BEAVER BARRACKS ACOUSTICAL ENGINEERING CASE STUDY

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1 Introduction

This paper presents a case study of the acoustical engineering undertaken in support of a 252 unit affordable housing project. It was located in an area just south of the Ottawa downtown core, known as the "Beaver Barracks" (so-named for the past use of the site as temporary housing for troops during the Second World War).

The project started with a competitive bidding process. We partnered with the successful proponent, Centretown Citizens Ottawa Corporation (CCOC), with which we had/have an ongoing working relationship. High levels of cooperation between the Owners, Project Architect, Mechanical and Electrical Engineers, and the General Contractor meant that good acoustical performance was delivered in a timely and cost-effective manner.

This paper describes the project process from concept to final commissioning, including design criteria, concept designs, environmental (traffic) noise, field reviews and testing. Many challenges arose during the project: complications due to the mechanical system sophistication (district heating with energy recovery); quality control issues with some sub-trades; and the complexities of three different building types (concrete apartments; wood apartments, and stacked wood townhouses); all located on a small site surrounded by buildings and roadways.

While nothing was particularly extreme in terms of acoustical design, the project in its entirety is an excellent example of the processes and interactions necessary to achieve the intended acoustical outcomes, including the twists and turns that emerged along the way.

2 Background and overview

The City of Ottawa has a large backlog of individuals on the waiting list for social housing. This need is especially acute in the downtown core where there are limited opportunities for new construction.

This project made use of a vacant block of land just north of the 417 highway, at the base of Metcalfe Street. Many social services are available within walking distance including the YMCA next door. Contributions came from all levels of government, and some private sector money as well, for a total project cost of $65 M.

The project included five different buildings, of three different types: two 8-9 storey concrete apartments at the south of the site facing the highway, a four storey wood apartment along the north side of the site, and two blocks of stacked townhouses to the west and east sides of the site, leaving an open courtyard at the center for the new community garden and other recreational usage. Almost all parking is underground. The ground floor levels of the concrete apartments include some commercial space as well. A variety of units were built, ranging from bachelors to three bedrooms.

Some general complications included budget pressures, an existing ambulance station on the site with the need for its function to be maintained during the project, and the design oversight by the National Capital Commission.

3 Project process

3.1 Development and design

The distinguished Ottawa-based Architectural practice of Hobin Architecture was the lead design authority for the entire project. Its wide portfolio and our long-standing prior-existing working relationship meant that our inputs to the design process were limited to a few drawing reviews and some value engineering.

Early in the design process, a sustainability Charrette was held. This two day event provided opportunities for many stakeholders to have input, including BUGS, the Bytown Urban Garden Society which occupied a small community garden on the site. This was a meaningful activity, which resulted in the support of all concerned parties. It also allowed for the consultant team to make revisions to the Site Plan in order to significantly reduce propagation of highway traffic noise on to the site, using the two concrete towers as barriers.

The following acoustical criteria were adopted for the project: City of Ottawa's Environmental Noise Control Guidelines (i.e. prediction and mitigation of traffic noise per MoE requirements [1]), STC 55-57, IIC 55, ASHRAE guidelines for noise levels in occupied spaces due to mechanical systems [2], and the control of plumbing noise following CMHC guidelines [3]. These and other details were collated in an Acoustic Design Brief that was circulated to all design authorities and Centretown Citizens Ottawa Corporation (CCOC) for ongoing reference.

During the detail design process we provided input concerning noise and acoustics, as well as identifying cost saving opportunities. One that was particularly noteworthy was a substantial reduction of the number of vertical plumbing stacks. This was done by putting single stacks within the party walls to serve two adjacent units, rather than double stacks with one on each side of the party wall. This also simplified the construction and added more floor space to the small units.

While the traffic noise study made with Stamson [4] indicated levels above the exposure limits for standard windows, the need for special acoustic windows was

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avoided. The original design was for windows with 6mm glazing on both panes, which was accepted as being more than adequate to ensure indoor noise levels were compliant.

For impact noise isolation, the wood buildings used a pre-manufactured product called Sonodeck by InsulFloor. In the concrete apartments, an engineered floor system was used with a modest impact isolation membrane below.

Some complications did however arise in the design process. Following a design review, the NCC directed that the south-facade of the concrete apartment buildings should have balconies, facing the highway. This would have added significant complexity and cost to the project, and the idea was rejected as it would increase the amount of traffic noise entering the apartments.

The manufacturer for the energy recovery ventilation (ERV) unit was changed for the second concrete appartment. This caused concerns for noise. We assisted the Mechanical Engineers with ASHRAE-based modeling [2] and confirmed that our design criteria would be achieved.

3.2 Construction

The construction was phased, so as to permit the use of the space on the site for all related staging. The first concrete apartment was built, which included a new ambulance station. This was then occupied, so that the prior-existing stand-alone ambulance station could be demolished to make way for the second concrete apartment. The third building to be built was the wood apartment to the north of the site, followed by the two blocks of stacked townhouses.

The prior-existing relationships between CCOC, the Architects, General Contractor and ourselves meant that we had a high degree of trust and confidence in each other's capabilities. The General Contractor also provided excellent Site Superintendents and First Lieutenants. Good continuity was maintained throughout the build, nearing two years.

Some complications for noise on this project came from the fact that the site was always busy and had many trades working on various aspects of the project. There were also entirely different crews working on each of the building types (wood versus concrete), which lowered consistency.

Complications also arose from the ducting required for the ERV system, with small fire-dampers for every unit. The site conditions made the ceiling-level bulkheads very tight and there were difficulties installing all of the needed duct work. Working with the City Authorities, Mechanical Engineers and General Contractor, we were able to delete some of the ducting and simply use the space enclosed by the bulkheads themselves as the duct for air transfer.

The new seismic requirements of the 2006 revision to the Ontario Building Code [5] proved to be an added challenge: sheet wood was required to be installed on both sides of the party walls in the wood apartment as it was being erected. This added the obvious conflict of the timing of insulation into the wall cavities before the roof went on. The City Building Permit Inspection Authorities insisted upon this, citing concerns of an earthquake during construction (which in fact did happen).

Vibration isolation of the heat pumps was also a concern, and a mock-up using rubber isolation pads was created in one apartment and verified.

Over the course of the project (2008-2012), we undertook 35 site inspections, sometimes visiting the site weekly. The drywall contractor was previously known to us from a condo project which had significant quality control issues. Our frequent site reviews, fully funded on an hours-worked basis by CCOC, most certainly had a positive benefit on the overall noise isolation performance achieved.

3.3 Commisionning and follow-up

Throughout the build we made frequent strong overtures to the drywall contractor and others, that there would be extensive testing of the final work and any defects identified would need to be corrected at no cost to CCOC or the General Contractor. In the end, very little testing was done.

Sound leaks were identified from the ambulance station to the apartments above. This was due to piping penetrations through the slabs. The ambulance station has a loud paging system which exacerbated the issue.

Concerns were expressed by some residents in the wood apartment about excessive low frequency noise and perceptible vibration. This was caused by a pump in the basement of the building, which was much louder than its companion. Repairs were made and the problem resolved.

There was some delamination in the laminate flooring of the wood apartment, that was originally attributed to issues related to the floating floor system below. It was later determined that the root cause was improper installation of the laminate flooring, aggravated by walking assist devices (wheelchairs and walkers).

4 Conclusion

This project demonstrated that a collaborative approach between the project owners, architects, engineers, and general contractor, can result in achieving the intended levels of acoustical performance.

Acknowledgments

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References

[1] Publication LU-131 Noise and Land Use Planning, Ontario Ministry of the Environment dated October 1997.

[2] ASHRAE HVAC Applications Handbook Chapter 47, 2003.

[3] CMHC Research Project Report on Plumbing Noise in Multi-Unit Buildings, prepared by MJM Acoustical Consultants Inc. (undated).

[4] Stamson Version 5.04, issued by the Ontario Ministry of the Environment 2000.

[5] Ontario Building Code 2006 Revision.