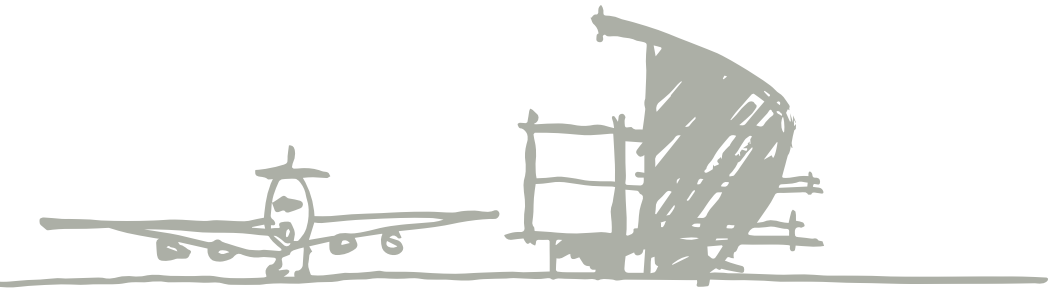
Raisbeck Aviation High School

Highline School District | Tukwila, WA

2014 James D. MacConnell Award Submission



Executive Summary

Raisbeck Aviation High School (RAHS) is part of the Highline School District and is adjacent to the Museum of Flight and King County International Airport in Tukwila, Washington. The aviation- and aerospace-themed STEM (Science, Technology, Engineering, and Math) school focuses on preparing students for college, careers, and citizenship.

The District encompasses a highly diverse community, with 70% of the students on the free or reduced lunch program. Located on the periphery of SeaTac International Airport, the District was awarded federal funds in 2002 to improve its schools both acoustically and academically, as mitigation for the construction of the airport's third runway. Feisty District visionaries decided to take a portion of these funds to seed a school that would outperform all expectations and embrace the airport business that threatened to overwhelm it.

RAHS was conceived as a response to Highline's proximity to the aviation industry, a deep desire to give underprivileged students access to college and engineering professions, and an educational vision that melded hands-on, project-based learning with academic rigor.

Operating in temporary campus spaces from 2004 until 2013, Aviation High School (as it was formerly known) was forced to move three times as the school grew from its original size of 100 students to its current population of 400. Throughout these formative years, the school's curriculum evolved through local industry partnerships including the Boeing Company and the Museum of Flight, support from the Gates Foundation, and faculty experiences. The result is a program where science and humanities are taught collaboratively and in partnership with highly qualified industry professionals; all with the shared goal of merging a high caliber career and technical program with academic excellence.

The design of the new school, located on the Museum of Flight Campus, is inspired by the leading edge of a wing

Learning at RAHS is project-based with an emphasis on students presenting and defending their work in front of industry experts. By sophomore year, each student is paired with a mentor from one of the school's industry partners who work with them until graduation. The mentor advises the students on course and career paths and assists with the selection of internships with local industries. Mentors and industry partners also advise RAHS faculty on the appropriateness of projects and their application in real-world settings.

The new school is a culmination of the program's evolution – from the site to the curriculum. Its Museum of Flight campus location provides the opportunity for RAHS and the Museum to share educational programming and volunteer opportunities.

The nearly 200 industry partners in the vicinity provide a steady stream of mentors. The key design feature of the three-story, 72,000 square foot building is its form – a curved cross-section inspired by the leading edge of a wing. Spaces within the building support teamwork, project construction, and presentations.

Take all of this – the vision, the relationships, and the curriculum – and add a building designed to support and celebrate it, and you'll find a high school that enables students to succeed; generating a level of enthusiasm among them that inspires everyone who walks through the door.

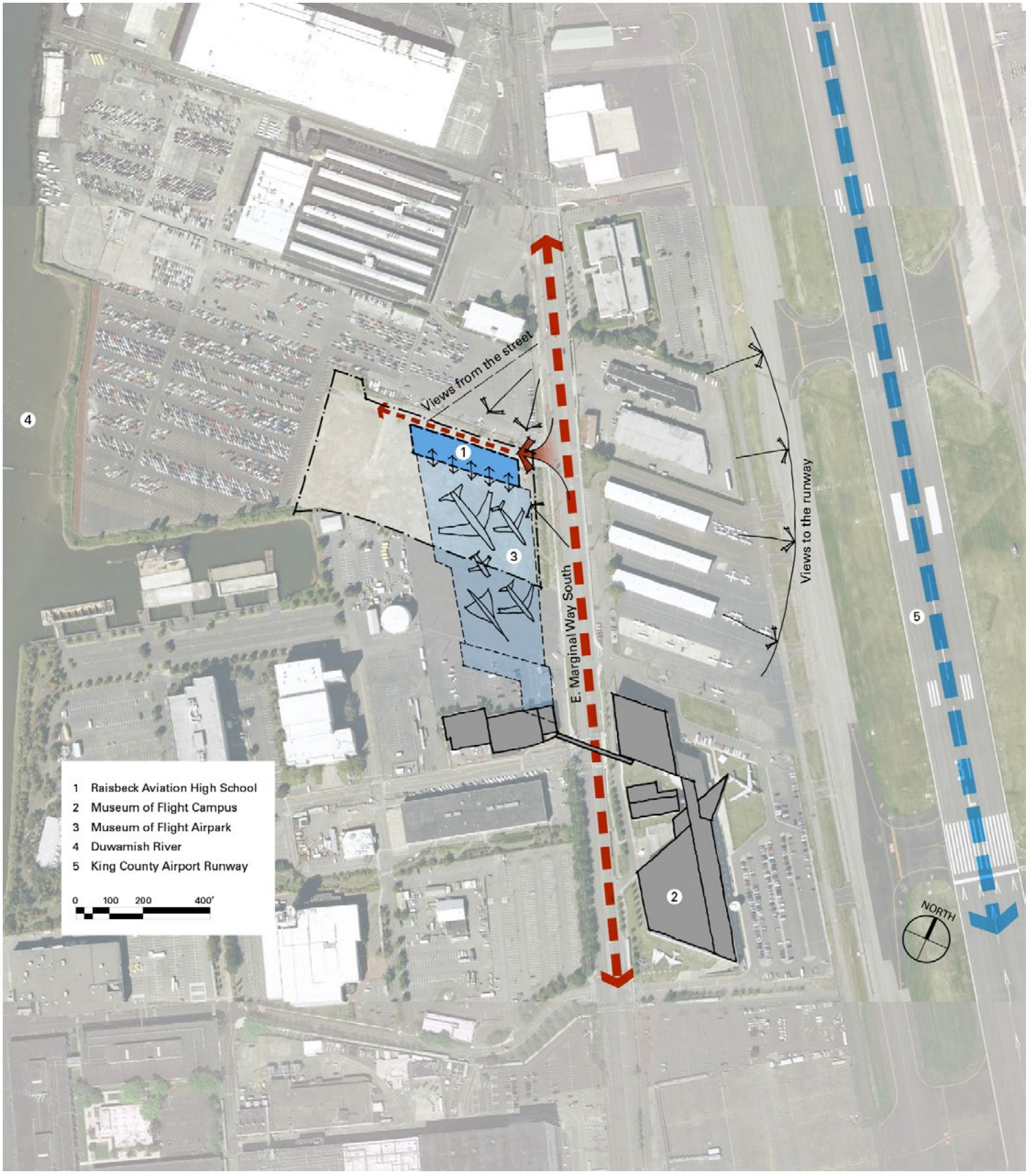
Scope of Work

The project scope for Raisbeck Aviation High School included the siting, educational specifications, and design of a new 400-student high school on the Museum of Flight Campus. The initial phase of work included participating in the Master Plan for the Museum's west campus to ensure space was available for the school. The school's footprint was shaped by the Museum's need for adequate turning areas for aircraft located on the west campus. The project included substantial site work to develop the access road and parking, both shared with the Museum. The design supports the school's aviation and aerospace immersion program with project labs for aircraft and robotics construction, state-of-the-art science labs, classrooms, and a multi-purpose gathering space.

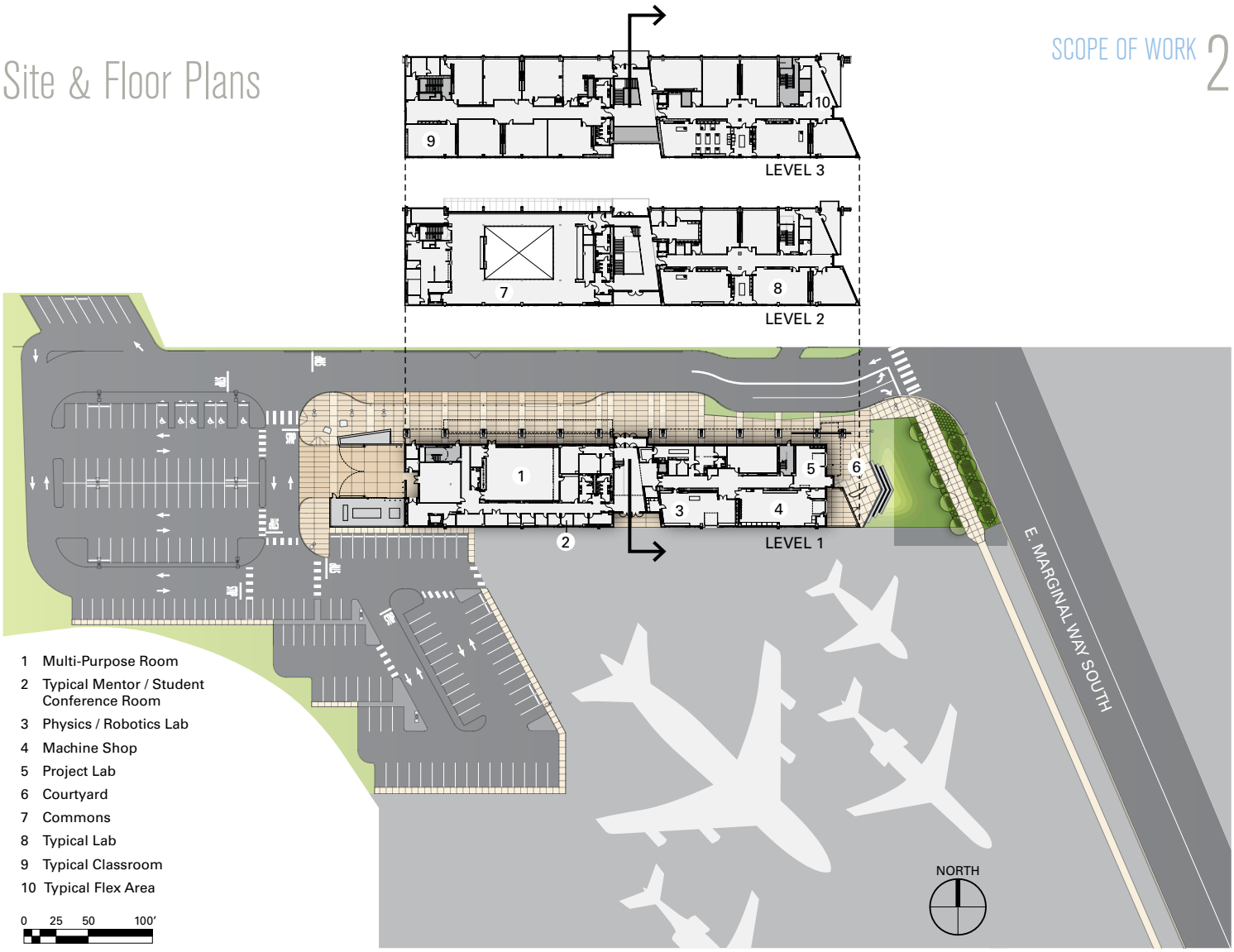
Key Stats

Project Name:	Raisbeck Aviation High School	Space per Student:	180 sf/student
Project Location:	Tukwila, WA	Total Project Budget:	$43.5 million
School Category:	High School	Construction Cost:	$25.6 million
Grades Served:	9 – 12	Cost per Square Foot:	$297/sf
Number of Students:	400	Construction Start:	September 2011
Size of Site:	1.4 acres	Opening Date:	September 2013
Gross Area of Building:	72,000 sf	Sustainability Rating:	WSSP (LEED Silver equivalent)

Vicinity Plan



Site & Floor Plans



Section of Grand Stair Looking East

Budget

Of the $43.5 million total project cost for the new facilities, 35% was through donation by individuals and private foundations, 32% by the school district, 23% by the Port of Seattle, 9% by the State of Washington, and 1% by the federal government.

The unusual circumstances of the school's funding engaged a broad community in guiding the design. Influences stemming from the funding included:

- Expectation that the school's size would be limited to provide equity with other District schools
- Anticipation that the school would be an architecturally significant structure on the Museum of Flight Campus
- Costs not usually anticipated for public school design needing to be budgeted to cover the land lease, finance mechanisms, and fundraising
- Strong interest from the business community for the school to be modeled on engineering workplaces by increasing the focus on labs, equipment, and innovation

Raising funds for the project was challenging, but resulted in a happy ending. Individuals and industry professionals who contributed became true champions and active mentors of the school, providing student internships and professional guidance.

School labs are equipped to explore real world engineering problems

Community Engagement

The Educational Vision

Conceived as a partnership between government, the aviation industry, and the District the mission of RAHS is to prepare students for college, career, and citizenship through a rigorous and relevant course of study, facilitated in the context of aviation and aerospace. To accomplish this mission, RAHS relies on the expertise and support of industry partners to assist staff members in developing aviation-themed learning experiences for the students.

A 2007 message from Principal Reba Gilman to industry partners illustrates this relationship:

Esteemed Friends of Aviation High School:

We are preparing for our fourth year of operation at Aviation High School. The new school year also brings new staff members to facilitate the senior year program, which includes advanced placement courses in physics, calculus, and literature along with a newly developed program called Flight by Design (FbD) that we are very excited about. FbD is an innovative course that will allow students to apply science, math, graphic design, and technology skills as they work together in a simulated Flight Test environment to create, instrument, and test a series of model planes. This capstone program is being partially funded by The Boeing Company and will be enhanced by active involvement of local aviation experts in the curriculum design

RAHS Principal and CEO Reba Gilman and students

and delivery process. Please know that you have an open invitation to visit once the school year gets underway to see the authentic, active learning that will be taking place in FbD as well as all other instructional programs!

To accomplish our mission, we rely on the expertise and support of our many partners and stakeholders.

While some staff members have previous experience working in a sector of aviation or aerospace, most are on a steep learning curve to acquire knowledge and understanding that will assist them in developing authentic aviation-themed learning experiences for our students. This is where we need your help.

On August 28th, our entire staff (all 24 of us!) will be gathering for a day of shared learning in preparation for the forthcoming school year. From 8:30-11:30 a.m. we have scheduled what we are calling a "roundtable discussion with aviation leaders," and we are very hopeful that you can be part of this group. Your role would be to do the following:

- *Provide a brief overview of who you are and what you do (or have done) in your professional career related to aviation and aerospace. We are interested in knowing how you selected post high school education and training options as well as what you found essential for college success and career advancement. If you believe the requirements for college and workplace success are now different from what you experienced, please share what you view as the current realities. If you are an educator, please also plan to share your specific experiences related to teaching or administering aviation-related programs and what you believe all students in an aviation-themed high school should know and be able to do by the time they graduate.*
- *Share one or two major issues in your industry/field of work for which solutions need to be developed – social, political, economic, cultural etc.*
- *Share employment & career pathways available within your organization.*
- *Answer questions that staff may have.*

Please know that your participation will make a significant difference in our ability to successfully prepare students for their future, which may include being a member of your own workforce."

Large scale graphics enliven hallways. Below: the Boeing 787 Dreamliner

Educational Specifications

Developed in 2008/2009, the Educational Specifications describe the building goals and specific details for the design of RAHS. The Educational Specifications are based on conversations with students, teachers, and staff and Highline School District Standards. The documents describe an ideal physical framework where model educational curriculum delivery methods may be practiced.

Because the school curriculum is in constant evolution, it was important for the Educational Specifications to reflect criteria that encouraged building flexibility and student success.

The goals established through meetings with students, staff, and District representatives were:

- Reflect the many aspects of aviation and aerospace
- Promote team-building and positive interaction
- Support academic excellence
- Celebrate student work and successes
- Anticipate change and allow the facility to evolve gracefully
- Be a good steward to the natural environment by promoting sustainable practice
- Protect and encourage user health and safety
- Incorporate technology wisely
- Create a durable, easily maintained facility

The space program was established using approximately 160 square feet per student, in order to provide parity with other District high schools. Because of RAHS' population of 400 students and an interest to accommodate large project work, the space limit forced the design to be efficient, especially in the creation of the presentation and physical education spaces.

Stakeholders

RAHS benefited from a large number of stakeholders advocating for the project. Because of the school's unique site, funding, and program three parallel stakeholder groups were established.

Site: The establishment of the school at the Museum of Flight was a major stakeholder effort and included former Museum of Flight CEO and astronaut Bonnie Dunbar, influential members of the Museum Board of Directors, the City of Tukwila, the Advisory Board of the School made up of aviation industry giants; and the District's superintendent and school principal.

Public Funding: State representatives, the Governor's office, and members of congress all provided key support in garnering public funds beyond normal school funding mechanisms. Because of the regional and state component for funding, RAHS agreed to accept up to 60% of its students from outside the Highline School District.

Program: The School Design Team (SDT) included students, industry partners, teachers, mentors, parents, administrators, and District facilities managers who worked with the architectural team to establish guiding principles and priorities of the project inside the framework of the Educational Specifications. Meeting every three weeks during the project design phases, the SDT's agendas included site development, sustainability goals, evaluating design options, and making final selections.

Students with partners and mentors from Alaska Airlines

Guiding Principles

Once design work started, the goals outlined in the Educational Specifications were refined to closely align with the school's location and the SDT's priorities. The SDT developed the following Guiding Principles, which were used as measurement criteria for evaluating design options.

1. **Signature/Uniqueness:** Location & aesthetics say a lot about purpose and priorities
   - Take advantage of the unique site to create a school that is elegant and simple in its form, and harmonious with the Museum of Flight's architecture.
   - Express the aviation theme through the design.
   - Provide view points to the surrounding Boeing Field landing strip, airport, and Airpark Gallery.
   - Create a landmark that is easily identifiable.
2. **Greeting and Oversight:** Initial steps into RAHS set the tone
   - Organize staff spaces throughout the building for passive supervision and encourage teacher/student interaction outside of the classroom.
   - Establish reception/ administration as the main greeting area and the lobby as a welcoming waiting area.
   - Celebrate accomplishments, awards, and donors.
   - Create whole school visual connections - a place to see and be seen.
3. **Visible Learning:** Learning is contagious
   - Create breakout spaces for informal meeting, individual study, and mentoring via flex spaces and small conference rooms.
   - Provide a state-of-the-art public presentation space.
   - Create opportunities for public display of student work throughout the school.
   - Be a model school for teacher practice and development.
4. **Community Gathering:** Find your voice and strength
   - Provide a space that can hold a whole school gathering for presentations and social events.
   - Pay attention to natural daylight and acoustics for gathering spaces.
   - Have the ability to secure portions of the building for public use.
5. **User Health and Lifelong Fitness:** Be strong; stay active; be well
   - Provide adequate bike facilities, refillable water stations, a small basketball court, and stairs for exercise.

Top: Reception and lobby set a welcoming tone; Below: A digital display on the water filling station shows students how many plastic bottles they save

- Consider daylighting, acoustics, and connection to the outside as part of a healthy environment.

6. **Environmentally & Human Friendly:** Steward our natural and human resources
   - Conform to the Washington Schools Sustainability Protocol (LEED Silver equivalent).
   - Use no- or low-VOC finishes to create a healthy interior environment.
   - Create a building that is energy efficient.
   - Create a site that is safe and secure.
7. **Building Longevity:** Invest in the future
   - Build to last 50 years with built-in flexibility, spaces that can accommodate multiple functions, simple layout of rooms, and adaptability of technologies.
   - Provide a lot of storage.
   - Use materials that are easy to maintain and abuse resistant.

An east/west orientation, 11-foot windows, skylights, and clerestory windows contribute to providing an evenly daylit learning environment in labs and classrooms.

Educational Environment

Aside from aviation and aerospace immersion, the RAHS curriculum distinguishes itself by relying on interactive, project-based learning and industry partnerships and mentorships as primary teaching methods. The design works with this program by providing several types of innovative, flexible spaces. All of these spaces support a variety of teaching and learning methods and allow each teacher to conduct their classes with any combination of mobility, teamwork, and hands-on learning.

A grand central stairway provides a social heart to the school as well as informal learning opportunities and student display areas. Humanities teacher Marcy Wombold said that she is partial to this space because it acts as a hub for connectivity. "Students put up posters, conversations happen there – if I want to get a sense of what people are up to, that's where I go." School traditions are being formed on the grand stairway including a robotics team send off and a place for the students to sing "Happy Birthday" to teachers.

"My classrooms are beautiful and the students feel that. It's a good place to be and they can be easy and present because the environment pushes them in that direction." Marcy Wombold, RAHS Humanities Teacher

Learning clusters radiate from the center stairs, each with a flexible breakout area overlooking either airport activity to the east, or boat traffic on the Duwamish River to the west. The flex areas are equipped with adaptable furnishings and writable wall surfaces to encourage teamwork and interaction. These areas have become prime real estate on the campus, and are a favorite of teachers and mentors, as well as students. Still in the line of sight for teacher supervision, flex areas live up to their name by providing space for classroom overflow, math club meetings, before and after school gatherings, and lunchtime discussions. Teachers report arriving as early as 6:30 in the morning to find students already filling the whiteboards with math equations.

Classrooms set themselves apart from the norm with teaching walls – another favorite among building users. Teaching walls present an array of options in class without forcing a choice between technology and whiteboards – a sliding feature provides this flexibility. The walls consist of three whiteboards, digital connection with an LED screen and Smart Projector (the Smart Projector uses the whiteboards as a screen), tack strips for pinups, and a surprising amount of storage. Wireless connections in each classroom and laptops allow students and teachers to digitally share and communicate as they learn and explore.

Top: Flex areas are equipped with adaptable furnishings and writable wall surfaces
Bottom: The Computer Design Lab features furnishings and connectivity that encourage both independent and team work

The school's most adaptable space is the Commons/Multi-Purpose Room – an innovative design response to square footage limitations – known fondly by RAHS students as "The Pit." These spaces accommodate physical activity, presentations, socializing, and eating. The Commons, located on the upper floor, has a view of the museum's Airpark and serves as the lunch room. Bar-height counters and stools along the north wall are regularly used by students during lunch, as well as throughout the day, to work on projects and to socialize. Large windows lining the counter have become a magnet for students to gather, work, and observe significant events at King County Airport.

During lunch, students burn off energy in the Multi-Purpose Room, designed to accommodate a half-court for basketball, while their peers look on from the Commons above. Students like to use both floors simultaneously for interactive games and both spaces are used for fund raising events.

For presentations, the Commons/ Multi-Purpose Room easily transforms into a state of the art lecture hall with upholstered pull-out theater seating, motorized roller shades to control daylight, and a sophisticated audio-video system. The space is flexible enough to accommodate a number of uses such as informal presentations to classmates and robotics demonstrations for visiting middle-schoolers; and professional enough to provide a space where students can defend their work to an audience that includes industry partners and mentors from companies such as Alaska Airlines, Rocketdyne, Boeing, and Microsoft.

Labs are designed to support rigorous programs such as the school's award winning robotics team, Skunk Works. These spaces are outfitted with the equipment and technology to encourage a broad range of exploration. A cutting-edge machine shop supports the aviation themed curriculum. Computer-Numerically-Controlled (CNC) laser and water-jet cutters sit among high precision metal and wood working tools enabling students to perform experiments and build their competition robots and full-sized airplanes. The Project Lab is replete with opening garage doors to accommodate wind tunnel operation without blowing down a wall. A CAD lab complements the machine shop with 3D modeling software, plotters, and a 3D printer to enhance testing, exploration, and prototyping.

During the visioning process, teachers expressed the desire to hang objects from the ceiling – an appropriate request for a school that deals primarily with the forces above us. A metal framing system is suspended from lab ceilings to allow this. The physics lab is designed to accommodate ceiling suspended power cord reels that provide additional power connections in the middle of the room. The machine lab has ceiling suspended cord reels that provide both power and air to six different locations at the center of the room.

Top: The robotics lab supports the school's award winning team; Bottom: Labs include moveable furniture for quick rearrangements between discussion and experimentation

Karl Nielsen, a RAHS sophomore, explained the way these rooms work together to assist his class in the creation of air foils. "We're printing out CAD models of specific air foils on our 3D printer, and then we're going to our brand new wind tunnel to test them at various speeds and angles of attack and measure the lift and drag. Then we compile all of the information into a giant air foil library database that the whole class collects together."

As juniors, Karl and his classmates will select their best air foil and use the lift to drag data to design a wing beam in CAD. After stress testing, the students will then present the wing in "The Pit" to a group of engineers from Boeing; pitching a sale to them by explaining why theirs is better than all of the others in the class. The cycle of collaboration and mentoring then completes itself to begin again in a different form.

"It's really made me want to give back because all of the time the mentors give to us and all the opportunities we get – it's really humbling." Skye McEowen, RAHS Senior

Small conference rooms support the school's mentor/student agenda and provide private areas for discussion and exchange. Above and beyond the original room purpose, the mentors use the rooms for professional gatherings and inviting students and teachers to join and observe.

One final collaboration space, the Professional Learning Center, takes it up a notch by providing a place for teachers to teach each other. In 2010, the Washington

State Legislature designated the Lighthouse Program as part of an overall strategy to improve STEM education in the state, and help fulfill the need for STEM-skilled high-tech workers at Washington-based companies such as Boeing, Microsoft, and others. The Washington school program provides grants to high-performing STEM middle schools and high schools each year and those "Lighthouse" schools use the funds to help other schools create STEM programs. RAHS was the only high school originally selected as a model for the program.

Reba Gilman explained, "We envision bringing in industry leaders with groups of educators to share our model and help them develop a curriculum. We can have people sitting around the table in the Professional Learning Center and use the cameras in the room to allow them to observe hands-on learning in action."

Student mentor Dan Hrehov, an engineer at Boeing, uses this space for the Society of Flight Test Engineers meetings where students can listen in on discussions about flight testing of aerospace vehicles.

"The design of the school invites partnerships. . . We get calls all of the time from people who work in the area and want to come by and visit. They don't necessarily know about Raisbeck Aviation High School, they just look at the building and want to see it." Reba Gilman, RAHS Principal and CEO

Leonardo da Vinci's Flying Machine

Physical Environment

The beauty of the RAHS design is that it blurs the line between the educational environment and the physical environment. The school's airfoil shape is not only representative of what goes on inside the building and around the neighborhood, but heightens student enthusiasm and inspiration for their work; enabling success.

At the neighborhood scale, the architectural expression of the building ties to the Museum of Flight campus and acts as an important anchor for its future west side development, while maintaining its own personality. The school's curved airfoil façade is also evocative of the museum's pedestrian bridge to the south. The shape allows for larger second and third floor plates, making it possible to meet program needs without increasing the footprint or adding stories.

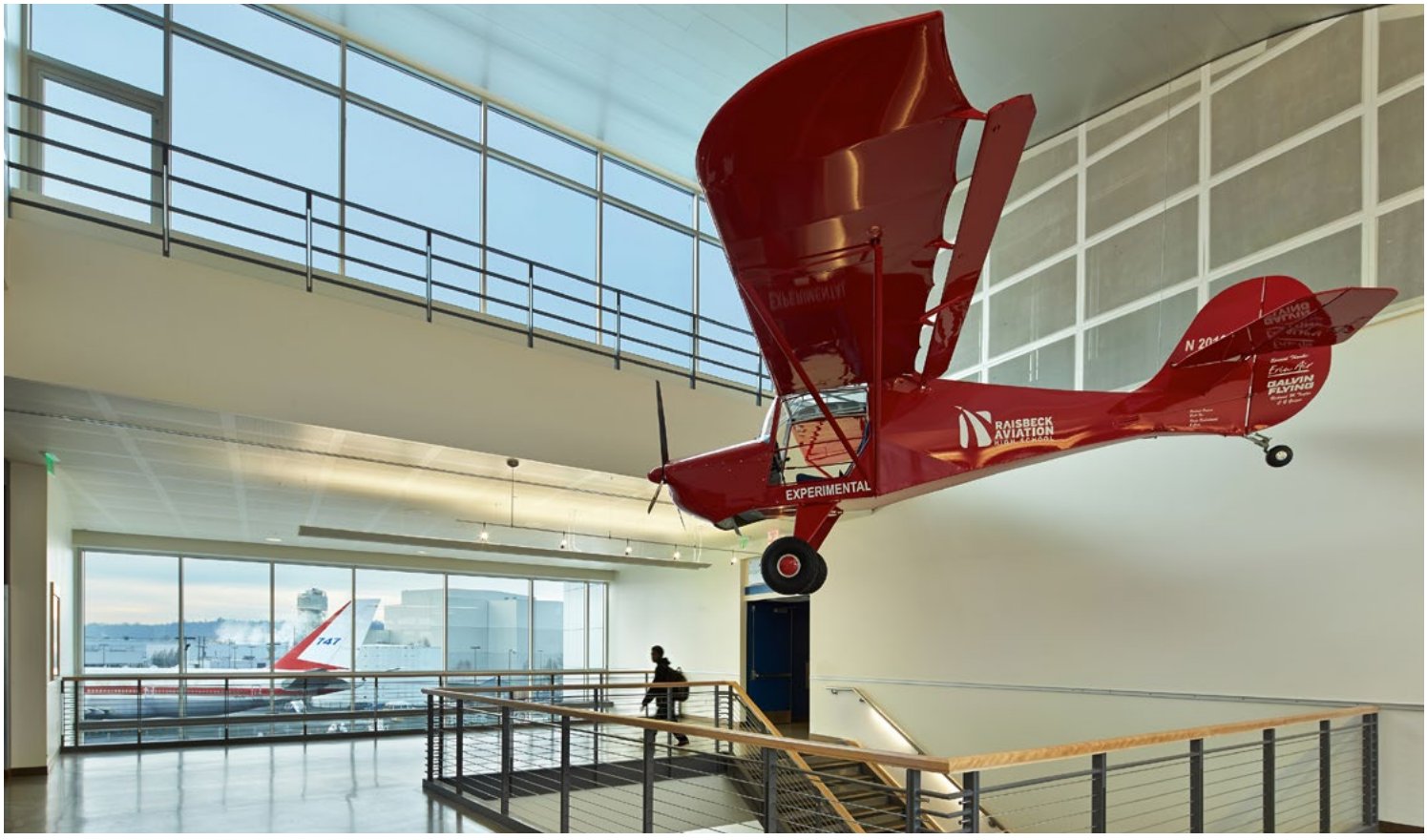
The building is sited to shield learning spaces from noise created by air traffic occurring approximately every 90 seconds. The glazing combines the most efficient noise reduction factor with solar reflectance for optimal acoustic and energy performance, while providing the means to take advantage of the school's extraordinary context. It also provides flexible learning spaces with daylight, connects corridors to exterior views, and floods the grand central stairway/entry lobby; defining it as the social heart of the school.

Tall windows allow for daylight penetration deep into the classrooms, most of which are located on the third floor where daylight is balanced with either clerestory light or skylights. All incoming daylight and potential glare is controlled by the user with vertical and horizontal roller shades.

This abundance of natural light is a remarkable feature of the new building for faculty, students, and teachers. "Just looking out at the 747 (in the Airpark) on a gray, rainy day through 20 feet of glass – there's so much light," said teacher Scott McComb. Mr. McComb often spends Sunday afternoons grading papers on campus in the winter because the school is so much brighter than his home office.

During the visioning process the SDT expressed the desire for a dynamic school entry with the realization that the first steps into a school set the tone for the experience. To that end, the entry was designed with places to showcase student awards and achievements, honor RAHS donors, and display the aviation and aerospace equivalent of art. Two pieces hang in the lobby: the red plane, constructed by now-graduated Aviation High School students, reminds students that they are capable of creating anything. A second piece, a full-scale prototype of a spiroid winglet, speaks to the innovative future of their careers.

Prototype of a spiroid winglet



In addition to showcasing the school's mission, the entry supports supervision and oversight. The organization of staff spaces throughout the building, and creation of areas that encourage student/teacher interaction outside the classroom such as flex spaces, enables both passive supervision and collaboration.

Large-scale images depicting aircraft, outer space, computer technology, and the history of scientific invention enliven the hallways and provide unique identities to the classroom wings. These areas are also functional, and provide teachers with the opportunity to stand at the end of a wing and connect with every student as they leave their class. Continuing the design team's theme of celebrating the students, corridors throughout the school are lined with display surfaces for showing class projects or advertising the many school clubs and events, and for featuring inspirational messages from industry leaders.

Within labs, floor patterns of molecules, electronic circuitry, and DNA formation remind students of their scientific and engineering pursuits. Ground floor labs promote the educational partnership with the Museum of Flight by opening directly to the museum's Airpark – an outdoor aircraft gallery where prestigious planes are exhibited such as the world's first 747, the Concorde, and Air Force One. Both the Machine Shop and Project Lab connect directly to the courtyard offering the opportunity to expand those learning environments to the outdoors. The courtyard performs double duty by also providing a

comfortable outdoor socializing and presentation space by creating a zone nested between the street and the school. Students can also breathe some fresh air while enjoying the view from the second and third floor balconies, where they observe planes taking off and landing at King County Airport.

Aside from the obvious advantage of industry connections, the new building found many ways to provide opportunities for students, teachers, and mentors to connect. Most of these users were surprised to find that the footprint is smaller than their old space. As Skye Mceowen explained, "I do robotics, so I'm here from 9:00 am to 9:00 pm and I don't get tired of being here. There's always a place I can go for a change of scenery."

Like many projects borne from the desire to make something better, the success of Raisbeck Aviation High School has manifested in ways that go beyond its original concept. This school's vision has provided hundreds of people, including the architects, the opportunity to reach for the stars, literally and figuratively.

"It was worth waiting for - to get a location with 200 air and space related entities and be on the property with the Museum of Flight, and to get a school with a design that just speaks to what we do here. . . It extends the learning opportunity – the learning on this campus is amazing!" Reba Gilman, RAHS Principal and CEO