

West Wing Geothermal Project

Fall 2012
ENGR333a
Calvin College
Prof. Heun

Spaelhof Addition
Rendering: View from Southwest



CALVIN
SPOELHOF CENTER ADDITION

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Calvin College is planning a West Wing addition to the Spaelhof College Center. LEED certification is being considered for the project (<http://www.usgbc.org/DisplayPage.aspx?CategoryID=19>). If attained, the West Wing would be the 2nd LEED certified building on campus, the Bunker Interpretive Center being the first.

To earn additional LEED points, a geothermal heating, ventilation, and air-conditioning (HVAC) system is needed for the West Wing. The challenge for your class this semester is:

What will it take for Calvin College to install a geothermal HVAC system for the West Wing?

To answer the primary question, you will find the need to explore several additional questions, including, but not limited to:

- At what rate is the West Wing expected to gain (lose) heat in the summer (winter)?
- What design options should be considered for the geothermal systems?
- If Calvin spends money on a more-efficient building envelope, can we save money on the geothermal system?
- What is the cost difference between conventional and geothermal HVAC systems for the West Wing?
- On what criteria will you assess HVAC system design options?

- How does the existing campus infrastructure constrain your selection of geothermal system design options?
- Is there an opportunity to utilize the Calvin Energy Recovery Fund (CERF) for the geothermal system?
- How can we monitor and audit the energy performance of the West Wing geothermal system?
- Which other schools have successfully implemented a geothermal system on campus, and can Calvin learn lessons from their experience?
- Is any external funding is available for such a project?
- What guidance does the geothermal dormitory suite in van Reken Hall provide for the West Wing geothermal system?

Your response to the main question (“*What would it take ...*”) should take the form of a single report containing comprehensive and accurate design and performance information for the West Wing HVAC system that could be used to implement the system when the building is constructed. Your report should be thorough enough for the customer (Henry DeVries) to make a decision whether to pursue a geothermal HVAC system for the West Wing.

Your deliverables are:

- (a) a final report that provides a detailed description of your work during the semester and a recommendation to the customer whether we should pursue a geothermal HVAC system for the West Wing,
- (b) two posters to be presented at the Calvin Environmental Assessment Program (CEAP) conference at 3:30 PM on Thursday 29 November 2012 (location TBD)
- (c) an Engineering seminar on Tuesday 4 December 2012 (location TBD)

Each student must attend either (a) the CEAP Poster Session or (b) the Engineering Seminar.

Your final report will consist of:

- (a) paper copies of your final technical memo with extensive appendices (the tech memo must be a single report for the entire class),
- (b) an electronic copy of your final report (.pdf format, one single file) to be posted at <http://www.calvin.edu/~mkh2>, and
- (c) a CD or DVD containing electronic copies of all posters, presentations, programs, and analysis tools that you developed during the project.

The ultimate customer for your final report is Calvin’s Vice-President for Finance, Henry DeVries. The final written report should follow the technical memo format, including a two-page summary with conclusions followed by extensive appendices. Each group (see below) must provide one detailed appendix (in technical memo format, of course) to the overall technical memo that describes the analyses performed by and the contributions from each group.

You must distribute copies of your final report (all three elements) to the VP for Finance, your supporting resources (from Calvin College administration and Midwest Energy Group), and your professor. The final report is due on **Tuesday, 11 December 2012 at 4:30 PM**. As a class, you must also send a note of appreciation to each resource for their assistance during the semester.

Prior to the first class meeting each week (typically Monday), each student must submit a weekly timecard that includes

- hours worked on the project
- brief (1 paragraph) description of work accomplished.

You will pursue this project in small groups of approximately 5 students each. Initially, the groups will be organized as follows:

- LEED certification and Energy Modeling
- Financial and CERF (tracks all financial concerns and CERF opportunities)
- Heating system (including controls)
- Cooling system (including controls)
- Infrastructure/Power Plant (investigates resources available from and constraints due to the rest of the campus infrastructure; investigates all energy issues)

As a class, you may find it necessary to adjust the topics being addressed by each group or redistribute the workforce among the groups as the semester progresses. You may simply make the change yourselves provided that you inform the professor and supply justification.

You should consider forming an executive council consisting of representatives from each of the five groups above. The executive council could be responsible for coordinating all activities among the groups, planning the final report, and writing the introductory two pages of the report, among other things.

The professor will select students to fill the groups. To apply for one of the available groups, prepare a cover letter and resume and deliver it to your professor on Wednesday 5 September 2012 before lecture. Your cover letter should indicate the group in which you are interested and why you are qualified for that position. Group assignments will be announced via Moodle in the evening of Wednesday 5 December 2012.

An initial task for each group is to develop a schedule of your activities for the semester that coordinates with the schedules of other groups. The schedule must show milestones corresponding to points of interaction with other groups. Schedules must be presented during the first oral progress reports (see below).

There will be three short, in-class progress reports in the form of oral presentations. There will be a longer in-class final presentation that summarizes the results of the renovation project. Each student must give either (a) a progress report presentation or (b) part of the final presentation. The presentations must be professional quality, must concisely report your progress, and must provide sufficient technical detail for customer, professor, and peer review of your progress. Please have only 1 student participating in oral progress report and 2 students (at most) participating in the final in-class report.

The in-class progress reports must follow the following outline:

- Status relative to your schedule (and any re-planning that has occurred since your last report)
- Work accomplished since your last report (including technical and cost details)
- Issues or concerns (and plan for addressing them)
- Work planned for upcoming reporting period

The final in-class oral report need not follow the outline above. Rather it should summarize the final technical details of your work, how your work was used in the final conclusions for the BIC project, and the conclusions for your group.

You must bring printed copies (6-up, double sided to save paper) of all in-class presentations for guests and the professor.

Although the customer for this report is the VP for Finance, your professor will assign final grades (in consultation with the resources for the project). Students will be assessed on (a) the quality of their team's contribution to the overall effort of the class and (b) peer evaluation. The professor, in conjunction with our external resource persons, will select an exemplary student for a teamwork award at the end of the semester.

Supporting Resources:

- Dr. Henry DeVries, VP for Finance: the ultimate customer
(616) 526-6148, hdevries@calvin.edu
- Trent DeBoer, GMB, external consultant
(616) 796-0200, trentd@gmb.com
- Paul Pennock, Physical Plant: contact for information about the existing campus HVAC systems
(616) 262-9230 (mobile), ppennock@calvin.edu
- Dan Slager, Physical Plant: contact for Calvin College energy purchasing information
(616) 526-6267, slagda@calvin.edu
- Ryan Hoff, CERF intern: contact for information about CERF
rmh32@students.calvin.edu
- CERF documentation, including
http://www.calvin.edu/~mkh2/thermal-fluid_systems_desig/2008_ceef_final_report.pdf
http://www.calvin.edu/~mkh2/thermal-fluid_systems_desig/2008_ceef_seminar.pdf
http://www.calvin.edu/~mkh2/thermal-fluid_systems_desig/2010-hvac-bht-final-report.pdf
- CERF policies (available from Ryan Hoff)
- Previous ENGR333 design projects available from
http://www.calvin.edu/~mkh2/thermal-fluid_systems_desig/
- Classroom learning on exergy, energy, economics, and thermal analysis
- Prior laboratory and lecture classes
- Independent research

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Full-class project meetings are held at 9:00–9:50 in SB102.

Note: bold schedule items will include participation of the customer and resources

Day	Date	Activity
Tue	4 Sep	Project introduction, objectives, deliverables, intro. to resources (Meeting at 8:50 due to adjusted schedule.)
Wed	6 Sep	Cover letters and resumes due to Prof. Heun at class. Groups assigned.
Tue	11 Sep	Project work day (Meet in the classroom for group work)
Tue	18 Sep	In-class group presentations (7 minutes + 2 for questions) Use required outline.
Tue	25 Sep	Project work day (Meet in the classroom for group work)
Tue	2 Oct	In-class group presentations (7 minutes + 2 for questions) Use required outline.
Tue	9 Oct	Project work day (Meet in the classroom for group work)
Tue	16 Oct	Project work day (Meet in the classroom for group work)
Tue	23 Oct	Project work day (Academic Advising)
Tue	30 Oct	In-class group presentations (7 minutes + 2 for questions) Use required outline.
Tue	6 Nov	Project work day (Meet in the classroom for group work)
Tue	13 Nov	Project work day (Meet in the classroom for group work)
Wed	14 Nov	Project work day (Meet in the classroom for group work)
Fri	16 Nov	Project work day (Meet in the classroom for group work)
Mon	19 Nov	Project work day (Meet in the classroom for group work)
Tue	20 Nov	Project work day (Meet in the classroom for group work)
Wed	21 Nov	Project final presentations (13 minutes + 2 for questions)
Mon	26 Nov	Project final presentations (13 minutes + 2 for questions) Report on final results.
Thur	29 Nov	CEAP Poster Session, 3:30 PM (Location TBD)
Tue	4 Dec	ENGR Department Seminar 3:30 PM (Location TBD)
Tue	11 Dec	Final report due at 4:30 PM