



**CANADA'S GREEN PLAN
LE PLAN VERT DU CANADA**

**DESIGN AND ANALYSIS OF PRELIMINARY
C-2000 MULTI-RESIDENTIAL BUILDING**

PREPARED FOR:

Energy Efficiency Division
Energy Technology Branch/CANMET
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PREPARED BY:

Buchan, Lawton, Parent Ltd.
5370 Canotek Road
Ottawa, Ontario
K1J 9E6
(613) 748-3762

SCIENTIFIC AUTHORITY:

Robin Sinha
Energy Efficiency Division
Energy Technology Branch/CANMET
Department of Natural Resources Canada
580 Booth Street
Ottawa, Ontario,
K1A 0E4

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Preface

This work was performed for CANMET's Buildings Group as part of its commercial-buildings research activities. These activities are distinct from but complimentary to the Buildings Group's Advanced Commercial Buildings Program (C-2000).

C-2000 is a small-scale pilot program to demonstrate that commercial buildings can be more energy efficient, have better indoor environments and have fewer adverse effects on the environment. It is also a vehicle to field test and accelerate the adoption of emerging technologies. C-2000 will result in the construction of a small number of high-performance buildings; the buildings will be monitored and the results will be transferred to industry.

The purpose of this project was to apply the ASHRAE 90.1 Standard to a multi-unit residential building and to examine what additional technical criteria could be incorporated into the C-2000 Program. In addition, the project determined how a building developer and the design team responded to the preliminary technical criteria for C-2000 buildings. Based on these responses, recommendations were made to improve the development of the technical criteria.

For more information on the project, contact CANMET's Robin Sinha, P.Eng., the project manager, at (613) 943-2260. For further information about C-2000 or the Buildings Group's other commercial-building research activities, contact Nils Larsson, MRAIC, the C-2000 Program Manager, at (613) 943-2263.

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EXECUTIVE SUMMARY

Presently, energy consumption in buildings represents over one third of the total energy consumed in Canada each year. The production of this energy results in the release of greenhouse gases and the production of radioactive waste. In addition, environmental damage is incurred through the consumption and pollution of water, the emission of ozone depleting substances, and the production of both construction and residential waste.

In response to these issues, Canmet, the research and development arm of Energy Mines and Resources, is implementing an Advanced Commercial Building Program referred to as the C-2000 Program.

Specifically, the Program is intended to result in the construction of office, multi-unit residential, retail and service buildings that will:

- consume significantly less energy than current construction,
- reduce adverse environmental impacts,
- create a more comfortable and healthy indoor environment, and
- reach a higher level of functional performance.

The purpose of this project was to apply the ASHRAE 90.1 Standard to a multi-unit residential building and to examine what additional technical criteria could be incorporated into the C-2000 Program. In addition, the project determined how a building developer and design team responded to the preliminary technical criteria for C-2000 buildings. Based on these responses, recommendations were made to improve the development of the technical criteria.

The results of this study will provide a basis for the next step in the C-2000 Program, which is the development of technical criteria such as performance targets, prescriptive requirements and verification.

The C-2000 design upgrades recommended for the multi-unit residential building studied in this project include:

- an airtight envelope,
- heat recovery,
- lighting control strategies,
- air distribution through dedicated ducting,
- humidifier controls,
- reducing odour and sound transmission between suites,
- reducing thermal bridging,
- water conserving appliances and fixtures,

- eliminating the use of CFCs and minimizing the use of HCFCs,
- implementing a recycling program for tenants, and
- using recycled material in the construction of the building.

For the multi-residential co-op building in this study, an energy savings of 9,442,482 MJ or 46.2% of the base ASHRAE 90.1 energy consumption was achieved through the C-2000 upgrades. Assuming \$0.09/kWh of electricity and \$0.17/M3 for natural gas, the annual operating costs for this building is reduced by approximately \$136,530.

The costs of the upgrades beyond ASHRAE 90.1 is approximately \$860,000 for all energy, environmental and indoor environmental upgrades. Assuming no changes in the energy costs, this translates into a 6.3 year simple payback. The payback period could be reduced by eliminating some of the less cost-effective measures, although this will reduce the energy efficiency and/or the quality of the indoor environment.

Water consumption of the C-2000 design can be reduced by 20.8 million litres annually from the initial design of the building.

The use of ozone depleting substances in the construction and operation of the building will be eliminated from the C-2000 design with the exception of refrigerators.

RÉSUMÉ

À l'heure actuelle, les immeubles consomment le tiers de toute l'énergie utilisée au Canada chaque année. La production de cette énergie génère des gaz à effet de serre et des déchets radioactifs. En outre, la consommation et la pollution de l'eau, les émissions de substances qui détruisent la couche d'ozone ainsi que la production de déchets domestiques et de construction causent des dommages à l'environnement.

En réponse à cette situation, CANMET, l'organisme de recherche et de développement d'Énergie, Mines et Ressources, met en place le Programme des bâtiments commerciaux performants, le Programme C-2000.

L'objectif du Programme est de construire des immeubles à bureaux et à logements multiples, des bâtiments de service ainsi que des immeubles destinés au commerce de détail dotés des caractéristiques suivantes :

- consommation d'énergie considérablement moindre que les constructions actuelles;
- diminution des effets nuisibles sur l'environnement;
- environnement intérieur plus sain et plus confortable;
- rendement plus élevé.

Le projet avait pour but d'appliquer la norme ASHRAE 90.1 à un immeuble à logements multiples et d'étudier les critères techniques supplémentaires qui pourraient être incorporés au Programme C-2000. Le projet a également permis de sonder l'opinion d'un promoteur et d'une équipe de conception en ce qui concerne les critères techniques préliminaires. Partant de leurs commentaires, on a formulé des recommandations en vue d'améliorer les critères.

Les résultats de cette étude serviront de point de départ à la prochaine étape du Programme C-2000, soit l'élaboration de critères techniques tels des objectifs de rendement, des normes obligatoires et des modalités de vérification.

Voici quelques-uns des domaines qui ont fait l'objet de recommandations dans le cadre du projet d'amélioration d'un immeuble à logements multiples :

- enveloppe étanche à l'air
- récupération de la chaleur
- techniques de contrôle de l'éclairage
- distribution de l'air par des conduits spécialisés commandes de l'humidificateur
- réduction de la transmission des bruits et des odeurs d'une pièce à l'autre
- réduction des ponts thermiques
- appareils de conservation de l'eau
- élimination de l'utilisation des CFC et des HCFC
- mise en place d'un programme de recyclage à l'intention des locataires
- utilisation de matériaux recyclés pour la construction de l'immeuble.

Les améliorations qui ont été apportées à la coopérative de logements en respectant les critères C-2000 ont permis de réaliser des économies d'énergie de 9 442 482 MJ, ce qui représente 46,2 p. 100 de la consommation d'énergie correspondant à la norme de base ASHRAE 90.1. En supposant que le coût de l'électricité soit de 0,09 \$/kWh et celui du gaz naturel de 0,17 \$/m³, la réduction annuelle des coûts d'exploitation de l'immeuble s'élève à quelque 136 530 \$.

Le coût de toutes les améliorations liées à la consommation d'énergie, à la protection de l'environnement et au confort à l'intérieur de l'immeuble, qui visent à dépasser la norme ASHRAE 90.1, s'élève à 860 000 \$ environ. Si l'on suppose que le coût de l'énergie ne changera pas, la période de remboursement sera de 6,3 ans. Cette période pourrait être réduite en éliminant certaines améliorations moins rentables, mais cela diminuerait l'efficacité énergétique de l'immeuble ou le confort à l'intérieur de celui-ci.

En modifiant la conception d'origine de l'immeuble suivant les critères C-2000, on peut réduire la consommation d'eau de 20,8 millions de litres par année.

La réfection de l'immeuble en fonction des critères C-2000 permettra d'éliminer l'utilisation de toutes les substances qui entraînent la destruction de la couche d'ozone, sauf pour ce qui est des réfrigérateurs.