Case Study

Issued: 18 January 2007
Due: various dates—interim and final submissions, plus presentation

Introduction
Vital Signs and Agents of Change are approaches to learning about buildings and design that involve visits to completed buildings; development of questions and hypotheses about selected aspects of building performance; establishment of methods to investigate appropriate questions; implementation of those methods using equipment, observations, and/or questionnaires; analysis of findings; and preparation of a case study report that describes all of the above. Examples of Vital Signs and Agents of Change case studies can be found on the World Wide Web at: <http://arch.ced.berkeley.edu/vitalsigns/bld/bld main.html> and <aoc.uoregon.edu>. Hints for conducting a successful case study are available from these Web sites. Note that many of these example case studies involved term- or semester-long efforts; don’t get carried away by example. This project (which will involve efforts both in and out of section) asks you to develop a case study on some aspect—of your own choosing—of building performance related to the subject areas (most likely climate control) covered in this course. The case study will involve a detailed investigation of a specific part of a building that is also of your own choosing.

There are four parts to this assignment, organized as such to help keep you on track. The final product generated by this assignment will be a completed case study in html (Hypertext Markup Language) suitable for posting and reading on the World Wide Web. You are responsible for all aspects of the case study, including design of the Web site. There are defined interim due dates and review deadlines as noted below. You may work in teams of 2, 3, or 4 (all members from the same section; to be established in section).

Part 1 Getting Organized (due 13 February 2007, in lecture) 5 points

Getting organized for a building performance case study generally involves the following:

- selecting a building/space to be used as the location for the investigation;
- touring the building and developing questions about its performance;
- converting the questions into hypotheses about building/system performance; and
- selecting one or more hypotheses for further investigation.

Select a Building: Surprisingly, selecting a building for a case study is fairly simple. Almost ANY building should be able to suggest hundreds of questions regarding its performance. Therefore, almost any building could be a valid subject for a case study. With this in mind, it makes sense to select a building (1) which is reasonably easy to get to and to get into and (2) is interesting, fun, and/or challenging.

Tour: Conduct a walk-through tour of the building/space that you select and be inquisitive; ask questions (to yourself) about this and that. These questions can cover almost any issues that you find interesting—but remember to include some questions about thermal response, thermal comfort, and/or climate control. This part of the assignment is not high-tech and not complex, it is simply reflective of a designer’s or visitor’s curiosity. That’s a great detail; I wonder if it works? Why is everyone wearing a sweater today? Does this sun shading device work better than it looks? Why is the window sill rotting away? Why is there dirt all over the diffuser? Record your questions on a tablet, note cards, tape recorder as you tour the building. Supporting your questions/notes with digital photographs is recommended.
**Hypothesis:** A hypothesis is a testable statement about some phenomenon. In effect, it is a question converted to a statement that can be scientifically investigated and proven (or refuted). The word scientific does not necessarily imply complex, mathematical, or requiring expensive equipment; it simply means rational (as in logical). A good hypothesis should address only ONE issue and should involve only ONE “clause” (no ands, ors, ifs, buts, therefore). A typical hypothesis might read: “The window sill is rotting because condensation often forms on the inside of the window pane in cold weather.” The statement (hypothesis) can be proved or disproved (if disproved, the sill is still rotting . . . there just must be some other reason). If you want to address more than one issue, write more than one hypothesis.

While forming your hypothesis, keep five things in mind:

- The hypothesis must involve a subject area covered in this course—don’t propose hypotheses regarding lighting, acoustics, plumbing, or electrical systems;
- The hypothesis should be reasonably narrow—dealing with shading on a south façade is preferable to dealing with shading on all building orientations; depth of study is preferred over breadth;
- The hypothesis must be testable in the time available for this assignment—don’t propose measuring summer conditions or annual average performance of some variable;
- The hypothesis should be measurable (either quantitatively or qualitatively)—avoid becoming enamored of hypotheses derived from “rhetorical” questions (What was the designer thinking?)
- Remember that you will conduct this investigation—avoid proposing studies that require equipment not likely to be available (you saw some of the available equipment in section earlier this term) or ready access to spaces that are not generally accessible.

**INTERIM SUBMISSION: PART 1** (see due date above)

- A brief description of the building/space you have selected. Digital photographs of the building in general and the area related to your hypothesis should be included as part of this description. Loanable digital cameras are scarce and often not readily available, so coordinate with Media Services to ensure access.
- A list of the questions (developed during the building tour) with the most relevance to your hypothesis (with specific reference to aspect of the building that initiated the question). These initial questions will later be modified into Inquiry Questions that will help prove or refute your hypothesis;
- A well-crafted statement of the hypothesis (or hypotheses) that you intend to use as the basis for the case study;
- A work schedule/plan for developing the case study that shows the major activities you believe will be necessary to complete the project, when these activities are scheduled for completion, and who on the team will be primarily responsible for each activity. Your work plan may become an appendix in the final case study.
- Send ONE e-mail to your GTF and Prof. Kwok (akwok@uoregon.edu). Include: the URL address where the case study will reside, your tentative title, the names and email addresses of team members (cc all members of the team), and your hypothesis.

This submission is to be prepared in html (Netscape Composer, PageMill, GoLive, Frontpage, Dreamweaver are a few html applications that are easy to use), posted to a team members’ home site, and submitted as a hard-copy printout of the WWW page(s).

**Part 2 Measurements and Data** (due 20 February 2007, in lecture) 5 points

Developing appropriate measurement techniques and collecting the resulting data are the core of a building performance case study. In general, this part of the assignment will involve:

- outlining and developing a methodology for data collection (designing an approach);
- reviewing the methodology to ensure that it can achieve what is intended;
- obtaining or developing appropriate equipment, questionnaires, survey procedures, or observation techniques to support the methodology;

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• installing equipment and/or conducting surveys in accordance with a pre-established work plan (necessary to minimize multiple trips to the building and alienating occupants or team members);
• gathering data and checking it for completeness and reasonableness.

Methodology: A good methodology is the key to a successful case study. The purpose of the methodology is to collect adequate and appropriate information that will allow you to prove or disprove your hypothesis. The information may be theoretical or applied, library or field derived, qualitative or quantitative. You must collect enough information, but should not collect too much information. Having a clear and focused hypothesis will make development of a strong methodology much easier.

Your methodology should be developed in sufficient detail—before you go to the building to make measurements—that you could hand the method to an outside contractor and they could (in theory) do the data collection for you without need for your supervision. In reality, stuff will happen at the site that requires last-minute changes (Don’t think you can just tape that thing on the wall! We’ve had a raft of thefts recently. Susan may have approved this, but she quit yesterday.); but the fewer of these surprises the better. Your methodology should define what is being measured, what will be used to make the measurements, how the measurements will be taken, where the measurements will be taken, at what interval measurements will be taken, for how long they will be taken, and what data is expected to be collected (in terms of scope, quantity, and character). Be sure to record the general conditions prevailing at the time of your measurements.

Review Methodology: Development of a methodology is basically a design problem. As with any design problem seek outside review of your proposed methodology while it can still be modified. Will the method achieve what is intended? Will you be collecting the information really required to address your methodology? [Temperature is not comfort; air speed is not air flow.] Will data that are collected be ambiguous? Is there a simpler approach to reach the same end? Are there any gaps in the approach? Seek input from other groups (on a return basis), from the GTFs, and from the instructor. Many times a great methodology will involve the use of surrogates—lacking electrical transducers to see when a pump runs, a team might measure the pump’s motor temperature to establish this information. Be creative, be careful. Your methodology will both guide your investigation and structure your telling the story of this effort. A clearly presented methodology will convince the reader of your scientific integrity. Examine other case studies for ideas on formatting the methodology section. Some of the most successful case studies illustrate each step, so that the procedure can be easily replicated.

Obtain Equipment/Develop Surveys: Make sure that any equipment that you require for measurements is available, will do what you want, and can be scheduled for use when you want to use it. It is a good idea to conduct trial (pilot) measurements (in a different setting) that are similar to those you will undertake in your study building. Such trials can point out problems or confirm good planning. In a similar manner, any questionnaire or survey should be piloted (using another sample population) to make sure questions are not ambiguous, biased, or too time-consuming. Notes about equipment: some of the best case studies have not used any formal equipment, but simply ingenuity. Although the Vital Signs/Agents of Change equipment is fun and easy to use, try to think of provocative and unique ways to collect data. Surveys may need to go through a review by the Office of Human Subjects Compliance http://darkwing.uoregon.edu/~humansub/. This review can take a week, so plan accordingly prior to conducting any surveys.

Install Equipment/Conduct Surveys: Plan for the installation of equipment (or collection of questionnaire/survey data) so as to minimize wasted time and/or inapplicable data. Make sure that everything you will need to locate and install equipment is available (duct tape, string, ladders, protective housings, “Please Do Not Disturb Equipment” signs including your contact information, copies of plans and forms, etc.). Verify that your intended schedule for in-building activities is acceptable to the building occupants and or managers. Install equipment—constantly checking for correct locations (in sun, in shade) and logging settings (interval, overwrite data switch, units). Make an accurate and precise record of the placement of all equipment (so it can all be retrieved and for use in the impending analysis efforts).
Gather Data and Review: As soon as possible after the measurements have been completed, review the data that have been collected to ensure that they are complete and appear to be appropriate and not corrupted. If there are any problems with the data, this review process will allow some time for re-measurements or re-thinking of methods.

INTERIM SUBMISSION: PART 2 (see due date above)
• A draft of the section of your case study entitled Methodology. The draft should address the general scope of information discussed above. Submit this in html posted to a team members’ home site and also submitted as a hard-copy printout of the html page(s). On the hard copy submission, note any problems that were encountered with your methodology and/or the installation of equipment or completion of surveys—and a brief discussion of how these problems were resolved.

Part 3 Preliminary Results & Analysis (due 27 February 2007, in lecture) 5 points

If establishing a strong methodology is the key to a successful case study investigation, presenting the data in an understandable way is the key to a great case study “document.” There are probably at least 10 ways to present any set of data—2 of the 10 ways may confuse more than clarify; 6 of the 10 ways may be “OK”; and 2 of the 10 ways may be fantastic. Seek out the fantastic that pulls readers into the information and makes it clear that you have proved (or refuted, which is equally valid) the hypothesis you set out to investigate. Edward R. Tufte’s series of books on information presentation (Envisioning Information; The Visual Display of Quantitative Information; Visual Explanations: Images and Quantities, Evidence and Narrative) are recommended as sources of good presentation practices. Data that are presented should be linked as strongly as possible to the physical setting that produced the data; this can be done verbally, but can be done elegantly through appropriate graphics.

INTERIM SUBMISSION: PART 3 (see due date above)
• A draft (in html format) of the two sections of your case study entitled Data and Analysis (or similar). Again, submit this via posting to a team members’ home site and as a hard-copy printout of the html page(s). On a separate sheet of paper note any questions you may have regarding your data or its presentation (these questions are to be based upon the draft sections you have developed; for example you may wish feedback on two presentation alternatives or have questions about the underlying meaning of the data).

Part 4 Completed Case Study (submit to Kwok by noon, Saturday 17 March 2007)

The completed case study is to be posted to an accessible URL as an html (World Wide Web) document. A hard copy of the case study is also to be provided, but as a secondary format. The specific design and layout of your case study is left to your creative capabilities (although the style and navigation should adhere to good Web design practices—including no need for horizontal scrolling, small image-file sizes, readable text in all graphics, workable links, the use of colors to improve information transfer, and the use of information “layers” where appropriate). Case studies should generally subscribe to the following organization:
• Title. A thoughtful title that captures the essence of the case study and your audience.
• Abstract. (or Summary) A one- or two-paragraph statement that sums up the case study (pretty much: what, why, when, where, how, and who). This summary introduces the project, questions, hypothesis, and provides a synopsis of the important findings. This can be the home page for your case study.
• Introduction. (or Background) Describes what you did and why it was of interest—it opens the door to the case study and tries to pull the passersby in. Typically several paragraphs in length, the introduction includes background information about the building/space, the designer's intent, the myriad interesting topics to study, what sparked your team's curiosity, and how the team decided on the topic.
• **Hypothesis.** (or Hypotheses) Presents the hypothesis (or hypotheses) that was the basis of your investigation, describes the question(s) that led to development of the hypothesis, and explains why the hypothesis was framed as it was (technical background, design interest, occupant concerns, etc.). Include a series of inquiry questions that would help you substantiate or refute the hypothesis. These will logically serve as stepping stones leading to the methodology.

• **Inquiry Questions.** A list of questions that will help support or refute the hypothesis once the information is gathered. These may not be the original observation questions, but a more focused list of questions from which the various methodologies were framed.

• **Methodology.** Describes the step-by-step methodology employed, explains why it is appropriate to this case study, and provides details of how, what, when, where, and who. It should be so clear that the methodology is easily repeatable by another investigator.

• **Results.** (or Data) Presents the data that were collected (so the reader can make a judgment about your work based upon same information you used); the data should be organized and processed to some degree for clarity but should not be just a summary.

• **Analysis.** An explanation of what the information you collected means in the context of the building/space, hypothesis, and methodology. The results (data) are just facts; the analysis is your interpretation (or opinion) of what the facts mean.

• **Summary.** A fairly concise statement of what the case study found and what you have learned from the process. Was the hypothesis proved? Can you try to explain what you found if there are odd things showing up? Can you recommend further work in this area of building/system performance or design? Can you suggest improvements in your methods for future case study developers?

• **Design Lessons Learned:** What are the lessons to be learned from this study relative to building/system design?

• **References.** Provide a list of applicable references; generally include only citations to materials that were critical to your case study (not a long bibliography). Be sure to cite references at the point of use in the document (including all tables and figures from external sources).

• **Acknowledgements.** Provide thanks to those who deserve it (politically or actually).

• **Appendix.** Use an appendix (if desired) to present supplemental materials that will enhance your case study, but which are not appropriately located in the body of your document, such as extra graphs, survey forms, team information, etc.

**FINAL SUBMISSION REQUIREMENTS** (see due date and time above)

• A CD or disk (PC formatted) with ALL case study files, clearly labeled with student names, GTF name, and the URL of the online version of the case study; these disks will be archived and not returned. *All links should be checked and referenced to the pages themselves NOT back to your computer’s drives.*

• A hard-copy printout of the case study;

• Presentations of all case studies will be held during the scheduled final exam period for the course (1:00-3:00 PM, Monday 19 March 2007); presentation locations to be announced in lecture.

• Your case study will be presented (during the final exam period) from your team’s host WWW site—be sure the team has an accurate URL. If in danger of running out of server space, be sure to clear out old and unnecessary files and optimize all case study images so they are as small as possible while retaining good quality resolution;
GRADING CRITERIA

The criteria that will be used to evaluate this case study assignment are as follows:

**Interim Submissions**: on time, complete, amenable to constructive comments (5 points **each**, allocated to section)

**Case Study Content**: 60% of case study grade
- Introduction and Hypothesis: appropriateness, clarity, quality of story
- Methodology: appropriateness, completeness, technical validity, clarity, creativity
- Data: appropriateness, completeness, clarity, creativity
- Analysis: appropriateness, technical validity, completeness, clarity, creativity
- Conclusions: appropriateness, technical validity, creativity

**Case Study Web Pages**: 20% of case study grade
- Quality, creativity, navigation, flow

**Final Case Study Presentation**: 20% of case study grade
- Clarity, story telling, keeping to allotted time (~10 minutes per team)

**IMPORTANT NOTES:**
- Attendance at the case study presentations (to be conducted as noted above) is MANDATORY. Failure to fully participate in this 2-hour event will result in an automatic deduction of 50% of the available grade for the case study assignment—this will be a personal deduction, not a group deduction. Late submissions of interim reviews or the final case study will NOT be accepted due to the sequential nature and fast pace of this assignment. As this is a group project: cooperation, coordination, and respect for all group members are critical (as is true in the practice of architecture).
- Case studies will be made public and represent work from a professional program at the University of Oregon. Grammar and spelling mistakes, offensive remarks, or commercialism are inappropriate and will result in an automatic 5% reduction of the total case study grade. Use spellcheck, find an editor friend, read and double check your work. It will be presumed that all materials submitted (including interim submissions) have gone through at least two internal reviews (i.e., it is at least a third draft that is being put forward for comment/grading).
- Case studies are to be turned in on CD (or perhaps disk) and must have working links to all images and cross-linked pages. Do not use absolute file names (including a specific drive /directory name); use relative links (which assume that files are in the same location as the linking page). Case studies with “broken” links will receive an automatic 5% reduction of the total case study grade.
- The Baker Lab of the University of Oregon has made substantial equipment available for students to use in the course of this assignment. This includes various Hobo dataloggers, temperature/RH sensors, infrared temperature devices, CO₂ sensors, sling psychrometers, various anemometers, and LiCor solar radiation sensors—at a substantial investment. **Your team is responsible for any damage, missing parts, or unreasonable wear and tear to equipment and is expected to return all equipment fully operable and whole. Failure to return equipment at the time of final case study submission will result in the withholding of a grade in the course (for the team).**
- You (as a team) are ultimately responsible for the quality of your case study. There are, however, ample opportunities to obtain feedback during the development of your final product. Take advantage of these opportunities—interim submissions, in-section reviews, and peer review—to fine tune and improve your study and its presentation. Peer reviewers (classmates) can often be the harshest critics. This goes both ways, so be sure to deliver your comments on others’ work in a professional and constructive manner.