The 2FH Design Group initiated the project process with an analytical evaluation of the existing Waterloo Wellington Flight Centre (WWFC) and how this site could better serve the professional and educational aviation community. This analysis brought the group to a few conclusions being that the site is lacking adequate green elements such as trees, lawn, and mass native plantings. The site also lacks character and charm which is a key element in creating a welcoming and inspiring work and learning environment for practitioners and students.

In review of many future-oriented flight training centres located in Europe, the 2FH Design Group produced a series of implementable design interventions that will work towards an overall net-zero goal for the future WWFC and the proud home of the Waterloo Institute for Sustainable Aeronautics (WISA). Rooted in sustainability, functionality and scalability, the design created by 2FH Group incorporates forward-thinking landscape architectural design of the site which is the foundation for the flight school building as well as the hangar. The site itself will become a carbon sink with the abundance of vegetation present both around, on and inside of the buildings. The hangar and main building are contemporary in design which leads to a simple, not overstated building that suits any climate and landscape it is built in.

The future of the aviation training sector is largely shaped by sustainable practice. This is not limited to the direct methods of training but extends into the design at both a large and small scale. This is reflected in the site with water capture and reuse, sustainable building materials and techniques, building-integrated photovoltaic, as well as active and passive strategies. Additionally, there is electric charging for aircrafts and other vehicles on the site. As such, it becomes a self-sufficient organism, extending benefits far beyond its borders through functions such as carbon sequestration and the potential of net-positive energy.

Supporting a sense of community and establishing success within the school is also reflected in the design. The entirety of the space is designed to be accessible to all and allow relationships to flourish. Students, staff, faculty, and community members all have a place within the site. The space is a tool for these members to thrive.

The feasibility of this project acts as a model for economic sustainability. With this, specific ideas and concepts are included in the overall design to incorporate economic sustainability. These concepts push the design into a new and more sustainable future. A large part of the economic sustainability is reflected in the green Interventions implemented across the concept site. Although these sustainability features have a larger initial cost, since this design is directed toward a sustainable future, they will pay for themselves over time, both economically and environmentally.

The material choices also act as an economic sustainability feature. The design and function of the main building and the hangar are influenced by the materials best suited for this application. Using materials that are natural, locally produced, multi-functionally, and universal, allows us to design a building that is sustainable from an economic and environmental perspective, but also promotes the idea of scalability and flexibility when used on different scales and in different locations across Canada and the rest of the world.

WISA DESIGN COMPETITION
Designing the Flight School of the Future

A NEW ALTITUDE

2FH Design

Giuseppe Ferreri (he/him) University of Waterloo

Vincent Fracchioni (he/him) University of Guelph

Corbin Hawkins (he/him) University of Waterloo

Design Proposal

Concept Overview

2FH Group found it necessary to initiate this design project with the creation of a project program. Through this program, the team identified three explicit goals that the design will achieve; these goals are to create a space that is equally User, Environment, and Future-oriented with the overarching goal of achieving net-zero.

The objectives of each goal are simple. To create a space that is student-oriented, we must consider the balance between learning, practicing, and working. By incorporating spaces that suit these needs, the space will be successful. Courtyards, common study spaces and classrooms accommodate all of the needs of the users.

To create a space that is environment-oriented, the team put all of their focus into using building materials that are sustainable, planting materials that are native to the Waterloo Region, and green infrastructure implementations that will push this flight centre far beyond net-zero standards and will blaze a path for sustainable buildings of the future.

Photo 1: Existing Example Site

It is the cumulation of both goals which solidified this design to be future-oriented; By creating a space that successfully serves as a net-zero aviation facility.

With the design of the main building, the primary focus was functionality for students and making efficient use of the spaces within the building and with outdoor extensions of the building. By designing a building that is inviting and inspiring, we can focus on promoting social sustainability in addition to economic and environmental sustainability as discussed previously.

While speaking to aviation students about their needs within the building, the idea of flow was discussed in length. Designing the main building to be open and inviting allows the interior to circulate throughout the building and provides easy access to any building amenities. The main building has many different inspiring and exciting student spaces with a variety of uses, including private and group study rooms, quiet spaces, cafe and lounge spaces, outdoor work areas, and other multi-functional areas. In addition, one design feature that allows this building design to stand out is the courtyard, immediately present in the foyer. This space is indoors and brings the outdoors inside with lots of natural light and vegetation.

The hangar is designed as an extension of the main building; differing in function, acting as interconnected tools to provide the foundation for success in the flight centre. Just a short walk from the main building, and equipped with multiple parking spots directly along the hangar, it is easily accessible. Having the hangar close to the main building encourages those within both to engage and interact with each other, and allows the students to quickly access anything they may need. Additional space around the back of the hangar has also been included to support any necessary future functions as growth occurs. The building is also equipped with green technologies and sustainable materials.

A crucial component to the success of the hangar and main building's function is the design of the site in which they exist. The site which surrounds these buildings is a demonstration of landscape architectural practices and environmental sustainability molded into a package that best suits the needs of the Waterloo Wellington Flight Centre. The hard surface requirement of an aviation facility is immense, and to counteract this commercial land use, the designed site provides nearly 2 acres of green space. This serves the sustainability and net-zero qualities of the design by providing collection and infiltration of over 10 million litres of water per year through proposed rainwater collection practices and the infrastructure that supports them being rain gardens, bioswales, a rainwater retention basin, and mass native tree planting to root the site in its net-zero sustainability goal.

Conceptual Site Plan

Conceptualized in the Waterloo Region, this flight training facility design finds its foundation in a diverse climate that urges forward-thinking sustainable construction. It was of most importance to create a site that can accommodate the current and future needs of the WWFC. This concept does so with adequate sheltered parking which improves ground-level microclimate and contributes to the site's net-zero goal with photovoltaic (P.V.) paneling. The location of the building and hangar are also strategic in a way that the building's P.V. cells absorb the eastern morning sun and the hangar's P.V. cells absorb the western afternoon sun. Neighbouring the buildings, the green landscapes play a crucial role in carbon sequestration, rainwater infiltration, and aesthetics which all play a role in the net-zero goal of the site.

Figure 1: Conceptual Site Plan

Main Building Concept

With the Main Building, the appearance, sustainability, functionality, and feasibility are the priorities of its design. As such, the material choice and green interventions implementation allows for the objectives to be reached.

The materials used for the construction of the main building were chosen based on availability not just on a local scale but also globally, their limited overall sustainability short and long term, their impact on the environment, and their transferability.

The material used includes Insulated Concrete Forms (ICFs) as the main building structure, in combination with photovoltaic glass and windows, cross-laminated timber (CLT), recycled metal, and stucco cladding. Additionally, green interventions including rooftop solar panels, permeable pavement, living walls, greywater collections, filtration and re-use, geothermal energy collection, and the use of double skin facade systems help the Main building reach and surpass the goal of a net-zero and carbon-neutral design.

This combination of materials provides flexibility in the overall design, transferability based on location, sustainability and functionality with the overall use and application of the materials.

Figure 2: Main Building Concept

Hangar Concept

Shaped by function, the hangar provides both unconditioned and conditioned space for aircraft storage and maintenance purposes. The entirety of the structure is divided into these two spaces; constructed in an “L” shape, with one rectangle being conditioned, and the other not. Each section is equipped with functioning doors facing the apron. The unconditioned space is equipped with an accordion door, while the other utilizes a bi-folding door.

The conditioned space is closest to the main building, and has parking along the front, allowing for quick and easy access. While primarily open space to support the functions of aircraft maintenance, there is a room designated for supporting the needs of the employees. Additionally, the space is suitable for gatherings the school may have that require more room than available in the main building.

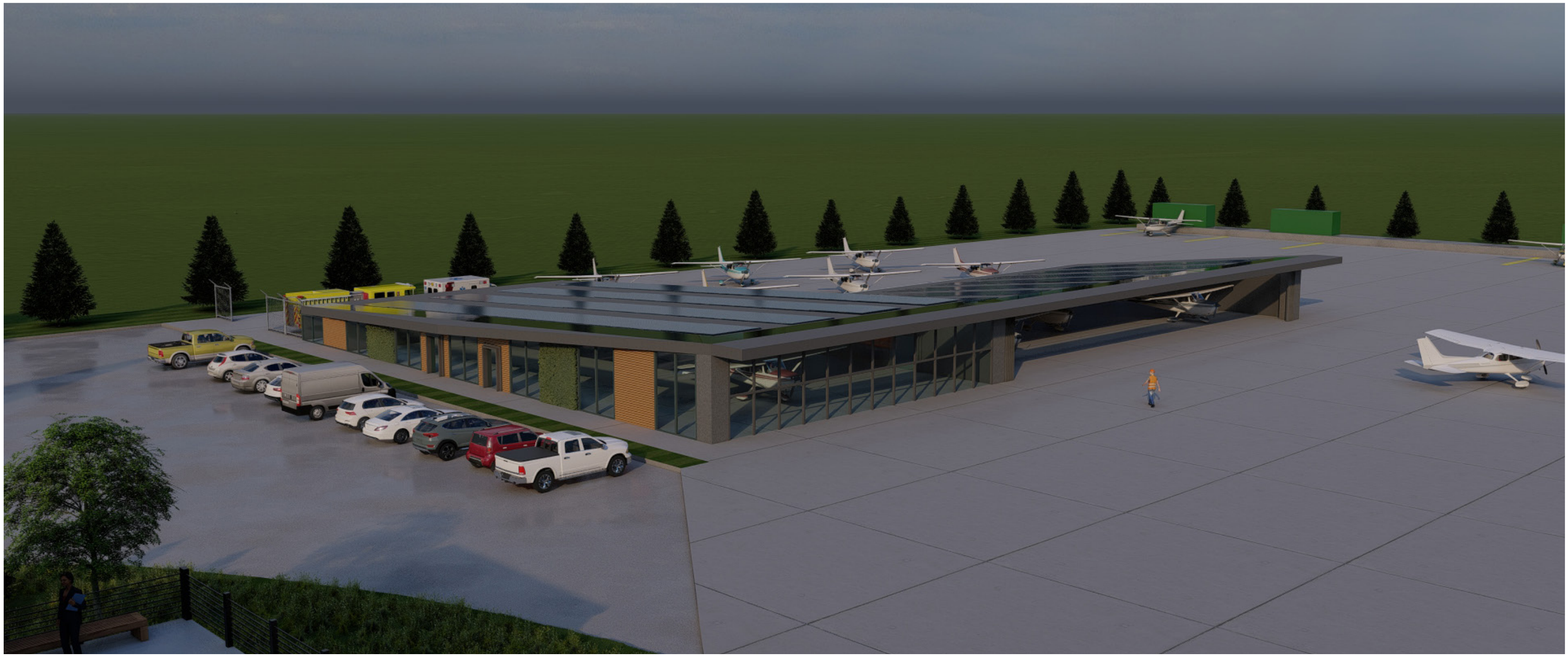


Figure 3: Hangar Concept

Main Building Floor Plans

First Floor

As mentioned previously, the floor plan of the main building allows for continuous circulation throughout the building. As you enter the building, an open concept design is present with the exciting and innovative courtyard and student space. Some of the classrooms as well as the flight dispatch area are near the primary entrance as they are normally used first in a typical day. The main eatery is also located on the first floor and includes a walkout area to an outdoor eating/study space. Finally, the amphitheater is centrally located in the middle of the building for easy access for larger gatherings.

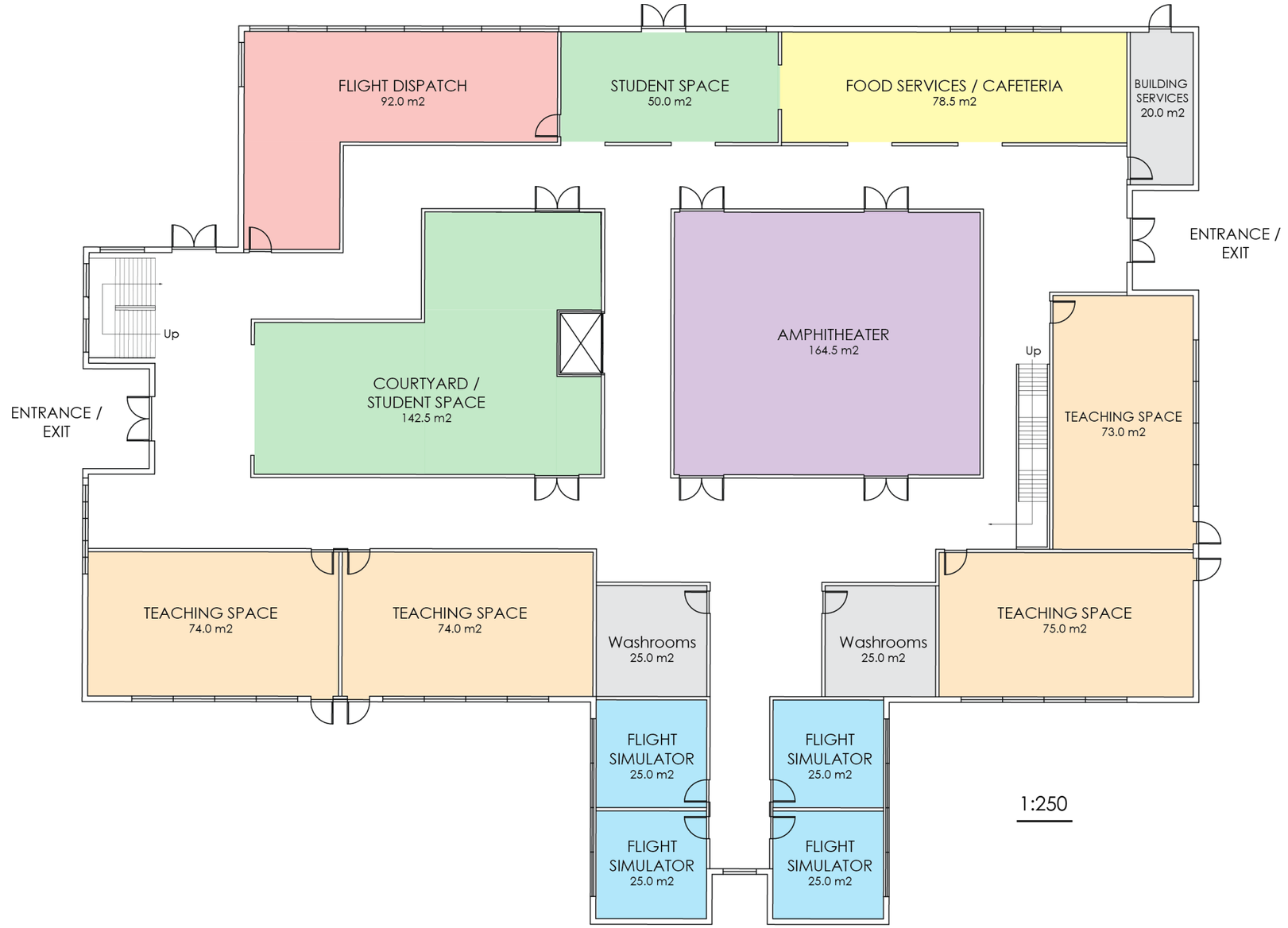


Figure 4: Main Building Floor Plans - First Floor

Main Building Floor Plans

Second Floor

The second floor builds off the idea of flexibility. It includes the administrative office space, the hoteling office space, a bookstore, and a mixture of inspiring student spaces. The focal point of the second floor is the central outdoor amenity space which acts as a secondary courtyard that is outdoors unlike the one on the first floor. Additionally, two balconies provide outdoor work areas and additional lounge and recreation space.

On the inside, there are various areas dedicated to studying and meeting spaces. This allows for flexibility between areas since these spaces are multi-functional. There is also a small cafe separate from the main eatery. This creates a more relaxed environment for students and staff to unwind and socialize between classes and activities.

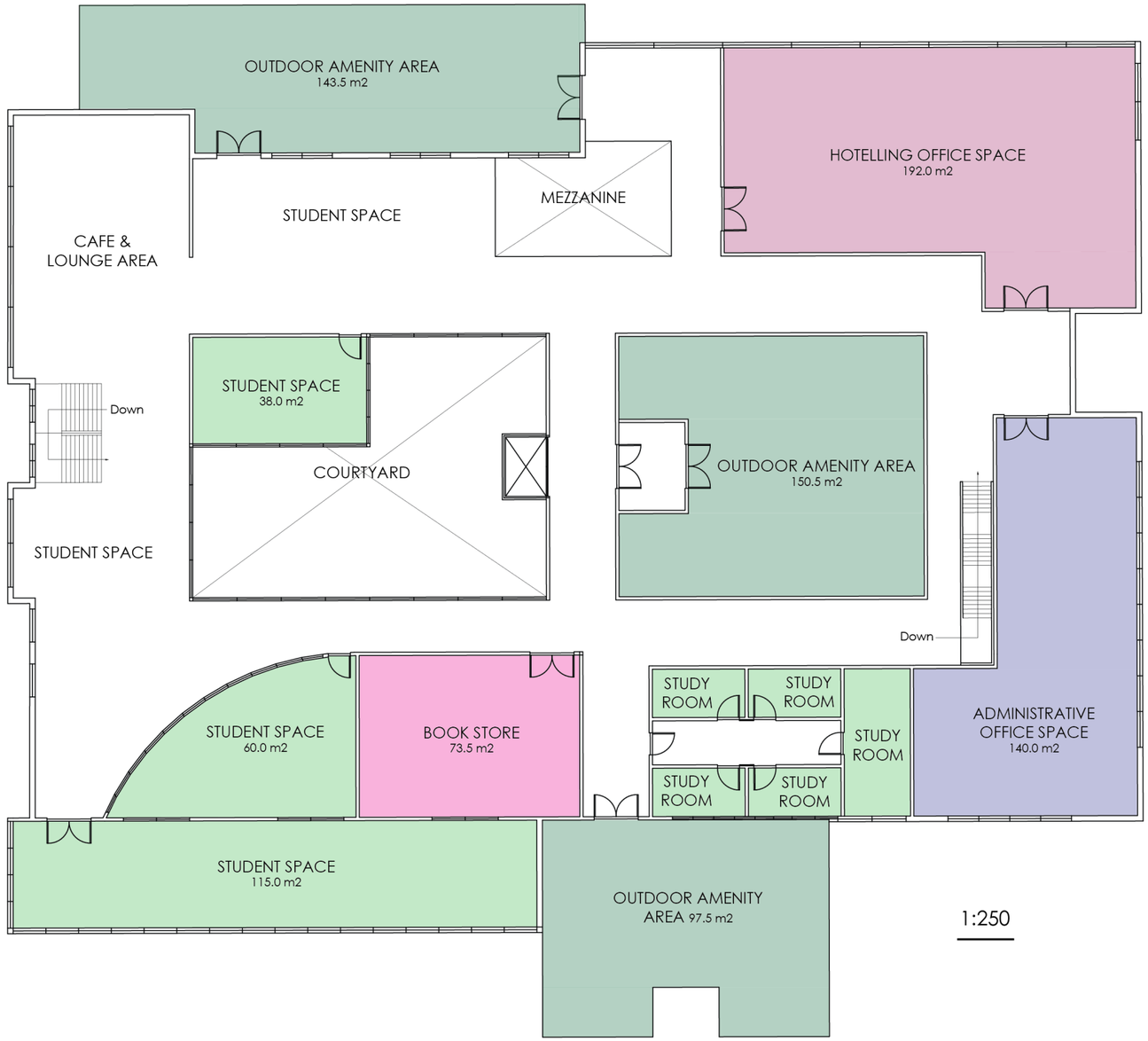


Figure 5: Main Building Floor Plans - Second Floor

Main Building Axonometric

Scalability in the construction and design of the building was a focal point. With the primary materials being insulating concrete forms and cross-laminated timber, the design is capable of being transferred to various climates. With just the use of the two main materials, the components illustrated can be constructed. However, it is also a very flexible concept, and not necessarily a “one-size-fits-all”. While still using the same method of construction and materials, the shape of the building can be easily molded to fit the needs and requirements of any flight school.

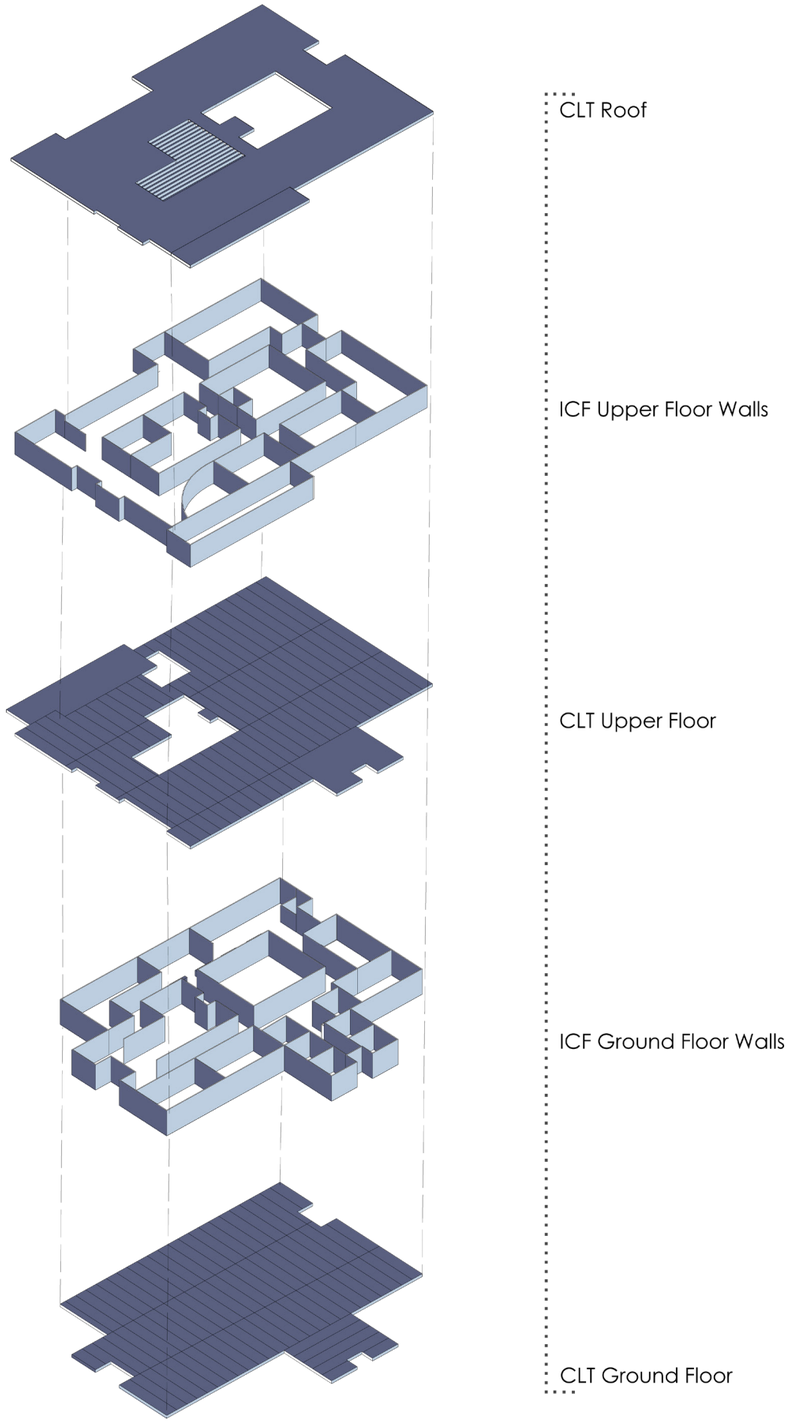
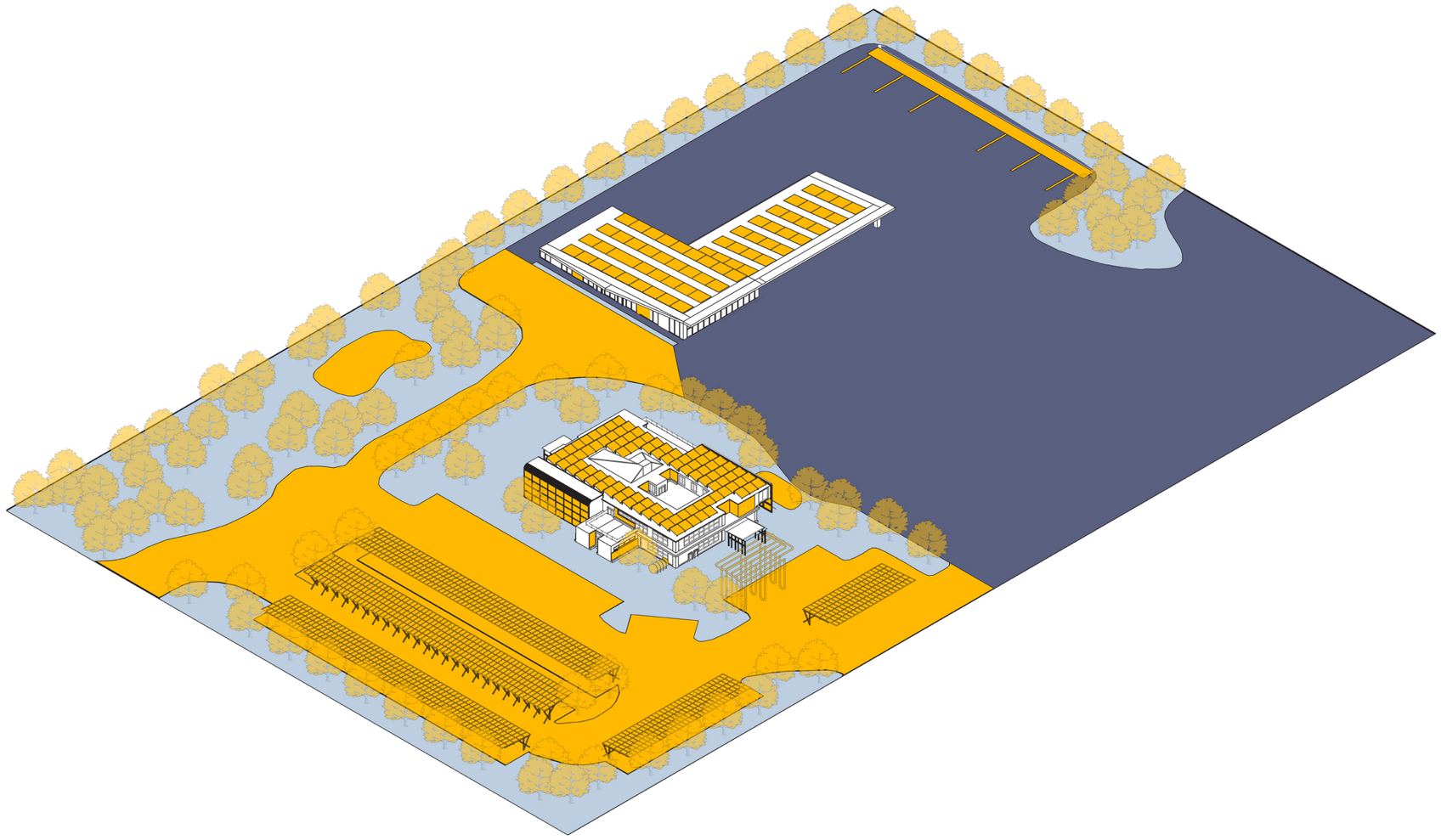


Figure 6: Main Building Axonometric

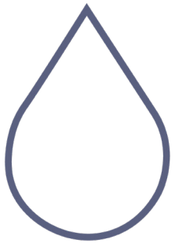
Green Interventions

With net-zero energy and carbon-neutral performance being important to the project, communicating how these goals will be achieved is necessary. The bird's eye achieves this, with the green interventions highlighted in yellow. In the main building, these include geothermal pumps, green walls, solar panels, building-integrated photovoltaic, and greywater storage. In the hangar, these include solar panels, green walls, and greywater storage. Within the site, these include a retention pond, a rain garden, solar panels, electric charging stations, permeable pavement, a bioswale, and trees. Each of these serves a specific function, but all work together to meet net-zero targets. These interventions were influenced by a set of criteria: water management and recycling, improving air quality, and renewable energy.



107
trees on site

3362
square meters of photovoltaic technology



10, 200,000
litres of water collected annually

Figure 7: Green Interventions - Site Scale

Parking Lot

The sustainable aspects of the site extend into the parking lot. Many of the parking spaces are covered with photovoltaic panels, providing energy throughout the site. The lot is also equipped with electric vehicle charging stations, and several accessible parking spaces. Additionally, porous pavement is utilized throughout the entire parking space.

Figure 8: Perspective - Parking Lot

Water Retention Pond

The pond serves the function of stormwater retention, biodiversity, and aesthetics. The area, paired with the green space around it is great for de-stressing and immersing in the natural environment.

Figure 9: Perspective - Water Retention Pond

RECREATIONAL SPACE

The main building which will serve as the new home for the WWFC is a demonstration of the most state of the art sustainable building practices of this time combined with modern-contemporary architectural design. The facade of the building is inspiring and welcoming, and this is the most important function of the building: to attract and excite its users. For students, staff, and other users, there is no shortage of recreational space whether it be outside on the lawn studying or in the atrium courtyard. The sustainability of social interaction is what this building was conceptualized around.

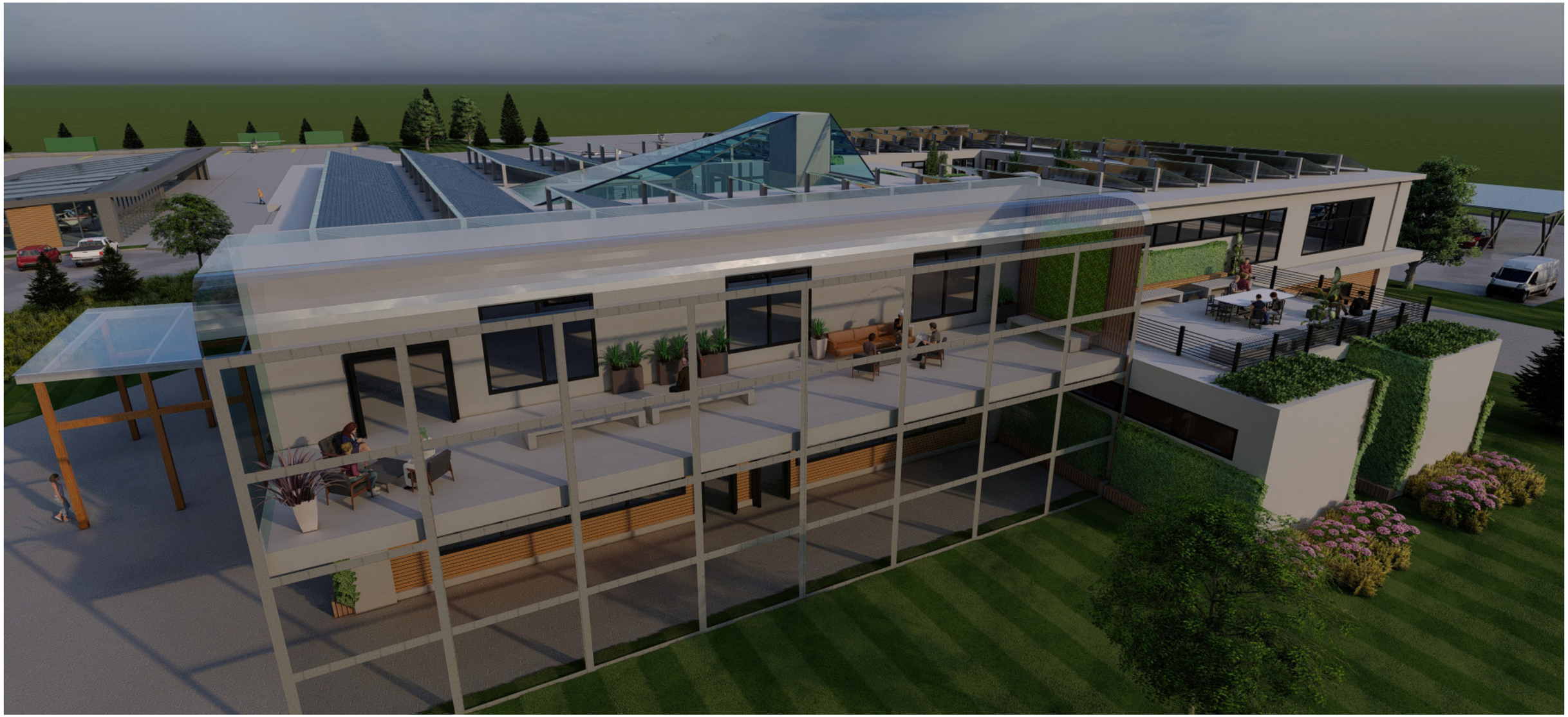


Figure 10: Perspective - Recreational Space

Conclusion

An important aspect of this design proposal is feasibility. However, designing a feasible project can be challenging when trying to incorporate advanced technologies and green initiatives to help reach the goal of net-zero. The feasibility of these implementations is counteracted by the use of materials as well as the use of green interventions throughout the site, including the main building and the hangar which act as hubs for green innovation. With these interventions, the design concept will over time, pay for itself and will continue to save money and resources as time goes on.

Sustainability is at the heart of this project in every form. The building and hangar exude sustainability through their use of natural, environmentally-friendly materials. They also promote economic sustainability through implementation of self-sufficient energy production systems in the forms of solar and geothermal. Both buildings far exceed their net-zero goals and are net-positive in energy production, setting them far ahead of most existing institutional buildings. The site itself is also a role model in sustainability harnessing a rainwater collection and infiltration system that reduces flooding events, benefits local flora and habitat while being reused as greywater onsite. Social sustainability is a driving force in the project's objectives, and it is present in the way the hangar and building have been designed to be open, allowing for free conversation, thought and inspiration.

While innovation on the site is defined by the interconnected systems and forward-thinking design, it extends beyond these tangible aspects, and into the spaces themselves. Each component has been integrated to support and strengthen innovation, allowing users to perform at the highest of their abilities. The site inspires environmental innovation, setting a standard for the aviation sector on an international scale. The site inspires future innovation, providing a framework that can be continually improved, and altered to fit and meet the needs of any location. Ultimately, it is the holistic design that sets this project apart. Comprising an innovative series of systems, objectives, and functions, 2FH design is proposing a site that would be the next proud home of the Waterloo Institute for Sustainable Aeronautics.

Video Link

https://youtu.be/3yF4QxpquVQ

This video takes the viewer on a journey through the site, highlighting the unique characteristics of the hangar and building's design in relationship to the site that supports them. There is a sense of community present in the designed site, and by balancing sustainability, aesthetics, and functionality, the many spaces act as one unified whole working towards a common net-zero goal.