A. Building Information Modeling (BIM) Guidelines: The Office of AECM will require the submission of BIM drawing files as part of an electronic file submission to the AECM project manager as requested during any point in the project and at the conclusion of each design phase. These files will primarily be used for collaborative efforts between the University and the consultant. Submitting BIM files does not relieve the consultant from the responsibility of submitting final project files in the .DWG file format following the University's CAD Standard Guidelines.

B. Office of Architecture, Engineering and Construction Management (AECM) Requirements
1. Architects shall use BIM software when directed to do so as part of the design project. 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.
2. Structural Engineers, Mechanical, Electrical, Plumbing, Fire Protection, and Civil Engineers shall use BIM software or discipline-specific 3D modeling software. 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 version of the software. In all cases, model building and infrastructure systems shall be developed 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.
3. Other Specialty Consultants shall use BIM software or discipline-specific 3D software. 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 version of the 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.

C. BIM Software
1. A/E's shall use one or a combination of the following BIM software for AECM projects.
   a. Autodesk Revit (Architecture, Structure, MEP) 2012-2014
   b. Autodesk Civil 3D 2012-2014
   c. Autodesk NavisWorks 2012-2014
2. AECM will consider other software products subject to their capabilities, features and benefits to the Campus.
3. Note: other BIM tools may be used for analysis, specialty design, and other project needs; however final design document files must be Revit or NavisWorks compatible.

D. Geo-referenced Model: A/E's shall geo-reference site plans and building models to coordinate with the Office of Campus Planning's GIS Standards.

E. Model Submittal: With submittal of documentation at the end of each design phase, A/E's shall also submit the Revit model(s) in native application's format. Any future changes to, or extractions from the model(s) will be the responsibility of the party making the changes.

F. Model Object Requirements Appropriate to Phase
1. A/E's are encouraged to use electronic programming and planning tools that integrate into their BIM software to capture early cost, schedule and program information.

2. A/E's may use any method to begin the design process but shall be using a BIM or 3D model(s) at a design phase requested by the University. All information needed to describe the design shall be graphically or alphanumerically included in and derived from these models. The Campus expects A/Es to use analysis tools, static images and interactive 3D to describe the design concepts.

3. Existing conditions - A/E's shall model all existing conditions needed to explain the extent of the construction work for alterations and additions projects. The extent of modeling beyond the affected areas and the level information to be included will be determined based on project needs. These requirements may be stated in the project program or discussed during the project kickoff meeting.

4. Comparative Cost Analysis - A/E's shall extract quantity information using BIM 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 end of each appropriate phase.

5. Comparative Energy and Sustainability Analysis - A/E's shall use building envelope energy modeling tools integrated with the BIM software to develop comparative energy analysis. Variables shall include orientation, massing, form, sun controls, wall construction, natural ventilation, area of glass, daylighting 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 the phase.

6. Program and Space Validation **-** A/E's shall use the BIM 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:
    a. Assignable Areas (ASF) and Non-assignable Areas (NaSF) measured to inside face of wall objects.
    b. Gross Area (GSF) measured to the outside face of wall objects.

7. Architectural Systems - Model the following architectural elements to a level that defines the design intent and accurately represents the design solution.
    a. Architectural Site Plan.
    b. Existing conditions to the extent required.
    c. Demolished items to the extent required.
    d. New interior and exterior walls.
    e. Floor, ceiling and roof systems.
    f. Elevators, stairs, ramps including railing systems.
    g. Casework, shelving, fireplaces and other interior architectural elements.
    h. Furniture and other Specialty equipment (food service, medical, etc); Model mechanical, electrical and plumbing items that require architectural space.
    i. Clearance zones for handicap 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.
    j. Wall types including openings.

8. Structural Engineering - Model the following basic structural elements such as:
    a. Appropriate foundation styles.
    b. Structural framing members.
    c. Load-bearing walls.

9. <u>HVAC Systems</u> - Model the following HVAC elements:
   a. Fans, VAV's, compressors, etc.
   b. Supply, return, exhaust, relief and outside air ductwork modeled to outside face.
   c. Ductwork and duct insulation (whichever is greater).
   d. Diffusers, grilles, louvers, hoods, radiant panels, perimeter units, wall units.
   e. Pipes sized at and over 2" OD; include any insulation in model.
   f. 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.
10. <u>Electrical systems</u> - Model the following electrical elements:
   a. Power.
   b. Interior and exterior transformers and other equipment.
   c. Main and distribution panels and switchgear including access clearances.
   d. Feeders and conduit at and over 2" OD.
   e. Outlets, switches, junction boxes.
   f. Permanently mounted lighting fixtures (moveable, plug-in fixtures need not be modeled as part of the electrical package).
   g. 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.
11. <u>Plumbing and Fire Protection Systems</u> - Model the following plumbing and fire protection elements:
   a. Waste and vents
   b. Piping sized at and over 2" OD; include any insulation.
   c. Roof and floor drains, leaders, sumps, grease interceptors, tanks, water treatments and other major items.
   d. Supply Piping sized at and over 2" OD include any insulation in model.
   e. Fixtures: sinks, toilet fixtures, water tanks, floor sinks.
   f. Fire protection sprinkler lines at and over 2" OD.
   g. Sprinkler heads.
   h. Stand pipes, wall hydrants, fire department connections, risers, including valve clearances.
   i. 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.
12. <u>Specialty Consultants</u> - Model the following specialty consultant elements to correct size and location. Extent of specialty consultant modeling shall be coordinated with the prime A/E :
   a. Equipment provided or specified by said consultants (Audio-Visual, Telecommunications, Data, Security, etc.).
   b. Rough-in connections points for power, data, communications, water service and waste, gas, steam, or other needed utilities.
   c. Clearance zones for access, doors 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.
13. <u>Civil Engineering</u> – Coordinate with Autodesk Civil 3D. All items must be geo-referenced such that all elements can be viewed as an overlay in the BIM model and the correct location in a GIS system. The Engineer is encouraged to model the following items:
   a. Existing site conditions.
   b. Utilities – underground and overhead.

   c. Sediment and erosion controls.
   d. Trees and shrubs.
   e. Paving, curbs, gutters, striping.
   f. Site amenities or structures.

G. **Final Design Construction Documents Phase:** A/E's shall continue development of the BIM (or 3D Models for Consulting Engineers and Specialty Consultants) created in previous phases. 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 "implementation documents" shall be graphically or alphanumerically included in and derived from these models only. Specifications are not required to be linked in BIM.

H. **Bidding Phase:** A/E's shall update the models with all addendum, accepted alternates and/or value enhancement proposals. Republish documents and deliverable files.

I. **Award Phase:** A/E's are encouraged to provide the final bid document Revit model to the awarded contractor in order to facilitate collaboration between the A/E, the contractor and the University.

J. **Construction Phase:** A/E's are expected to continuously maintain and update the model(s) with changes made during construction.

K. **Conflict Checking:** A/E's 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.

L. **Other Analysis and Checking Tools**: A/E 's are encouraged to analyze the design using software that interacts with the model in order to confirm program and refine daylighting, natural ventilation, acoustics, code issues and design issues.

M. **Quantity Take-off and Cost Control:** A/E's are encouraged to use quantity take-off features of the BIM and 3D tools coupled with unit costs to assist in construction cost control.

N. **Program and Program Verification:** A/E's shall use the methodologies described above to reconfirm program.

O. **A/E Contract Close-out:** A/E's shall submit one complete consolidated Revit model with contractor recorded changes and republish record documents to the AECM project manager.