1

MAKING BUILDINGS

1.1 Environmental Impacts of Materials

In this exercise, you will compare life-cycle environmental impacts of three materials of your choice. You must choose materials for which Environmental Product Declarations (EPDs) are available. Most often these can be found on the web sites of the manufacturers of the materials. In other cases you may obtain this information from trade associations or other sources (for example, the Athena Sustainable Materials Institute listed in the Web Sites section at the end of Chapter 1 in the textbook).

Following are a few tips for reading EPDs:

1. Most EPDs are based on either *cradle-to-grave* or *cradle-to-gate* life cycle analyses. If you are having trouble finding this information, try a text search for "cradle" within the document.

2. *Functional unit* is the amount of material for which impacts are reported. For example, flooring materials may be reported in a functional unit of 100 square feet or 10 square meters. Other materials may be reported by weight, volume, or other relevant measure. In order to meaningfully compare different materials, the same functional unit should be used for each.

3. Environmental impacts are usually reported in the latter parts of the EPD. Sometimes they are reported both by individual life cycle stage as well as in summary form for all stages. You only need to refer to the summary data for this exercise.

4. Most EPDs use the same units for reporting environmental impacts, and the most commonly used units are provided on the next page of this exercise. For example, global warming potential is reported as kilograms carbon dioxide equivalent (kg CO_2 eq). As much as possible, list impacts in the same units for your three chosen materials, so that meaningful comparisons can be made.

1. Describe a building construction product type of interest, for example, flooring, insulation, roof shingles, finish coatings, exterior siding, windows, etc.: _____

2. Within this product type, choose three specific material or product options for which EPDs are available. For example, if you chose flooring, you could consider wood, vinyl, and ceramic tile. List your three choices:

_____ _____

_____

3. Complete the following information for your chosen materials.

	material 1	material 2	material 3
Manufacturer/ product:			
Functional unit:			
Impacts:			
Global warming (kg CO_2 eq):			
Ozone Depletion (kg CFC-11 eq):			
Acidification (kg SO_2 eq):			
Eutrophication (kg N eq):			
Smog (kg O_3 eq):			
Fossil primary energy (MJ):			
Fresh Water (liters, L):			

Name: _____

4. Compare the environmental qualities of these materials, considering for example:

   Does one of your chosen materials consistently outperform the others or are the results mixed?

   Do the differences between materials appear significant or relatively minor?

   What other qualities or attributes, not included in the EPDs, might you consider when choosing between these materials?

1.2 Building Code Restrictions

In this exercise you will become familiar with some of the ways in which building codes affect the design of buildings. To complete this exercise, you will need to refer to Figures 1.4, 1.5, and 1.7 of the textbook, as well as to the list of *occupancies* provided in the accompanying text. You may also find it helpful to review the example application of these building code requirements to the design of a hypothetical commercial building included in the same section.

The building code includes many detailed provisions for adjusting building height, area, and fire resistance requirements. For the purposes of this exercise, you can apply the following generalized modifications to the height and area information provided in Figure 1.4:

-For buildings two stories in height, the combined area of both floors may be double the allowable area for one floor listed in Figure 1.4.

-For buildings three or more stories in height, the combined area of all floors may be up to three times the area for one floor listed in the figure.

If the building is fully sprinklered, you may also apply the following adjustments. These adjustments may be applied in combination with those previously listed:

-For a single-story building, the allowable building area may be quadrupled and the allowable height increased by 20 feet.

-For a building of two or more stories, the allowable height may be increased by 1 story and 20 feet, and the allowable area may be tripled.

Building Code Restrictions

1. An old, unsprinklered warehouse of heavy timber construction with exterior walls of brick masonry is being considered for conversion to a drama theater. The building is two stories high, 80' by 70' in plan, and conforms to the definition of Type IV (HT) construction. Theaters are Occupancy A-1.
   a. Is this conversion within the height and area limits of the International Building Code (IBC)? _____
   b. If exterior bearing wall modifications are required, what fire resistance rating must be maintained? Ignore the influence of any adjacent buildings. _____

2. A client has asked you to design a clothing store of protected platform frame, Type VA, wood construction. The building will not be sprinklered.
   a. How tall can this building be? _____
   b. If built to its maximum permitted height, what is the maximum allowable area for all floors combined? _____
   c. What is the required fire resistance rating for components of the structural frame? _____

3. What is the maximum height for a reinforced concrete office tower of Type 1A construction? _____
   a. What is the required fire resistance rating for columns? _____
   b. What fire resistance is required for floor beams? _____
   c. Why do you think the answers in a. and b. differ?

_____

_____

_____

_____

_____

Name: _____

4. You have decided to use steel framing, Construction Type I or II, for a new five-story hotel, Occupancy Group R-1, with 41,500 square feet per floor. The building will be fully sprinklered.

   a. What is the least expensive (lowest fire-rated) Construction Type you are permitted to use? _____

   b. How tall, in feet and number of stories, may the building be? _____

   c. What level of fire protection will be required for each of the following elements of this building?
   Structural frame: _____
   Floor construction: _____
   Roof construction: _____

   d. There is a public way, with a 15-foot-wide fire separation distance, along one side of your building. The building owner would like to develop this way as a pedestrian shopping lane. Can an all-glass exterior wall, with a fire resistance rating of zero, be used along this edge of the building? (See Figure 1.5 in the text, IBC Table 602.) _____

5. How tall, in number of stories and in feet above grade, can you build an apartment building, Occupancy Group R-2, made of wood light frame construction with floor joists and roof rafters left exposed inside, Construction Type VB? The building will be fully sprinklered. _____

1.3 Observing Construction

Real buildings do not get built on paper! Seeing construction take place in the realm of soils, materials, labor, equipment, and weather is an essential part of learning about the making of buildings. The ability to knowledgeably observe work in progress is also an important skill for the design or construction professional. In this exercise, you will visit a construction site to observe work in progress, record your observations, and, where necessary, follow up later with analysis of what you have seen.

Your instructor will provide specifics related to the duration and scope of this assignment. It may be performed in the course of a single site visit or span a series of regular visits to a site over the course of the term.

Observations should be made in the form of notes, sketches, and photographs. In cases where follow-up research is needed, provide concise, clear explanations, and note your sources of information. You may use the form on the following pages as a template for recording your observations and follow-up notes. Make additional copies of these pages as needed.

During each visit, try to answer as many of the following questions as possible:

1. What **types of work** are underway during your visit—for example, excavation of soil, concrete pouring, steel erection, wood framing, etc.?
2. What are the **weather** conditions during your visit (temperature, precipitation, humidity, sky cover)? How might this be affecting the work?
3. What **materials** are being stored, delivered, or removed from the site (excavated soil being trucked offsite, delivery of steel concrete reinforcing bars, stockpiling of lumber, gypsum board, etc.)?

4. What are the building's primary **structural materials** (steel frame with cast-in-place concrete floors, light wood frame with OSB sheathing, etc.)?
   Follow-up: Is this combustible or noncombustible construction? Referring to Figures 1.4 and 1.5 in the text, what Construction Types might this building be?

5. If possible, describe the **exterior wall system**, listing components in order from exterior cladding to interior finish.
   Follow-up: For elements that cannot be determined from your observations, suggest possible materials and explain why you think they might be an appropriate choice for this project.

6. What kinds of **temporary supports, services, protection, lifting machinery, and other materials and processes related to construction activity** can you see (excavation shoring, erosion control, dewatering, temporary bracing, scaffolding, formwork, tree protection, wind protection, temporary heating, power, worker fall protection, temporary guard rails, etc.)?
   Follow-up: Explain their purpose.

7. What aspects of the **site's physical organization** reflect the need to facilitate the movement of construction materials, labor, and machinery around the site?

8. If you have the opportunity to **talk with a site supervisor**, ask about the organization and challenges of the construction process. How long is the construction planned to take? What activities are most affecting the schedule? What aspects of the construction are most technically challenging or unusual?

9. What do you see that you do not understand? Describe, sketch, or photograph these items.
   Follow-up: Using the textbook as a reference or by comparing notes with your classmates, try to explain what you saw.

SITE VISIT REPORT

Project: Date & Time:

Weather: Temp. Range:

Observations & Notes:

Name: _____

1.4 Providing Construction Services

Fill in the blanks in each of the following:

1. Overlapping design and construction phases of a project is an example of _____, used to shorten the overall project schedule.

2. A _____ limits an owner's financial risks by capping contractor fees in a cost plus a fee contract.

3. In _____ construction , construction work does not begin until all design work is complete.

4. _____ owner/contractor agreements are well suited to projects where the full scope of construction work is not yet determined at the time of agreement.

5. Profit sharing is one example of an _____ _____, used to bring the interests of the contractor and owner into closer alignment.

6. In _____ project delivery, an owner does the following, in sequence: contracts with a design team, completes design of the facility, bids the construction work, hires a contractor, and completes construction.

7. When the scope of work is well defined, an owner may use a _____ construction agreement so as to begin construction within an established total cost.

8. In _____ project delivery, design and construction are performed by one contractual entity, and the traditional boundaries between design and construction are less distinct.

Name: _____

9. Explain briefly the distinctions between design/bid/build, design/build, and single-purpose entity project delivery methods.