RESEARCH HIGHLIGHT

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Integrated Design Charrette for the Beaver Barracks, Ottawa

BACKGROUND

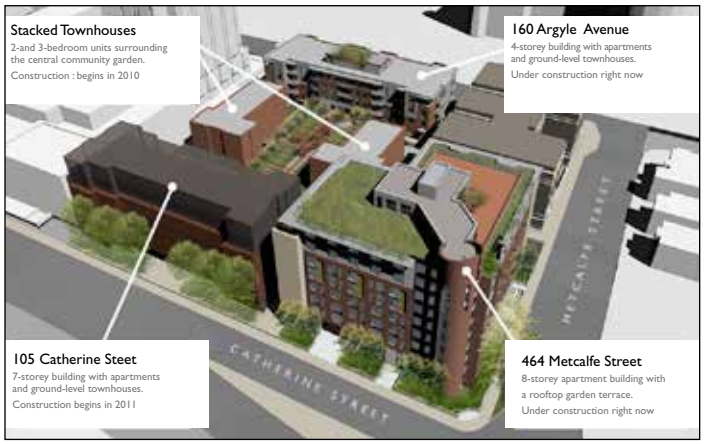
In the spring of 2007, the City of Ottawa requested proposals for the development of a Centretown property for affordable housing. Previously the location of Beaver Barracks, a Canadian Forces facility, the challenging infill site occupies about 3,800 square metres (41,000 square feet) and is located just north of Highway 417 (also known as the Queensway), in Centretown Ottawa. The City desired a landmark building that would enhance this important entry point to Ottawa's downtown. The primary objectives of the development were to provide affordable housing that not only adds to the local social and economic dynamic of the Centretown location but would also demonstrate environmentally responsible development.

The development team proposal that the City selected was led by the non-profit housing provider *Centretown Citizens Ottawa Corporation* (CCOC). The team proposed a compact urban infill design of at least 180 housing units comprising townhouses and multi-storey residential buildings that would include commercial space and underground parking (Figure 1). The site shares the block with the existing high-rise building housing the YMCA to the west and the Windsor Arms, an older apartment building, at the northeast corner of the property. An Emergency Medical Services building (EMS) is located on the southwestside of the block and the Queensway highway is immediately to the south. Part of the site will also be occupied by a community garden—a cherished feature for the Centretown community (Figure 2).

THE INTEGRATED DESIGN CHARRETTE

CCOC initiated an integrated design charrette (the "charrette") to further define the performance objectives for the development and to identify possible design and construction features and practices that could be employed to meet the objectives. It was the intent of CCOC to develop an integrated mixed-income residential and commercial community that would also be a leading example of sustainable development.

The objective of the charrette was to fully explore the environmental and social design features with all the relevant stakeholders. The charrette allowed the stakeholders and community participants to take the time to identify issues that needed additional study. It also allowed the design team to hear community concerns about the



Credit: Barry J. Hobin & Associates Architects

Figure 1 The Beaver Barracks concept

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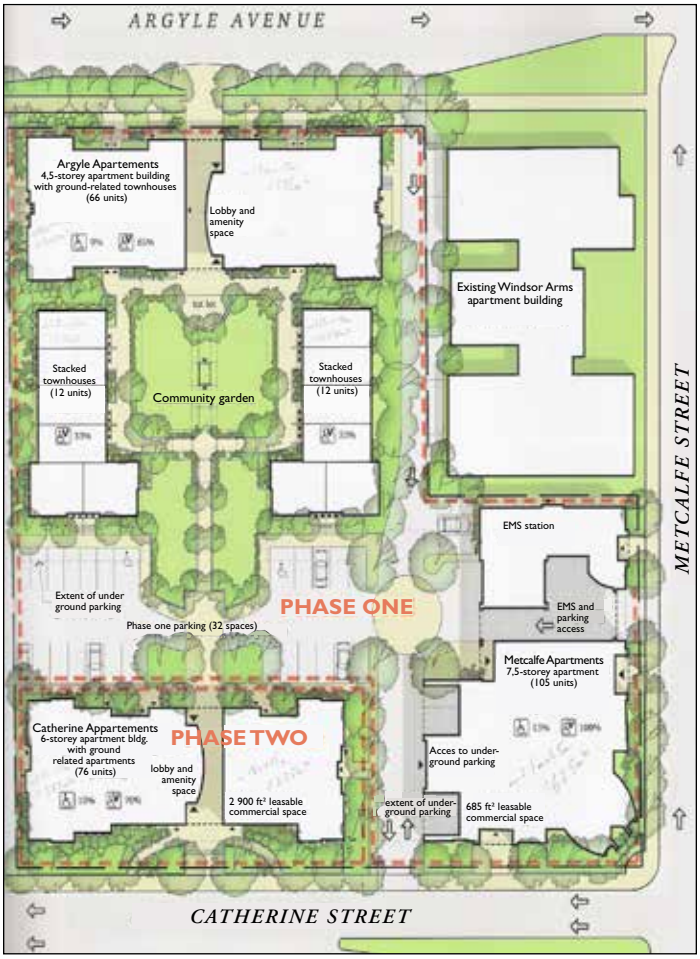
development and to develop mitigating solutions in keeping with the design concept's sustainability, social, economic and functionality objectives.

In advance of the charrette, CCOC and members of the design team met several times with key stakeholders and City representatives to clarify the charrette goals and procedures and expected outcomes. Potential participants were identified and an invitation list developed as part of the City's community consultation process. As well, experts on green building features and technologies were recruited to support discussion on energy efficiency, building envelope systems, efficient and effective building services, green roof systems and community energy systems. It was the intent of CCOC to gather information from the charrette while the project was still in an early design development stage so that modifications could be made to the design and construction as necessary.



Credit: Barry J. Hobin & Associates Architects

Figure 2 Beaver Barracks site plan

The participants included representatives from CCOC, the City of Ottawa, the project architects, engineers, planners, and landscape designers. Other stakeholders included representatives from the neighbouring buildings, Canada Mortgage and Housing Corporation, the YMCA, the Bytown Urban Garden (BUGs) group, the In Community, VRTUCAR and the adjacent Museum of Nature. Staff from various departments in the City of Ottawa were made available to present the City's plans including planning, building, zoning, wastewater and drainage, transportation, infrastructure and transit.

The charrette had the following objectives:

- **To identify strategies to meet the following design objectives of the Beaver Barracks development:**
  - Offer 180 affordable, sustainable and attractive housing units.
  - Provide a children-friendly environment.
  - Foster independent living, visitability and universal access.
  - Provide appropriate space for a community garden for food security.
  - Facilitate integration with the existing neighbourhood (YMCA, Windsor Arms, shopping, highway, EMS, Museum of Nature, BUGs).
  - Attenuate noise and pollution.
  - Incorporate commercial space.
  - Provide employment opportunities for the community.

- **To develop strategies to help ensure operation and maintenance (O&M) support the design objectives**
  - Use durable and trouble-free materials and systems.
  - Encourage occupants' pride of ownership and sustainable behaviour.
  - Reduce operating costs to owner and occupants.
  - Optimize solar design and mechanical systems with air conditioning, avoiding solar overheating.
- **To achieve major energy and water use goals such as LEED® Neighbourhood Development (LEED® ND) requirements**
  - Reduce energy use by at least 50 per cent compared to typical city projects.
  - Explore energy sources and district heating potential, considering synergy potential with surrounding properties.
  - Reduce water costs by 50 per cent of the city average.
- **To consider project development issues**
  - Take into account phasing and barriers to implementation.
  - Apply lifecycle costing and capital budget planning.
  - Continue following an integrated design process.
  - Plan for construction waste management.

Integrated design charrettes have been effective in encouraging communities and their building professionals to think in a positive and innovative way about building design and construction. As brainstorming workshops, they can elicit positive community visioning that looks to the future to guide present actions. They can provide a positive and creative environment to discuss issues from new perspectives. Through discussion among a range of experts, owners, developers, designers, community members and property managers (all stakeholders), new solutions can be found. Charrettes can begin a more integrated design process starting from the project inception through the development and construction to the final commissioning of the building or development.

THE INTEGRATED DESIGN CHARRETTE PROCESS

The charrette took place over two consecutive days in a location close to the development site. A charrette moderator facilitated the discussions and managed the charrette schedule. At the start of the first day, a roundtable discussion (Figure 3) was held to solicit each participant's objectives and interests. Afterwards, the design team members presented the original development concepts and objectives for the project.

The participants were then assigned to working groups to discuss specific social and technical elements of the development. Preliminary design drawings were made available to the working groups to show the participants the design concepts along with the many design constraints including the highway traffic entering the Centretown area, the existing community garden, the locations of the existing apartment block and YMCA building, the future location of the ambulance station.

Each working group was provided with people to facilitate and record the discussions and with experts to support the specific subjects each working group was assigned to discuss. The groups focused on issues and opportunities associated with:

- the site and building design;
- the mechanical and electrical services for heating, ventilation and air conditioning; and
- social and liveability issues.

Figure 3 The design charrette meeting

The participants began the second day of the charrette by confirming the first day's conclusions. Then, they worked toward both refining the issues raised, the possible solutions identified and any outstanding issues that would require additional consideration. Finally, the groups gathered together to present and discuss their conclusions, concerns and insights on the design of the site and building.

The charrette moderator collected the notes prepared by the working group recorders to serve as a record of the discussions that would continue to inform and guide the design and construction teams as the development moved forward.

CHARRETTE RESULTS

The output from the charrette included many recommendations for improving the design and construction of the Beaver Barracks site and building that were later considered and implemented.

Key features that were recommended for the design and construction of the building included the following:

Building orientation and solar shading

The long axis of the building was proposed to be changed to follow Catherine Street that runs east-west along the south side of the building and to provide solar shading over the south-facing windows. These changes would offer the following outcomes:

- Passive solar gains to the building to offset winter space heating energy consumption and costs.
- Reduced east-west solar gains to prevent the overheating of suites on those elevations.
- Better solar access for the existing Windsor Arms apartment building.
- A widened lane between the new CCOC building and the existing Windsor Arms, providing more room for streetscape and a buffer space between the buildings.
- Improved sound barrier between the courtyard and the traffic noise from the Queensway.

Building envelope and balconies

To optimize the energy performance of the building envelope and 'right-size' the space conditioning systems, the integration of architectural, mechanical and cladding design was seen to be critical. The design team had already planned an energy-efficient building envelope, so opportunities for recommendations for improvements to the design through the charrette were more limited. However, specific improvements to the building envelope included:

- enhanced window energy efficiency performance;
- enhanced building air leakage control measures;
- the elimination of balconies on the south side of the building, because traffic noise from the highway would make them less desirable. This eliminated a source of thermal bridging, which would otherwise adversely impact the overall building thermal insulation value.

HVAC and energy systems

The proposed energy system was a central, community geothermal system that would provide all of the buildings on the site with space heating, space cooling and domestic hot water. A further study to determine the feasibility and cost of this option was recommended and subsequently conducted. CCOC's experienced development and construction staff guided the decision to have central ventilation air delivery to the suites, noting the difficulty of servicing in-suite, stand-alone units, and the challenge of tenant participation for regular maintenance. To help reduce ventilation-related energy costs, the system is equipped with an energy recovery system that transfers heat from the outgoing exhaust air (from the kitchen and bathrooms in each apartment) to the incoming fresh air.

Social aspects

The working group considering the social aspects of the development provided many recommendations regarding the buildings and the site though not all could be achieved.

- The installation of sound barriers on the Queensway (not achieved).
- Provision of a community garden to support local food production and green space needs (Figure 4).
- The installation of a gate on the Argyle Avenue carriageway entrance to discourage non-resident pedestrian traffic in the central courtyard and to redirect foot traffic through the laneway instead.
- The relocation of the courtyard walkway around, and not through, the community garden.
- The placement of community art (for example, murals) on the walls of neighbouring buildings.
- The provision of studio and single-bedroom units in recognition of the neighbourhood's demographics and subsequent housing needs.
- The use of higher quality finishes for ease of maintenance and improved lifecycle costs.

Financial aspects

CCOC's ability to finance the development was largely influenced by the estimated rental income and interest rates. These parameters defined the budget for potential improvements that CCOC could consider for the project. However, CCOC recognized that investments in energy efficiency and other upgrades have a positive impact on longer term project lifecycle costs and was prepared to make the upfront investments it could to save on future operating costs.

THE OUTCOME OF THE INTEGRATED DESIGN CHARRETTE

After a public meeting and presentation of the project and charrette results later that month, a follow-up meeting of the design team and CCOC took place to further explore the feasibility, costs and benefits of all the major features of the site and building, including those advanced through the charrette.

In the spring of 2008, a sustainable design briefing was prepared for CCOC outlining the guidelines for general operations, LEED Silver Level requirements for materials and indoor air quality for the project. Further design refinements, including soft and hard landscaping, green rooftops, water conservation, ENERGY STAR equipment, increased insulation levels, site erosion control, commissioning of building systems, minimum energy performance, waste reduction, indoor air quality measures and materials sourcing, were considered.

Credit: Barry J. Hobin & Associates Architects

Figure 4 Pre-charrette garden concept

Credit: Barry J. Hobin & Associates Architects

Figure 5 View of Phase 1—Metcalfe Street

Credit: CMHC

Figure 6 Phase 1—Metcalfe Street, as-built

Construction of the development started in March 2009. Key features of the project are presented below.

Site

It was determined that the Emergency Medical Services station located on Catherine Street could be integrated into the new Metcalfe Street building (Figure 5). As a result, the land that the EMS building occupied was made available to the project and the original goal of 180 living units was increased to 247, with 160 apartments in Phase 1 and 87 more in Phase 2 (the Catherine Street building beside the YMCA and stacked townhouse units on Argyle Avenue [Figure 6]). Street level commercial office space and some more advanced solar energy features (discussed below) are planned for the Phase 2 development on Catherine Street.

The site constraints reduced the space for parking and required a city bylaw variance. Parking spaces are being provided for a rental car-sharing arrangement that would be available to residents (VRTUCAR). Ample bicycle parking will be provided at the ground-floor level of both the Metcalfe and Argyle buildings. The inner courtyard will contain the community garden as well as garden space for the residents. This garden space, a welcomed addition to inner city areas, is to be augmented by roof terraces, green roof and roof garden boxes. The neighbouring YMCA and the Museum of Nature's park-like spaces will help fulfill play-space needs for children.

Roofs

Growing plants on roofs, balconies and the interior courtyard has remained a key design focus for the Beaver Barracks project. A lightweight extensive green roof installed on the Metcalfe building will not be accessible but will help reduce cooling loads, heat island effect and control stormwater runoff. For the gardening residents, wheelchair-accessible rooftop planters will be provided. Arbours and a small potting shed are also planned for this area. The other roofs will be covered by a two-ply modified bitumen membrane with a white granular surface to reduce the roof temperatures on sunny days.

Credit: Barry J. Hobin & Associates Architects

Figure 7 View of Argyle Apartments

Credit: CMHC

Figure 8 Argyle Apartments, as-built

Building envelope

To achieve the proposed 50-per-cent reduction in energy use, a more energy-conserving wall system than typical was designed. The design includes double-glazed, low-e, argon-filled windows and airtight building envelope construction. These features not only save space heating and cooling energy, they also help to attenuate the noise from the nearby traffic. As the apartments are provided with cooling via the central geothermal system, smaller operable casement windows were provided as part of the larger fixed fenestration areas.

Energy modelling explored the potential of sunshades to prevent overheating and showed that, in the spring and fall seasons, the higher performance windows would help reduce solar heat gains and the geothermal heating system could effectively move the heat from units where it was not needed, to those where it is needed. The sunshades, which would also decrease daylighting in the apartments, were not included in the final design of the buildings.

Building services

A central geothermal heating system will be installed to meet space heating, space cooling and domestic hot water needs. The inclusion of the geothermal system was a pivotal design decision. This choice was made upon the completion of a feasibility study and test drilling carried out by a micro-utility company that confirmed the costs and benefits. The company will build, operate and maintain the system and will charge CCOC for its energy consumption.

CCOC intended to incorporate solar design into the Catherine Street building. Provisions for photovoltaic or solar thermal systems were included in the design of the building structure. However, an evaluation of the costs and benefits of a solar hot water option for this project was not favourable at this time. CCOC will consider the option of installing a photovoltaic system at some point in the future.

Ventilation

To reduce energy consumption and costs, a central energy recovery ventilator (ERV) will capture both the latent and sensible heat from the air exhaust from the kitchen and bathrooms in each unit and transfer it to the ventilation air that is delivered to each apartment. To ensure better indoor air quality, the airflow design will be 50 per cent higher than the code minimum. The ERV system will operate at reduced speeds at night, based on a time-clock setting in order to reduce ventilation-related energy consumption and costs.

The suites will be compartmentalized (that is air-sealed from the outside, one another and from the common areas) to reduce inter-zonal air movement, odour migration and noise transfer. Compartmentalization can also help reduce air

leakage into, and out of, the building. Blower door testing will be performed on representative suites, to ensure that the airtightness objective is reached.

The solar ventilation air preheating system option to preheat the ventilation air was not chosen because the geothermal and heat recovery systems made it less cost effective.

Embodied energy

One of the Beaver Barracks design team's goals has been to reduce the "embodied" energy and greenhouse gas (GHG) emissions in the manufacturing, delivery and construction processes. An analysis was carried out to determine the difference in lifecycle green house gas (GHG) emissions between the proposed construction and typical Ottawa construction practices. Analysis of the improved insulation levels of the new buildings (RSI-3.3/R-19 walls and RSI-5.3/R-30 roof), compared to the typical construction levels (RSI-1.9/R-11 walls and RSI-3.9/R-22 roof), showed that the proposed insulation levels would reduce yearly GHG emissions by about one-quarter (equivalent to 165 metric tonnes of CO_2), and this will offset the increased embodied energy of the materials used after only three years of occupancy.

Lighting

Energy-efficient lighting fixtures will be installed. Less used spaces will employ occupancy/motion sensors to turn off lights when not required. Half of the common area lighting will use occupancy sensors for operation at night to reduce lighting-related electricity consumption. Specially designed exterior lighting fixtures will light the site parking and garden while reducing the amount of poorly directed artificial light that blocks the city's view of the stars. Solar-ready electrical provisions will be installed on the Metcalfe building roof to facilitate the installation of photovoltaic and/or solar hot water at some future time.

Domestic hot water

Energy-saving, variable-speed domestic hot water booster pumps will supply hot water to the suites. To maintain an even flow rate, pressure tanks will be located in the mechanical penthouse. The washing machines in the laundry room will have cold water supply with an option for hot water at an additional charge, while the dryers will be gas-fired to reduce electricity consumption and loads. Both the washers and dryers will be high-efficiency, front-loading commercial machines.

Other

Energy-conserving features include an energy management system that will control the overall heating system. The Metcalfe building garage will be kept at a minimum temperature sufficient to prevent freezing. Glycol fan coil units will temper incoming ventilation air. Additionally, as a lifecycle cost saving feature, a glycol radiant heating system (as opposed to an electric system) will be installed at the garage entry ramp to prevent ice build-up.

Water

In line with the overall objective of reducing the water consumption to one-half the normal per-capita water consumption, water-efficient, dual-flush toilets will be installed in all units.

Waste management

There will be no garbage chute installed in the buildings. Although this means that the residents will have to take their garbage and recycling to the basement, this change provides more floor area for the apartments and reduces problems associated with noise and odours. Additionally, CCOC recognizes that residents will become more aware of the waste they produce if they are required to take some responsibility in dealing with its disposal. This may encourage the residents to take steps to reduce the waste they produce. Tenants will also be encouraged to reduce kitchen waste by participating in the garden composting system.

Accessibility

Accessibility has been an integral part of the project from the beginning. Nineteen units will be fully wheelchair-accessible, while 94 per cent of the units in Phase 1 will be visitable. All amenity areas will also be barrier-free.

SUMMARY

Through the planning and facilitation of the integrated design charrette, the project development team for the Beaver Barracks was able to identify and implement many additional design and construction features that will improve the overall performance of the buildings. The charrette included a wide variety of project stakeholders with different perspectives on the development project to help ensure the project not only met the needs of the owner and future occupants but also stakeholders impacted by the infill development project. This diversity helped the project developers to identify opportunities and challenges for the development early enough in the process to allow improvements to be made to the design and construction of the building.

The integrated design charrette continued to represent a valuable undertaking well after it was completed. CCOC reported that often during follow-up design meetings, the team would return to the outputs from the charrette for ideas and guidance. As a result, the vision for the long-term performance of the Beaver Barracks development has been maintained.

Credit: CMHC

Figure 9 Phase 1—Catherine Street

IMPLICATIONS FOR THE HOUSING INDUSTRY

The Beaver Barracks charrette demonstrates the advantages of engaging a wide variety of stakeholders in the conceptual design of development projects. Through the consultative nature of a well-facilitated design charrette, a diversity of interests, opinions, concerns and solutions can be consulted and considered on the design of buildings and communities. Not only can charrettes identify creative ways to improve the design of buildings and communities, they can also help reduce barriers and overcome challenges that can help projects to proceed. In the case of the Beaver Barracks, the charrette helped the project owners identify cost-effective technologies and practices that could improve the overall sustainability of the project while helping to ensure the development was well-integrated into the existing neighbourhood.

For more information on the construction of this project, readers can access the CCOC website at **www.beaverbarracks.ca.**

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