Introduction

First developed by the Romans millennia ago, to create unprecedented monumental public spaces and artificial ports—moldable, pourable, waterproof, durable and quick-setting—concrete is the most common building material in use today. This module explores the ancient Roman use of concrete and uses lessons learned to suggest how we can use new smart building materials in purposeful ways to address social needs. The use of a material for a particular application is shaped by what a culture needs and values; recognizing these influences is vital to using new materials in ways that combat materials degradation.

Module Objectives

Students will:

- identify the properties of concrete
- identify examples of smart building materials
- discover the uses and applications of concrete both historically and in modern times
- examine how cultural values shape the use of materials in a society
- discover the sustainability concerns with concrete as a building material

Readings, Lecture, and Practice

Watch: Buidling Materials (16:42) AND Smart Building Materials (4:38)

Read: *Engineering Society through Social Spaces* by Mary Ann Eaverly

To prepare for your quizzes and exams, take notes and think about how the lecture content relates to your readings as you watch the lecture.

Practice: Take the Building Materials Quiz

The practice quiz has 10 questions. You will have 90 seconds to complete each question. You may only take the practice quiz one time and you must finish it once you open it so be sure you have adequately prepared by taking notes while you watched the lecture and by reading the chapter and studying before you begin.

Assignment: Application Video Analysis

Key Concept: The ability to integrate shape memory alloys and piezoelectric sensors into concrete offers the possibility of creating smart building materials. These building materials not only enable the ability to detect when cracks form, but also the possibility of a building self-healing itself after suffering damage. These new materials offer intriguing new opportunities for concrete, a very ancient material. But how will cultural values in our society shape how we use these exciting new materials? Will we continue to build coliseums like the Romans?

Assignment Instructions:

Before the video reflect on the lessons of this unit by considering the questions below. As you watch the video, think about how each question is answered.

- What makes a material a 'smart' material?
- What properties of smart materials are useful in their non-construction applications?
- What properties of smart materials are useful in their construction applications?
- What are the benefits and limitations of using smart materials in building construction or repair?
- How might smart materials assist humans during natural disasters?
- Where should smart materials be employed in buildings to be most useful?
- Is cost an obstacle to more widespread usage of smart materials?

Watch: Building Materials (15:01)

Write a 1-page essay synthesizing the answers to the questions above with what you've learned in the lectures and readings. (full sentences in paragraphs, double-space, 11-12 pt. font). This assignment will be graded out of 10 points on effort, use of the lecture, video, reading materials, and thoughtful reflection. See the rubric attached to this assignment for grading criteria. Be sure your name is on the paper. A cover page is not necessary.

Refer to the DUE DATES document for submission dates and the rubric below for grading criteria.

Application Video Analysis Rubric

Criterion	9-10 points	6-8 points	3-5 points	0-2 points
Response Content (10 Points)	Responses are appropriate, thoughtful, and indicate engagement with the video.	Responses have minor inconsistencies with the video or are not supported by content.	Responses have major inconsistencies with the video or are not supported by content.	Responses are inaccurate, careless, and/or opinions are not supported by content.
Mechanics (10 Points)	Grammar, sentence structure and punctuation are correct and paper is properly cited.	Minor issues with grammar, punctuation and/or sentence structure and citations.	Significant issues with grammar, punctuation and/or sentence structure and citations.	Major issues with grammar, punctuation and/or sentences and citations
Total				

Assignment: Material Entanglement and Impact Paradigm Reflection

Think about your own and society's relationship with this module's material both in the past and present.

Part 1 Instructions:

- **Open** to your Material Entanglement Reflection Document created in Module 2.
- **Label** this new entry with this module's material and the date at the top of the page. *(Example: 1/23/16 Module 15: Diamonds)*
- **Create** a tanglegram that illustrates your relationship with the material from this module. (*If this module covered more than one material, then choose just one of these materials to explore your entanglement.)
    - Refer to the example tanglegram in the Module 2 reading, *Entanglement of Earth.* Make sure that this tanglegram demonstrates the new information about the relationship of materials to society that you learned in this lesson (e.g., our dependence on trade to acquire materials)
    - *Note that you may hand draw your tanglegram and take a picture to add to your document or use any other type of application that suits you. There are many free concept mapping applications found online. Just search mind-mapping applications.*
- **Add your tanglegram** under your new entry.
- **Source an image** that illustrates an aspect of your entanglement (or supports your lack of entanglement) with the material from this module. The image can be found, created, or photographed. If the image isn't yours, be sure to include a reference.
- **Add your sourced image** under your tanglegram.
- **Caption** the image telling what it is and its context.
- **Discuss** your thoughts related to your personal relationship with this material and how that relates to society.

    Consider:
    - How do the social and cultural properties of this material affect you and society?
    - Based on what you've learned about this material what might be the consequences of the corrosion, degradation, or scarcity of this material?

Note: Your entry should be no more than two paragraphs. Entries are evaluated for content, thoughtfully supported writing, and mechanics. Refer to the ***Physical and Social Properties of Matter*** *document introduced in Module 1 to guide your discussions.*

Part 2 Instructions:

- **Open** your Impact Paradigm Document
- Add at least one question to any one of the categories. If you're having trouble coming up with a new question, think about the particular case studies of the material in this module, and the new information that you've learned about the relationships between materials and society. What is one new way to think about the social life of materials that you learned in this module?

- Submit BOTH your Material Entanglement Reflection Document AND your Impact Paradigm Document

Refer to the DUE DATES document for submission dates and the rubric below for grading criteria.

Material Entanglement and Impact Paradigm Reflection Grading Rubric

Criterion	9-10 points	6-8 points	3-5 points	0-2 points
Response Content (10 Points)	Responses are appropriate, comprehensive, and indicate thoughtful engagement with the information and concepts from the lecture, readings, and videos. Novel ideas, creativity, and attention to complexity are a plus. Tanglegram is fully supported by responses and image.	Good effort. Responses and arguments are not as clearly presented, or as comprehensive and thoughtful as in a full credit answer. Tanglegram is fully supported by responses and images.	Responses are less appropriate to the assignment, less thoughtful and engaged, with less complete information. Tanglegram is partially incomplete or unrelated to images and responses.	Responses are inaccurate, careless, and/or opinions not supported by content. Tanglegram is incomplete.
Mechanics (10 Points)	Grammar, sentence structure and punctuation are correct. Works are cited properly when appropriate.	Occasional grammar or mechanics issue or works are cited incorrectly.	Some issues with grammar, punctuation and or sentence structure or chosen image or other works are not cited when appropriate.	Major issues with grammar, punctuation and or sentences. Chosen image or other works are not cited when appropriate.

Additional Resources

- Designs of future cities in one building: http://io9.gizmodo.com/these-futuristic-cities-are-housed-inside-a-single-gig-472987873