Georgia Tech Facilities Management

Georgia Tech BIM Requirements & Guidelines for Architects, Engineers and Contractors

January 1,

2021

These BIM Requirements apply to Georgia Institute of Technology A/E/C selections advertised after November 1, 2020. BIM methodology is required for all construction projects.

Version 2.0

Issue Notes:

This document supersedes the "Georgia Tech BIM Requirements & Guidelines for Architects, Engineers and Contractors" BIM guidelines 1.5, issued 2016. Previous versions were prepared by Applied Professional Services, LLC.

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1) Introduction

The intent of the Georgia Tech BIM requirements is to create a prescriptive framework with which Building Information Modeling (BIM) enabled teams will coordinate with Georgia Tech, the Board of Regents, the Georgia State Finance & Investment Commission, and other applicable groups on requirements to be delivered. This document will allow all stakeholders to weigh the importance of each requirement on a per-project basis. Through this collaborative effort, a project-based set of requirements and corresponding BIM Execution Plan will be prepared and continuously revised.

Georgia Tech (GT) requires that all design and construction deliverables for BIM-enabled projects be derived from building information models and expects that data associated with the installed components be validated through construction and associated deliverables. The information collected during design and construction is critical for successful long-term facility life cycle management.

2) BIM Execution Plan (BEP)

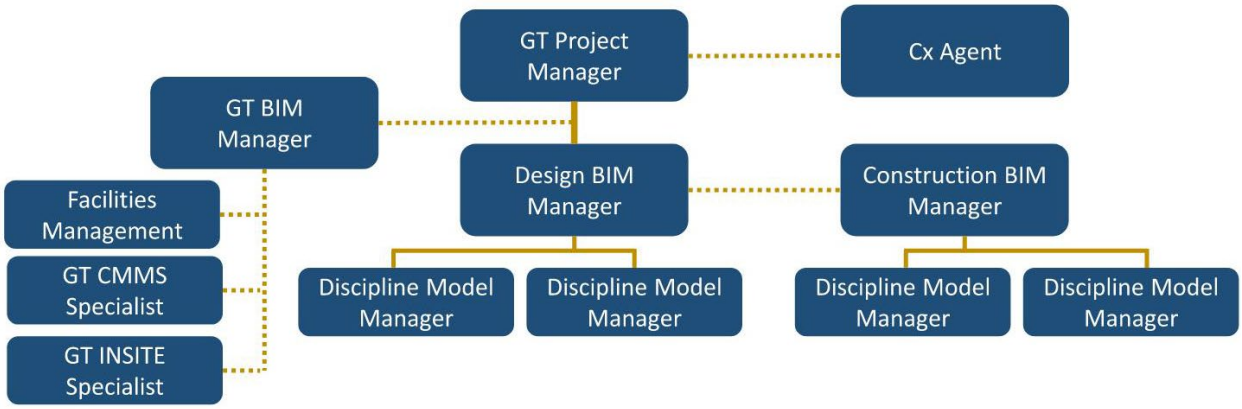
The BIM Execution Plan (BEP) is a living document that will continue to mature over the course of the project and be reviewed at major project milestones. Georgia Tech encourages that an Integrated Project Methodology Plan (IPP) be incorporated and detailed in the BEP but does not provide a template.

The BEP will be prepared by the Design Team prior to the Project Kick-off meeting and be reviewed by the Georgia Tech team within 14 days of submittal. The schedule for review during the project will be agreed upon within the BEP.

All contractors bidding on the project will be required to review the BEP as part of the contractor selection process. The BEP will be revised again once a construction team is in place, and new construction deliverables and schedules are established. The Design and Georgia Tech teams will review the construction phase BEP and approve within 14 days of submittal. The BEP template can be found at: https://facilities.gatech.edu/standards-forms.

3) BIM Team

The BIM project team will be made up of members from GT as well as the Design and Construction teams. BIM team member names and contacts will be included in the BEP. The specific structure of the consultant's team may vary depending on the structure of the contract. The diagram below may be refined as part of the BEP.



GT Project Manager

- Serve as liaison between design and construction teams and GT's BIM related staff.
- Identify the Use Cases that will be required and incorporate them in the RFP.
- Provide final approval of the BEP.
- Participate in BEP reviews
- Facilitate the submittal of deliverables identified in the BEP.

GT BIM Manager

- In conjunction with the Project Manager, will identify required use cases prior to the RFP.
- Review BEP prior to Project Manager's authorization
- Distribute BIM templates and information, existing Revit models and GIS data to design and Construction teams as needed.
- Coordinate the selection of COBie categories to be included in the scope.
- Participate in BEP reviews, coordination meetings, review models and deliverables for compliance and interference detection and clash reports.

GT Database Specialist

- Receive COBie exports and validate for compliance with GT standards
- Imports COBie data into Institute's CPPM software.

GT Facilities Management (Area Manager and/or O&M Project Coordinator)

- Review COBie exports and validate for compliance with GT standards
- With the GT BIM Manager, support the Design and Construction Teams in the selection of asset groups to be included in COBie exports given project scope.

Cx Agent

- In conjunction with GT staff, prepare and review the Owner's Project Requirements (OPR).
- Review the BEP at all major milestones to ensure compliance with the OPR.
- Review Energy Model and associated data to ensure compliance with the OPR and project goals.
- Review COBie data and closeout deliverables along with Facilities Management Submittal to ensure all required documentation has been provided and meets standards established in the OPR.

Design Lead Model Manager

- Prepares BEP for design phase and manages its implementation.
- Oversees Design Model and coordination with all Sub-discipline Model Managers.
- Collaborates with Construction Model Manager to ensure models are coordinated and as-builts maintained current.
- If Design model is selected as Facilities Maintenance Model by GT BIM Manager, will ensure model is cleaned and formatted for the final submittal.
- Ensures consistent compliance with GT's BIM Standards.

Construction Lead Model Manager

- Revises BEP for construction deliverables during the construction phase and, with the Design Lead Model Manager, manages its implementation.
- Oversees Construction Model and coordination with all Sub-discipline Model Managers.
- Collaborates with Design Model Manager to ensure models are coordinated and as-builts maintained current.
- If the Construction model is selected as Facilities Maintenance Model by GT BIM Manager, will ensure model is cleaned and formatted for final submittal.
- Ensures consistent compliance with GT's BIM Standards

Discipline Model Manager

- Manages a discipline's model and ensures its accuracy and completeness.
- Oversees their discipline's compliance with GT BIM Standards and COBie requirements.

4) References

The following documents will be referenced throughout these requirements and should be available to all members of the BIM team throughout the duration of the project.

GSFIC Georgia State Construction Manual
http://scm.ga.gov/Manual.html
National CAD Standard
http://www.nationalcadstandard.org/ncs6/
AIA E203 2013 Digital Information Modeling and Digital Data Exhibit
http://www.aia.org/contractdocs/AIAB099319
BIM Forum, Level of Development Specification (Most Current version)
http://bimforum.org/LOD/
buildingSMART Alliance
https://www.buildingsmart.org/standards/
General Services Administration (GSA) – 2003 National 3D-4D BIM Program
https://www.gsa.gov/real-estate/design-construction/3d4d-building-information-modeling
NBIMS National BIM Standard
http://www.wbdg.org/bim/nbims.php

Postsecondary Education Facilities Inventory and Classification Manual (FICM)
http://nces.ed.gov/pubs2006/2006160.pdf
GT Master Planning Standard – Referenced for incorporation into milestone deliverables
http://www.space.gatech.edu/masterplan/assets/2004MasterplanUpdate.pdf
GT Space Identification & Room Numbering Guidelines
http://www.space.gatech.edu/sites/default/files/documents/roomnumbering.pdf
GT FICM Standards
https://facilities.gatech.edu/standards-forms

5) BIM Project Use Cases

GT will use models and associated data for facility lifecycle management, including operations and maintenance, and informing future renovations. The following use case descriptions are intended to inform the facilities management goals that drive specific requirements. Not all use cases will be applicable to all projects, cases are to be identified and scheduled as part of the BIM Execution Plan.

A. Owner's Project Requirements (OPR) Coordination

Where an OPR has been prepared by GT team and their selected commissioning agents, the requirements set forth in the OPR shall inform the selection of the BIM use cases to be included in the BEP. The BEP and the OPR shall be reviewed concurrently and coordinated at all major milestones or as deemed necessary by the GT Project Manager.

B. BIM Kick-Off Meeting (Design/Construction)

A BIM kick-off meeting shall be scheduled by the GT Project Manager at the beginning of all BIM enabled projects. It may be a stand-alone meeting, or be incorporated into a design meeting. The Kick-off shall precede the preparation of the BEP. Where the construction team is not present at the kick-off meeting, a second meeting may be required prior to the construction phase review of the BEP.

C. Programming and Program Validation

The correct documentation of spatial information is necessary not only for Program Validation and organization of COBie data during the current project, but will be critical to the continued Space Management of the facility during its complete life cycle. The Design Team shall use BIM authorizing software to compare and validate stated program requirements with the design solution. Information shall be derived from the BIM model and exported into an Excel Sheet for reporting. Space Validation shall be based on The Postsecondary Education Facilities Inventory and Classification Manual (FICM) and the Georgia Tech derivatives. See *(GT FICM Standards)* for a full listing.

Program Space IDs: Program space IDs are to be tracked within the models to validate program, design and construction space requirements. Program space ID's shall include space use categories as identified by FICM, sqft, and room numbers when available.

1. "Roll-up" FICM Codes are to be tagged as early as the schematic design phase. By the Design Development phase GT specific codes shall be used where applicable.
2. *Assignable Areas (ASF) and Non-assignable Areas (NaSF).*
   a) (ASF) measured to inside face of wall.

b) (NaSF) measured to inside face of wall objects and designated boundaries of areas.

3. *Gross Area (GSF) measured to the outside face of wall objects*.
4. Rooms shall be labeled with appropriate room numbers during the Design Development phase and will be subject to review and approval by the Office of Capital Planning and Space Management. Subsequent reviews of all room numbers will take place with milestone deliverables. All room numbering shall follow the GT Room Numbering Guidelines: https://space.gatech.edu/sites/default/files/documents/roomnumbering.pdf

D. Cost Estimating & Comparative Design

Costing exercises during the design phase will be derived from model geometry and will support comparative costs analysis of design options and alternatives. The extracted geometry information may be based on Quantity Takeoffs (QTO) of elements, square foot costs or a combination of the two and is to be converted to spreadsheets and included in the design solution justifications as scheduled in the BEP. Specific costing methods shall be specified for each phase in the BEP for approval.

1. SqFt cost: Design Team shall extract categorical sqft information using interoperable BIM tools. Output shall be converted to spreadsheets and submitted as part of the design solution justification at the end of the design phase.
2. Quantity Take-off: (QTO) The objective of quantity takeoff analysis is to use modeling property data to automate or simplify the QTO process. Design Team shall extract categorical quantity take-off information using interoperable BIM tools. The original modeling author will need to include all relevant property information in the design and an agreement of modeled content communities to estimate. Output shall be converted to spreadsheets and submitted as part of the design solution justification at the end of the design phase.

E. Surveys

1. The Facilities Management team at Georgia Tech manages the space in between our buildings as well as the space within them. To that end all Surveys shall include 3D geometry for all major components, and be formatted in electronic format and allow for incorporating into our GIS system and BIM models as described below. All surveys shall comply with the requirements described in Section 022100 of the Georgia Tech Yellow Book.
2. General Requirements
    a) Detailed requirements of what is to be included in survey deliverables is managed by GT staff in consultation with the Design Team on a project-by-project basis.
    b) All surveys must clearly define the project site and include accurate x/y/z coordinates on all survey items.
    c) All land surveys and Building Construction projects must be tied to the following projected coordinate system: NAD 1983 State Plane Georgia West Zone US Foot. All points must land within the State's GIS datum within the margin of error that is normal for the industry.
    d) Surveys to be developed in AutoCAD Civil 3D (or equal) for all surveying surface features and gravity-based drainage systems.
    e) All pressure-based systems such as natural gas, chill water, steam, as well as electrical system etc. shall be developed by using BIM authorizing software such as REVIT MEP.

3. Topographical Surveys
    a) Ground Elevations shall be depicted with sufficient resolution to determine all major drainage and terrain features.
    b) At a minimum, 2 foot contours shall be shown to extend outside the project site as needed for any excavation that occurs on the project site.
    c) A digital model is preferred in an industry standard Digital Elevation Model (DEM) or Digital Terrain Model (DTM) format to be included with topographic survey.
4. Property Line Surveys:
    a) Property lines shall be identified and depicted with adjacent owners referenced.
5. Easements shall be identified and referenced as needed for any utilities or access across the project site. Utilities: All underground utilities shall be 3D objects located at topographic elevations illustrating, nominal sizes, type of utility (gas, electrical, chill water, steam, etc.). Depths of existing utilities shall be located with ground penetrating radar. Where necessary for clarification some utilities located in the x/y/z plane by physically touching and recording the x/y/z locations along the utilities.
    a) Existing utilities will be located with surface locations and elevations and separated by layers for each utility type.
    b) Underground utilities shall include depth, size, and material information.
    c) Underground utilities will be verified as needed for project requirements, including 'pot-holing' for visual verification, ground penetrating radar, or hand excavation as needed for accuracy and safety.

F. Existing Conditions - Building Model

The Design Team shall model existing conditions needed to explain the scope of the construction work for alterations and additions. The extent of modeling beyond the affected areas and the level information to be included will be determined based on project needs. These requirements will be included in the BEP. Existing BIM models are available from the GT BIM Manager for a significant portion of campus. These models vary in level of accuracy and complexity and should only be used as a reference in the preparation of a new model; the Design Team BIM Manager should develop a strategy for verification.

G. Laser Scanning-Design

The use of laser scanning and selective conversion of the resulting point clouds to model as-built data are encouraged during the length of the project and may be used to create or verify an Existing Conditions model. Appropriate use may be discussed with GT team and defined as scope in the BEP.

H. Design Model

Building information models shall be created by the Design Team to include all the geometry, physical characteristics and product data needed to describe the design and construction work. All drawings and schedules required for assessment, reviews, bidding and construction shall be derived from these models either directly (as in scheduled, floor plans etc.) or indirectly (as may be the case with details). The Project Team shall follow the guidelines and requirements detailed in this document for BIM related services. Design models shall include Civil, Structural, MEP, Specialty models and minimal site models where the site design extends less than 5'-0" from the outside face of the exterior walls. Deliverable

requirements are described later in this document. Benchmark reviews are to include 3D presentations of the model by the owner by means of flythroughs or walkthroughs and live presentations of the model.

I. Site Design

Where site designs extend more than 5'-0" (or as determined by design team in BEP) outside the exterior walls of the building, a separate design model shall be created that can be linked into, or that can host, the building design models. This model shall include hardscape, softscape, as well as appropriate site utilities and infrastructure. The model shall be of a format that can be incorporated into GT's GIS system.

J. Structural Analysis

Structural analysis tools use the model to analyze the building's structural properties. Structural analysis programs typically use the finite element method (FEM) to measure the stresses on all structural elements of the design. For structural analysis to work seamlessly, the original structural modeling tool needs to be compatible with the structural analysis tool, and the original structural model property data must include information about the structural elements.

K. Embodied Carbon/Life Cycle Assessment (LCA)

Georgia Tech is committed to selecting responsibly sourced materials that safeguard the health and safety of its students, faculty and staff as well as minimizing the environmental impact of their procurement, transportation and installation. Embodied Carbon analysis will be required throughout the design process as well as a Life Cycle Assessment and product inventory. See Yellow Book section 018113 for benchmarks and requirements.

L. Energy Information Model & Assessment

Energy Information Models (EIM) and Assessments will be required on projects that have a significant energy use component, as determined by GT and the Design Team. The models will document and support meeting the Energy Requirements and thresholds defined in the OPR. The Design Team shall also establish an energy modeling methodology to be included in the BEP that will detail how energy modeling will be accomplished for the project.

Additional energy requirements and deliverables can be found in the Yellow Book in the following sections:

010001- General Requirements- 4.02.A.6/4.02.B.11/4.02.C.6
013329- Sustainable Design Reporting- 1.01.C.3

Software: At a minimum, the required software to perform the energy modeling for the project shall be any software listed acceptable by the US Department of Energy. Energy Plus will be required at critical deliverables but other software can be used during the process. Recommended software includes (but is not limited to: Energy Plus (Required for milestone deliverable), Green Building Studio (Optional), Ecotect (Optional), EQuest (Optional), Trace 700 (Optional). The deliverables related to Energy modeling shall be as follows:

1. Energy Budget – (See Yellow Book 010001- General Requirements 4.02.A.6) and the Project OPR.
2. Comparative analysis/conceptual energy model: (See Yellow Book 010001- General Requirements 4.02.B.11) The purpose of this early model and analysis is to narrow down the design strategies from the multitude of deign possibilities to those that are in line with, and will achieve, the project's energy goals and targets. The model shall define the building footprint and include all exterior walls. Interior spaces of similar use and occupancy shall be grouped into larger blocks or rooms with interior walls limited to those separating areas of dissimilar use. This model should include all variables and other factors appropriate to decision making. Modeling parameters shall be based on local climate data and actual site conditions.
3. Energy Information Model: The design team is required to analyze the design using software that interacts with the BIM model software to refine load calculations, daylighting, natural ventilation, acoustics, code and design issues. The results shall be documented by the input assumptions about all facility use schedules, mechanical equipment assumptions, maximum and minimum weather data and other assumptions to validate subsequent energy modeling results.
4. Information developed in the EIM should be formatted for a gbxML export or other format as needed for selected analysis software.

M. Interference Detection (Design)

Interference reports shall serve to assure that designed building structure, assemblies and systems can be integrated without overlaps or intrusions into required program or service spaces. Interference reports shall be exported in XML, HTML or Text format from the pre-approved software. An interference report will be required along with other design deliverables at major milestones or as determined in the BEP.

1. The tolerance level for each deliverable shall be identified in the BEP and shall include one or a combination of the thresholds below.
   a) Level 1 Interference – Considered critical to the design process:

Fire ratings	Ceilings, walls, floors, ductwork/dampers, openings
Structure	Exterior finishes, ductwork, plumbing piping
Mechanical & Electrical Equipment	Structure, ceilings, ductwork

   b) Level 2 Interference – Considered important to the design and construction process:

Furnishings/Casework	Exterior finishes, ductwork, plumbing piping, structure, ceilings

   c) Level 3 Interference

ADA and Service Clear Space Requirements	Structure, ceilings, ductwork Doors, Fixtures, Walls, casework, furnishings

d) All other interferences not listed above are not ignorable nor should they be discarded but they do not need to be included in reports to the university unless design team is looking for input from the institute's team.

2. Each tolerance shall be identified as "hard", "soft" and "programmatic" as defined below.
   a) A "hard" interference will be where the geometry of two different objects, such as structural beams and ductwork, have an overlap or intersection of over 2".
   b) A "soft" interference is where a predefined clearance or reserved space surrounding an object geometry have an overlap or intersection of over 2".
      i. Clearance zones required for operation, maintenance, repair and general accessibility would be indicated for those categories of objects identified in the category of object and potential inference checking with other categories of objects needed. The BEP should identify what object have clearance zones associated with them and the type of representation to comply with GT standards.
   c) A "programmed" interference is where interference requirements have been pre-programmed based on agreed upon rules and object types.

N. Construction Model

The construction models will include fabrication models, coordination models or shop drawing models. In the case where there is an existing design model in .RVT format, the design model shall use it in support of the construction phase. The construction model shall be verified against the design model on a regular basis as determined in the BEP.

O. Laser Scanning-Construction (As-Builts)

The use of laser scanning and selective conversion of the resulting point clouds to model as-built data are encouraged during the length of the project. Appropriate use may be discussed with GT team and defined as scope in the BEP.

P. Scheduling/Sequencing & Site Management

There will be no deliverables related to model based scheduling, but the use of BIM models for sequencing and schedules is encouraged and will be supported by the GT team. BIM models linked to schedules shall be used to communicate the relationships with construction activities on site and their duration and impact on project schedules and site logistics. The frequency of scheduling and sequencing reviews is to be described in the BEP.

Q. Collision detection (Construction)

All construction collision detection shall be between trades that naturally would cause construction conflicts. Interference reports shall be exported in XML, HTML or Text format from the from pre-approved collision detection software and turned-in to Georgia Tech's BIM manager at bi-weekly intervals during construction or as determined in the BEP. The reports are to include the following to a minimum:

1. Date of the Collision Report Run
2. List of all collisions detected, their status, and their proposed solution.

All unresolved collision items are to be addressed during OAC meetings as appropriate.

R. COBie (Construction Operations Building Information Exchange)

Building Information data collected through COBie is critical in ensuring Georgia Tech can efficiently transition from a construction project *into the ongoing maintenance of an active campus building.* COBie is an information exchange system that is used to collect building data in a spreadsheet format that can then be imported into Georgia Tech's Computerized Maintenance Management System (CMMS). Once in our system, Georgia Tech can track each asset for which data has been collected, assign maintenance schedules, track costs etc. The information provided will be validated through GT's data management processes. Unique Globally Unique Identifiers (GUIDs), assigned in the BIM authoring tools, will be maintained to support data in workflows that can then be used throughout the design, construction and building commissioning process. The complete COBie spreadsheet consists of several worksheets within a single file. The data rich Microsoft Excel integrates with GT's design, construction and turnover deliverables. http://www.wbdg.org/resources/cobie.php?rom

1. Design-Phase COBie
    a) Schematic: The Design Team, with the support of the GT BIM team, shall identify the asset groups that will apply to the project. The groups shall be identified in the COBie template. No information will be required in the model in this phase.
    b) Design Development: The Design Team, with the support of the GT BIM team, shall review and update the asset groups that apply to the project. New groups may be added as needed and in coordination with the GT team. The categories shall be identified in the COBie template. Assets in the model may, but will not be required, to be tagged with the correct Asset Group in this phase.
    c) Construction Documents: The Design Team, with the support of the GT BIM team, shall review and update the asset groups that apply to the project. New groups may be added as needed and in coordination with the GT team. The groups shall be identified in the COBie template. Assets in the model shall be tagged with all the relevant fields identified as the responsibility of the Design team in the "COBie Data Roles and Responsibilities" in Appendix C in this document.
2. Construction Phase-COBie
    a) The Design Team shall make edits to the model and COBie export if any changes occur during construction but will not be required to add any further detail.
    b) The Construction Model shall be incrementally populated with all remaining COBie data as identified in the "COBie Data Roles and Responsibilities" in Appendix C in this document. All COBie data is expected to be populated by 75% Construction and included in the Facilities Management Set.
3. The following references may be useful in the preparation of COBie deliverables:
    a) Building Smart Alliance: http://projects.buildingsmartalliance.org/files/?artifact_id=2612
    b) OmniClass: http://www.omniclass.org/
    c) IFC (Industry Foundation Class) Current release version 2x3: http://www.buildingsmart-tech.org/specifications/ifc-overview

S. Concurrent As-Built Models

Both the Design and Construction models, and all the sub-discipline models, shall be submitted to GT upon completion of the project. Both models are expected to be maintained current during the extent of construction and coordinated. The Project Team shall submit a plan to the Owner for review that outlines the process for concurrent as-built documentation. Concurrency is mandated. Methods for recording as-built information are left to the discretion of the Project Team.

T. Facilities Management Model (FMM)

In order to continue the maintenance of the building, the facilities department will select either the design or the construction model to serve as the Facilities Management Model. Which of the two models will be maintained will depend on the size of the project, the project delivery method selected and the complexity of the existing facilities model. The selection will be recorded in the BEP and will affect some of the deliverables throughout the length of the process. The FMM will be due with the Facilities FMA at close-out. Details on the preparation of the Facilities Management Model are detailed in the Appendix A.

U. Facilities Management Set (FMS)

The Facilities Management Set is to be turned into the GT BIM team at 75% completion of construction, or as determined by the GT Project Manager in order to allow for validation and incorporation into GT's CMMS software prior to the move-in date and day-1 maintenance needs. The following worksheets shall be provided:

1. COBie Template Export
2. Manual - Instruction manuals for sets of/or components
3. Warranty -Warranty information for sets of/or components
4. Spare - Spare/parts reordering info for sets of/or components
5. Installation - Installation/operating instructions
6. Tests - Test of System and component test results
7. Certification – Installation certifications
8. Material – Special materials needed for a given Job Plan Task
9. Tool – Special tools needed for a given Job Plan Task
10. Training – Special training needed for a given Job Plan Task
11. PM – Identifies specific PM tasks and frequency
12. Safety – Identifies required safety tasks
13. Trouble –Manufacturer start-up procedures/reports
14. Start-Up & Shut-down procedures
15. Shut-Down - Emergency operating procedure

V. Facilities Management As-Built (FMA)

This set will include the final 100% Facilities Management Model along with any updates to any of the FMS Deliverables. FMA to be turned in no later than 30 days after the issuance of the Certificate of Occupancy.

6) BIM - Deliverables

The below chart represents a summary of the project BIM deliverables by phase. The appropriateness of each deliverable relative to each project will be discussed during the BIM Kick-off and identified for submittal in the BEP.

Review Yellow Book section 01001 General Requirements and the OPR for additional deliverable requirements not directly associated with BIM standards.

Design Phase BIM Deliverables

Deliverable	**Pre-Design**	**SD**	**DD**	**CDs**	**Permit/Bidding**
OPR	Review	Review	Review	Review	Review
BEP	Review	Review	Review	Review	Review
Programming	Validation	Validation	NA	NA	NA
Room Numbering	NA	Review	Review	Review	NA
Survey	As needed	NA	NA	NA	NA
Existing Conditions	As needed	NA	NA	NA	NA
Architecture	LOD 100	LOD 150	LOD 200	LOD 300 Autocad DWG	LOD 300
Site Model	LOD 100	LOD 150	LOD 200	LOD 300	LOD 300
Civil	NA	LOD 150	LOD 200	LOD 300	LOD 300
Structural	LOD 100	LOD 150	LOD 200	LOD 300	LOD 300
MEP	LOD 100	150	LOD 200	LOD 300	LOD 300
Specialty models/Structural Analysis	NA	LOD 150	LOD 200	LOD 300	LOD 300
Embodied Carbon/LCA	Structure Analysis	Exterior Skin Analysis	Materials Inventory	Product Selection/ Specifications	Product Selection/ Specifications
Energy Budget and Analysis	Energy Budget	(1) Updated Energy Budget (2) Preliminary model	(1) Detailed model/analysis (2) Updated energy cost report	(1) Detailed model/analysis (2) Updated energy cost report	1. Detailed Model (2) Updated energy cost report
Interference Detection	NA	Level 1	Level 2	Level 3	NA
Cost	Comparative Analysis	Sq Ft Estimate	Systems + Energy cost estimates	Quantity Cost Estimate	NA
COBie	Asset Group Selection	Asset Group Review	Template & Model Review	Template Export Model Review	Template Export Model Review

*See Appendix for LOD definitions.

Construction Phase BIM Deliverables

Deliverable	Pre-construction	Construction	75%	Closeout
BEP	Review	Review	Review	Review
OPR	Review	Review	Review	Review
Design Models	LOD 300	LOD 300/As Built	LOD 300/As Built	LOD 300/As Built
Construction Models	LOD 350	LOD 450 As-Built	LOD 500 As-Built	LOD 500 As-Built
Fabrication Models	LOD 350	LOD 450 As Built	LOD 450 As Built	LOD 450 As Built
Clash Detection	Report/Review	Bi-weekly report	As Needed	NA
COBie	LOD 400	LOD 450	Facilities Management Export	Facilities Management As-Built
Facility Management Model	NA	NA	LOD 500	LOD 500

*See Appendix for LOD definitions.

7) Deliverable Reviews

Reviews of all BIM deliverables associated with each design milestone should occur concurrently with all other deliverables. The schedule of review shall be included in the BEP and reviewed throughout the length of the project. In the case a model sharing platform like BIM 360 is used, GT BIM Manager will be given access to the models and will review directly at pre-determined milestones.

8) Project Closeout Phase

A. Deliverables
   1) Design and Construction Teams shall update their respective models with recorded construction changes, republish record documents, submit full model with all needed objects, and reference drawings in original authored software and in IFC format.
   2) DWG files shall be provided for all drawing sheets in addition to DWG (bind all xrefs) and IFC file formats for the BIM models. All BIM files shall be provided in RVT and NWD as applicable.
   3) See Yellow Book Section 010001 General Requirements for Project Closeout Documentation requirements.

Appendix A – Model Geometry Requirements and Guidelines

A. General
   1) *Interoperability:* While the milestone deliverables are specific in nature and are intermediary requirements, GT has adopted open architecture for data exchange. The Project Team may use any BIM software capable of delivering the necessary requirements during the design and construction process but is encouraged to use products based on or using open architecture for greatest interoperability between consultants and GT, the Industry Foundation Classes (IFC) file format developed by the buildingSMART.
   2) Building information models shall be created by the Design Team to 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 derived from these models either directly (as in schedules, floor plans, etc.) or indirectly (as may be the case with details). The Project Team shall follow the guidelines and requirements detailed in this document for BIM related services. Deliverable requirements are specified later in this document.
   3) Modeled elements from all disciplines should at least meet the deliverable standards as set forth in the GT Yellow Book. Due to the nature of using BIM software, additional elements may be necessary to describe the design intent. The detail and responsibility to fulfill these modeling requirements should be addressed fully within the BEP. Components that are not modeled are to be listed in the BEP as exclusions.
   4) BIM Model managers are responsible for model and data synchronization across disciplines.
   5) Time stamps will be added to models prior to design milestone deliverables and reviews. Time stamp data is to be apparent within the deliverable report for model correctness. Time stamp text information should be placed within the title block of the project as well as appended at the end of any submitted file(s).

B. Software
   1) Authorizing 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 year version: Autodesk Revit Architecture, Autodesk Revit MEP, Autodesk Revit Structure, Autodesk Civil 3D
   2) Coordination Software:. The Design Team is encouraged to use the GT project collaboration tool such as Autodesk 360 Glue/ A360 Field, “ARC Document Solutions (http://www.e-arc.com)for document management and file sharing. Other collaboration reviewing tools, project communication websites, web meetings, and video conferencing are also encouraged. The collaboration team’s roles and responsibilities will be defined in the BIM Execution Plan.
   3) Interference Detection and Collision Detection: All final internal and external model coordination and conflict detection are required to use the following software in its native file format in it's current year version: Autodesk Navisworks
   4) Deliverable Software: The Project Team will deliver files in the most current, stable releases of the Autodesk Revit file format (.RVT); Autodesk Navisworks file format (.NWD) and Autodesk Civil 3D file format (.DWG) available at the ‘official’ project start date. Any further

needs should be defined in the project BIM Execution Plan and coordinated with the Georgia Tech facilities group.

C. Building Numbering

For new buildings, building numbers will be determined by the office of Capital Planning and Space Management and be provided to the team by GT staff.

D. Level and Room Naming conventions: Maintaining level names that are consistently labeled in one model to the next is critical to GT's facility design staff's ability to maintain models through the life cycle of the building. Please see level naming guidelines along with room naming guidelines at: http://www.space.gatech.edu/sites/default/files/documents/roomnumbering.pdf

E. LOD – Model Development

The Level of Development shall progress from one milestone to the next. The LODs assigned to deliverables in section 6-Bim-Deliverables shall correspond to definitions established in the most current version of http://bimforum.org/LOD/ and as defined below. Changes to the specified LOD will need to be identified and approved in the BEP.

LOD Level	Required Task
LOD 50	Analyze and integrate owner spatial requirements
LOD 100	Start with a 2D Sketch or 3D Massing study
	End with a 3D Conceptual Massing (Area, Height, Volume, Location, and Orientation)
LOD 150	Specify project location (latitude/longitude)
	Link in Civil site survey with 3D topo, property lines, set backs, and easements
	Establish model origin/ shared coordinates, true North orientation
	Create major building systems (walls, floors, roofs, ceilings, stairs, ramps)
	Generate cost estimates based on floor area, floor volume, and exterior surface area
	Establish 3D/2D file linking protocols
	Create discipline specific view templates
	Perform schematic massing-based energy analysis
	Define Uniformat II Classification as assemblies
LOD 200	Update massing-based energy analysis
	Provide Design Options (if requested by owner)
	Perform a project Life Cycle Assessment (LCA) for optimal performance
	Generate cost estimates based on assemblies
LOD 250	Create Component-based energy analysis
	Optimize design for reduced energy use and carbon footprint (if requested by owner)
	Define CSI Master-Spec Material classification
	Generate cost estimates to be based on count and material take-offs
LOD 300	Update component-based energy analysis
	Base cost estimate on detailed components
	COBie data added by design team
	Define Omniclass Classification for Asset Tracking
LOD 350	Use models for Construction Pre-Fabrication
	Define Assemblies & Parts
	Create detailed means and methods Project timeline
	Manufacturer specific component
	Update Cost Estimates based on actual components at buyout
LOD 400	Use models for Construction shop drawings
	Analyze models for detailed systems performance
	Update models per actual & accurate As-Builts
	COBie field data added by construction team
LOD 450	Ongoing model updates based on RFI's, supplemental sketches, and change orders
	Update models to match As-Built conditions
LOD 500	COBie field data added by construction team
	Systems testing and commissioning
LOD 550	Room Area Plans based on BOMA standards
	BIM models used for spatial planning
LOD 600	COBie FM data added by owner
	Integration with Assetworks AiM system
	As-built geometry utilized for Alterations & Additions

F. Model Quality

These guidelines are to allow GT internal assessment of a Building Model, for different uses. They reflect good modeling practices, for all types of facilities. This is an evolving set of requirements that will become more articulated as BIM experience progresses.

1) Phases: Use appropriate phasing tools inherent in BIM tool throughout the project to track existing vs. new conditions, and to clearly identify future phases or bid alternates.
2) Walls: Revit walls that belong to the Exterior perimeter or shell, will comprise of a single wall type that reproduces the exterior and interior components of that wall type.
   a) Wall segments that are made up of uniform material layering should be avoided.

b) Walls should be modeled accurately to reflect their correct height.
c) Wall height(s) should be from top of slab (or knee wall, ramp or other base) to underside of slab above or structural beam above.
d) Trim walls at corners and join wall segments as necessary.
e) Walls that are at the ceiling height must have their area space heights' set to be the same heights.
f) Exterior walls shall have their materials organized according to the face the correct exterior and interior sides
g) Interior partitions that have materials on both side of an air conditioned space should have the "exterior" components of the REVIT wall face towards the predominately public side of a space.
h) Walls shall be modeled so there are no gaps in exterior walls so that the boundary between inside and outside is incomplete.

3) Doors
   1) In all design stages after Design Development all installed doors should be their intended width and height, with their swing and direction, or other opening mechanism indicated.
   2) Doors and openings to be uniquely identified and tagged to the door's functional room or space.
4) Slabs
   1) In all design stages after Design Development, slabs will have cutouts for all sleeves, openings and penetrations, allowing volume estimates, safety checking for construction and other uses.
   2) Slab thickness should represent intended structural slab thickness, without plenum space. The gap between bottom of slab and Ceiling of space is considered potential plenum space.
   3) Sloping slabs or ramps are to be modeled accurately.
5) Windows: In all design stages after Design Development, windows will be their intended width, height and placement within walls. Window glazing will be modeled as a subcategory of the window component.
6) Curtain wall and glazing: In all design stages after Design Development, curtain wall and glazing will be their intended width, height and placement. Horizontal and vertical mullion detail should be modeled, and be consistent with basis of design manufacturer details. Window glazing will be modeled as a subcategory of the curtain wall component.
   A. Equipment: In all design stages after Design Development, equipment will be modeled with access and maintenance space geometrically modeled, so that access codes and maintenance can be reviewed. Modeled access geometry will have an ability to be turned off.
   B. Columns: In all design stages after Design Development, all columns are to be modeled. Column structures are to extend from top of grade beam or slab, and extend to underside of beam or slab. All model component overlaps should be eliminated.
7) Space Objects
   A. Space objects should cover all the interior space bounded by interior partitions and exterior walls. These should include elevator shafts (Elevator space), mechanical shaft spaces (Shaft space) multi-floor spaces (spaces above base space are "open to below" space name)

B. Space names should conform to The Post-secondary Education Facilities Inventory and Classification Manual (FICM) space name categories. Any special use or common names needed to address multi-use or other spaces not in program should be reported separately to GT so they can be included in the space program reviews.
C. In buildings with planned departmental assignments, each space will also receive a departmental name and must maintain the space program unique identifier. These names will be provided by GT at project initiation, for entry and management in the building model.
D. In general, the space object geometry shall be modeled as the perimeter of the building space bounded by walls or “virtual wall” segmentation. (The “virtual wall” is not a physical wall but instead an imaginary boundary that extends past the top of the wall to the underside of either the structure above or ceiling above)The space volume is then extruded upward to a height designating the bottom of finished ceiling height.
E. It is recommended that space floor coverage should be associative and automatically made consistent with walls if moved, to maintain consistency. Ceiling height of spaces, if there are major changes in height within a space, should be modeled to indicate changes.
F. All space objects should be tight fitting and non-overlapping.

Appendix B – COBie

COBie data shall be recorded in the model and exported to the GT BIM Template using the most current version of COBie. This shall be an iterative process where subsequent information exchanges verify, validate and add to the previous contributors. The following chart identifies the expected roles and responsibilities described below but may vary on a project by project basis. They will be identified and agreed upon in the BEP.

Design					
Region Code					Provided by GT
Facility ID (Building Name)					Provided by GT
Bldg (Building Number)					Provided by GT
Location Code (Room #)					
Shop (GT Zone)					Provided by GT
Description					
Asset Group					See Asset Group List provided by GT
Construction					
Asset Group					
OmniClass					
Asset Type					Serialized
New Aim Asset (Y/N)					Always ("Y"), except in renovations
Description					
Asset Tag					
Serial Number					
Status Code					
Rentable (Y/N)					Always ("N")
Location ID (Room # ID)					
Lockoun(Y/N)					Always ("Y")
Manufacturer Code					
Manufacturer Part Number					
Serial Number					
Purchase Price					
Purchase Date					
Warranty Start Date					
Warranty Expiration Date					
Replacement Cost					
Parent Asset Tag					
Construction Deliverables					
Facilities Management Set					An update of the Designer's Cobie Worksheets, See Section 5.6.3.4
Facilities Management Model					An update of the Operations Planning Set of items individually identified in the "Component" worksheet, See Section 5.6.3.4
Close Out					
Design Data					
As-built Data					

* Lighter colors represent the responsibility to review only

A. Definitions

1. Region code: This is the first and highest level of the location hierarchy (Region/Facility/Property/Location) for the property. In most cases, the value is “GT-MAIN” for main campus. If outside of the main campus, please confirm with GT BIM Manager.

2. Facility ID: Facility is the second highest level in the location hierarchy and represents a 15 character abbreviated facility name.
3. Bldg (Building Number): Third level in the location hierarchy, it is the specific building number where the work is to be done.
4. Location code: Defines the room/location of the asset. Shall correspond to room numbers approved by CPSM.
5. Shop: The asset will be maintained by a specific shop in the organization as indicated in this field. GT will provide Shop ID.
6. Description (of Asset Group): Describes the Asset Group acronym. See BIM-Asset Template for complete list of asset group and descriptions.
7. Asset group: This is the acronym that identifies an Asset. See BIM-Asset Template for Asset Group lists. If additional Asset Groups are required, submit for GT Review and approval.
8. OmniClass: classification
9. New Aim Asset: (Y/N) is this asset new in the CMMS software (Y), or existing (N). Most assets entered will be new (Y).
10. Asset type: Type of asset. The value of this field is always 'SERIALIZED'.
11. Asset Tag: The asset tag is based on a specific format, which is used to define a single asset, groups or systems of assets. An example of the format used is 184-HTR-01-001. 184 is the building/ facility number. HTR stands for UNIT HEATER, 01 is the floor number, and 001 indicates unit # 1. Furniture that is moveable or portable shall not be included with an asset tag. This serves as the Global Unique Identifier and appears on asset barcodes.
12. Serial number: Serial number provided by the manufacturer.
13. Status code: This term identifies the current condition or situation of the asset, such as installed, out of service, available, rented, etc. Upon completion of the project, this value is always "IN USE".
14. Manufacturer Code: The manufacturer of the asset. See BIM-Asset Template for a list of official manufacturer names as entered in the CMMS software.
15. Manufacturer Part Number: The model number provided by the manufacturer.
16. Purchase Price: Purchase price of the asset
17. Purchase Date: Date of purchase of the asset.
18. Warranty start date: The warranty start date as provided by the contractor.
19. Warranty expiration date: The warranty end date as provided by the contractor.
20. Replacement cost: Expected cost to replace an asset
21. Parent Asset Tag: Asset Tag of parent asset in a system.

Appendix C – Terminology

A

As-Built Documents: As-built documents are the collection of paper drawings or electronic drawings that typically reside in the contractor's onsite trailer that contain mark-ups, annotations, and comments about changes that have been made to the contract documents during the construction phase.

As-Built Model: Design Intent Models that have been updated throughout the construction process. These changes and updates have been communicated from the Contractor to the Design Team through the comments, annotations, and mark-ups from the As-Built Documents. These typically, but not always, are discipline specific models.

B

BIM Execution Plan (BEP): A plan that is created from the GT BIM Execution Plan Template that establishes the BIM deliverable requirements and schedules for the project. The BEP helps define the roles and responsibilities within a project team.

C

COBie (Construction Operations Building Information Exchange): COBie is a standard of information exchange that allows information to be captured during design and construction in a format that can be used during the operations of a building once completed.

D

Design Team: The Design Team is considered 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.

DOE2 (Department of Energy Version 2): DOE2 is a file type that is an open file format. This file format is used by most energy modeling software. It is also an approved file type for LEED simulations.

DWF: DWF is a file type developed by Autodesk to be locked and non-editable 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.

DWG: DWG is a native AutoCAD file format. It is a widely used file format for exchanging drawing information and 3D information to different programs. While not a database file type, it still has lots of uses for exchanging information.

E

EIM (Energy Information Model): EIM is a concept of producing a "light" and "lean" model that can be used for simulating the building's performance very early within the design process. The EIM is the process of modeling only the exterior envelope, and the interior volumes to produce a model that energy modeling software can use.

F

FICM (Postsecondary Education Facilities Inventory and Classification Manual): FICM is standard that describes practices for initiating, conducting, reporting, and maintaining an institutional facilities inventory.

G

gbXML: A gbXML file is a Green Building file type. It is used to run simulations through energy modeling software. It is a widely accepted file format for those types of software.

I

IPD (Integrated Project Delivery): IPD describes a contractual relationship between all members of the project team including the Owner, Designers, Consultants, and Construction teams. It is a project delivery method that integrates people, systems, business structure and practices into a process that collaboratively harness the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction.

IPD Methodology: IPD Methodology is a concept that uses methods from the IPD contracts, but does not have the contracts actually in place. It idealizes the concepts of integration of all team members to try and benefit the entire project.

IPP Methodology Plan: The IPP Methodology Plan is a declaration of how the project team will achieve the goals of an IPP Methodology. The plan can have several components and is encouraged to be part of the BEP. The completion of a Reverse Phase Schedule or Critical Path Modeling is two examples of an IPD Methodology Plan.

N

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

NWC: An .NWC file is a NavisWorks Cache File that is used by NavisWorks to quickly read many other file types. All linked files in NavisWorks have an .NWC file created automatically. In addition, Revit will export directly to the very small file type of .NWC for quick access by NavisWorks.

NWD: A much larger file than the .NWC, the .NWD file shows snapshots in time of a NavisWorks file. No linked files exist but all geometry is included.

NWF: The .NWF file is a native NavisWorks file that has all linked files, interferences/ collisions, markups, animations, schedules, etc.

O

Open Architecture: Open Architecture is a concept of creating a framework that helps to describe a common set of rules for how a project is created. This includes what types of software, the interoperability of the information, and how the participants interact with each other. This is different

from open standards in that it promotes progress while not anchoring forward thinkers to a rigid standard.

OPR: Owner's Project Requirement documents.

P

Phases: The phases of a project can be describe in two different ways as the adoption of IPD terminology starts to penetrate the BIM Execution Plan and the IPD Methodology Plan. Below is a list of the traditional names followed by the IPD name.

Pre-Design/Conceptualization Phase

Schematic Design/Criteria Design Phase

Design Development/Detailed Design Phase

Construction Documents/Implementation Phase

Project Team: The Project Team is considered the combination of the Design Team, Contractor, and at times, GT stakeholders; a complete team needed to make holistic project decisions and approvals.

R

Record Drawing: The production of Record Drawings is the capturing of the As-Built Document's annotation, comments, and mark-ups in a drawing format only. This does not typically include the updating of any models.

Reverse Phase Scheduling: Reverse Phase Scheduling Is a method of demonstrating Integrated Project Delivery. It sets a plan within the Design Team that accounts for the activities of each discipline and how they interact with each other. It uses the completion date as a point to work backward from to schedule all of the project's activities.

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.

T

TMY2/TMY3: The TMY2/3 file format is a Typical Meteorological Year file. It is used for in conjunction with a gbXML file to create energy simulations.