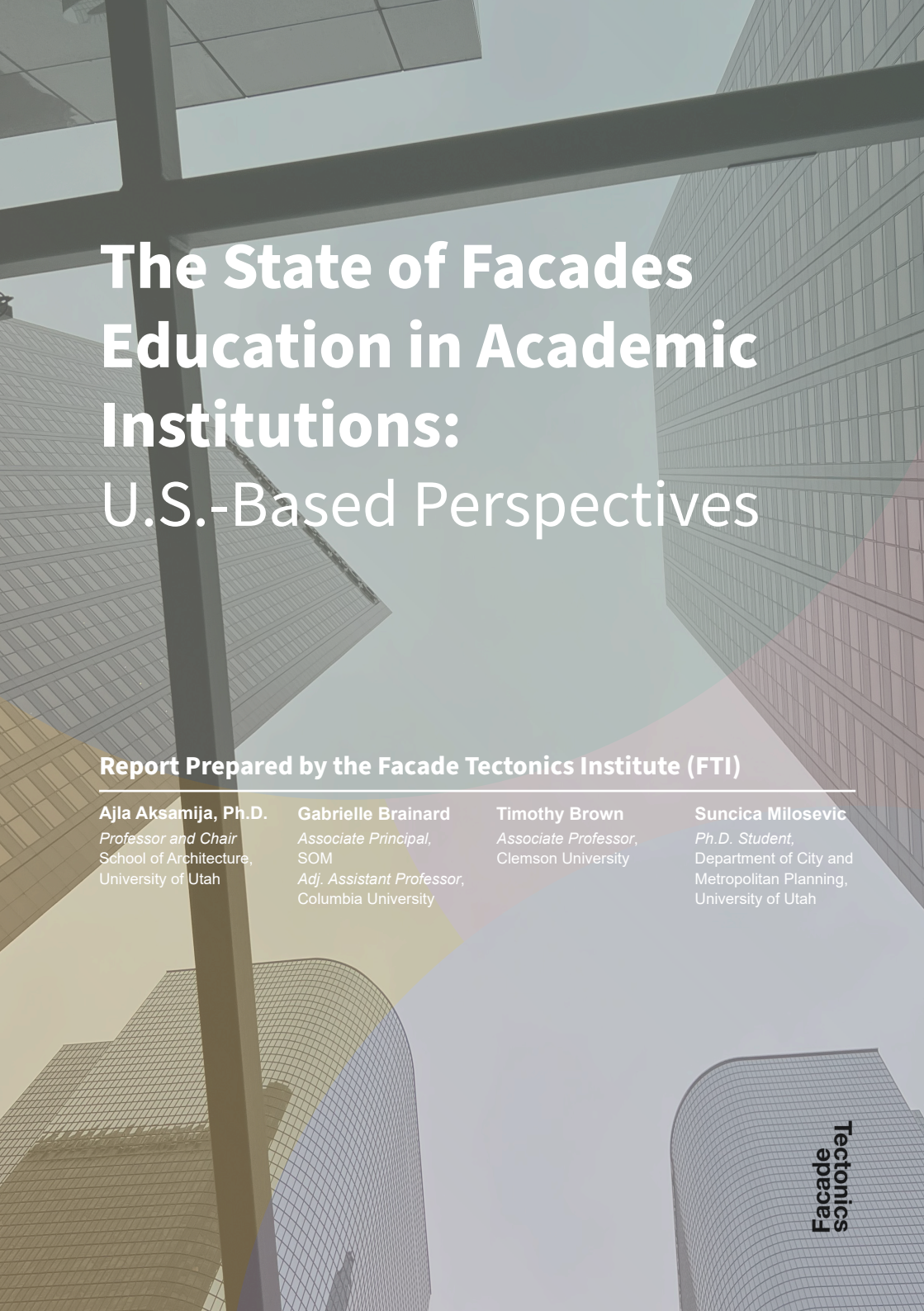

The State of Facades Education in Academic Institutions:
U.S.-Based Perspectives

Report Prepared by the Facade Tectonics Institute (FTI)

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Facade Tectonics

The Facade Tectonics Institute (FTI) is a non-profit member organization, whose primary mission is to advance the art, science, and technology of the building skin through research, practice, and education, including:

- Expanding recognition and understanding of the integral role the facade system plays in resilience, sustainability, energy efficiency, durability, health and productivity in buildings and urban habitat.
- Building a collaborative, facade-based action-oriented dialogue bridging industry silos and filling key knowledge gaps.
- Accelerating innovation and tangible improvements in buildings and urban habitat through strategic facade-based initiatives.
- Providing the industry-leading platform for building facade knowledge-sharing, communication and collaboration.

This report has been prepared by the FTI Eduction Committee. The mission of the FTI Education Committee is to advance educational programs and opportunities focusing on the design, engineering and construction of building facades for the FTI members, professionals and students. The committee is comprised of representatives from academic institutions and the profession, and as such aims to bridge the gap between the academia and industry in developing contemporary educational programs and opportunities.

Contents

Executive Summary:

This report outlines the results of a research study conducted by the Facade Tectonics Institute (FTI) Education Committee, focusing on the state of facades education at higher-education institutions across the United States. The objective was to identify coursework focusing on facades (or enclosure systems), and analyze how these courses relate to the overall curricula, educational content, and teaching methods at various universities. The study began by identifying universities that offer facade-related courses, and by administering a survey via the FTI membership, the Society of Building Science Educators, and the Building Technology Educators' Society. The survey asked participants to identify facades-related courses in their institutions, provide the course names and numbers, indicate course level (graduate or undergraduate), course format (studio, lecture, seminar) and the relation to the curriculum (elective or required course). Contact information for instructors was collected as well. Subsequently, syllabi were requested from instructors for each of the identified courses. Around seventy facade-related courses were identified in various North American programs. However, detailed information and course syllabi were collected for thirty-six facade-related courses offered by the U.S. higher-education institutions.

The next step of the research study involved quantitative and qualitative analysis of the submitted syllabi. The collected information was classified into different categories, including geographic regions, program type, course format, whether the courses are offered as part of a professional program, instructor type, identification of topics that are covered in various classes, learning outcomes, and course assessment methods.

The results indicate that the majority of the U.S. facade-related courses are offered in the East region, followed by the Midwest, West and Southeast region. Also, the majority of the courses are offered at institutions located in major metropolitan areas, and a slightly higher number of courses are offered by private institutions compared to public universities. Courses are predominantly graduate-level and elective courses, indicating that the pool of students who gain exposure and knowledge of facades and facade systems in the U.S. is significantly smaller than anticipated and alarmingly small given the importance of this subject matter.

The findings also indicate that U.S. architecture programs typically intertwine facade-related educational content into building technology lecture courses and integrated or comprehensive architecture design studios.

In order to improve the state of facade education in the U.S., it is necessary to expand course offerings that offer in-depth study of facade systems, design processes, physical behavior, structural analysis, technical detailing, materials, building performance analysis, etc. Courses that introduce emerging materials and facade technologies, new fabrication methods, as well as rapidly evolving construction techniques would greatly benefit the architectural/engineering/construction industry.

The recommendation for architectural programs is to carefully consider, especially in light of changing National Architectural Accrediting Board (NAAB) accreditation requirements, how technical topics are to be more fully integrated into curricula. For undergraduate pre-professional programs, introduction to basic principles of facade design is beneficial since this allows students to understand relationships between architectural design and building aesthetics, materials and assemblies, and to develop an understanding of the relationships between enclosure design and building performance. For NAAB accredited professional programs, deeper understanding about facades' design and performance, impact on building systems, integration with structure and HVAC/lighting systems, technical detailing, and emerging technologies is critical to prepare students for professional careers. Developing more specialized graduate programs, such as graduate certificate programs, Master of Science and Doctoral programs that focus on facades is necessary in order to expand research and development efforts, as well as the collective "state-of-knowledge" relating to facade systems.

1. Introduction, Objectives and Methodology

The mission of the FTI Education Committee is to advance educational programs focusing on the design, engineering and construction of building facades.

The FTI Education Committee initiated a research project in 2020, with the aim of identifying current facade-related coursework and educational opportunities offered by architecture programs at North American institutions of higher education. The overall objective was to investigate the current state of facades education in architecture programs, the types of courses that are being offered, and the teaching methods employed within a geographic context. For the purposes of this research facades are defined as any type of exterior wall.

Research questions that were addressed by the study are listed below:

- Which universities offer facades-related courses?
- What is the geographic distribution of these universities, and are these public or private institutions?
- Which topics are covered by facade-related courses? Who typically teaches these classes? Are these undergraduate or graduate courses? Are these pre-professional or professional degree programs? And are these required or elective courses?
- What types of teaching methods are utilized by faculty?

The study was initiated by first identifying universities that offer courses and programs based on our personal knowledge and FTI Education Committee's input. Then, a survey was distributed to wider FTI membership and two organizations (the Society of

Building Science Educators and the Building Technology Educators' Society) to reach a broader network of educators.

The survey asked participants to identify facades-related courses in their institutions, and these following questions:

- Name and contact information of instructor(s)
- Course name and course number for every identified course
- Course level (graduate or undergraduate)
- Course type (studio, lecture, seminar)
- Relation to curriculum (elective or required course).

We also asked instructors to share their course syllabi, if they wished to do so. Initially, around seventy courses offered by institutions in the United States and Canada were identified.

However, we collected detailed information and course syllabi for thirty-six courses offered in U.S. programs. Then, we proceeded with the quantitative and qualitative analysis of each submitted syllabus. The information that was collected was classified into different categories, including regions, instructor type (tenure-line or adjunct faculty), program type (pre-professional or professional), level (undergraduate or graduate), course format (lecture, seminar, or design studio), requirements in terms of the overall curriculum (required course or an elective), topics that are covered, learning outcomes and methods of the assessment. This data collection and analysis process are illustrated in **FIGURE 1**.

This report summarizes the outcomes of the study, outlines analysis results, and provides recommendations for improving educational opportunities for facades education.

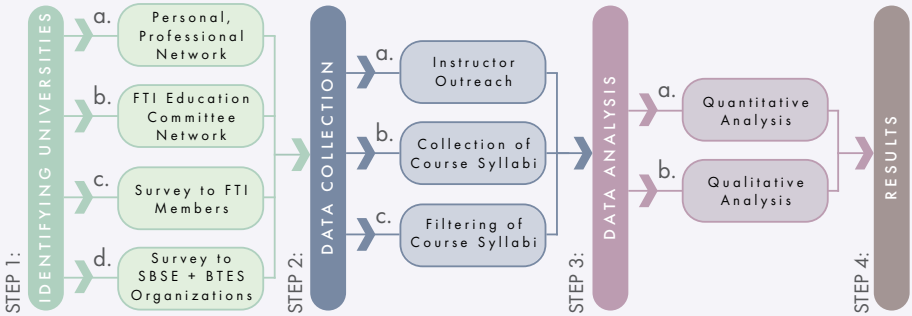


FIGURE 1: Data collection and analysis diagram.

2. Literature Review

2.1 Architecture Programs in the U.S.

Post-secondary architecture studies can be undertaken in both undergraduate and graduate degree programs. Undergraduate architecture programs include the five-year Bachelor of Architecture (B.ARCH) professional degree, and four-year pre-professional degrees which may grant a Bachelor of Arts or a Bachelor of Science degree. Pre-professional programs offer entry into Master programs with advanced standing and are commonly referred to as 4+2 programs.

As of September 2022, there were 54 NAAB accredited B.ARCH degree programs, and approximately 150 pre-professional undergraduate programs in the U.S.

Some institutions offer undergraduates professional and pre-professional program options but most schools offer one or the other, not both.
Apart from a single Doctor of Architecture program (University of Hawaii at Mānoa), the terminal degree for architecture education is the professional Master(s) of Architecture (M.ARCH).

As of September 2022, there were 115 NAAB accredited M.ARCH programs in the U.S.

Although not fully represented in this research report, there are a number of non-professional Master of Science (MSc) in Architecture programs, which are typically thesis-based and research intensive. These programs may address facade design but usually align with larger program emphases or faculty's areas of expertise.

2.2 Curricula

Because undergraduate BA/BS pre-professional programs are not accredited by NAAB, their curricula and specific programs of study vary widely between institutions. Degree requirements tend to include a large share of general education courses, STEM courses, field of study electives, free electives, and even minor degrees. Required architectural design studios, the curricular heart of U.S.

architectural education, may be a sequence of as few as five studios, or as many as eight studios. Architecture-specific coursework varies widely in both focus and depth of study. Given the breadth of curricular scope and credit hour limits, few of these pre-professional programs delve deeply into building construction, systems or technologies - including facade-related content.

In contrast, five-year professional B. ARCH programs are accredited by NAAB and therefore must satisfy specific curricular requirements. These programs tend to be more highly organized around the architectural design studio sequence and will typically require more architecture-specific coursework and a much wider range of technical content.

If undergraduate students are encountering facade-related courses it would likely be within a B.ARCH program rather than a pre-professional program.

Professional M. ARCH programs offer two degree paths: a nominal three-year path for students entering the field without an undergraduate degree in architectural studies, and a two-year path for students who have completed the BA or BS in Architecture degree. These programs are also accredited by NAAB based on specific educational outcomes and, like the B.ARCH programs, typically offer extensive coursework covering building technologies and systems.
Finally, the non-professional MSc in Architecture programs tend to draw students who have completed a B.ARCH program and are interested in focused thesis projects, students interested in moving into Ph.D. programs, and international students interested in advanced studies but not requiring U.S. credentials for professional practice abroad.

2.3 National Architectural Accrediting Board

The NAAB accreditation requirements concerning educational content and curricula are described in a set of Program Criteria (PC), and Student Criteria (SC).

The current NAAB 2020 Conditions for Accreditation and Procedures for Accreditation are markedly different from prior versions in the shift from specific criteria to fewer and much more general criteria. The immediate prior 2014 Conditions for Accreditation had twenty-six Student Performance Criteria across four topic areas. (The syllabi included in this research project typically reference the 2014 or 2020 versions as appropriate.)

The current 2020 requirements are organized around six SC and eight PC. 2020 requirements that relate, directly or tangentially, to facades and enclosure systems are the following:

- **PC.5 Research and Innovation**: How the program prepares students to engage and participate in architectural research to test and evaluate innovations in the field.

- **SC.4 Technical Knowledge**: How the program ensures that students understand the established and emerging systems, technologies, and assemblies of building construction, and the methods and criteria architects use to assess those technologies against the design, economics, and performance objectives of projects.

- **SC.6 Building Integration**: How the program ensures that students develop the ability to make design decisions within architectural projects while demonstrating integration of building envelope systems and assemblies, structural systems, environmental control systems, life safety systems, and the measurable outcomes of building performance.

Over time, the educational material that programs are required to cover has become broader but has also moved away from heavy concentration on technical knowledge.

For comparison, the Student Performance Criteria from the NAAB 2014 Conditions for Accreditation related to facades are listed below:

- **B.4 Technical Documentation:** Ability to make technically clear drawings, prepare outline specifications, and construct models illustrating and identifying the assembly of materials, systems, and components appropriate for a building design.

- **B.6 Environmental Systems:** Ability to demonstrate the principles of environmental systems' design, how design criteria can vary by geographic region, and the tools used for performance assessment. This demonstration must include active and passive heating and cooling, solar geometry, daylighting, natural ventilation, indoor air quality, solar systems, lighting systems, and acoustics.

- **B.7 Building Envelope Systems and Assemblies:**
  Understanding of the basic principles involved in the appropriate selection and application of building envelope systems relative to fundamental performance, aesthetics, moisture transfer, durability, and energy and material resources.

- **B.8 Building Materials and Assemblies:**
  Understanding of the basic principles used in the appropriate selection of interior and exterior construction materials, finishes, products, components, and assemblies based on their inherent performance, including environmental impact and reuse.

- **B.9 Building Service Systems:**
  Understanding of the basic principles and appropriate application and performance of building service systems, including lighting, mechanical, plumbing, electrical, communication, vertical transportation, security, and fire protection systems.

- **B.10 Financial Considerations:**
  Understanding of the fundamentals of building costs, which must include project financing methods and feasibility, construction cost estimating, construction scheduling, operational costs, and life-cycle costs.

- **C.1 Research:**
  Understanding of the theoretical and applied research methodologies and practices used during the design process.

- **C.2 Integrated Evaluations and Decision-Making Design Process:**
  Ability to demonstrate the skills associated with making integrated decisions across multiple systems and variables in the completion of a design project. This demonstration includes problem identification, setting evaluative criteria, analyzing solutions, and predicting the effectiveness of implementation.

- **C.3 Integrative Design:**
  Ability to make design decisions within a complex architectural project while demonstrating broad integration and consideration of environmental stewardship, technical documentation, accessibility, site conditions, life safety, environmental systems, structural systems, and building envelope systems and assemblies.

The most challenging question is whether evolving NAAB accreditation requirements will expect B.ARCH and M.ARCH programs to offer coursework addressing buildings' materiality, construction, assemblies, or technical systems.

2.4 Beyond Graduation: Internship

Internship was not included in this research study but each state requires successful completion of a formal internship/apprenticeship program for architectural licensure, so this period should be considered as a critical component of an architect's educational path. The National Council of Architectural Registration Boards (NCARB) administers the national Architecture Experience Program (AXP), which requires completion of ninety-six "tasks" spread across six experience "areas".

Only a few requirements refer in any way to facade or enclosure systems and all are in the Project Planning and Design area:

- Select materials, finishes, and systems based on technical properties and aesthetic requirements.
- Determine design parameters for building engineering systems.
- Oversee design integration of building components and systems.
- Understand implications of evolving sustainable design strategies and technologies.

If NCARB, like NAAB, is moving towards more generalist educational standards, where will emerging professionals learn about complex building technology and systems design, such as facades?

3. Results

3.1 Quantitative Analysis:

The total number of course syllabi analyzed that either focus on facades (as a stand-alone course) or integrate facades in other courses was thirty-six, all located in the United States. This accounts for 31% of accredited M.ARCH programs in the United States; the authors recognize the limitation of the data set, and acknowledge that there may be other courses offered in different institutions but that were not identified during the data collection process.

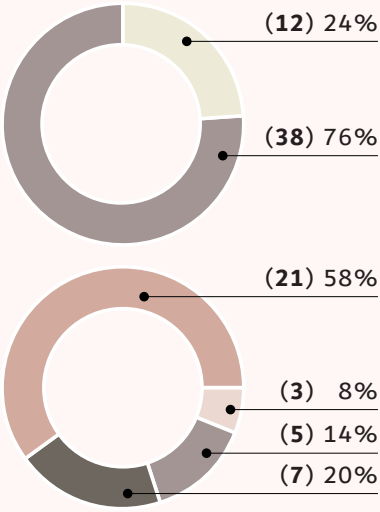
All of these courses were taught during the span of fall semester 2019 through spring semester of 2023. The following figures illustrate some of the general, quantitative patterns regarding the current state of facades education in the U.S. The complete table of results is included in the appendix of this report (see **TABLES 1 and 2**).

FIGURE 2 graphs illustrate that facade-related courses, which were identified in this study, are taught in 12 of the 50 U.S. states, of which the majority are located in the East region (21 courses), followed by the Midwest region (7 courses), then the West region (5 courses), and lastly the Southeast region (3 courses).

As shown in the following figures, **FIGURES 3 and 4**, a higher number of facade-related courses are taught in large, major U.S. cities and metropolitan areas.

Among the evaluated courses, the predominant cities were New York City (9 courses), Philadelphia (6 courses), Chicago (3 courses), and Los Angeles (2 courses).

FIGURE 4 also shows that the distribution of facade-related courses between private and public universities is close to equal; however, private universities are slightly leading, with 53%. Seven of the evaluated facade course syllabi are taught among four Ivy League schools (Columbia University, Harvard University, Princeton University, and University of Pennsylvania), accounting for 20% of results (see **TABLE 1 and 2**).



KEY:

(**# Courses**) % Courses of 36 TOTAL

COLOR LEGEND:

- U.S. States with Facade Education
- U.S. States without Facade Education
- Facade Courses in **U.S. EAST**
- Facade Courses in **U.S. SOUTHEAST**
- Facade Courses in **U.S. WEST**
- Facade Courses in **U.S. MIDWEST**

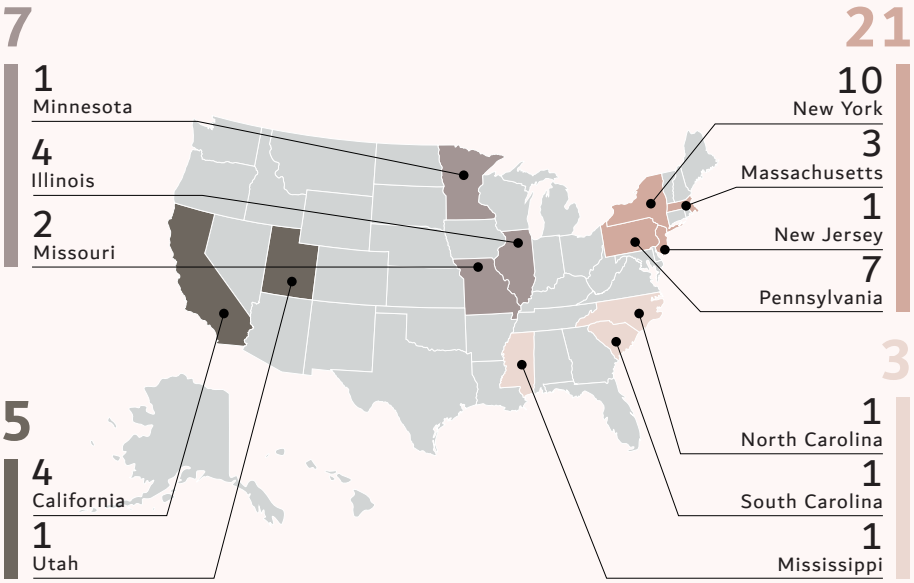


FIGURE 2: Distribution of facade-related courses in the U.S. by geographic regions.

KEY:

(**# Courses**) % Courses of 36 TOTAL

COLOR LEGEND:

- **REGIONAL U.S.** Locations
- **URBAN U.S.** Locations
- **PUBLIC UNIVERSITIES**
- **PRIVATE UNIVERSITIES**
- **NON-IVY LEAGUE UNIVERSITIES**
- **IVY LEAGUE UNIVERSITIES**

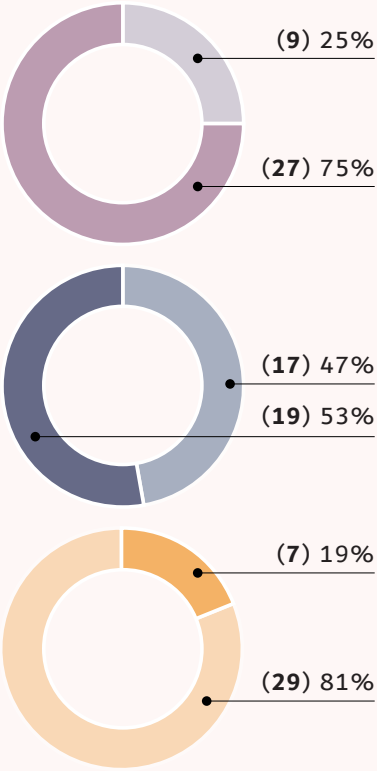


FIGURE 3: Distribution of facade-related courses between regional and urban locations, and between public and private universities in the U.S.

Meanwhile, **FIGURE 5** graphs illustrate that facade-related courses in the U.S. are predominantly graduate-level, elective courses that are taught primarily within the architectural discipline departments.

These results show that the pool of students who gain exposure and knowledge of facades and facade systems in the U.S. is significantly smaller than anticipated and alarmingly small given the importance of this subject matter.

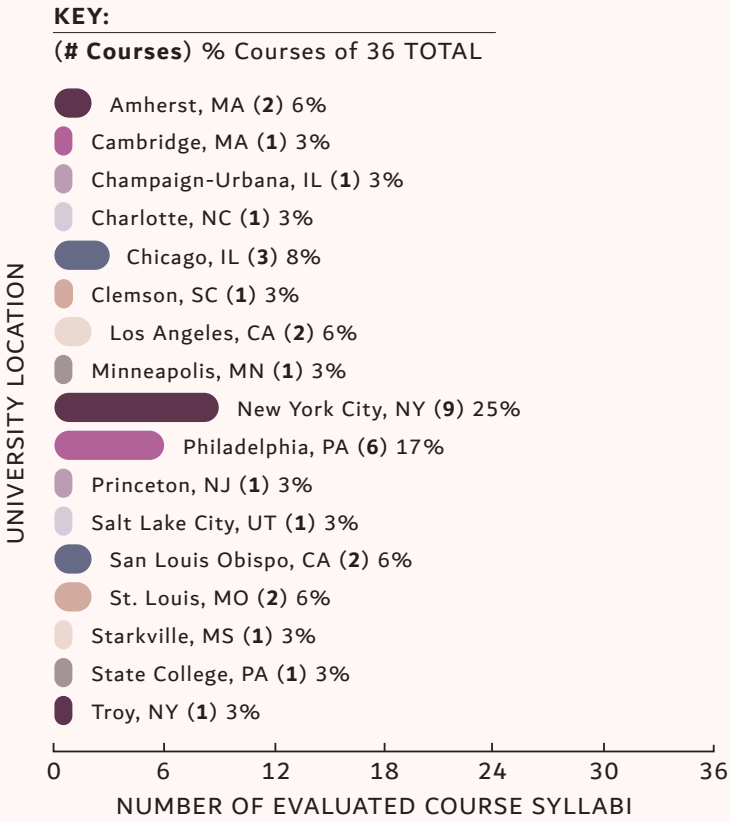


FIGURE 4: Distribution of facade-related courses among specific town or city locations in the U.S.

Additionally, as the courses are predominantly graduate-level and elective courses, the pool of students who have exposure to these courses is even smaller. This may also reflect on the financial ability required to pursue an advanced graduate degree, which in the U.S. may range from 2 to 4 additional years of higher education. Even then, these courses are mostly optional.

This means that the majority of university students in the U.S. may complete their architectural degrees and pursue their professional careers without specific knowledge of facades.

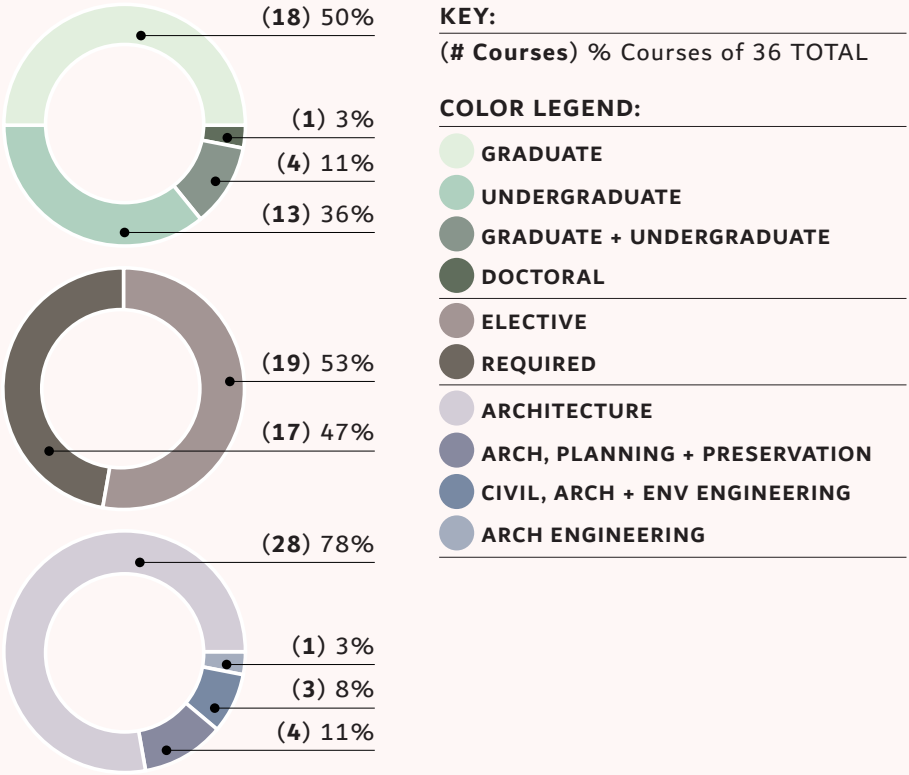


FIGURE 5: Distribution of facade-related courses between course level tiers, between elective and required courses, and between discipline departments in the U.S.

As shown in **FIGURE 6**, among the facade-related courses that are taught in the U.S., not all of them are specifically focused on facades or facade systems. This may include only a single ninety-minute lecture on facade systems. **FIGURE 6** also shows that the majority of the facade-related courses in the U.S. are taught by full-time, tenure-line faculty.

For roughly one-third of these courses (36%), facades education is an integrated, partial component to an overarching topic of the course.

However, a very large proportion of these courses (44%) are taught by adjunct faculty who are professionals in the architectural and related fields and may teach these courses out of a passion for these topics. This may be a reflection of the lack of resources among some of these universities to hire full-time faculty with expertise in facades.

Looking at the course structure chart in **FIGURE 7** and the course evaluation chart in **FIGURE 8**, the majority of facade education courses are structured as lecture courses (92%) that include a design project (92%) with presentations of those results (89%). Another trend observed in the results was that courses tended to integrate workshops (56%), which mostly involved demonstrations and tutorials on computational and simulation software. This was followed by a significant number of courses that integrated field visits and tours (36%), which involved sites for precedent analysis, sites for the assigned design projects, and sites of manufacturing and testing facilities.

Of the evaluated courses, only about one-third (28%) were structured as traditional design studios. Additionally, about half of the courses included verbal discussions (50%), reading assignments (58%), writing assignments (44%), and the production of drawing assignments (47%).

Very few facade-related courses assess student knowledge through quizzes or exams; rather, the primary graded component includes design projects, which may be a reflection of the nature of these courses that focus on real-world applications and design methods used in the architectural and engineering industries.

The course topics chart in **FIGURE 9** illustrates a more detailed breakdown of all the facade-related topics that have been implemented in the course descriptions and course assignments of the evaluated syllabi.

It shows that the majority of facade-related courses in the U.S. focus on facade materials and material assemblies (89%), general knowledge of facade systems and their design (81%), and environmental response and analysis (81%).

Similarly, 75% of evaluated courses integrate precedent research and analysis for either historic or contemporary facades and facade systems, and more than half of the evaluated courses focus on technical drawing and documentation of facade systems (58%) and the integration of facade systems with other building systems (56%).

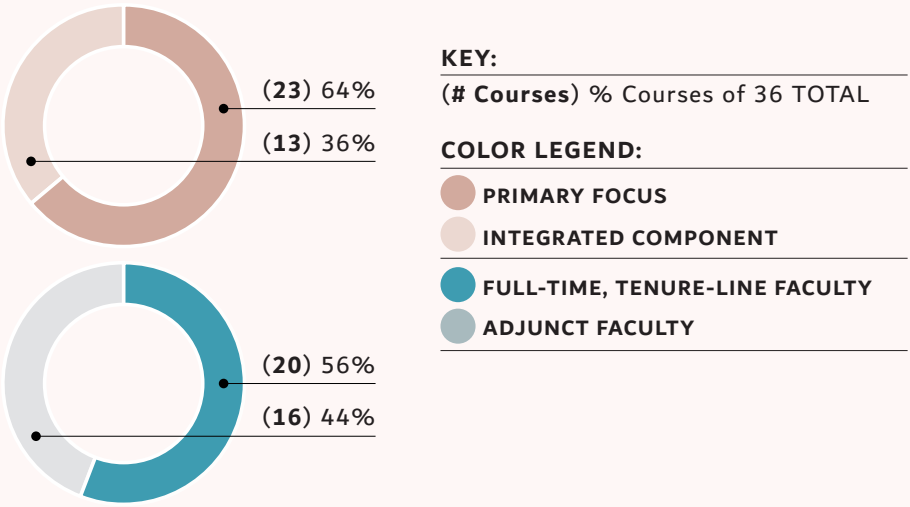


FIGURE 6: Distribution of facade-related courses between a primary focus on facades and an integrated component on facades, and between courses that are taught by full-time, tenure-line faculty and adjunct faculty in the U.S.

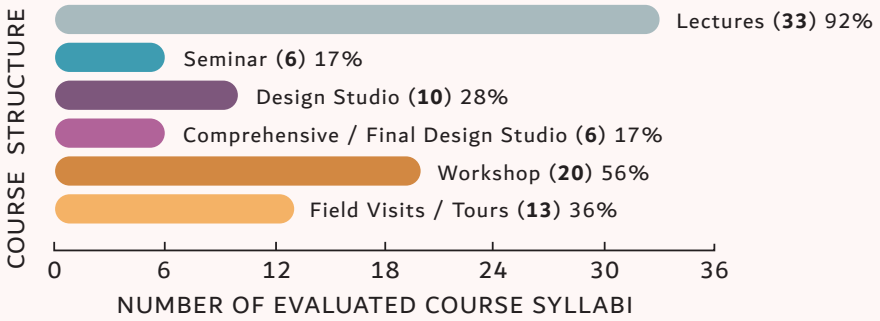


FIGURE 7: Course structure chart for facade-related courses in the U.S.

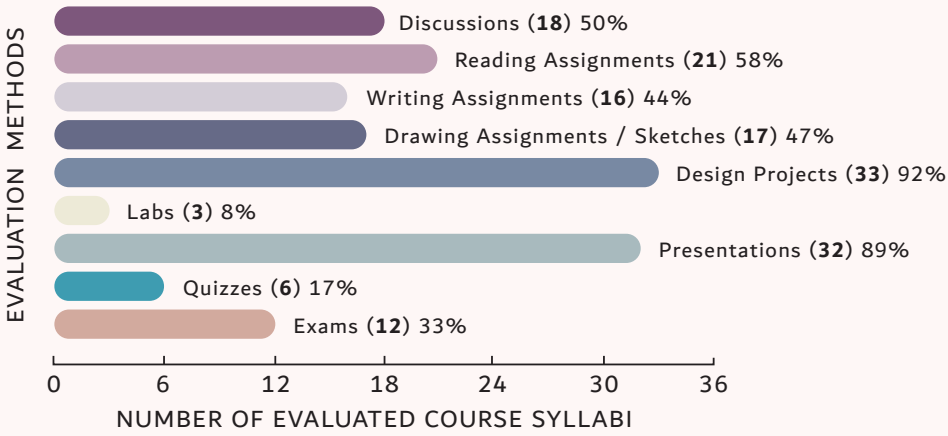


FIGURE 8: Course evaluation methods chart for facade-related courses in the U.S.

About half of the evaluated courses focus on computational modeling (50%). Meanwhile, less than half of the evaluated courses integrate performance simulations (42%), sustainability and mitigation of the effects of climate change (47%), and building codes and standards, including fire safety (42%).

Less than half of the evaluated courses focused on facade system detailing or tectonics (44%).

Limited integrated course topics were topics related to historic facades such as facade history (22%), retrofit facade design (19%), vernacular techniques (8%), and ornamentation (3%), which shows that the focus on current facades education in the U.S. is on contemporary buildings and new construction design.

Results also show that topics of cultural sensitivity, inclusive design and accessibility, and waste reduction or recycling were only covered in 1 of all evaluated course syllabi (3%).

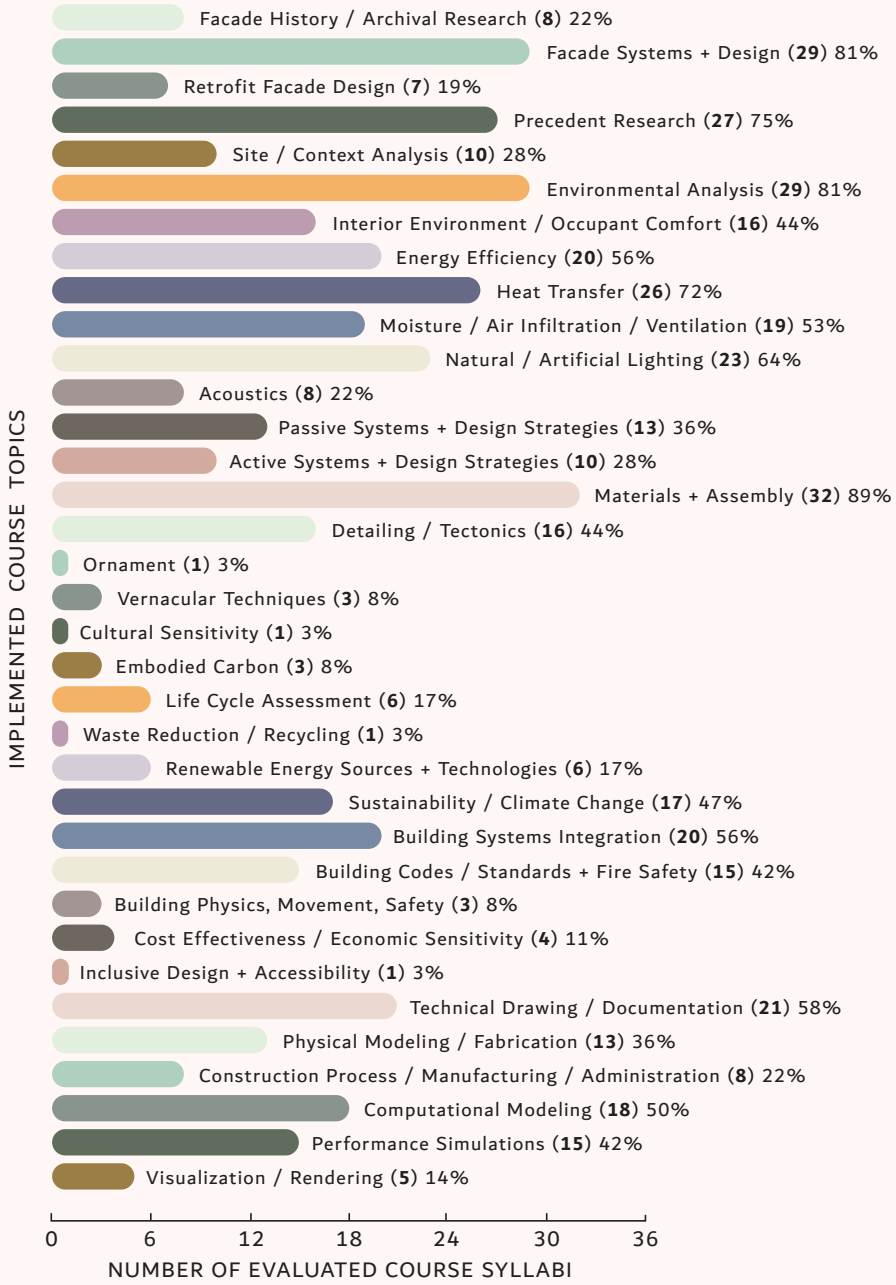


FIGURE 9: Implemented course topics for facade-related courses in the U.S.

3.2 Qualitative Analysis:

The analyzed courses fall into four major categories:

1. **Building technology lecture course:**
   This is typically a required lecture course (2-4 credit hours) in which enclosure materials and systems are presented as a module within a broader technology course. These courses are often organized around building materials (concrete, masonry, earth, metals, stone, glass) or building systems (structural systems, enclosure systems, mechanical systems). Enclosures may be addressed via their materials (concrete, brick, terracotta, glazing, metal panel, GFRC, etc.) or their system typologies (mass wall, barrier wall, rainscreen, window wall, curtain wall).

   Typically, these courses introduce common building materials and their origins, and explore how materials are combined into assemblies that achieve specific performance criteria, including structural and environmental performance. Materials and detailing of building assemblies are explored through case studies, orthographic drawing, and modeling. These courses are fact-based and may use quizzes and exams as methods of assessment. The required building technology lecture course in B. ARCH and M.ARCH programs typically addresses technical NAAB criteria and is often designed to complement and reinforce the content of the integration studio.

2. **Integration studio + Technical course:**
   The terminal architectural design studio, also known as a capstone or comprehensive studio, addresses comprehensive building design with a focus on the technical resolution of building systems and their integration into a functional whole. Enclosure systems are typically one of many building systems that may be addressed in a comprehensive studio, such as structural/HVAC/lighting systems, accessibility, and life safety.

   These studios treat systems and assemblies as a studio module so enclosures material might be delivered in concert with the project development phase. A co-requisite technical lecture course may be offered concurrently with the comprehensive design studio. Case study research and analysis help develop the studio design and technical detailing at the same time, or students may revisit a

design project from a previous semester with a technical lens. Instructors are often subject matter experts drawn from the adjunct faculty pool, which may include practicing facade specialists depending on the location of the school. The deliverable is typically a set of "construction documents" modeled on a drawing set from a professional environment. The integration studio (with or without a co-requisite technical course) has typically satisfied a number of the NAAB Student Performance Criteria.

3. **Facade elective:**
   The last, and most diverse category of courses are the facade electives. These optional courses (2-3 credit hours) cover a wide range of topics related to the building enclosure, including history and theory of facade design, environmental simulation, parametric design, architectonics, technical detailing, and building science.

   These courses may be taught by either tenure-line or adjunct faculty, but typically reflect the professional and/or research interests of the instructor. And they may be offered in various formats, such as lecture, seminar, or workshops. For this reason, the course content is highly variable and subject to frequent change. While elective courses may offer a comprehensive introduction to building enclosure systems and design, they are only taken by a small fraction of students in any graduating class. As elective courses they typically do not address the NAAB criteria for professional degree programs.

4. **Other courses:**
   Content on enclosure systems may be found outside the course types noted above, for example within lecture courses on environmental control systems, within core or advanced studios, or in courses offered by other university departments. This "distributed" content is more difficult to identify based on course syllabi alone, and therefore may be under-represented in our dataset.

4. Conclusion and Recommendations

The findings of this research study indicate that architectural programs in the United States typically integrate educational materials on exterior wall systems into building technology lecture courses and integrated design studios.

Undergraduate students in B.ARCH programs have many more options for facade-related courses than those undergraduates studying in pre-professional programs. There are very few stand-alone elective courses focusing on facades. Those that exist are likely offered in professional programs (B.ARCH and M.ARCH) located at urban sites with ready access to active professionals having specific technical backgrounds in facade systems. Moreover, graduate programs that solely focus on facades (such as specialized MSc programs or graduate certificates) are very rare.

In order to improve the state of facade education in the U.S. it is necessary to expand course offerings that offer in-depth study of facade systems, design processes, physical behavior, structural analysis, technical detailing, materials, building performance analysis, etc.

Courses that introduce emerging materials and facade technologies, new fabrication methods, as well as rapidly evolving construction techniques would greatly benefit the architectural/engineering/construction industry.

The recommendation for architectural programs is to carefully consider, especially in light of changing NAAB accreditation requirements, how technical topics are to be more fully integrated into curricula.

For undergraduate pre-professional programs, introduction to basic principles of facade design is beneficial since this allows students to understand relationships between

architectural design and building aesthetics, materials and assemblies, and to develop an understanding of the relationships between enclosure design and building performance.

For NAAB accredited professional programs, deeper understanding of facades' design and performance, impact on building systems, integration with structure and HVAC/ lighting systems, technical detailing, and emerging technologies is critical to prepare students for professional careers.

Developing more specialized graduate programs, such as graduate certificate programs, Master of Science and Doctoral programs, that focus on facades is necessary in order to expand research and development efforts, as well as the collective "state-of-knowledge" relating to facade systems.

References:

1. National Architectural Accrediting Board, 2020 Conditions for Accreditation
2. National Architectural Accrediting Board, 2014 Conditions for Accreditation
3. National Council of Architectural Registration Boards, Architecture Experience Program

Acknowledgements:

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Appendix:

The following pages include summary tables, **TABLES 1 and 2**, of collected data for facade-related course syllabi.

Table 1: *Facade-related course syllabi results (part 1/2)*

#	Course Title	University	US Region	State	City / Town	Regional / Urban	Private / Public	Course Level	Required / Elective	Education Department
1	***Architectural Systems Integration 3.3***	California Polytechnic State University	West	California	San Louis Obispo	regional	public	undergraduate	required	architecture
2	***Architectural Technology Fundamentals 2.3***	California Polytechnic State University	West	California	San Louis Obispo	regional	public	undergraduate	required	architecture
3	***High-Performance Facade and Building Design***	City University of New York	East	New York	New York City	urban	public	undergraduate	required	architecture
4	***Building Performance Workshop***	City University of New York	East	New York	New York City	urban	public	undergraduate	elective	architecture
5	***Facade Design Studio***	City University of New York	East	New York	New York City	urban	public	undergraduate	required	architecture
6	***Reinventing Environmental Systems Design***	University of Pennsylvania	East	Pennsylvania	Philadelphia	urban	private	graduate	elective	architecture
7	***Advanced Curtain Wall***	Columbia University	East	New York	New York City	urban	private	graduate	elective	architecture, planning + preservation
8	***Facade Detailing: A Material Understanding***	Columbia University	East	New York	New York City	urban	private	graduate	elective	architecture, planning + preservation
9	***Building Envelope Systems***	Drexel University	East	Pennsylvania	Philadelphia	urban	private	undergraduate	elective	civil, architectural + environmental engineering
10	***Optimizing Facade Performance: A Deep Dive on Design Decisions***	Harvard University	East	Massachusetts	Cambridge	urban	private	graduate	elective	architecture
11	***Architectural Technology 3: Envelopes***	Columbia University	East	New York	New York City	urban	private	graduate	required	architecture, planning + preservation
12	***Building Enclosure Design***	Illinois Institute of Technology	Midwest	Illinois	Chicago	urban	private	graduate + undergraduate	elective	civil, architectural + environmental engineering
13	***Building Envelope Rehabilitation***	Illinois Institute of Technology	Midwest	Illinois	Chicago	urban	private	graduate	elective	civil, architectural + environmental engineering
14	***Digital Documentation: Facades***	University of Minnesota Twin Cities	Midwest	Minnesota	Minneapolis	urban	public	graduate	elective	architecture
15	***Enclosures: Selection, Affinities & Integration***	University of Pennsylvania	East	Pennsylvania	Philadelphia	urban	private	graduate	elective	architecture
16	***Building Enclosure Science and Design***	Penn State	East	Pennsylvania	State College	regional	public	graduate	elective	architectural engineering
17	***The Tectonics of Complex Facades and their Materials***	Southern California Institute of Architecture	West	California	Los Angeles	urban	private	undergraduate	elective	architecture

18	***Contemporary Facade Design***	Princeton University	East	New Jersey	Princeton	urban	private	graduate	elective	architecture
19	***Art of the Detail***	Temple University	East	Pennsylvania	Philadelphia	urban	public	undergraduate	elective	architecture
20	***Experimental Envelopes***	University of Illinois Urbana-Champaign	Midwest	Illinois	Champaign-Urbana	regional	public	graduate	elective	architecture
21	***Sustainable and High-Performance Facades***	University of Massachusetts Amherst	East	Massachusetts	Amherst	regional	public	graduate + undergraduate	elective	architecture
22	***Build Test Iterate Repeat***	University of North Carolina Charlotte	Southeast	North Carolina	Charlotte	urban	public	undergraduate	elective	architecture
23	***Advanced Surface Tectonics: Methods in Materials & Enclosures***	University of Southern California	West	California	Los Angeles	urban	private	post professional / doctoral	elective	architecture
24	***Building Integration***	Columbia University	East	New York	New York City	urban	private	graduate	required	architecture, planning + preservation
25	***Environment and Building Systems I***	Illinois Institute of Technology	Midwest	Illinois	Chicago	urban	private	undergraduate	required	architecture
26	***Passive Building Systems***	Mississippi State University	Southeast	Mississippi	Starkville	regional	public	undergraduate	required	architecture
27	***Integrated Building Systems***	Pratt Institute	East	New York	New York City	urban	private	graduate	required	architecture
28	***Materials and Assemblies***	Pratt Institute	East	New York	New York City	urban	private	graduate	required	architecture
29	***Materials and Enclosures***	Rensselaer Polytechnic Institute	East	New York	Troy	regional	private	graduate + undergraduate	required	architecture
30	***Architecture Technology and the Environment***	Temple University	East	Pennsylvania	Philadelphia	urban	public	undergraduate	required	architecture
31	***Integration Studio***	University of Massachusetts Amherst	East	Massachusetts	Amherst	regional	public	graduate	required	architecture
32	***Comprehensive Design Studio***	Temple University	East	Pennsylvania	Philadelphia	urban	public	graduate	required	architecture
33	***Advanced Building Systems***	Washington University	Midwest	Missouri	St. Louis	urban	private	graduate	required	architecture
34	***Environmental Systems II***	Washington University	Midwest	Missouri	St. Louis	urban	private	undergraduate	required	architecture
35	***Comprehensive Building Technology II***	University of Utah	West	Utah	Salt Lake City	urban	public	graduate	required	architecture
36	***Facades / Skins / Enclosures***	Clemson University	Southeast	South Carolina	Clemson	regional	public	graduate + undergraduate	elective	architecture

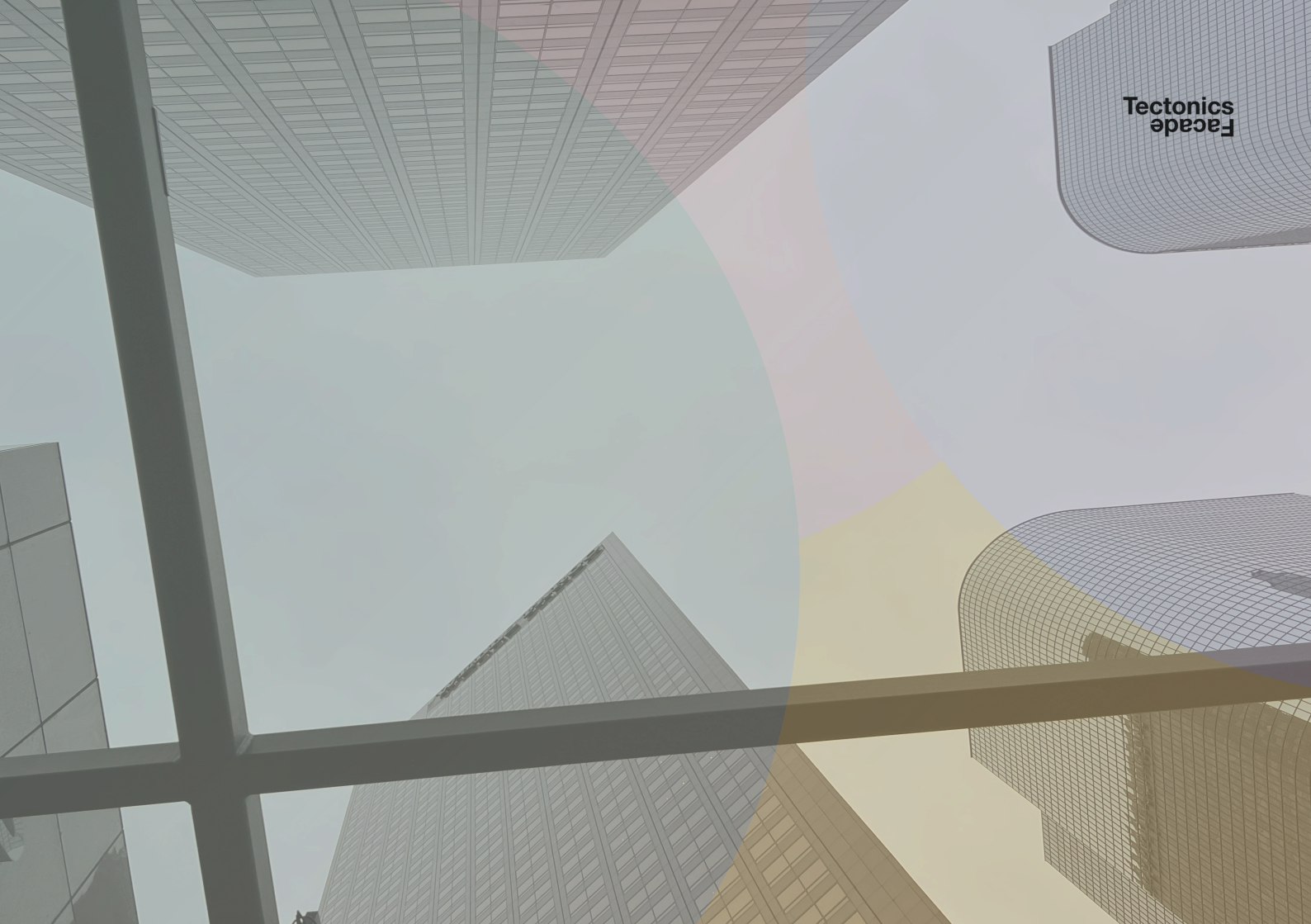
Table 2: *Facade-related course syllabi results (part 2/2)*

#	Course Title	*Primary vs. Integrated Facade Education*	*Faculty Status*	*General Format*	*Evaluation Methods*	*Implemented Course Topics*
1	***Architectural Systems Integration 3.3***	primary focus	full-time, tenure-line faculty	lectures, workshop, field visits / tours	discussions, reading assignments, design projects, labs, presentations / reviews, quizzes, exams	Facade Design, Facade Systems, Environmental Response, Interior Environment Control, Moisture Resistance, Lighting, Acoustics, Ventilation, Passive Strategies, Active Strategies, Detailing, Materials, Technical Drawing / Documentation, Building Systems Integration
2	***Architectural Technology Fundamentals 2.3***	integrated component	full-time, tenure-line faculty	lectures, workshop	discussions, reading, drawings / sketches, labs, presentations / reviews, exams	Facade Design, Facade Systems, Environmental Response, Interior Environment Control, Energy-efficiency, Moisture Resistance, Heat Transfer, Materials, Technologies, Renewable Energy Sources, Computational Modeling, Sustainability, Building Code(s) / Fire Safety, Site / Context Analysis
3	***High-Performance Facade and Building Design***	integrated component	full-time, tenure-line faculty	comprehensive / final design studio, field visits / tours	discussions, reading, design projects, presentations / reviews	Facade Design, Facade Systems, Environmental Response, Interior Environment Control, Occupant Comfort, Lighting, Ventilation, Fabrication / Physical Modeling, Technical Drawing / Documentation, Computational Modeling, Energy Modeling, Performance Calculations, Computational Simulations, Sustainability, Visualization / Rendering, Building Systems Integration, Precedent Research
4	***Building Performance Workshop***	primary focus	full-time, tenure-line faculty	lectures, workshop	design projects, presentations / reviews, quizzes	Facade Design, Facade Systems, Environmental Response, Interior Environment Control, Occupant Comfort, Energy-efficiency, Heat Transfer, Lighting, Ventilation, Passive Strategies, Materials, Technologies, Computational Modeling, Energy Modeling, Performance Calculations, Computational Simulations, Sustainability, Climate Change Mitigation, Vernacular Techniques, Field Surveys, Empirical Analysis, Archival Analysis, Precedent Research
5	***Facade Design Studio***	primary focus	adjunct faculty	lectures, workshop, comprehensive / final design studio	discussions, reading, design projects, presentations / reviews	Facade Design, Retrofits, New Design, Facade Systems, Environmental Response, Interior Environment Control, Occupant Comfort, Energy-efficiency, Heat Transfer, Lighting, Detailing, Materials, Embodied Carbon, Fabrication / Physical Modeling, Technical Drawing / Documentation, Computational Modeling, Sustainability, Building Systems Integration, Precedent Research, Site / Context Analysis, Structural Systems
6	***Reinventing Environmental Systems Design***	primary focus	adjunct faculty	lectures, workshop	drawings / sketches, design projects, presentations / reviews	Facade History, Facade Design, New Design, Facade Systems, Environmental Response, Occupant Comfort, Energy-efficiency, Heat Transfer, Lighting, Ventilation, Passive Strategies, Active Strategies, Embodied Carbon, Technologies, Fabrication / Physical Modeling, Computational Modeling, Performance Calculations, Computational Simulations, Sustainability, Climate Change Mitigation, Building Code(s) / Fire Safety, Precedent Research, Economical Sensitivity
7	***Advanced Curtain Wall***	primary focus	adjunct faculty	lectures, workshop, design studio, field visits / tours	discussions, reading, writing, drawings / sketches, design projects, presentations / reviews, exams	Facade Design, Facade Systems, Detailing, Materials, Technologies, Technical Drawing / Documentation, Precedent Research, Construction Administration
8	***Facade Detailing: A Material Understanding***	primary focus	adjunct faculty	lectures, workshop	drawings / sketches, design projects, presentations / reviews	Facade Design, Environmental Response, Heat Transfer, Detailing, Materials, Fabrication / Physical Modeling, Technical Drawing / Documentation, Precedent Research, Manufacturing and Construction

9	***Building Envelope Systems***	primary focus	adjunct faculty	lectures, workshop	discussions, writing, drawings / sketches, design projects, presentations / reviews, exams	Facade Design, Retrofits, New Design, Facade Systems, Environmental Response, Interior Environment Control, Occupant Comfort, Energy-efficiency, Moisture Resistance, Heat Transfer, Lighting, Detailing, Materials, Technologies, Renewable Energy Sources, Technical Drawing / Documentation, Performance Calculations, Computational Simulations, Building Systems Integration, Building Code(s) / Fire Safety, Precedent Research, Site / Context Analysis, Construction, Life-cycle Assessment
10	***Optimizing Facade Performance: A Deep Dive on Design Decisions***	primary focus	adjunct faculty	lectures, workshop, field visits / tours	discussions, design projects, presentations / reviews	Facade Design, New Design, Facade Systems, Environmental Response, Interior Environment Control, Occupant Comfort, Energy-efficiency, Moisture Resistance, Heat Transfer, Lighting, Ventilation, Computational Modeling, Energy Modeling, Performance Calculations, Computational Simulations, Precedent Research, Life-cycle Assessment
11	***Architectural Technology 3: Envelopes***	primary focus	adjunct faculty	lectures, workshop, design studio, field visits / tours	writing, drawings / sketches, design projects, presentations / reviews, quizzes	Facade Design, Facade Systems, Heat Transfer, Materials, Technologies, Fabrication / Physical Modeling, Technical Drawing / Documentation, Performance Calculations, Building Systems Integration, Construction Administration, Economic Sensitivity
12	***Building Enclosure Design***	primary focus	adjunct faculty	lectures	reading, writing, design projects, presentations / reviews	Facade Design, Retrofits, New Design, Environmental Response, Interior Environment Control, Occupant Comfort, Energy-efficiency, Moisture Resistance, Heat Transfer, Lighting, Acoustics, Ventilation, Materials, Technologies, Energy Modeling, Performance Calculations, Computational Simulations, Building Code(s) / Fire Safety, Field Surveys, Empirical Analysis, Archival Analysis, Precedent Research, Site / Context Analysis, Building Movements, Deterioration, Life-cycle Assessment, Economic Sensitivity
13	***Building Envelope Rehabilitation***	primary focus	full-time, tenure-line faculty	lectures, workshop, field visits / tours	discussions, writing, drawings / sketches, design projects, presentations / reviews, exams	Facade Design, Retrofits, Facade Systems, Energy-efficiency, Moisture Resistance, Heat Transfer, Detailing, Materials, Sustainability, Building Code(s) / Fire Safety, Field Surveys, Empirical Analysis, Archival Analysis, Precedent Research, Repair Methods, Structural Design, Life-cycle Assessment
14	***Digital Documentation: Facades***	primary focus	adjunct faculty	lectures, seminar, workshop	discussions, reading, drawings / sketches, design projects, exams	Facade History, Facade Design, Retrofits, Facade Systems, Detailing, Materials, Technical Drawing / Documentation, Computational Modeling, Building Systems Integration, Archival Analysis, Precedent Research
15	***Enclosures: Selection, Affinities & Integration***	primary focus	adjunct faculty	lectures, seminar	drawings / sketches, design projects presentations / reviews	Facade History, Facade Design, New Design, Facade Systems, Environmental Response, Energy-efficiency, Heat Transfer, Lighting, Acoustics, Passive Strategies, Active Strategies, Detailing, Materials, Renewable Energy Sources, Technical Drawing / Documentation, Sustainability, Building Systems Integration, Building Code(s) / Fire Safety, Archival Analysis, Precedent Research, Construction
16	***Building Enclosure Science and Design***	primary focus	full-time, tenure-line faculty	lectures	writing, design projects, exams	Facade Systems, Environmental Response, Interior Environment Control, Energy-efficiency, Moisture Resistance, Heat Transfer, Lighting, Ventilation, Materials, Technologies, Performance Calculations, Building Systems Integration, Building Code(s) / Fire Safety, Building Science, Physics, Safety
17	***The Tectonics of Complex Facades and their Materials***	primary focus	adjunct faculty	lectures, seminar	drawings / sketches, design projects, presentations / reviews	Facade Design, New Design, Facade Systems, Environmental Response, Moisture Resistance, Heat Transfer, Lighting, Detailing, Materials, Technologies, Technical Drawing / Documentation, Computational Modeling, Building Systems Integration, Precedent Research, Economic Sensitivity, Life-cycle Assessment, Design and Construction Process, Structural System

18	***Contemporary Facade Design***	primary focus	adjunct faculty	lectures, workshop, field visits / tours	discussions, drawings / sketches, design projects, presentations / reviews	Facade History, Facade Design, Retrofits, Facade Systems, Environmental Response, Materials, Technologies, Fabrication / Physical Modeling, Technical Drawing / Documentation, Computational Modeling, Archival Analysis, Precedent Research
19	***Art of the Detail***	primary focus	full-time, tenure-line faculty	lectures, workshop	discussions, reading, writing, design project(s), labs, presentations / reviews	Facade History, Facade Design, Detailing, Materials, Technologies, Ornament, Technical Drawing / Documentation, Computational Modeling, Precedent Research
20	***Experimental Envelopes***	primary focus	full-time, tenure-line faculty	lectures, seminar	discussions, reading, design projects, presentations / reviews, quizzes	Facade History, Facade Design, New Design, Facade Systems, Environmental Response, Interior Environment Control, Occupant Comfort, Energy-efficiency, Lighting, Detailing, Materials, Fabrication / Physical Modeling, Technical Drawing / Documentation, Computational Modeling, Energy Modeling, Performance Calculations, Computational Simulations, Building Systems Integration, Precedent Research
21	***Sustainable and High-Performance Facades***	primary focus	full-time, tenure-line faculty	lectures, seminar, workshop	discussions, reading, writing, design projects, presentations / reviews	Facade Design, Retrofits, New Design, Facade Systems, Environmental Response, Interior Environment Control, Occupant Comfort, Energy-efficiency, Moisture Resistance, Heat Transfer, Lighting, Acoustics, Ventilation, Passive Strategies, Detailing, Materials, Technologies, Renewable Energy Sources, Technical Drawing / Documentation, Computational Modeling, Energy Modeling, Performance Calculations, Computational Simulations, Sustainability, Climate Change Mitigation, Archival Analysis, Precedent Research, Testing Procedures
22	***Build Test Iterate Repeat***	primary focus	full-time, tenure-line faculty	lectures, workshop	writing, design projects, presentations / reviews	Environmental Response, Moisture Resistance, Heat Transfer, Lighting, Materials, Technologies, Fabrication / Physical Modeling, Computational Modeling, Precedent Research, Building Physics, Thermodynamic Principles, Building Science
23	***Advanced Surface Tectonics: Methods in Materials & Enclosures***	primary focus	adjunct faculty	lectures	discussions, reading, writing, design projects, presentations / reviews	Facade Design, New Design, Facade Systems, Environmental Response, Interior Environment Control, Occupant Comfort, Moisture Resistance, Heat Transfer, Lighting, Acoustics, Ventilation, Materials, Embodied Carbon, Technologies, Computational Modeling, Computational Simulations, Sustainability, Climate Change Mitigation, Precedent Research
24	***Building Integration***	integrated component	adjunct faculty	lectures, comprehensive / final design studio, workshop, field visits / tours	drawing / sketches, design projects, presentations / reviews	Facade History, Facade Systems, Environmental Response, Energy-efficiency, Passive Strategies, Active Strategies, Materials, Technical Drawing / Documentation, Visualization / Rendering, Building Systems Integration, Building Code(s) / Fire Safety, Precedent Research, Site / Context Analysis, Building Systems, Cultural Context
25	***Environment and Building Systems I***	integrated component	full-time, tenure-line faculty	lectures, workshop	reading, design projects, presentations / reviews, exams	Facade Systems, Environmental Response, Interior Environment Control, Occupant Comfort, Energy-efficiency, Heat Transfer, Lighting, Passive Strategies, Active Strategies, Materials, Computational Modeling, Performance Calculations, Computational Simulations, Sustainability, Climate Change Mitigation, Building Systems Integration, Environmental Control Systems, Life-cycle Assessment
26	***Passive Building Systems***	integrated component	full-time, tenure-line faculty	lectures, field visits / tours	discussions, reading, design projects, presentations / reviews, exams	Environmental Response, Energy-efficiency, Passive Strategies, Climate Change Mitigation, Building Systems Integration, Vernacular Techniques, Waste Reduction / Recycling, Ecology, Passive Building Systems
27	***Integrated Building Systems***	integrated component	full-time, tenure-line faculty	lectures, comprehensive / final design studio	design projects, presentations / reviews, quizzes	Facade Design, Environmental Response, Heat Transfer, Lighting, Ventilation, Passive Strategies, Active Strategies, Detailing, Materials, Technologies, Fabrication / Physical Modeling, Technical Drawing / Documentation, Energy Modeling, Sustainability, Visualization / Rendering, Building Systems Integration, Building Code(s) / Fire Safety, Precedent Research, Site / Context Analysis, Construction

28	***Materials and Assemblies***	integrated component	adjunct faculty	lectures, design studio, field visits / tours	reading, design projects, presentations / reviews, quizzes	Facade Design, Facade Systems, Environmental Response, Interior Environment Control, Moisture Resistance, Heat Transfer, Acoustics, Materials, Technologies, Technical Drawing / Documentation, Performance Calculations, Sustainability, Building Systems Integration, Building Code(s) / Fire Safety, Structural Systems, Construction
29	***Materials and Enclosures***	primary focus	adjunct faculty	lectures	reading, writing, drawing / sketches, design projects, presentations / reviews, quizzes	Facade Design, Facade Systems, Moisture Resistance, Heat Transfer, Ventilation, Materials, Technologies, Fabrication / Physical Modeling, Technical Drawing / Documentation, Performance Calculations, Visualization / Rendering
30	***Architecture Technology and the Environment***	integrated component	full-time, tenure-line faculty	lectures, workshop	discussions, reading, writing, drawing / sketches, design projects, presentations / reviews, exams	Environmental Response, Occupant Comfort, Energy-efficiency, Moisture Resistance, Heat Transfer, Lighting, Acoustics, Materials, Technologies, Fabrication / Physical Modeling, Technical Drawing / Documentation, Sustainability, Climate Change Mitigation, Building Code(s) / Fire Safety, Precedent Research, Site / Context Analysis
31	***Integration Studio***	integrated component	full-time, tenure-line faculty	design studio	reading, design projects, presentations/ reviews	Facade Design, Facade Systems, Environmental Response, Detailing, Materials, Fabrication / Physical Modeling, Technical Drawing / Documentation, Computational Modeling, Building Systems Integration, Building Code(s) / Fire Safety, Site / Context Analysis, Inclusive Design and Accessibility
32	***Comprehensive Design Studio***	integrated component	full-time, tenure-line faculty	comprehensive / final design studio, workshop, field visits / tours	drawing / sketches, design projects, presentations / reviews	Facade Design, Facade Systems, Environmental Response, Energy-efficiency, Moisture Resistance, Heat Transfer, Lighting, Passive Strategies, Active Strategies, Detailing, Materials, Renewable Energy Sources, Fabrication / Physical Modeling, Technical Drawing / Documentation, Computational Modeling, Sustainability, Climate Change Mitigation, Visualization / Rendering, Building Systems Integration, Building Code(s) / Fire Safety, Precedent Research, Site / Context Analysis, Structural Systems
33	***Advanced Building Systems***	integrated component	full-time, tenure-line faculty	lectures, workshop	reading, writing, drawing / sketches, design projects, presentations/ reviews, quizzes	New Design, Facade Systems, Environmental Response, Interior Environment Control, Energy-efficiency, Moisture Resistance, Heat Transfer, Lighting, Passive Strategies, Active Strategies, Materials, Technologies, Sustainability, Building Systems Integration, Precedent Research, Site / Context Analysis, Structural Systems
34	***Environmental Systems II***	integrated component	full-time, tenure-line faculty	lectures, workshop, field visits / tours	discussions, reading, writing, drawing / sketches, presentations / reviews, exams	Facade Design, New Design, Facade Systems, Environmental Response, Interior Environment Control, Energy-efficiency, Moisture Resistance, Heat Transfer, Lighting, Acoustics, Ventilation, Passive Strategies, Active Strategies, Materials, Performance Calculations, Building Systems Integration, Building Code(s) / Fire Safety, Precedent Research
35	***Comprehensive Building Technology II***	integrated component	full-time, tenure-line faculty	lectures, design studio	reading, writing, design projects, presentations / reviews, exams	Facade Design, Facade Systems, Environmental Response, Energy-efficiency, Moisture Resistance, Heat Transfer, Lighting, Passive Strategies, Active Strategies, Materials, Technologies, Renewable Energy Sources, Technical Drawing / Documentation, Computational Modeling, Energy Modeling, Performance Calculations, Computational Simulations, Sustainability, Climate Change Mitigation, Building Systems Integration, Building Code(s) / Fire Safety, Precedent Research, Structural Systems
36	***Facades / Skins / Enclosures***	primary focus	full-time, tenure-line faculty	lectures, seminar, field visits / tours	discussions, reading, writing, exams	Facade History, Facade Design, Facade Systems, Environmental Response, Moisture Resistance, Heat Transfer, Lighting, Detailing, Materials, Vernacular Techniques, Precedent Research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