École Lawrence Grassi Middle School

CANMORE, ALBERTA

Canadian Wood Council / Conseil canadien du bois

woodWORKS! Project of the Canadian Wood Council

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Introduction

Canmore is a recreational and administrative centre located at the entrance to Banff National Park in the Canadian Rockies, 105 km west of Calgary. It is a community of 12,000 permanent and 5,500 non-permanent residents. The former elementary school was constructed in the 1950s and since then, significant population growth has occurred in Canmore.

GEC Architecture was engaged to conduct a feasibility study that led to the recommendation to build a new school, the École Lawrence Grassi Middle School, for students attending Grades 5 to 8, inclusive. The Province of Alberta approved funding for a replacement core school and 12 modular classrooms. The new school opened in September 2008.

The new school is located in a residential area, near existing sports fields (Figure 1) and in close proximity to the Rocky Mountains that surround Canmore.

The design team responded to client design objectives that established that the new school:

- be a functional, cost-effective, modern school facility that presented an image consistent with the prevailing architecture of the Canadian rocky mountain communities;
- meet environmental conservation and sustainable building objectives by achieving Leadership in Energy and Environmental Design (LEED®) Silver accreditation from the Canada Green Building Council;
- have energy performance 50% less than the baseline defined in the Model *National Energy Code of Canada for Buildings* (MNECB);
- incorporate building technologies available locally.

The design met the needs of the educational program and the funding ceiling by incorporating:

- nominally smaller classrooms to provide room for teaching breakout spaces;

FIGURE 1 Site Plan

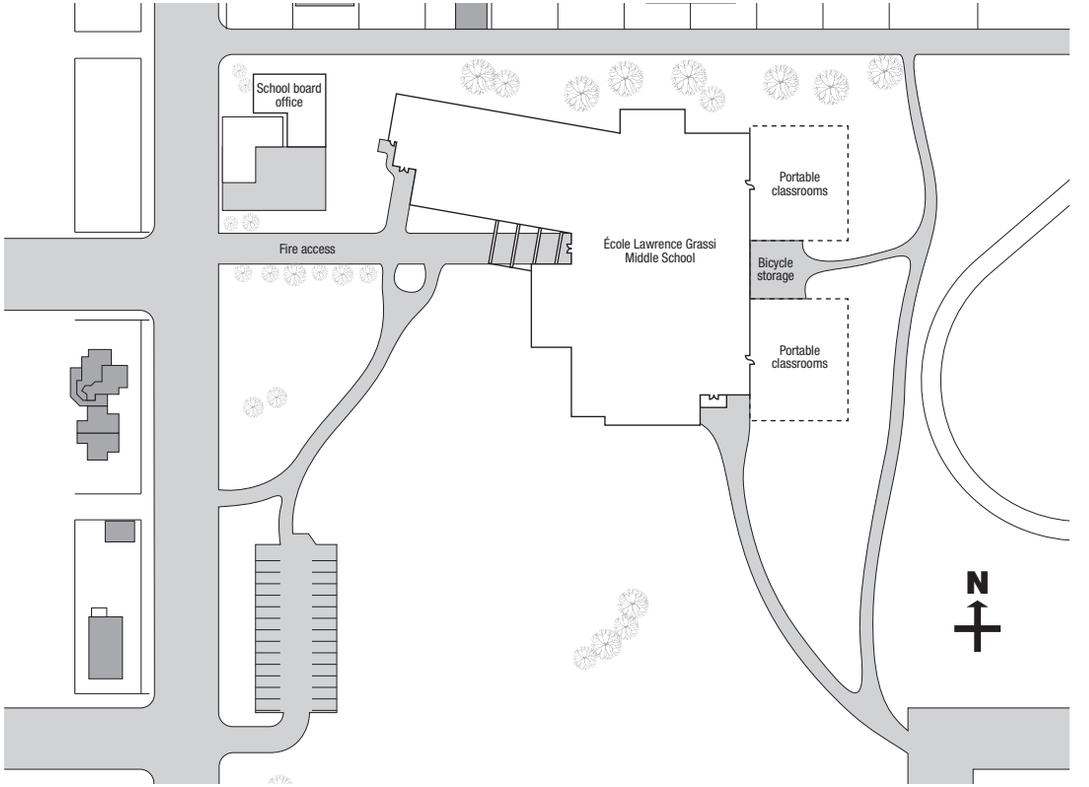

Photo: Rory Koska

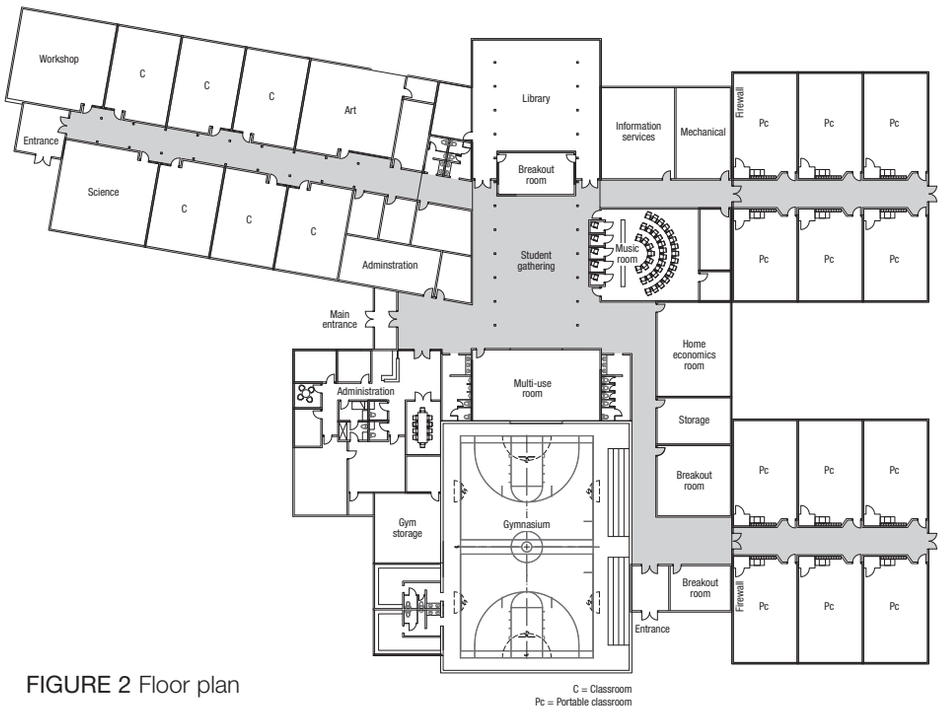

FIGURE 2 Floor plan

- larger washroom areas to facilitate supervision and reduce travel distances;
- ancillary spaces that support strong band, art and drama programs;
- science classroom allotment that reflects overall flexibility of teaching spaces;
- technology classroom configuration that supports a strong shop program.

Building Description

Architecture in the Canadian Rockies makes extensive use of indigenous materials – stone and wood. The majority of historic and modern buildings in Canmore and throughout the Rockies make use of wood because of its appearance, economy, availability and its historic performance in the mountain climate.

École Lawrence Grassi Middle School is comprised of wood-frame construction, and post-and-beam construction where large spans are required. The school has 13 specialty classrooms and 12 modular (portable) classrooms (Figure 2). The core building features a wood workshop, mechanics workshop, computer lab, art classroom, library, music room, home economics room, gymnasium, administration offices, and various support services and mechanical rooms.

In the main public spaces and corridors, the tactile and visual warmth of the primary and secondary glue-laminated structure - columns, beams, joists and purlins - is given either partial or full expression depending on room-specific lighting and acoustics requirements. These high-traffic areas are also accented with stained wood panels, battens, and other trim elements. The glue-laminated structure is given partial expression in the classrooms, offices, library, music and other ancillary spaces. Wood casework of local and regional origin and wood doors are used throughout the school.

A main feature of the building is the School Gathering Area. This warm, inviting space features natural lighting through clerestory windows and exposed wood structural members. This area is an informal gathering space for students and is also used for school presentations and assemblies. The construction contract included the provision of footings and services for the 12 portable classrooms, which were supplied and installed under a separate arrangement.

Standard 2x6 wood-frame walls were used to enclose the building. The base of the exterior walls is clad with regionally-sourced, burnished concrete block veneer. The middle portion of the exterior walls is clad with custom profiled, rough-sawn, clear western red cedar siding. In reference to the Town's not-too-distant coal-mining heritage, the upper portions of the exterior walls and the main mass of the school gymnasium are clad in a prefinished corrugated metal siding. Window openings are strategically sized and placed to provide views and natural light.

Structure

Wood beams and purlins were used throughout the school except for the gymnasium where open web steel joists were used for the roof framing. The wood beams are either glulam or Parallam® and are up to 215 mm wide and 798 mm deep. The largest members span the Library and School Gathering area. The roof purlins are 38x235 mm dimension lumber spaced at 610 mm centres. The wood columns are either Parallam® or built-up columns made from two to five plies of 38x140 mm dimension lumber. Parallam® was used where members were left exposed to view, such as in the School Gathering area. The exterior walls and interior shear walls were stick-framed and sheathed with oriented strandboard (OSB) and plywood respectively.

Like many North American codes, the Alberta Building Code (ABC) classifies schools as "High Importance" buildings, requiring them to be able to accommodate higher snow and wind design loads than regular buildings in order to provide refuge during emergencies. These requirements were easily met with

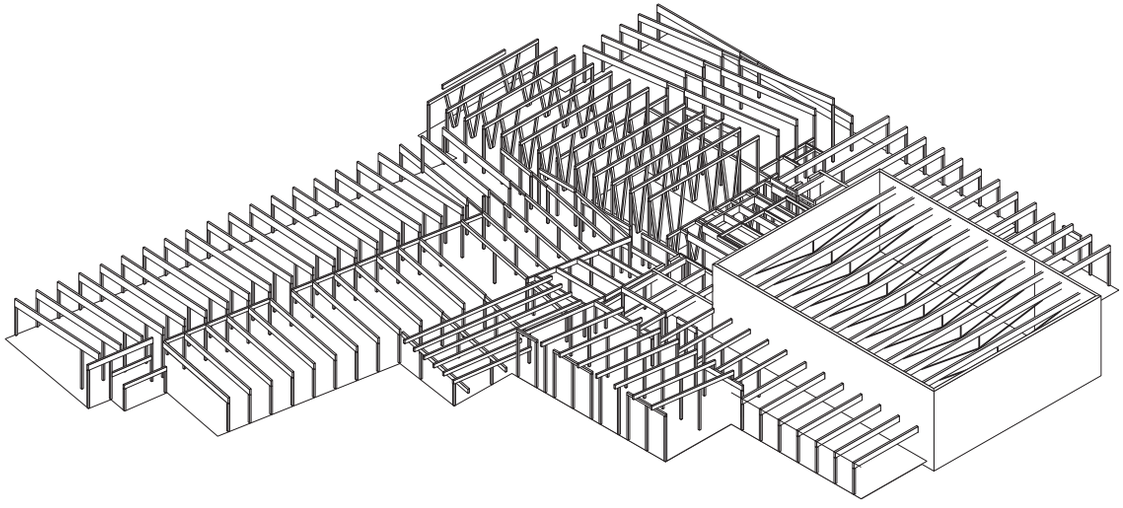

FIGURE 3 Framing schematic

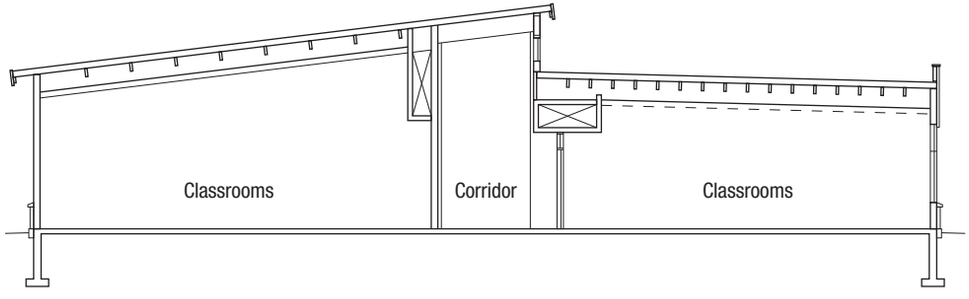

FIGURE 4 Typical section through classrooms

wood construction. Plywood or OSB shearwalls were located at specific locations in exterior, interior and corridor walls and were nailed and tied to the foundation to meet design requirements for lateral stability.

Edmonton-based glulam manufacturer, Western Archrib, used its three-dimensional software and machinery to model all the members, make the appropriate cuts, and prepare the connections (Figure 3). The modelling and machining meant every piece and connection went together without site modification.

The building's primary structural skeleton of glue-laminated columns and beams supports the light-weight and thermally-efficient roof comprised of 4x8 ft. structural insulated panels (SIPs). The SIPS are composite panels consisting of two outer plywood faces and an inner core insulating material. The use of SIPs was somewhat novel for school construction, but was very cost-effective and easily exceeded the level of thermal insulation required. The roof panels and the plywood-sheathed, insulated wood-framed walls that wrap around the glue-laminated frame provide a thermally and structurally efficient stressed skin exterior.

The waterproofing membrane applied over the roof structure is 25mm fibreboard with factory-applied SBS (styrene-butadiene-styrene) base sheet and a torch-applied, granular cap, sheet roofing membrane.

Sound Control

Sound privacy was an important design requirement. Classroom walls were built to provide a sound transmission class (STC) rating of 55 by installing acoustic insulation, one layer of Type X gypsum board on one side and two layers on the other side. The music room walls were designed to STC 61 through the use of one 2x6 and one 2x4 wood-frame walls separated by a 25mm space. Each wall cavity was filled with acoustic insulation. One layer of Type X gypsum board was installed on one side and two layers on the other.

Cost

Like some other North American jurisdictions, the Province of Alberta sets funding ceilings for school construction based on the number of projected students. École Lawrence Grassi Middle School met the strict funding ceiling set by the Province, and still obtained the additional architectural appeal stemming from the use of natural light and exposed wood members. Preliminary cost comparisons by the architect showed that glulam structural members were cost competitive with steel. The design maximized the use of local materials and trades, which also allowed the cost to stay within the funding limitations. The overall cost was $3,100 per square meter.

Heating and Cooling

The heating and cooling system was designed to exceed *Model National Energy Code of Canada for Buildings* energy reduction objectives and contributes to improved air quality and energy efficiency. The building is equipped with a small, conventional, central forced air heating system, but the vast majority of the heating and cooling is provided by two, high efficiency, gas-fired, fully condensing boilers that circulate heated water through in-slab piping. Unlike conventional systems that rely on air circulation for both heat distribution and ventilation, the majority of the heat is delivered through the concrete floor slab, at a temperature that is only slightly above the desired ambient room temperature.

The building has no mechanical air conditioning system. Instead, on warmer days, some radiative cooling is achieved using the building's concrete floor slab as a heat sink. By prior "free-cooling" of the building's ventilation air and in-slab circulating water with cooler nighttime air, a further cooling effect is achieved. Warm, stale air is displaced at low level by fresh incoming air and removed near the top of each room via ductwork connected to heat recovery ventilators.

Photo: Rory Koska

Sustainable Design

The building was required to achieve a LEED® Silver rating. The certification is still in progress and it is expected the building will actually achieve a LEED® Gold rating.

The LEED® rating has two credits in the *Materials and Resources* section aimed at increasing the demand for building materials that are "extracted and manufactured regionally". These credits recognize that certain modes of transport, when combined with the mass of a given construction material, can affect energy use and air pollution, and recognize that materials originating from regional manufacturers and labour forces minimize transportation energy and, in some instances, may be better adapted to local climatic conditions. In the case of École Lawrence Grassi Middle School, each of these factors influenced the choice of materials used in the building envelope, structural systems, and interior finishes for the project.

However, materials should not only be efficient and low-impact from the standpoint of extraction, manufacture and construction, they should also be inherently resource-efficient and durable in terms of long-term use and maintenance. Viewed from this 'whole-life' perspective, the decision becomes less about one material versus another, and more about strategically deploying each material, component and assembly in a manner that will yield the best overall outcome environmentally, economically and architecturally. In addition, Canmore is a community with a labour force skilled and experienced in wood construction and wood fits well with the Town's Design Guideline that calls for the use of materials, colors, textures, and other elements based on the region's natural and built heritage.

In conjunction with the high-efficiency HVAC systems, the design employed motion detectors, occupancy sensors, and low water plumbing fixtures to achieve additional energy savings and reduced environmental impacts. Natural light was used to reduce electricity use and to enhance the learning atmosphere.

A waste management plan drafted in advance of construction had an objective of recycling or diverting 75 % of waste (by weight). During construction, waste management was discussed and reinforced at weekly safety meetings. Every contractor or sub-contractor was informed of the location of appropriate recycling bins and re-use piles. Recycling bins were clearly labelled, and prior to removal, each bin was inspected to ensure it was not contaminated with inappropriate waste.

Some preservative-treated wood was used for the framing of roof overhangs and treated wood waste was collected separately from other wood waste. Non-treated wood off-cuts were stacked in strategic locations so that workers could use them for short-length applications, such as blocking. Glulam and Parallam® posts and beams were shop fabricated and the machining was done for fastener installation. This meant there was no on-site waste from these materials. Metal and paper construction waste was also collected for recycling.

Fire Safety Requirements

According to the Alberta Building Code, the major use and occupancy classification of the school is Group A, Division 2 (Assembly, Schools). This means the building could be up to 4,800 m^2 in building area for single-storey construction, when protected by automatic sprinklers, and could be of combustible or non-combustible construction. With automatic sprinklers installed in the building, it was not necessary to design and construct the roof assembly and its supports to provide a fire resistance rating of 45 minutes, nor for the heavy timber elements to conform to the minimum sizes specified in the code for 'heavy timber construction.' The school is one storey, sprinklered throughout, and has an area of 4,649 m^2 and a design occupancy load of 465.

For the purposes of fire safety, there are two buildings separated by a masonry block firewall – the core school and the portable classrooms. Building A is the core school and Building B is comprised of the portable classrooms. The firewall separating the two 'buildings' has a 2-hour fire resistance rating and is finished on the exterior with non-combustible cladding. The firewall is required to limit the size of the core building to the area allowed for the building classification.

The variations in purpose-built rooms like the specialty classrooms, mechanical room, administrative offices, wood working room, and science laboratory required careful attention to fire separation and fire-resistance rating requirements as follows:

- Janitor rooms: Fire separation, no rating
- Storage rooms: 45 minute fire separation
- Corridor serving classrooms: No fire separation required for travel distances less than 45 metres
- Fuel-fired appliance mechanical rooms: 1 hour fire separation
- Electrical rooms: fire separation, no rating

Extra precautions were taken to avoid fire on site during construction. Dry heaters were used in place of open flame heaters, and security fencing was installed and maintained around the entire construction site.

Photo: Caitin Paraschuk

Conclusion

The Lawrence Grassi Middle School is a clear example of how wood construction can meet all building science and code challenges, and do so while meeting budget limitations and providing extraordinary architectural appeal. The school provides a bright, inviting learning environment. Exposed wood structural elements and natural lighting combine to provide an architectural appeal too often lacking in schools.

The design of the school should result in energy use that is 50% below the baseline defined in the *Model National Energy Code of Canada for Buildings* and is on track to obtain a LEED® Gold rating.

École Lawrence Grassi Middle School shows how a simple, rational and cost-effective construction system based on regionally harvested and manufactured materials, components and assemblies can harness local skills, enhance the local economy and create durable and functional buildings of lasting beauty and enduring cultural significance.

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