Concrete, Cast Stone & Mortar (CCM) **Fall 2014**
Joan Berkowitz, Norman R. Weiss and John Walsh
A6786 **2:30-5:00, 655 Schermerhorn Extension**

***Introduction**

Why concrete? What is it?; basics of binders/setting mechanisms; lime chemistry (calcite vs. dolomite); powders vs. putty; lime-pozzolans; hydraulic limes and natural cements; manufacturing of portland cement; ASTM standards; historic references

Key readings: *Canadian Building Digest 145
*Ashurst & Ashurst on lime (from PBC, Vol. 3)

***Aggregates & admixtures**

Sand and crushed stone; mineralogy; particle size distribution (C144) and shape; gravel; historic sources; pigments; water reducers; retarders and accelerators; bonding agents

Key readings: *PCA sand gradation & mortars
*NRMCA supplementary cementitious materials
*ACI chemical admixtures

***Concrete history**

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)

Key readings: *History of calcareous cements
*Meridian Hill Park
*Preservation Brief 15 (Historic Concrete)

***Concrete construction 101**

Cement chemistry; water/cement ratio; scientific mix design; structural theory; reinforcement and formwork; transit mix; quality control; the 1980's and innovations

Key readings: *Cement chemistry
More….

***Concrete deterioration**

Carbonation, corrosion and construction flaws, shrinkage cracking; freeze/thaw; alkali-silica reaction (ASR); surface erosion; lime "run" and stalactites

Key readings: *Powter on 19th century fortifications
*ASR in concrete

***Analytical studies: concrete/mortar petrography**

Hands-on introduction to the polarized light microscope; examination of pastes and aggregates in thin section; characterization of mortar and concrete samples

Key readings: *Petrography PDH
*Krotzer and Walsh on mortars and stuccos

***Concrete testing & repair w/ Nancy Hudson**

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

Key readings: *Frens on Mercer Museum
*ACI Repair Application Procedures
*Trienens et al on Guggenheim Museum

***Corrosion and corrosion protection w/ Gina Crevello**

Mechanisms of corrosion of reinforcing steel; sacrificial anodes; impressed current cathodic protection; corrosion inhibitors and primers

Key readings: *Drewitt CPA Tech 2
*July 2001 Concrete Technology Today
*Johnson and Lee on Soldier Field
*NACE Corrosion and bridges

***Cast stone w/ R. Pieper**

Historical evolution of technology; major manufacturers; specialty aggregates; surface washing/sand blasting/tooling; replication

Key readings: *Kearney in Future Anterior
*Tyler on the Nashville Parthenon
*Preservation Brief 42 (Cast Stone)

***Cast stone field trip: Essex Works**

Field measurements; pattern and mold making; custom colored mixes; casting/finishing techniques

***Mortars for pointing**

Mortar history; performance criteria (waterproofing, compatibility, appearance); proportioning (C270/C1713); installation and finishing

Key readings: *Teutonico et al on the Smeaton Project
*ASTM C270 and C1713

***Mortars field trip: International Masonry Institute**

Hands-on exercise: cutting out defective joints (hand and power tools); mortar mixing; pointing of joints in brickwork

Key reading: *Preservation Brief 2 (Repointing Mortar Joints)

***NDE field trip w/ Chas Bransby-Zachary**

Instrumentation for NDE/NDT (ground-penetrating radar, ultrasound, cover meter, Schmidt hammer); interpretation of data

Key readings: *Feldmann on non-destructive testing
*March 2003 Concrete Technology Today