ADVANCED BUILDING SYSTEMS I

INSTRUCTOR
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ISSUE

Rethinking Technology As Design Agency
Building technology is inevitable in modern building. It transcends a mere instrumental "tool" for architectural realization. The critical selection and integration of technologies—determining what systems are available, how to employ, why they align with design intent, and how they materialize spatial narratives—constitute fundamental acts of design articulation.

In term 1, during course ARCH 5422, the Technical Workflow: 1 Building Programs (functional demands) - 2 Building Performance (environmental/ experiential outcomes) – 3 Building Systems (structural, MEP, envelope) - 3Systems Integration (synthetic coordination) – 4 Architectural Design (conceptual-spatial vision) has been established. Building on this foundation, the course will now delve into the complexity of these systems and their implementation, focusing on how technological synthesis actively shapes and elevates architectural design.

DESCRIPTION

The Progressive Framework

Instructors Zachary Wong and Nelson Tam have reimagined ARCH 5421/5422 as a year-long scaffolded exploration of building technologies synchronized with design studios. In term 2, based on the foundation laid in term 1, the focus is on the building systems-led approach to examine cases on building systems integration.

From Solution to Articulation

Technical requirements are reframed as creative design parameters, while technical resolutions, options to serve the design purpose. For any performance target (e.g., "net zero energy", “transitional housing/school”):

1. Passive/Baseline Approaches: Natural ventilation strategies in Sui Wo Court
2. Active/Engineered Solutions: Fire engineering solution for the Kaitak Stadium

Systems Integration ss Design Synthesis

Aligning with the progress of the studio, students will develop technical resolutions for their design projects following the Chinese Lunar New Year holiday. The focus will be on selecting a key aspect of their project to demonstrate how technological systems can be cohesively integrated to advance architectural intent. This involves addressing a “system integration challenge”—such as:

“How might a structural exoskeleton (structural system) enable column-free gallery spaces (program), reduce embodied carbon (performance), and satisfy fire-rating requirements (compliance)?”

This exercise serves as the ultimate test of students’ ability to synthesize technical knowledge into their design work, transforming structural, environmental, and regulatory constraints into coherent and innovative spatial arguments.

IMPACT AND SUSTAINABILITY

The Compound Effect of Integration as Agency of Ecological Design
Through the integration of building systems and core building elements, the course encourages students to critically re-examine and refine their design strategies toward achieving sustainable outcomes. By understanding how structure, envelope, and interior systems interrelate and influence each other, students learn to move beyond isolated solutions and embrace holistic design approaches that maximize ecological performance. The integration highlights the importance of considering energy efficiency, water management, indoor environmental quality, and material sustainability as interconnected components rather than separate issues. This mindset fosters innovation, resilience, and environmental responsibility in their architectural practices, ultimately guiding students to create buildings that are not only functional and beautiful but also regenerative and adaptive to future challenges.

COURSE SYLLABUS

Advanced Building Systems Syllabus Matrix for ARCH 5421
Core Building Elements/ Systems

See Appendix 1

METHODS

This course employs a pedagogical matrix to illustrate the interdependencies among building performance, core systems, and technological approaches. The framework operates as follows:

Design Drivers (x-axis): Core Building Systems
1. Structural: Load-bearing frameworks and seismic strategies.
2. Interior: Space-defining partitions and finish assemblies.
3. Envelope: Climate-regulating skins and interfaces.

Implementation Spectrum (y-axis): A Range of Technical Possibilities
While M&E (Mechanical & Electrical) systems are important, this course emphasizes that they are not the only solution. The spectrum of implementation cases is curated to showcase a diverse range of resolutions—including natural, passive, and vernacular means—thereby presenting technology as a series of relative possibilities rather than absolute solutions.

Building codes serve as a essential baseline; however, the spectrum encourages students to critically evaluate technical options against their specific project parameters and design concepts. Ranging from affordable solutions to cutting-edge innovations, this approach aims to demonstrate how technical agency can enhance design creativity.

Through diverse building program case studies, the course demonstrates how specific performance needs inform design decisions across relevant building systems. Students are expected to reflect on these examples to inform their own studio design development iteratively. The ultimate goal of the Implementation Spectrum is to help students develop their own technical agency by exposing them to a wide array of technical stances and applications.

Format
The course will be delivered through a series of lectures, site visits, and—most importantly—technical

consultation workshops aligned with the design studio schedule, focusing on the core topics in the syllabus matrix.

Weekly lectures will establish a strong foundational knowledge. This will be complemented by site visits to exemplary projects and guest lectures from industry professionals, providing firsthand practical insights. These experiences are designed to elevate student learning from theoretical knowledge to practical know-how.

Assignments include a group project (Assignment 1), aimed at fostering collaborative skills and mutual learning, and a final individual assignment based on the student's own studio project which set out to translate students' knowledge of the subject into their studio projects.

DELIVERABLES

1. Group Work- Conversion - Physical Model + Plans (Detail Design / Tender standard)
Refine your conversion schemes based on feedback received and construct a 1:75 physical model that effectively demonstrates the integration of your building systems.

Design your model to visually highlight the intricate spatial relationships among different building system components and emphasize the meticulous coordination of these systems.
Update your drawing package as needed. Please continue using the same set of drawings from previous Assignment.

*Each Big Group will present a comprehensive model that can be partially disassembled for presentation purposes if required. A booklet of annotated photo records of the model making process is required.

2. Individual Work – Technical Report of your studio project
including but not limited to the following:

1. Notes on Design concepts, Building Program, Building performance & Building Systems
2. Section (with int. elevation) or Sectional Perspective (showing the key space and its space for building services in the same view)
3. Exploded Axon. revealing all major building systems their spatial relationships
4. A HVAC (from source to terminals) diagram based on scaled drawings
5. A full set of scaled & dimensioned drawings (site plan, floor plans, sect. & ele.) (Basic Info)
6. Model Photos
7. A3 Portrait, Bound

You are welcome to go beyond the above deliverables in terms of media types, depth and quantity. Discuss with us for customisation or alternatives.

LEARNING OUTCOMES

1. Understand the design articulation relies on our exploration with technical solutions.
2. Be able to formulate the "systems integrating challenge" for your studio project.
3. Be able to model major building systems spatially by digital or physical means.
4. Design building systems with respect to building program and systems' technical requirements.
5. Recognize the significance of sustainable development and architects' roles in promoting it.
6. Be able to consider barrier-free environments for your studio project.
7. Be able to investigate and select alternative structural, constructional, and material systems relevant to local architectural design practices.
8. Comprehend the physical properties, characteristics, and environmental impact of building materials, components, and systems.
9. Practice integrating building systems involving at least four core components/systems.
10. Create a schematic building program considering site parameters and regulations.
11. Be able to prepare technical documentation meeting industry standards.
12. Acknowledge managerial responsibilities in project management, cost control, legal compliance, building code adherence, and contract management.

ASSESSMENT SCHEME

SPECIFIC ASSESSMENT

1. Participation (10%)
2. Group Work- Conversion – Physical Model + Plans (Detail Design / Tender standard) (30%)
3. Individual Studio Project Technical Report (40%)
4. Test 2 (20%)

Total: 100%

COURSE FORMAT

Teaching Days
1. Students must attend for F2F teaching during these teaching hours.
   Teaching Day: Friday 2:30 pm – 5:15pm
2. Teaching Venue: WMY Room 505
3. Field trips, lectures, and other learning activities may be scheduled outside of teaching days.

Student Study Effort_3 credit course (Total: 120 hrs)
1. Class Contact: 40 hrs (Lecture, Tutorial, Critique, Field Trip)
2. Other Student Study Effort: 80 hrs (Self Study / Assignments)

Assistant
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REQUIRED READINGS

Building Systems Intergration

1. Rush, Richard D. The Building Systems Integration Handbook. Boston: Butterworth-Heinemann, 1986. Print.
2. Bachman, Leonard R. Integrated Buildings: The Systems Basis of Architecture. New York: J. Wiley & Sons, 2003. Print.

Construction

1. Deplazes, Andrea. Constructing Architecture: Materials, Processes, Structures, a Handbook. Basel: Birkhäuser, 2005. Print.
2. Advanced building systems: A technical guide for architects and engineers. Daniels, K. (2003). Basel: Birkhäuser.
3. Allen, Edward. and Patrick Rand. Architectural Detailing: Function, Constructibility, Aesthetics. Third edition. Hoboken: Wiley, 2016. Print.
4. Allen, Edward. Fundamentals of Building Construction Materials and Methods, 2nd ed.
5. Watts, A.. Modern construction envelopes (Modern construction series). (2011). Wien: Springer.
6. Ching, Francis. Building Construction Illustrated, Wiley and Sons. 1975.

Building Services & Environmental Technology

1. Grondzik, Walter T. Mechanical and Electrical Equipment for Buildings. 11th ed. Hoboken, N.J: Wiley, 2010. Print.
2. Bradshaw, Vaughn., and Vaughn. Bradshaw. The Building Environment: Active and Passive Control Systems. 3rd ed. Hoboken, N.J: Wiley, 2006. Print.
3. Climate and architecture (1st ed.). Dahl, T. (2010). Milton Park, Abingdon, Oxon; New York, N.Y.: Routledge.

Technical Documentation

1. Lewis, Paul, Marc Tsurumaki, and David J. Lewis. Manual of Section. First edition. New York: Princeton Architectural Press, 2016. Print.
2. Ching, Francis. Building Codes Illustrated. Wiley and Sons. 2003

Building Codes

General

1. Cap. 123F Building (Planning) Regulations
2. Cap. 123I Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations
3. Cap. 123J Building (Ventilating Systems) Regulations
4. Cap. 123M Building (Energy Efficiency) Regulation
5. Cap. 123Q Building (Construction) Regulation
6. Cap. 102 Waterworks Ordinance
7. Cap. 610 Buildings Energy Efficiency Ordinance

Comfort

1. Code of Practice for Overall Thermal Transfer Value in Buildings, Buildings Department https://www.bd.gov.hk/doc/en/resources/codes-and-references/code-and-design-manuals/OTTV1995_e.pdf
2. Code of Practice for Energy Efficiency of Building Services Installation https://www.emsd.gov.hk/beeo/en/pee/BEC_2024_ENG.pdf

3. Code of Practice for Building Energy Audit
   https://www.emsd.gov.hk/beeo/en/pee/EAC_2024_ENG.pdf

Safety
1. Code of Practice for Fire Safety in Buildings
   https://www.bd.gov.hk/doc/en/resources/codes-and-references/code-and-design-manuals/fs_code2011.pdf
2. Codes of Practice For Minimum Fire Service Installations and Equipment And Inspection, Testing and Maintenance of Installations and Equipment
   https://www.hkfsd.gov.hk/eng/source/safety/File2022.pdf
3. Technical Guidance: LPC Rules for Automatic Sprinkler Installations
   https://www.hkfsd.gov.hk/eng/source/guidance/Technical_Guidance_LPC_Rules_eng_20200911_153808.pdf

Health
1. BEAM Plus New Buildings Version 2.0
   https://www.hkgbc.org.hk/eng/beam-plus/file/BEAMPlus_New_Buildings_v2_0.pdf
2. WELL Building Standard
   https://standard.wellcertified.com/sites/default/files/The%20WELL%20Building%20Standard%20v1%20with%20May%202016%20addenda.pdf
3. Handbook on Plumbing Installation for Buildings
   https://www.wsd.gov.hk/filemanager/en/content_1369/HBonPIB.pdf
4. Role of healthy drains in the prevention of spread of COVID-19
   https://icidportal.ha.org.hk/Home/File?path=/Training%20Calendar/161/Role%20of%20healthy%20drains%20in%20the%20prevention%20of%20spread%20of%20COVID-19.pdf

Energisation
1. CLP Code of Practice 101 for Distribution Substation Design, and Drawings
   https://www.clp.com.hk/content/dam/clphk/documents/customer-service-site/open-and-close-account-site/cop-101-distribution-substation-design-site/COP%20101%20version%2015%20drawings.pdf
2. HEC Guide to Connection of Supply
   https://www.hkelectric.com/documents/en/CustomerServices/CI/Documents/GCS_7th_en/GuidetoConnectionofSupply_Full_En.pdf
3. Code of Practice for Building Works for Lifts and Escalator
   https://www.bd.gov.hk/doc/en/resources/codes-and-references/code-and-design-manuals/BWLE2011e.pdf
4. Guidelnes on Application for Installation of Emergency Generators
   https://www.epd.gov.hk/epd/sites/default/files/epd/english/environmentinhk/air/guide_ref/files/guidelines_for_e_generator.pdf
5. Task Lighting Design
   https://www.emsd.gov.hk/filemanager/en/content_764/Task_Lighting_Design.pdf
6. Code of Practice for the Installation and Maintenance of In-building Telecommunications Systems
   https://www.coms-auth.hk/filemanager/statement/en/upload/104/cop201201e.pdf

Structure
1. Code of Practice for Foundations
   https://www.bd.gov.hk/doc/en/resources/codes-and-references/code-and-design-

manuals/FoundationCode2017.pdf
2. Code of Practice for Dead and Imposed Loads
https://www.bd.gov.hk/doc/en/resources/codes-and-references/code-and-design-manuals/DIL2011e.pdf
3. PNAP ADV-36 Modular Integrated Construction
https://www.bd.gov.hk/doc/en/resources/codes-and-references/practice-notes-and-circular-letters/pnap/ADV/ADV036.pdf

Drawing Standard
1. CIC BIM Standards - General (Version 2.1 - 2021)
2. Guidelines for using Building Information Modelling in Statutory Submissions

IMPORTANT NOTE TO STUDENTS

Expectations for Professional Conduct
The motto of The Chinese University of Hong Kong (CUHK) is "Through learning and temperance to virtue". This motto places equal emphasis on the intellectual and moral education of students. In addition to pursuing academic excellence, students of CUHK are expected to maintain and uphold the highest standard of integrity and honesty in their academic and personal lives, respect the rights of others and abide by the law. More information on Postgraduate studies can be found in the PG Student Handbook. https://www.gs.cuhk.edu.hk/

Attendance
Class attendance is required in all courses. For an excused absence, the instructor must be notified and presented with documentation of illness or personal matter. Please note: **Three (3)** or more unexcused absences may result in a failing grade for the course.

Academic Honesty
The Chinese University of Hong Kong places very high importance on honesty in academic work submitted by students and adopts a policy of zero tolerance on academic dishonesty

Attention is drawn to University policy and regulations on honesty in academic work, and to the disciplinary guidelines and procedures applicable to breaches of such policy and regulations. Details may be found at: http://www.cuhk.edu.hk/policy/academichonesty/.

With each assignment, students may be required to submit a statement that they are aware of these policies, regulations, guidelines and procedures.

Third-Party Assistance
All intellectual work essential to the design project must be completed by the student and cannot, under any circumstance, be outsourced to a third party (including, but not limited to a company, consultant, alumni, and/or friend).

In the design studio context, students may utilize external resources, such as printing services for presentation materials, and/or laser cutting and 3D printing services for prototyping purposes. Use of such third-party services constitutes non-intellectual work done by others. It is only permitted with prior written consent from the studio tutor and acknowledgment of such work done by the third party.

Assistance from other students or friends for aspects of project production also constitutes non-intellectual work done by others; this is allowed only if declared and acknowledged in a written statement attached to any such work that has received assistance.

Under all circumstances, students must declare all work done by others by completing the school's designated form before assessment. This form must include a detailed explanation of the third party's identity (name and relationship to the student), when and how they were utilized, and the specific tasks they performed in the project. The completed form, signed by the student, must be endorsed by the tutor and presented during the final review. The school will collect and retain this form for record-keeping purposes.

Failure to follow this code of conduct may be considered a case of academic dishonesty, to be reviewed by a disciplinary board, and possible failure of the course.

Artificial Intelligence
Students may use some AI tools in some learning activities and/or assessments on the condition that they make explicit acknowledgement and proper citations of the input from AI tools.

Acknowledging support from AI tools
Students are required to acknowledge all functional uses of an AI tool and cite it when they paraphrase, quote, or incorporate into their own work any content (whether it is text, image, data, or other format) that was created by it.

An example of acknowledgement
"I acknowledge the use of (name of AI tool – e.g. ChatGPT (https://chat.openai.com/) to (specify the support, e.g. plan my essay, generate some ideas for the content, ask for examples of data collection instruments, get the dates of historical events, etc.)."

An example of citation
OpenAI. (2023). *ChatGPT* (Mar 20 version). https://chat.openai.com/chat

Students are reminded that due to the rapid developments of AI tools, some citation formats may be updated regularly.

An example of including texts generated by an AI tool in their work
"The following text was generated by an AI tool/language model (ChatGPT):"
[Insert the text generated by ChatGPT here.]

An example of including texts generated by an AI tool and the prompts that were used to elicit the text from the AI tool
"[The prompt], as generated by an AI language model (ChatGPT):"
[Insert the text generated by ChatGPT in response to the prompt.]

Students are reminded to learn and use the AI tools responsibly and ethically and be aware of the limitations.

Improper/unauthorized use of AI tools in learning activities and assessments will constitute acts of academic dishonesty which will be handled in accordance with the University's Procedures for Handling Cases of Academic Dishonesty.

Students are reminded to clarify with the course teacher and obtain permission if necessary when in doubt.

Students may refer to Approach 2 of the CUHK 'Use of Artificial Intelligence tools in Teaching, Learning and Assessments' – A Guide for Students.

Student Work
Submission of studio documentation must be complete and correctly formatted. Missing or incomplete submission of the documentation folder will result in the grade for the course being withheld. This will prevent registration for the following term or delay graduation. In addition, a grade deduction of *one letter grade* will be made.

External Examination
Of paramount importance to the academic rigour and professional relevance of the architecture programme, the external examination process serves as a critical and impartial review mechanism. An invited panel of distinguished practitioners, academics, and industry experts convenes to rigorously evaluate the school's pedagogical ecosystem. This comprehensive audit scrutinises the fairness and consistency of the internal assessment process, benchmarks the standard and ambition of student work against national and international norms, and provides invaluable feedback on the intellectual and pedagogical direction of the curriculum itself.

As a cornerstone of this process and a mandatory graduating requirement, final-year students from both the Bachelor of Social Sciences (Architecture) and Master of Architecture programmes must present their final project and portfolio work in person. This formal defence before the external panel not only validates the authenticity and depth of their learning but also simulates a professional practice environment, demanding they articulate their design rationale, critical thinking, and technical resolution to an authoritative audience, thereby preparing them for the collaborative and discursive nature of the architectural profession.

SCHEDULE

IMPORTANT DATES

Group Work_Physical Model + Plans	FEB
Test 2	MAR
Individual Studio Project Technical Report	MAY

Term 2: 5 January 2026 (Monday) – 18 April 2026 (Saturday)

WEEK 19		
09.01	**LECTURE + WORKSHOP**	Topic: Building Systems & Integration
WEEK 20		
16.01	**LECTURE + WORKSHOP**	Topic: BSI-Structure Featured
WEEK 21		
23.01	**GUEST LECTURE + MIC VISIT@CU**	
WEEK 22		
30.01	**LECTURE + WORKSHOP**	Topic: BSI-Envelope Featured
WEEK 23		
06.02	**LECTURE + WORKSHOP**	Topic: BSI-Interior Featured
WEEK 24		
13.02	**VISIT**	Building Visit (TBC)
WEEK 25		
20.02	**Lunar New Year Vacation (16-22 Feb)**	No Class
WEEK 26		
27.02	**LECTURE + WORKSHOP**	Structural Component Recycled, Prof. WSZ (TBC)
WEEK 27		
06.03		
WEEK 28		
13.03	**TEST + LECTURE**	Light, Agile & High-Performance Construction System, Prof. ZJX (TBC)
WEEK 29		
20.03	**ASSIGNMENT 3 REVIEW**	
WEEK 30		
27.03	**ASSIGNMENT 3 REVIEW**	
WEEK 31		
03.04	**CONSULTATION WORKSHOPS**	
WEEK 32		
10.04	**CONSULTATION WORKSHOPS**	
WEEK 33		
17.04	**CONSULTATION WORKSHOPS**	

APPENDIX 1

Advanced Building Systems Syllabus Matrix for ARCH 5421
Core Building Elements/ Systems

		Core Building Elements			
	Issues/ Systems	Structure	Envelope	Interior	
	Topics	Stability/ Economy/ Emission	Expression / Climatic Control	Spatial Experience / Building Program	
Technology Approach	Governing Factors (Statutory / Technical)	Foundation/ Superstructure & Material types	Façade Systems/ Waterproofing/ Lightning Protection	Ceiling/ Flooring/ Partition Systems/ furniture systems	Cost
Passive Design	Baseline	Temp structure/ transitional building/ Basic Structure / Envelope	Heat Reduction and Retention / Waterproofing systems	Exposed	Basic/ Affordable
Active / Integrated Design	Common Practice	Common Structural Systems: RC & Steel	Cladding, Curtain wall	Integrated/ Concealed	
	Advanced / Special Practice	Extension/ Structure as Space	Integrated façade system	Merged	
Pioneering / Experimental Engineering	MIC, DfMA, robotics, 3D printing, new materials, etc.	Advanced Buildability/ Precast / Prefabrication / Modular Construction	Active Façade	Flexible Space	Advanced: articulated, engineered & customised

Grade	Descriptor	Criteria	Points
A	Excellent	Comprehensively excellent performance on all aspects of the design intention, development, technical resolution and presentation. Achieving all learning outcomes with distinction.	4
A-	Very Good	Generally outstanding performance on the design intention, development, technical resolution and presentation. Achieving all learning outcomes with merit.	3.7
B+	Good	Substantial performance on the design intention, development, technical resolution and presentation. Achieving all learning outcomes satisfactorily.	3.3
B			3
B-			2.7
C+	Fair	Fair performance on the design intention, development, technical resolution and presentation. Achieving all learning outcomes at a passing standard.	2.3
C			2
C-			1.7
D+	Pass	Barely satisfactory performance on the design intention, development, technical resolution and presentation. Achieving all learning outcomes at a barely satisfactory standard.	1.3
D			1
F	Failure	Unsatisfactory performance on the design intention, development, technical resolution and presentation. Not achieving all learning outcomes.	0

Written Feedback to Students

Term: _____ **Grade:** _____

Course Code: _____

Review: _____

Tutor: _____

Student Name: _____

Student ID: _____

Feedback from Tutor:

Achievements:

Challenges: