Course Description

In the evolving panorama of architectural discourse, the rise of computational design has emerged as a pivotal development. Rooted in early advocacies like Greg Lynn's "Animate Form," which championed the role of computation in moulding architectural forms, parametric design has matured from a niche experiment to an essential skill set in the modern architect's toolkit. Patrik Schumacher's discussions on 'parametricism' further underscored this paradigm shift, positioning parametric strategies at the forefront of contemporary architectural practice. This course offers an immersive introduction to parametric design using Grasshopper for Rhino, an instrumental platform in this transformation.

Over the past few decades, as the digital and tangible realms of architecture began to intertwine, computational design has proliferated, offering capabilities far beyond mere formal exercises. Today, architects harness its potential to analyze building performance, optimize structural intricacies, and ideate innovative concept models, among numerous other applications.

This course embarks on an exploration of computational design's rich history, its ascension to prominence, and its indelible imprint on the architectural profession. Students will be introduced to the basic techniques of Grasshopper. By the end of the semester, students will also have a holistic understanding of where parametric design sits within the broader architectural narrative and why it remains an indispensable skill in contemporary architectural discourse.

The pedagogical structure of this course is built around four project-centric assignments, each progressively delving deeper into advanced computational design techniques. Supplementing these assignments are meticulously curated lectures, readings, and architectural precedents that collectively enrich the learning experience. Notably, the trajectory of these assignments is harmoniously aligned with the curriculum of the ARCH 102b design studio. This strategic alignment enables students to seamlessly integrate and apply the computational techniques mastered in this course to their core studio projects.

At the outset, students will familiarise themselves with the foundational aspects of Grasshopper, acquiring the skills to craft simple yet impactful scripts. As the course progresses, students will be empowered to harness Grasshopper's potential in generating a great number of design iterations, fostering a deeper understanding of design possibilities and outcomes.
The latter half of the course accentuates the aesthetic representation of designs. Here, students will be introduced to rudimentary rendering techniques, refining their ability to visualize and present their computational constructs. Concluding the course, there is a pivotal exploration into the realm of generative A.I. tools. The course will help students grasp how to wield these tools effectively, leveraging artificial intelligence to enhance and evolve their design concepts.

**Learning Objectives**
In this course, we will embark on a journey through the advanced realms of architectural representation and graphics, emphasizing the transformative role of computational design. Our objectives are structured to equip students with the skills and critical thinking necessary to excel in modern architectural practices, leveraging the power of tools like Rhino, Grasshopper, and A.I. image generators.

- **Understanding Parametric Design:** Students will explore how parametric design expands design capabilities and its value within the broader architectural narrative. Emphasis will be placed on understanding the transformative impact of parametric design in creating more dynamic and responsive architectural solutions.

- **Indispensability of Computational Design:** The course will highlight why computational design remains an indispensable skill in contemporary architectural discourse. Students will gain insights into how these skills are crucial for modern architectural practices and the evolving demands of the profession.

- **Enhancing Form-Making through Computational Tools:** Students will learn how computational tools and techniques can enhance the assessment and implementation of form-making technologies. This includes exploring innovative ways to visualize and represent architectural concepts, leading to a deeper understanding of the design process.

- **Informed Design Decisions in Architectural Representation:** The course will focus on developing the ability to make informed design decisions through architectural representation. Students will learn to use their skills in computational design to effectively communicate and refine architectural ideas.

- **Critical Reflection on Design Representation:** Students will be encouraged to cultivate an ability to critically reflect on their design representation process and outcomes. This self-evaluative approach will foster continuous improvement and adaptability in their design practices.

- **Utilizing Line Weight Standards for Clarity:** An integral part of the course will be learning how to use line weight standards in drawings to enhance legibility and clarity. This skill is essential in creating professional and effective architectural representations.

- **Mastery in Computational Design Tools:** Students will develop proficiency in advanced computational design tools like Rhino and Grasshopper, integrating these skills into their design workflow to create innovative architectural forms.

- **Exploration of A.I. Image Generators:** The course will introduce students to A.I. image generators, such as Midjourney and Stable Diffusion, and explore their integration in architectural representation for enhanced creativity and visualization.

- **Integration of Procedural Animation in Design Process:** Procedural animation techniques will be integrated into the design process, offering students new perspectives and methods to visualize and present architectural concepts dynamically.

**Assignments**

**Assignment 1: Learning the Language**
Assignment 1 introduces the interface and basic commands in Grasshopper. Each student will construct their own definition that references a set of geometric explorations from their studio project. Students will be able to test various geometric aggregations via Grasshopper definitions iteratively.

**Assignment 2: 3D to 4D**
Assignment 2 guides students through iterating digital model geometry via animation. These iterations will not be solely formal in their explorations, but students will learn how to animate textures and patterns as well as the base geometry. Each student will produce animations of these formal and material studies. By the end of Assignment 2, students should have a foundational set of capabilities in Grasshopper and an understanding of how to use the software to quickly generate countless iterations through animation.
Assignment 3: Rendering + Descriptive Drawings
Assignment 3 introduces students to principles of image composition via rendering software (V-ray/Enscape). Students will learn how to construct scenes, apply texture mapping, and control lighting. Students will then use these new techniques to create description drawings of their digital models from assignment 2. These drawings are meant to go beyond the traditional architectural drawings in a way that they need to explain how the different parts are assembled together and the relationships between these parts and the whole.

Assignment 4: Controlling AI
Assignment 4 introduces AI as a tool not solely to generate images but will teach the students how to control the tool by feeding their own images/renderings into the tool to generate new atmospheric environments and material effects from their own prompts. The AI output imagery will then be produced via both student-authored images as well as prompts. These processes will introduce students to how to better control A.I. to produce several interactions of what would normally be a highly time-intensive rendered view.

Project requirements will be communicated through studio presentations and written guidelines. In instances where the course is taught across multiple coordinated sections, daily expectations might be provided orally and could vary between sections. Thorough completion of all assignments is vital for success in this course. Incomplete or subpar assignments will be excluded from desk critiques, pin-ups, and review sessions. Students must submit their assignments and ongoing work using Google Drive. All project deadlines can be found on the assignment document and Blackboard.

Desk Crits and Pin-ups
Individual desk critiques and pin-ups are the primary instruments of design instruction and will occur regularly in class. The success and quality of these one-on-one dialogues with the studio instructor are highly contingent upon the student’s preparation and timely production, as well as the student’s ability to absorb, understand, and apply critical feedback.

Reviews
Scheduled reviews provide students with varied perspectives and insights from a jury of instructors and invited critics. Juror comments, design criticism, and discussion provide valuable insight and constructive feedback on a student’s work and that of colleagues. Full attendance, active participation, and engagement are expected for the duration of all reviews and are a significant aspect of the “participation” component of grade evaluation (see below).

Lectures
Throughout the semester, first-year instructors and guest critics will address the entire first-year class in order to introduce projects or lecture on design concepts, precedents, and techniques. Typically, these will occur in Watt 1 Lecture Hall. Technical skill-building, including software demonstrations, will be provided in lectures and small group discussions with the aid of class assistants. Attendance is mandatory at all lectures. It is imperative that all students are on time and take notes.

Research and Analysis
Study of design precedent is an essential component of each studio assignment. Students are expected to regularly use the library and other resources (not just the internet) to investigate ideas and projects relevant to the course. Notes, drawings, diagrams and other materials pertaining to this research are to be incorporated into the design notebook (see below).

Supplies and Equipment
Please refer to the welcome letter and First Year Computer Recommendations and Supply Requirements List that you received this summer. You may also need to purchase additional model-making materials during the course of the semester. Material requirements will be outlined in the assignment handouts and/or by studio instructors.

Readings
Relevant readings will be assigned throughout the course and discussed throughout the semester. They must be
completed in-depth, not skimmed. Informed intellectual discourse is expected in the studio environment.

**Course Bibliography**

The following texts are required for this course and will be available online via Blackboard:

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**Studio Notebook**

Students are required to maintain a design notebook. It is meant to be a thorough and well-organised record of and instrument for critical inquiry and design process. The notebook is to include (freehand and/or digitally produced) generative diagrams and design sketches, weekly process drawings, notes/diagrams/sketches from desk crits, graphic analysis of relevant precedents, class/lecture/reading notes, as well as any other material relevant to design exploration in this course. Date and label all entries clearly and in a consistent manner.

**Portfolio**

Each student will be required to submit a digital portfolio at the end of the semester. The content should be thoughtfully presented in a letter size (8.5”x11”) portfolio. All assignments must be included in the portfolio, so students are advised to regularly document all work.

**Evaluation and Grading**

Work will be evaluated periodically so that you have an indication of your progress. Unsatisfactory performance warnings will be issued to students whose work does not meet minimum requirements. Active and regular participation in studio discussions is an essential part of the grade, as is regular and thoughtful maintenance of your studio notebook.

Grading Breakdown:

- Project 1: 15%
- Project 2: 20%
- Project 3: 25%
- Project 4: 25%
- Portfolio: 5%
- Participation: 10%

A minimum grade of ‘C’ is required to continue on to the next semester in the studio sequence. Consult University policies for IN (incomplete) grades and deadlines for withdrawal ('W' grade). University guidelines on plagiarism pertain to original design work. Students are expected to do all of their own design and presentation work. Substantial assistance in the form of model construction and drawing preparation, or deliberate appropriation of the design work of others will be considered non-original work and will be treated as plagiarism. See “Academic Integrity” section below for more information.

**Attendance**

It is essential and required for all students to be on time and present for all studio meetings, class lectures, field trips, and reviews. Lateness and absences will be recorded and can seriously affect course grades. A maximum number of two absences are allowed without direct impact to the student’s grade. A student's overall semester evaluation may be lowered by up to a full letter grade for each additional absence. Any student not in class within the first 10 minutes of class is considered late. Three instances of lateness equal one absence. Any student
absent for more than 1/3 of any class period (in any form including lateness, sleep, technological distraction, bathroom break, etc.) will be considered absent. Excused absences must be in writing and must be approved by the studio instructor. It is always the student’s responsibility to seek the means and make up for work missed due to any type of absence. Dates called out in the syllabus as review dates are considered examination periods. Absences on project review dates may lead to automatic failure of the assignment unless pre-approved by the instructor. Such an absence may only be due to personal illness, family emergency or religious observance. The University recognizes the diversity of our community and the potential for conflicts involving academic activities and personal religious observation. See: http://orl.usc.edu/religiouslife/holydays/

**Estimate of Costs**

Adobe Creative Suite - $80 for student discount annual subscription

A.I. Image Generator Subscription Costs for one month (Apr 11 - May 9):
- LookX - Free
- Midjourney Basic Plan - $10/month
- Midjourney Standard Plan - $30/month
- Stable Diffusion - Free
- Stable Diffusion Basic Plan - $9

**Studio Protocol**

Apart from lectures, reviews and field trips, instructors will meet with students in their separate studio sections. It is imperative to respect the quality of this unique creative environment and the work of others, during and outside of class hours.

- **Work Area** – Students are to immediately set up and maintain a fully operational workspace for drawing and modelmaking. It is strongly encouraged that students work in their studio workspace for this course and all other courses so that they may fully participate in and benefit from the productive exchange of ideas, informal discussions and critical dialogs that are central and unique to the studio environment.
- **Hours** – Apart from lectures, reviews, and trips students are expected to be present in studio and productively engaged in studio work for the duration of the class meeting time (2:00 – 5:50pm Mondays and Thursdays).
- **Food** – Food and drink in studio during class hours are strictly prohibited and can cause accidental spills that destroy equipment and other student work.
- **Music, Noise, and Cell Phone Use** – Studio is a shared work environment. Students shall demonstrate courtesy to others by always wearing headphones when listening to music, and by keeping voices low. Ringers are to be turned off and phones put away during class. Except in cases of emergency, students should not be on their phones during class, lectures, or reviews. Outside of class hours, students are to keep ringers on low and take all calls outside of studio.
- **Computer Use** – Apart from software demonstrations, there will be limited computer use during class time. All assigned work is required to be printed in time for (i.e. well before) the beginning of class.
- **Digital Resources** – A limited number of desktop computers, printers and a plotter are provided in studio, for work and digital output. Additional machines are available in other studios and in digital labs on campus. Time management and consideration of others is strongly advised in the use of these shared, finite resources.
- **Access** – Swipe card access to the studio with a USC ID is provided as a safeguard for students and their possessions. DO NOT PROP OPEN STUDIO DOORS. As a general precaution, students are to be mindful of their surroundings and watch for suspicious activity or unfamiliar faces. Students may contact the University’s Department of Public Safety at (213) 740-4321 to report suspicious activity and/or request security personnel.
- **Clean-up, Trash, and Recycling** – Trash and recycling bins are located throughout the studio. Students are advised to make use of them by sorting and disposing of trash in the appropriate receptacles and to keep their studio spaces clean. Food waste should not be disposed of in studio trash bins.
- **Knife Blades** – Used knife blades pose a danger to University cleaning staff and others. DO NOT place used knife blades directly into trash bins or leave them on the ground or work surfaces. Collect used bladed in a sealed container and then discard.
• Graffiti, Defacement of Property – Defacement of property belonging to the school or others will not be tolerated. Make use of provided butcher paper for messy tasks. NEVER SPRAY INDOORS. All aerosol sprays (glue, paint, etc.) must be used outside in conjunction with drop cloths to contain overspray.

• USC Smoke Free and Drug Free - The university is committed to promoting a healthy, safe, and comfortable environment for all students, faculty, staff, and visitors. Smoking is prohibited in all indoor and outdoor facilities on university-owned and leased property with no exception. This includes all university teaching, research, clinical and office spaces. For purposes of this policy, smoking is defined as inhaling, exhaling, burning, carrying, or possessing any lighted cigarette, cigar, pipe, electronic cigarette, hookah, or other lit product and including the use of any substance, including but not limited to tobacco, cloves, or marijuana. Refusal by students to comply with this policy may result in appropriate disciplinary action. In addition, unauthorised use, possession or dissemination of alcohol, tobacco products, unauthorised or illegal drugs, or drug-related paraphernalia in the university community or at university-sponsored activities, is prohibited. (See SCampus, Part B, Section 11; SCampus, Part F, Sections 4 and 5.)

**Academic Integrity**

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university’s mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the USC Student Handbook. All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or “recycle” work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offence against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the student handbook or the Office of Academic Integrity’s website, and university policies on Research and Scholarship Misconduct.

**Zoom Etiquette**

**Circumstances for Permitted Zoom Use:**

This course is designed to be conducted in-person to maximize the learning experience. However, understanding that there may be exceptional circumstances, Zoom may be used under the following conditions, with prior permission from the instructor:

- Illness or Medical Reasons: Students who are unable to attend class due to illness, medical conditions, or medical appointments can request to participate via Zoom to maintain continuity in their learning.
- Emergency Situations: In cases of personal emergencies or unforeseen circumstances (such as family emergencies or severe weather conditions) that prevent physical attendance, students may use Zoom as a temporary solution.

**Requesting Permission:**

- Students must email the instructor at least 24 hours in advance to request permission to attend a class session via Zoom.
- The email should clearly state the reason for the request and, if applicable, any supporting documentation may be required.
When permission is granted, the student is required to attend on time and stay for the whole session. Video camera should be kept on throughout the session when possible.

**Course Content Distribution and Synchronous Session Recordings Policies**

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. ([Living our Unifying Values: The USC Student Handbook](https://www.osas.usc.edu), page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorised use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the internet, or via any other media. ([Living our Unifying Values: The USC Student Handbook](https://www.osas.usc.edu), page 13).

**Policy for the Use of AI Generators**

Since creating, analytical, and critical thinking skills are part of the learning outcomes of this course, all assignments should be prepared by the student working individually or in groups. Students may not have another person or entity complete any substantive portion of the assignment. Developing strong competencies in these areas will prepare you for a competitive workplace. Therefore, using AI-generated tools (including but not limited to: Midjourney, Chat GPT, Adobe AI Tools) is prohibited in this course, will be identified as plagiarism, and will be reported to the Office of Academic Integrity.

**Disability Accommodations and Support Systems**

USC welcomes students with disabilities into all of the University’s educational programs. [The Office of Student Accessibility Services](https://www.osas.usc.edu) (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at [osas.usc.edu](https://www.osas.usc.edu). You may contact OSAS at (213) 740-0776 or via email at [osasfrontdesk@usc.edu](mailto:osasfrontdesk@usc.edu).

**Sustainability Initiative**

The School of Architecture has adopted the 2010 Initiative for Sustainability. Solutions to design problems must engage the environment in a way that dramatically reduces or eliminates the need for fossil fuel.

**NAAB Accreditation**


Course Responsibilities: As a required course for an accredited professional degree program, this course is accountable for achieving learning outcomes associated with the following NAAB Criteria.

**Program Criteria:**

**PC.2 Design:** This course introduces students to the role of the design process in shaping the built environment and introduces methods by which design processes integrate multiple factors, in different settings and scales of development, from buildings to cities primarily through lectures.

**PC.7 Learning and Teaching Culture:** All students and faculty in the M.Arch and B.Arch programs prescribe to the Studio Culture Document. This document fosters a positive and respectful learning environment that encourages the fundamental values of optimism, respect, sharing, engagement,
collaboration, and innovation between and among all members of our community, and innovation among its faculty, students, administration, and staff.

**Student Criteria:**

**SC.4 Technical Knowledge:** This course 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.5 Design Synthesis:** This course introduces students to exercises that develop their ability to make design decisions within architectural projects while demonstrating synthesis of user requirements, site conditions through teaching students about translation and creation of 2D orthographic drawings, the use/creation of 3D models, and an iterative approach to design.

All students can access and review NAAB Conditions of Accreditation (including student performance criteria) on the NAAB website at [http://www.naab.org/accreditation/](http://www.naab.org/accreditation/)
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

988 Suicide and Crisis Lifeline - 988 for both calls and text messages – 24/7 on call
The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355 (WELL) – 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 740-0411
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101
Information on events, programs and training, the Provost’s Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call
Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-2850 or otfp@med.usc.edu
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.