# Pre-Approved Accessory Dwelling Units Design

## Project Description

This project, undertaken by the student team named “Uncharted Engineering”, focuses on addressing the ongoing housing shortage and affordability challenges in Anchorage, Alaska. In recent years, Anchorage has experienced a significant imbalance between housing supply and demand, resulting in rapidly rising home prices and highly competitive market conditions. Median home prices have reached approximately $405,000, and properties frequently sell within 30 days, often above the asking price. This current housing landscape presents substantial barriers to entry, particularly for first-time buyers and younger residents.

To address this shortage, the Municipality of Anchorage (MOA) aims to add 10,000 new housing units over the next decade, of which 5,000 are intended to be Accessory Dwelling Units (ADUs). ADUs are secondary, self-contained residential units located on the same lot as a primary single-family home. These units may be attached to the main residence, integrated within it, or constructed as fully detached structures. ADUs are designed to function as independent living spaces, typically including a kitchen, bathroom, sleeping area, and separate entrance. The project team was tasked with designing two Accessory Dwelling Units (ADUs) that will be included in the MOA's “Pre-approved Catalog” of ADUs. This catalog will include a handful of pre-designed and already-approved ADU design plans that are free for residents to use to construct on their property. The two designs were for a 400 square-foot “tiny home” and a 900 square-foot two-bedroom home, both detached and intended to be new construction.

For homeowners, ADUs present an opportunity to generate supplemental income through rental use, offset mortgage costs, or provide flexible housing for family members. For the community, increased ADU development can help diversify housing options and gently increase neighborhood density without large-scale redevelopment. The advantages of the pre-approved designs are that they will save the owner the cost of design, as well as the time and expense of the application and review of the designs by the building code department. It is the MOA’s hope that this will lower barriers for homeowners considering adding an ADU to their property.

The core objective of this project was the engineering and architectural development of two detached ADU designs that are cost-effective, functional, and adapted to Anchorage’s snow, wind, and seismic conditions. It is important to note that this is not a hypothetical project; the designs were developed under the guidance of professional mentors, and after further review and approval, the students’ designs will be included in the MOA design catalog for construction.

The two sizes (400 $ft^2$ and 900 $ft^2$) were specifically limited in area so that they fit within existing code exceptions and provisions for tiny homes and detached ADUs. With the help of their mentors and advisors, the team produced effective and efficient floor layouts within these constraints. With basic floor plans in place, the team proceeded to the structural, thermal, and geotechnical considerations with an eye toward constructability and cost optimization. Structural calculations were conducted to determine window placement, wall heights, and member sizes, thus iterating the design. Material selection, prefabricated elements, and simplified geometries were analyzed to reduce labor costs and construction timelines. The team evaluated Anchorage's varied soil conditions and explored multiple foundation options, focusing on common practices, standard details, and readily available materials. Cost estimates were produced for both materials and labor by procuring estimates from local contractors.

The final deliverables include 95% design drawings and specifications, 3D renderings, supporting calculations, a project poster, and a final presentation.

## Collaboration of Faculty, Students, and Licensed Professional Engineers

The five-member student team worked closely with a licensed architect and a licensed professional engineer (structural) from the community. In addition, the client and faculty advisor are both licensed structural engineers:

**Client:** Daniel T. King, P.E. License #119118

**Professional Mentors:** Seth Anderson, P.E., License #131176

Petra Wilm, AIA, License #AELA11210

**Faculty Advisor:** Scott Hamel, P.E., Ph.D., License #AELT13547

The professional mentors met with the students weekly to guide them on all aspects of the project. The mentors discussed the design process (the order of questions and tasks to tackle), highlighted architectural code provisions for review and incorporation, discussed design and technical questions, and provided advice on software, presentations, and producing professional plans.

The faculty advisor also met almost weekly with the team to receive the mentor's advice, guide the academic deliverables, monitor group interaction, and provide process and schedule-related advice. The faculty member also had several separate class sessions with the team to teach them timber design, a class that none of the students had yet taken.

The client met with the students only twice, at the beginning and end of the semester. However, the client provided written feedback to the 35% and 65% submissions.

Additional Licensed professional engineers who were serving as professional mentors for other Capstone projects gathered to review and give feedback for three 10-15 minute mid-semester project presentations. The professionals provided comments on the project's pitch (telling their story), the current and developing design, graphics, and language used to portray the project, and public speaking skills.

Finally, the project followed a real-world Civil Engineering project process. The client presented an RFP, to which the team responded with a proposal. The two parties drafted a contract that set out a scope, schedule, and budget. The team tracked their hours, used realistic billing rates, and "billed" the client monthly. At the conclusion of the project, they examined their initial estimates and determined if their firm would have made or lost money. This process provided students with an opportunity to question mentors about billing rates, time spent on various tasks, and various project delivery methods.

## Protection of Public Health, Safety, and Welfare of the Public

**Public Safety (Structural & Environmental Protection):**

The project ensured structural safety by designing ADUs in compliance with Anchorage's specific building codes, which have currently adopted the 2018 IBC. More recent codes, however, were used for portions of the design, including the 2021 AWC Special Design Provisions for Wind and Seismic (SDPWS), 2024 National Design Specification for Timber, and ASCE 7-22 Minimum Design Loads and Associated Criteria for Buildings and Other Structures. The use of ASCE 7-22 is particularly important because this edition updates snow loads and seismic accelerations in Alaska. The structures were designed for code-prescriptive values of snow loads, wind loads and seismic loads. Fire safety and occupant protection were incorporated through proper setbacks, fire-resistant materials, and code-compliant egress requirements.

**Public Health and Welfare (Living Conditions, Affordability, & Accessibility):**

Anchorage has a significant unhoused population. Many studies have concluded that this is largely due to the lack of affordable housing. This project increases public welfare by expanding the affordable housing supply, with all of the downstream benefits of reducing homelessness. ADUs' also enable flexible living arrangements, minimize neighborhood disruption through small-scale density, and reduce market pressures for starter homes. Detached ADUs also increase property values and allow middle-class residents to purchase higher-priced properties, knowing they can generate rental income by investing in the construction of an ADU. Cost-efficient and replicable ADU designs improve accessibility for homeowners while contributing to a more stable housing market.

Public health is addressed by providing healthier living conditions in the form of new, high-performance building envelopes, proper insulation, and ventilation. Anchorage has a relatively large number of manufactured homes from the 1970s and 80s, which are well past their usable life, creating a substantial fire and health (mold and mildew) hazard. These structures continue to be used because no economical replacements exist.

## Multidiscipline and Allied Professional Participation

This project encompassed several disciplines within the AEC industry, including architecture, structural engineering, geotechnical engineering, construction management, and drafting. The team also gained knowledge in cost estimating, scheduling, and permitting.

The team worked closely with their architectural mentor to determine the floor layouts while accounting for various fire-code and dimensional requirements, such as ceiling heights. They worked with their structural professional mentor and faculty advisor to ensure that their designs met all the structural and geotechnical design requirements. From there, the students truly diverged from classroom activities and contacted contractors, pre-fabricators, builders, truss suppliers, masons, excavators, and municipality inspectors to gain an understanding of the cost and time impacts of various details and design choices. They also worked with their mentors to learn various rendering and BIM software needed to produce professional caliber drawings and images. The drafting and rendering tasks were truly a separate discipline, as members of the team had no prior experience with Revit or architectural rendering programs.

## Knowledge and Skills Gained

This project gave team members experience in a real-world design environment, creating designs that will be further developed and adopted by the local municipality. Skills were gained in the areas of Technical and engineering design, professional skills, and communications.

### Technical Knowledge and Engineering Design Skills

The team developed a strong understanding of residential design principles including layout efficiency, livability requirements, and building-code provisions. They learned gained knowledge and design-code familiarity in the areas of wood design and foundations. They also developed an appreciation of construction considerations, including both material and labor cost drivers, as well as experience in methods of developing cost estimates. The team members created conceptual designs and experienced the iterative design process, producing ADU plans and renderings that evolved as they learned new things, applied additional constraints, and considered different costs and perspectives.

Students used numerous programs throughout this project, including:

- AutoDesk Revit
- Chief Architect
- Mathcad Prime
- Microsoft Excel
- Microsoft Teams
- Microsoft Word
- Microsoft PowerPoint

### Communication & Professional Skills

Through the design iterations and multiple project presentations, the team strengthened technical communication skills, including clearly explaining complex ideas to their mentors and presentation audiences. They also practiced storytelling to justify the project's relevance. The students developed team collaboration skills, working under a shared identity, and coordinating roles and tasks across members. Engagement with a client and mentors further supported professional interactions.

Writing a response to an RFP, drafting a contract and budget, producing progress reports, and creating final deliverables provided a holistic understanding of the project process. The team had to create a design and perform calculations, but also produce effective and concise visuals and explanations of the designs and their design choices. The project process also encouraged them to create a realistic schedule (using a Gantt chart) and stick to it e. This proved to be a valuable new skill and helped to illustrate when they were on track or behind.

Verbal presentations throughout the semester, which included significant feedback from professional mentors, encouraged the team members to improve their public speaking skills for both a technical and non-technical audience.

## Conclusion

The capstone course overall was an extremely effective way to introduce students to the field of civil engineering that they will enter upon graduation. It allowed students to form relationships with industry professionals and strengthen not only their technical skills, but also their non-technical skills, which are often overlooked in undergraduate education. Students were able to see the importance of collaboration, participate in a carefully guided project with a successful outcome, develop a new appreciation for the knowledge of their mentors, and create excitement for their future careers.

The Pre-Approved Accessory Dwelling Units Design project helps to address Anchorage's pressing housing challenges by delivering practical, code-compliant, and cost-effective ADU designs that are near-ready for real-world implementation. Through close collaboration with licensed professionals and engagement in a realistic project workflow, the team not only produced high-quality technical deliverables but also gained valuable experience in multidisciplinary design, construction considerations, and professional practice. Ultimately, the project demonstrates an effective collaboration in developing community-oriented solutions and preparing students for professional practice.