

The Impact of Materials on Society

Modules 6 – Concrete - Outline of Instruction for Faculty

This week focuses on the most popular building material in the world today. Concrete was first developed and exploited by the ancient Romans who used it to create monumental public spaces such as the Colosseum. This module explores the rich history of concrete and its legacy in the modern world, focusing upon the role of concrete in ancient Roman society, today's technical advances in concrete construction, and concrete's environmental drawbacks. The module examines how concrete construction is shaped by societal ideals today, just as it was by societal ideas about status and imperial power in ancient Rome.

Module Objectives:

Students will:

- identify the properties of concrete
- discover the Roman origins of concrete
- analyze the societal forces that determined how the Romans used concrete
- uncover modern societal ideals that shape today's use of concrete
- identify examples of smart building materials
- analyze the benefits and drawbacks of concrete construction in the modern world
- examine how cultural values shape the use of materials in a society
- discover the sustainability concerns with concrete as a building material

Student Reading Assignment before Day 1

Read excerpt (pp. 124-133) from

Sass, Stephen L. (1998/2011) *The Substance of Civilization*. New York: Arcade Publishing.

Day 1 Class – Material Science & Engineering Lecture on Concrete

Material Science Professor presents background on building materials and concrete.

Materials Science Lessons

Concrete is a classic building material. It is a form of a composite. This lecture discusses the formation of the ingredients that are used in concrete specifically the formation of cement and then reviews composite types and finally the environmental impact of concrete.

Day 1 Lecture Development Resources:

1. **Lecture:** [Building Materials](#) (PPT)
2. **Sample Lecture Video:** [Building Materials Lecture](#) (16:42) ([Transcript](#))
Excerpt from Kevin Jones' Lecture
3. **Demo Video:** [Heating Limestone Demonstration](#) (1:09)

Classroom Demo: make a small bar of pure cement and one of concrete. Bring them to class and hit each with a hammer.

Student Reading Assignment before Day 2

Read: [Engineering Society through Social Spaces – Concrete Construction](#) by Prof. Mary Ann Eaverly

Abstract: The most popular building material in the world today, concrete was first developed and exploited by the ancient Romans who used it to create monumental public spaces such as the Colosseum. The design of Roman concrete structures reinforced Roman ideas about social status and imperial power. This chapter explores the rich history of concrete and its legacy in the modern world, touching upon the role of concrete in ancient Rome, today's technical advances in concrete construction, and concrete's environmental drawbacks. The chapter also examines how concrete construction is shaped by societal ideals today, just as it was by societal ideals in ancient Rome.

Day 2 Class – Lecture on of Roman use of Concrete

Guest Classics/ Art History professor presents Roman Concrete: Engineering Society through Social Spaces.

Social Lessons:

- 1) The impact of materials varies depending upon their **socio-cultural context**.
- 2) **A society's ideals determine its use of a material.** The design of Roman concrete structures
 - a. reinforced Roman ideas about social status and imperial power. Societal forces also
 - b. determine modern concrete uses.

Day 2 Lecture Development Resources:

1. **Lecture:** [Engineering Society through Social Spaces](#) (PPT) slides by Prof. Mary Ann Eaverly (UF)

Main points of Lecture:

1. **Roman concrete revolution.** The next section focuses on the Roman development and exploitation of concrete for construction. Contrast the stone post-and-lintel system used in Greek architecture (Parthenon) with the concrete arch and vault used in Roman architecture (Pantheon). One structure is supported by stone columns the other by concrete arches and vaults. You can use diagrams of vaulting and post- and lintel for this comparison. The “revolution” was that the new concrete construction, free of the need for internal supports allowed the creation of massive interior space.
2. **Composition of Roman concrete.** Volcanic pozzulana made concrete possible. Illustrate with image of pozzulana and map of volcanic region in Italy. Roman concrete was rough and was

laid not poured. Romans faced it with brick or stone. You can find illustrations of this under *opus caementicum* (the Roman name for concrete) and images of facing from Pompeii.

3. Social forces that influenced Roman concrete development

Roman society was highly stratified. Illustrate with chart showing social classes (usually a pyramidal structure). Main social classes are Patricians (upper-class) Plebeians (majority), slaves and freed persons (former slaves). Latter two classes are the bottom. Display of status was very important to patricians.

4. Examples of societal ideals that drove Roman concrete construction

- 1) Aqueducts—bring water, but although could have brought running water to every household instead used for display (fountains in private houses) Illustrate with House of Octavius Quarto Pompeii.
- 2) Water also supplied baths. Illustrate with imperial bath complexes.
- 3) Colosseum- amphitheater. Compare with ancient Greek theater (Pergamon) which needed a hillside to provide stadium seating. The colosseum and other amphitheaters in Roman world were used for gladiatorial games which reinforced social ideals (seating was by class) and Roman ideas of world domination—animals from all over the world brought to Rome.

5. Prompt to think about what societal needs drive modern concrete construction

Show a modern stadium, especially if you have one on your campus. Why is this important to our society? You can also show soldier field in Chicago. It is a modern concrete structure which is decorated with Greco-Roman columns.

Student Homework Assignment before Day 3

Take or find 2 photos of the same modern concrete social space (any space which has been designed for public use and constructed from concrete, such as a theatre, stadium or sports venue, museum, airport, or shopping mall) and preferably one that you have seen both inside and outside. One photo will be turned in with your paper the other will be used for the in-class activity on Day 3.

Complete the following analysis of the elements of this space (include a copy of your photo in your assignment):

- a. How do people inhabit and use this space?
- b. How and where does the space use concrete?
- c. What is the role of the space in modern American society? (its social function, and what it symbolizes in American culture)
- d. How does concrete afford this space's social function?

Please answer these questions in either bullet points or full sentences. Your responses will probably take ½ to 1 page. Assignment will be graded on effort, use of the lecture, video, and reading materials, and thoughtful reflection. A cover page is not necessary. Be sure your name is on the assignment.

Due at beginning of Day 3

Grading Rubric.

2= Responses are appropriate, thoughtful, and indicate engagement with the video and any other required viewing/reading materials. Grammar, sentence structure and punctuation are correct.

1= Responses and arguments are incomplete and/or inconsistent with the required viewing/reading material. Some issues with grammar, punctuation and or sentence structure.

0= Responses are not appropriate to the assignment or missing entirely. Major issues with grammar, punctuation and or sentence structure.

Points = 2

Student Video and Homework Assignment before Day 3.

View the video [Building Materials](#) (15:01) ([Transcript](#))

Consider answers to the following questions for class discussion:

As you watch the video, think about the following questions (**don't have to turn these in**):

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

Day 2 Individual Assignment:

Assignment: [Module 6—Individual Homework Assignment](#) (Word)

Building Materials Homework Assignment due start of class Day 3

Day 3 Class - Flipped Classroom Activity with Smartcrete, Concrete and Public Spaces

Key Concepts: Concrete is a versatile material made even more useful by Smartcrete technology. Yet society's use material based on their ideals. How do the types of buildings made from concrete reflect our society's ideals? (This will come out in the group homework presentation and the

instructor should circulate among the groups to prompt this discussion). The Smartcrete exercise builds on this to ask if new materials can operate in new ways within or outside of societal limitations.

Day 3 Classroom Activity: Smart Materials, Concrete and Public Spaces

Break into groups. Present the space you chose for the Homework assignment to the group. (15 minutes) The group will then choose a space on which to focus.

You've seen smartcrete. Create a group report describing in one to two paragraphs how you could manipulate your structure by building it from this material so that it supports or alters its current social function. (20 minutes) Each group then presents to the class as a whole (or alternatively the instructor writes the ideas on the board and then the class as a whole picks one and adds to it) (15 minutes total)

Material Science Professor sets up the classroom activity

Day 3 Lecture: [Smart Building Materials](#) (PPT)

Video: [Smart Building Materials](#) (4:38) ([Transcript](#))

Excerpt from Kevin Jones' Lecture

Classroom Demo: Smart Memory Alloy demonstration

Demo Video: [Nitinol, Shape Memory Alloy Demonstration](#) (1:41)

Complete Assignment:

- Refer to [Day 3 In-Class Activity: Smart Materials](#) (WORD) worksheet for specific instructions.
- Refer to the rubric for grading criteria.

Your grade will be determined from the following criteria.

Grading Rubric.

5= Responses are appropriate and indicate engagement with the preparatory material. Grammar, sentence structure and punctuation are correct.

4= Responses and arguments are not as clearly presented. Some minor issues with grammar, punctuation and or sentence structure.

3= Responses are not appropriate to the assignment and do not reinforce the physical and cultural properties of materials. Mistakes in grammar, punctuation and or sentence structure.

2= Responses are incomplete. Major problems with grammar, punctuation and or sentence structure.

1= Responses are inconsistent with material covered in class, videos, and readings. Missing elements of assignment. Poor grammar, punctuation and or sentence structure.

Day 3 Lecture Development Resources:

1. **Lecture:** [Smart Building Materials](#) PPT slides
2. **Video:** [Smart Building Materials](#) (4:38) ([Transcript](#))

3. **Demo Video:** [Nitinol, Shape Memory Alloy Demonstration](#) (1:41)
4. **In-Class Activity:** [Smart Materials handout](#)

Complete Impact Paradigm Assignment:

Thinking about the material that we covered in this week's unit, add another question to the impact paradigm.

- **Assignment:** [Module 6 —Impact Paradigm Individual Homework Assignment](#) (Word)

Additional Resources

Online Course Module

- a. View the online Module 6 in [Word](#) or [PDF](#) format
- b. Available soon: The full online course to upload to your Learning Management System. Contact Kevin Jones at kjones@eng.ufl.edu or Pamela Hupp at hupp@mrs.org for more information.

Videos:

- a. [Building Materials](#) (15:01) video
- b. Gangbing Song. [IMOS Materials for Construction – Smart Materials](#) (12:36) video
- c. National Science Foundation and NBC Learn. ["Nanotechnology: Super Small Science - Breaking the Rules" \(Links to an external site.\)](#) (6:06)
- d. Gladiators: Sports and Entertainment in the Roman World, The Institute for Mediterranean Studies Lecture Series, Vol. IV. (VHS video only)
Seek permission to use at <https://chengfind.wpunj.edu/Record/292962>

Articles:

- a. Miklós, Vincze. ["These futuristic cities are housed inside a single, gigantic building." \(Links to an external site.\)](#) *io9*, Web. 15 April 2013.