's model.

4. Equipment Clearances
   Clearances and access zones shall be modeled for use in clash detection process and maintenance access requirements

10.6 Design Model elements rules: Fire Protection

Fire protection components inside building: Standpipes, main laterals, lateral run outs and pipe routing for head connections, vertical standpipe drain piping,

standpipe drain assembly, hose connections, inspector test assemblies and zone valve feed assemblies. Sprinkler head locations/head drops, pipe supports and seismic bracing, clean agent fire protection systems, drains, sensors, heat and smoke detectors, notification devices, control panels and related equipment shall be added detailing and development of the contractor's model.

10.7 Design Model elements rules: Electrical

1. Power
   Transformers, emergency generators, main and distribution panels, switchgear, receptacles, switches and junction boxes shall be modeled. Electrical feeders and conduits 2" and larger shall be modeled, including underground runs.

2. Lighting
   Permanently mounted light fixtures, lighting controls, switches and junction boxes shall be modeled unless otherwise specified in the BIM execution plan.

3. Communications
   All existing and new communications service controls, audio equipment, speakers, phone and data ports and connections, both above ground and underground shall be modeled. Cable tray routing shall also be modeled. Communications conduits 2" and larger shall be modeled.

4. Security
   All security devices, keypads, cameras and motion sensors shall be modeled.

5. Equipment Clearances
   Clearances and access zones shall be modeled for use in clash detection process and maintenance access requirements.