

# Affordable Housing with Passive Solar Consideration for Regina, Saskatchewan, Canada

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## INTRODUCTION

The project is meant to educate and demonstrate design and building strategies of affordable homes that incorporate passive solar gain concepts. The projects outlined here are a result of collaboration between the City of Regina, Saskatchewan Housing Corporation, Canada Mortgage and Housing Corporation (CMHC) and the Affordable Homes Program at McGill University School of Architecture.

The conception of these projects took place in the winter of 2002 and involved seven international students. Karla Camino, Sanaullah Kakar, Jiang Zhu, Changhua Wei, Ping Yan, Xu Yang and Jian Zhang worked on their design under the instruction of Professors Louis Pretty and Avi Friedman. At the outset and during the term the design team was informed about the site, received background information about passive solar design and had their work reviewed by Robert (Bob) Bjerke, Garry Quiring from the City of Regina and Thomas Green, Senior Researcher with CMHC.

It is essential to state at the outset that the projects presented here are preliminary designs and not fully developed architectural projects. Several underlying aspects are common to all the projects. First, they are all pragmatic in nature. The projects have been designed for specific sites in the City of Regina with a particular cost and target user group in mind. It was also envisioned that they will be constructed primarily by private sector developers and builders: therefore particular attention was paid to existing building codes and bylaws, which the projects respected. When changes to bylaws were introduced they were intended to help reach the target cost or density.

Design for affordability was another shared objective. The need to lower cost of land and infrastructure required particular attention to density and site planning. Reaching a lower unit

cost required efficient use of interior space in a way that would not compromise comfort. Ongoing verification of a range of design strategies ensured that the projects could remain within the desired affordable cost range.

Incorporating design approaches for passive solar gain was another notable attribute of the projects. The designers included simple yet effective measures that took advantage of Regina's latitude and climate with many sunny days. Thinking about heat gain and its effect in both winter and summer required an acquaintance with approaches to building orientation, unit layout and shading devices.

The designers also considered the historical context in which the projects were proposed. Fitting the designs with their immediate surroundings and the dwelling culture, attitude and habits of Regina was another key feature of the design. The students closely examined images of neighbouring homes and communities. From these images, they drew the architectural vocabulary of the place and used it in their design.

Each of the projects outlined here presented a unique challenge. Homes for inner city narrow lots, a transition site between residential and commercial uses, a crescent bound by busy transportation arteries, an infill project in a densely populated area, a high density proposal in a low density context, a home for the aged, and an addition to an existing suburban development were some of the sites and the challenges undertaken. Although the solutions are site-specific, they can educate designers and builders of future projects about the design of affordable passive solar homes and communities.

## DESIGN OBJECTIVES

Two main objectives have been set for the housing projects in Regina: affordability and passive solar design. The first aimed at incorporating design and construction principles that lowered the cost of a home and made it accessible to households with modest income. The second objective required the designers to follow another set of design criteria that was meant to lower the occupants' utility expenses through passive solar energy gain and increase the level of comfort in their homes.

Review and analysis of these two separate sets of principles demonstrate that at times they complement each other very well. Such as when enhanced solar energy gain and comfort is achieved with a resulting goal of lowering operating costs. At other times, achieving in one area may compromise in another, such as the increased initial cost of a highly efficient building envelope. Therefore, the task of designing affordable passive solar homes becomes a balancing act. The mindset that one needs to bring to the process is that of optimising the benefits between different sets of consideration. The process needs to begin by establishing a clear set of priorities and objectives for each site and project.

Within the realm of passive solar home design there are challenges as well. This creative process is a balancing act between designing for optimal solar energy heat gain, reducing summer overheating, and providing enough thermal mass and good air circulation in the home to provide a comfortable and consistent indoor environment. A method commonly used to strike a balance between all these factors is known as the Optimal Value Engineering (OVE). OVE is a comparison and selection process of alternative materials and methods to determine the least costly combination that will result in a product acceptable to its users.

The need to find this balance is rewarding. Whereas some tend to believe that the affordability challenge ends when a would-be homebuyer finally purchases a home and moves in, others suggest that affordability begins upon moving in. The need to pay household expenses such as maintenance and upkeep in addition to monthly mortgage payments put a financial strain on the family budget. Reducing utility costs will make a contribution towards alleviating that financial burden.

There are, of course, other reasons for the need to take advantage of the sun as an energy source. The environmental benefits of solar gain are obvious. It is a non-polluting source. When strategies for passive solar gain are used, the financial investment, dependant on work done, is relatively small compared to the potential gain throughout the building lifecycle. Passive solar gain bears other advantages as well. Incorporating and letting in the sun increases the homeowner's sense of personal comfort primarily in Canada's long winters. The link between sunny spaces and people's moods, primarily

in the case of the elderly, has been demonstrated repeatedly. At the same time one needs to take into account the fact that our summer months can be hot and introduce all the necessary devices to protect the home against overheating and excessive use of air conditioning.

It is therefore worthwhile to consider these advantages and reach both affordability and passive solar gain while conducting a "balancing act".

During the studio, students developed several planning schemes for their site, not all of which are shown in this publication. Examples shown here were chosen to illustrate a variety of site and design responses, which combine affordable and passive solar design strategies.

## DESIGN PRINCIPLES

Cost reduction in housing is achieved by implementing large or small measures. A large measure can be the increase in the housing density for a given site or altering the way the infrastructure is constructed or simplifying the overall shape of a home. A small measure can be the use of a lower cost product, or leaving some interior spaces unpartitioned. The very same approach can be applied to the design of a community and homes with regard to passive solar gain. Fenestrating south elevations of the homes with large windows and building a high performance thermal building envelope will yield more solar gain and energy savings. Alternatively, orienting only part of the home's façades towards the south and having smaller windows will yield small gain. Designers need to identify and list their possible strategies when they approach designs for both affordability and passive solar energy gain from the outset.

Listed below are a range of approaches that make an attempt at achieving a balance between affordability and passive solar gain. Some can be considered large scale measure and some small scale.

## SITE PLANNING

The sites that were given to the students in the city of Regina ranged in size from a narrow front lot for a single dwelling in the city's core to a 1.62 hectare (4 acre) site in a new development. Each of the sites required a unique approach to planning, yet, common strategies were used in all the projects in order to lower the cost of each unit. The principles embedded in these strategies can be used by builders to lower the cost of housing in other sites as well.

## **INCREASED DENSITY**

Lowering the cost of land and infrastructure was achieved by increasing the sites' density. That is, more units have been built on each site to better make use of the land and the services. Several strategies were used to this end. The first was to propose homes on smaller lots and the second to incorporate buildings with multi-family units. An additional approach was to group the units together and form rowhousing. These strategies were evident in the St. Joseph's School site where townhouses and an apartment building were proposed (Fig. 1). The design contributed to the efficient use of land and the reduction of service cost for each unit.

The challenge when choosing a higher density planning strategy is to make sure that the appearance of the development will not be compromised. The single family home and lot has not lost its appeal and will likely continue to be a popular housing form in Regina. It is therefore necessary to design for higher density while keeping in mind basic amenities like public and private outdoor spaces. In the St. Joseph's School site two green open spaces have been created around which the homes were placed. Wherever possible the parking was placed at the periphery of the site. Increasing density from the current 18-25 units per hectare (7-10 units/acre) to 35-60 units (14-24 units/acre) will reduce land and infrastructure costs by half and therefore can be considered as a large scale measure with a strong effect on cost.

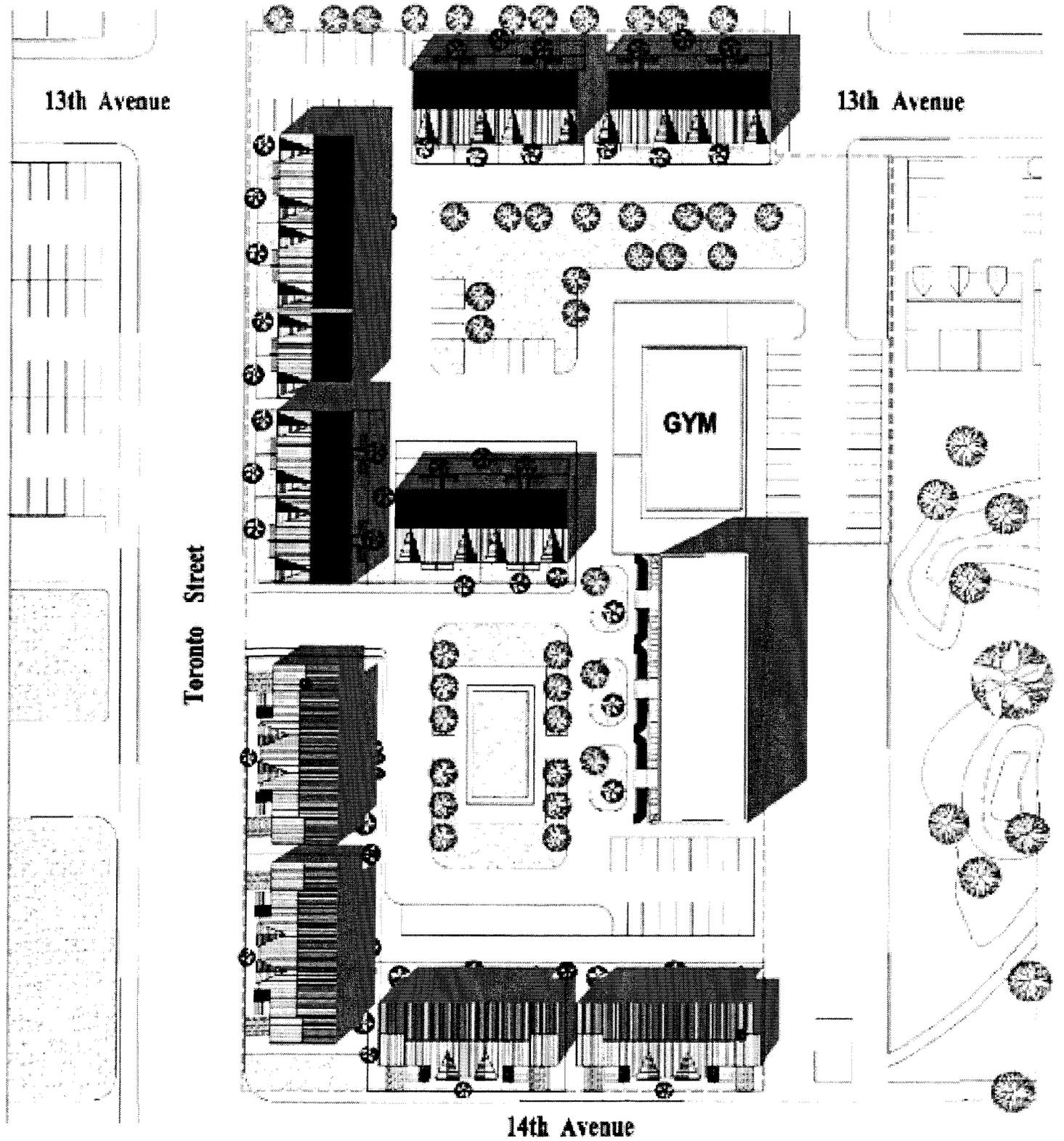


Fig. 1. Site plan for the St. Joseph's School site



*An infill affordable home in Regina, Saskatchewan, Canada*



*Row of affordable units with passive solar arrangement in Regina, Saskatchewan, Canada*



*A community with affordable dwellings in Regina, Saskatchewan, Canada*