
Source: https://cdn.britannica.com/89/154289-050-9CC40AA3/Pompidou-Centre-architects-Paris-France-Renzo-Piano-1977.jpg

# BUILDING SYSTEMS INTEGRATION

**INSTRUCTOR**
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# ISSUE

What are the organs that keep the human body functioning? How are the organs being organised with our skin, our skeleton, and our mind? Likewise, what are the "organs" of architecture that keep the building performing, and how are they integrated with envelopes, structures and design concepts? Are there tools to reveal the implicit and explicit relationships between the tangible and intangible elements of architectural systems?

# DESCRIPTION

There are many books about architectural masterpieces that moved us with their magnificent spaces, and there are also plenty of manuals telling us how building technology and equipment work. What seems lacking is the bridge in between to show us how we can practice integration in our design process and let the design results, i.e., the space and the design concepts, benefit from integration.

After exposure to material and construction (ARCH 2413), building structures (ARCH 2422), and environmental technology (ARCH 3424), it is time for students to take these systems and considerations to shape their next studio project. Through the appreciation of finely integrated projects and examination of daily surroundings, students are encouraged to rethink the core value of integration to the practice of architectural design and appreciate the technical aspects that inform our design decisions and strengthen our scheme from the inside.

The course "Building Systems Integration" aims to empower students to 1) acquire fundamental understanding towards building systems, 2) anatomize existing buildings by investigating the system integration through building information modelling (BIM), and 3) challenge the effectiveness and efficiency of the existing design by proposing sustainable redesign strategies Through the process, students reflect on how building technologies can be integrated for the articulation of their design concepts and resultant spaces.

# IMPACT AND SUSTAINABILITY

Is integration a matter of technology or art? The credit for an exquisite traditional wood joint may go to the carpenter who crafts it, while the "craftsmanship" of an architect lies in his/ her conscious practice of building systems integration. Exactly, it is the spot where architects can showcase his/ her artistic solutions to problems, with the aid of technology, though not necessarily "high-technology". The competency to practice integration ensures quality design solutions. Building systems integration is vital to achieve quality building performance for the people, the planet, and prosperity. Experienced practitioners would probably find it a great tool for design development in the early conceptual stage as well.

Friendliness to the planet is one of the key measures of a quality design solution. The efficiency of a structural system or cooling system is not merely of economic concern. Consciousness in using low-carbon emission materials and reducing energy consumption during the building life cycle has become increasingly important. Sustainability issues would merge into various topics of building systems integration, and creative examples will be used to showcase how we can integrate our design concepts, sustainability needs and building systems all together into a piece of architecture.

# METHODS

This course is challenge-driven and student-led, as structured by a series of lectures, guest lectures, student presentations, field trips, hands-on workshops and project-based assignments.

Lectures will offer students the fundamental understanding towards building systems and the essential knowledge to prepare candidates for pursuing professional practice in the industry. Industry professionals will be invited to deliver guest lectures about practical experiences and expectations from the practitioner's perspective.

Field trips will be organized for students to align the text-based knowledge with the tangible systems in the built environment, starting from our own building – the School of Architecture, to transitional housing (which echoes with the studio project), the "high tech" architecture of HSBC Headquarter Hong Kong, and the M+ (a museum that requires high level of spatial integrity).

Project-based assignments include 1) Case studies, which equip students with the foundational knowledge regarding building systems and their integration with architecture, 2) Anatomical studies and 3) Redesign Project.

Case studies will consist of both residential architecture (to facilitate and enhance the student project development) and non-residential architecture (to supplement the knowledge beyond residences) from the textbooks. (Assignment 1; Group of 8 students)

The Anatomical Studies will enable students to develop digital competency in building information modelling (BIM) by investigating existing medium-scale buildings on the campus. Field trips will be arranged to visit the selected buildings (Cases A to G) to align the textbook knowledge with the tangible elements. ***In-class training by BIM expert will be arranged in the second half of selected classes*** (Assignment 2; Group of 8 students; Pin-up Review)
The Redesign Project will challenge students to interrogate the effectiveness of the existing design as investigated in Assignment 2. Students are requested to propose new sustainable redesign strategies to improve the spatial quality and building performance for selected areas. (Assignment 3; Individual; Pin-up Review)

The level of difficulty increases progressively from Assignment 1 to 3 and will align with studio teaching to maximise the learning outcomes from the students' perspective. Tutorials will be arranged to have in-depth discussions with students in group formats.

# DELIVERABLES

**Assignment 1_Case Studies (20%)**
Format: Group Presentation (**max. 30 nos. of slides**; 15 mins presentation + 15 mins peer commentary). Two groups will present in the same class, another two groups will comment on the presentations. The presentation file in both PPT and PDF formats should be submitted on the same day for record. Students are expected to produce efficient and effective graphical apparatus (e.g. diagrammatic illustrations) to explain their understanding of system integration ideas.
Size: 7-8 students per group; 8 groups in total

Content: Each group will pick **ONE non-residential case** from the textbook (Bachman, 2003) and **ONE residential case** (in Hong Kong or from the textbook), and discuss how building systems are integrated with the architectural design. Aspects of building systems should include 1) structural

design, 2) MVAC, 3) fire safety, 4) plumbing and drainage, 5) electricity and power, 6) acoustic design, 7) passive design strategies, and 8) materials and envelope.

**Assignment 1_Participation (10%)**
The peer commentary on group presentations in Assignment 1 will be evaluated based on the knowledge of students and their overall participation.

**Assignment 2_Anatomical Studies (45%)**
Format: Group booklet submission including BIM modelling screenshots and exported drawings.
Size: 7-8 students per group; 8 groups in total

Content: Students will visit existing buildings on CUHK campus, investigate technical drawings, and produce BIM models for the selected case. In-class training will be arranged to equip students with the basic operational skills of BIM software(s) on a weekly, thematic basis. Final outcomes will be generated from the BIM models and showcased in a collective pin-up review.

**Assignment 3_Redesign Project (25%)**
Format: Individual submission and pin-up review. To be submitted within 2 weeks after the studio final review.

Content: Each student will propose a redesign scheme for their anatomical cases to improve the spatial quality and building performance using sustainable design strategies. The redesign strategy should be supported by respective analysis and evidence through BIM model operations.

**Final Documentation**
Each student will upload a final documentation (InDesign package, with all original materials produced for the above assignments) on the submission date of Assignment 3.

# LEARNING OUTCOMES

Students are exposed to the knowledge in the areas:

1. The role of the architect within the design team and construction industry, recognizing the importance of current methods and trends in the construction of the built environment;
2. Understand through investigation, how selection of alternative structural, constructional and material systems are relevant to architectural design;
3. Strategies for building construction, and ability to integrate knowledge of structural principles and construction techniques;
4. The physical properties and characteristics of building materials, components and systems, and the environmental impact of specification choices.
5. Principles associated with designing optimum visual, thermal and acoustic environments;
6. Strategies for building services, and ability to integrate these in a design project.
7. Understand the cost control mechanisms which operate during the development of a project.

# ASSESSMENT SCHEME

**Assignment 1** _20% (Group)
**Participation** _10% (Group)
**Assignment 2** _45% (Group)
**Assignment 3** _25% (Individual)

Each assessment result will be released to students upon completion accompanied by written comments based on student progress and performance.

**Reminder:**

A sub-grade will be deducted from the final grade (e.g. from B+ to B) if the student fails to submit the final documentation before the deadline.

**A Peer Evaluation Form** will be distributed to all students upon the submission of Assignment 2. **Grading over individuals for Assignment 1 and 2** will be adjusted according to the peer evaluation on the group work regarding (1) Participation and Team Work; (2) Timely Input and Punctuality; (3) Leadership; and (4) Knowledge, Innovative Ideas and Quality of Work throughout class and group discussions within and outside classroom.

# COURSE FORMAT

**Teaching Days**
Date: 02/09, 09/09, 16/09, 23/09, 30/09, 14/10, 21/10, 28/10, 04/11, 11/11, 18/11, 25/11
Venue: WMY 306
Time: Tuesday, 10:30am -1:15pm

**Student Study Effort (Total: 140 hrs)**
Class Contact: 39 hrs (Lecture, Tutorial, Visit)
Other Student Study Effort: 100 hrs (Studio / Self Study)

**Visits**
Campus buildings
M+ by Hdm / Tai Kwun (TBC)

# REQUIRED READINGS

Bachman, Leonard R. Integrated Buildings: The Systems Basis of Architecture. New York: J. Wiley & Sons, 2003. Print. ARL; NA2543.T43 B33 2003
Bradshaw, Vaughn., and Vaughn. Bradshaw. The Building Environment: Active and Passive Control Systems. 3rd ed. Hoboken, N.J: Wiley, 2006. Print. ARL; TH6012. B73 2006

# OTHER REFERENCES

Allen, Edward, and Patrick Rand. Architectural Detailing: Function, Constructability, Aesthetics. Third edition. Hoboken: Wiley, 2016. Print. ARL; NA2840. A38 2016
Bradshaw, Vaughn., and Vaughn. Bradshaw. The Building Environment: Active and Passive Control Systems. 3rd ed. Hoboken, N.J: Wiley, 2006. Print. ARL; TH6012. B73 2006
Deplazes, Andrea. Constructing Architecture: Materials, Processes, Structures, a Handbook. Basel: Birkhäuser, 2005. Print. ARL; TA403.6 .C659 2005
Grondzik, Walter T. Mechanical and Electrical Equipment for Buildings. 11th ed. Hoboken, N.J: Wiley, 2010. Print. ARL; TH6010. S74 2010
Rush, Richard D., and Richard D. (Richard David) Rush. The Building Systems Integration Handbook. Boston: Butterworth-Heinemann, 1986. Print. ARL; TH145. B844

# 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 undergraduate studies can be found in the UG Student Handbook. https://rgsntl.rgs.cuhk.edu.hk/aqs_prd_applx/Public/Handbook/

**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 are not allowed to use any AI tools in any kind of learning activity or assessment that will be counted towards students' final grade of the course, or used for evaluating students' attainment of the desired learning outcomes. Students are expected to produce their own work independently without any collaboration or use of AI tools. Such information should be spelt out clearly in the course outline or learning activity/assessment guide.

Students may refer to Approach 1 of the CUHK 'Use of Artificial Intelligence tools in Teaching, Learning and Assessments' – A Guide for Students.

**Student Work**
Submission of course work 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.

**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.

## Term 1: 2 September 2025 (Tuesday) – 9 December 2025 (Tuesday)

| | | |
|---|---|---|
| **WEEK 01** | | |
| 02.09 | **INTRODUCTION**<br>**FIELD TRIP** | *The Idea of Integration and BIM management*<br>**School of Architecture** |
| **WEEK 02** | | |
| 09.09 | **LECTURE**<br>**IN-CLASS WORKSHOP** | Environmental Strategies<br>BIM Modelling: 01 Architecture |
| **WEEK 03** | | |
| 16.09 | **LECTURE**<br>**IN-CLASS WORKSHOP** | Site and Design<br>BIM Modelling: 02 Architecture |
| **WEEK 04** | | |
| 23.09<br>TBC | **IN-CLASS WORKSHOP**<br>**FIELD TRIP** | BIM Modelling: 03 Structure and 04 Sheets and Annotation<br>***Campus Buildings (Assignment 2)*** |
| **WEEK 05** | | |
| 30.09 | **GROUP PRESENTATIONS** | ***Group 1 to 7 (Assignment 1 submission)*** |
| **WEEK 06** | | |
| 07.10 | **NO CLASS** | The day following the Mid-Autumn Festival |
| **WEEK 07** | | |
| 14.10 | **LECTURE**<br>**IN-CLASS WORKSHOP** | HVAC systems<br>BIM Modelling: 05 HVAC systems |
| **WEEK 08** | | |
| 21.10<br><br>TBC | **GUEST LECTURE**<br>**IN-CLASS WORKSHOP**<br>**FIELD TRIP** | Electrical and Plumbing Systems<br>BIM Modelling: 06 Electrical and Plumbing Systems<br>**M+ (TBC)** |
| **WEEK 09** | | |
| 28.10 | **GUEST LECTURE**<br>**IN-CLASS WORKSHOP** | Fire Service Installations<br>BIM Modelling: 06 Electrical and Fire Protection |
| **WEEK 10** | | |
| 04.11 | **LECTURE** | Materials and Envelope<br>BIM Modelling: Q&A |
| **WEEK 11** | | |
| 11.11 | **PIN-UP REVIEW** | **Assignment 2 submission** |
| **WEEK 12** | | |
| 18.11 | **LECTURE** | Procurement, Tendering and Cost Estimation |
| **WEEK 13** | | |
| 25.11 | **NO CLASS** | Final Review Week<br>Tutorial |
| **WEEK 14** | | |
| 09.12 | **PIN-UP REVIEW** | ***Assignment 3 submission***<br>***Final Documentation submission*** |

## Assignment 1: Case Studies (Group)

**Choose ONE non-residential case and ONE residential case from below (Bachman, 2003):**

**List of Non-Residential Cases:**

**Office buildings:**

1. John Deere Headquarters
2. Willis Faber Dumas Insurance Headquarters
3. Briarcliff House
4. Lockheed Building

**High Tech Architecture:**

5. Centre Georges Pompidou
6. Sainsbury Centre for Visual Arts
7. Lloyd's of London

**Green Architecture:**

8. The Gregory Bateson Building
9. NMB Bank
10. Emerald People's Utility District Headquarters
11. Adam Joseph Lewis Center for Environmental Studies

**Laboratories:**

12. Richards Medical Research Building
13. Salk Institute for Biological Studies
14. Schlumberger Research Laboratory
15. PA Technology Laboratory
16. Wallace Earth Sciences Laboratory.

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**List of Residential Cases:**

1. The Eames House and Studio
2. Magney House
3. Experimental House at Almere
4. Two-Family House at Pullach

## Assignment 2: Anatomical Studies (Group)

**Choose ONE campus building from below:**
***(TBC with management offices)***

**Case A: 2 Sep**

School of Architecture,
Lee Shau Kee Architecture Building
香港中文大學建築學院

**Case B: 22 Sep (11:30am confirmed)**

University Library Complex
大學圖書館新翼大樓

**Case C: 23 Sep (2:30pm confirmed)**

Mei Yun Tang Student Hostel, New Asia College
梅雲堂學生宿舍，新亞書院

**Case D: 23 Sep (4:00pm confirmed)**

School of Journalism and Communication,
Humanities Building, New Asia College
新聞與傳播學院，新亞書院人文館

**Case E: 24 Sep (2:30pm confirmed)**

Pommerenke Student Centre, Chung Chi College
龐萬倫學生中心，崇基書院

**Case F: 24 Sep (4:00pm confirmed)**

Kunkle Student Centre, Chung Chi College
龔約翰學生中心，崇基書院

**Case G: 25 Sep (10:00am confirmed)**

Lo Kwee Seong Pavilion, Art Museum
文物館羅桂祥閣

| Grade | Descriptor | Criteria | Points |
|---|---|---|---|
| A | Excellent | Outstanding performance on all learning outcomes. | 4 |
| A- | Very Good | Generally outstanding performance on all (or almost all) learning outcomes. | 3.7 |
| B+ | Good | Substantial performance on all learning outcomes, OR high performance on some learning outcomes which compensates for less satisfactory performance on others, resulting in overall substantial performance. | 3.3 |
| B | | | 3 |
| B- | | | 2.7 |
| C+ | Fair | Satisfactory performance on the majority of learning outcomes, possibly with a few weaknesses. | 2.3 |
| C | | | 2 |
| C- | | | 1.7 |
| D+ | Pass | Barely satisfactory performance on a number of learning outcomes. | 1.3 |
| D | | | 1 |
| F | Failure | Unsatisfactory performance on a number of learning outcomes, OR failure to meet specified assessment requirements. | 0 |

# Written Feedback to Students

Term: _____ **Grade:** _____

Course Code: _____

Review: _____

Tutor: _____

Student Name: _____

Student ID: _____

**Feedback from Course Instructor:**

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|---|
| Achievements: |
| Challenges: |