NAIT
PRODUCTIVITY
& INNOVATION CENTRE

Owner | Architect | Structural Engineer | Mechanical Engineer | Electrical Engineer | Civil Engineer

OVERVIEW

The Productivity and Innovation Centre (PIC) at the Northern Alberta Institute of Technology (NAIT) is a 17,650 square metre applied research centre and teaching facility that houses advanced manufacturing and testing laboratory spaces, acceleration spaces for small and medium-sized businesses, a 250-person multi-purpose lecture theater, classrooms, and collaboration spaces along with administrative, and industry partner offices.

PIC will enhance productivity, spur innovation, foster a deeper culture of entrepreneurship, and drive solutions to industry-driven problems through applied research. Building on NAIT's established strengths and historic relationship with industry, PIC is transformative for Alberta.

Funding for PIC was made possible through the Government of Canada's Post-Secondary Institutions Strategic Investment Fund (SIF) and is the first building at NAIT dedicated to helping industry partners become globally competitive. The funding source mandated that the building be substantially complete by April 30, 2018 in order to receive the funding. This established a strict 22 month schedule from design through construction that had to be realized to meet the project objectives.

Collaboration and communication were emphasized throughout the design and construction process. An extensive consultation process was led by GEC Architecture which brought together the entire consultant team with key stakeholders from the NAIT team, along with the construction manager, Clark Builders.

The primary component of the building programme was to provide laboratory and research spaces for industrial focused research and development. It was important to understand the initial design requirements, as well as future program needs in order to effectively size and configure the laboratories and necessary building systems. Future flexibility was also built into the spaces and building systems to support new and evolving research programmes. This allows for the repurposing of spaces over time as industry partners change or programmes grow with success. There was a balance required in providing efficient systems for the present researchers while incorporating scalability and flexibility for future needs at a reasonable cost.

The close collaboration was also essential in accommodating a compressed design and construction schedule. The compressed schedule meant that detailed design was being completed as construction of the building's superstructure was underway,

BUILDING SYSTEMS AND INNOVATIONS

ARCHITECTURE

The massing and formal resolution of the Productivity and Innovation Centre has been developed to address the campus context, functional requirements and NAIT Design Guidelines. The result is a unique architectural expression that reinforces NAIT's polytechnic campus design. Located on a triangular site, the building massing has been designed to create a street presence on Princess Elizabeth Avenue that steps down towards the Westwood neighbourhood to the north.

The building contains a diverse set of laboratories and applied research centres which GEC distilled down and divided programmatically into two general Lab space types. These space types were divided into two building wings - a single storey high-bay laboratory wing and a 4-storey multi-purpose wing incorporating laboratory, research, acceleration, teaching and administrative spaces. A dynamic, light-filled atrium connects the two wings supporting collaboration and interaction between researchers.

The exterior cladding supports NAIT PIC's polytechnic design through the use of standing seam aluminum, brick, and a textured, high performance concrete panel cladding system.

The interior design of PIC consists of a simple palette of exposed concrete, wood, and stainless steel. A balance of fully finished spaces and exposed structure allows for future flexibility for NAIT and their industry partners.

STRUCTURAL

Fast + Epp was the structural engineering sub-consultant and was responsible for all aspects of the primary building design from concept engineering through to detailed design and construction administration.

The building was conceived as two distinctive wings each with their own unique structural system that was tailored to specific research functions. The single story high-head laboratory wing utilizes a steel frame system. While this appears conventional, a unique and innovative steel truss and girder solution was developed to simplify the installation and routing of the mechanical and electrical systems as well as provide future flexibility as the spaces are repurposed overtime. A 6m clear working height was provided throughout the laboratory spaces with all mechanical and electrical infrastructure located within the large steel trusses.

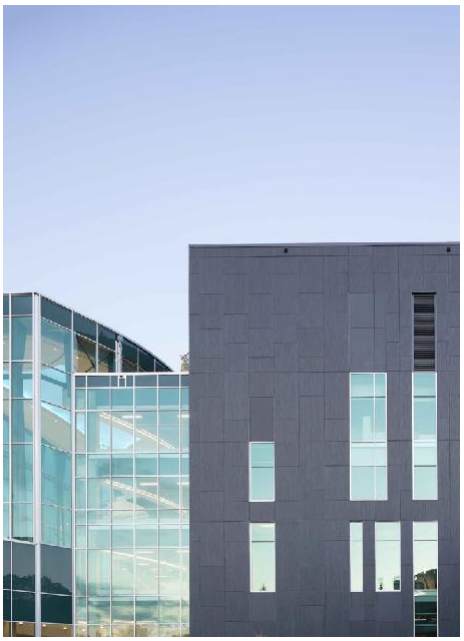
A large 9m column spacing was developed to allow for open flexible laboratory spaces with a central circulation spine to access each bay. The trusses incorporated a robust HSS bottom cord to allow a researcher to hang equipment and easily alter their spaces without interference from mechanical and electrical systems or the need for adding additional structure. The 1.9m tall steel trusses allow for consistent large open spaces for the extensive systems of ducts and services.

Structural, mechanical and electrical infrastructure was modeled three-dimensionally, early in the design phase in order to minimize costly site conflicts and ensure flexibility within the systems. Due to this early design and coordination, the site installation and erection proceeded smoothly.

The adjacent multi-storey wing was designed with a two-way flat slab to reduce the structural depth and provide appropriate fire resistance ratings. The clean structural surface allowed for easy installation of the mechanical and electrical systems. The flat slab also allowed for flexibility for future coring and alterations to the slab as research priorities change.

The combination of the two structural systems was developed with our construction manager and allowed for two separate crews to work in tandem. This provided for an efficient and quick construction of the building's superstructure. The concrete contractors were able to finish ahead of their initial aggressive schedule.

FLEXIBLE LAB SPACE IN STEEL FRAME SYSTEM



DISTINCT BUILDING WINGS + ATRIUM

MECHANICAL

CIMA+ (formerly KFR Engineering) was the Mechanical engineering sub-consultant, responsible for the mechanical design from concept engineering through to detailed design and construction.

The NAIT PIC programme is to support leading edge research & development, fundamental to the Alberta economy in a variety of industrial applications. The laboratory heating, ventilation and air conditioning (HVAC) systems are designed to be modular in nature, with services such as cooling water, fume exhaust and additional ventilation air available at every laboratory. With this provision, any given laboratory can be refitted to suit a new research programme with varying equipment intensities, while at the same time, adjacent laboratories and research programmes are undisturbed by renovation work.

Several spaces required specialised environments from the start for unique research and development activities. The Measurements Laboratory features highly sensitive electron microscopes that require very stable room temperature and quiet conditions to remain accurate. The HVAC systems for this space were specially selected for temperature stability and quiet operation. Other spaces such as the tailings laboratory may contain significant off-gas from open vessels required special exhaust provisions. Other areas are equipped with high powered research systems that needs special cooling service.

In all these instances, specific lab requirements were developed with the research teams and detailed fit-up was designed for the universal “modular” lab HVAC systems. Future research activities will be similarly accommodated within the modular labs.

Laboratories are typically high energy consumers due to the need for high rates of ventilation and cooling. Energy saving lab design makes significant reductions in carbon emissions while maintaining safe environments for lab workers.

Several laboratory HVAC technologies were used to dynamically reduce ventilation rates including specialised variable volume control systems that reduce the exhaust coming from fume hoods, while maintaining fume hood containment and lab relative pressurization.

Heat recovery systems scrub heat from the outgoing fume exhaust and recycle the heat to temper the incoming ventilation air. Preventing potential cross-contamination is a key requirement for design and operation of such systems in laboratory facilities.

In addition to the laboratory spaces, the building features extensive teaching and administrative facilities. In order to provide quiet comfort in these spaces with maximum energy efficiency, “chilled beam” technology was used to condition these spaces. Chilled beams are ventilation and cooling units mounted in the ceiling that provide measured quantities of fresh air for ventilation while inducing air movement through chilled water cooling coils. This highly efficient system provides space conditioning with minimal energy expense. High efficiency condensing boilers serve the perimeter heating and a high efficiency magnetic bearing chiller provide energy efficient performance year round to achieve highly energy efficient performance to meet the buildings LEED objectives.

HIGH EFFICIENCY MECHANICAL SYSTEM

ELECTRICAL

SMP Engineering was the Electrical engineering sub-consultant for this project and was involved in the design of the power distribution system, emergency power system, low tension systems (including the data, telephone, and emergency call systems, audio visual system, camera (CCTV) system, access control system, and clock system, the fire alarm system and photo voltaic schematic design.

The intent of the design was to provide an energy efficient building with minimal operating costs, while keeping mindful of the available budget. The intent was to:

- Design efficient control of building loads (especially lighting loads).
- Avoid the use of specialized materials and equipment that may have a high replacement cost and may not permit competitive bidding.
- Provide enough extra capacity and a suitable raceway system to ensure that current and future uses of the building are met.

The electrical service size to the Productivity and Innovation Centre is 2000A, 3P, 4W at 600V. Power service is provided by Epcor via an existing switching cubicle. A single 13.8kV feeder has been provided to the building along with spare raceways to allow the addition of a future 13.8kV feeder for increased redundancy if required. A fibre service is also provided by Telus to the building.

The main distribution is completed with a double ended substation in a main tie main configuration complete with metering and two cast coil transformers. This provides ease of maintenance for the future as well as building redundancy. Each transformer is sized to accommodate the total load of the building.

Sub electrical rooms are situated within the floor spaces of the A and B laboratory spaces complete with both 600V and 1200/208V power. Power panels are provided within each lab space at 120/208V. A 600V bus duct system is also present within the A space labs for future flexibility.

The emergency power for PIC is provided by a 750kW, self-contained outdoor mounted skin-tight generator. This generator is complete with a diesel 24-hour sub base fuel tank. Emergency power provides for the building fire pump, life safety systems, security door control power, telecommunication equipment power, egress lighting, fire alarm, and selected equipment power. The centralized UPS system is also present for all user data backup for equipment in the labs and office space, security and low-tension systems.

Photovoltaic System

The design allows for a total of 200kW to be connected to main distribution. This total is based on total roof/wall space that photovoltaic panels can be installed. Photovoltaic panels were installed on the roof area as well as the front north façade to showcase the extent of Solar Design that was utilized.

Lighting Control

The Lighting Control System is a DALI-based system by Fifth-light that is complete with occupancy and daylight sensors that are interconnected to the BMS system. DALI is a digital technology, two-way communication system for lighting and is an international standard for communication. The system allows individual LED drivers/ballasts “talk” to the Owner and allows the Owner to “talk” back via DALI controllers and appropriate computers software.

Most of the building can be controlled remotely through this system while addressable lighting control is provided with local switches. This allows additional control requirements based on User’s needs. Additionally, the stairwells use ultrasonic sensors to turn on/off lighting.

Electric Vehicle Charging Stations

There are two Level 2 Electric Vehicle Charging Stations located in the parkade level.

Special Systems

A main communications room for data, telephone and emergency call systems was designed and built with:

- Head end equipment, data racks, fire alarm control panel, and security head end equipment. Sub communication rooms are located throughout the building.
- Completed fiber connectivity to each room and data racks which supports all the cable terminations from the outlets within the building. A fiber backbone was provided from the main communications room to each sub communication room.
- Cat 6 cabling was installed throughout the building and is the cabling standard for data outlets.

- The servers are APC mounted in cabinets except for other head end equipment which is mounted in two post racks.
- The networked lighting control panels, and access control/CCTV panels are located within the communication rooms. The access control/CCTV system utilizes a discrete segregated component of the IT backbone.
- The use of “smart building technology” such as telemetry, and card access to activate building systems was considered during the design phase.
- VOIP and wireless access is deployed throughout the building. One (1) Cat 6A cables is installed in each wireless location. Help phones and emergency phones are located throughout campus and in the parkade, additionally, telephone handsets are available at each touchdown space and classroom.
- USB outlets are installed throughout the lounge spaces and student amenity spaces for added convenience.

A discrete Co-Locate Main Server room is also present and designed to meet the capacity requirements. The understanding was that NAIT’s industry partners utilizing the facility will operate on NAIT’s Public Network and will not typically access the NAIT Data Centre, except for connectivity to the outside world. The server room consists of shared lockable cabinets (5-6), raised computer floor, cooling units, UPS power supply and redundant power to each rack from distribution panels located within the room.

Audio Visual System

An audio/visual teaching and/or presentation system was designed and provided throughout the building which included the following:

- Single display based on presentation systems in the identified small and medium break-out rooms.
- Dual short throw projection teaching and presentation systems in the large break-out rooms, large meeting rooms, classrooms, teaching labs, flexible lecture rooms and divisible lecture rooms. Projection surfaces make use of suitable white board type projection surfaces.
- All AV teaching and presentation systems in the large break out rooms, large meeting rooms, classrooms, flexible lecture rooms and teaching labs have an AV equipment rack located inside the room.

Camera (CCTV) System

- CCTV camera surveillance system included expansion of existing OnSSI Ocularis system and has cameras at all major public entrances to the building and in front of all Elevator and washroom hallways, entry hallways leading to stairways, parking level and loading dock areas and general circulation points around the cafeteria and open work spaces.
- Integration will include addition of automatic call up of any camera that views an alarm event such as door forced, door held, duress alarm, or as defined by the NAIT standard operations policies.

Access Control System

- Standard hardwired C-Cure 9000 Prox Card system and automatic access control was added at all major public access doors that enter from outside the building, enabling a lockdown function to all other entry doors.
- Card access was added to lab spaces and controlled spaces (e.g. bunker rooms in basement and 3D printing room). Access control was also added to the Public corridor entrances for the Mechanical and Electrical/ Data closets and Janitor closets.
- The integration of access control was also expanded to include trigger of video for alarm events, integration to intercom for remote release of doors (where appropriate) and integration of intrusion alarm for continuous monitoring purposes.

ATRIUM LIGHTING WITH COLOR-CHANGING LED’S

SUSTAINABILITY

The Productivity and Innovation Centre is targeting LEED Gold certification for new construction, exceeding the project's mandated Silver target.

Sustainable priorities for the centre include:

- Showcase and make apparent sustainable strategies to students and guests of the facility.
- Incorporate renewable energy sources.
- Employ durable and reliable sustainable energy sources.

Several ways these objectives were achieved were through the use of a photovoltaic system, the use of structural systems that minimized material usage and through the use of efficient mechanical and electrical systems.

The NAIT PIC includes 380m² of facade integrated photovoltaic panels, and a 100% dedicated outdoor air ventilation system with heat recovery.

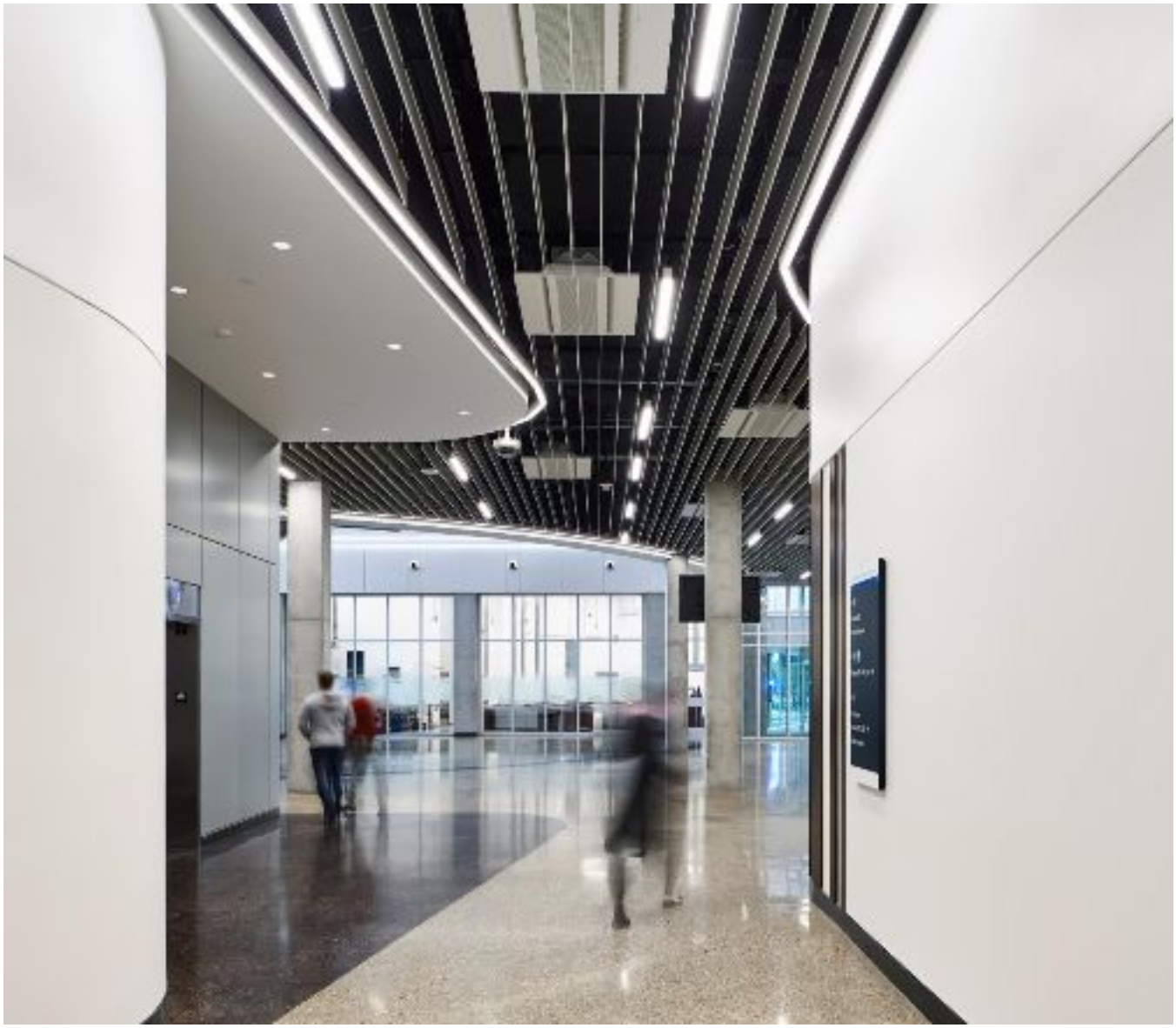
MINIMIZED STRUCTURAL MATERIAL USAGE AND FACADE INTEGRATED PHOTOVOLTAIC PANELING

PROJECT COSTS

The PIC was completed under a construction management contract with the mechanical and electrical sub-CMs. The final cost of construction was under the $68,790,000 project budget that was established with the Construction Manager and NAIT.

PROJECT SCHEDULE

The project was completed on an aggressive timeline that was mandated by the project's Strategic Infrastructure Funding (SIF). This required the project to reach substantial completion by April 30, 2018. This meant that the award of the project through design and construction was completed within a very compressed 22 month schedule. This required close collaboration between the design team, client and contractor to ensure sessions where made timely while meeting the needs of the institution. After substantial completion the project underwent a detailed interior fit-up of the applied research laboratories which was completed on time to accept researchers and industry partners in September of 2018.



NAIT PIC WAS DELIVERED IN A COMPRESSED 22-MONTH SCHEDULE

RISK MANAGEMENT

The project's funding through the government's SIF program meant it needs to be completed by April 30, 2018 or risk losing all of the project's funding. This drove a compressed schedule within a fixed budget. Meeting this schedule was the biggest project delivery risk.

The team mitigated this risk by working collaboratively with NAIT and our construction manager to ensure the project's design goals were met while provide constructible and cost-effective solutions. The mechanical and electrical scopes were delivered using a design assist model which allowed the sub-contractors and sub-consultant teams to work together directly and the development of the building system designs. This had a major impact on the speed of the decision-making process and streamlined the documentation and construction of the design.

The major design risk of the project was to leave NAIT with a facility that could not adapt to changing research needs and funding priorities. This was a primary focus of the design team and informed all of the early decision making. Spaces were purposely built in ways that allowed them to be easily and cost effectively adapted over time. The high head laboratory space is a primary example of this kind of thinking that permeates the design. Similarly, mechanical and electrical systems have been designed for expansion with areas of the building specifically designated for more intensive laboratory functions in the future. All this means the project will be able to provide lasting value to NAIT and their industry partners.

BENEFIT TO SOCIETY

NAIT is one of the largest polytechnic institutes in Canada, providing education in advanced technologies, business, skilled trades and allied health to more than 80,000 registrants annually in the Edmonton Metropolitan Region, in Alberta as well as nationally and internationally. NAIT graduates provide the skilled workforce required to support Alberta's current and emergent economic needs. Recognized for the last three years as one of the top employers in the Province of Alberta, NAIT is one of Canada's foremost trainers in technology-based education.

The addition of the Productivity and Innovation Centre to the NAIT campus will continue to allow NAIT to provide world leading research and train a highly skilled workforce. The sustainable technologies employed in the construction of the Centre will provide an efficient highly adaptable building that will be utilized for many generations.