

A6786: Concrete, Cast Stone & Mortar, Fall semester 2016

655 Schermerhorn Extension, Thursdays, 3:00-6:00

Norman R. Weiss and John J. Walsh

This course discusses the growing importance of concrete, cast stone and mortar--and the associated construction techniques--during the Industrial Revolution, reviewing discoveries that led to the development of novel lime- and cement-based compositions from the late 18th century to the present. By the 20th century, advances in technology transformed concrete and precast from functional engineering media into the most expressive and sculptural substances of modernism. The visual simplicity of these materials belies the complexity of their curing and aging mechanisms. Materials science is the fundamental tool used to examine history, and to define suitable repair, replication and maintenance methods for masonry and concrete structures. Key topics are binder types and curing mechanisms; the role of aggregates and admixtures; performance criteria; construction/manufacturing methods; and field and laboratory evaluation. The format of this course is a lively combination of lectures (including guest speakers), hands-on exercises and field trips.

Schedule

Date	Topic	Description
Sept. 8	Introduction	Basic characteristics and concepts; hands-on introduction to plastic cementitious mixtures.
Sept. 16	Binders	Raw materials for limes, cements, gypsum binders, and pozzolans; geographic controls, methods of production; key performance characteristics and applications.
Sept. 22	Aggregates and admixtures	Sand, gravel, and crushed stone; mineralogy; particle size distribution and shape; effects on material properties; pigments; property-modifying admixtures such as air-entrainers, set-controllers, water-reducers, etc.
Sept. 23 (Friday)	Masonry mortar field trip, 10:00-1:00	Visit to International Masonry Institute: hands-on exercise: cutting out defective joints (hand and power tools); mortar mixing; pointing of joints in brickwork.
Sept. 29	Masonry mortar and stucco 1st paper benchmark: submit topic for discussion and approval.	Mortar history; strength, set time and durability; fundamental performance criteria (waterproofing, compatibility, appearance); proportioning mixes; installation and finishing.
Oct. 6	Cast stone	Guest lecturer, Richard Pieper: historical evolution of technology; major manufacturers; specialty aggregates; surface washing/sand blasting/tooling; replication.
Oct. 13	No class (travel week for Advanced Studio)	
Oct. 19 (Wednesday)	Cast stone field trip	Essex Works visit: field measurements; pattern and mold making; custom colored mixes; casting and finishing techniques.

Schedule (cont'd)

Date	Topic	Description
Oct. 20	Concrete	Concrete and historic preservation; UK and France (Godwin; Wilkinson; Monnier; Coignet); Hennebique system and Ransome; American pioneers (Fowler; Gillmore; Ward and Hyatt; Edison and Earley; Akeley).
Oct. 27	Concrete 2nd paper benchmark: one page summary progress report and short bibliography.	Cement chemistry; water/cement ratio; scientific mix design; structural theory; reinforcement and formwork; transit mix; quality control; 1980's innovations.
Nov. 3	No class (travel day for APT conference)	
Nov. 10	Performance and deterioration	Distress and decay mechanisms; distinguishing workmanship, design, and environmental issues; surface defects, carbonation, freeze-thaw distress, sulfate attack, aggregate reactions, etc.
Nov. 17	Deterioration (cont'd.) Corrosion and corrosion protection	Guest lecturer, Gina Crevello, Echem Consultants: mechanisms of corrosion of reinforcing steel; sacrificial anodes; impressed current cathodic protection; corrosion inhibitors and primers.
Nov. 24	No class (Thanksgiving holiday)	
Dec. 1	Non-destructive evaluation	Guest lecturer, Chas Bransby-Zachary, Echem Consultants: instrumentation for NDE/NDT (ground-penetrating radar, ultrasound, cover meter, Schmidt hammer); interpretation of data.
Dec. 8	Engineering and repair solutions	Guest lecturer, Nancy Hudson, Silman: Probes and sampling; laboratory testing (carbonation depth, strength, microscopy, chloride analysis); structural assessment; anchoring, epoxy injection and carbon fiber strengthening; custom patching mixes and proprietary products.
Dec. 15	Deadline for final paper submission: due by email at 12 noon sharp.	

Readings

Relevant readings will be posted to CourseWorks/Canvas for every session, and these will supplement the material covered in class. Some of the documents will be identified as "Essential Reading" and you are expected to have read these before the next class session. In some cases, the next class will assume knowledge derived from the readings. We will reserve a few minutes at the start of each class to give you an opportunity to ask questions or to render opinions on the readings. Class participation is expected from everyone. Material in the readings is also fair game for quizzes.

Grading

Component	Percentage of grade
Class participation	20%
Quizzes (2 or 3)	20%
Final paper	60%

Class Participation

All students are expected to take an active role in the class. Do not apologize for your questions, even if they seem tangential... answering them is the real reason we're teaching this course! Please be engaged in class exercises and field trips. Interrupt lectures for clarification or feel free to challenge us with thoughtful arguments. We cannot evaluate your scholarship and growth without hearing how you think. This is the easiest part of your grade, so please use it to your advantage.

Quizzes

Two or three 15-20 minute quizzes will be given during the semester. These may include material from the lectures, field trips, or readings. You will be given fair warning a week in advance. The purpose of the quizzes is to ensure that everyone is following along with the more basic concepts. These will not be overly challenging and preparing for these should not interfere with the more critical final paper.

Final Paper

60% of the final grade will be determined from a research paper due on December 15th. We will provide a list of possible topics that should help guide your choice. You should come up with a concept that relates to the scope of the course. You are encouraged to choose something that may help broaden your knowledge in the “vicinity” of your thesis topic, as long as the paper is not simply a short summary of your main thesis points.

We will enforce several firm deadlines with respect to your papers to ensure that you are continuously working to this end during the semester. These are listed in the following table. The expectations for these benchmarks will be elaborated upon in class.

Date	Benchmark
Sept. 29 th : beginning of class	Submit topic for discussion and approval.
Oct. 27 th : beginning of class	Submit one page summary progress report and short bibliography.
Dec. 15 th : 12 noon	Deadline for final paper submission.