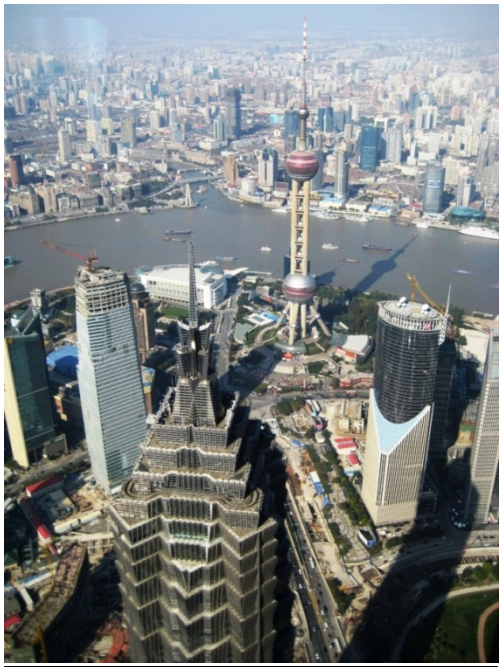

BSCI-4990 THESIS RULES & REGULATIONS

Effective for: Spring Semester - 2016

All thesis students are responsible for compliance with the requirements in this document. Specific requirements contained within this handout may not be omitted. Your thesis advisor must approve changes in the physical scope of the project in writing.

PRELIMINARY REQUIREMENTS

Project Approval

Prerequisites specified in the Auburn University Bulletin will be enforced. No course can be taken during the final term that conflicts with the scheduled Thesis course time: 8:00 a.m. to 11:50 a.m. MWF. The Thesis student is responsible for completing a "Graduation Check" and verifying that all of the required course work has been satisfactorily completed.

The student must submit Project Plans with a Thesis Approval Form to the School of BSCI Office **no later than the last class day of the preceding academic term. No Project Plans will be approved during semester break.** A copy of the Approval form is located in Appendix A. Written approval is required prior to starting any thesis work. The approval form must be included in the thesis submittal as noted in the Thesis Assembly section of this document. Any project scope changes must be approved and noted on the approval form by the thesis reviewer at time of submission. Only one set of plans will be approved for each student. A student may apply for approval of a project up to two academic terms before graduation.

GENERAL REQUIREMENTS

Course Administration

Thesis Lab is in session during scheduled class time; a*ttendance will be taken during that time period.* A series of one-hour lectures relative to thesis will be conducted periodically by BSCI faculty and will be announced by e-mail. Attendance is mandatory for all thesis lectures. The lectures may cover the following topics: Estimating, Recap Sheets and Bid Forms, Scheduling, Contract Documents, Structural Assessments, Materials, Erosion Control and other related thesis topics as requested by the class. In addition, desk critiques with faculty and group meetings with faculty will occur on an ongoing basis. Attendance for all of these events is mandatory.

Three unexcused absences will be allowed without penalty. More than three will be reported to your thesis jury and will affect your final thesis grade. Absences will be excused at the discretion of your thesis advisor only as stated in the Syllabus.

The BSCI Thesis Laboratory is a space set aside for the use of the thesis students. The School of BSCI acknowledges the effort it takes to complete an exceptional thesis project. Thesis students will have access to the Thesis Laboratory 24 hours per day, seven days per week unless the University schedules otherwise. A library atmosphere shall be maintained in the BSCI Thesis Laboratory. **Eating, drinking, smoking and spit cups are not permitted in Gorrie Center.** Radios without headsets are not permitted in the BSCI Thesis Laboratory.

For most Thesis class sizes, each student is entitled to one desk to work on. Desks and computer equipment are to remain as arranged by the thesis faculty so that the rooms can be used for an occasional class or exam. The computers in the Thesis Laboratory are protected by a fiber optic security system. This system does not allow for rearrangement of furniture or computers.

Computing Support

The computer is a valuable tool in the preparation of the thesis. The McWhorter School of BSCI recognizes that the students rely on computing to complete their thesis. Computers, printers, and plotters are available in Gorrie Center. The McWhorter School of BSCI maintains this equipment and will respond as quickly as possible to any problems. ***However, it is the student's responsibility to complete the project in a timely manner.*** Any failure of computer equipment is not an acceptable excuse for a late or incomplete thesis project. ***Students must make periodic backups to protect their respective progress. Students are completely responsible for their backup strategies***.

The School will provide all printing and plotter supplies. Each student should exercise caution and print only when necessary. **The printer is not a copy machine.** The more it is used, the more likely it will crash. **Do not open the printer for any reason! The printers are monitored 24/7. The cost of repairs due to student damage will be charged to the student and will have to be paid to be cleared for graduation.**

Job Placement Assistance

The industry recognition and appreciation of Auburn University Building Science is what attracts top construction firms to recruit. Your participation in the process is important to all of us. Companies will be making presentations and conducting interviews in Gorrie Center. Cassandra Calloway will make a presentation to the Thesis class to explain the interviewing process. Honor your job interview commitments or cancel well in advance. Broken commitments can result in problems with the contractors returning to campus in the future. For more information, see Cassandra Calloway on the first floor of Gorrie Center.

BSCI maintains an electronic job board cataloging jobs those firms that have job openings are available. Your communication with these firms should be professional and open. We also have current AGC and ABC national directories for your use. Contact Cassandra Calloway for further information regarding job placement and opportunities.

BSCI Graduate Exit Interview

All students are **REQUIRED** to complete the graduate survey and participate in the exit interview process. The purpose is to continue to improve our program in all aspects; the input of our "most recent alumni" is to ascertain their perspective on their experience in Building Science and to solicit their input and comments on the program and its future. A copy of the **graduate survey** must be completed online.

THESIS SUBMITTAL REQUIREMENTS

General Requirements

Thesis projects will be accepted until 10:00 a.m. on Friday, April 15, 2016. The thesis will be turned in to the thesis instructor in the Faculty Conference Room, where a drawing will be held to determine thesis juries. Thesis jury hearings will be completed on or before dead day of that academic term (Time & Location, TBA). Submit your approved drawings and specifications with your completed thesis for grading. Drawings and specifications will be returned after jury hearings. **Your name should be clearly marked and easily found on the outside of all your documents.** Theses receiving a passing grade will be made available for pick-up on graduation day in the School of Building Science. All remaining theses will become property of the School of Building Science. The School reserves the right to retain copies of Theses for quality control and accreditation requirements. The jury is a formal presentation and defense of the student's work. The student should be dressed as if making a formal presentation to a major prospective client. **The student should take the Means BCCD used for pricing to the jury meeting.**

The Thesis presentation should be of professional quality, as if you were presenting your company to a prospective client. **Your thesis document shall be in 8½" x 11" page format submitted in a "D" ring binder.** Your work should be neat, thorough and original. Improper grammar and misspelled words will lower your grade. Although all thesis work is to be your own, you may exchange ideas and discuss problems with other students. The faculty is available to answer questions appropriate to the courses they teach. The faculty will not, however, take

the time to re-teach course materials. Nor will the faculty "pre-grade" portions of your thesis to "check if it has been done correctly." Refer to your class notes for any necessary review. You may also ask questions of contractors, architects, suppliers, and building industry officials, preferably those associated with your project.

THESIS ASSEMBLY

Assemble the thesis in logical order (i.e., chronological). Number all pages, **in ink**, including assumptions, worksheets and summary sheets, documents, and other information. A complete Table of Contents is required listing the sections, titles and page numbers. It should show all divisions of work contained in the worksheets and summary sheets. Worksheets and summary sheets will have a dual numbering system; one number system for the estimate itself and one for the thesis document. The typical work sheet and summary sheet heading areas should be complete.

Carefully plan sequencing and dating of all documents; i.e., Bid, Agreement, Bonds, Billing, etc., so that they are reasonable and consistent. You may assume any dates required to complete the thesis such as the bid date, project start date and company start date. A project time line is required.

Include your full name, as registered with the university, and thesis semester on both cover and title page. Anticipate binding room on each sheet of paper when copying or printing. Do not submit a machine copy of your thesis. **All documents must have original hand written signatures.**

Minimum Requirements / Thesis Assembly Model

The minimum requirements and recommended assembly for a complete thesis are as follows (do **NOT** use Appendix B – Thesis Evaluation & Grading Criteria as your Thesis Assembly outline):

Preliminary	Title Page
	A Complete Table of Contents w/ page numbers
	Thesis Proposal Approval Form
	Project Brief
	Assumptions
	Detailed Project Time Line of Events
	List of Student Selected Work w/ page numbers
Company	Company History, Philosophy and Goals
	Organizational Chart
	Duties of Key Personnel
	Contractor's Licenses
	Business Licenses (state and local)
Financial	Contractor's Qualification Statement
	Balance Sheet

Income Statement - current and projected
Financial Narrative including business position and strategies consistent with financial statements
Financial Ratios and a thorough analysis of each: Net and Gross Margins, ROI, Current Ratio, Fixed Asset Newness, and Average Ages of Receivables and Payables
Labor Burden Determination (home office and field)
General Overhead Determination

Project Estimate

Specification Take-off / Drawing Notes Issues
BIM Model of Structure
QTO Worksheets (***including Site Utilities)***
Document earthwork quantities using "Earthworks" or other suitable program. Include printout of software including graphic image of cut/fill.
Pricing Sheets ***including Site Utilities and unit prices (if required)***
Job Site Overhead
Recap Sheet
Bid Calculation Worksheets (base bid, alternates and unit prices)
Explanation/Analysis of MEP systems
Subcontract Scope Statement for MEP systems

Project Documents

Master Surety Agreement
Proposal Form with at least one alternate bid item
Bid Bond
Power of Attorney for Bond Agent
Agreement Form (per your specs.) w/acceptance of one alternate
Bond Application Form
Performance and Payment Bonds
Certificate of Insurance
Project Specific Safety Plan
LEED Assessment
Subcontract Agreement Short Form (AGC) w/ detailed scope of Work and listing of project documents as attachments.
Building Permit (not the application)
Project Cash Flow Projection
Submittal/shop Drawing Control Document
CPM Activity Worksheets
Schedule of Values Reports showing Period Costs for first three months, from which the pay applications are generated
Change Order prompting, i.e. RFI, Architect's directive, etc.
Change Order QTO, Pricing, Recap sheets, and cover correspondence to Architect
Change Order (executed in first 3 months)
Payment Requests (for first 3 consecutive months)
Substantial Completion Documentation

	Consent of Surety to Release of Retainage (when appropriate) Affidavit of Release of Liens Affidavit of Payment of Debts & Claims Consent of Surety to Final Payment Certificate of Occupancy List of all required Warranties and at least two actual Warranties
Structural	Structural Analysis
Project Schedule	Color plot of original Bar Chart (with logic arrows), cost loaded, clearly indicating a timeline, all appropriate activities, their durations, total float, and ALL logic/lag ties [front and end] for each activity. Inclusion of Schedule Draft; to be returned to student upon submission of final project
Appendix	Site Utilization Plan (graphic and written narrative)
References	Reference all sources used in Thesis Attach a complete copy of the Thesis Instructions

Grading

Completing all the minimum requirements listed in the preceding section does not mean an automatic grade of "A". If all items are included and most of the items are reasonably correct, then the student can expect a grade of "C". Significant omissions and/or errors will result in a grade in the "D" range or an "F". Additional copies of the items listed in minimum requirements will not be considered "Student Selected Work". Per the University's definition, an "A" is for superior work.

Thesis projects will be presented to and defended before a faculty jury. The jury will evaluate the projects for:

1. Meeting the minimum requirements listed in the Thesis Instructions in a manner appropriate to the student's thesis project.
2. The accuracy and applicability of student selected work.
3. The integration of the minimum requirements and the student selected work into a cohesive whole.
4. The professional quality of the thesis document.
5. The professional quality of the student's presentation and defense.
6. The student's ability to explain the reason and meaning of each part of the thesis. **(If you don't know what it is, how it was developed, why it's there, and what it means, it lowers your grade!)**

The jury will assign a letter grade based on this evaluation. Possible grades are A+, A, A-, B+, B, B-, C+, C, C-, D+, D, D- and F.

If the thesis is graded as an "F" (failure), the thesis will be retained. The School Head will determine whether the student is allowed to retake the course using another approved set of drawings and specifications. An "IN" (incomplete) will be assigned only if extenuating circumstances warrant and requires the School Head's approval and per University mandated criteria.

A thesis that is submitted on time but that is not complete, will be evaluated and given a grade appropriate to the degree of completion and the quality of the work submitted. A thesis that is submitted after the designated time, but prior to 11:00 am on the due date, will be penalized by a letter grade reduction. Theses will not be accepted for grading after 11:00 am on the date due and an "F" will be assigned.

Project Brief

A brief overview of the project should be done prior to beginning your project. This overview shall be submitted on Friday, September 4th. The brief should address the following items:

- Identification of the 2 or 3 major risks on the job for your construction firm
- Identification of the work you plan to self-perform and what you plan to subcontract (you are encouraged to self-perform one trade)
- Identification of key dates-Bid, start, finish, etc…
- Identification of major site issues including earthwork requirements and site logistic issues if any exists
- Consideration for how quality will be measured
- Identification of 3 or 4 largest safety risks specific to this project
- Construction of a schedule of the key 10-15 items on the job (may be drawn by hand)
- Specification Take-off

Company and Project Documents

All documents are to be fully executed as if real, and dated, signed and notarized where appropriate. The student is required to comply with all requirements contained within the contract documents by:

a. Compliance with the requirements, or
b. Written assumption concerning the requirement approved by the Thesis Professor.

The student may have to provide additional documents to meet the minimum requirements depending on their project.

The student is required to set up an organization that is capable of constructing their project. Be realistic in relating organization and overhead to annual construction volume, and use good management principles in staffing your organization.

An analysis and determination of the unique annual overhead, fee objectives, and labor burden for field and office employees must be clearly demonstrated and explained for the most recent

complete year as well as the projected values for the duration of the thesis project.

The faculty strongly requests that multiple copies of forms or reports such as subcontracts and state licenses should be omitted. All information included should have a purpose and only one example of an executed document is required. However, pay requests are required for three months. Any additional pay requests are not considered extras and should not be included.

Students are encouraged to be creative and original in the development of forms, letterheads and other documentation. However, the creation of these items can have a negative impact if they cause excessive paper use or do not add to the overall appearance of the document. Remember, "Fluff is not a substitute for substance."

COST ESTIMATE - All scope changes must be approved by the Thesis Instructor and noted on the plans. Verbal approvals are not acceptable.

Each thesis will include a comprehensive, detailed cost estimate for the selected thesis project. Generally, the project will be taken-off manually and priced manually using the "productivity" pricing method (the normal Pricing Sheet pricing method).

Takeoff

The quantity survey can be accomplished using both manual and electronic tools. Tabulation of quantity takeoff into worksheets should be organized in such a manner as to allow intuitive review. Quantity takeoff sheets should be organized by trades, each sheet should be limited to a single trade. Students need to utilize a consistent methodology and an easy to follow audit trail. The audit trail should seamlessly blend both manual and electronic takeoff. With manual takeoff the audit trail should include a plan reference and further dimensional and location and orientation information to allow reviewers to retrace your steps and verify quantities. If electronic means are used for quantity takeoff the audit trail should include an explicit reference to an appended document (Onscreen Takeoff sheets w/image legend) which clearly demonstrates how the quantities were derived and where they came from. You will be required to justify your methodology for your calculated quantities. Waste and overages need to be considered on your quantity takeoff sheets. **Quantities for Divisions 3, 4 and 5, must be extracted from the BIM Model, and Division 7 which may be taken off and priced using square foot assembly pricing.**

You may design your own worksheets, summary sheets, and recap sheets as long as they are similar to those used in Project Controls. **Site work is a required item** and must be estimated and priced in a detailed manner. In addition, it should be noted that site utilities and erosion control are to be taken off and priced as Site Work "subcontract" work. Proper analysis of the site work requirements is critical to the successful completion of a project. The student should understand the grading operations and the effects of shrinkage and swell. Using a cut/fill program is acceptable. However, the appropriate reports showing existing layers and volumes, proposed layers and volumes, structures, total cut and fill, existing elevation data and proposed elevation data must be included and incorporated in the thesis in an organized manner. It is

required that the thesis student prepare a narrative in order to defend their understanding of earthmoving operations.

Do not take off demolition work, trees and shrubs in landscaping, lawn sprinkler systems, fire alarm and/or sprinkler systems, or any low voltage wiring. Include these items in the bid amount by estimating a lump sum price for each item. The thesis faculty will provide limited guidance in this area. Do not assume this work will not be accomplished. Be prepared to explain your approach to these lump sum prices.

Worksheets, Summary Sheets, Job Overhead Sheets and Recap Sheets may be completed in pencil, but must be neat and legible. All estimating work should be self-explanatory to a reviewer and demonstrate an **easy-to-follow audit trail** throughout the estimate. Be sure to highlight totals on worksheets which are carried forward to summary sheets and totals on summary and job overhead sheets which are carried to the recap sheet indicating the page number of the destination in the appropriate manner. You will be required to justify your methodology, waste and conversion factors, and all computation in your estimate.

Pricing

You may use spreadsheet software to price all items in a format similar to the pricing sheets. Provide the pricing guide page number and line number after each item priced on the summary sheet. The reference column is for the work sheet number and should be provided for all items on the pricing sheets.

Pricing sheets should reference quantity takeoff sheets from which the quantities were derived. Pricing sheets should also be limited to a single trade per sheet. In no event should more than one trade be included on a pricing sheet, but often a single trade will require more than one sheet. It is appropriate to summarize cost information for each trade at the end of its last pricing sheet and then for that information to be forwarded to the recap sheet.

On-Screen Take-off, or other estimating software may be used to take-off and price all sections. All computer estimate reports should be produced in a manner to easily review the information. It will be the student's responsibility to clearly present the information in a format that shows the audit trail, crew designations and makeup, systems/work groups procedures, the pricing according to the current Means being used, and proper calculation of unit prices and subcontractor mark-ups.

Develop "raw" (raw means no general contractor markup) prices for all work done at the project site including subcontracted work other than roofing. You may estimate each subcontractor's total markup at 22% to 32% if the work is totally subcontracted; the mark-up is 40% and 45% if only labor and equipment are subcontracted. ***While these markup rates are somewhat arbitrary for this exercise, you have to show in some form (and be prepared to defend) what factors are included in the markup.*** Show subcontractor markup on the final pricing sheet for each trade. Highlight the subcontractor quote (including markup) and carry to Recap sheet.

The bid must include **at least two** alternates with the estimate and on the proposal form. If no alternates are listed in the specifications, the student is required to submit an addendum to the bid documents that creates the alternates. **One (1) alternate must be accepted in the agreement with the owner**.

Use the proposal form and the Bid Bond form from the project specifications, if provided.

As in industry, the alternate is accepted after bid day and before the contract is written. The student must prepare the prices for these items separately for the owner to select. The student can select which will be accepted.

You are required to show the calculations of any unit prices required on your bid for additive or deductive work. These unit prices should include markup. Also, show the calculations for contract change orders and alternate bid items including markup.

Special Pricing Considerations

Price all concrete by the cubic yard, brick by thousands, block by each, and rebar and structural steel by the ton. The only exception is that the square foot/square yard pricing can be used for sidewalks and paving.

Connections for steel, wood, etc., may be estimated on the summary sheet as an adjustment to the quantity (additional materials). Use proper judgment by interpolating or adjusting Means line items.

Determine the quantity and type of all wood and light gage metal roof trusses. Use the Means pricing data for your truss pricing or an actual truss manufacturer quote. The contractor/subcontractor will still need additional material for bracing and labor to erect the trusses.

If it is necessary to adjust pricing in Means, use proper judgment when interpolating between line items. Add price adjustments to your list of assumptions and be prepared to defend your methodology.

Recap

The recap sheet is “part and parcel” to the pricing sheet and in addition to summarizing the project’s cost. It also provides a document that an estimator could use for bid day evaluation. Therefore, each line item on the recap sheet should be organized by trade. The recap sheet should reflect if the estimator plans to self-perform or subcontract the work. Recap sheets are used to add indirect cost and markups to the estimate. Recap sheets need to be produced for alternates, change orders and unit prices.

BIM GUIDELINES:

All thesis students MUST create a BIM model for the structure in their projects, as described below. Any BIM software available in the McWhorter School labs may be used.

Frame	Required	Not Required
Steel	Foundations, columns, beams, braces trusses, load bearing walls, retaining walls, rebar (foundation & walls), elevated slab on deck, ground floor slab, OWSJ and joist girders	Connections, base plates, anchor bolts, partitions and other miscellaneous steel
Concrete Frame	Foundations, columns, beams, load bearing walls, retaining walls, rebar, elevated slabs, ground floor slab (foundation, beams, columns & walls)	Formwork, slab on grade outside the foot print of the building.
Wood Frame	All load bearing components of the building, foundations, rebar, trusses, braces	Partitions

Students MUST use quantities from the models above in their estimates (See thesis folder for formatting and quantity extraction instructions).

PROJECT SCHEDULE

The work plan and project schedule must correspond to the project's cost estimate. You must include CPM Activity Worksheets to justify activity costs. A single page schedule with 6-10 activities is recommended (but not required) to be complete prior to beginning your estimate.

A *draft project schedule* shall be submitted no later than the end of class on Friday, September 25, 2015. It should contain a calendar timeline, and milestone activities with durations for the complete project including construction. The schedule should be represented in a clear, legible, organized manner, and it should follow standard CPM drawing conventions, contain a title block, date and legend, and not exceed a sheet size of 36"x 48". It will be submitted in a 9" x 12" manila envelope with the student's name, project name, and thesis semester neatly and legibly written on the cover. This schedule will be inserted into the thesis when the thesis is submitted. **While this submission should be complete, it should be a draft that demonstrates your understanding of how the building will be assembled, and its relativity to your pricing of equipment, crews, and overhead. The draft should be in bar-chart form, should include a time scale plus all activities and logic ties. Obviously, your final schedule may (and likely should) reflect refinements to this draft. Make sure you retain or make a copy of the draft, as you will not be allowed to reference it after it has been submitted.** Time-based items in the estimate must agree with the scheduled time frame of the project. The pay requests are derived from the cost loaded CPM schedule and are representative of the planned progress of the work.

Each category of work must be planned and scheduled. The schedule should contain a sufficient

number of activities (100 activities +/-, excluding procurement activities) for the Project Manager to coordinate the work on a weekly basis. The sequence of activities should represent the Project Manager's plan and follow standard construction practices. In addition, the schedule should show procurement activities including fabrication and delivery of critical and other time-sensitive materials to the jobsite in time not to delay the project.

Each activity must be assigned an earned value in order to produce an anticipated "Early Start Earned Value Curve." The student must include on this diagram an anticipated "Income Curve" based on the Early Start Earned Value Curve, as well as an anticipated "Actual Costs Curve". The student will then produce and include a report showing the cash flow projection of the project based on the plotted curves.

The student will assign a "Schedule of Value" code to each activity and produce a SOV report. The codes in this report will correspond with the G703 pay request cost items and agree with the pay request amounts. Therefore, if the schedule is updated, the earned value should equal the pay request amount without the stored material.

The student is required to update the schedule for the first three months of the project and produce a SOV report that verifies the pay request amounts based on "costs this period" as well as "costs to date."

For scheduling-related reports, the student shall include **only** the following: 1.) a Classic Schedule Report and a Detailed SOV Report for the initial, as-planned schedule, 2.) an updated Detailed SOV Report for each of the three updates.

Schedule Activity Worksheets should be sorted by activity and include totals for each activity as well as an overall total. A list of items not assigned to activities and included in the markup must be included as part of the schedule activity worksheets. The individual and total $ value of these items must be shown on the list.

PROJECT MANAGEMENT

Use the forms (Proposal, Bond, Contract, Pay Request, etc.) furnished with your specifications. If none are provided, use the latest version of AIA forms.

It is required to complete the pay request documents for the first three months of the project. Show stored materials on each request. It is not realistic for a job not to have stored materials in the early months.

The "Schedule of Values" for the pay request is a breakdown of the work for the owner to approve payments. The breakdown should identify the major subcontractors and/or work areas. SOVs limited to the 16 CSI Divisions are not acceptable.

Execute all documents (fill in all blank spaces including correct signature, stamps and seals). Clearly identify the drawings and specifications in the contract agreement. Do not include any documents that are not required by your project. Use the AGC subcontract agreement form

rather than the AIA document for your required subcontract.

The thesis is to include a list of submittals and shop drawings for the project with identification of the vendor/party responsible for originating each and the scheduled/required delivery date for each submittal. This list is to be developed from the submittal requirements given in the project specifications. Major procurement items (+/- 10 each) should be included in the schedule.

The student is required to execute a change order during the first three months of the project. This change order will be reflected in the pay request(s) as is appropriate. The change order amount and scope of work will be at the student's discretion. The actual work required in the change order does not have to be accomplished during the first three months. The scope of the change order must be such that the contract duration and/or the contract sum is/are changed. Worksheets and Summary Sheets showing the changes are required.

SITE SPECIFIC SAFETY PLAN

Company Safety Policy (10%):
Briefly state the importance of the health and safety of your employees to your company?
What is your company's Experience Modification Rate (EMR)? A new EMR is issued to companies each year by the National Council on Compensation Insurance (NCCI) based on the number and value of claims over the last three years. How does your present EMR effect your company? (Insurance premiums, OSHA fines, lost time, morale, litigation, job opportunities, etc.)

Safety Manager (10%):
How do you plan to access the hazards and regulate the safety program for this project?
Who is your safety manager?
Who does he report to?
How is safety information from this project communicated to upper management?
What is the role of each level of management in safety for this project?
What are the rules for non-compliance for the workers? Supervisors?

Planning (40%):

Initial Review - Job Hazard Analysis (JHA)
Perform an initial review of the project and select at least one hazard that is inherent with the project based on its location, topography, weather conditions, active campus, etc. Describe and give visual illustrations for the hazard and your method(s) of hazard mitigation. Include a risk assessment of the hazard.

Hazard	**A condition, set of circumstances, or inherent property that can cause injury, illness or death**
Risk	**An estimate of the combination of the likelihood of an occurrence of a hazardous event or exposure, and the severity of injury or illness that may be caused by the event or exposure**

Ongoing Review – Job Safety Analysis (JSA)

Perform a review of at least two hazards that will be encountered during the construction phase of the project due to nature of the work, construction procedures, hazards inherent with this type of construction, etc. Perform a Job Safety Analysis providing a step by step process of the work activity with hazards encountered at each step and mitigation measures to be enacted. Describe the OSHA standards that apply. Include visual illustrations. Explain why these two hazards are considered high risk on this project. Describe the specific training procedures required for your employees prior to engaging in these specific work processes and/or prior to their exposure to these specific hazards.

Hazardous Communication Program (20%):
How are you going to communicate information concerning the hazardous materials that will be encountered by your employees during the course of this project?
What is your plan for providing, maintaining, and updating the MSDS sheets as materials are brought onsite?
What is your policy on container labeling of materials?
What provisions have you made for the storage of hazardous materials during the construction phase?
Provide at least one example of how your hazardous communication process will work to inform and protect your employees from a specific hazardous material that will be used on your project during the course of construction. (Lead, silica, acetylene, gasoline, etc.)
Develop a Safety Data Sheet for the above substance and two additional hazardous materials on the project in accordance with the specified 16-section format that went into effect in June 2015 and with the Globally Harmonized System (GHS) pictograms.

Injury/Accident Plan (20%):
What is your plan to provide care for your employees if they are injured while working on this project?
Who are you going to contact when an accident occurs?
Where is the nearest hospital or source for emergency responders? Provide a map showing route and the distance/time to the facility.
What are you provisions for first aid? (First Aid Kits, Eyewash stations, trained personnel) Does the proximity of your jobsite require that a person trained in first aid be present to meet the OSHA requirements?
What are your procedures for accident investigation and reporting? (OSHA 301 form, accident recreation, interviews with witnesses, determination and elimination of the root causes of the accident)
Describe your accident prevention/rescue plan for one activity/hazard that will be encountered on this project (suspension trauma during steel/precast erection, confined space rescue plan, excavation cave-in, etc.) Tell how you have made preparations in advance so that you will be ready if an accident occurs.

STRUCTURAL ASSESSMENT

Structural System:

Include a conceptual assessment of the structural systems of the building. The assessment must provide a detailed explanation and identify the following:

a. The basic structural system for carrying vertical loads. Include diagrams that trace the path of vertical loads in the structure from roof to ground. A section view through a major axis of your building would be used for this. Make use of gravity force vectors of differing weights to indicate accumulation of load from roof to ground. A detailed verbal description must accompany the graphic one.

b. The basic structural system for carrying lateral loads (wind). Include diagrams that trace the path of lateral loads applied to the structure. A plan view of your building indicating the reacting structural elements for wind load striking each of the major building axes is required. You should use different colors or separate diagrams for each wind direction. Show section views with wind load vectors for clear demonstration of how wind loads travel to the ground. A detailed verbal description must accompany the graphic one.

Special Structures (for students with wood/metal pre-fab trusses or pre-engineered metal buildings)

a. For students with pre-engineered metal buildings, substitute traditional steel members for prefabricated members and complete the following:
    a. Develop a paragraph indicating the substitutions you plan to make (bar joists for typical purlins, wide flange members for girders, etc.)
    b. Determine the required size of members noted in a.
    c. Develop a price for the structure sized in (b).
    d. Develop a paragraph indicating the difference in the cost of the structure between your approach in the estimate and your answer in (c). Reflect on the differences.
b. For students with wood/metal pre-fab trusses, complete the following:
    a. Select a typical truss and sketch an elevation of that truss. Select a possible layout of web members. Show all dead and live loads applied to the truss on a plf basis along the top and bottom chord or as a point load at truss joints. Essentially, indicate the vertical load on a horizontal projection of the truss.
    b. Produce a plan(s) of trusses showing all required temporary bracing. You may use any accepted national standard for bracing such as Alpine's "Builders Guide for Trusses".
    c. Design and provide a sketch for the diagonal brace at the end of the truss that takes the force to the ground. (This item may also be used for the temporary bracing design requirement of the thesis.)

Temporary Structure:

Students must provide one detailed structural analysis of a temporary structure such as that identified below, such as the concrete formwork for one of the major building components, elevated slab, wall, beam or slab. The analysis must include detailed load determination, selection of appropriate materials, and structural analysis, including strength, stiffness and stability considerations. A virtual model of the temporary structure should be provided. The work should also include a temporary compression ground brace for wall or truss system: size

and spacing of braces must be determined considering lateral (wind) loads, slenderness ratio, strength analysis, connectors and anchorages, etc.

- Example 1: Trench shoring: determine soil lateral loads, design sheeting, wales and shores considering slenderness, strength, and deformations.

- Example 2: Elevated slab formwork design: determine all sources of gravity loads to design sheathing, joists, stringers, and shores, considering strength and stiffness. Stability must be considered in slenderness of shores and system stability in lateral bracing of overall shoring system.

- Example 3: Wall or column form: determine all loads to calculate lateral form pressures, and design sheathing, studs, wales and ties considering strength and stiffness. . Determine lateral stability.

MECHANICAL, ELECTRICAL AND PLUMBING

Provide a complete ***scope of work*** for HVAC, Plumbing, and Electrical contracts.

Provide descriptions of the HVAC, Plumbing, and Electrical systems shown in your project. Include the following as a minimum:

HVAC System:

(1) Describe the components of the system or systems (AH, VAV, RTU, Chiller, cooling tower, piping, pumps, type of duct, etc.).
   A. The purpose of each component.
   B. How the component works.
   C. How the components work together.
(2) Discuss the controls of the system and who installs the controls.
(3) Discuss the process of the cooling cycle through the system.
(4) Discuss the process of the heating cycle through the system.
(5) Discuss the energy conservation measures, if any, for the building.
(6) Why was this system used as compared to another?
(7) Discuss the impact of the HVAC system on the schedule.

PLUMBING System:

(1) Potable water supply source, waste discharge point for sanitary and storm.
(2) Type and location of water pipes.
(3) Type and location of sanitary sewer pipes.
(4) Discuss the pumps in the systems.
(5) Discuss any controls in the system.
(6) Discuss the hot water source and distribution (re-circulation or non-re-circulation)
(7) Discuss the impact of the plumbing system on the schedule.

ELECTRICAL System:

(1) List service amperages and voltage to the MDP.
(2) List operating voltage(s).
(3) Describe the control systems.
(4) Describe the electrical from the entrance, meter, and/or MDP through the sub-panels.
(5) Describe the building equipment needs other than lights and receptacles (pumps, AH, Chiller, RTU, elevators, etc.).
(6) Describe the types and locations of conduit.
(7) Describe the emergency power system.
(8) Discuss the impact of the electrical system on the schedule.

The estimate for the MEP portion of the project may be completed with a cost per square foot price (from Means) for the MEP subcontracts.

SUSTAINABLE CONSTRUCTION ASSESSMENT

You are to conduct an assessment of your project building to demonstrate that you understand how the design and construction of your building reflects the basic principles of sustainable construction. Set out below are specific tasks to complete that relate to principles of sustainable construction. You are to answer these as they relate specifically to your building.

1. The USGBC through its LEED certification program has different certification programs for different construction projects.
    a. Select the current certification program that would be applicable to your construction project and locate and reference at least two resources or tools from the USGBC website that set out the requirements of the specific certification program.
2. During construction a contractor should consider the environmental impacts of construction activities on the site and its surroundings. A LEED Pre-requisite on any LEED certified project is *to reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust*.
    a. Review you project documents to identify any national, state or local requirements that control site erosion and sedimentation.
    b. Identify 6 specific measures incorporated into your project that reduce pollution from construction activities. Describe how each measure helps to reduce pollution using illustrations obtained from project documentation or other sources.
3. Sustainable construction projects seek to minimize non-renewable energy consumption, protect water resources and conserve water consumption. This is accomplished through good design and operating the building using sound environmental practices. A LEED Pre-requisite on any LEED certified project is to provide fundamental commissioning and verification to *support the design, construction, and eventual operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability.*
    a. Review you project documents to identify and summarize any specific requirements related to commissioning and verification.
    b. Review the document *New Construction Building Commissioning Best Practice* by the *Building Commissioning Association*. Identify and describe the contractor's

commissioning responsibilities during the construction phase for a project such as yours.

c. Identify 6 pieces of commissioned equipment from your project that might be included in the construction checklist and describe the specific commissioning process for at least one piece of equipment.

4. Sustainable construction projects seek to use environmentally preferable products in the construction process. The LEED certification process seeks to minimize *the embodied energy and other impacts associated with the extraction, processing, transport, maintenance, and disposal of building materials* and gives credit for using construction products that provide *building product disclosure and optimization.*
    a. Choose 3 construction products used in your project that you believe are environmentally preferable.
    b. Locate the product manufacturers website and use the information available to explain how these products seeks to minimize *the embodied energy and other impacts associated with the extraction, processing, transport, maintenance, and disposal of building materials*
5. Another sustainable construction principle is to reduce construction and demolition waste disposed of in landfills and incineration facilities by recovering, reusing, and recycling materials.
    a. Identify 3 material streams used in your project where waste materials could be diverted from landfill or incineration.
    b. Describe with specific reference to your project how the 3 waste materials streams will be collected during the construction phase and processed locally after they leave the site. Your description should include a site utilization plan highlighting key features specific to waste management (i.e. dumpsters, salvage material lay down)
6. The quality of the indoor environmental is essential in sustainable construction projects. LEED certification seeks to *promote the well-being of construction workers and building occupants by minimizing indoor air quality problems associated with construction and renovation.* This is achieved by developing and implementing an indoor air quality (IAQ) management plan for the construction and preoccupancy phases of the building.
    a. Identify the requirements and procedures and describe how you would protect the air distribution system (for example ductwork) during construction.
    b. Give an example specific to your project and describe how you would protect absorptive materials stored on-site and from moisture damage.

Related References:

1. http://www.usgbc.org/cert-guide
2. http://www.bcxa.org/wp-content/pdf/BCA-Best-Practices-Commissioning-New-Construction.pdf
3. http://apps.necanet.org/files/NECA090_2004.pdf
4. http://your.kingcounty.gov/solidwaste/greenbuilding/construction-demolition.asp
5. http://www.mcaa.org/green/Construction_IAQ_Final.pdf
6. http://cbcs-ky.com/doc/IAQPlan2-9-2011.pdf

SPECIFICATION TAKE-OFF / DRAWING NOTES ISSUES

The student shall provide an analysis of all items that impact time, money, or other risks that are associated with, but not be limited to, supplemental conditions, general notes on drawings, and all specifications. The analysis shall be presented in the form of an internal memorandum directed toward company employees affiliated with this project.

STUDENT SELECTED WORK

Students are required to add relevant information into their thesis document. The information should be insightful and provide the faculty with additional understanding concerning the project or the construction process as seen by the student. You may enhance your thesis by taking photos, including work on related items that interests you, and adding originality where it enhances your total project. The Student Selected Work submitted should involve **approximately 40 hours of work** completed by the student. Examples of "Student Selected Work" are listed below:

E-Portfolio:

Students are strongly encouraged to engage the e-portfolio as their student selected work. See specific directions in Canvas.

Cost Analysis:

The student can identify a component of the building and do a value analysis to determine which system may be better to use. The analysis needs to address the cost of the item, its effect on the schedule and the life cycle cost. The important thing to remember is to identify and analyze various systems. The project can remain the same.

Temporary Structures:

In addition to the information required in the Building Stability section, the student could do in-depth investigations of several areas. Trenching, bracing wood trusses, bracing masonry walls, structural steel bracing and shoring could all be studied as they relate to your specific project. The complete design could include sketches, citations from applicable codes or OSHA sections, connection details, construction sequencing and other relevant information.

Scheduling:

Project planning is an area that the student could explore. Creating a detailed Work Breakdown Structure which represents the organization of the project is acceptable. This plan should be reflected in the actual schedule that is required.

Creating a detailed Two-week Schedule that deals with a specific operation or area of the project could also enhance the thesis. This schedule could be used by the superintendent to direct field personnel or coordinate subcontractors. This could also represent a project meeting schedule where the actions of the last week and the next two weeks would be discussed. This schedule would be more detailed that the overall project schedule, but represent the activities that need to be completed during the time period.

APPENDIX A: BSCI 4990 – THESIS PROPOSAL APPROVAL FORM (version 1-7-13)

This form is to be submitted **directly to the BSCI Office,** along with drawings and separately bound specifications. The student is encouraged to submit the drawings and specs. on a USB drive in PDF format. The Thesis Instructor will make notations on this sheet as to their approval and any special requirements. After the project has been approved, the BSCI Office will return a copy of this form and the plans/specs/cd to you and retain a copy of this form for filing. If disapproved, the plans/specs/cd and form will be returned to you. The Building Science Office phone number is **(334) 844-4518**.

Today's Date: _____ Semester & Year you will take Thesis: _____

Full Name of Student (as in AU Banner): _____ AU e-mail: _____

Exact Title of Project on Plans/Specs: _____

Name of Architect: _____ Date of Plans: _____

Architect's Project #: _____ Location of Building, City: _____ State: _____

Cost of Project: _____ (Should be between $1,000,000 and $3,000,000)
Use actual bid figures or A/E's or G.C.'s estimate/budget.

Building Floor Area (should be approximately 9,000 - 12,000* s.f.) _____ No less that 7,000 s.f. of the area must have finished floors, partitions, walls and ceilings. * BIM Thesis is a minimum of 15,000 s.f.

Types of buildings that do not lend themselves to be good Thesis projects and will not be approved:

- Pre-engineered roof trusses and wall systems
- Pre-engineered metal buildings or pre-cast walls
- Branch banks
- Wal-Mart or supermarket type buildings
- Drug Store projects (CVS, Walgreens, etc.)
- Houses or Apartments

Select **Yes** or **No** to the following questions.

	Yes	No
Required Items for Thesis Proposal Approval:		
Do you have a complete set of bound Specifications, Division 0 thru Mechanical/Electrical/Plumbing?	___	___
Do you have the following forms in the General Conditions: Bid Proposal, Agreement?	___	___
Do you have complete Civil drawings (u.g. utilities, grading, parking, elevations, erosion control, etc.)?	___	___
Do you have complete Architectural drawings (doors & windows, interiors, ceiling, elevations, etc.)?	___	___
Do you have complete Structural drawings (foundations, floor & roof framing, wall sections, etc.)?	___	___
Do you have complete Mechanical drawings (HVAC, ductwork, equipment schedules, piping, etc.)?	___	___
Do you have complete Electrical drawings (lighting fixture schedule, power, panel board schedule, etc.)?	___	___
Do you have complete Plumbing drawings (non-pressure & pressure piping, fire protection, etc.)?	___	___
Required Items for *Thesis Class* (strongly recommend inclusion in Thesis Proposal):		
Do you have a *Geotechnical Report*?	___	___
Do you have any *Formwork* required such as retaining wall, elevated slab, columns, etc.?	___	___
Do you have a *Finish Hardware* schedule in the specifications or listed on the drawings?	___	___
Do you have any *Alternates* in the Bid Proposal and/or specifications?	___	___
For BIM Thesis only: Do you have *CAD drawings* and *digital specifications*?	___	___

Student Comments Regarding Proposal: _____

_____

BSCI Office Approval: _____ Date: _____

BIM Thesis Faculty Approval: _____ Date: _____

Thesis Instructor Approval: _____ Date: _____

Thesis Instructor Comments & Special Requirements for approval: _____

_____

_____

Appendix B - Thesis Evaluation & Grading Criteria (updated 8/15/15)

Student Name:	
Each Subpart (In Blue) will be graded as a unit with the weight of Subpart shown in 1st column	
	A 10-point scale will be used with this grading criteria
	Completing all the minimum requirements does not mean an automatic grade of "A".
	If ALL items are included and most of the items are reasonably correct, then the student can expect a grade of "C".
	Significant omissions and/or errors will result in a grade in the "D" range or an "F".
15%	**General Overview**
	Understanding the Plans
	Understanding the Specifications
	Understanding Materials
	Understanding Methods
	Organization of the Book
	Appearance of the Book
	Misc. Factors
5%	**The Thesis & Company Items**
	Title Page
	Thesis Proposal Approval Form
	Table of Contents with page numbers
	Assumptions
	Spec Takeoff - Division 1 & Plan Notes Issues
	Detailed Project Time Line
	List of Student Selected Work w/page numbers
	Company History, Philosophy, and Goals
	Organizational Chart
	Duties of Key Personnel
	Contractor's Licenses (State and Local)
	Reference all sources used in Thesis
	Project Brief
10%	**Financial**
	Contractor's Qualification Statement
	Income Statement - current and projected
	Financial Narrative including business position and strategies consistent with financial statements
	Financial Ratios and a thorough analysis of each: Net and Gross Margins, ROI, Current Ratio, Fixed Asset Newness, and Average Ages of Receivables and Payables
	Labor Burden Determination (home office and field)
	General Overhead Determination
15%	**Project Estimate**
	Document earthwork quantities using "Earthworks" or other suitable program. Include printout of software including graphic image of cut/fill.
	Classify Materials and Methods by Trades
	Calculate Building Quantities
	Choose appropriate Technology for Creating Estimate
	BIM Model
	Create an Estimate
5%	**Safety Plan**
	Specifics on the Project
	Emergency Contacts
	Safety manager
	First Aide
	Emergency Plan
	Regulations
	Create a Safety Plan
	Create a Plan for Compliance

5%	**LEED Assessment**
	LEED Certification Selection
	Environmental impacts of construction activities on the site
	Commissioning
	Environmentally preferable products
	Construction waste management
	Indoor environmental quality
15%	**Project Administration**
	Proposal Form with at least one alternate bid item
	Change Order (executed in first 3 months)
	Change Order prompting, i.e. RFI, Architect's directive, etc.
	Change Order QTO, Pricing, Recap sheets, and cover correspondence to Architect
	Agreement Form (per your specs.) w/acceptance of one alternate
	Schedule of Values Reports showing Period Costs for first three months, from which the pay applications are generated
	Payment Requests (for first 3 consecutive months)
	List of all required Warranties and at least two actual Warranties
	Subcontract Agreement Short Form (AGC) w/ detailed scope of Work and listing of project documents as attachments.
	Explanation/Analysis of MEP systems
	Subcontract Scope Statement for MEP systems
	Project Cash Flow Projection & Analysis
5%	**Project Documents**
	Master Surety Agreement
	Bid Bond
	Power of Attorney for Bond Agent
	Bond Application Form
	Performance and Payment Bonds
	Certificate of Insurance
	Building Permit (not the application)
	Submittal/shop Drawing Control Document
	Substantial Completion Documentation
	Consent of Surety to Release of Retainage (when appropriate)
	Affidavit of Release of Liens
	Affidavit of Payment of Debts & Claims
	Consent of Surety to Final Payment
	Certificate of Occupancy
10%	**Project Schedule**
	CPM Activity Worksheets (activities derived from cost estimate, cost loading the schedule, SOV #s, etc.)
	Full Plotted Schedule, (critical path, procurement activities, etc.)
	Site Utilization Plan (Graphic & Written Narrative)
5%	**Structural**
	Identify the structural components of a building
	Identify common methods of stabilizing structural frames
	Classify Loads on Buildings
	Trace the path of vertical and lateral loads through structural components of a post and beam building
	Design and Construct strong, stiff & stable temporary structures and formwork
	Calculate internal member forces in structural elements of buildings
	Determine internal stresses on structural bending elements
10%	**Student Selected Work**
	Requires 40 hours of work for full credit.
	(i.e., LEED, BIM, pictures with narrative, etc)

Appendix B, Rubric 1: Estimate

Name:

Criteria	Key Metric	Grading Scale 5	4	3	2	1	Student Score
Classify Materials and Methods by Trades	Recapped and organized estimate according to appropriate trades	All items organized well and assigned to appropriate trade	Minor errors in organzation and classification only	One key item with significant organization or classification issues	2-3 key items with significant organization or classification issues	More than 3 key items that wer organized or classified poorly	
Calcuate Building Quantities	Is it complete?	All items were addressed correctly	All items addressed, but some minor errors were made in the QTO	One major omission or error in the QTO (may also include minor errors)	2-3 key omissions or errors in the QTO (may also include minor errors)	More than 3 key omissions or errors in the QTO (may also include minor errors)	
Choose Appropriate Technology for Creating Estimate	There is a consistent level of detail through the estimate, and the audit trail is obvious	Solid choices were made for creating the estimate. A consistent level of detail and audit trail are clear and well developed.	Generally good choices were made to create the estimate. Some minor errors in level of detail or audit trail may be present.	One major issue associated with choice of technology for the esitmate. Inconsistencies in level of detail or the audit trail occur.	2-3 inconsitencies in level of detail or the audit trail.	Significant issues with level of detail or audit trail throughout the estimate.	
BIM Model	Are required items included in the model?	Model is complete and readily accessible	Model is generally complete and/or accessibility of model is not clear	Model lacks one key item and/or accesibility of model is difficult	Model lacks 2-3 key items that should be included or model cannot be accessed.	Model lacks 3-4 key items that should be included or model cannot be accessed.	
Create an Estimate	QTO, Pricing, Recap, Alternates, Bid Proposals, Documents	All required items are included, and no errors or omissions are evident	Only minor errors or ommissons noted	One key item with significant errors or omissions	2-3 key items with significant errors or omissions	More than 3 key items that were omitted or entered with errors	
						Estimate Score:	

Total Score	(Sum of all points above)		**This score to overall rubric**	
% of total Points	(Total Score/25)			
Score to Overall Rubric	(% of total Points * 15%)			

Appendix B, Rubric 2: Sustainability

Name:

Criteria	Key Metric	Grading Scale						Student Score
		5	4	3	2	1		
LEED Certification Program Selection	Correct Program Selected							
Environmental impacts of construction activities on the site	Identify requirements that control site erosion and sedimentation.	All project specific reqs identified	Most project specific reqs identified	Some project specific reqs identified	Reqs identified are not project specific	Some generic non project specific reqs identified	No reqs identified	
(5 Points)	Identify and describe 6 specific measures	6 project specific measures identified and fully described and illustrated	Less than 6 project specific measures identified and/or descriptions lacking detail	Less than 4 project specific measures identified and/or descriptions lacking detail	Measures identified and described but are not project specific	Measures identified but little attempt to describe them	No measures identified	
Fundamental commissioning and	Identify and summarize project	Documents reviewed and all					No evidence of project	
(5 Points)	Identify and describe contractors responsibilities	Identification and description consistent with best practice	All responsibilities identified and some description	All responsibilities identified	Some responsibilities identified but little description	Some responsibilities listed	No responsibilities identified	
	Identify 6 pieces of equipment and describe one process in detail	6 pieces of equipment identified and process well described	6 pieces of equipment identified and process somewhat described	6 pieces of equipment identified	4 pieces of equipment identified	2 pieces of equipment identified	No equipment identified	
Environmentally preferable products (5 Points)	Choose 3 environmentally preferable products	3 products correctly identified					No products identified	
	Explain how products are environmentally preferable	Website information used to explain all ways the 3 products reduce environmental impact	Website information used to explain some of the ways ways the 3 products reduce environmental impact	Website information used to explain some of the ways 2 products reduce environmental impact	Non-product information used to explain some of the ways 3 products reduce environmental impact	Non-product information used to explain some of the ways 2 products reduce environmental impact	No explanation	
Reduce construction waste (5 Points)	Identify 3 material streams	3 material streams identified					No material streams identified	
	Describe how materials collected and processed	Collection & processing of material streams for all 3 are described & are project specific	Collection & processing of material streams for all 3 are described but are not project specific	Collection & processing of material streams for 2 are described & are project specific	Collection& processing of material streams for 2 are described but are not project specific	Only 1 Collection & processing of material stream described	Collection and processing not described	
	Site utilization plan for CWM	Site utilization plan shows project specific locations of dumpsters, salvage material lay down etc. for all 3 streams	Site utilization plan shows project specific locations of dumpsters, salvage material lay down etc. for 2 streams	Site utilization plan shows project specific locations of dumpsters, salvage material lay down etc. for 1 stream	General information about locations of dumpsters, salvage material lay down etc. given but not project specific		No site utilization plan	
Indoor air quality (IAQ) management plan (5 Points)	Identify requirements and procedures and describe protecting the air distribution system	Requirements, and procedures are project specific and description is consistent with industry best practice		Requirements, and procedures are not project specific and description is not consistent with industry best practice			No Requirements, and procedures identified	
	Example of	Example is		Example is not			No example	
							Total Score (Max 25)	
							Transfer to Grading Rubric – Total Score/25 (Max 5)	

Appendix B, Rubric 3: Structure

Name :

Criteria	Key Metric	Grading Scale 5	4	3	2	1	Student Score
Identify the structural components of a building	Verbal description of structural system that includes graphic depiction in either 2D or 3D	All key structural elements are identified along with their function. A clear understanding of structure is presented.	Description covers almost all structural components of the structure with most member functions addressed. The student has an understanding of items presented.	Approximately half of the members are identified with function shown. The student lacks some understanding of the structure.	Key elements of the structure are not included in the description and a lack of understanding of components is evident.	Key structural elements are not identified. Student lacks an understanding of components of the building.	
Identify common methods of stabilizing structural frames	Verbal description of lateral system that includes graphic depiction in either 2D or 3D	Lateral load resisiting system is clearly identified. Student illustrates how load is transmitted to lateral system.	Lateral load resisting system is clearly identified. A lack of clarity is present in how the load is transmitted to the system.	Lateral system is address but is not complete. Student does not have clear connection with how lateral load is transmitted to the foundation.	Lacks sufficient detail in the lateral load system of the buidling. A lock of understanding is present.	Fails to identify correct lateral system and does not attemp to identify lateral load flow.	
Classify Loads on Buildings	Verbal and graphical depiction of building loads	All dead loads, live loads, and wind loads are corectly shown on the building.	Loads shown on building are generally correct but lack sufficient detail for full credit.	Either dead loads, live loads, or wind loads are incorrect.	Two of three key loads are incorrect or not suffiiciently addressed.	Loads on the buidling are not clear or are not adddressed.	
Trace the path of vertical and lateral loads through structural components of a post and beam building	Verbal and graphical depiction of building loads	All loads are shown clearly transmitting to the ground.	Load paths shown are generally correct but lack sufficient detail to confirm all are resolved to the ground.	Load paths shown have minor errors or lack clarity.	One load case is not resolved to the ground. Others are generally correct.	Neither gravity or wind loads are resolved to the foundation.	
Design and Construct strong, stiff, & stable temporary structures and formwork	Temporary structure analysis	Temporary structure design is complete and accurate	Temporary structure design lacks minor details or has minor errors	Temporary structure design lacks at least one major componetn or has one major flaw	Temporary structural design is not complete or multiple errors are present	Lack of understanding of temporary structure design and construction	
Calculate internal member forces in structural elements of buildings	Temporary structure analysis	Forces for all elements were determined and sufficiently resolved.	Forces for all elements were determined, but some were not resolved.	Most member forces were determined and resolved.	Major errors are present in the structure analysis of forces in temporary members.	Little or no effort was made to determine internal member forces within temporary structural members.	
Determine internal stresses on structural bending elements	Temporary structure analysis	All members for temporary structure have internal stresses identified and sufficiently resolved.	All members for temporary structure have internal stresses identified but may not be sufficiently resolved.	Most members in the temporary structure have internal stresses identified and resolved.	Major errors are present in the structure analysis of stresses in temporary members.	Little or no effort was made to determine internal member stresses within temporary structural members.	
						Structure Score:	

Total Score	(Sum of all points above)		**This score to overall rubric**				
% of total Points	(Total Score/35)						
Score to Overall Rubric	(% of total Points * 5%)						

Appendix B, Rubric 4: Safety

Name:

Criteria	Key Metric	Grading Scale 5	4	3	2	1	Student Score
Specifics on the Project (5%)	Specifics on the project provided including location, OAC, key phone numbers, and key addresses	All information included and accurate	All information addressed with minor errors	Missing key information and/or major errors	Only a few issues addressed	Little if any information is specifically addressed	
Safety Manager (5%)	Who is the person? What % of their duties? How are they managing daily inspections? How are they managing subcontractors' safety programs?	All information included and accurate	All information addressed with minor errors	Missing key information and/or major errors	Only a few issues addressed	Little if any information is specifically addressed	
First Aid (5%)	Who is the person? What % of their duties? How are they managing daily inspections?	All information included and accurate	All information addressed with minor errors	Missing key information and/or major errors	Only a few issues addressed	Little if any information is specifically addressed	
Emergency Contacts and Events (5%)	Location of emergency services Phone Location and response time of project for emergence responders Plans for storms and fire.	All information included and accurate	All information addressed with minor errors	Missing key information and/or major errors	Only a few issues addressed	Little if any information is specifically addressed	
Accident Plan (5%)	Plans are provided in the event of an accident. An accident investigaton plan is in place. OSHA Form 301 included. Suspension trama response plan and/orPermits required for contained spaces or evacuation are in place.	All information included and accurate	All information addressed with minor errors	Missing key information and/or major errors	Only a few issues addressed	Little if any information is specifically addressed	
Training (5%)	Fed OSHA, State OSHA, Company Safety Plans, Site Specific Safety Plan	All information included and accurate	All information addressed with minor errors	Missing key information and/or major errors	Only a few issues addressed	Little if any information is specifically addressed	
Analyze hazards (35%)	Complete Job Hazard Analysis matrix identifying hazards present and mitigation plans	Shows an excellent understanding of the OSHA Requirements and the ability to see how those standards relate to the construction project	Shows a good understanding of the OSHA Requirements and the ability to see how those standards relate to the construction project	Shows a fair understanding of the OSHA Requirements and the ability to see how those standards relate to the construction project	Shows a poor understanding of the OSHA Requirements and the ability to see how those standards relate to the construction project	Shows a very poor understanding of the OSHA Requirements and the ability to see how those standards relate to the construction project	
Create A Safety Plan and Plan for Compliance (35%)	Complete Job Safety Plan addressing 2-3 major safety issues identified along with the steps, tools, and equipment for mitigation (include visual illustratons). A minimum of 3 Hazard Communication Safety Data Sheets are detailed specific to the project. At some point in the project, a jobsite inspection form is completed to show comlpliance or remedial action needed.	Shows an excellent understanding of how to apply the OSHA regulations	Shows a good understanding of how to apply the OSHA regulations	Shows a fair understanding of how to apply the OSHA regulations	Shows a poor understanding of how to apply the OSHA regulations	Shows a very poor understanding of how to apply the OSHA regulations	
						Safety Score:	

Total of Items worth 5% each	(30 possible points)		**This overall score to rubric**				
Total of Items worth 37.5% each	(10 possible points)						
Total Score based on 100%	.3*(total of items worth 5% each) + .7*(total of items worth 35% each))						
% of total Points	(Total Score/100)						
Score to Overall Rubric	(% of total Points * 5%)						

Appendix B, Rubric 5: Schedule

Name:

Criteria	Key Metric	Grading Scale 5	4	3	2	1	Student Score
Develop Work Breakdown Structure at Consistent and Appropriate Level of Detail, minimum # of activities as described in the Thesis Instructions	Thoughtful and Consistent Listing of Activities, Grouped Appropriately	All Project Components Broken Down at Sufficient Detail by which to Direct the Trades, and at a Consistent level of Detail, minimum # of activities as described in the Thesis Instructions	Minor errors or omissions in breaking down components into activities	1 to 2 key ommissions or errors in breaking down or organizing the project components	3 - 5 ommissions or inconsistencies in key components into activities	More than 3 key components that were broken down poorly or at an inconsistent level of detail	
Calculate and Apply Reasonable and Appropriate Durations	Are Durations Reasonable Relevant to Crew Sizes, and to the Overall Project Duration?	All activities assigned a reasonable duration based on logical crew sizes and overall project duration	1 - 2 minor errors in the assignment of reasonable duration, causing minor problems with sequence and/or the critical path	1 or 2 problematic errors with key activity durations, causing issues with overall sequence and the critical path	3 - 5 problematic errors with key activity durations, causing issues with overall sequence and the critical path	More than 5 significant errors in assignment of durations, causing significant problems with overall sequence and the critical path	
Assign Relationships and Constraints Demonstrating Understanding of the Building and Site's Sequence	Major Phases of the Project (Site, Structure, Skin, Rough-In, and Finishes) have Relativity in Sequence	Solid choices were made for creating the estimate. A consistent level of detail and audit trail are clear and well developed.	Generally good choices were made to create the estimate. Some minor errors in level of detail or audit trail may be present.	One major issue associated with choice of technology for the esitmate. Inconsistencies in level of detail or the audit trail occur.	2-3 inconsitencies in level of detail or the audit trail.	Significant issues with level of detail or audit trail throughout the estimate.	
Leverage the Software Platform to Appropriately Reflect the Information, Sequence, Critical Path	Critical Path Illuminated, Relationships Shown, Numerical Data Shown (duration, Start Date, Float), and Sequence Understood Easily	Model is complete and readily accessible	Model is generally complete and/or accessibility of model is not clear	Model lacks one key item and/or accesibility of model is difficult	Model lacks 2-3 key items that should be included or model cannot be accessed.	Model lacks 3-4 key items that should be included or model cannot be accessed.	
Create a Comprehensive Project Schedule	Submission Shows a Comprehensive Understanding of the Building and Site Components, Their Sequence and Constructability, and Represented Properly in the Software Platform	All required items are included, and no errors or omissions are evident	Only minor errors or ommissons noted	One key item with significant errors or omissions	2-3 key items with significant errors or omissions	More than 3 key items that were omitted or entered with errors	
						Estimate Score:	

Total Score	(Sum of all points above)	25	**This score to overall rubric**	10.00%			
% of total Points	(Total Score/25)	100.00%					
Score to Overall Rubric	(% of total Points * 10%)	10.00%					