BIG & TALL

Construction History from the Pyramids to the Burj

Spring, 2016
ARCH 528B sections 1a & 1b
Thomas Leslie, AIA, Instructor
TR 1540-1700 3cr

SYLLABUS (Preliminary, correct as of 9 February 2016)

WEEK	DATE	TOPIC & READINGS (Those marked "**" are particularly recommended).
1	12 Jan	1. Introduction: On Making and Form. *Causation, Design, and Experience;* On Growth and Form *as model for thinking about* Why *and* How *things are made; the importance of agency in design and experience; an alternative history of "building" as a verb, not a noun.* Stephen Jay Gould, "The Exaptive Excellence of Spandrels as a Term and Prototype." *Proceedings of the National Academy of Sciences of the United States of America*, 94:20, Sep. 30, 1997. 10750-10755. Max Hocutt, "Aristotle's Four Becauses," *Philosophy*, 49:190, Oct., 1974). 385-399. Robert Mark, "Architecture and Evolution," *American Scientist,* 84:4. July-August, 1996. 383-389. **D'Arcy Thompson, *On Growth and Form* (rep. New York: Dover, 1992). Chapter 1, "Introductory," 1-21.
	14 Jan	2. The Ancient World I—Timber and Stone. *Wood as ideal material for manual fabrication: felling, cutting, joining techniques across building cultures. Deforestation and problems with strength and fire. Stone as immediate alternative: natural resources in Egypt, Greece, Latium, etc. Techniques for quarrying, fabricating, and placement, implications for design and construction. Formalization of techniques in embryonic building science—Archimedes, Vitruvius, and codification of principles according to geometric systems.* Jean-Pierre Adam, *Roman Building: Materials and Techniques.* (Bloomington: Indiana University Press, 1994). 20-57, "Materials: Stone;" 87-101, "Materials: Wood;" 102-118, "Construction Using Large Stone Blocks;" and 196-215, "Carpentry." Addis, *Building*, 3-27. Alison Burford, "The Builders of the Parthenon." *Greece & Rome*, Second Series, 10, Supplement: "Parthenos and Parthenon," 1963. 23-35. Somers Clarke and R. Engelbach, *Ancient Egyptian Construction and Architecture.* (reprint, New York: Dover, 1990). Carmelo Malacrino, *Constructing the Ancient World.* (English Edition, Los Angeles: Getty, 2010). 7-40, 77-110.

		Henry Petroski, "Engineering: Pyramids as Inclined Planes." *American Scientist*, 92: 3, May-June, 2004. 218-222. K. D. White, *Greek and Roman Technology*. (London: Thames and Hudson, 1984). Chapter 7, "Building," 73-83.
2	19 Jan	3. The Ancient World II—Brick and Concrete. *Latium as a rich source of building material. Ancient brickmaking techniques, Roman mastery of masonry construction. Lime and pozzolanic concrete, use of hybrid construction techniques and advantages of monolithic behavior. Imperial construction: formwork and scaffolding to create rudimentary vaults of concrete and brick. Colosseum and Pantheon as case studies showing achievements and limitations of Roman technique and materials.* Jean-Pierre Adam, *Roman Building: Materials and Techniques.* (Bloomington: Indiana University Press, 1994). 58-86, "Materials: Clay" and "Materials: Lime and Mortar;" 125-157, "Masonry Construction;" and 158-195, "Arches and Vaults." Addis, *Building,* 27-60. Lynne Lancaster, *Concrete Vaulted Construction in Imperial Rome: Innovations in Context.* (Cambridge: Cambridge University Press, 2005). Carmelo Malacrino, *Constructing the Ancient World.* (English Edition, Los Angeles: Getty, 2010). 41-76, 112-138. Robert Mark, "Reinterpreting Roman Structure," *American Scientist*, 75:2, Mar-Apr, 1987. 142-150. Robert Mark and Paul Hutchinson, "On the Structure of the Roman Pantheon," *The Art Bulletin*, 68:1, Mar, 1986. 24-34. Rabun Taylor, *Roman Builders: A Study in Architectural Process,* 92-212. K. D. White, *Greek and Roman Technology*. (London: Thames and Hudson, 1984). 83-90.
	21 Jan	TL out of town—no class
3	26 Jan	4. Vaults and Domes—The Middle Ages I. *The Basilica type in late Imperial construction. Roman Baths and the introduction of the groin vault. Basilica of Maxentius as final building act of empire, parallel introduction of Christian basilicae throughout Europe as outcome of liturgical and technical influences. Parallel traditions from the East following traditions of centrally-planned spaces, coming together of basilica and dome in Aya Sophia.* Henry J. Cowan, "Domes: Ancient And Modern," *Journal of the Royal Society of Arts*, 131: 5320 March, 1983. 181-198. Jacques Heyman, *The Stone Skeleton: Structural Engineering of Masonry Architecture*. (Cambridge: Cambridge University Press, 1997). Chapter 1, "Introduction," 1-11; Chapter 2, "Structural Theory of Masonry," 12-26; and Chapter 3, "Domes," 27-47.

		Lynne Lancaster, *Concrete Vaulted Construction in Imperial Rome: Innovations in Context.* (Cambridge: Cambridge University Press, 2005). Rowland J. Mainstone, "Justinian's Church of St Sophia, Istanbul: Recent Studies of Its Construction and First Partial Reconstruction," *Architectural History,* 12, 1969. 39-49, 102-107. Robert Mark, *Light, Wind, and Structure*. (Cambridge: MIT Press, 1990). 74-89. **Robert Mark and E. C. Robison, "Vaults and Domes" in Robert Mark, ed., *Architectural Technology up to the Scientific Revolution*, (Cambridge: MIT Press, 1993). 138-181.
	28 Jan	5. Height and Light—The Middle Ages II. *Western evolution of the basilica type and importance of light. Ecclesiastical development reflected in planning. Implications of groin vaults for skeletization of walls below. Evolution of plan and section in 12th & 13th century France, Italy, and England. Structural instinct and modern analysis of vaulting, buttressing, and equilibrium. Notre Dame, Amiens, and Chartres as paradigmatic cases. Further evolution of fan vaulting in England and blurring of structural and ornamental. Disaster of Beauvais and its implications.* Addis, 86-112. K. D. Alexander, R. Mark and J. F. Abel, "The Structural Behavior of Medieval Ribbed Vaulting," *Journal of the Society of Architectural Historians*, 36:4, Dec., 1977. 241-251. Alan Borg and Robert Mark, "Chartres Cathedral: A Reinterpretation of Its Structure," *The Art Bulletin*, Vol. 55:3, Sep., 1973. 367-372. Jacques Heyman "The Gothic Structure," *Interdisciplinary Science Reviews*, 2:2, 1977. 151-164. **Jacques Heyman, *The Stone Skeleton: Structural Engineering of Masonry Architecture*. (Cambridge: Cambridge University Press, 1997). Chapter 4, "The Masonry Vault," 48-82 and Chapter 5, "Some Structural Elements," 83-108. Richard Krautheimer, "The Constantinian Basilica," *Dumbarton Oaks Papers,* 2, 1967. 115-140. Robert Mark, *Light, Wind, and Structure*. (Cambridge: MIT Press, 1990). Chapter 4, "Structural Experimentation in High Gothic Architecture," 91-135. William Taylor and Robert Mark, "The Technology of Transition: Sexpartite to Quadripartite Vaulting in High Gothic Architecture," *The Art Bulletin*, 64:4, Dec., 1982. 579-587. David Turnbull, "The Ad Hoc Collective Work of Building Gothic Cathedrals with Templates, String, and Geometry." *Science, Technology, & Human Values,* 18:3, Summer, 1993. 315-340.

		Maury I. Wolfe and Robert Mark, "The Collapse of the Vaults of Beauvais Cathedral." *Speculum*, 51:3, Jul., 1976. 462-476.
4	2 Feb ANALYTIC PROJECT SELECTION DUE	6. Renaissance—Order and the Ideal. *Revival of Vitruvius and the introduction of geometry as imperfect but useful structural basis. Transition from Gothic exemplified by Brunelleschi's dome for Florence Cathedral. Engineering advances and parallel theories throughout 15th and 16th centuries. New St. Peter's and the limits of pure geometry.* Addis, 117-174. Barry Jones, Andrea Sereni and Massimo Ricci, "Building Brunelleschi's Dome: A Practical Methodology Verified by Experiment." *Journal of the Society of Architectural Historians*, 69:1, March 2010. 39-61. Rowland Mainstone, "Brunelleschi's Dome Revisited," *Construction History*, Vol. 24, 2009. 19-30. Rowland J. Mainstone, "The Dome of St Peter's: Structural Aspects of its Design and Construction, and Inquiries into its Stability." *AA Files*, No. 39, Autumn 1999. 21-39. William Barclay Parsons, *Engineers and Engineering in the Renaissance* (Cambridge, MIT Press, 1968).
	4 Feb	7. The Engineering Revolution—Theory. *Emergence of experimental method in aftermath of the Renaissance. Discoveries in building science by Da Vinci and Galileo. Applied science in work of Poleni, Wren, and Hooke, nascent separation of 'engineering' and 'architecture' as disciplines. New tools for calculation and modeling—calculus, graphic statics.* Addis, 184-213, 225-232, 304-317. J. A. Bennett, "Christopher Wren: The Natural Causes of Beauty." *Architectural History*,15, 1972. 5-22. Cecil D. Elliott, *Technics and Architecture: The Development of Materials and Systems for Buildings*. (Cambridge: MIT Press, 1992). Esp. "Structural Engineering," 385-406. Galileo Galilei, *Discourses on the Two New Sciences* (trans. Henry Crew and Alfonso de Dalvio, 1914). 109-152. Stanley B. Hamilton, "The Place of Sir Christopher Wren in the History of Structural Engineering." *Transactions of the Newcomen Society*, 14:1. 27–42. Robert Mark, *Light, Wind, and Structure*. (Cambridge: MIT Press, 1990). Chapter 5, "Christopher Wren, Seventeenth-Century Science, and Great Renaissance Domes," 138-167.
5	9 Feb	8. Iron and Industry. *Industrial developments in Europe's 'iron belt.' Rapid advances in iron fabrication and construction, parallel need for new type of mill building. Emergence of beam and column theory by Fairbairn and Euler, applications in Europe and the U.S. including cast iron facades and structures by*

		Bogardus in New York. Addis, 245-277, 342-354. Turpin C. Bannister, "Bogardus Revisited: Part I: The Iron Fronts." *Journal of the Society of Architectural Historians*, 15:4, Fifteenth Anniversary Issue, Dec., 1956. 12-22. James Bogardus, "Cast Iron Buildings" in Leland M. Roth, ed., *America Builds: Source Documents in American Architecture and Planning*. (New York: Harper and Row, 1983). 68-74. _____. "Bogardus Revisited: Part II: The Iron Towers." *Journal of the Society of Architectural Historians*, 16:1, Mar., 1957. 11-19. Cecil D. Elliott, *Technics and Architecture: The Development of Materials and Systems for Buildings.* (Cambridge: MIT Press, 1992). esp. "Iron and Steel," 67-110. Carol Gayle and Margot Gayle, "The Emergence of Cast-Iron Architecture in the United States: Defining the Role of James Bogardus." *APT Bulletin*, 29: 2, 1998. 5-12. **Robert A. Jewett, "Structural Antecedents of the I-Beam, 1800-1850." *Technology and Culture*, 8:3, Jul., 1967. 346-362. William Harvey Pierson, Jr., "Notes on Early Industrial Architecture in England." *Journal of the Society of Architectural Historians*, 8:1/2, Jan. - Jun., 1949. 1-32. James Strike, *Construction Into Design: The Influence of Construction on Architectural Design 1690-1990.* (London: Butterworth-Heinemann Ltd., 1991). Chapter 1, "Pioneers of the Iron Frame, 1690-1840," 6-27.
	11 Feb	9. Glass. *Development as minor building material in antiquity, refinement of methods in medieval era. Spread of Venetian techniques in 16th c., industrialization in England. Crown, Cylinder, and Plate techniques in 19th c.. Ferro-vitreous tradition of glass houses; Palm House at Kew and Crystal Palace as examples of new type.* Addis, 215-219, 335-339, 354-363. Cecil D. Elliott, *Technics and Architecture: The Development of Materials and Systems for Buildings.* (Cambridge: MIT Press, 1992). esp. "Glass," 111-148.. Hentie Louw, "Window-Glass Making in Britain c.1660-c.1860 and its Architectural Impact." *Construction History*, 7, 1991. 47-68. Violet Markham, "Joseph Paxton And His Buildings." *Journal of the Royal Society of Arts*, 99:4836, Dec. 15, 1950.67-84. G. F. Chadwick, "Paxton and the Great Stove." *Architectural History*, 4, 1961. 77-92.

		John Hix, *The Glass House*. (Cambridge: MIT Press, 1974). James Strike, *Construction Into Design: The Influence of Construction on Architectural Design 1690-1990.* (London: Butterworth-Henemann Ltd., 1991). Chapter 2, "A New Language From the Use of Iron and Glass, 1810-1855," 28-51. Michael Wiggington, *Glass in Architecture*. (London: Phaidon, 1996), esp. Chapter 01, "History and the Architectural Context," 10-60.
6	16 Feb	10. The Case for Structural Rationalism—Viollet-le-Duc and the 'Graeco-Gothic.' *Viollet-le-Duc's theory of architecture and importance of function and construction to form and ornament. Biographical sketch, career as restoration architect and educator. Viollet's "three great traditions" and importance of Gothic as synthetic moment. Five-point synthetic program for building design including importance of expression. Viollet's own exemplary projects. Influence in Europe and America.* Leo Arnaud, "A Definition for Gothic Architecture by Viollet-le-Duc," *The Journal of the American Society of Architectural Historians*, 4:3/4 (Medieval Architecture), Jul. - Oct., 1944. 42. Michael Barker, An Appraisal Of Viollet-Le-Duc (1814-1879) and His Influence," *The Journal Of The Decorative Arts Society 1850 - The Present*, 16, "Historicism And International Exhibitions In Europe, 1830-1880," 1992. 3-13. "Eugene Emmanuel Viollet-le-Duc," *Proceedings of the American Academy of Arts and Science*s,15, May, 1879 -May, 1880. 394-399. **Millard Fillmore Hearn, *The Architectural Theory of Viollet-le-Duc: Readings and Commentary.* (Cambridge, MIT Press, 1990), esp. "Differences Between Greek and Roman Architecture," 82-86; "The Middle Ages," 86-92; "Gothic Structure as a Source of Inspiration for Modern Architecture," 115-116; Chapter 4, "Adopting a Design Method," 141-166; Chapter 5, "Handling Materials," 169-179; Chapter 6, "Planning Rationally," 182-203; and "Metaphor as the Inspiration for Style," 219-230. Robert Mark and David P. Billington, "Structural Imperative and the Origin of New Form," *Technology and Culture*, 30:2, Special Issue: "Essays in Honor of Carl W.Condit," Apr., 1989. 300-329.
	18 Feb	11. The Advent of the Skyscraper. *Skyscraper as synthesis of several developments in 19th c: new masonry techniques, new conveying technology, new ideals in cladding and lighting, and new metals. Problem of definition, evolution through "proto-skyscrapers" in New York, Kansas City, and Chicago. Development of "Chicago construction" and unique geological and economic conditions there. Influence of powered construction and services in early 20th century.* Addis, 385-405. **Dankmar Adler, "Function and Environment," in Lewis Mumford, ed., *Roots of Contemporary American Architecture* (New York: Grove, 1959). 243-250.

		Gerald R. Larson and Roula Mouroudellis Geraniotis, "Toward a Better Understanding of the Evolution of the Iron Skeleton Frame in Chicago." *Journal of the Society of Architectural Historians*, 46:1, Mar., 1987. 39-48. Thomas Leslie, "As Large as the Situation of the Columns Would Allow": Building Cladding and Plate Glass in the Chicago Skyscraper, 1885-1905." *Technology and Culture*, 49:2, Apr., 2008. 399-419. **Louis H. Sullivan, "The Tall Office Building Artistically Considered." *Lippincott's Monthly Magazine*, March, 1896. 403-408. James Strike, *Construction Into Design: The Influence of Construction on Architectural Design 1690-1990*. (London: Butterworth-Henemann Ltd., 1991). Chapter 5, "Development of the Steel Frame, 1870-1914," 72-82. Sara Wermiel, "The Development of Fireproof Construction in Great Britain and the United States in the Nineteenth Century," *Construction History*, 9,1993. 3-26.
7	23 Feb	12. The *Arriere-Garde:* Arts and Crafts. *Reactions to industrialization in England. Pugin, Ruskin, and the nostalgia for the Gothic. Influence in America—Emerson, Greenough, and questions of ethics or morals in aesthetics. Impact on industrial design and influence on European movements including* Deutsche Werkbund *and the Bauhaus. Question of building as industrial design writ large.* Theodore M. Brown, "Thoreau's Prophetic Architectural Program." *The New England Quarterly*, 38:1, Mar., 1965. 3-20. Edgar Kaufmann, Jr., "The Arts and Crafts: Reactionary or Progressive?" *Record of the Art Museum, Princeton University*, 34:2, "Aspects of the Arts and Crafts Movement in America," 1975. 6-12. Edgar Kaufmann, Jr., "Nineteenth-Century Design." *Perspecta*, 6, 1960. 56-67. Robert B. Shaffer "Emerson and His Circle: Advocates of Functionalism." *Journal of the Society of Architectural Historians*, 7: ¾, Jul. - Dec., 1948. 17-20. Frank Lloyd Wright, "The Art and Craft of the Machine." *Brush and Pencil*, 8:2, May, 1901). 77-81, 83-85, 87-90.
	25 Feb MIDTERM ISSUED	13. Concrete Re-Emergent. *Re-discovery of Roman techniques in 15th-18th centuries. Development of artificial cement ('Portland') in early 19th century. Early experiments in France, Britain, and America.* Systeme Hennebique *and the codification of design and construction in early 20th c. Early pioneers—Garnier, Maillart, Perret. Legacy and problem of appropriate form and expression.* Addis, 418-438. Reyner Banham, "Ransome at Bayonne." *Journal of the Society of Architectural Historians*, 42:4, Dec., 1983. 383-387.

		Karla Britton, "The Poetic Economy of the Frame: The Critical Stance of Auguste Perret." *Journal of Architectural Education*, 54:3, Feb., 2001. 176-184. Peter Collins, *Concrete: The Vision of a New Architecture* (rep., Montreal: McGill-Queens University Press, 2004). Carl W. Condit, "The First Reinforced-Concrete Skyscraper: The Ingalls Building in Cincinnati and Its Place in Structural History." *Technology and Culture*, 9:1, Jan., 1968. 1-33. Cecil D. Elliott, *Technics and Architecture: The Development of Materials and Systems for Buildings.* (Cambridge: MIT Press, 1992). esp. "Cements," and "Reinforced Concrete," 149-197. Andrew Saint, "Some Thoughts About The Architectural Use Of Concrete [I]." *AA Files*, 21, Spring, 1991. 3-12. Andrew Saint, "Some Thoughts About The Architectural Use Of Concrete [II]." *AA Files*, 22, Autumn, 1991. 3-16. James Strike, Construction Into Design: The Influence of Construction on Architectural Design 1690-1990. (London: Butterworth-Heinemann Ltd., 1991). Chapters 3 and 7, "Pioneers of Concrete Construction, 1820-1900," and "Towards an Expressive Use of Concrete," 52-61 and 98-116.
8	1 Mar	14. Great Bridges. *Functional implications of rail and road construction. 19th century developments in England, applications of new scientific principles to greater spans. Patents for truss types, importance of fabrication and transport. Suspension bridges and the achievement of Brooklyn, simultaneous development of cantilever truss type at Firth of Forth. Eiffel's Tower as summative statement of bridge technology. Emergence of concrete as viable alternative. Maillart's bridges.* Max Bill, *Robert Maillart: Bridges and Constructions.* (Zurich: Verlag für Architektur, 1949). David P. Billington, "An Example of Structural Art: The Salginatobel Bridge of Robert Maillart." *Journal of the Society of Architectural Historians*, 33:1, Mar., 1974. 61-72. David P. Billington, "Bridges And The New Art Of Structural Engineering: Good Bridge Designs Exemplify The Three Criteria Of Structural Art: Minimum Use Of Materials, Minimum Cost, And Maximum Aesthetic Expression." *American Scientist*, 72:1, January-February 1984. 22-31. David P. Billington and Robert Mark, "The Cathedral and the Bridge: Structure and Symbol." *Technology and Culture*, 25:1, Jan., 1984). 37-52. Emory L. Kemp and Jet Lowe, "The Fabric of Historic Bridges." *IA. The Journal of the Society for Industrial Archeology*, 15:2, "Bridges," 1989. 3-22. Montgomery Schuyler "The Bridge as a Monument," in W. H. Jordy

		and R. Coe, eds. *American Architecture and Other Writings*. (New York: Atheneum, 1964), p. 161-174.
	3 Mar	TL out of town—no class
9	8 Mar MIDTERM DUE	15. Building and Power: War, Industry, and Production. *WWI as warfare industrialized. Effects of technology transfer and industrial overrun on building economy and technology. Interwar years and role of neo-liberal states in new scale of construction—Hoover Dam and TVA, e.g. Factory design and production. Henry Ford and Albert Kahn and the Taylorization of building and buildings. Massive mobilization during WWII and resulting new techniques of production and new materials to match new demographics.* Siegfried Giedion, "The Assembly Line and Scientific Management," rep. in William W. Braham and Jonathan A. Hale, *Rethinking Technology: A Reader in Architectural Theory*. (London: Routledge, 2007). 83-112. Charles K. Hyde, "Assembly-Line Architecture: Albert Kahn and the Evolution of the U.S. Auto Factory, 1905-1940." *IA. The Journal of the Society for Industrial Archeology*, 22:2, 1996). 5-24. Robert Lewis, "Redesigning the Workplace: The North American Factory in the Interwar Period." *Technology and Culture*, 42:4, Oct., 2001. 665-684. "TVA Architecture and Design." *The Bulletin of the Museum of Modern Art*, 8:4, Apr. - May, 1941. 8-9. Richard Guy Wilson, "Machine-Age Iconography in the American West: The Design of Hoover Dam." *Pacific Historical Review*, 54:4, "Architecture and the American West," Nov., 1985. 463-493.
	10 Mar	16. The Contemporary Curtain Wall. *Early glazed walls. Interwar glass technology. Problems of solar gain and waterproofing. Technology transfer from wartime, esp. aluminum and glass. Development of glazed curtain wall, air conditioning.* James Ashby, "The Aluminium Legacy: the History of the Metal and its Role in Architecture." *Construction History*, 15, 1999. 79-90. William Dudley Hunt, *The Contemporary Curtain Wall: Its Design, Fabrication, and Erection*. (New York: F. W. Dodge, 1958). Esp. Chapters 1 & 2, "The Curtain Wall" and "The Functions," 1-36. John Peter, *Aluminum in Modern Architecture*. (New York: Reinhold, 1956). David Yeomans, "The Pre-History Of The Curtain Wall." *Construction History*, 14, 1998. 59-82.
10	15 Mar	SPRING BREAK
	17 Mar	SPRING BREAK

11	22 Mar	ANALYTIC PROJECT PRESENTATIONS
	24 Mar	ANALYTIC PROJECT PRESENTATIONS
12	29 Mar	17. Jean Prouve and Buckminster Fuller. *Two careers exemplifying the new potentialities of postwar materials and entrepreneurialism. Prouve and the French example, career based in manual iron crafting in France's iron belt, development of new materials, esp. aluminum after the war. Cladding systems and expansion into architectural production. Fuller and the American example. Fantasy-based 'Dymaxion' business propositions in 1920s, wartime service in supply chains during WWII and subsequent mapping experiments. Geodesics as technique and as strategy, development into humanitarian work during 1970s.* Buckminster Fuller, "Buckminster Fuller." *Perspecta*, 1, Summer, 1952. 28-37. Marks, Robert, and R. Buckminster Fuller, *The Dymaxion World of Buckminster Fuller*. (New York: Anchor, Doubleday & Co., 1973). Jean Prouvé, "The Organization of Building Construction," rep. in Benedikt Huber and Jean-Claude Steinegger, eds., *Jean Prouvé, Une Architecture par l'Industrie.* (Zurich: Artemis, 1971). 7-26. Peter Sulzer, *Jean Prouvé: Oeuvre Complet.* (3 vol., Basel: Birkhaüser, 1999, 2000, 2002).
	31 Mar	18. Long Spans and Thin Shells: Postwar Engineering. *Advances in steel and concrete research, parallel to new demands for long span sheds—sports arenas, aircraft hangars, etc. Surface structures and their behavior, calculation, and construction. Major figures in development of techniques and engineering: Nervi, Torroja, Candela. Problematic application at Sydney and ongoing debate over form and structure.* Addis, 480-499. Fred Angerer, *Surface Structures in Building.* (London: Tiranti, 1961). esp. 1-33. Jürgen Joedicke, *Shell Architecture*. (New York: Reinhold, 1963), esp. 10-13. Pier Luigi Nervi, *Aesthetics and Technology in Building* (Cambridge: Harvard University Press, 1965). Mario Salvadori, "Thin Shells" in Robert Fisher, ed., *Architectural Engineering: New Structures.* (New York: McGraw-Hill, 1964). 26-44.
13	5 Apr	19. The Tall Building Technically Reconsidered. *Break in skyscraper construction during Great Depression and WWII. New structural techniques incl. tube structures. "Second Chicago School." Development of super-tall towers, including Sears and Hancock in Chicago, World Trade Center in New York.* Mir M. Ali, *Art of the Skyscraper: The Genius of Fazlur Khan.* (New York: Rizzoli, 2001). David P. Billington and Myron Goldsmith, eds. *Technique and*

		Aesthetics in the Design of Tall Buildings: Proceedings of the Fazlur R. Khan Session on Structural Expression in Buildings. (Bethlehem, PA: Institute for the Study of the High-Rise Habitat, 1986), esp. Mark Fintel, "New Forms in Concrete," 39-56 and Hal Iyengar, "Structural and Steel Systems," 57-70. Carl W. Condit, "The New Architecture of Chicago." *Chicago Review*, 17:2/3, "New Chicago Writing and Art," 1964. 107-119. **Myron Goldsmith, "The Effects of Scale" in *Myron Goldsmith: Buildings and Concepts.* (New York: Rizzoli, 1987), 8-22.
	7 Apr	20. "The Architecture of the Well-Tempered Environment." *Growth of environmental science. Air conditioning as fundamental technique in environmental control. Mechanical systems and new 'poche.' Power-membrane ceilings, beginnings of efficiency studies and concerns over air quality, expense.* Reyner Banham, *The Architecture of the Well-Tempered Environment.* (Chicago: University of Chicago Press, 1969), esp. chapters 9-12: "Towards Full Control," "Concealed Power," "Exposed Power," and "A Range of Methods," 171-289., Robert Bruegmann, "Central Heating and Forced Ventilation: Origins and Effects on Architectural Design.*" Journal of the Society of Architectural Historians*, 37:3, Oct., 1978. 143-160. Cecil D. Elliott, *Technics and Architecture: The Development of Materials and Systems for Buildings.* (Cambridge: MIT Press, 1992). Esp. "Sanitation," "Lighting," "Heating and Ventilation," and "Air Conditioning," 215-326.
14	12 Apr	21. The New Precisionists—Stirling, the Smithsons, and Kahn. *Postwar attitudes to town planning and reconstruction. Influence of CIAM, Team X. British culture of engineering—Spitfire legacy. 'New Brutalism' as movement linking art, science, production in U.K. Smithsons and debt to Mies. James Stirling and technology as ornament. Kahn's approach to structural and mechanical systems as grammar for design.* Reyner Banham, "The New Brutalism," reprinted in Mary Banham, *et al*., eds., *A Critic Writes: Essays by Reyner Banham*. (Berkeley: University of California Press, 1996). 7-15. Kenneth Frampton, "On James Stirling: A Premature Critique." *AA Files* 26, Autumn, 1993. 3-6. August Komendant, *18 Years With Architect Louis I. Kahn.* (New York: Aloray, 1975). Alessandra Latour, *Louis I. Kahn: Writings, Lectures, Interviews* (New York: Rizzoli, 1991). Vincent J. Scully, Jr., "The Precisionist Strain In American Architecture." *Art in America*, 48:3, 1960. 46-53. D. Theron, "The New Brutalists," *Theoria: A Journal of Social and Political Theory* 24, June, 1965. 49-52.

	14 Apr ANALYTIC PROJECT DUE	22. Capsules and Components: Mass Production and the Promise of Prefab. *Application of principles, materials from wartime industry to problems of housing and building. Precedents including catalogue housing, Lustron and similar products. Development of new materials such as fiberglass, new paradigms from aerospace industry. Capsule housing and the fantasy of building as a consumer good.* Reyner Banham, "A Home is Not A House," rep. in Penny Sparke, ed., *Reyner Banham: Design by Choice.* (London: Academy Editions, 1981). 56-61. James Strike, *Construction Into Design: The Influence of Construction on Architectural Design 1690-1990.* (London: Butterworth-Henemann Ltd., 1991). Chapter 10, "The Building Component as an Element in Design, 1945-1970," 150-166. Konrad Wachsmann, *The Turning Point of Building: Structure and Design.* (New York: Rheinhold, 1961). 49-55, 230-232.
15	19 Apr	23. High Tech. *Second postwar generation influenced by massive engineering advances in wartime and postwar reconstruction. Influence of Fuller, Kahn, and Stirling on Anglo-Italian movement. Major figures: Foster, Rogers, Piano. Pompidou, Lloyds, HongKong Bank as monuments to integrated engineering, fabrication, and performance. Reactions and critique of technological, as opposed to historical, pastiche.* Chris Abel, "Modern Architecture in the Second Machine Age: The Work of Norman Foster," in *A+U Extra Edition: Norman Foster, 1964-1987,* 1988. 11-22. Colin Davies, "Introduction," in Colin Davies, ed., *High-Tech Architecture*. (New York: Rizzoli, 1988). 6-21. Nicholas Grimshaw, "Structure, Space and Skin," in Rowan Moore, ed., *Structures, Space, and Skin: The Work of Nicholas Grimshaw and Partners.* (London: Phaidon, 1993). 236-243. Martin Pawley, "Technology Transfer," in William W. Braham and Jonathan A. Hale, *Rethinking Technology*. (New York: Routledge, 2007). 294-307.
	21 Apr FINAL ISSUED	24. Arts and Crafts Revisited: The Tectonic and Resistance. *Continuing debate over technology as progressive or dehumanizing force. Ideal of resistance to spread of industrial/corporate culture. Legacy of Arts and Crafts revived in arguments for resistance in place or production. Question of industrial craft.* Kenneth Frampton, "Towards a Critical Regionalism: Six Points for an Architecture of Resistance," in Hal Foster, ed., *The Anti-Aesthetic: Essays on Post-Modern Culture.* (Port Townshend: Bay Press, 1983). 16-30. **Kenneth Frampton, "Rappel a l'Ordre: The Case for the Tectonic," in Kenneth Frampton, *Labour, Work Architecture: Collected Essays on Architecture and Design* (London: Phaidon, 2002). 91-103. Peter McCleary, "Some Characteristics of a New Concept of

		Technology," in William W. Braham and Jonathan A. Hale, *Rethinking Technology*. (New York: Routledge, 2007). 325-336.
16	26 Apr REVIEW WEEK	25. Sustainability. *1973 oil crisis and rapid concern with efficiency. Passive solar experiments in England and America, early efforts to harness solar energy to heat buildings. Daylighting and passive cooling developments in 1990s, broader emphasis on town planning and transportation to achieve economies of scale. Looming climate crisis and infrastructural responses.* **William McDounough, "Design, Ecology, Ethics, and the Making of Things," and "The Hannover Principles," in Kate Nesbitt, ed., *Theorizing a New Agenda for Architecture: An Anthology of Architectural Theory 1965-1995*. (New York: Princeton Architectural Press, 1996). 398-411. Alisdair McGregor, Cole Roberts, and Fiona Cousins, *Two Degrees: The Built Environment and Our Changing Climate.* (London: Routledge, 2013). Richard Rogers, *Cities for a Small Planet.* (London: Basic Books, 2008).
	28 Apr REVIEW WEEK	26. Stocktaking: New Problems, New Methods, New Materials. *Digital precedents in engineering and calculation tools since antiquity. Early applications to building science. CAD and CAM and the rise of mass customization, form-finding, and digitized production. Building Information Modeling and quasi-genetic algorithms. Smart Buildings. Composite and functionally gradient materials, biomorphic production.* Addis, 541-549. Kenneth Frampton, "On the Predicament of Architecture at the Turn of the Century," in Kenneth Frampton, *Labour, Work, and Architecture*. (London: Phaidon, 2002). 8-21. Deven Golden and James Timberlake, "James Timberlake," *BOMB* 104, Summer, 2008. 74-82. William J. Mitchell, "A Tale of Two Cities: Architecture and the Digital Revolution." *Science* 285:5429. Aug. 6, 1999. 839, 841. Tom Wiscombe, "Emergent Models of Architectural Practice," *Perspecta*, 38, "Architecture after All" ,2006). 57-68.
17	3 May	FINALS WEEK. No Class
	5 May FINAL DUE	FINALS WEEK. Final Exam Due, Analytical Project exhibition during scheduled Final Exam period, location TBA.