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National Icon Rediscovered: Hockey Arena for a Sustainable Future

David Panopoulos
Ryerson University

NATIONAL ICON REDISCOVERED:
HOCKEY ARENA FOR A SUSTAINABLE FUTURE

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David Panopoulos, B. Arch Sci. Ryerson, 2005

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ABSTRACT

National Icon Rediscovered: Hockey Arena for a Sustainable Future

M. Arch Fall 2010

David Panopoulos, Master of Architecture, Ryerson University

In Canada the hockey arena has served as a place where individuals would not only gather to play hockey but a place for socializing on and off the ice. With today's high pace, high demand life styles and with the shift in individual's needs and desires, the arena has lost all of its interactive and engaging traits with the user and observer. The arena offers nothing besides hockey.

This thesis will examine the reconsideration of hockey arena design for a sustainable future. Through literatures on past and present arenas designs, sustainability in sports designs and designing sports facilities for communities as a designer we are able to generate new and innovative design responses. Commencing with case studies on sustainable sports design projects, lessons can be learnt to help gather successful design traits, in addition to learning from mistakes of the past.

Through a design proposal which implements a new and innovative scheme, and by challenging design through the three issues of sustainability, will aid in demonstrating how by expanding the role of the arena will provide beneficiary needs and desires for a community. This would potentially add to longevity of the infrastructure while increasing its overall building usage. By addressing these problems as a designer we can recreate the arena back into a destination point in which it once was, but now with new flexible, interactive and engaging community and public spaces.

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Lastly, I offer my regards and blessings to all of those who supported me in any respect during the completion of the thesis|project, especially my family and friends whom mean the world to me.

David Panopoulos

DEDICATION

This thesis is dedicated to my parents, my sister and family who have supported me all the way since the beginning of my studies.

Also, this thesis is dedicated to my fiancée Melissa who has been a great source of motivation and inspiration.

Finally, this thesis is dedicated to all those who believe in the richness of learning.

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1.0 INTRODUCTION

Figure 1 - North York Hockey Arena - Example of solid building view (D. Panopoulos, 2009)

“We’re trying to use these buildings to enliven the surrounding streetscape, not just create a big black box which eats up volume. As a pedestrian you would walk for two blocks past a wall you couldn’t see in. You know there’s an arena there, but there is not ability to connect with in. The space was dead when there wasn’t an event going on in the building,” envision of today’s arenas by Daryl Katz, Edmonton Oiler Owner. (Cult of Hockey, 2009)

In Canada the hockey arena has served as a place where individuals would not only gather to play hockey but a place for socializing on and off the ice. With today's high pace, high demand life styles and with the shift in individuals needs and desires, the arena has lost all of its interactive and engaging traits between the user and observer. This offers nothing besides hockey. This underlines the building has become a location strictly for the user, and the observer and all other traits associated with that social and physical engagement have disappeared.

With a growing need for a facility of this type in urban areas, there is the opportunity of expanding the role of the arena (which provides additional needs and necessities) and creating it into a destination point in which it once was; providing for a sustainable future.

The term sustainability is often defined as maintaining and preventing the negative impacts on the natural environment. To a building it generally refers to the impact of the three pillars of social, environment and economic sustainability on the design. When looking at the way arenas are designed today they never really live up to this challenge and tend to leave one of these pillars out of the overall design; thus not truly creating a fully sustainable building type.

There have been numerous new attempts in the present day to challenge the way arenas are designed sustainability. These attempts have been implemented to address specific problems or needs but never truly addresses all the sustainable issues currently press on the way an arena is designed.

As an example of this attempts we can look at the new four pad hockey arena project proposed in the city of Toronto Portland's area along Lake Ontario. This project is proposed to be situated within a fully new sustainable community.

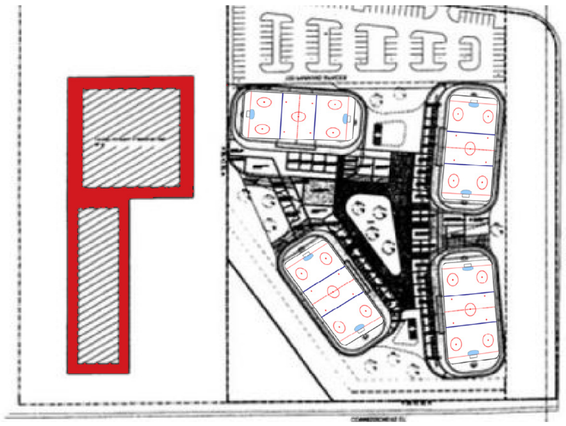


Figure 2 - Proposed design scheme - Toronto Portlands Arena (urbantoronto.ca)

Figure 3 - Proposed design location - Toronto Portlands Arena (urbantoronto.ca)

The project is proposing to house four NHL size arenas, in various orientations on grade (Figure 2) and incorporated in the design are features such as natural light to minimize day lighting, green roofs to minimize heat loss and solar collection for energy production. This may all seem great, but the general problem with this proposal is order to be deemed a fully sustainable project the three pillars of sustainability should be addressed not just the single issue of green technology in this case. This community as a whole will incorporate other items such as living, working, and playing to achieve full sustainability, but in the arena proposal (Figure 3) does not achieve this goal mainly due to the lack of connection between the building and the users to and from the building and community.

Questions have arisen from this attempt of challenging sustainability which is, "How would one address a big box proposed facility that occupies a large volume of space, has a large surface parking area and has no connectivity traits to a community." And also how is a full sustainable community suppose to interact with a building which only operates during certain times of the day and year, secludes itself from its surrounding environment within a sea of parking in a volume which eats up vital green space for the community?

From a analyzing a project such as this, as a designer we can reconsider arena design, which would reestablish the means of engagement and interaction. Ultimately creating a sustainable future for the arena building type, that increases building usage and aids in longevity of its life span.

Possibilities of achieving this could be from the exploration of alternative program spaces, provide new and improving on existing necessities and reestablish the socialization and engagement of the past between users and observers. The opportunity will also be available to enhance user and buildings needs through sustainable technology traits; income generation, providing necessities of physical activity, and user interaction all beneficial for a community.

Figure 4 - Example of a community hockey arena (www.hockeyarenamaps.com, 2010)

Figure 5 - Toronto Cricket & Skating Club - Example of growing sports (torontocricketclub.com, 2010)

With the growing and rapidly changing needs and desires of our communities around the city of Toronto, we must reconsider the arena, the way it is the designed, the way it is currently being used and the way it could be used to its fullest potential. From looking at what communities have (Figure 4) and what they currently need (Figure 5) one can establish an opportunity to a reconsideration and ask the question of what if? (Figure 6).

Figure 6 - Envision of alternative use of arena (D. Panopoulos, 2010)

From Figure 6 this would in the end create a new iconic building type for the future, one in which happens to house or national sport hockey and potentially much more.

Sport and sports participation processes can be used as a tool which provides meeting places, provides an opportunity for the acquisition of fitness and skills, give meaning to life, allows one to test and affirm oneself in new ways, test strengths and aptitudes to better know their body, provides an opportunity to search for adventure and strength of emotions, and can become a part of the personals set of habits which helps with interaction with others, and the arena has this possibility to provide all of these.

This thesis will begin with a literature view, from authors, writers and publications, which are broken into a series of subheadings, outlining the main issues which effect arenas today. Each section gathers information from the source, analyses it, deems importance and concludes with metric which can aid in bettering of the arena.

Beginning with a study on literatures of community arenas today, as a designer we are able to see and understand how the arena has evolved over time. We are also able to get an understanding on where the infrastructure of the arena is at, where infrastructure is heading and truly understanding the importance of the arena to a community.

Next by gathering information and understanding the literatures on how age affects arena infrastructure, and how the current needs, costs to repair or to retrofit existing structures will prolong life spans or by recreating new design solutions provide more viable options.

By viewing and analyzing writings on the change in needs of people in communities, as a designer we are able to see how the role of the buildings (ie arena) has changed. Especially on how it is being used, and what needs to be done to existing building program will meet with this change. The possibility of creating flexible, and multi-purposeful spaces which can adapt to changing community needs and desires are possible solutions which are also investigated.

The literature review will conclude with viewing the importance sustainability has on the future of the arena. By understanding the three pillars of sustainability: environment, economic and social aspects of the building and from seeing how arenas are designed today as designers we would understand that there is a need for redesign to meet this change and to provide for a better future.

Once the literatures have concluded seven case studies have been chosen which vary in program and scale. Each highlight items which show problems with arenas today, as well help us as designers understand a variety of measures which have been made to help address and fix the problems of arena.

Lessons learned from the case studies highlight the importance of sustainability has on the future of the arena. Whether it is technology, building usage, public and private spaces, providing flexibility and multi-purposeful spaces to adapt to change, this section concludes that in order for arenas to survive, it must continuously meet the needs of communities as they change.

By concluding the report with a design project that addresses the literature, and that takes lessons learned from the case studies will aid in producing the best possible design response. By choosing a specific site and designing the arena to best serve that community will test the buildings true sustainability. Through testing various schemes on the site, choosing a solution which best suits the community and its users and reinforcing it through sustainability will provide for a successful future of arena designs.

2.0 LITERATURE REVIEW

2.1 Community Arenas Today

To begin documented from the literatures on community arenas, nine of ten of Ontario's smallest communities (population under 5,000) report owning a community arena. While every municipality with a population over 25,000 owned a facility offering multi-purpose space to the community, thus indicating the importance of the arena to our everyday lives.

Studies have shown that 80% of the nation's 2,500 hockey arenas specifically in the city of Toronto are outdated, insufficient and costly to maintain and repair, this would ultimately provide an excellent opportunity to test new methods of reconsideration and redesign. Bob Nicholson president of Hockey Canada states, "Our number one priority is to keep hockey healthy with facilities, and if you don't have facilities, you can't recruit and grow the game. (Canadian Recreation Facilities Council, 2006)

The Canadian National Hockey Census states that the nation's arenas are decaying and are expensive to maintain. (Canadian Recreation Facilities Council, 2006) In the Greater Toronto Area, none of the city's 51 indoor rinks makes a profit, despite being booked to capacity. This is mostly due to constant repairs required, since most of the buildings are out of date, which in turn leaves no room to expand any programs. With overall costs being a heavy municipal burden most GTA Arenas make about half of the money needed to operate. Presently the city of Toronto rinks are constantly patching and fixing their facilities with the sporadic major renovation. All arenas in the city could eventually be retrofitted one day for energy efficiencies (i.e. Occupancy sensors) which aren't the most cutting edge technology but will help trim operational bills, but hold a burden of cost.

Bryn Weese writer for the Toronto Sun states that to help deal with the increases in operational and maintenance fees, leagues such as the Greater Toronto Hockey League are charging more money to the users of the facilities; as much as 3.7% annually. (Weese, 2009) The GTHL a competitive hockey league has increased their admissions at the door for the parents/spectators of the teams from $5 to $7 to help generate revenues of $1.5million to help deal with their $5million operating costs.

The GTHL is considering increasing competitive league costs by 4.7% and given that non profit organizations spend about $1 million on municipal rink fees in the city, which could be an increased cost of $47,000. Already this hockey league is just over $400,000 in the red from operational fees.

Mary Ormsby a sports editor for the Toronto Star gives an excellent example of how two current out of date facilities are operating annually. She looks at Scarborough's Commander Park which is a twin pad that runs at $620,000 annually (including staffing and maintenance) and returns $477,000 (from rentals and permits) which is about 77percent recovery, making it one of the high performers. A single pad arena in Mimico, costs are $368,000 yearly and about 56 percent of that is covered at $205,000 (Ormsby, On Thin Ice Our Crumbling Arenas, 2008).

This continues to point out that arenas around the city are short falling when it comes to covering costs. This infrastructure crisis does not only threatens to shut out new recruits to the sport but leaves existing players scrambling for ice time. The 'Arena' is being seen as a battered relic that is compromising the future of the national sport.

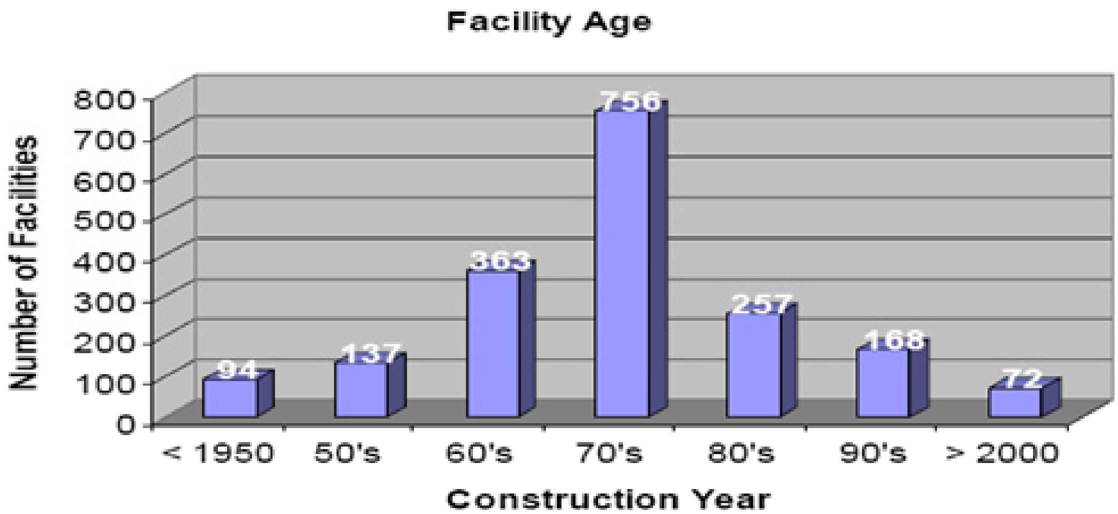


Figure 7 - Chart demonstrating age of facilities constructed across the province
(Canadian Recreation Facilities Council, 2006)

According to the National Arena Census, the above writers/authors and from Figure 7 this diagram indicates that our arena facilities are at a point where they are aging and they are beyond their life expectancy. It has been seen through this investigation that these aging facilities have out of date technology which is costly to repair and costly to maintain. The average arena around the city of Toronto is far beyond its 32 year life expectancy noted by the National Arena Census, and the only way for the city to operate on a functional and viable budget there needs to be substantial amount building redesign or upgrade. The National Arena Census concludes that there is a need for research for new technology and design which will not only help the function of the building, but lower operational costs. By giving the user a functional building which continuously operates and serves at a low cost will help all user groups of a community use and occupy the building.

There have been many retrofit projects ongoing in the city of Toronto, to help lower operational bills of arenas, but due to new technology being applied to old technology and old design, there are continuous costly problems. New technological advancements will not operate at their fullest potential and without the proper equipment.

An example of this is seen at the Don Mills Arena where it is estimated that $5 million is needed to fix and upgrade the venue of the next five years to bring it up to current building requirements and energy efficiencies.(Ormsby, Face-lift for Aging Facilities, 2008)

Figure 8 - Ajax Community Arena (www.townofajax.com, 2009)

Figure 9 - Proposed Community Centre (www.flickr.com, 2009)

There have also been numerous of attempts to renovate or repair existing facilities, but by mixing new and old technologies (being structure, ice making, lighting) more money will been spent making and maintaining these up grades then actual cost saving. Due to the state of this infrastructure a facility of this type being beyond repairs, this type of facility should be redesigned and reconsidered.

From Figures 8 and 9 indicates how arenas around the province and city exist today, and what they could potentially look like in the future. The possibilities of new and innovative designs are endless in the future for arenas, and arenas have the opportunity to become more than just a place to play hockey but a place to bring communities together.

2.2 Aging Facilities

According to the major municipal sports and recreation facility inventory facility life cycles of arenas become more expensive to operate as they age. Capital repair and reinvestment costs are more significant at various age thresholds. (Parks and Recreation Ontario, 2006). Sports arenas generally fall into the category of a life span which is 30 years. Facilities which fall under this category will need large-scale rehabilitation or replacement. In Ontario 80% of Ontario's single pad arenas are over 25 years old and 13% being over 50 years of age. Single ice surface arenas generally operate inefficiently and their advanced years suggest they are likely in need of capital rehabilitation.

Arena infrastructure is at a point in its life cycle where within the next few years massive amounts of funding will be required both to maintain and sustain this infrastructure. The burden of this funding will lay with municipal governments, as they are the owners of 86% of the infrastructure.

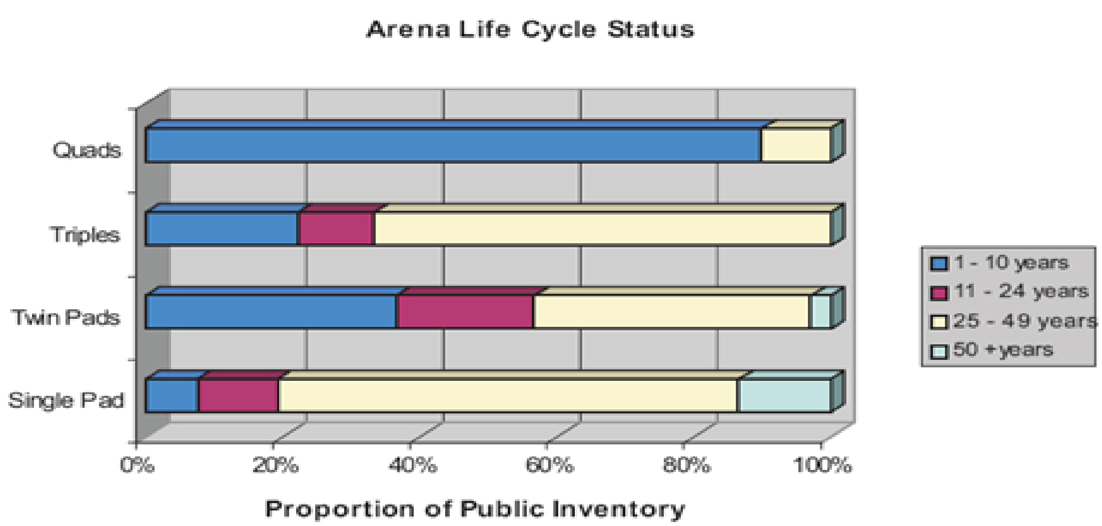


Figure 10 - Arena life cycle status chart (Ministry of Natural Resources Canada, 2003)

The life cycle status of our municipal arenas in the GTA reveals that the majority of single pad buildings (82%) are beyond 25 years of age and likely in need or substantial repairs, however twin and quad pad facilities which were built more recently are in better physical condition. In the city core of Toronto 95% of the facilities are single pads and are at the age of 25 years old. A facilities of this age will likely require capital improvements to update design and to increase customer appeal irrespective of renovations required to deal with age deterioration. (City of Toronto, 2008)

Eight of ten public arenas are single pads, and most municipalities often contemplate replacing several aging single pads with more up to date designs involving multiple ice surfaces. More recent designs (within the past 10 years) are multiple pad designs, where twin, triple and quad pad arena facilities are part of the design, making them more usable, as well as expanding their ice time availability.

According to the Major Municipal Sports and Recreation Facility Inventory list provided by the city of Toronto, the life cycle of building components for a hockey area is the following: A typical mod bit roofing system 20-25 years, concrete ice slab 30-40 years, an HVAC system 15-25 years, rubberized flooring in common and dressing room spaces 10-15 years and doors and windows 15-25 years. This 25 year window indicates major renovations are required after that time frame, due to the main building components life spans being exceeded.

From the literature on aging facilities and from provided information in Figure 10, arenas in the core of the city of Toronto are aging and are beyond repair. It has been shown that the last arena to be constructed in the Toronto area was in Scarborough in 1981, which leaves the newest facility 28 years of age, 4 years before it life expectancy is suppose to end, the remainder of the arenas are older.

The life expectancy of major building materials for a hockey arena usually fall in the 15-30 year mark which indicates that major renovations or rehabilitations will either need to happen or as the National Arena Census suggest that at 32 years of age the entire facility will need to be reconstructed. An example of a building well beyond its state of repair is the Ted Reeve Arena in Figure 11 and Figure 12 built in the 1950's, an arena which needs reconsideration

Figure 11 - Ted Reeve Arena - Example of Aging Facility (D. Panopoulos, 2009)

Figure 12 - Ted Reeve Arena - Example of Aging Interiors (D. Panopoulos, 2009)

2.3 Arenas Beyond Repairs

With our arenas facilities being at the end of their ideal life cycle decisions need to be made if they can be re mediated or removed. Repairing or replacing a facility would involve dealing with the facility and its standard amenities and would not involve other physical enhancements or upgrades. Repair and replacement estimates are based on the capital cost to construct the facility and its standard amenities. Most estimates include building and site construction, fees, expenses, equipment and furnishings. Stated in the Nation Arena Census an example of cost repairs to a typical two rink pad today with a typical building program, the chart below shows the cost factors to repair as the facility ages as a portion of the capital cost, and the amount of repairs which is needed to take place to the facility. (Canadian Recreation Facilities Council, 2006) Example: Twin Arena and Community Hall: The facility includes two 85 X 185 ice surfaces, 1,000 bleacher seats in one arena, 10 – 12 team rooms, service spaces, lobby, concession, 400 person community hall with bar and kitchen.

GFA (sf)	*Current Capital Cost*	*Category 1 1 – 10 yrs Cost Factor*	*Category 2 11 – 25 yrs Cost Factor*	*Category 3 26 – 49 yrs Cost Factor*	*Category 4 50+ yrs Cost Factor*
88,000	$13,200,000	5%	40%	50%	130%

Brian Baker of the Daily Commercial News and Construction Record has noted that the Maple Leafs Sports and Entertainment is teaming up with Home Depot to put money together to try to help upgrade indoor rinks beyond repairs around the city. Over the next five years a minimum of three arenas will be upgrade with an average of $100,000 per rink with the materials and from the labour from employees on a volunteering time. By refurbishing arenas, which not only house hockey teams but serves about 200,000 children annually across the city. Toronto has 51 municipal indoor arenas; most of the facilities are a decade beyond their 32 year life expectancy and require constant repairs. The organization has help repair seven rinks to date but the indoor rinks can only be repaired as far as the specified budget will take them. (Baker, 2006) The city has not fully funded the construction of a new arena since two twin pads were built in Scarborough 28 years ago and no rink has been built in the city's core since the early 70's.

Uncovered from the literatures on aging facilities as facilities age there will always be a high price tag to follow up with repairs or upgrades. Repairs can only take a building so far, as we can see above statement by Brain Baker. There have been donations made by MLSE but their limited budget only allow for new patches to be put onto old wounds. From investigating and interviewing operators at the facilities which have received money from MLSE what has been learnt was that new technology (IE occupant sensors) have been added to original lighting, original mechanical and electrical systems, which allow them to shutdown in time of non-use, which helps trim small portions of energy bills. But when combining new and old technology together the smooth transition doesn't always run properly, and in the end you end up with the same results; needs for repairs.

Figure 13 - East York Arena - Example of Outdated Interior (D. Panopoulos, 2009)

Figure 14 - East York Arena - Example of Exterior Crumbling (D. Panopoulos)

2.4 Retrofits

The city of Toronto has created a mandate in which current and new arenas around the city will begin to focus on the reduction in energy usage, to achieve sustainability goals, while providing improved quality of amenities. The city of Toronto states that it will be taking steps to reduce operation and maintenance fees by retrofitting systems. (City of Toronto, 2004) Starting in 2004, with efforts involving the EWMO in Facilities and Real Estate as well as Parks, Forestry and Recreation, arena projects will fall within the Energy Retrofit Program set by the city.

With arena projects, the program is set to improve various technical enhancements which include: lighting systems (efficient and brighter), advanced building automation systems (control lighting and ventilation, heat recovery systems), building envelope improvements (reducing drafts and leaks around openings), pipe insulation (improving efficiency of rink refrigeration equipment), brine header insulation, and upgrading heating, ventilation, and air conditioning systems. All of these systems will now monitor and verifying cost savings over time. Energy and water retrofits will result in reduced operating costs, increased energy and water efficiency, facility improvements and reduced CO2 emissions the arena current produces. (City of Toronto, 2005)

Estimated costs and savings from the arenas energy retrofit project is only a small step but will save the City $1.25 million a year on utility costs and reduce the amount of greenhouse gases produced by the City's arenas by 15%. Lighting advancements included dimming systems and occupancy sensors, as well as replacement of old arena lamps, BAS upgrades include controlling building functions from work station and well as infrared temperatures sensors to cycle brine pump, building envelope improvements such as improving building seals, pipe insulation, brine header insulation which feeds refrigerant to maintain ice surface. By insulating the pipe will eliminate heat gain, provides a water proof barrier and prevents ice building up on pipes. (Toronto Parks, Forestry and Recreation, 2009).

Other retrofit programs are discussed by Kevin Reichard of Green Building Venues, who has discusses the first green roof which was applied to the Target Centre Arena in Minnesota. Stated was the roof was retrofitted green which its covering utilizes a layer of dirt, an extensive drainage system and plant to capture storm water and regulate extreme temperatures in the summer and winter (captures nearly 1million gallons of runoff). This arenas now houses the 5th largest green roof in the US. This retrofit project is to help trim utility bills all in return helping control water surface runoff as well as heat island affects, as well as being a leader in green technology. (Reichard, First arena green roof unveiled at Target Center , 2009)

Figure 15 - Bill Bolton Arena - Interior Retrofit
(D. Panopoulos, 2009)

Figure 16 - Bill Bolton Arena - Arena Repairs
(D. Panopoulos, 2009)

From the literatures on retrofitting arenas discovered is that there are steps being taken by the city of Toronto as well as other arenas across North America to help will dealing with sustainability of the building and improving on energy usage. Learned lessons are the city of Toronto is will attempt major and costly retrofitting changes. These changes which will work on newer facilities but may fail short in an older designed facility to improve and save on energy usage and consumptions.

Learned from Kevin Reichard, is that sports arenas have large unoccupied roof surfaces areas which really do cause a lot of harm to the environment, so the idea of retrofitting a green roof on top of the facility not only benefits the facilities, but an entire community. The arena could potentially benefit from this by lowering environments impacts to the area as well as saving energy use and consumption. These are all see as small stepping stones in solving our arenas sustainable future.

2.5 Changing Needs

Over the past number of years it has been recorded that 585,000 Canadian are enrolled in minor hockey, 60% in Ontario, which is actually a significant drop. Across the province at the minor league level, enrolment in male and female hockey is down approximately 10 percent from where it was 10 years ago. (Mandel, 2008) In the city of Toronto as an example, which has higher than average living costs compared to most cities in the province had one of the most significant drops in the sports enrolment where the price to play we incredibly high and unaffordable.

Toronto which also sees one of the largest migrations of immigration population in Canada has sufficient amount of bodies to contribute to the sport of hockey at all levels, but high playing rates have discouraged the possibilities of this group of individuals from being involved. These individuals now tend to partake in alternative and cheaper sports (which mostly have little or no facility fees attached with registration), most of these sports being a popular sport from their country of origin. (I.e. soccer/cricket) It has been recorded that the average house league hockey registration costs in Canada are $400 - $600 a person with 30-50% being paid towards facility fees. (CBC, 2003) This shows that the sport of hockey which was once affordable to all is now been considered a sport for an elite group of individuals, but the opportunity should be available to all.

Contrary to stereotypes that immigrants aren't interested in skating and hockey, reports suggest that newcomers to Canada would actually be a new wave of facilities users. The city of Toronto begun to run an aggressive outreach programs to connect kids and sports and also plans to launch a universal school skating program for grade 5 students in the GTA to introduce families to the sport. (Wallace & Spears, 2009)

Figure 17 - Toronto Cricket & Skating Club - Alternative sports played (torontocricketclub.com)

Figure 18 - Toronto High Park FC - Alternative sports being played (torontohighparkfc.ca, 2010)

Misty Harris of Can West News Services has discovered that hockey has taken in spite of its cultural enshrinement makes a strong case that immigration patterns. There has been a 'Death of a Mono Culture' which has lead to a splintering of individuals interests with more consumer choices leading to fewer pastimes that are truly embraced on a national level. In 2008 four in ten Canadian teens with Canadian born parents followed pro hockey, among those born here but whose parents (one or both) were born elsewhere the proportion dropped to one third. For teens which were born outside Canada interest bottomed out at one in five. (Harris, 2009)

Lois Kalchman writer for Toronto Star believes poor professional team performances, game inaccessibility, and higher immigration rates (In 2006, fully 52.3 percent of Canadian Immigrants lived in Ontario, led by Toronto) causes this group of individuals to be separated from the sport. Canadian Immigration Magazine believes that it will take CBC's Punjabi broadcasts of HNIC as a step to draw individuals to the sport. (Kalchman, 2009)

As an example hockey in Scarborough is dying, the victim of a changing population that prefers to play affordable sports such as soccer, cricket and even badminton writes Kalchman. The Scarborough Hockey Association fifteen years ago had an enrollment of 10,000 players and today there are just 2,800, which are leaving rinks empty and unused. This is a sign that sports has begun to change as new immigrants arrive to an area. Most of the population in the area is of non hockey playing countries where other kinds of sports are played that they are more familiar with. The cost of hockey has prohibited noting immigrants can't afford to pay every winter to put a child in a hockey program, where in contrast a summer of soccer costs as little as $100.

Nigel Hannaford of the Calgary Harold states that there is a need to find new strategies on reaching out to communities that don't play hockey and sell the game by giving them an opportunity to try the sport for themselves. All of this within an atmosphere in which they are comfortable learning in. (Hannaford, 2009)

Figure 19 - Scarborough Minor Hockey - Dying hockey association (www.syhl.ca, 2010)

Figure 20 - Markham Minor Hockey - Diverse ethic hockey association (mmha.hockey.com, 2010)

Highlighted from the literatures on the change in needs of arenas is the enrolment in the sport of hockey is dropping because there are less individuals interested in the sport, due to enormously high playing fees and from the influx of the immigration population.

With that said when revenues are not being made there is no need to better facilities, and in turn user fees will increase to help cover the costs of the lower enrolments and balance budgets. Major factors for many children of immigration is cost, by the time parents pay for equipment and registration the costs quick mount and all of a sudden its is $1000 to play the sport for one individual. By proving the landscape of the visible minority that represents the percentages in the local population is changing and providing and meeting their needs while helping them adapt to the sport is a positive step in rebuilding this tarnished sports infrastructure and viability. There must be a reconsideration in which arena spaces are designed and which they are used to best serve the diverse community.

2.6 Reprogramming Spaces

The way a space was originally designed and programmed within an arena should be reconsidered. By looking at a community physical nature (whether if its income status or age group) the spaces within the facility should always meet the needs of its current community. By reprogramming existing spaces and functions within an arena and address what the community needs through these spaces will allow for more community engagement and interaction to take place. Specific targeted user groups such as immigrants and lower income groups are continuously growing and need to be address within a facility of this type, giving the opportunity to everyone.

The City of Toronto Park, Forestry and Recreation department with the Government of Ontario state that they are beginning to implement programs to improve the overall health of Canadians by addressing common preventable health rinks factors. They state that by 2015 there is a targeted increase of 20% of Canadians that will participate in regular physical activity. (City of Toronto Park, Forestry and Recreation, 2007) And a direct connection between physical activity levels and sports participation provide appropriate provisions of health, a mandate of this program.

“Improved infrastructure will advance sport and physical activity in communities across the city while addressing critical health challenged and strengthening Canadian Communities.” (The City of Winnipeg Department Of Community Services Public Works Property, Planning & Development, 2004)

By these new mandates by the Government and Health Canada and the city of Toronto, additional programming space, as well as current activities partaking at a hockey arena will be beneficial for additional user groups. A typical space which we see in an everyday arena could eventually be reprogrammed to meet the needs of various user groups around a community. This would allow an arena which usually has part time users occupying spaces and have continuous user groups using the facility more times of the day.

Typically a community centre component should be incorporated within a design of an arena and be designed to allow and adapt for change. These spaces should be flexible and allow for quick and easy change, to meet the needs of the physical and social landscape change. This will not only benefit the community but contribute to the overall community image to give a sense of choice.

Unveiled in the literature of reprogramming arena spaces is the social and physical landscape of a community can change in an instant. Currently spaces within sports arenas are not adapting, and in fact are not interchangeable and do not meet the needs of current communities at all times. Thus this leaves spaces empty and unusable within facilities, removing the opportunity for certain community user groups from participating and engaging with others in the community and in the facility. A re-examination on the way we view these spaces needs to be considered and possible redesigned. The Canadian Government is beginning to force the idea of healthy living thus adding to the pressure of community interaction and engagement within these types of recreation and leisure spaces, and the role of the building will have to change to meet these needs.

Arena designs as discussed above are discovered to be the most successful when there are flexible multi-use aspects applied to the building program. When designing an arena today questioning and research must be done to the surround community which will be receiving this facility to see what will be provided in the facility will be viable in that location. An important factor is if the facility will provide something to the community (whether it is space) provides and to meet the needs of the people of community.

Figure 21 - Brampton Soccer Club - Multi-purpose facility (www.oaa.collabra.ca, 2009)

Figure 22 - Brampton Soccer Club - Flexible interior spaces (Soccer (www.oaa.collabra.ca, 2010)

2.7 Sustainability in Sports Design

Sustainability should be an integral part of hockey arena design. A sustainable building is defined as a building which engages and involves users of the community while being designed and reinforced through green build technologies. This allows for the building to be designed in fashion in which people from a community no matter what their limitations, engage and participate within a space that offers flexible and multi-purposeful functions and has the opportunity to adapt to the changing community needs.

A arena of this type has the ability to create paying jobs as well as volunteering jobs to serve others in the area. A sustainable facility will also lower the impact on the environment through its green building traits, which will help cut operational and maintenance costs, as well as reducing carbon emissions and overall carbon footprint.

Stan Sersen who is part of the US Green Building Council discusses how the city of Baltimore is proposing the idea of a Green Concert Arena, which as designers we can learn ideas from. Being at a larger scale refining some of his ideas from the design and apply them to a smaller community level is a possibility. Notably learned from his study, he discovers the possibilities of the arena in helping rejuvenate a downtown sector. From this the arena could create new jobs and the design may also reduce operating costs, provide benefits and gives something back to the community all together.

Stan sees projects of this magnitude from below grade and up, and considers that these types of projects should go above and beyond any public and private space in regards to sustainability. He states that "Arenas should set a wow factor architecturally and be an example of sustainability for the world." (Sersen, 2008) He has deemed that an arena is a perfect high profile building which will help redevelop communities and in turn could help businesses and residents within an area. An arena's can be used as model for other public and private green projects alike.

By in injecting green into a new facility may require deconstruction of an old one and through salvaging building materials. "This is a key component on saving our carbon footprint." (Sersen, 2008) Noted is that connecting a new facility along public transit lines will help lower impact on community's carbon footprints. (The potential for less use of vehicles) Stan discusses that education and jobs should be a main attribute from a new arena facility design. This will actually integrate the community into the maintenance and operations of the building. Local new technologies and local materials are so advanced in all areas of North American that they can be readily available at anytime and we see no need for importing any building material or product. He examines arenas as eco smart facilities which could renew energy and create cost saving approaches. He also makes a strong point that agriculture can be used in part of this type of building design which could provide for community, local restaurants or even for the facility.   Greenhouses are seen to be potentially used as part of this future building's design. Arenas in general have roofs with large surface area which could quite possibly house this idea.

Stan's overall vision is summarized thorough this quote, "So you sit down to some event or concert in some future year, and you order a personal-size pizza. The pizza features arena-grown tomatoes, and it was baked in an oven that got its energy from solar panels.

Sustainable pizza in a sustainable arena, this is what the future is all about." (Sersen, 2008)

Another piece of literature which is seen as vital to sustainable arena design is by Paul MacLatchy, the city director of strategy, environment and communications Kingston Ontario, through an interview by Ms Pickett with the Kingston newspaper the Wig. Paul envisions the idea of a Green Arena with in the city. Paul believes strongly that a new building should not use high impact materials which release organic compounds into the air hurting the environment. He makes a strong point that, "Of the 91 LEED certified buildings in Canada not one is a certified arena. This is poor because arenas are community based facilities which houses our national sport. It is a facility in which the general public can learn much from." (MacLatchy & City of Kingston Director of Strategy, 2008).

Paul has pointed out that Nancy Grenier, manager of communications and marketing for the Canada Green Building Council, said the Canadian Council is revamping its certification process. "The idea is that the rating system will become a tool for any type of building at any point in its life cycle." So whether you're looking to certify an arena, a commercial building or a home, the system will be universal. (MacLatchy & City of Kingston Director of Strategy, 2008) This statement presses all designers of all spectrums to go with this path in the near future.

MacLatchy said it is challenging to go for LEED certification for an arena, but it is important to educate the public about the environmental features of the arena; these centres could have a “green” building kiosk or signage to let people know they are inside an environmentally friendly building. (Pritchett, 2008)

Paul states for LEED projects within Canada and the US you look at two to five percent in capital cost increases which is not bad in means of turn around and is a great investment in energy costs and savings. He said that a new arena is estimated to be 34 percent more energy efficient that a conventional arena in similar size and function. LEED certifying was put in for two reasons: one, to save energy costs, and, two, to reduce the amount of greenhouse-gas emissions a city produces.

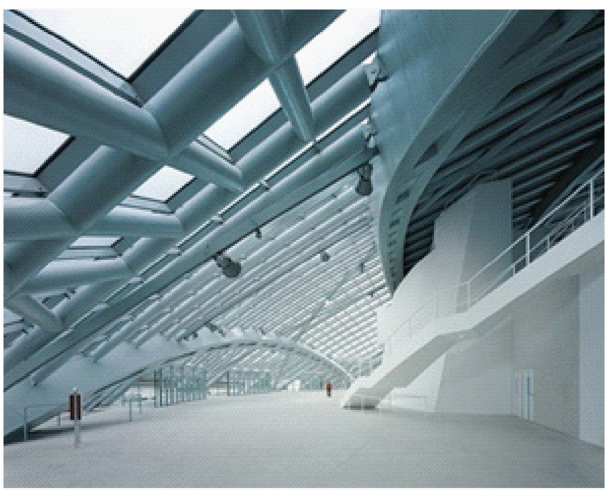


Figure 23 - City of Jaca Arena: natural light exploration (www.coll-barreu-arquitectos.com, 2010)

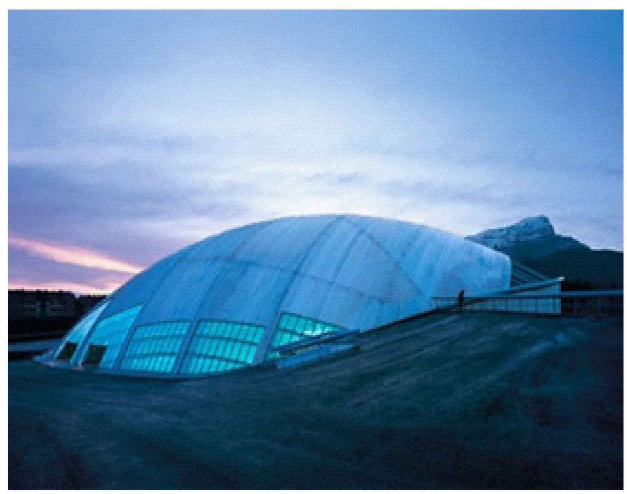


Figure 24 - City of Jaca Arena: Alternative energy exploration - Thermal mass (www.coll-barreu-arquitectos.com, 2010)

Angela Altass writer for Award magazine discusses the multifunctional needs and uses in which should be an integral part of a new arena design. This would help the building be continuously used on a regular basis, extracting the full potential of the design. Altass had investigated the Activa Sportsplex in Kitchener Ontario by PKMB Architects, and has discovered that this facility has shared amenity spaces by two organizations to maximize the use of the facility. The facility is also located on a site adjacent to a school and integrated within the current site context.

Arenas should be considered as being an indoor and outdoor recreational space, and be developed with community input. Altass sees a designers approach is to preserve, protect, enhance and improve the site and target LEED Gold. Altass additionally states that by introducing various green ideas, such as bringing nature into the arena, using raw building materials, applying green roofing to control runoff, heating and cooling, as well as using new light technology, all while being controlled on occupancy sensors can create energy savings of approximately 72%. (Altass, 2008)

Tyler Hamilton writer from Toronto Star whom thorough an interview with Steve Thuringer, executive director of facilities, at Upper Canada College discusses how the new school sports facility and arena can be a leader in energy efficiencies. Thuringer stated that on the facilities side he began making easy changes which began conserving energy and kept their budgets intact. This in turn began to save the school $200,000 on its gas and electricity bills annually (Hamilton, 2009). Thuringer looked for additional ways of offsetting the school's energy needs with renewable sources.

Geothermal was chosen because it was the largest asset they had; been land. Thuringer explained that in 2006 they had the opportunity to access the land when they renovated the main sports field. The surface was in need of removal so geothermal piping was laid in the ground under the sports field and used the underground loop to make the ice in the new arena. This kept the arena cool, and heat other areas including the bleacher seats.

Enermodal Engineering the consultants of the project states that the new arena, which holds one Olympic-sized and one NHL-regulation rink, officially opened in February and so far the energy savings are impressive – a reduction of 38 per cent compared to a conventional complex. (Enermodal Engineering, 2009) The new ice increases accessibility for all students, so that more boys have time to practice and play, not just on teams but also as a part of the core athletic program.

This facility provides the College with double the ice surfaces, as well as football, rugby, soccer and hockey locker rooms, an alumni lounge, increased spectator viewing and a spacious lobby, among many other needed amenities. To ensure that the sports complex meets the school green goals regarding energy and resource conservation, the facility design team was guided by the principles of the LEED Building Rating System as administered by the Canada Green Building Council. This made it a Gold Candidate Facilities.

To add to the sustainability research the Angus Glen Community centre in Markham Ontario as well as the Burnesville Arena in Minnesota have begun to apply sustainable design aspect to their entire facilities. These in which are not only beneficial to the owners of the facilities but are seen as providing needs for an entire community.

Stated by the Canadian Wood Council the Angus Glen Community Centre and Arena can be used as an case study when designing a sustainability facility because it uses high tech operation systems, heating and cooling and it uses wood construction as is most integral part of its sustainable design for construction. (Canadian Wood Council, 2009) In

Burnesville described by Kevin Reichard of Green Sports Venues takes a typical arena and uses geothermal refrigeration systems to cool the ice and provide heat to other parts of the arena complex. (Reichard, Green Sports Venues, 2009) These design ideas provide cost saving measures for the arena as well as providing beneficiary cost saving measures for users in the communities.

Finally to enforce the idea of sustainability the City of Toronto and the Canadian Green Building Council has started a new mandate which it states that on new schools, non profit housing, multi-unit residential, commercial and all recreational facilities, green roofs are required to cover a minimum amount of new buildings in the city. This will help utilize wasted roof spaces, and create social benefits of food production and the addition of much needed recreation space. They city sees green roofs as being fully attained through alternative less costly means of aiding to our ailing environment. (I.e. storm water retention) (Canadian Green Building Council, 2009) Since an arena has ample roof space it can house such a beneficial trait.

Uncovered in the literature on sustainability in sports design, is that sports and recreational professionals can benefit by gaining an understanding of the potential benefits of green design and sustainability. Green and sustainable being structure designed, built, renovated or operated in an ecologically and resource efficient manner. Buildings of these type will utilize energy efficient processes to accomplish long term cost savings. Benefits of Green Facility: Conserve natural resources, increase energy efficiency and water conservation, improve indoor environment, which leads to cost savings over life span and improve productivity for the buildings inhabitants.

With construction costs almost parallel with conventional building techniques and with the promise of reduced life cycle costs, green buildings represent not only a socially responsible choice but a smart fiscal decision. Improved energy usage and occupant productivity are other tremendous reasons to invest in the green movement. It is important to explore environmentally and economically feasible design and development techniques in order to create structures that are multi functional to serve a broad spectrum of the community, flexible and sustainable, healthy and functional.

Figure 25 - University of Florida Football Complex - Sustainable sports facility (www.athleticbusiness.com, 2009)

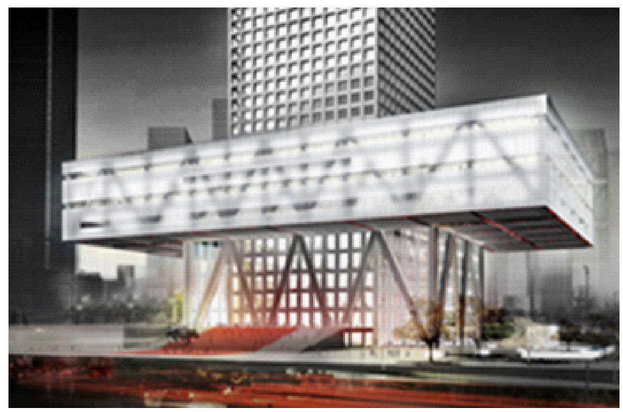


Figure 26 - OMA - Small sustainable sports centre competition (news.architecture.sk, 2009)

2.8 Arena Design

When it researching arena designs, a few writers touch on the building basics and design usually defaults to city guidelines to be followed. Richard Diedrich, the author of Building the Basic for Recreational Facilities, Kevin Dickens Hockey Rink Basics as well as Reports from the city of Toronto and Strathcona Regional District outline the basic for a typical arena design.

Richard Diedrich and Kevin Dickens believe that a typical arena's main goal to maintain professional grade ice and enough comfort so that spectators will stick around. Old systems would dump too much outside air into the space and then chase good indoor environment out of the facility (Dickens, 2003) (Diedrich, 2005). The modern hockey rink should have a proper building envelope which will help maintain good ice and in turn provide proper air temperatures.

Rink construction, air temperature, and ice conditions are critical, because revenue is closely tied to the quality of ice, in many cases the ideal dew point of 35[degrees] can only be reached and maintained with active desiccant systems. Ventilation can be a back breaker, but the incorporation of demand control and passive energy recovery can make for a viable solution. A positive pressure relationship between the rink and other spaces must be maintained. And heating and cooling should be kept as simple as possible, always considering the impact of the ice.

Energy Management Manual for Arena and Rink Operators outline the specific energy outputs and the current costs of technologies in arenas today. The authour's add to the basis for typical arena project planning. (Sask Power; Saskatchewan Parks and Rec; Office of Energy Conservation, 2007)

In a report by Sask Power states the entire project planning concepts for a building or maintenance project for a typical arena, the construction of an entirely new facility, and typical construction costs and practical examples. The report takes a position that Project Concept Demand forces will dictate the design process. Questioning on who will use the project, what features will the users want, if there is a chance for profitably and how will the designed facility affect other programs within it.

Economic base analysis and economic and demographic forces will shape the design and overall building decisions. Demographics for community as well as issue of a person's life stage needs are all important factors, and by determining if a population is increasing or decreasing. As an example the report states for considering a hockey rink and the residents of the community age 6-39 are on the decrease, and then you should include other programming to meet the needs of the main group of the population.

An important factor stated by the report is the employment knowledge and income of the community in which is being designed for. Circumstances may occur where the community have some other unique factors that will enhance the viability of your project. There can be unique opportunities that could be pursued to enhance a projects worth. By looking at reducing costs by sharing facilities and expanding services to incorporate other needs maybe an option. Locating an arena near school the students can use it during the day as part of their physical education, by creating meeting rooms and spaces can be attractive for local senior citizen. Over all Planning for Energy Efficiency Cost avoidance, inflation, and financial analysis are all important factors.

New sustainable arena design is discussed by Jennifer Pritchett of the Wig Standard and by Arcturus SMG Canada of Kingston Ontario. The writer and operator of the K-Rock Centre discuss the operation and design of one of Canada's first environmentally friendly arenas. With solar panel being one of the signs of its green attribute, the building is constructed without using materials and furniture that release these volatile organic compounds into the air. Arcturus SMG states that the arena constructed by Ellis Don Construction is expected to receive a special designation from LEED (Silver Certification) first of its kind in Canada. The arena is equipped with green building kiosk and signage and includes other green features includes a white roof, which Arcturus declares doesn't contribute to the urban heat island effect. Pritchett investigates the sustainable aspects of the building and writes that the building material that the arena is made of, including steel and cement (high recycled content with ash, and reuse steel products), the exterior lighting efficient and equipped with cut off's to reduce light pollution, efficient heating and cooling systems are used as well as high efficient water fixtures.

All of the wood used in the construction is sustainable and ecologically friendly and materials come from a radius of under 800 km to reduce carbon footprint, 75% of all construction waste was sent to a recycler and diverted from landfill. The entire arena is outfitted with windows to increase natural light, and the facility is constructed on brownfield site.

Ellis Don states that approximately 1.2 million of 46.5 million project budget for LEED certification, which includes two to five percent in capital cost increase due to the LEED program. Pritchett notes that the arena is estimated to be 34% more energy efficient than a conventional arena of similar size and function and the goal to save energy costs and reduce amount of greenhouse-gas emissions the city produces. Other cost in energy savings over a reasonable time period includes site efficiency, water efficiency, energy, and atmosphere, materials and resources, indoor environmental quality and innovation and design process (Arcturus SMG Canada, 2009) (Pritchett, 2008)

From arena designs literatures as discussed above discovered is that arenas are to be the most successful when there is multi programming and multi use applied to the building program. When designing an arena questioning and research must be done to the area to see if the arena will survive in the location. An important factor is if the arena facility will benefit from the community and if the community will get something from the arena. Pritchett highlights the importance of the new found success of in sustainable/ multi functional design with strengthen the overall performance of the facility.

Figure 27 - Alternative energy exploration - Solar panel technology (www.community.ecoseed.org, 2009)

Figure 28 - Berlin Arena - Sustainable arena proposal (www.communities.canada.com, 2009)

2.9 Literature Review Conclusion

Discovered from the literature study noted above, sustainability should be an integral part of our everyday design schemes. As designers if we want to drive down operational costs we must introduce green technologies, community involvement and full engagement of all users to the facility. This in turn in the long run helps lower fees for users and operators as noted 2-5 percent annually on average. As well the Canadian Government also gives special grants, incentives and rates to help new environ-friendly technologies and buildings to succeed. Numerous possibilities may arise when these structures are incorporated into community arena designs.

Facilities which are heavily used by our general public and are iconic to our Canadian culture as a arena can be used and should be seen as a learning centre or to showcase for future designs of buildings. The public may learn from implemented ideas and do their own part of creating a catalyst of sustainability use. Communities will also have the opportunity to learn about lessening wasted spaces, reduction of operational fees and energy savings. In addition as designers we will learn how to produce for your own community, water management and how to potentially produce your own energy through these new building design techniques. We should always view a building with the following diagram in mind when it comes to the design stages, which will help benefit all users of the facility.

With the arena infrastructure in the city of Toronto being a point in its life cycle where within the next few years a large amounts of facilities will either be required to be fully renovated or completely rebuilt, proves to be an excellent opportunity to be used as the regeneration tool building type for a community renewal. A community arena is a structure which is typically positioned in the centre of an area and serves a population over 25,000 and offers additional programming to serve the broader spectrum of the surround area.

With this in mind there must be a re-evaluation in the way these facility types are designed. The current issues of design must be addressed before we can improve and more forward. Sports arenas n our city today must be consider change and be able to adjust through time. New facility designs should include the injection of sustainability, which will not only help with operational costs to run and maintain the facility but increase user engagement and participation within the facility. New facilities should be multi-use and offer flexible multi functional program spaces to meet the continuously changing needs of users. The building programming should always be beneficial to the social wellbeing of individuals and improve in cognitive and learning skills to allow them to be successful within society.

Community arenas can be used as learning and teaching technology because it is proven that using sports in the regeneration of people and can be used as a regeneration tool for a community. Sustainability in sports arenas will teach a community about energy and sustainable design ideas, as well as environmental ideas and teach about Green Architecture today.

Other items learned is how to produce for your own community, water management and how to potentially produce your own energy through new sustainable building design techniques. As designers we should always view a building with the following figure 29 diagram in mind when it comes to the design stages, which will help benefit all users of the facility.

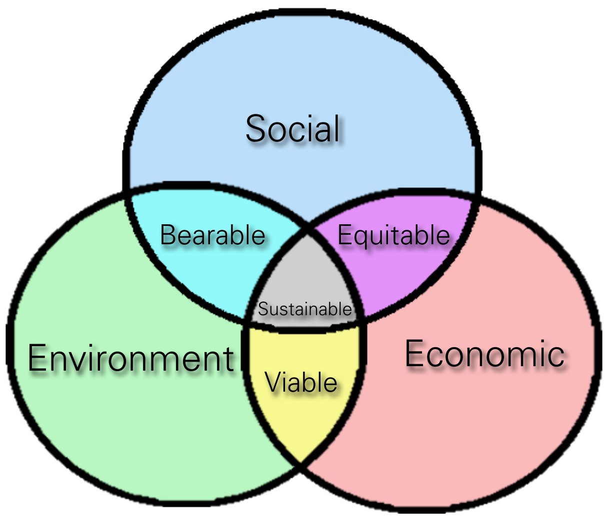


Figure 29 - Sustainable Theory Diagram (revised D. Panopoulos, 2010)

By addressing the arena through the three pillars of sustainability arena designs can achieve the following quote, "We can use these buildings to enliven the surrounding streetscape; they become part of a community, and part of a landscape. As a pedestrian from about two blocks you can see the livelihood of the building, because of its transparency and you can see the activities taking place. You know there's an arena there, because you have the ability to connect with it and all its functions. The space was alive even when there wasn't hockey going on in the building," David Panopoulos.

3.0 DESIGN CASE STUDIES

The following seven case studies have been selected to reinforce the thesis statement and literature review as well as aid in the thesis project design solution. The case studies range in size and scale which attempt to tackle sports facility and arena design and sustainability, through green technologies and revisiting building programming.

Five of the projects are new built structures, one being a retrofit project and one being a documentation of existing facilities around the city of Toronto and their attempts to solve issues affecting the building. From the study of these projects noted are the projects vital statistic, important building traits, as well what is being learnt from and what can be use to apply to the design project.

I Upper Canada College: Purpose of Study: Multi-purpose sports facility on a private school campus, using sustainable technologies such as geothermal and solar technologies to return carbon footprint and energy consumptions.

II Manitoba Arena Purpose of Study: Arena retrofits converting natural made ice to synthetic ice technology to create savings on maintenance and operations

III Activa Kitchener Purpose of Study: This multi-purpose facility uses natural materials, natural lighting, and thermal mass energy to reduce environmental impacts. By expanding the buildings program to share with multiple disciplines to increase building and user engagement and usage.

IV Angus Glen Community Centre: Markham Ontario: This multi-purpose facility uses natural materials, natural lighting, and thermal mass energy to reduce environmental impacts. By expanding the buildings program to share with multiple disciplines to increase building and user engagement and usage.

V K-Rock Centre: Kingston Ontario: Purpose of study: First LEED certified arena in Canada, multi-use/multi-functional arena facility

VI Consol Energy Centre Pittsburgh Pennsylvania: Purpose of Study: First LEED Gold Certified Arena in North America, Professional League Arena with multi-functional tasks, sustainable building traits, part of downtown renewal

VII Downtown Toronto Arena Status Study: Purpose of Study: Review aging rinks around the city of Toronto, investigating their life expectancies, their current repairs, current technologies, and current building use with program

I Upper Canada College - William P. Wilder '40 Arena & Sports Complex

Purpose of Study

To review this multi-purpose sports facility which is located on a private school campus, that uses sustainable technologies such as geothermal and solar technologies to reduce carbon footprint and energy consumptions. The facility is the first "green" arena complex at a Canadian independent school, with significant environmentally sensitive and cost-effective heating and cooling infrastructures, which shows that a building of this type and scale can be used as leader in green building leadership.

Building Profile

Building Name: William P. Wilder '40 Arena & Sports Complex

Address: 200 Lonsdale Road, Toronto, Ontario

Architect: Bregman Hamann

Client: Upper Canada College

Building Type: Private School Sports Complex

Project Budget: $17,000,000

Completion Date: Feb. 2009

Certification: LEED Gold

Figure 30 - William P. Wilder Arena & Sports Complex Rendering (Toronto Star May 5, 2009)

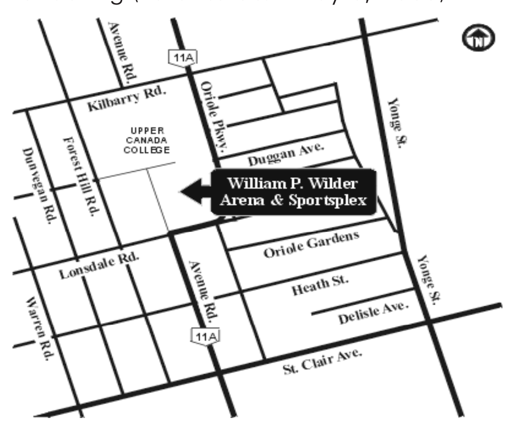


Figure 31 - Location of UCC Campus arena location (arenamaps.com, 2009)

Building Program

Facility: Located on the south side of Upper Canada College Campus the facility provides the college with double the ice surfaces, as well as a football, rugby, soccer, and hockey locker rooms, an alumni lounge, increased spectator viewing and a spacious lobby along with many other amenities.

Arena: The new facility has one NHL-size and one Olympic-size rink, making it home to one of only four Olympic-sized ice surfaces in Ontario. The hockey arena will also accommodate more spectators with an increased seating capacity and a lounge area for meetings and celebrations. The building structure is steel frame and concrete block with brick façade and strip footings and the roof is a pre-engineered steel frame system.

Intended Users

The complex will provide much needed ice time for students of the college as well as helping the surround community host events. The increase in accessibility for the students will help in expand the core athletic programs within the college as well as providing more space for play and practice.

Sustainable Traits/ Technologies

To ensure that the sports complex meets the Green School goals regarding energy and resource conservation, the facility design team was guided by the principles of the LEED Building Rating System as administered by the Canada Green Building Council. The area of focus for this site and development is water efficiency, energy efficiency and indoor environmental quality and achieve LEED Gold certification. The twin pad arena implements an erosion and sedimentation control plan to minimize the negative impacts on water and air quality. The surrounding site landscaping uses permeable surfaces to assist and retention of water, and water management.

Figure 32 - Interior of UCC arena (D. Panopoulos, 2010)

The arena has a white roof to enhance its ability to reflect sunlight. With better reflection means less heat absorption on the roof. In addition the roof also captures rainwater that is used in toilets to reduce the use of clean city water. There is also a small room inside the arena has two desktop computers used by the facilities manager to monitor and control all aspects of energy use in the building. Specialized software that connects to all sensors, equipment and lighting in the building gives the school the ability to analyze patterns and fine-tune energy use at various times of the day.

Geothermal piping was used to make the ice in the new arena, keep it cool, and heat other areas of the facility, including the seating area. This ground loop was implemented under the seven new playing fields totalling nearly three hectares in area. Since the site was being excavated for the new fields the opportunity was available to take full advantage of this new technology.

This facility's many green features include:

- The re-use of waste heat from the ice-making process to heat the spectator area and shower water, melt the snow pit, and heat the ground under the soccer dome
- A reflective white roof that does not contribute to the urban heat island effect
- A rainwater cistern that supplies water for toilet-flushing
- A photovoltaic system that supplies some electrical power
- Permeable pavers to reduce the urban heat island effect and to allow storm water infiltration
- Bicycle racks for staff, students, and visitors
- Low-flow fixtures to conserve potable water
- Waterless urinals in the dressing rooms and public toilets
- Drought-resistant native plants
- Construction materials with recycled and/or regional content

To date the energy savings have been impressive with a reduction of 38 per cent compared to a conventional complex.

Figure 33 - Rendering of arena looking south west in campus (www.dcnonl.com, 2007)

What was learned?

Ontario government's commitment to spend $550 million over two years to make more than 1,000 schools in the province more energy efficient, a projects such as this one is a expected to result from this financial injection will ultimately lower the long-term energy costs for budget-constrained school boards. Buildings such as school campus' as well as large, flat rooftops such as arenas provide ideal locations for solar thermal and photovoltaic systems, and sports fields are excellent places to install geothermal systems in aiding in heating and cooling of a single building as well as surrounding buildings in which can tap into the loop system.

Figure 34 - Main entrance to arena (www.ucc.on.ca, 2010)

Figure 35 - Thermal Loop system hidden under playing field and track (www.ucc.on.ca, 2010)

Figure 36 - UCC school emblem (www.ucc.on.ca, 2010)

Outcome of Study

UCC's hockey arena and sports complex was designed to be sustainable, and is working to maintain is gold-level LEED certification. To reduce energy consumption from heating in the arena and sports complex, UCC installed geothermal heating beneath a nearby playing field, which provides the heat supply for the arena and sports complex. Geothermal heating assists in reducing the complex's energy use by 35 to 40 per cent annually. A building of this type can become a leader in cost reduction, energy generation and energy reduction for itself and for a surrounding community and be used as a learning tool.

II Miami Manitoba Arena

Purpose of Study

To review an arena and community centre facility which has implemented a simplified geothermal ice-making system to aid in reducing costs of electricity, maintenance, operations and improving on the existing natural ice and electric heating system which originally existed. A review of this new system would show how the elimination of annual fall start-up and spring shut-down costs of a conventional ammonia or freon ice plant, can be achieved and how the technology works. This is an arena retrofit project.

Building Profile

Building Name:	Miami Arena
Address:	762 Pth 23 Manitoba
Designer:	KUBE Systems
Client:	Town of Miami
Building Type:	Retrofit
Project Budget:	$212,500
Completion Date:	Arena 1998, Community Hall 1999
Savings:	$30,000 annual operating, maintenance and energy savings

Figure 37 - Interior of Miami Arena (www.nrcan.gc.ca/es/erb/reed, 2000)

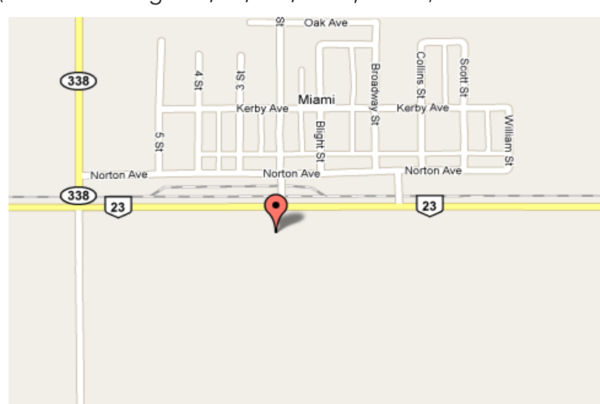


Figure 38 - Location map of arena (arenamaps.com, 2010)

Building Program

Facility: The hockey arena is the centre of activity during long Manitoba winters in the small town of Miami, in the south-western corner of the province. Since the arena was erected in 1952, it relied on bitter prairie winds to create ice for hockey teams and figure skaters. The arena could be used for skating for 50 to 100 days, but often with interruptions during mid-January warm spells. As more and more surrounding towns built arenas with artificial ice, Miami was bypassed for tournaments and events.

In 1998, the community devised a strategy to keep the ice pad reliably solid for a longer season and, at the same time, slash operating costs and keep maintenance to a minimum. Using a unique ice pad design and a geothermal system, the Miami arena takes advantage of thermal storage to make ice and provide heating and air conditioning to the arena and an adjacent community hall. Revenues have increased because ice is available up to six weeks sooner in the fall, and up to a month later in the spring and the comfort level in both buildings has been increased. The estimated payback of the geothermal heat pump strategy as opposed to the installation of a conventional ice plant is less than three years.

The building is a wood arch-rib structure, approximately 27 metres by 67 metres. One end of the building, 27 metres by 11 metres, includes a viewing area, concessions and offices on the main floor. The basement houses change rooms and the mechanical room. The second floor is approximately 21 metres by 11 metres.

The unheated ice shed is not insulated, and covers an ice sheet of 25 metres by 56 metres. Windows from the viewing area and second floor hall overlook the ice. A 929 square metre community hall was built about 24 metres from the arena in 1974. Electric heaters provide most of the space heating. The community wanted to install an ice making system, but was deterred by high energy, operating and maintenance costs of a conventional ice plant. Several arenas using geothermal heat pump systems had been operating successfully in Manitoba for some time, so the community decided to opt for a similar system.

Sustainable Traits/ Technologies

A system which is incorporated into the project is an integrated geothermal system. This system which is a vertical earth loop constructed by arena boring 48 ten-centimetre diameter holes to a depth of 38 metres into the clay soil. The supply and return lines are connected to a header in the mechanical room where it joined into two 5 ton forced air heat pumps will replace the two 30kW electric furnaces to heat and cool the viewing area, locker rooms and hall, using the warm earth as a heat source.

The integrated geothermal system offers more than energy cost advantages over a conventional ice plant. Maintenance costs are significantly less. Ice plants using ammonia or Freon require operators qualified under the Refrigeration Plant Operators Training Course. They also require daily monitoring, the keeping of a performance log and complex fall start-up and spring shut-down procedures. When savings in maintenance costs are calculated, the payback for the geothermal system drops to less than two years, this project Costs per Year – Conventional System $54,025 Geothermal System $24,130.

The initial project costs are higher for this system than a conventional ice plant, but conventional ammonia systems entail additional costs for constructing the housing for an ice plant, as well as ventilation systems are required for safety regulations, which are not required for geothermal systems. Geothermal systems additionally have utility incentives from the government (in this case $15,500 a year) for an over price with installation of $212,500 compared to a conventional system $179,500. Geothermal system actually uses less energy than natural ice making when the cost of operating the original electric heating system is considered and energy costs of this facility natural ice/electric heat $11,600 integrated geothermal $8,500 conventional ice plant/ electric heat $22,000 in

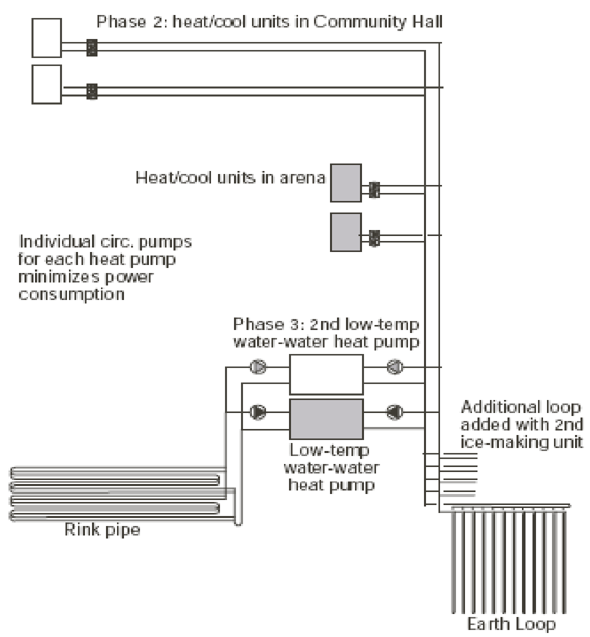


Figure 39 - Piping schematic - Indicates ice making units rejecting heat to earth loop, and hvac units drawing heat from earth loop (www.nrcan.gc.ca, 2000)

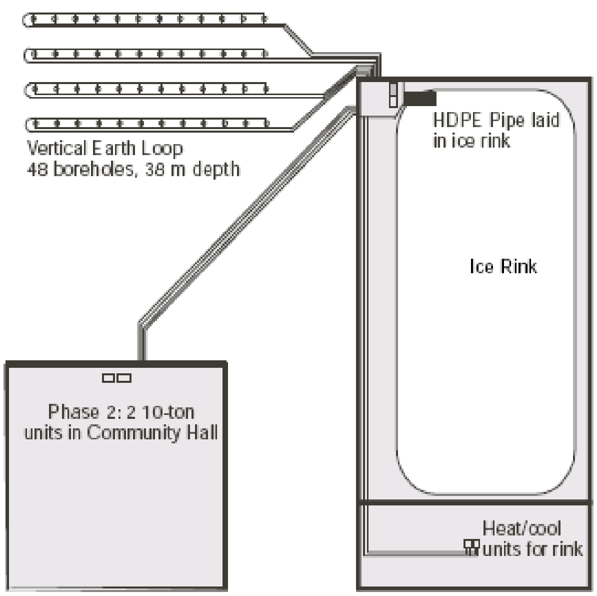


Figure 40 - Site plan of Miami hockey arena and community hall (www.nrcan.gc.ca, 2000)

addition by using thermal storage for efficient ice making: By creating a thermal storage buffer under the ice, the buffer helps maintain constant ice temperature during heavy usage of the ice. This allows the low temperature heat pumps to chill the buffer when the ice is not being occupied. The cold buffer zone helps maintain ice for several days in the event of a power outage. This system is eco friendly using non-CFC refrigerants as well as using minimal power to operate by using a refrigeration duty compressor.

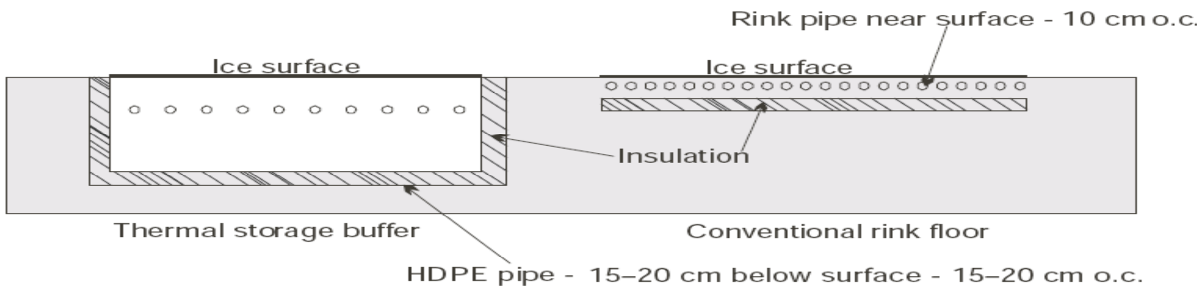


Figure 41 - Construction of conventional rink floor & floor with thermal storage buffer (www.nrcan.gc.ca, 2000)

The facility also has future plans to implement additional cost saving energy and operational systems which includes a the addition of low-emissivity ceiling will enhance the performance of the system by reducing the heat gain to the ice and a new concrete floor can be installed in which a second layer of pipe could be laid, which will speed ice-making in fall and allows for future expansion into the summer months.

What was learned?

Since its installation in the fall of 1998, the installing contractor and the owners have had no complications in commissioning and operating the system. Straightforward control features of the new system have minimized difficulties in operating the ice-making and HVAC systems: individual digital thermostats for the heat/cool units; heat pump-controlled power supply to the circulators; and, a two-stage controller using liquid-line temperature sensors for ice-making and antifreeze circulation. The pre-packaged nature of the of the geothermal heat pump system requires little monitoring. Not only are the arena operators pleased with the system's low maintenance, they are delighted with the energy savings attributable to the integrated geothermal system. The comfort of the viewing area, lockers and community hall has improved. The community is looking forward to installing additional heat pumps to increase the rink's ice-making capacity and to heat the adjacent hall. On average, one MW.h of electricity generated in Canada produces 187 kg of CO_2 emissions. The system installed in the Miami Hockey Rink and Community Hall reduced energy consumption by approximately 254.7 MW.h, avoiding 47.6 tones of CO_2 emissions annually as well has reduced the amount of greenhouse gas emissions.

Outcome of Study

From this investigation and lessons learnt many cost saving technologies are expensive when initially purchased but their returns in the future are well worth the early risk. A variety of new technologies which are eco-friendly have now been invented to help trim operational and maintenance costs to run facilities such as this arena, all in which provide a better quality product on and off the ice.

Figure 42 - Exterior view of arena (www.nrcan.gc.ca, 2000)

Figure 43 - Ice Kube technology used as refrigeration system (www.nrcan.gc.ca, 2000)

III Activa Sportsplex

Purpose of Study

To review a facility which has a large amount of multi-purpose uses and programs plugged into it making it available to a large growing community. Through natural materials, natural lighting and other sustainable building traits this facility can be used as a model of energy efficiency, multiple programming and community engagement. This facility demonstrates how by providing multiple sports disciplines under one roof will increase the amount a facility will be used and will increase the amount of user engagement and interaction between users.

Building Profile

Building Name:	Activa Sportsplex
Address:	135 Lennox Lewis Way, Kitchener, Ontario
Architect:	PBK Architects
Client:	City of Kitchener
Building Type:	Sports Complex
Project Budget:	$20.1 Million
Completion Date:	Sept. 2008
Certification:	LEED Gold
Total Building Area:	110,000 sq.ft
Savings:	$125,000 per year in operating costs

Figure 44 - View of Activa Sportsplex (www.kitchener.ca, 2009)

Figure 45 - Location of arena (arenamaps.com, 2010

Building Program

Facility: Kitchener, Ontario's Activa Group Sportsplex has received the highest LEED Canada rating of all sports facilities in the country. Also the first ice rink in the country to earn Gold under the Canada Green Building Council's (CaGBC's) Leadership in Energy and Environmental Design program, the 10,250-m2 (110,330-sf) building features a twin pad NHL size rinks equipped with 11 dressing and one club room, a 7,50 square foot boxing facility, a cardio and weight training facility, 3 lane indoor track, a pro shop, a minor hockey league head office, a meeting room for 75-100 people, 357 surface parking spaces and 600 spectator seats with full concession services.

Intended Users

The Activa Sportsplex is the home to Kitchener Minor Hockey Association and Waterloo Regional Boxing Academy.

Sustainable Traits/ Technologies

Enermodal Engineering, the project's LEED consultant, worked with PBK Architects to meet the city's goal of LEED Gold Standard innovative green design with this project. "Rinks are difficult to 'green' because a significant amount of energy is needed to create and maintain ice while also keeping the arena temperature warm enough for spectators," Stephen Carpenter, Enermodal president, told Construction Canada Online. "However, the design team was able to reuse the heat generated during ice-making to radiantly heat the stands, as well as heat change rooms and indoor water."

The building's unique HVAC system also uses this waste heat to warm the facility, preheat water for ice resurfacing, and heat the snow melting pit—which helps offset the energy-intensive requirements of the ice rink. Expected to achieve a 72 per cent energy cost savings for approximately $125,000 per year, the facility includes other sustainable elements, such as: energy recovery ventilators (ERVs), occupancy sensors for lighting, energy-efficient lighting fixtures, carbon dioxide sensors for building ventilation and a reflective ceiling in the rink area to help keep the ice cool.

Additionally, the facility annually saves 1.2 million L (0.3 million gal) of potable water, due to low-flow fixtures, no-irrigation landscaping, and a 30-m3 cistern that provides water for ice resurfacing and toilet flushing. To top it all off, the sportsplex has a green roof. The building is sited on a decommissioned snow dump adjacent to a school, and a storm water retention pond has been provided on the site for controlling yearly melting of snow. The removal of snow and water retention is a very crucial issue with this site. These retention ponds inspired the redevelopment of the site as a natural park like setting. Through building materials and views within the facility gives the opportunity to bring nature into the arena.

Conserving the earth's precious resources starts with re-using and recycling resources already in use. At the Activa Sportsplex, over 24% of construction materials have high recycled content—over 1 million dollars in value. These materials include steel, concrete, concrete block, rebar, gypsum board, asphalt, masonry, millwork, and insulation (batt and foam).

When construction materials are from regional sources, the fuel and pollutant impacts of transporting materials are reduced, and the local economy is strengthened. The following materials are from within 800 km of the Sportsplex: asphalt, steel, concrete, concrete block, rebar, gypsum board, asphalt, and landscaping materials. These constitute about 47% of the materials used to construct the building.

Figure 46 - Interior view of arena (constructioncanada.net, 2008)

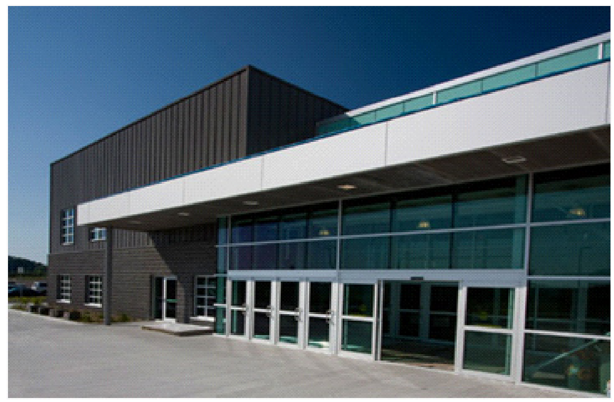


Figure 47 - Front entrance to sportsplex facility (constructioncanada.net, 2008)

Materials were left raw, reducing amount of heavy pigments and VOCS, and with light wall colours and materials combined with natural light reduces electrical requirements for lighting. Materials have highly recycled contents especially the main cladding concrete block and galvalume metal siding.

In addition the facility has shared amenity spaces by two organizations to maximize use of facility, as well as creating interactive and social gather spaces for members of the community to meet up and enjoy activities. The building is also set up as a complex with completes the areas an indoor and outdoor recreational facility, which was developed with community input. More than just an arena, this will be an outstanding community athletic complex that will serve the needs of participants in ice sports, summer indoor sports, boxing, as well as recreational walkers. By providing more recreational facilities for residents to use year round, the environmentally-friendly Activa Sportsplex helps the city to achieve its objectives of improving the quality of life for its residents and minimizing its carbon foot print on the environment.

Figure 48 - Green kiosk booths inside complex(constructioncanada.net, 2009)

Figure 49 - Interior arena view (constructioncanada.net, 2009)

What was learned?

Activa is a facility that thrives on energetic lifestyles of the young and old alike. Individual growth and skill development are encouraged through the various amenities offered, and a zest for life fills the building.

Sustainable building traits are important part in lowering operational costs of the facility. Measures such as local building materials, the use of day-light to minimize the use of electric powered lights, and the use of the landscape as part of the design to capture the thermal mass of the earth to reduce heat transfers were all integral parts of the design. Users of the facility have plenty of interaction and learning spaces within the facility, all which are used by large groups of individuals on regular basis creating a strong community presence.

Outcome of Study

From this investigation and lessons learnt when an independent consultant conducted an ice demand study for Kitchener he concluded the demand for ice time in the city exceeded the supply of rinks. A facility of this magnitude provides more recreational activity spaces for residents to use year round, and the environmentally-friendly facility helps the city to achieve its objectives of improving the quality of life for its residents and minimizing its carbon foot print on the environment, while producing a success product.

Figure 50 - Exterior facility view (constructioncanada.net, 2009)

Figure 51 - Night image view of front entrance (constructioncanada.net, 2009)

IV Angus Glen Community Centre: Markham Ontario

Purpose of Study

To review a facility which has a large amount of multi-purpose uses and programs plugged into it making it available to a large growing and diverse community. Through natural materials, natural lighting and other sustainable building traits this facility can be used as a model of energy efficiency, multiple programming and community engagement. This facility demonstrates how the way the building is programmed adapts to a changing community.

Building Profile

Building Name:	Angus Glenn Community Centre
Address:	3990 Major Mackenzie Drive E, Markham,
Architect:	Shore Tilbe Irwin & Partners, & Stafford Haensli Architects
Client:	City of Markham
Project Budget:	$42,000,000
Visitors:	25,000-30,000 per week
Completion Date:	April 2004

Figure 52 - Side entrance of Angus Glen Community Centre (D Panopoulos, 2009)

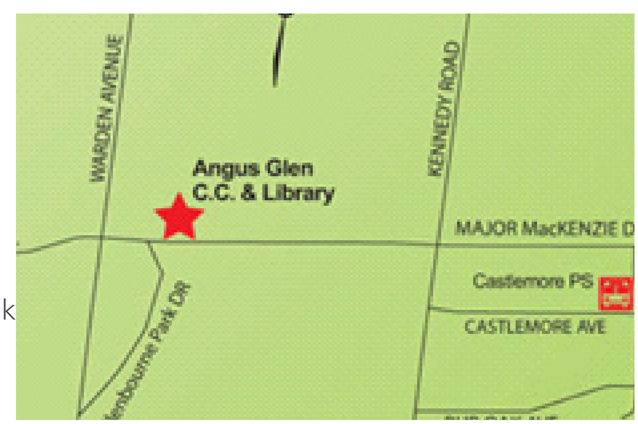


Figure 53 - Location map of facility (arenamaps.com, 2010)

Building Program

Facility: Located on the north side of Major Mackenzie Dr E, just east of Warden Avenue, the 160,000 sq. ft. complex was accepted by Markham Council in September 2001 and opened its' doors in two phases in October 2003 and January 2005.

Aquatic Centre/Pool: Includes a 25m Lane Pool with 6 lanes, a Leisure Tank and a Splash Pad. As well there are Female, Male and Family Change Rooms.

Arena: With (2) twin NHL ice pads, 85' wide by 200' long. Seating Capacity in both the East and West Rinks is 450. Each rink includes six dressing rooms (each with shower & washroom facilities) - two accessible dressing rooms - gondola, timekeepers boxes with music & PA capacities, and scoreboards. There's also a players lobby, vending, seating and a glass viewing lounge. Usage and ice availability is generally from September to May, but summer ice (in July & August) is available based on demand.

Gymnasium: The facility has a double gymnasium that can be used as one or divided into two. The full gym is 7000 sq.ft. And it can be divided into two equal portions of 3500 sq.ft. Court facilities include; one basketball court & two practice basketball courts, one tournament volleyball court & two practice volleyball courts, one tennis court and four badminton courts. Support facilities include; Female, Male & Family Change Rooms, Sound System/CD Player/PA capacity, six motorized basketball backboards, tennis supports & nets, badminton supports & nets, volleyball supports & nets and a scoreboard.

Meeting & Multi-Purpose Rooms: The building has multi-purpose rooms suitable for private functions, parties, receptions, meetings, seminars, etc. Rooms can accommodate from 24-180 people. There are also two small meeting rooms suitable for meetings or seminars, which can each accommodate a standard set-up up to 16 people.

Seniors & Youth: The facility includes dedicated areas for Seniors Activities and Youth Activities. The Seniors Centre has a large & open main area of 1073 sq. ft., an inner lounge area of 400 sq. ft. and a prep kitchen (with stove, fridge, microwave & dishwasher) of 150 sq. ft.

The facilities include; 10 card tables, 50 chairs and divider screens. Activities include; Line Dancing, Ballroom Dancing, Table Tennis, Card Games, Bingo and Socials. The Youth Centre has a main area of 1050 sq. ft. and a video lounge area of 369 sq. ft. The facilities include; a Billiards table, a Foose Ball table, Table Tennis, an Air Hockey table, a DVD/VCR unit, a large screen TV and sound system. (Canadian Wood Council, 2009)

Intended Users

Community of Markham Ontario and the rest of the general public in and around the Greater Toronto Region who wish to use any of the programming within the facility.

Sustainable Traits/ Technologies

Situated in Markham, Ontario, which is a fast-growing community with a burgeoning need for recreational facilities. To help meet this demand, the Angus Glen Community Centre and Library was designed to provide a first-class recreational experience for one area of Markham.

Official LEED certification was not sought after, but the facility was designed to meet client expectations for a low environmental footprint. The facility was oriented on purpose to use the sloping site to advantage. In the case of the arena, the topography was used to partly bury this element and use the thermal mass of the earth to reduce heat transfer. The site storm water management was attained through a sequence of tiered retaining ponds which will reduce the load on the public sewers. This has allowed for the natural creation of an attractive wetlands zone, which is developed along sitting areas and nature trails.

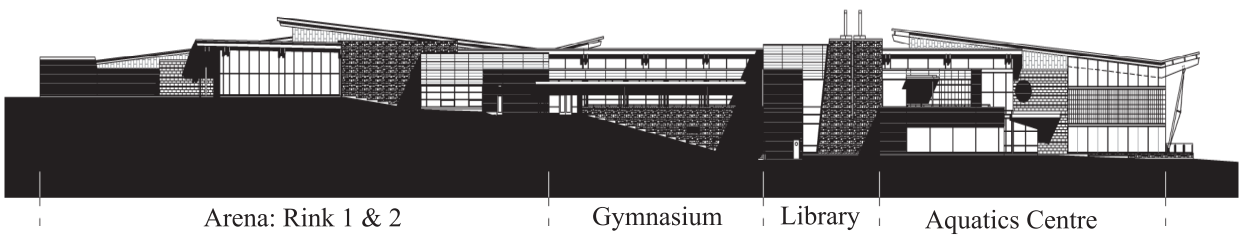


Figure 54 - South elevation of building demonstrating arena using thermal mass for energy storage (www.cwc.ca, 2009)

To maximize the day-lighting into the building, large areas of glazing in combination with translucent panels, window shades, bris-soleils and baffles are used, while providing control of glare into sensitive areas such as the Aquatics Centre and Library. This will significantly reduce the need for daytime lighting in these spaces. (Canadian Wood Council, 2009) And the use of wood was a significant feature in meeting the client's desire to obtain a building with a low environmental footprint. By using one of Canada's world leading forest certification and management practices, the use of wood products gives not only natural attributes, but is proven to outperform other building materials.

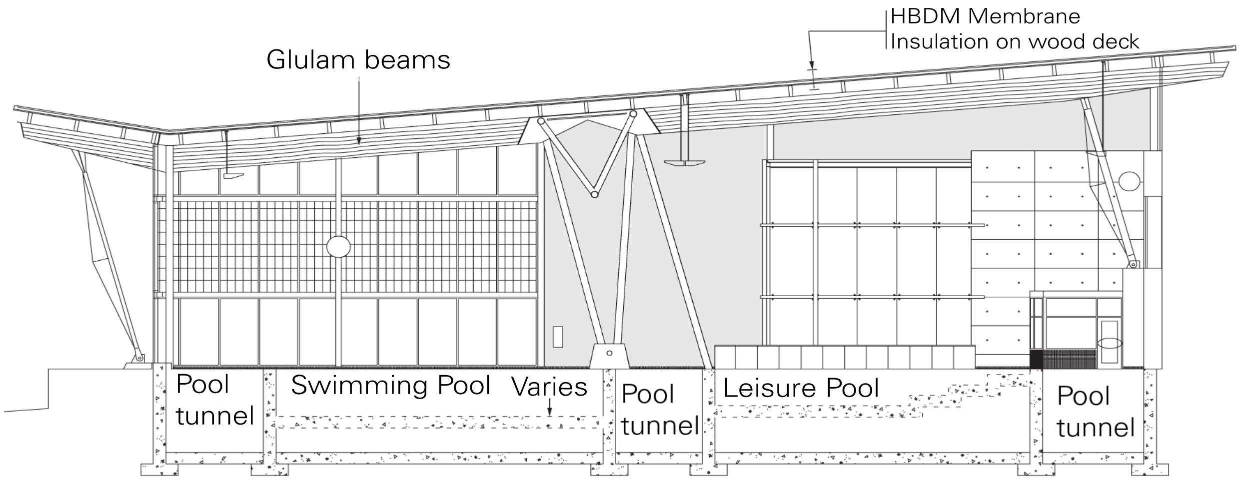


Figure 55 - Section through swimming pool showing sustainable wood roof construction (www.cwc.ca, 2009)

What was learned?

The Angus Glen Community Centre and Library has been a tremendous success for the Town of Markham. The recreation complex uses a variety of structural and decorative wood materials and natural materials to create a welcoming, attractive atmosphere. By creating a multi-purpose and multi-functional facility it satisfies the needs of a growing and multi-national community in which is serves. Sustainable building traits are important part in lowering operational costs of the facility. Measures such as local building materials, the use of day-light to minimize the use of electric powered lights, and the use of the landscape as part of the design to capture the thermal mass of the earth to reduce heat transfers were all integral parts of the design. Users of the facility have plenty of interaction and learning spaces within the facility, all which are used by large groups of individuals on regular basis creating community interaction and engagement.

Outcome of Study

From this investigation and lessons learnt this facility is an integral part of community interaction and serves as a destination point for the community on a regular basis. The inclusion of multi-functional spaces and program within a facility is very important for the success of a building of this type. The community of Markham and other communities in Toronto are in need for a facility of this type which will help serve the needs of a large spectrum of ethnicity and incomes. A facility of this scale can be seen an important learning tool for sustainability, community engagement and green technologies.

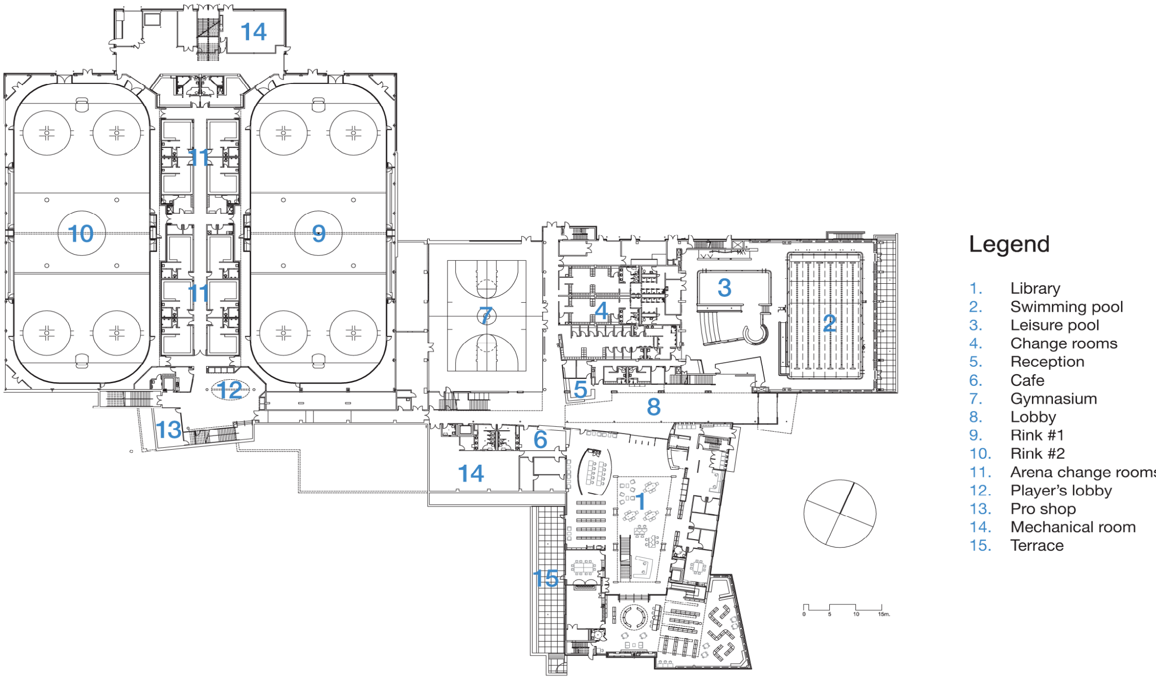


Figure 56 - Ground floor plan of facility (www.cwc.ca, 2009)

Figure 57 - View of library entrance (D. Panopoulos, 2009)

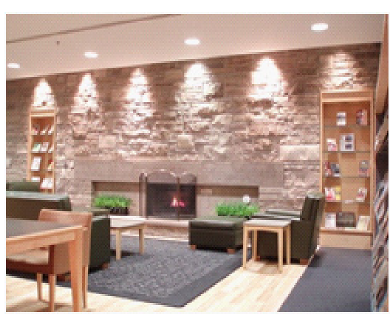


Figure 58 - View of Lounge (D. Panopoulos, 2009)

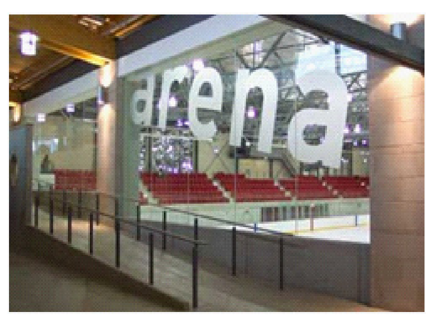


Figure 59 - View of Arena (D. Panopoulos, 2009)

V K-Rock Centre: Kingston Ontario

Purpose of Study

To investigate the first LEED (Silver Rating) Certified Hockey Arena in Canada. As well to study the building program of the facility which incorporates hockey, the conversion of the arena to basketball and concerts as well as many other multi-functional and multi-use program spaces. The building housing a group of organizations which share and use the facility, as well sustainable arena building traits which lower operational costs, will be dually noted.

Building Profile

Building Name:	K- Rock Centre
Address:	1 Barrack Street Suite 300 Kingston, Ontario
Architect:	Brisbin Brook Beynon Architects
Client:	City of Kingston
Project Budget:	$46.5 million
Annual Operating budget:	$684,000
Annual Revenue:	$124,163
Visitors:	Fluctuates
Completion Date:	February 2008

Figure 60 - Front entrance of K Rock Centre (BBB Architects, 2008)

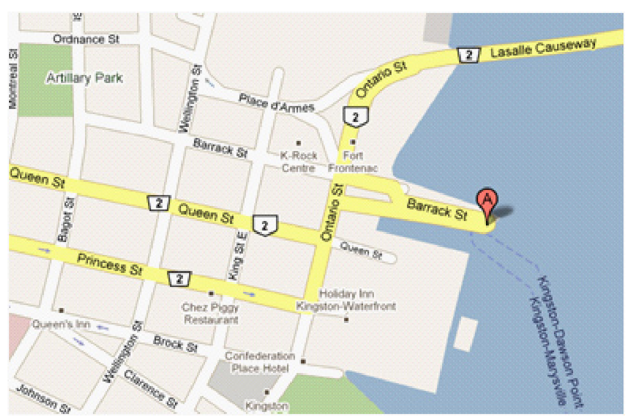


Figure 61 - Location of arena (Google Maps, 2009)

Intended Users/ Building Program

This high-tech facility will be used for Ontario Hockey League hockey games and tournaments, concerts, figure skating, conferences, trade shows and other community events. It will be the new home for the Ontario Hockey League's Kingston Frontenacs. This spectator arena will accommodate 5,000 people (6,800 for concerts) and will also include private suites, club seats, concessions and a restaurant. On the concourse level, there will be Kingston and District Sports Hall of Fame exhibits, a sports café and retail space, all with access from the street or within the facility. (Acturus SMG Canada, 2009)

Multi Functional Option Layouts

The facilities surface is multi-functional to meet the needs of the above mentioned intended users. Ice surface can be covered with rubberized flooring material, to accommodate new use, end seats can fold in to give my floor space and hockey rink boards are quickly demountable to give add to the floor space as well.

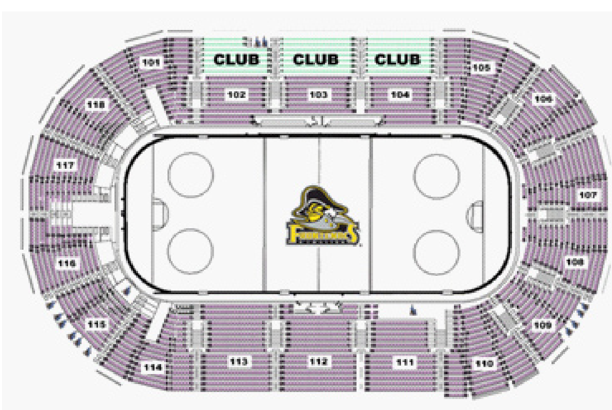


Figure 62 - Hockey arena layout (www.k-rockcentre.com, 2009)

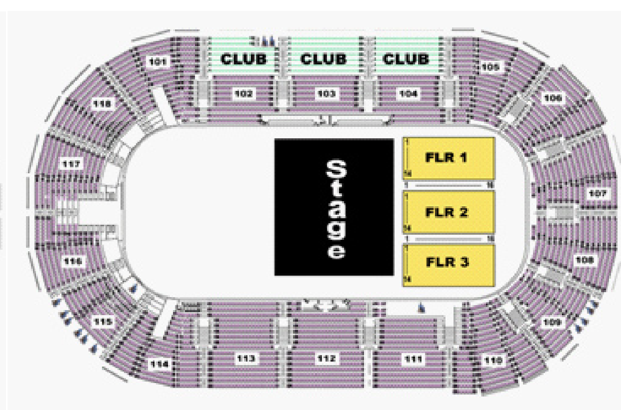


Figure 63 - Theatre play arena layout (www.k-rockcentre.com, 2009)

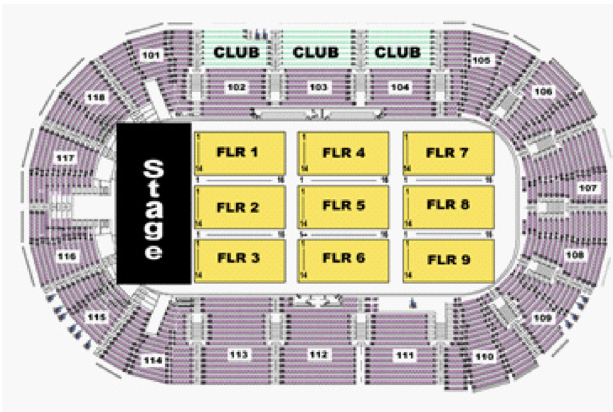


Figure 64 - Concert arena layout
(www.k-rockcentre.com, 2009)

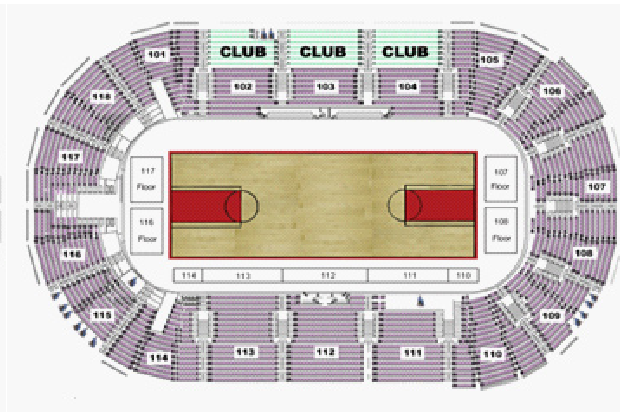


Figure 65 - Basketball arena layout
(www.k-rockcentre.com, 2009)

Sustainable Traits/ Technologies

The environmental and financial sustainability of this centre had been integrated into the facility itself. The facility was designed with LEED certification in mind and has achieved the LEED Silver Rating.

The building is situated on a past brown site, and with dispersed parking and the incorporation of bike racks positioned around the facility the encouragement of alternative means of transportation is a stressed upon idea. The facility uses eco-friendly furniture as well as, recycling room, and uses green housekeeping products as part of the maintenance of the facility to secure a high environmental rating of the building. Visitors and residents are able to acquire information on all LEED credits achieved inside the Centre through an interactive booth installed on the main floor.

A total of $1.2 million has been devoted to securing this level of environmental design to offer leadership by example to other such amenities across the nation. Under the certification program, the buildings meet prerequisites and earn credits in a number of categories, including: Sustainable sites, water efficiency (water reduction technology in washrooms), energy and atmosphere, materials and resources, indoor environmental quality, and innovation & design process. Most of the credits are performance-based, which means that they measure the degree of improvement relative to a recognized standard. (Acturus SMG Canada, 2009)

New municipality facilities, like this centre, are planned to attain at least a LEED Silver rating, now-a-days and can expect significant savings in energy costs. The official adoption of the LEED approach is an integral part on putting the city of Kingston on the leading-edge of sustainable developments. This will ensures that new City buildings maximize energy efficiency, provide the uppermost quality of internal working environment and diminish any building's burden on the natural environment and long-term operating budgets.

What was learned?

By incorporating sustainability traits to a facility of this magnitude will see the large operational costs ultimately lowered. Re-using an existing site and using environmentally friendly and local building materials is important for achieving new goals of LEED.
An arena facility can be used as a learning tool for a community giving them the opportunity and availability to investigate and do their own research into energy savings and sustainability. To get the full potential out of this facility, it has the opportunity to be flexible and change its physical state to meet the needs of other users. Also by incorporating other functions such as the Sports Hall of Fame and restaurant,

café and retail as part of the facility, not only attracts more users to the facility but creates social, economic and community interaction spaces. This is seen as an integral part of sustainability within the city of Kingston.

Outcome of Study

From the investigation and lessons learnt was the facility in a downtown core of a major city should be programmed with multi-functional and multi-use amenities and attributes. By having the ability to have flexible and interchangeable spaces more programs and events will be able to be used within it allowing the facility to expand it hours of operation.

To add, sustainability is an important characteristic of any arena facility design. This allows for cost savings and achieving environmental improvements, as well as creating an atmosphere of community interaction and community involvement. The overall depiction is creating a facility which is known as a LEED certified building in helping establish a community to be put on a map making it an important site for this new and respected designation. "Committing To Building 'Green' Going Forward"

Figure 66 - Entrance of arena on a concert night (tourism. kingstoncanada.com, 2009)

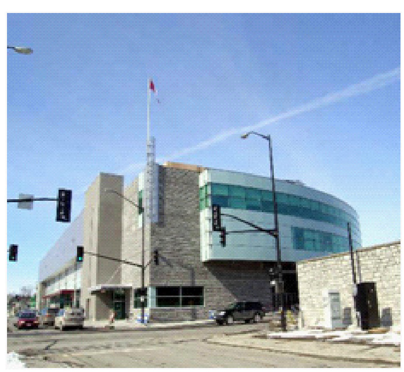


Figure 67- South East Arena Perspective (images.google.ca, 2009)

Figure 68 - Image on hockey night at facility (images.google.ca, 2009)

VI Consol Energy Centre Pittsburgh Pennsylvania

Purpose of Study

This arena concept is designed specifically for the NHL Pittsburgh Penguins, but flexible enough for other uses. The facility will integrate with the downtown cityscape, creating stunning views of the city and skyline. The design features local materials, chosen to be distinct from the adjacent church, rather than to diminish the history of the building. Integral to the overall design is the premise that the arena will assist in the ongoing revitalization efforts of the downtown Pittsburgh area, and also adding another building to one of the most green cities in the US.

Building Profile

Building Name:	Consol Energy Centre
Address:	5th Avenue Center Avenue & Washington Place, Pittsburgh PA
Architect:	Populous (formerly HOK Sport Venue Event)
Client:	Sports & Exhibition Authority of Pittsburgh and Allegheny County
Project Budget:	$355 Million
Completion Date:	Fall 2010

Figure 69 - Rendering of Consol Energy Centre (pittsburghpenguins.com, 2009)

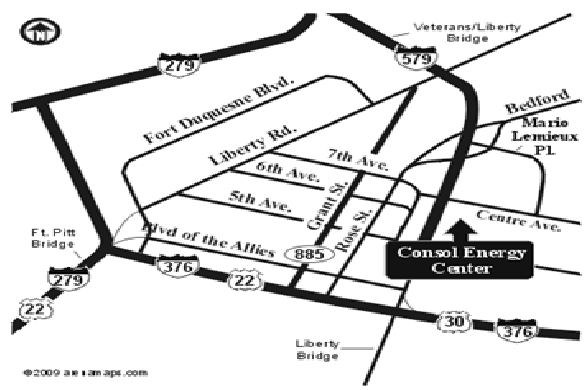


Figure 70 - Consol Energy Centre arena location map (arenamaps.com, 2009)

Building Program

- 710,000 Square Foot New Ice Hockey/multi-purpose arena
- 18,300 seats for hockey, 19,000 for basketball, 14,536 End Stage Concerts and 19,758 Boxing
- Concession concourse with open viewing to playing surface
- Private lounge and 2,000 box seats, 66 Luxury Suites
- The latest state-of-the-art sports venue technology.
- Premium seating and site lines
- Retail corridor

The arena will also include a concession concourse with open viewing to playing surface, private lounges and suites, premium seating, premium site lines and a retail corridor. (Pittsburgh Penguins, 2009)

Figure 71- Exterior Rendering of Arena (pittsburghpenguins.com, 2009)

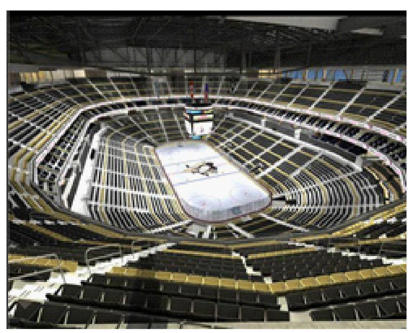


Figure 72 - Interior Rendering of arena surface (pittsburghpenguins.com, 2009)

Figure 73- Glass atrium along south side of building (pittsburghpenguins.com, 2009)

Intended Users

National Hockey League Pittsburgh Penguins, and with its capacity basketball, concerts and an assortment of other events, as well the arena will serve as the anchor of the urban redevelopment district.

Sustainable Traits/ Technologies

The arena will be LEED gold certified building which will be the only one of its kind in the NHL. (Pittsburgh Penguins, 2009) It will speak volumes to the rest of the country that Pittsburgh is continuously progressing as a city that invests a lot of money in environmentally sustainable polices which will reshape the steel industrial city it once was. The new Pittsburgh Arena will provide a brightly lit glass atrium along the Washington Place side of the building allowing patrons to view the city streetscape of downtown Pittsburgh and a spacious open concourse both which will bring in more natural light a key pointer for LEED ratings. The arena is also hoping to earn points for the amount of green space around the building, recycling, using materials bought locally for construction, the purchase of at least some electricity from "green" power sources, water management, indoor air quality, heating and cooling efficiency, and the selection of environmentally friendly paints. Many of the green features might not be readily obvious to fans and the public but they, too, will benefit from better air quality, improved heating and cooling, and other environmentally friendly aspects.

Community Sustainability

Integral to the overall design is the premise that the arena will assist in the ongoing revitalization efforts of the downtown Pittsburgh area. There is an office/housing/retail development estimated more than $500 million proposed across the street from the new arena. The development which included the demolishing of the existing arena includes a new hotel and city park. The development would provide 5,000 new jobs, housing for 2,500, at creates over $20 million in additional tax revenue. (Pittsburgh Penguins, 2009) The project would take at least 15 to 20 years to complete.

Figure 74 - Proposed master plan of existing arena and surrounding area (pittsburghpenguins.com, 2009)

This development would site on the 28 acres now occupied by the 42 year old arena and its surround parking lots. The site being near public transportation and being in proximity to the town it allows the opportunity to rebuild a piece of the city which was lost in the past. The new arena would be kick-starting the revitalization of the lower Hill District, (Figure 74) joining such major real estate investment as Duquesne's $50 million student center and the University of Pittsburgh Medical Center's plans to revitalize and ongoing resident growth of Crawford Square. (Pittsburgh Penguins, 2009) The new arena facility would also contain spaces which would provide the community with banquet space and room for three or four retailers in 13,500 square feet of space along the streetscape.

As the Penguins' new arena site steps closer to the University of Duquesne development there has been identified mutual growth which would support a new hotel. This construction by Horizon Properties is to build a 147-room hotel on the acre site next to the Consol Energy Centre. The hotel's design will seek to create pedestrian connections to the streetscape, creating momentum for development to carry forward. With the arena able to generate other events, will help bring more people to the area that would not be associated with hockey and add to the use of the hotel. These downtown projects, are seen as helping to expand Downtown toward the city's university district, bringing in more jobs and new housing, and new revenues which would revitalize a section of the city of Pittsburgh.

What was learned?

The Consol Energy Center would join 14 other buildings in Pittsburgh as gold-certified, which would put the city as one of the front running sustainable cities in North American. This will also make this arena as the first LEED gold certified facility in professional league in North America. This facility will integrate multi-functional programming and spaces which will allow the facility to expand it program and be available to multi user groups. The arena surface can be retrofitting allowing it to house other events and programs during a specified time frame. The facility has applied sustainable building technologies such as energy efficient items which will lower energy costs, natural lighting to minimize day-lighting, and increasing green space which allows for community interaction and engagement. The arena is part of a proposed downtown regeneration master plan.

The plan calls for a mix of housing and retail which will join the hockey arena facility to the redevelopment and expansion of the local university. To add to the master plan a large hotel will be built to meet the needs of travelling scholars of the university and visitors to the arena. The entire project is seen as a way of regenerating a community which was lost in the 1950's due to the current arena which exists there today. The original arena is located across the street from the new facility and is part of the master plan to be demolished and integrates new program.

Outcome of Study

From the investigation and lessons learnt is facility of this scale can be used as part of regeneration for a large downtown population of a major city. A smaller scaled facility of this type can be seen as a way to help regenerate a specific community within a city. The use of sports as a regeneration tool can be seen as a tool to help revitalize an entire area.

To meet the needs and to expand the use, an arena facility should have the opportunity to expand its program to other users to maximize its overall use. Having flexible spaces and flexible programming, which involves community interaction is the best tool of community regeneration and cohesion. And by equipping the building with green and cost saving technologies, users accessing the building will be able to afford it.

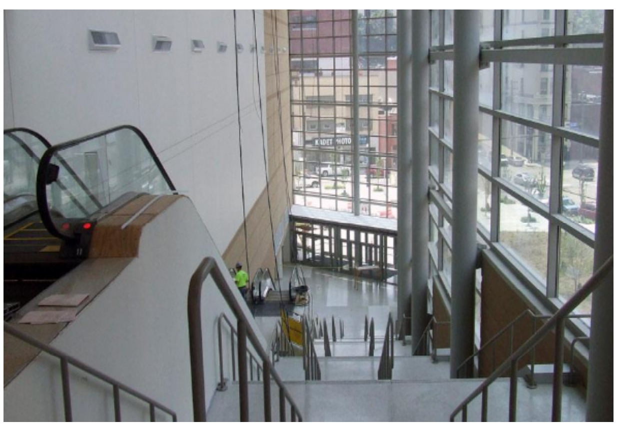


Figure 75 - Interior view of glass atrium (pittsbughpenguins.com, 2009)

Figure 76- Aerial view of new and old area location (pittsburghpenguins.com, 2009)

VII Downtown Toronto Arena Inventory Study

Purpose of Study

To investigate the status of the current inventory of hockey arenas in the downtown core in the city of Toronto. Eight arenas were investigated recording the date of building construction, location of project, building program, building structure, key energy uses and operational costs, usage of facility during year and during periods of day, additional project information and demographics of community location. This study will determine what is store for these facilities in the near future, and shows the need that a most sustainable approach for future designs.

Site Research

Project#	Facilities Investigated	Date of Construction	Location
1	Bill Bolton Arena	1972 – 37 years old	Dupont & Bathurst
2	East York Arena	1951 – 58 years old	Woodbine & Cosburn
3	Forest Hill Arena	1967 – 42 years old	Eglinton & Champlain
4	George Bell Arena	1961 – 48 years old	St Clair &Runnymede
5	McCormick Park Arena	1970 – 39 years old	Dundas & Dufferin
6	Moss Park	1975 – 34 years old	Queen &Sherbourne
7	North Toronto Arena	1965 – 43 years old	Younge & Eglinton
8	Ted Reeves Arena	1954 – 55 years old	Main & Gerrard

Outcome of Study: Average Age of facilities 44.5 years, which is 12.5 years beyond of life expectancy of 32 years as per guidelines provided by the Canadian National Arena Census. (Canadian Recreation Facilities Council, 2006)

Arena Building Program

#	Building Program of Facilities
1	Single ice surface with bleacher seating, six dressing rooms, concession stand with public restrooms and viewing area
2	Single ice surface, bleacher seating, ten dressing rooms in lower area, proshop
3	Single full ice surface with bleacher seating, single half practice rink, nine dressing rooms, pro shop, main office main lobby
4	Single ice surface with bleacher seating, six dressing rooms, concession stand with public restrooms and viewing area
5	Single full surface with bleacher seating, single half practice rink, six dressing rooms, pro shop, main office and lobby
6	Single ice surface, bleacher seating, six dressing rooms, proshop, & main office
7	Single ice surface with poured concrete seating, wood seats, six dressing rooms, pro shop, main office, board room (used by senior groups) and lobby, storage rooms, snack shop, ticket office
8	Single ice surface with bleacher seating, concession room, eight dressing rooms and meeting room

Outcome of Study: Average facility has a single ice surface with six dressing rooms, snack bar, pro shop, main office and multipurpose spaces. The fixed seated arenas host major junior Toronto hockey teams.

Arena Construction and Materials

#	Building Structure	Roof Structure
1	Construction: Brick, block and metal siding	Steel scissor roof truss and wood roof decking
2	Construction: Brick, block and metal siding	Steel scissor roof truss and steel roof decking
3	Construction: Steel post/beam, block & metal siding	Steel scissor roof truss and wood roof decking
4	Construction: Brick, block and metal siding	Steel scissor roof truss and wood roof decking
5	Construction: Steel post, block and metal siding	Arched steel roof truss and metal roof decking
6	Construction: Steel post, block and metal siding	Arched steel roof truss and metal roof decking
7	Construction: Concrete block and precast concrete	Wood beams and metal roof panels & wood post and beam decking
8	Construction: Concrete block &metal siding decking	Wood beams and wood roof and wood post and beam

Outcome of Study: Average facility is composed of brick and concrete block half wall and with metal siding for the remainder of the height. Roof structures were generally 16" steel scissor roof trusses with a mix of wood and steel roof decking. Flat roofs of existing arenas have been seen as a way of being used to collect solar energy which would help offset part of operational costs.

Facility Operational Times

#	Months	Day Usage and Hourly Usage Mon-Thurs 7am-3pm	4pm-12am	Fri-Sun 7am-3pm	4pm-12am
1	Sept-Aug	30%	100%	100%	100%
2	Sept-Apr	35%	100%	100%	100%
3	Sept-Aug	85%	100%	100%	100%
4	Sept-Apr	25%	100%	100%	100%
5	Sept-Apr	30%	100%	100%	100%
6	Sept-Aug	65%	100%	100%	100%
7	Sept-Apr	35%	100%	100%	100%
8	Sept-Apr	30%	100%	100%	100%

Outcome of Study: Majority of arenas operate from September to April, and operate on an average of 42% occupancy on Mondays to Thursday from 7am to 3pm, and the arenas operate at 100% on Mondays and Thursday after 4pm-12am and 100% on all hours on the weekend. Questions arise from these numbers in the sense of what other programming or activities can be used when hockey is not being played which will added to the overall use of the facility.

Key Building Energy Uses

#	Key Energy Uses in Building
1	Gas and electric heating systems, Cimco refrigeration systems, halogen lights on ice surface, fluorescent lights in locker rooms and common spaces, electric compressor, ammonia brine ice freezing system

2 Halogen lights, electrical and gas systems heat systems, Blanchard-ness ice refrigeration, boilers, Re-verber-ray Radiant ceiling heaters (in arena), forced air duct system in all common spaces and dressing rooms, ammonia brine ice freezing system

3 Halogen Lamp lighting, Refrigeration Systems, Boilers, Electric and gas powered furnace in common areas and dressing room Ice Surface: Ammonia Freezing. Cimico Air Refrigeration Systems

4 Halogen Lamp lighting, Refrigeration Systems, Boilers, Electric and gas powered furnace in common areas and dressing room Ice Surface: Ammonia Freezing. Cimico Air Refrigeration Systems

5 Halogen Lamp lighting, Refrigeration Systems, Boilers, Electric and gas heating Gas powered furnace in common areas and dressing room Ice Surface: Ammonia Freezing. Cimico Air Refrigeration Systems

6 Fluorescent tube lighting, Refrigeration Systems, Boilers, Electric and gas powered furnace in common areas and dressing room Ice Surface: Ammonia Freezing. Cimico Air Refrigeration Systems

7 Halogen lighting, Refrigeration Systems, Boilers, Electric and gas powered furnace in common areas and dressing room as well as electric heaters Ice Surface: Ammonia Freezing. Cimico Air Refrigeration Systems

8 Electrical and Gas and sump pump system. Electrical hanging space heaters in arena, baseboard heating in common areas, Halogen Flood Lights, Ice Refrigeration, boilers Electrical heating in all spaces Ice Surface Ammonia freezing, Cimico Air Refrigeration

Arena Operational Costs

#	Yearly Operational Costs
1	$333,860
2	$350,500
3	$420,841
4	$234,221
5	$291,325
6	$310,890
7	$349,676
8	$342,624

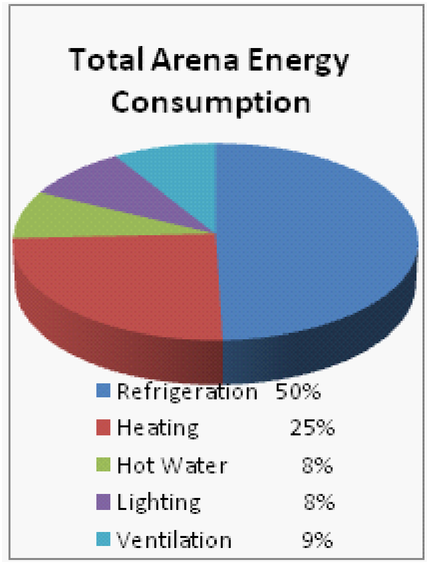


Figure 77 - City of Toronto Hockey arena's energy consumption - modified chart (Ministry of Natural Resources Canada, 2003)

Outcome of Study: Average year operation costs to run a single rink facility in the downtown Toronto core is $291,742 with 50% expenditures on refrigeration, 25% on heating, 8% on hot water, 9% on ventilation and 8% on lighting. Minimal costs saving measures are currently being implemented by the city of Toronto to trim operational costs. For example occupancy sensors have been applied to existing lighting systems, which will all for shutoffs to occur, but due to new and old technologies coexisting many problems have occurred.

Additional Arena Observations

#	Additional Observations
1	Surrounding amenities: Bocce Pits, park land, Primary Catholic School, day-care and playground, propane powered zamboni. Cost Saving Measures: Occupant sensors, Low E Ceiling, rain water collection

2 Surrounding amenities: Public Park with baseball diamonds and outdoor pool. Arena snow dumping at rear of building, and propane zamboni used. Cost saving measures: Natural day lighting in lobby spaces, Optimara Sensor System for energy consumption

3 Surrounding amenities: Arena next to elementary school, Public Park with soccer/ football field and 2 baseball diamonds. Snow Removal at rear, propane powered zamboni. Cost saving measures: Occupant sensors, natural diffused day lightning, glass block into dressing room spaces and low E ceiling

4 Surrounding amenities: Public Park and playground. Arena Snow dumping at rear, propane zamboni. Cost saving measures: Occupancy sensors

5 Surrounding amenities: Arena next to community centre with offices, meeting spaces and day-care, ball diamond, basketball court and playground all on premises, snow removal at rear and propane powered zamboni. Cost saving measures: Occupant sensors and low E ceiling

6 Surrounding amenities: Arena next to community centre, Public Park, baseball diamond, basketball court and tennis court, snow removal at rear, propane powered zamboni, adjacent to Canadian Armory. Cost saving measures: Occupant sensors

7 Surrounding amenities: Arena in ravine equipped with community rooms, community garden, outdoor hockey rink/tennis court, soccer fields, ball diamonds and playground, snow removal at rear, and propane powered zamboni. Cost saving measures: Occupant sensors, washroom fixture sensors, low E ceiling, and natural lighting in lobby (diffused)

8 Surrounding amenities: Temporary sports training dome attached to arena,

Children's playground and 2 baseball diamonds on premises, snow removal dumped in parking lot and zamboni runs on propane system. Cost saving measures: Occupancy sensors

Community Demographics of Arenas

#	Area Demographics
1	40% family income over $100,000
2	Mixed family incomes across the board
3	40% family income over $100,000
4	31% family income over $100,000
5	14%-20% of family income between $20,000 - $100,000
6	20% family income over $100,000, low income across the board
7	40% family income over $100,000
8	Mixed family incomes across the board

Conclusion to Arena Study

From this investigation learned was that the average age of the hockey arena facilities in the downtown core of Toronto is Average Age 44.5 years. The life expectancy of 32 years is the suggest age before a major amount of capital repairs are required. Majority of arenas operate from September to April, and operate on an average of 42% occupancy on Mondays to Thursday from 7am to 3pm, and the arenas operate at 100% on Mondays and Thursday after 4pm-12am and 100% on all hours on the weekend.

On average a facility has a single ice surface with six dressing rooms, snack bar, pro shop, main office and multipurpose spaces and the construction is composed of brick and concrete block half wall and with metal siding for the remainder of the height. Roof structures were generally 16" steel scissor roof trusses with a mix of wood and steel roof decking. Average yearly operational costs to run a single rink facility in the downtown Toronto core is $291,742 with 50% expenditures on refrigeration, 25% on heating, 8% on hot water, 9% on ventilation and 8% on lighting.

Outcome of Study

From was the lesson learnt rinks in the downtown core in Toronto, are beyond their prime, and eventually will need to be replaced in the very new future. A lot of them may need to be replaced all at one time, leaving users without ice time. Arenas current operate at only 42% full capacity during the day from Monday to Thursday so these buildings required programming to be filled during no peak hours to make up operational costs. From the study on the operational costs, alternative measures and methods of refrigeration, heating, ventilation and lighting can be explored to help lower theses costs, all in turn making the facility affordable to be run and to be used to its maximum potential by the public.

Figure 78- Bill Bolton Arena entrance (D. Panopoulos, 2009)

Figure 79 – East York Arena entrance (D. Panopoulos)

Figure 80 - North Toronto Arena entrance (D. Panopoulos, 2009)

Figure 81 – Forest Hill Arena entrance (D. Panopoulos, 2009)

Figure 82 - McCormick Park Arena entrance (D. Panopoulos, 2009

Figure 83 – Ted Reeves Arena entrance (D. Panopoulos, 2009)

Figure 84 – George Bell Arena entrance (D. Panopoulos, 2009)

Figure 85 – Moss Park Arena entrance (D. Panopoulos, 2009)

4.0 DESIGN PROPOSAL

4.1 Design Problem

Discovered from the literatures and from the case studies as designers we gained an understanding of what issues face the arena today. We have learned that arenas are currently not engaging all members of the community, lack sustainable technological building traits and are costly to maintain and repair. The arena offer nothing other then hockey to a community. These problems which face the arena can be summarized through the diagram of the three pillars of sustainability - social, environmental and economic.

Arenas of the past and present have been viewed and studied from numerous case studies and as a designer we have learned how arenas have changed, what arenas needs have changed, how communities have changed and what specific items need to be address to meet these changes.

From the entire research as a designer we can ask the question of, "What kind of design proposal will address the issues that current press on the arena and how can we solve them to provide for sustainable future"?

Through a sustainable design response can the arena be re-established as a focal point of a community, one in which provides necessary interactive and engaging spaces, which are not only beneficial to a specific user group but provides needs to an entire community as a whole?

4.2 Design Response

Through implementing a sustainable design scheme which challenges and addresses the three pillars of sustainability of the arena, and by implementing and testing the design proposal on a specific site as a designer we are able to address the needs and desires of a community, thus making for a successful project.

The arena's reconsideration will challenge and revise the building program which currently exists, and also focus on addressing the needs of the surrounding community. By doing this, concrete spaces which once existed inside of the arena will become flexible and multi-purposeful spaces, giving the opportunity to change with the desire of the user. Issues such as operational technologies and fees will be viewed and dealt with through sustainable green products, cutting user fees, while reducing the environmental impact the arena creates.

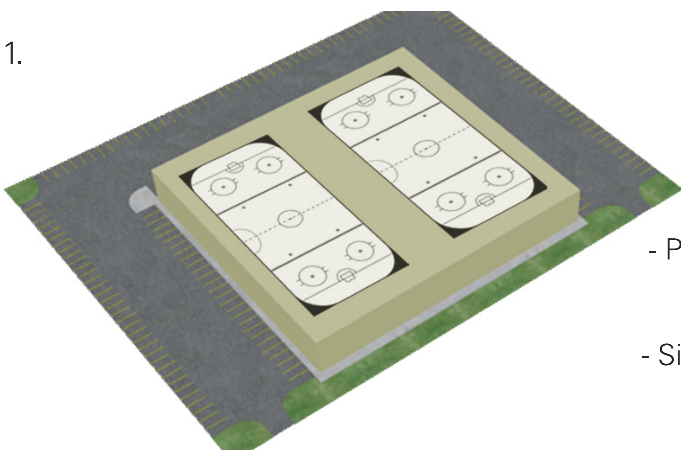
Additional issues such as building and user integration, the review and proposal on new building structure and materials, addressing the need of transparency to and from the street, and from the implementation of multi-layering building program will be examined not only to increase the usage of the building but will help create new and innovative public and private spaces which never occurred in the arena. Ultimately the redesign of the arena will provide a new and sustainable building type for communities, one on which can be used as a learning tool for any public and private building; this one happens to house our national past time, hockey.

4.3 Conceptual Work

Arena Conceptualization: Before reconsidering the way the arena is design an investigation must be made to understand how the building may be conceptualized. This investigation has been set up to illustrate the orientation of the building in regards to best serve the users in the community and maximize the amount of interaction and engagement spaces in the building, around the building and with the environment.

To begin after the initial research it was discovered that a minimum of a twin arena facility would be the best possible solution to part of solving the problem of arena design, due to the current state of the buildings which exist in the city as well of meeting the demands of ice time which is need. From viewing the way a typical twin pad in orientated on a site we get an understanding of how much volume is needed on a site (1).

1.



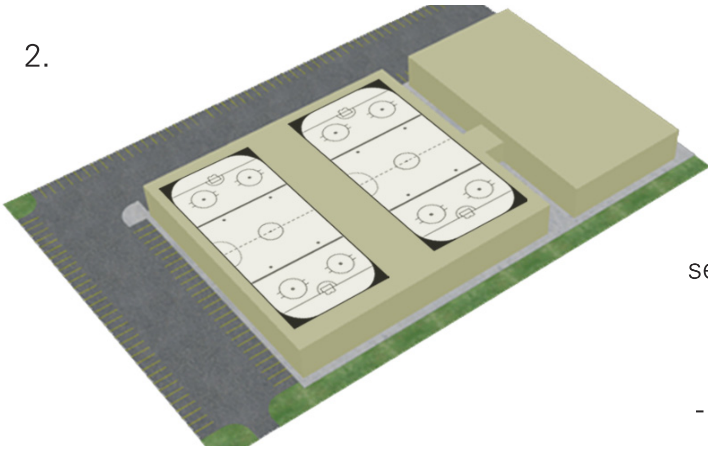
Typical Twin Pad Arena

- Program is arena related only (ice surfaces, dressing rooms)

- Size of facility is ideal to meet the need and demand of the city

To increase the usage of the facility to other means of engagement a community component can be added to the building, which expands the role of the building while providing additional program space and expands the user groups of the building(2). Discovered once the community component was integrated within the building it increases the amount of interactive and engaging spaces but also increases the amount of built volume on a site(3).

2.



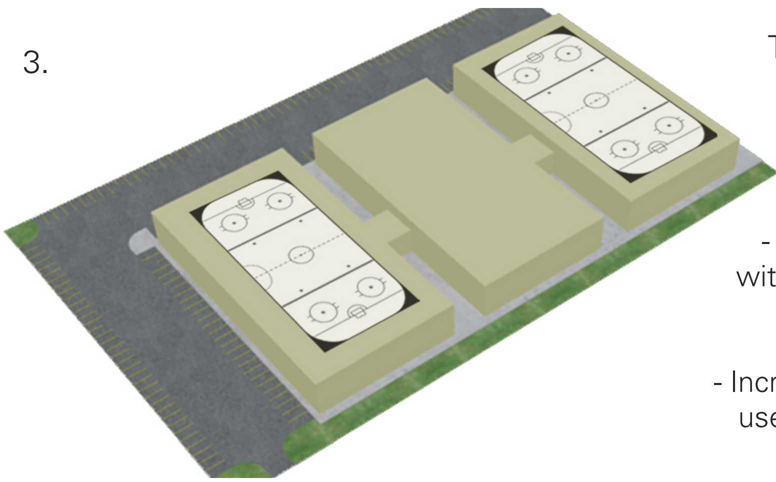
Twin Pad Arena with/ community

- Community component added as a separate component to twin arena facility

- Expands user groups within building

- Provides additional program and spaces

3.



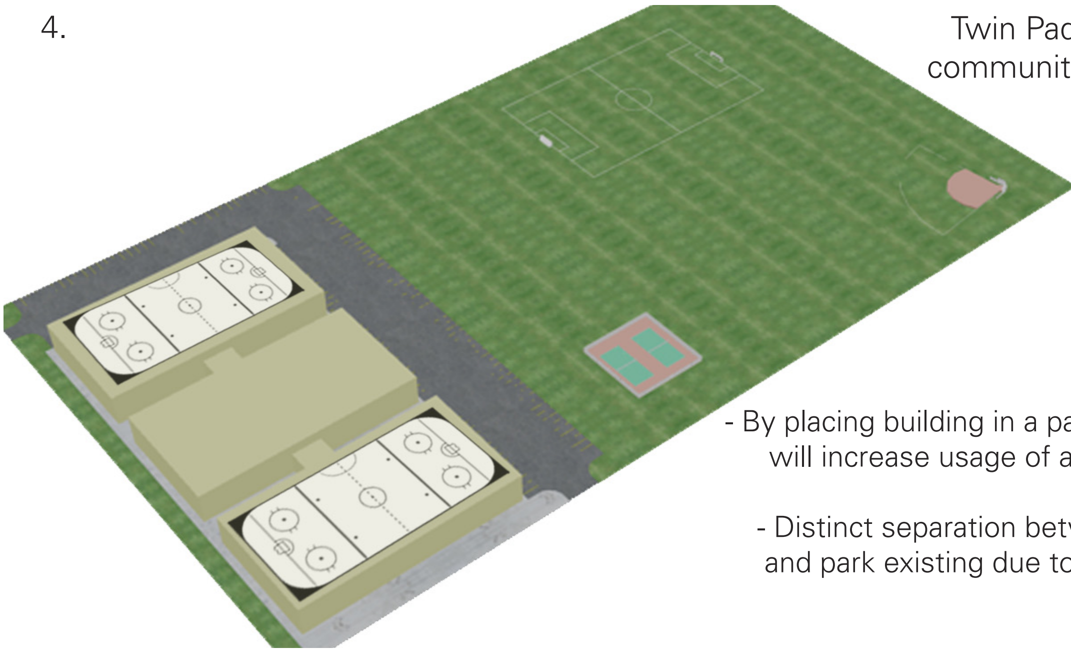
Twin Pad Arena with/community integrated

- Community component integrated within twin arena facility to engage all users within same complex

- Increase usage of facility and engages users with all aspects of program and building space

To locate a building of this type onto a site which would best serve a community which allows for maximum usage as well as expanding the role of the building is to situate it within a park like setting, which is generally located within the centre of a larger community(4). By reducing the building footprint and incorporated flexible and multi-purpose spaces which are able to change to serve more than one purpose more of the parkland can be made available to the community while still maintaining the purpose of the building as well as the park(5).

4.



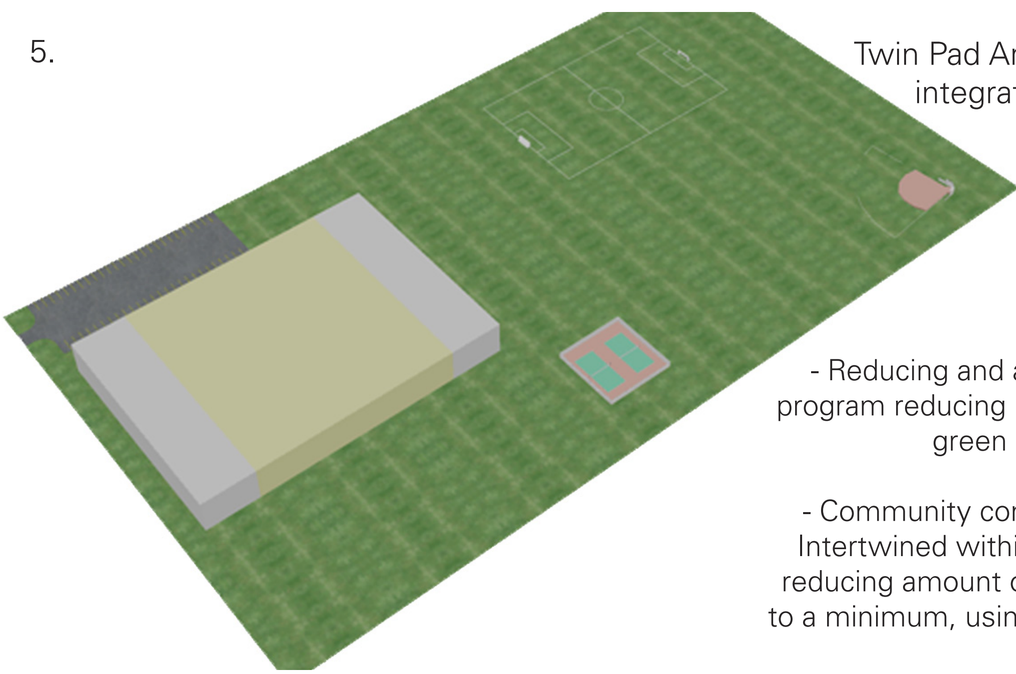
Twin Pad Arena with/
community integrated,
park setting

- By placing building in a park like setting will increase usage of arena and park

- Distinct separation between building and park existing due to large parking surface area

As the investigation continues it is discovered that the building can actually be part of the site to maximize the building area as well as maximizing the amount of user space on the site(6). The building could actually be used as a layering of program which connects users two and from the community as well as two and from the park(7) the best response.

5.

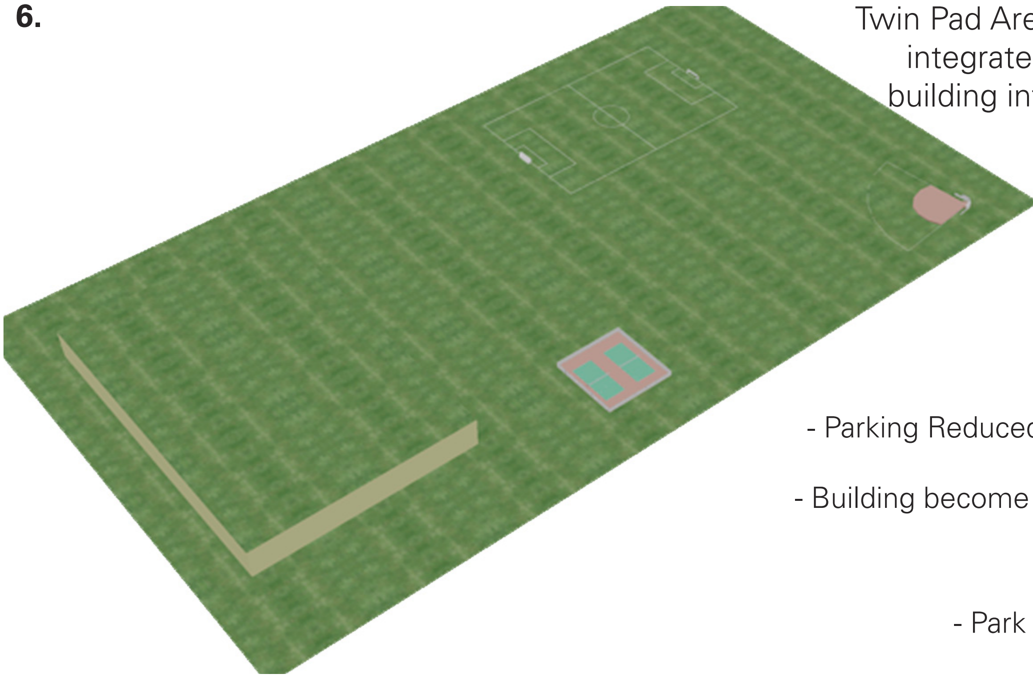


Twin Pad Arena community
integrated, park setting

- Reducing and arranging building program reducing building footprint, green spaced increased

- Community component become Intertwined within arena complex, reducing amount of surface parking to a minimum, using public street as parking overflow

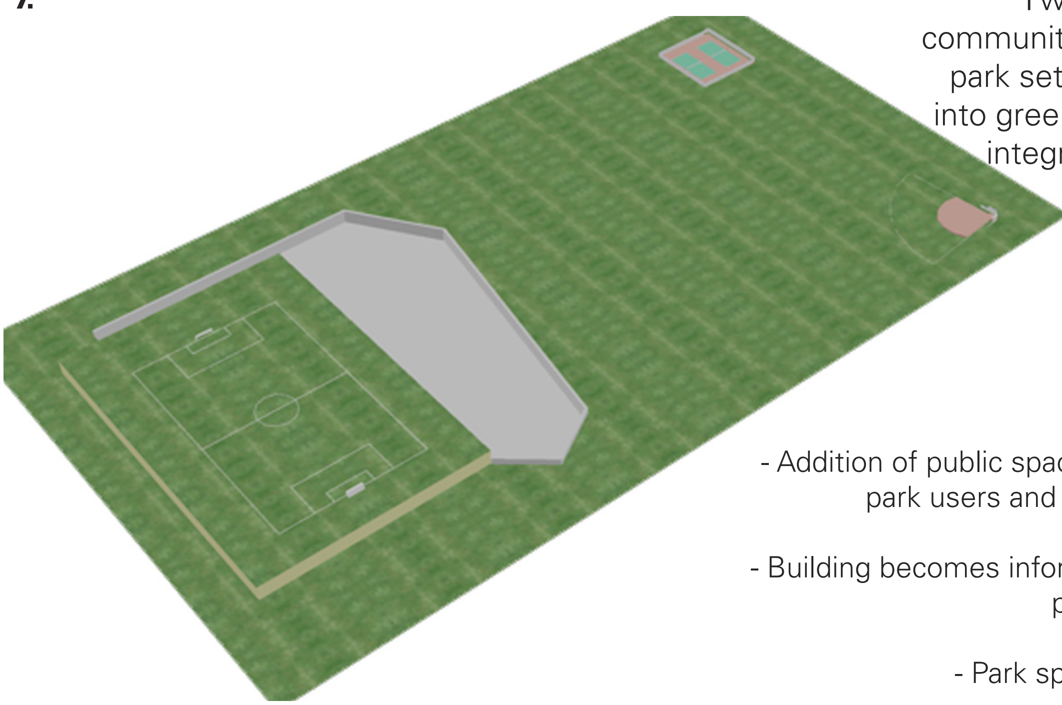
6.



Twin Pad Arena community integrated, park setting, building into green space

- Parking Reduced entirely off site
- Building become additional green space
- Park space increased

7.



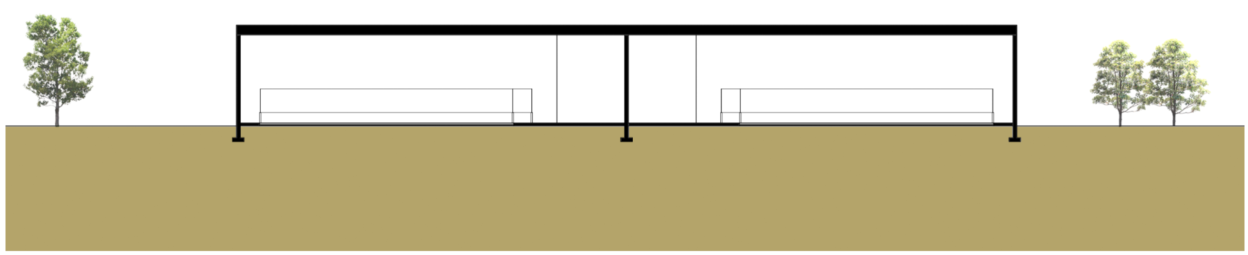
Twin Pad Arena community integrated, park setting, building into green play space, integrate with site

- Addition of public space to integrate park users and building users
- Building becomes informal additional program space
- Park space increased

Building Section Conceptualization

In additional to building orientation on a site, investigated is how this building could respond in section. From viewing six very different orientations of two rinks above grade, below grade, layer building services, to partially burying the building each presents positive and negative attributes which will provide beneficial traits to make for a successful project. From this test it was discovered that a building which is partially submerged into the terrain would be the best possible solution and is noted in the end summary due to the positive vs negative attributes.

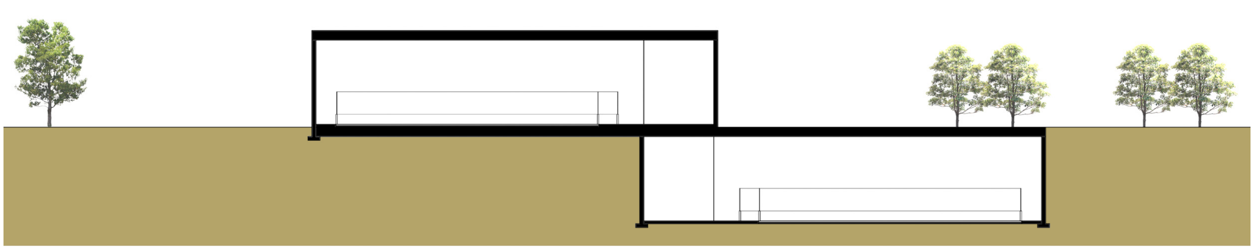
1.



Typical Rink Construction

This scheme allows for the possibility of providing sustainable building traits which will minimize environmental impacts as well as provide beneficial cost saving energy efficient approaches such as offsetting heating costs from thermal mass of the earth, solar collection on roof surfaces and reducing the heat island effects with the possibility of a green roof.

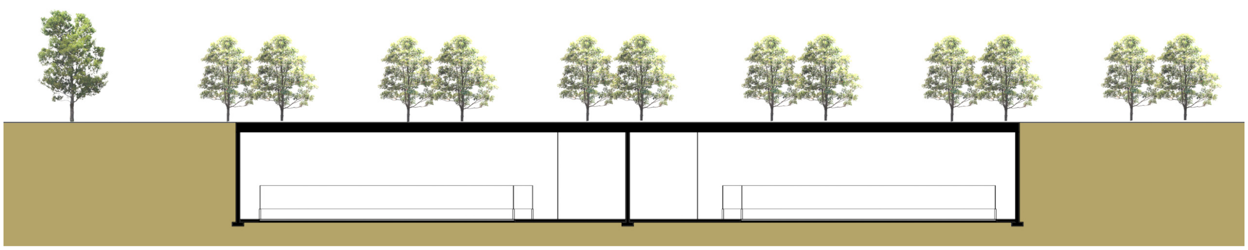
2.



Overlapping Service Spaces

From the building plan and section analysis and from choosing the best possible response, issues of increasing building and user engagement can be investigated. This conceptual analysis will demonstrate how the building has the opportunity to increase its usage as well as creating additional interactive spaces thus expanding the role and program of the building.

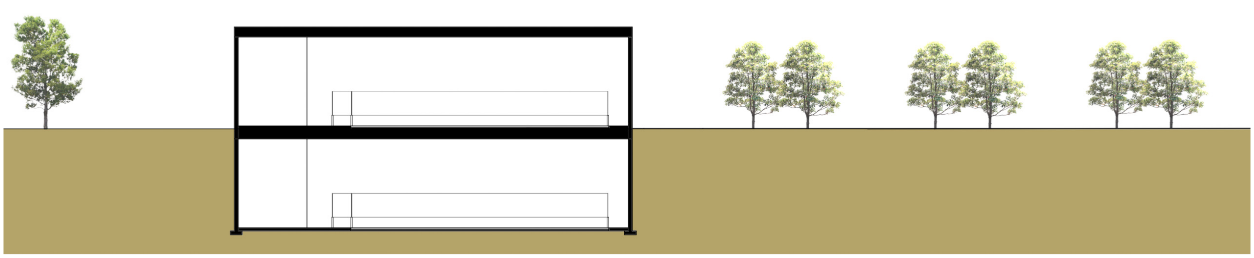
3.



Building Full Submerged

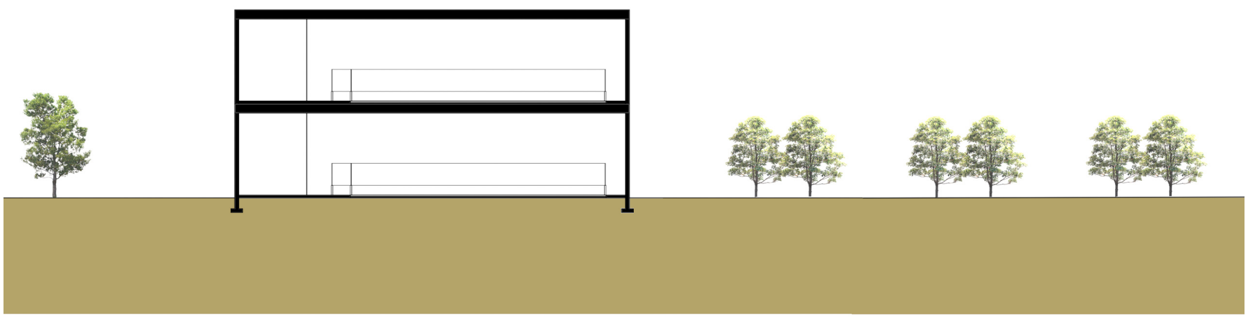
Discovered is that from having the design scheme partially buried the building creates direct and indirect views to users inside and outside of the building, allowing for glimpses of activities taking place from all views around the site. It also allows for the building to create direct and indirect contact with the natural environment and capturing cost saving operational costs such as natural light, energy collection and heat absorption and reduction.

4.



Stacked Rink Concept Below Grade

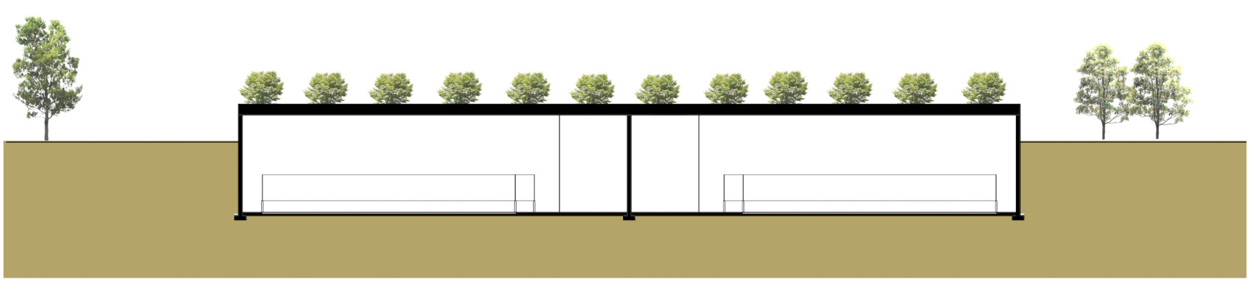
5.



Stacked Rink Concept Above Grade

This study also demonstrates how the building can potentially become part of a multi-layering process of activities which not only increases building usage but creates additional areas of contact and interaction between different user groups within a community. Users around the site can access the building at all hours of the day whether it is in the controlled environment interior or on the roof and site surface at their own leisure.

6.



Partially Building Submerged

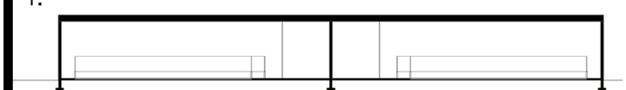
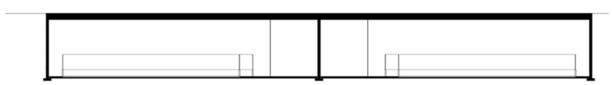
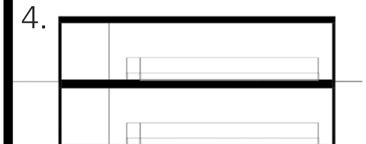
This demonstrates that the building can be more than just a standalone building type which is a single volume that occupies a large area of space, but actually is integrated into the site.

Design interpretations can start to be generated from these studies demonstrating how the building can be arranged or designed according to the site. This exploration gives you as a designer an idea about how the building can become part of the landscape above and below grade and can become any shape or size to fully capture all of the possibilities of a site no matter the location.

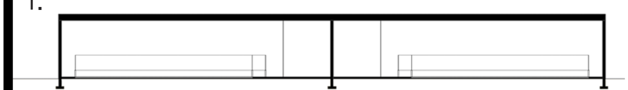
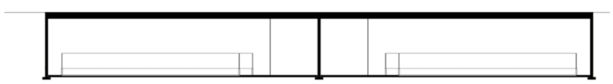
From this exploration through the testing of these design schemes, orientations as well as building interactive spaces can be applied to a chosen site. The chosen site to test this method of building redesign and reconsideration and is discussed in Chapter 4.4 is Moss Park which is in the city of Toronto.

The proceeding two pages summarizes and outline all of the positive and negative attributes leading to the final choice of building section orientation chosen. Chosen was orientation number six which provides ample opportunity to create a successful sustainable project.

Conceptual Arena Sections Summary

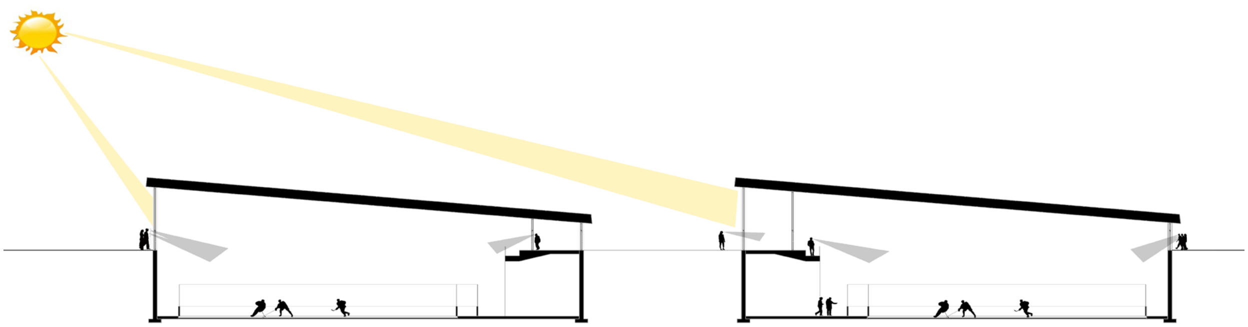
ORIENTATION	POSITIVE ATTRIBUTES
1. 	- Ease of access - Large roof spaces for energy collection - Ease of construction
2. 	- Increased green and roof space - Sustainable technologies available - Reduced building footprint
3. 	- Building removed from site - Sustainable technologies available - Increase green and park space - additional program space
4. 	- Reduced building footprint - Sustainable technologies available
5. 	- Reduced building footprint - Sustainable technologies available
6. 	- Sustainable technologies available - Direct & Indirect engagement - Increase green space & program space - Access at grade, roof, below - Indoor and outdoor building space

Conceptual Arena Sections Summary

ORIENTATION	NEGATIVE ATTRIBUTES
1. 	- Large surface area - Loss of park/ green space
2. 	- Building access below grade - Removal of site material
3. 	- Building access from grade N/A - Lack of interaction between user and building
4. 	- Building access below grade - Removal of site material
5. 	- Access of building above grade - Shadows and uninviting dark spaces
6. 	- Removal of site material

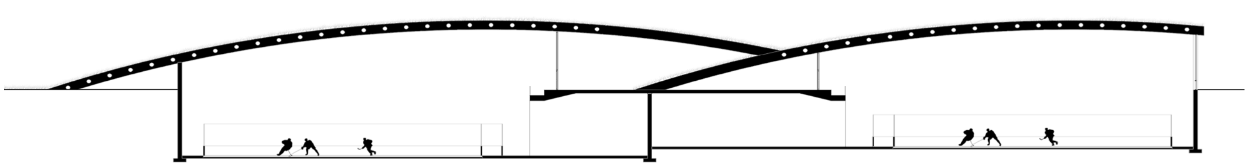
Building as Engagement

Following with the selection of the building section which is partially integrated into the site various studies have been made to the building section to address the issue of the building as engagement, an important trait to sustainability.



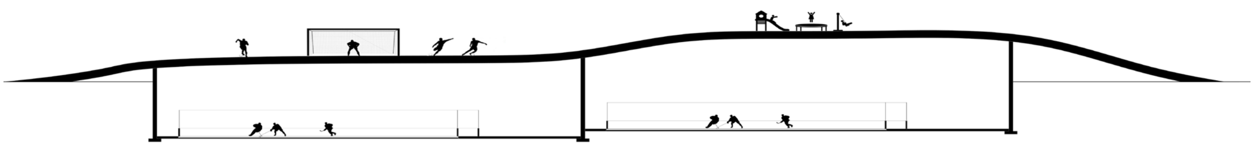
Building creates direct & indirect views with users and to environment

Analyzing how the building can create direct and indirection views with users and with the environment could provide beneficial building traits. By increasing the transparency to the building it can capture and use sustainable technological traits such as solar energy, direct and indirect day lighting in spaces. All of these are proven to trim energy costs as well as make public spaces viewable to all, creating new points of interaction and engagement.



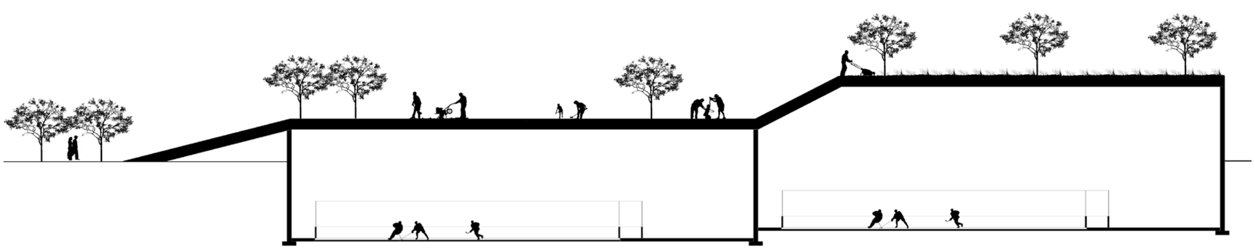
Landscape becoming part of building

The landscape of the building in this design scheme above has the opportunity to create new interior and exterior public and private spaces. This scheme also provides a sustainable trait in a green roof technology which could reduce heat loss. The roof can become a productive grow and play space as well a create indoor and outdoor green spaces throughout the building.



Building As Multi-Functional Sports Interior And Exterior

The building section above demonstrates an opportunity to expand its program into a multi-layer scheme. Due to the fact that the chosen building scheme is partially integrated into the site, activity can take below grade as well as above. Outdoor sports as well as play spaces can be incorporated into the scheme to maximize the buildings usage.



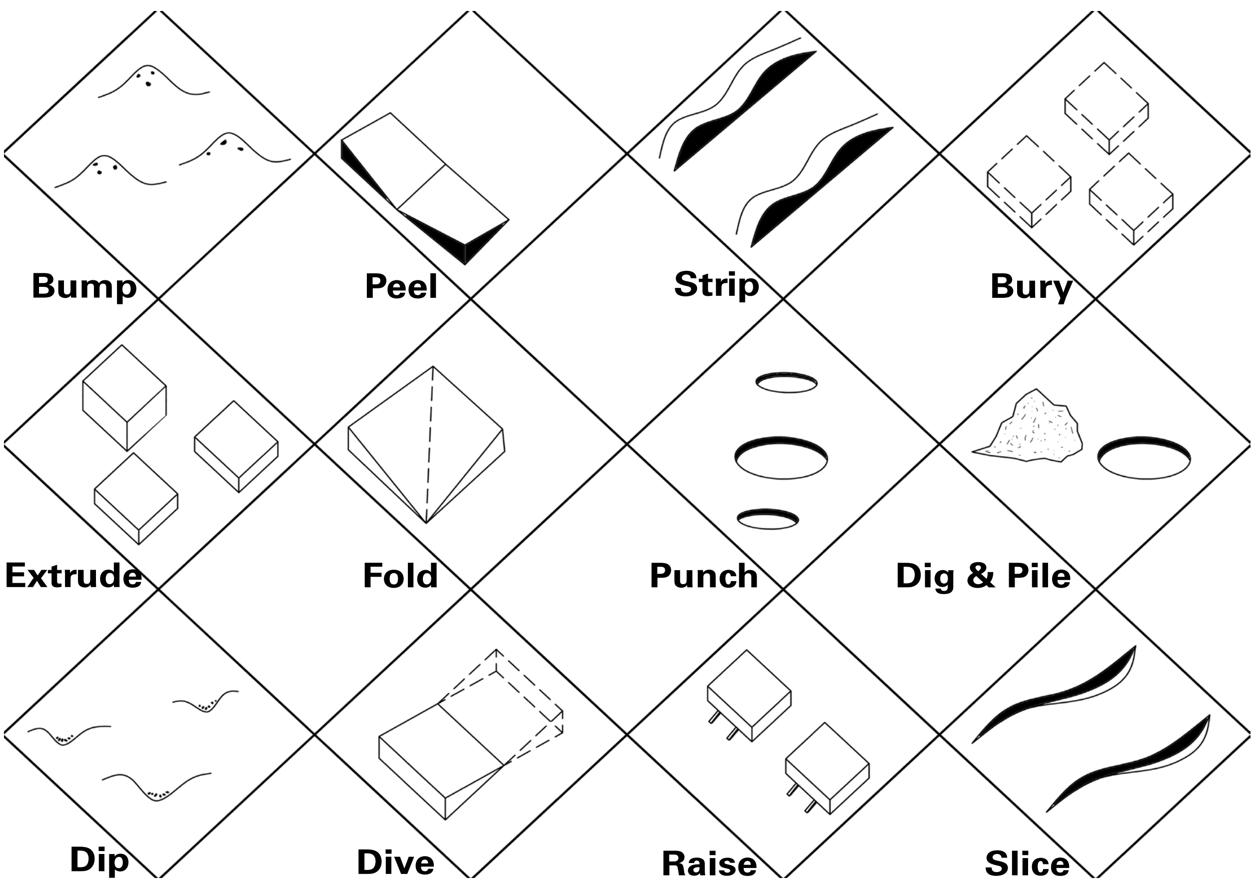
Building As Productive Growing for Community

The roof space also has the opportunity to be converted into a productive space. Growing, and harvesting can produce food for users of the building as well as providing for the community. Community growing promotes a healthy lifestyle as well as providing new spaces of interaction and engagement between building users and the community integrating the two. All of these sections provide great solutions but the one the best suits the location would be the most viable choice.

Building Interpretations

In addition to analyzing the building in section various interpretations of the building being part of the landscape can be made to add a new layer complexity to the architecture of the arena. The twelve schemes below, represent how the building could be oriented around the site all in which provide traits to aid in the building increasing its overall sustainability.

Note: This study conducted was based on the purpose of expanding train of though and design exploration in graphic form. No specific design was chosen.



4.4 Site Selection

Moss Park

The Moss Park region is one of Toronto's largest community housing projects, and the neighbourhood is located in the poorest part of the city. The Moss Park area has the potential to be a great community due to its proximity to downtown Toronto but crime has tarnished its representation. Community Aid Agencies have been located in the area by the city to try to work with the community to try to revolve the area. Toronto Life magazine claims that "Moss Park has excellent potential, but hampered by crime, it remains on the city's list of 13 at-risk neighborhoods."

Problems: The community which was polarized by the closing of industrial plants in the region in the 70's had lead to the growing amounts of large Public Housing projects encompasses the site, which this low income/ no income population litter the streets during the day and night with no daily programming which keeps them occupied. This results in the outcome of crime and vandalism. The availability of affordable and interactive facilities in the area, in which they can socially and physically interact with others within the community, is missing.

Potential: Large open multipurpose site, well equipped for multiple sports and multi-use. Centre part of community which lacks social connections and physical engagement. Large population surrounds sites, in community and surrounding communities which is in need multi-purpose, multi-use spaces, for gathering and community activities.

Potential Site Technologies: Orientation of building on large open park site can take full advantage of sun energy collection and create energy production, geothermal technologies under redeveloped sports park will benefit arena, rainwater, and grey water collection and minimal surface water collection can be used for areas within arena and for irrigation of surround site

History: The neighbourhood was part of a 100 acre park lot which was owned by one of Toronto's earliest wealthiest citizens William Allan. In 1830 Allan constructed a large mansion on the centre of the estate and named it Moss Park for the abundant amount of moss found in the area. (The Toronto Green Community, 2004) The mansion was built on the west side of Sherbourne Street between Queen Street and Shuter Street.   A short time after his death, his son who inherited his estate immediately subdivided the estate and this area soon became known for its Victorian homes. (The Toronto Green Community, 2004)The mansion lot was left as a big park land lot.

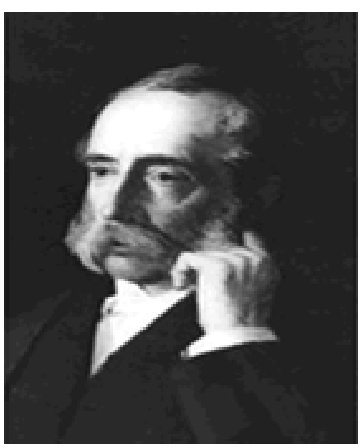


Figure 86 - Portrait of George William Allen (www.absoluteastronomy.com, 2009)

Figure 87 - Image of mansion which existed on George William Allen's property (www.townofyork.com/model/legend50.htm, 2009)

In 1854, sixty-nine lots were laid out from present day Dundas Street up to Gerrard Street for suburban villas. Two arched streets: Wilton and Wellesley Crescents, which were uncommon for the period, were then opened. Pembroke Street was urbanized as a tree-lined boulevard and was considered one of the city's premium residential streets in its day.

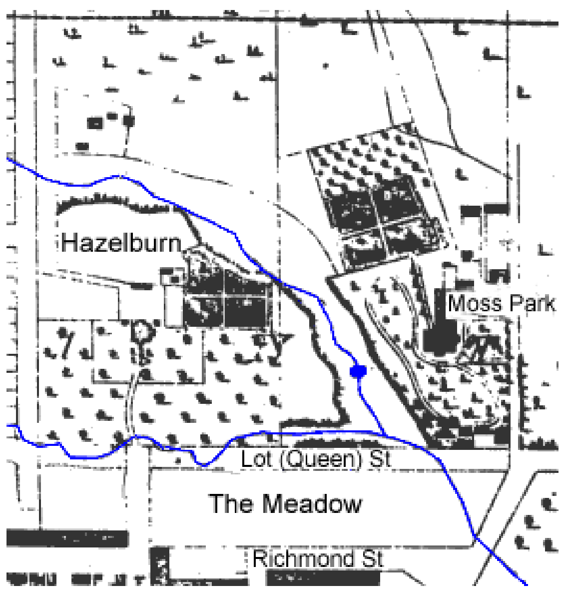


Figure 88 - Moss Park property boundaries in 1845 (www.lostrivers.ca/points/mosspark.htm, 2009)

Moss Park was initially the heart of Toronto's manufacturing area, and was home to large factories and the tightly packed homes of the workforce they employed. In the 1960s a large group of these buildings were demolished to make way for the Moss Park public housing project, a group of three large towers at Queen and Parliament Street run by the Toronto Community Housing Corporation. Following the de-industrialization of the 1970s roughly all the factories left the region, and it became one of the lowest income areas in the city. In the current years the region has seen immense gentrification. Past manufacturing structures such as the Merchandise Building and factories of the Distillery District have become fashionable lofts and stylish shopping areas. The existing row houses of Corktown, similar to neighbouring Cabbagetown, have also mainly been refinished and the demand factor for them is on the rise.

Figure 89 – Moss Park apartment towers (Google Images, 2009)

Figure 90 – Moss Park apartment towers (google images, 2009)

The neighbourhood nowadays is roughly L-shaped, bounded on the north by Carlton Street to Parliament Street, on the east by Parliament Street to Queen Street East and the Don River, on the south by Eastern Avenue and Front Street, and on the west by Jarvis Street.

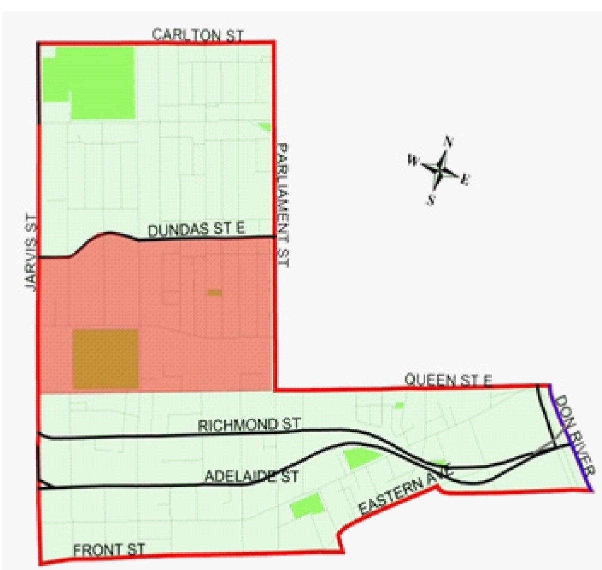


Figure 91 - Moss Park neighbourhood boundaries map (Statistics Canada Census, 2006)

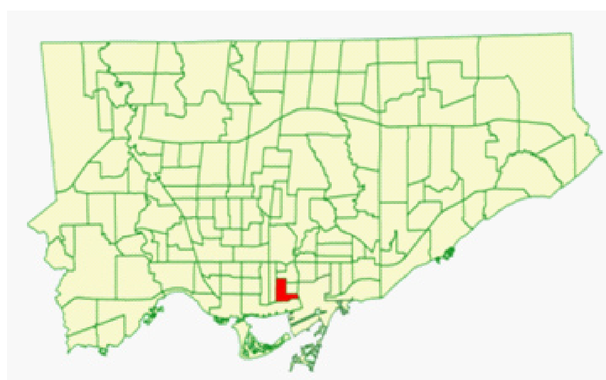


Figure 92 - Key area map of Moss Park neighbourhood (Statistics Canada Census, 2006)

Vital Statistics

Moss Park neighbourhood statistics

- The population in 2006 numbered 5,528
- The population density is 17,351 people per square kilometre compared with Toronto's 866 people/km2 average
- Statistics Canada has suppressed it for the area, which signifies that few people in the region responded to the 2006 Census (Stats Canada, 2008)

Moss Park houses many low-income families, numerous homeless shelters, a public park, an arena, and the Moss Park Armoury which is a military training base used by many reserves and cadet units of the Canadian Forces.

According to 2006 census figures, there are fewer children, you and seniors in the area compared to the average in a Toronto neighbourhood.

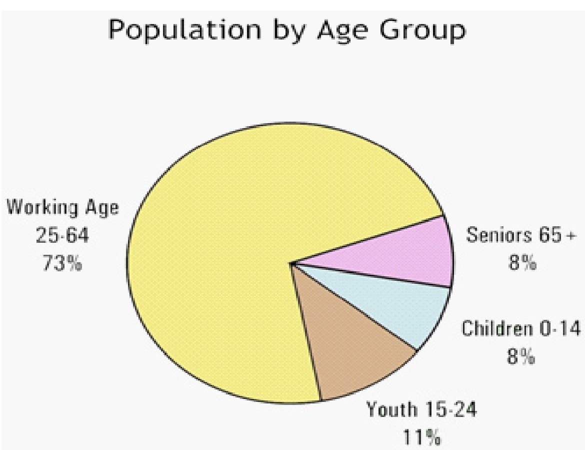


Figure 93 - Housing stock status of Moss Park neighbourhood (Statistics Canada Census, 2006)

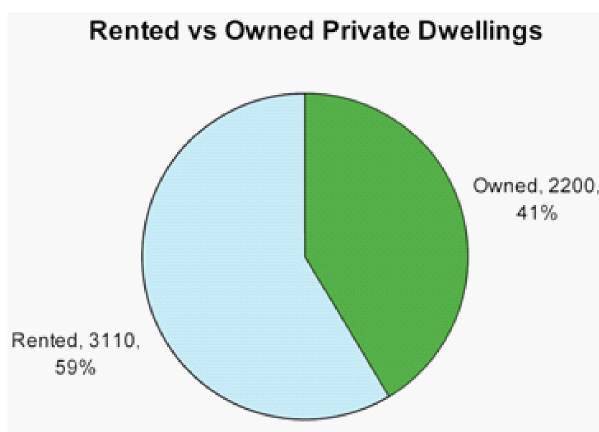


Figure 94 – Housing Stock Status (Statistics Canada Census, 2006)

Some residents praise Moss Park for its diversity and safety, calling it “a nice place to live” while citing as positives its proximity to the Eaton’s Centre and local shopping. Others are vocal about how dangerous it is due to the considerable amount of drug trafficking and crime that takes place there.

The neighbourhood’s buildings are typically split between rental and government housing, which helps to create a noticeable schism of opinions about the area. Compared to the rest of the city of Toronto the amounts of renters are higher, the amounts of seniors are much higher and the amounts of single and multifamily dwellings are much lower. Approximately 59% of the dwellings in the area are rented, compared to the 41% owned. (City of Toronto, 2008)

Community Image

The area is full of many small hidden streets with a mix of old and new housing types. The residential housing stock varies enormously, from small scale townhouses are dominate the area, which mixes with condo and loft developments on King Street East. A group of three 16 storey residential towers with approximately 300 subsidized rental units over shadows the community. Community is typically known as being comprised of large housing projects between Sherbourne and Parliament Street south of Dundas Street. The rest of the area is known to the as Moss Park included the Distillery District, the Garden District and Corktown.

Moss Park is positioned to the west of the district apartment buildings and is one of Toronto’s largest proportioned parks. The program which is included on the site is a sports field, a baseball diamond, and two tennis courts and adjacent to the John Innes Community Recreation Centre. This recreational facility features an indoor swimming pool, a gymnasium, a running track, a weight room, a cardio training room, a games room, a woodworking shop, and a craft room and is next door to Moss Park Arena.

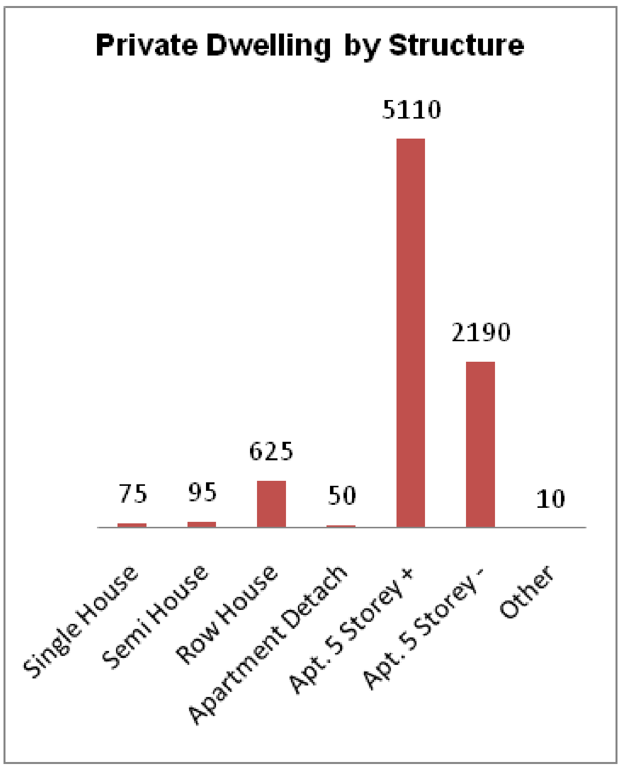


Figure 95 - Modified Housing Structure Type (Statistics Canada Census, 2006)

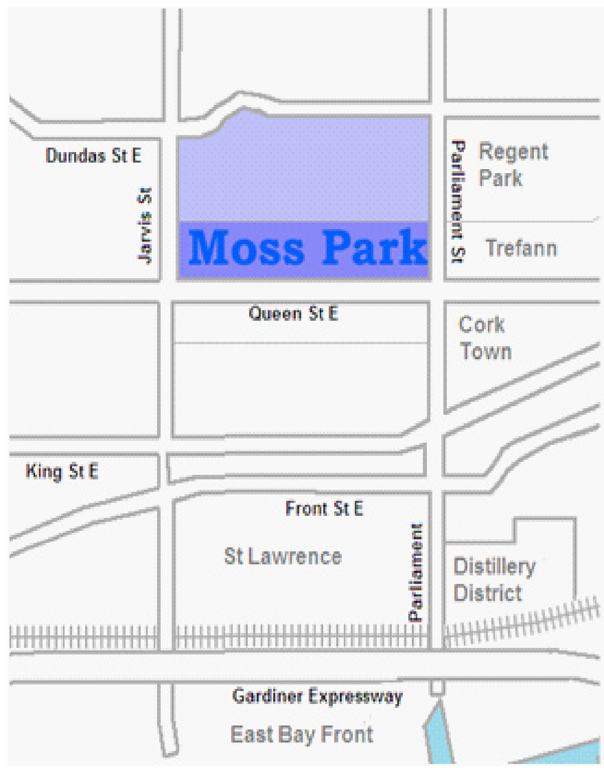


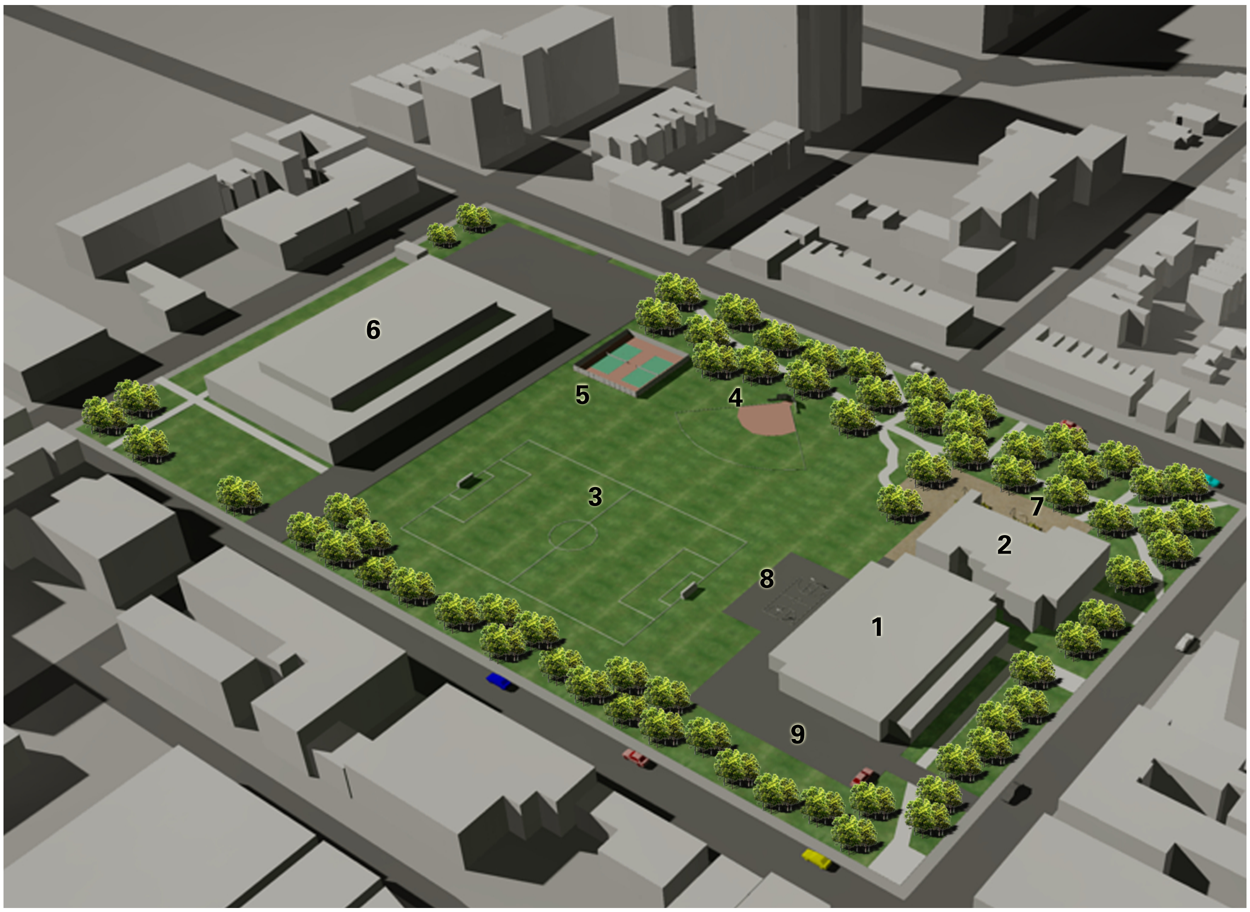
Figure 96 - Moss Park neighbourhood location map (google images, 2009)

The area immediately around the housing complex remains quite poor, and this is the area today typically meant when referring to Moss Park. This neighbourhood is almost exclusively rented out, and houses many low-income families. According to Toronto Life, "Moss Park has long had a reputation among Torontonians as a notoriously oppressed and dangerous neighbourhood." It is home to several homeless shelters. (Toronto Life Publishing Company Limited, 2009)

Moss Park Arena serves the citizens of the City of Toronto in the downtown core with a hockey arena. The rink is located at the northwest corner of Sherbourne Street and Queen Street East and is easily accessed via the TTC.

The northeast corner of Jarvis and Queen is occupied by Moss Park Armoury, which is used by several regiments of the Canadian Forces Primary Reserve. These include the 25 Field Ambulance, the 48th Highlanders of Canada, the 7th Toronto Regiment Royal Canadian Artillery, and the Queen's Own Rifles of Canada. Several cadet units also use the facility. The proceeding page indicates the existing site plan of the site graphically.

4.4 Moss Park - Existing Site Plan



Legend

1. Existing Hockey Arena
2. Existing Recreation Centre
3. Existing Soccer Field
4. Existing Baseball Diamond
5. Existing Tennis Courts
6. Canadian Armory
7. Existing Playground
8. Existing Basketball Court
9. Existing Parking Lot

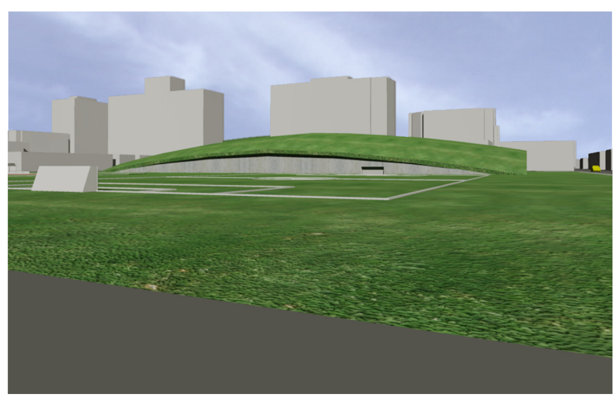
4.5 Design Schemes

Once Moss Park had been selected as the implementation site various design schemes had been tested. Six renditions were generated demonstrating various design items such as responses to the landscape, sensitivity to the site, form generation as well as orientation to maximize the potential use of sustainable building traits and maximum usage. Noted earlier a building type which was partially integrated into the site was the best design response.

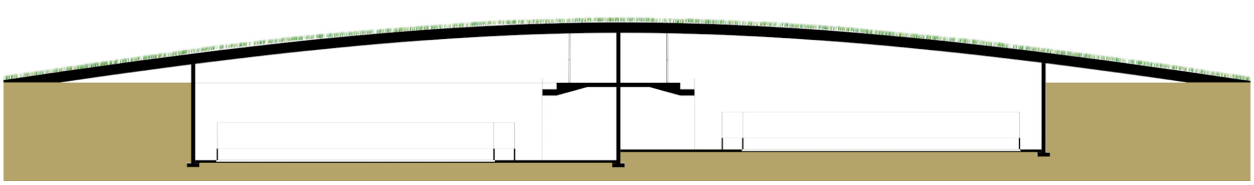
The first two concepts demonstrate how the building can become a part of the natural landscape. These ideas allow for maximum green space to be given back to the park, increasing the amount of usable site area as well as using the landscape to take advantage thermal heating and cool. The buildings are partially submerged into the

Scheme 1

South East Perspective along Sherbourne

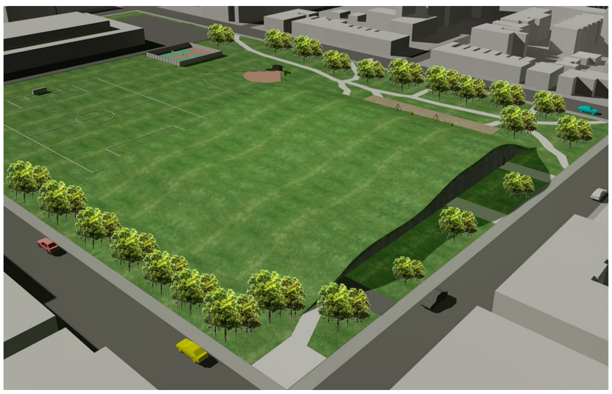


South West Perspective from Armory

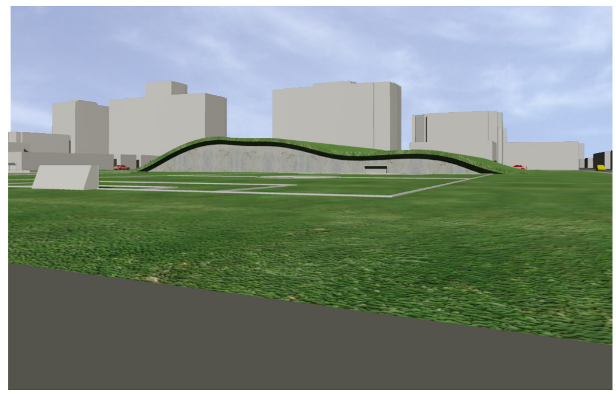


Section - Continuous Landscape Wraps Building landscape with access from street level which flows at grade through the entire building. The arena levels are fully submerged below grade.

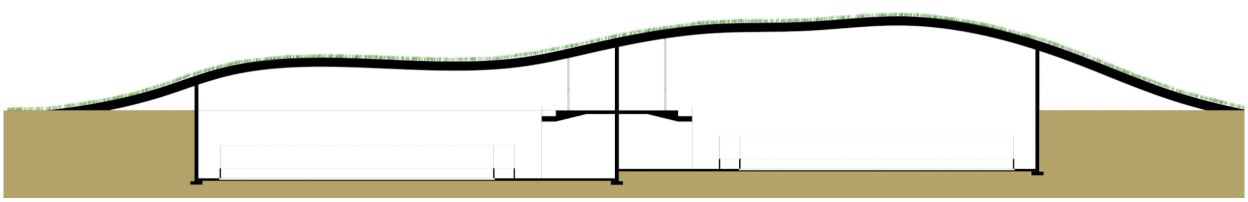
Scheme 2



South East Perspective along Sherbourne



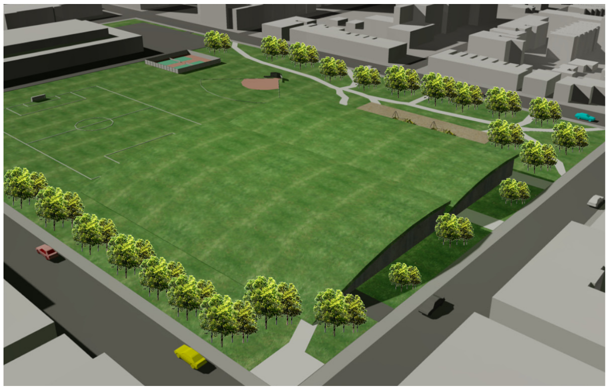
South West Perspective from Armory



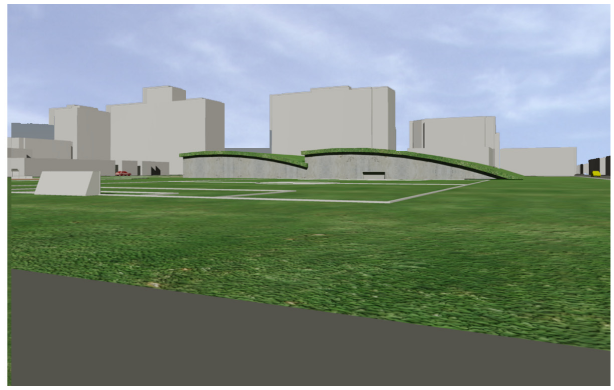
Section - Continuous Landscape Wraps Building

The third and forth concepts begin to expand and push the envelope of the building further. The building does not only become part of the landscape but it begins to open to the exterior elements allowing for additional sustainable technologies to be used such as direct and indirect natural lighting while still taking advantage of the green/ programmable roof space. These schemes partially separate the building into two spaces with a joined community core in the centre and like schemes one and two is accessed from street level. The arenas submerged below grade and community flow through the building to the park. Also providing direct and indirect views between users of the site and users of the building create engaging and interactive spaces.

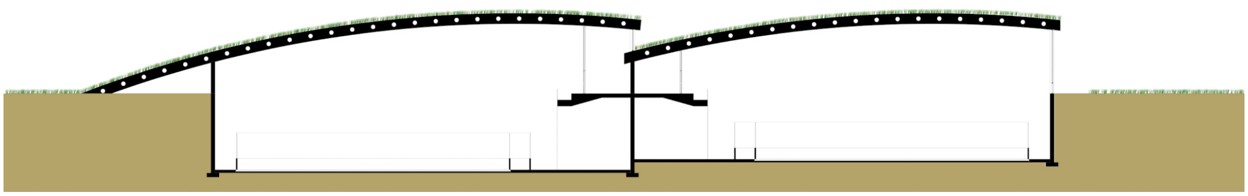
Scheme 3



South East Perspective along Sherbourne

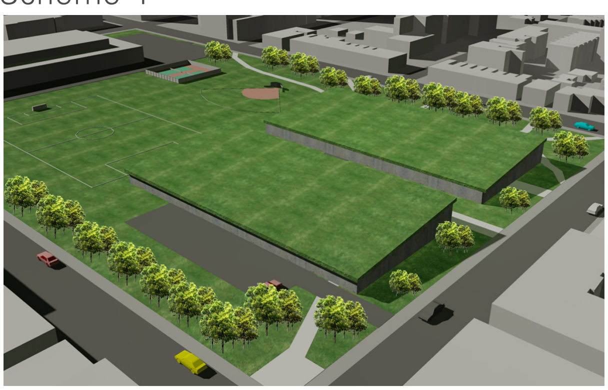


South West Perspective from Armory

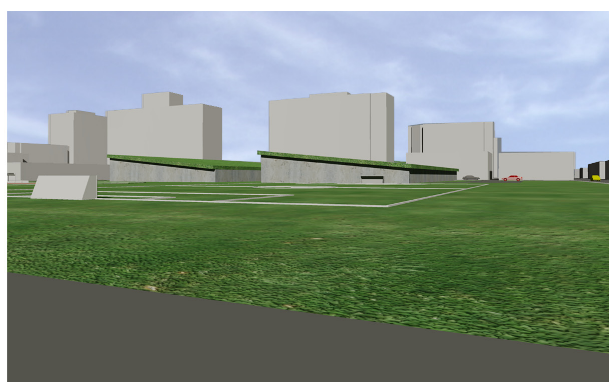


Section - Continuous Landscape Wraps Building

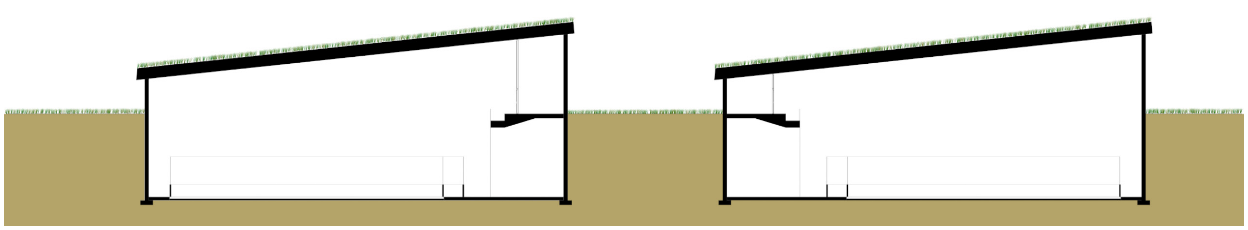
Scheme 4



South East Perspective along Sherbourne



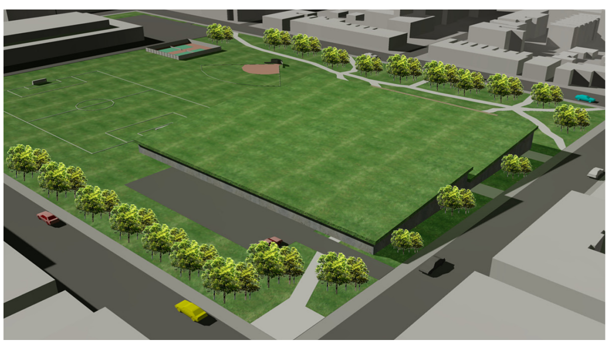
South West Perspective from Armory



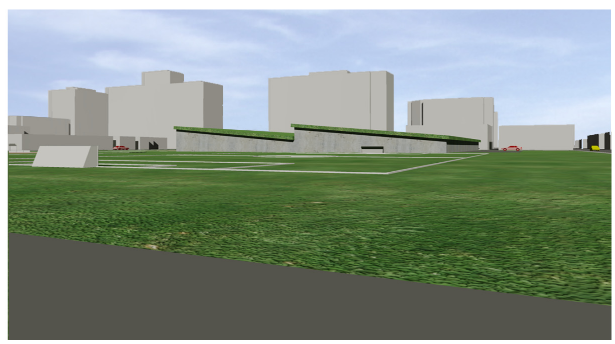
Section - Continuous Landscape Wraps Building

The fifth and six concepts begin to refine and address issues of current arenas all well as providing a building for a successful sustainable future. It has been demonstrated through these final two design schemes that the building can be more than just a stand alone building, or a building just integrated into a site. It can become a building with multi-layering of programming, a building of interaction and engagement of users of the building to a community and from community users to the building. It creates places of common interest as well as providing destination points where more than one activity can take place. A large amount of sustainable technologies can be applied to these design schemes

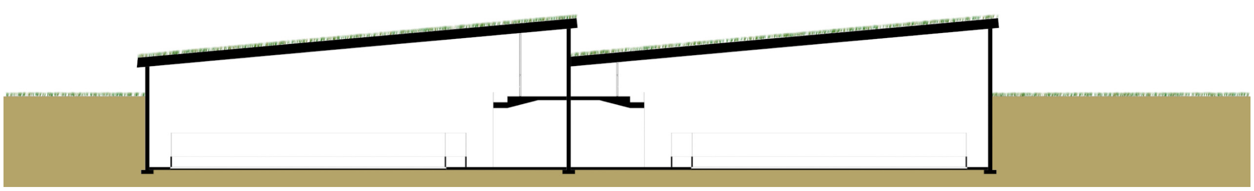
Scheme 5



South East Perspective along Sherbourne



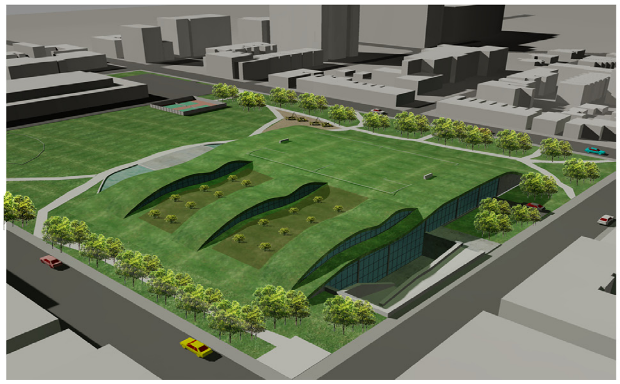
South West Perspective from Armory



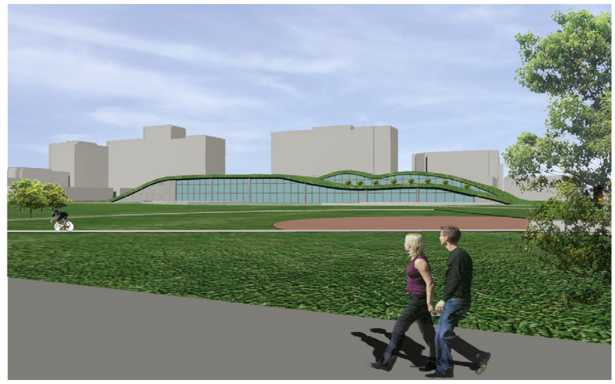
Section - Continuous Landscape Wraps Building

By integrating into the landscape and integrating multi-leveling of programming will ultimately increase and maximize the usage of the building at all times of the day as well as providing ample amount of time. From this design scheme testing a final scheme can be produced after the current building program is looked at.

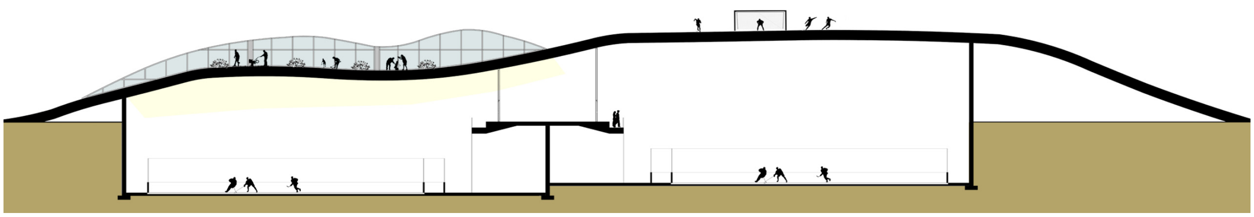
Scheme 6



South East Perspective along Sherbourne



South West Perspective from Armory



Section - Continuous Landscape Wraps Building

Scheme 6 provides the best collection of opportunities in design orientation, and design ideas. A final form generation will refine and minimize unused spaces within this scheme to produce a successful design project. All of the highlighted traits of this scheme will be incorporated in the final design.

4.6 Arena Scheduling - Time Usage Study

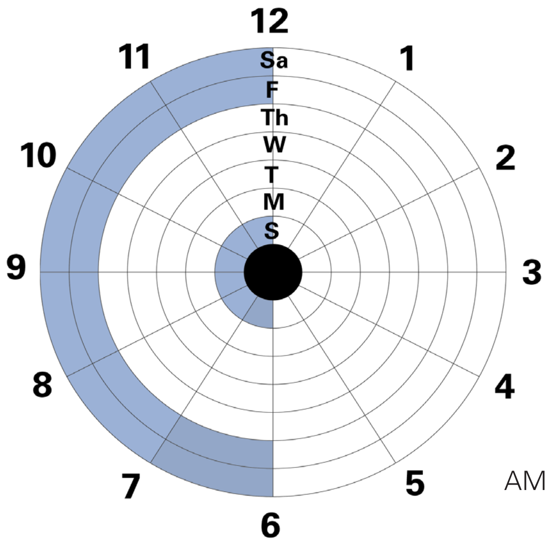
Before implementing a design proposal one additional issue which needs to be addressed is the current usage and or scheduling of the arena. From the research on eight typical arenas in the city of Toronto the following two diagrams have been generated demonstrating the hours of usage during the winter months of the year during the hockey season, as well as the typical summer month of season.

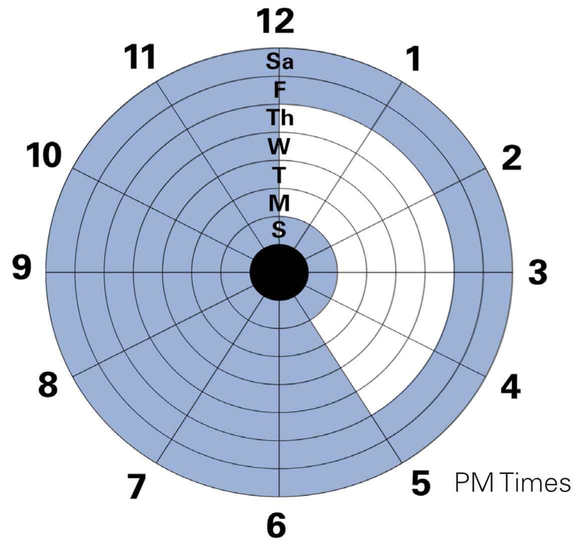
Gathered and learned was the during the week from Monday's thru Thursday's arenas operate a full capacity from 5pm till 12am and on weekends from 6am till 12am, during the winter months of hockey season. During the day from 6am-4pm during the week the arenas are left empty and unused.

During the summer months, the arenas studied were left empty and unused. The buildings were use sporadically for indoor training or skateboarding but for the majority of the time vacant. This leads to the conclusion that during the summer months a building of this type is not only in need of finding programming to fit on the ice surface area but a reconsideration on the way that the building functions may have to be analyzed. From this time, day and month study will provide additional evidence to increase the usage of the building at all times of the day and at all times of the year additional programming and usage is needed for the sustainability of the arena. The arena should be able to be flexible and have the ability to change without major work to expand its use and role, while providing multiple layers of activity spaces. These will create interactive and engaging spaces for more than one use; hockey.

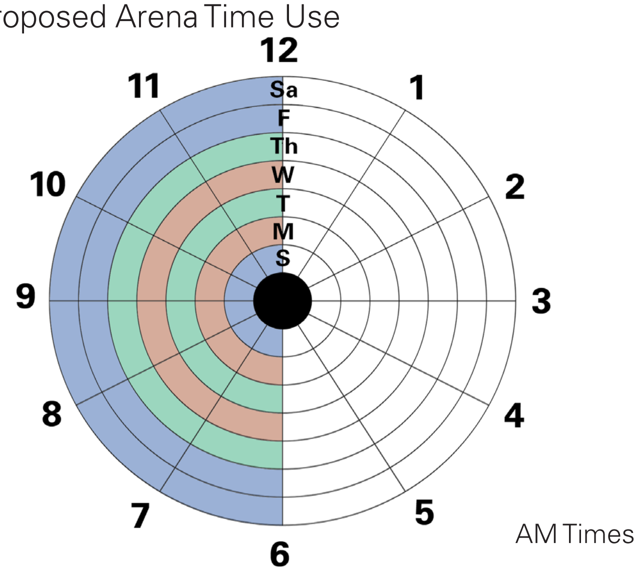
4.6 Typical Arena Use During Winter Months

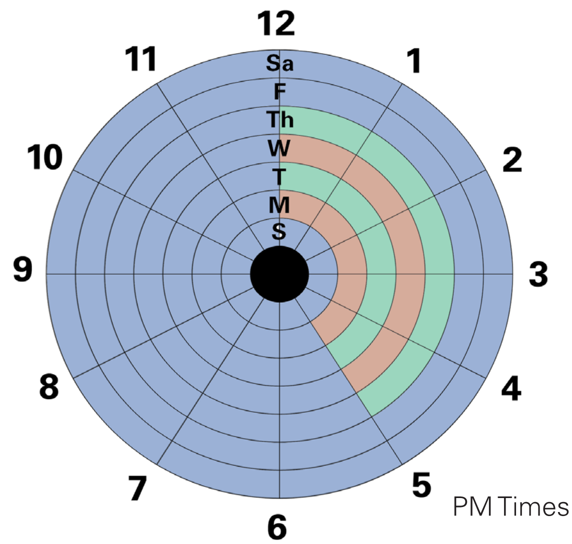
Existing Arena Time Use





Proposed Arena Time Use



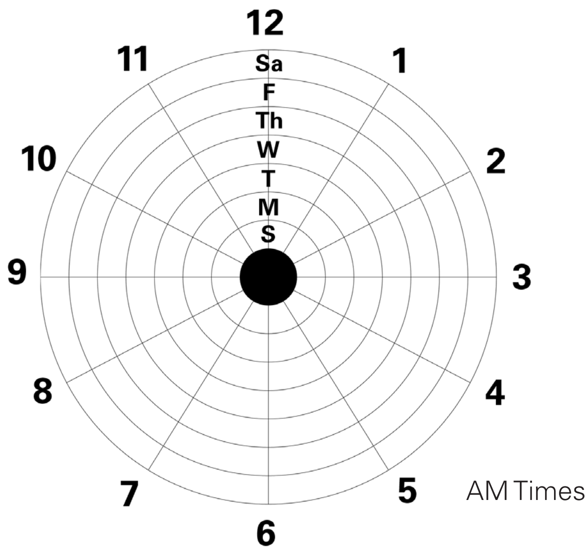


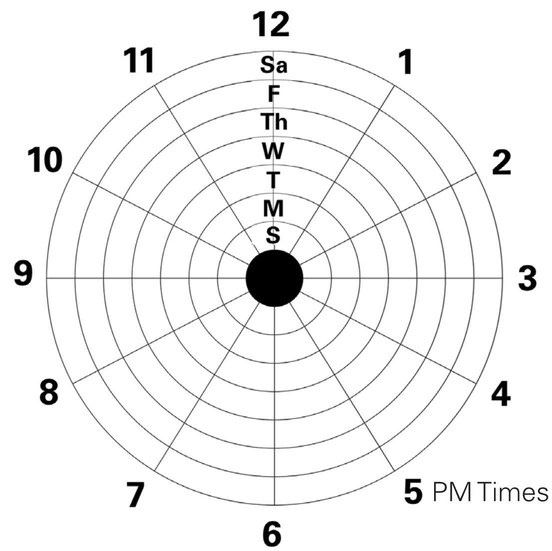
Legend

- Hockey
- Market
- Community
- Performances

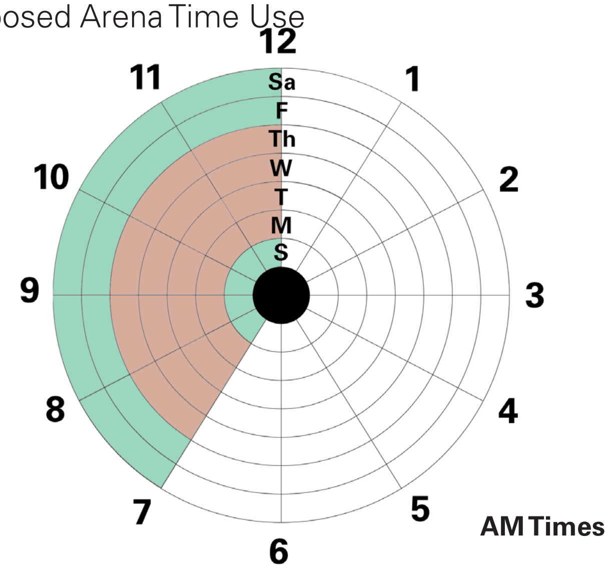
4.6 Typical Arena Use During Summer Months

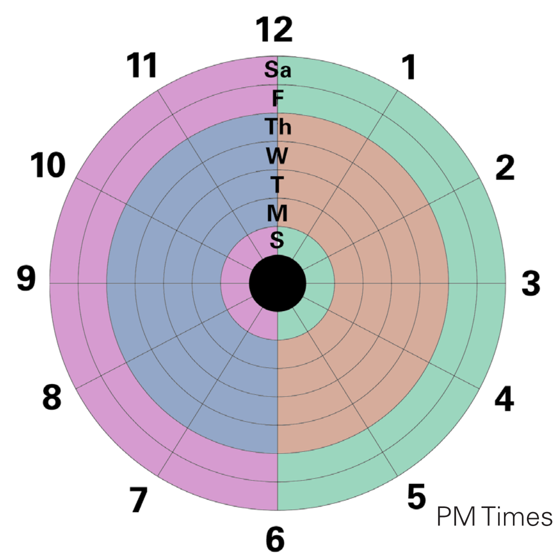
Existing Arena Time Use





Proposed Arena Time Use





Legend

- Hockey
- Market
- Community
- Performances

5.0 DESIGN PROPOSAL

From the literature on the way arenas are currently designed and from discovering issues on what problems they face today, in the future a reconsideration and redesign is in store to provide a sustainable future for this building type. From investigating form versus function generation, site implementation, building program arrangement, time use scheduling and sectional analysis the best possible solution can be generated for this building type.

By addressing issues such as environmental impacts, reducing energy consumptions, and the production of energies will greatly improve the longevity and efficiency of the building. Addressing issues of programming, as well as creating new and improving on existing interactive and engaging spaces will increase connectivity between the current users to the building as well as giving the opportunity to introduce new users to the building.

Dealing with the problem of flexibility will also be implemented within the design proposal. This will allow for the time of day and time of year when the building is vacant but filled with additional program and usage at minimal change to the actual building form. The concern with energy usage and sustainability will be challenged and implemented through design strategies of green roof technologies which will reduce heat loss as well as provide additional building space, thermal mass which will use the ground source as a way of cooling and heating the building at various times of the year. This design will also providing a cheaper source of refrigeration for the ice as well as providing solar energy collection and natural lighting to reduced energy consumption and minimizing energy bills.

Structure is a topic which has been looked at and designed through salvaged, recycled materials such as steel in the building's roof trusses and ash in the buildings structural concrete walls and natural materials such as wood and timbers. All of the natural materials will emit little to no VOC's which are harmful to the environment and as well to the users.

By adding a layer of transparency to the building, will allow the building to become viewable and interactive with the community. This will give the community and passer buyers a glimpse of the activities which are taking place in and around the building which create direct and indirect contact at all times of the day and year.

Layering the actual building program of the building will also add additional interactive and engaging spaces. This will potentially increase the usage of the building to all times of the year allowing the building to be used at all times. By providing locations of program overlap will help introduce users whom are not familiar with a specific program or function the opportunity to become engaged. This contact may lead to individuals whom want to explore new and exciting challenges and participations in new activities.

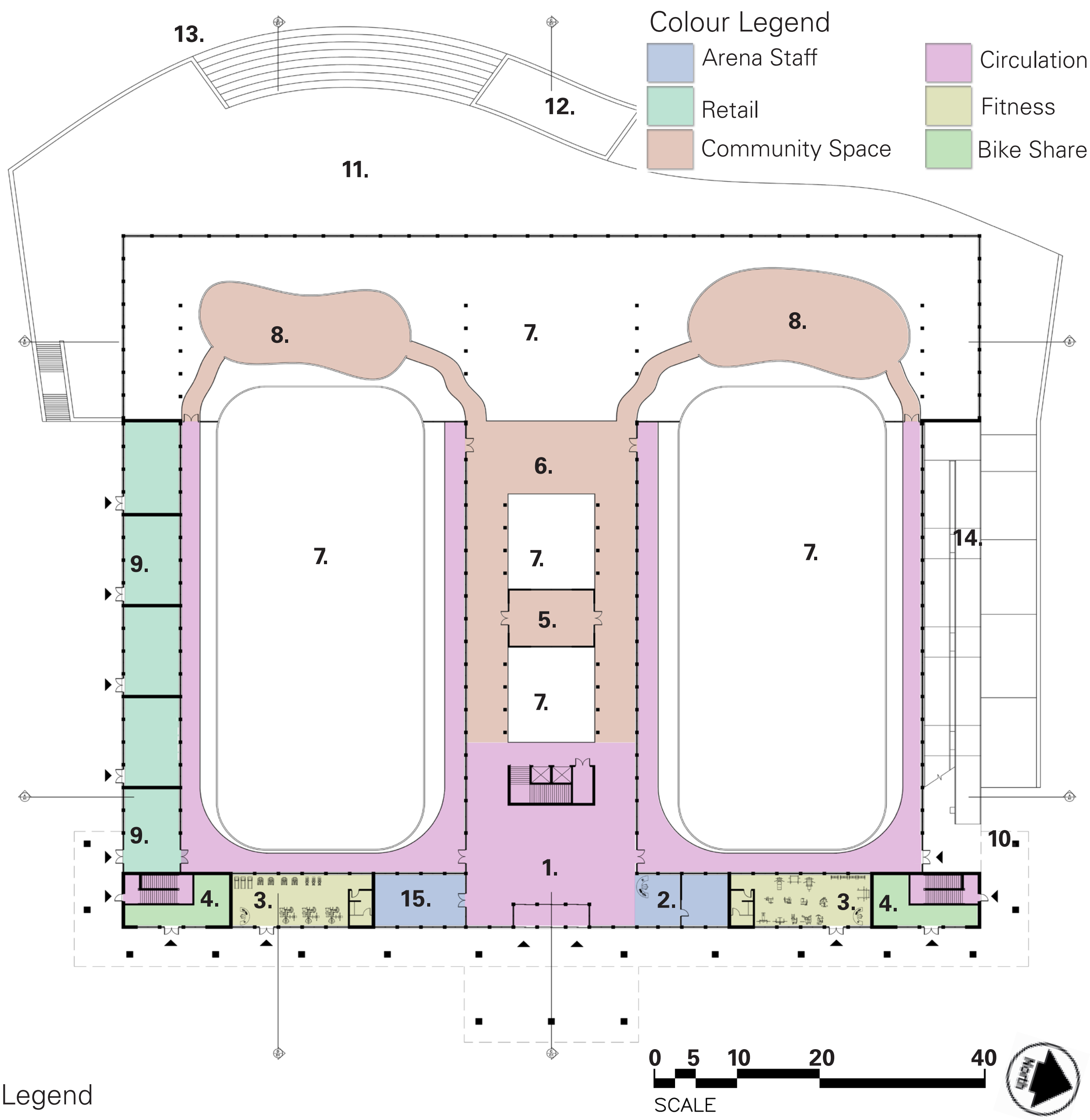
By increasing usage, connectivity with the community and users and re-enforcing them through green technologies will provide a community of Moss Park with an arena building type as learning tool for other buildings and communities around the city and country in regards to sustainability; one in which happens to house our national past time, hockey.

5.0 Proposed Site Plan

Legend

1. Proposed Building
2. Car Drop off Area
3. Street Parking
4. Existing Play Structures
5. Modification to Existing Paths
6. Relocated Baseball Diamond
7. Sunken Public Square
8. Water Feature
9. Ramp from Grade to Green Roof
10. Tiered Concrete Seating
11. Pedestrian Stairs to Lower Lev.
12. Service Ramp to Lower Level
13. Relocated Tennis Courts
14. Additional Tree Planting
15. Open Green Space
16. Street Level Blvd. To Retail

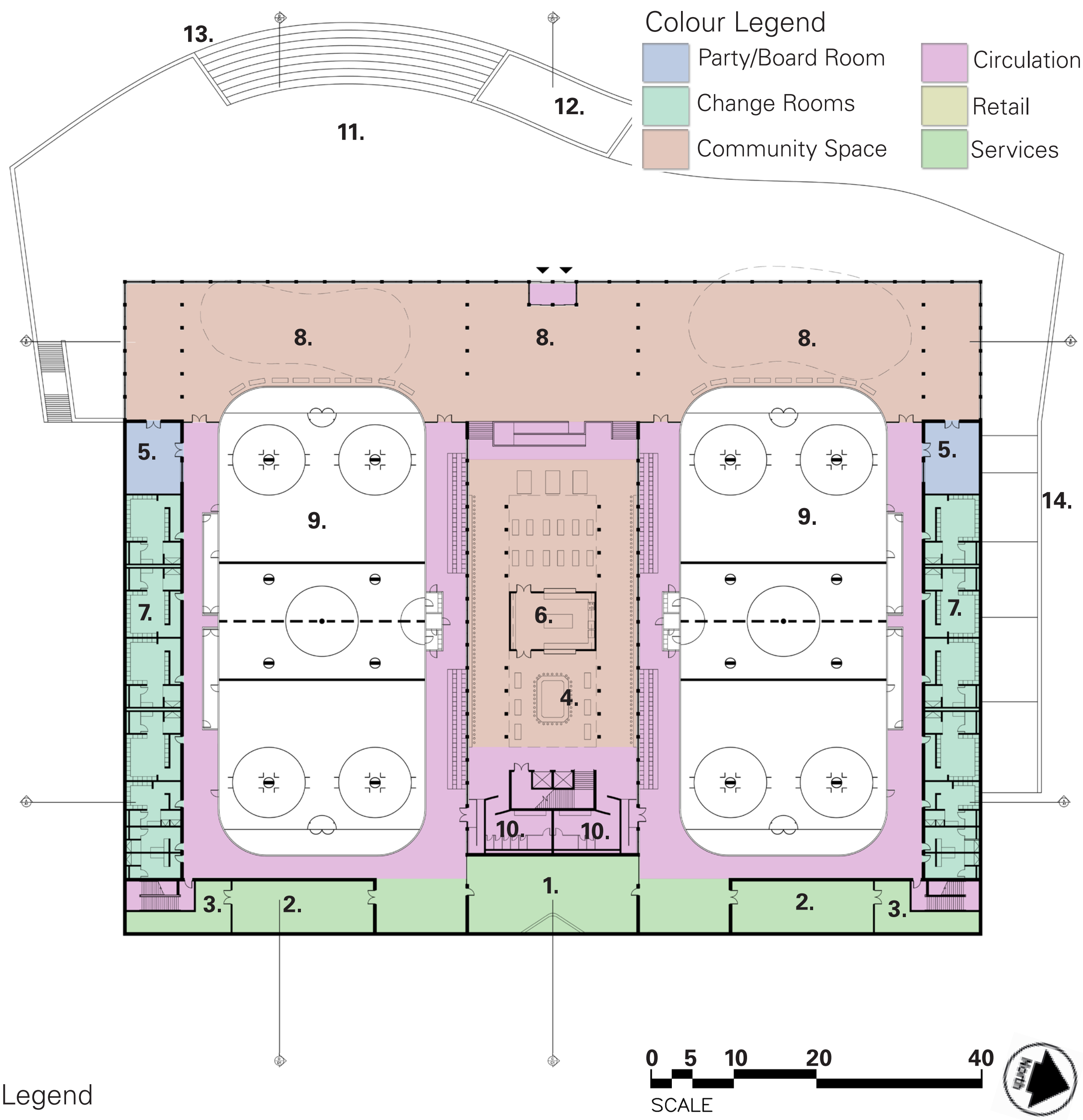
5.0 Ground Floor Plan



Legend

1. Entrance Lobby & Circulation
2. Building Administration
3. Fitness Club
4. Bike Share Program
5. Community Room
6. Informal Gather Space
7. Open to Below
8. Community Pods
9. Retail Shops
10. Exterior Ramp to Roof
11. Public Square
12. Water Feature
13. Tiered Concrete Seating
14. Service Ramp to Lower Level
15. Pro Shop

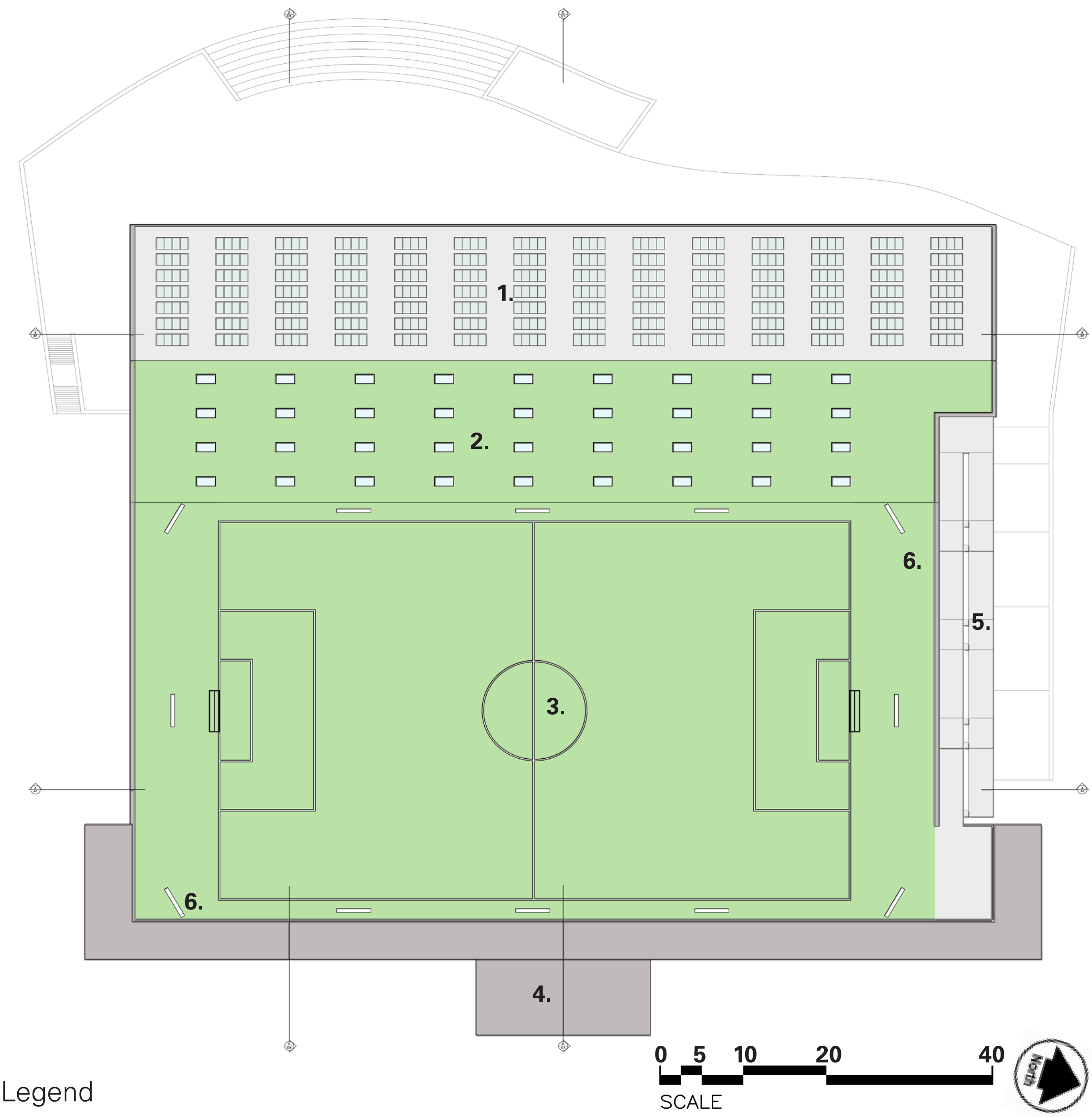
5.0 Lower Floor Plan



Legend

1. Zamboni/Ice Melting Pit Room
2. Mech/ Refrigeration Room
3. Electrical Room
4. Bar/Restaurant
5. Party/ Boardrooms
6. Restaurant Kitchen
7. Player and Referee Rooms
8. Market Space
9. Ice Surface
10. Public Washroom
11. Public Square
12. Water Feature
13. Tiered Concrete Seating
14. Service Ramp to Lower Level

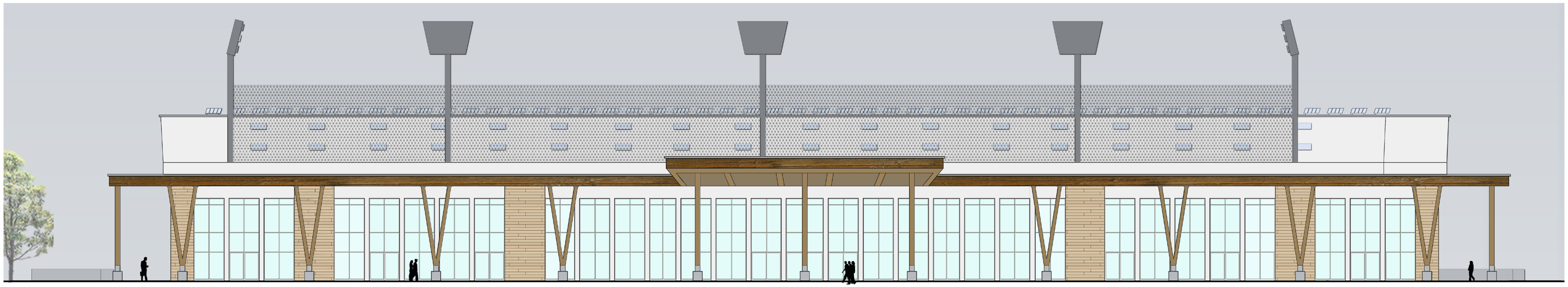
5.0 Roof Plan



Legend

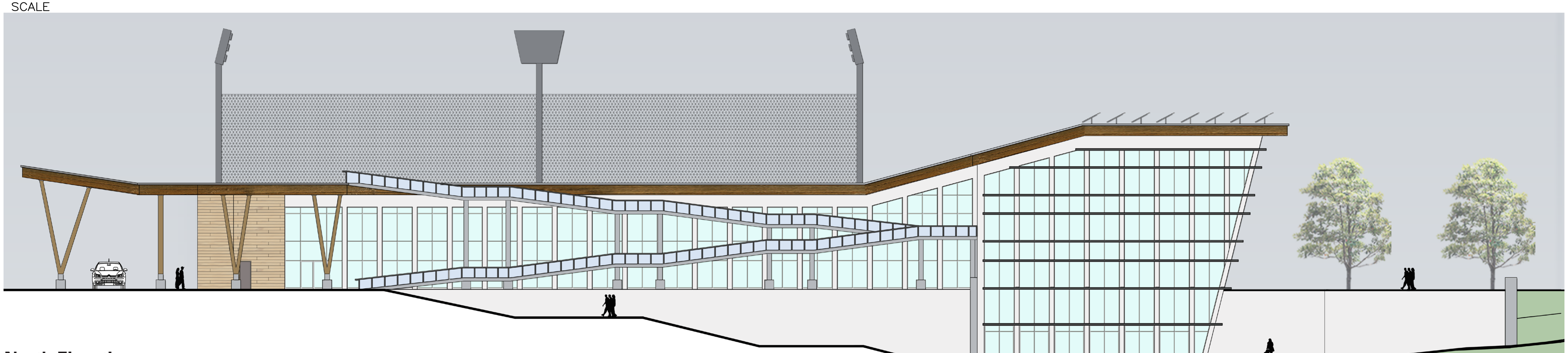
1. Upper Roof_ Solar Collection
2. Skylights
3. Green Roof_ Soccer Field
4. Front Canopy
5. Exterior Ramp to Grade
6. Flood Lights Equipped with Soccer Ball Recovery Netting

5.0 Proposed Elevations



East Elevation

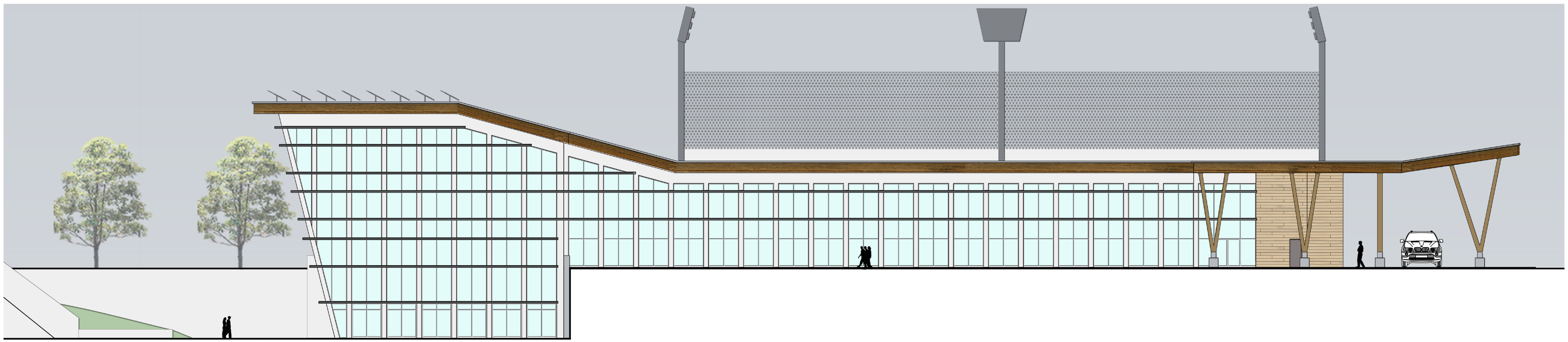
0 2.5 5 10 20
SCALE



North Elevation

0 2.5 5 10 20
SCALE

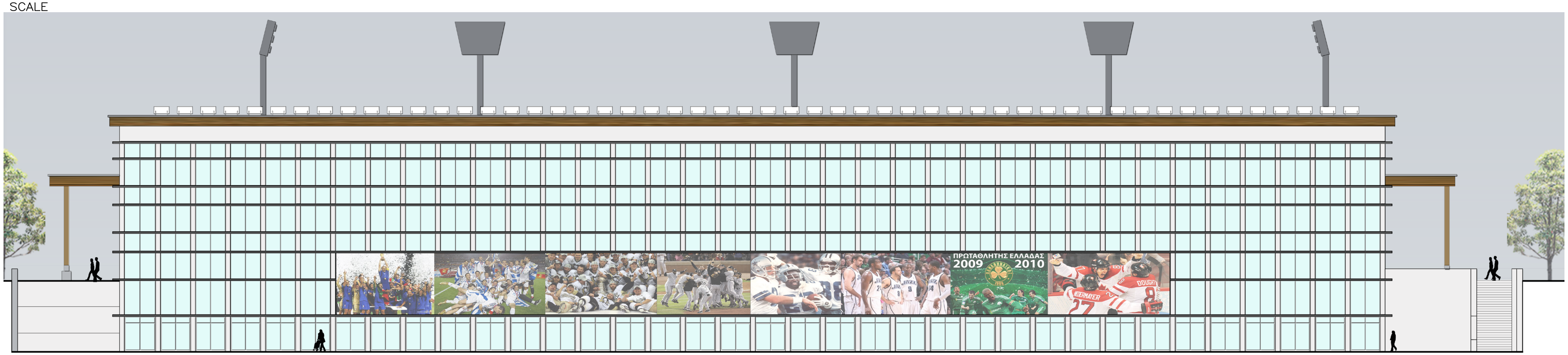
5.0 Proposed Elevations



South Elevation

0 2.5 5 10 20

SCALE

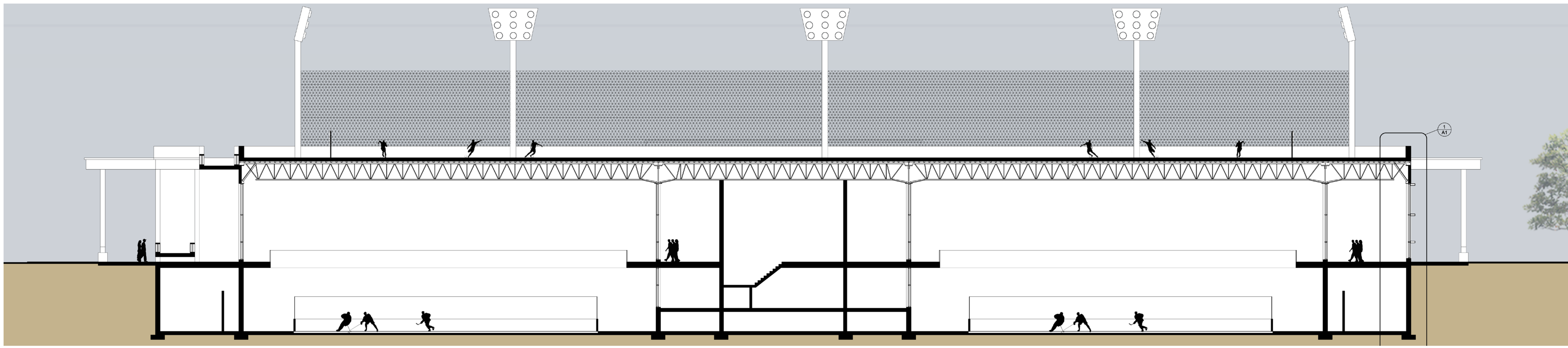


West Elevation

0 2.5 5 10 20

SCALE

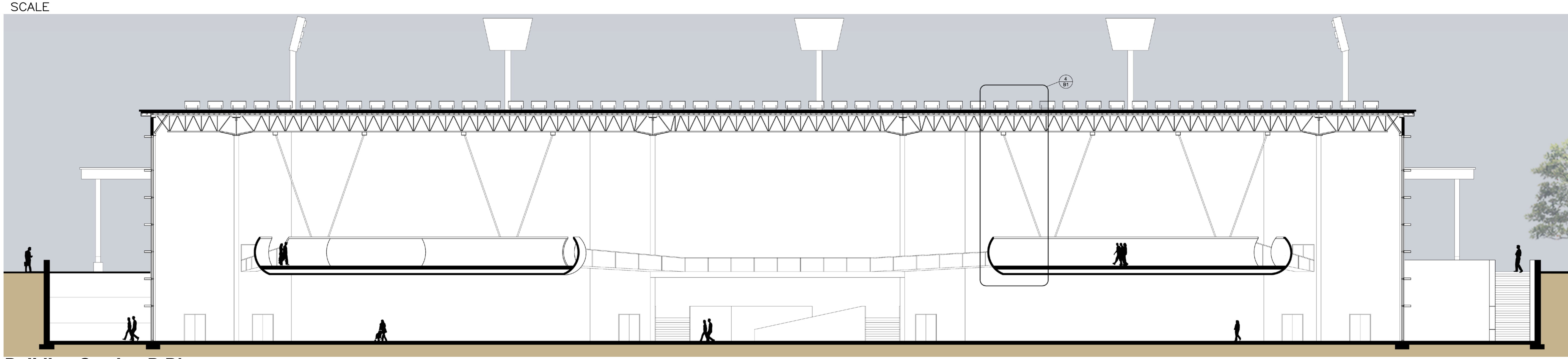
5.0 Proposed Building Secitions



Building Section A-A'

0 2.5 5 10 20

SCALE



Building Section B-B'

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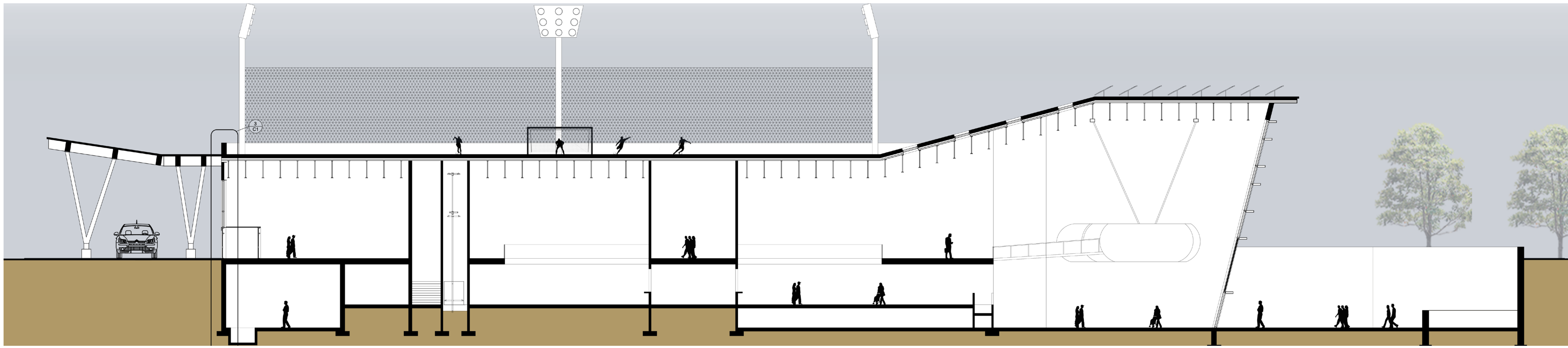
SCALE

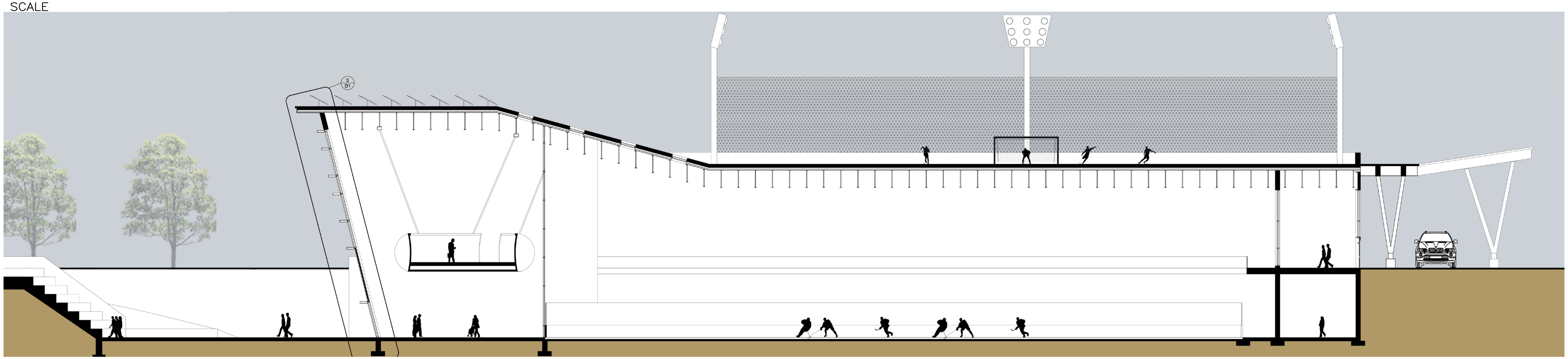
5.0 Proposed Building Secitions



Building Section C-C′

0 2.5 5 10 20

SCALE

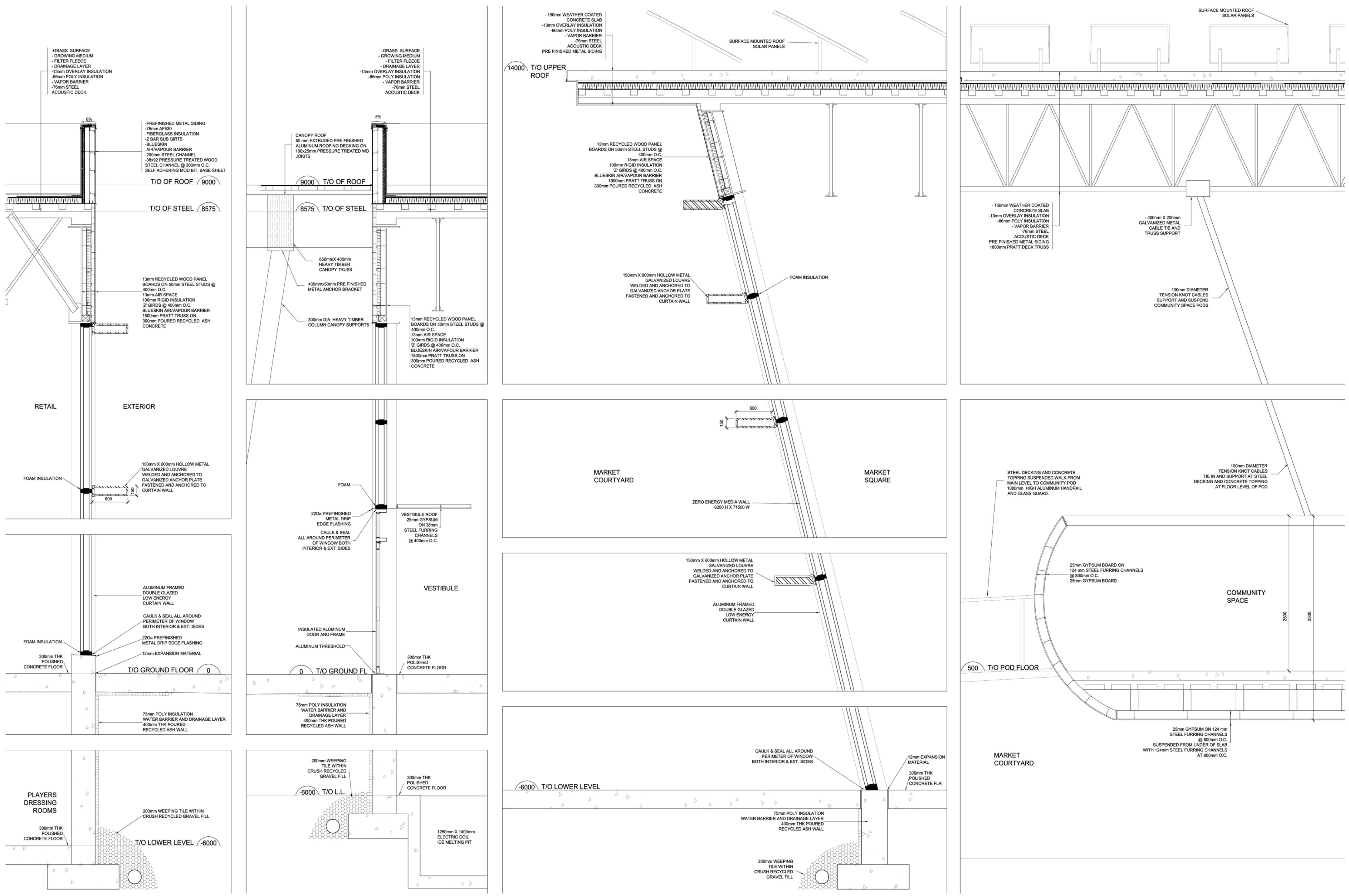


Building Section D-D′

0 2.5 5 10 20

SCALE

5.0 Building Details



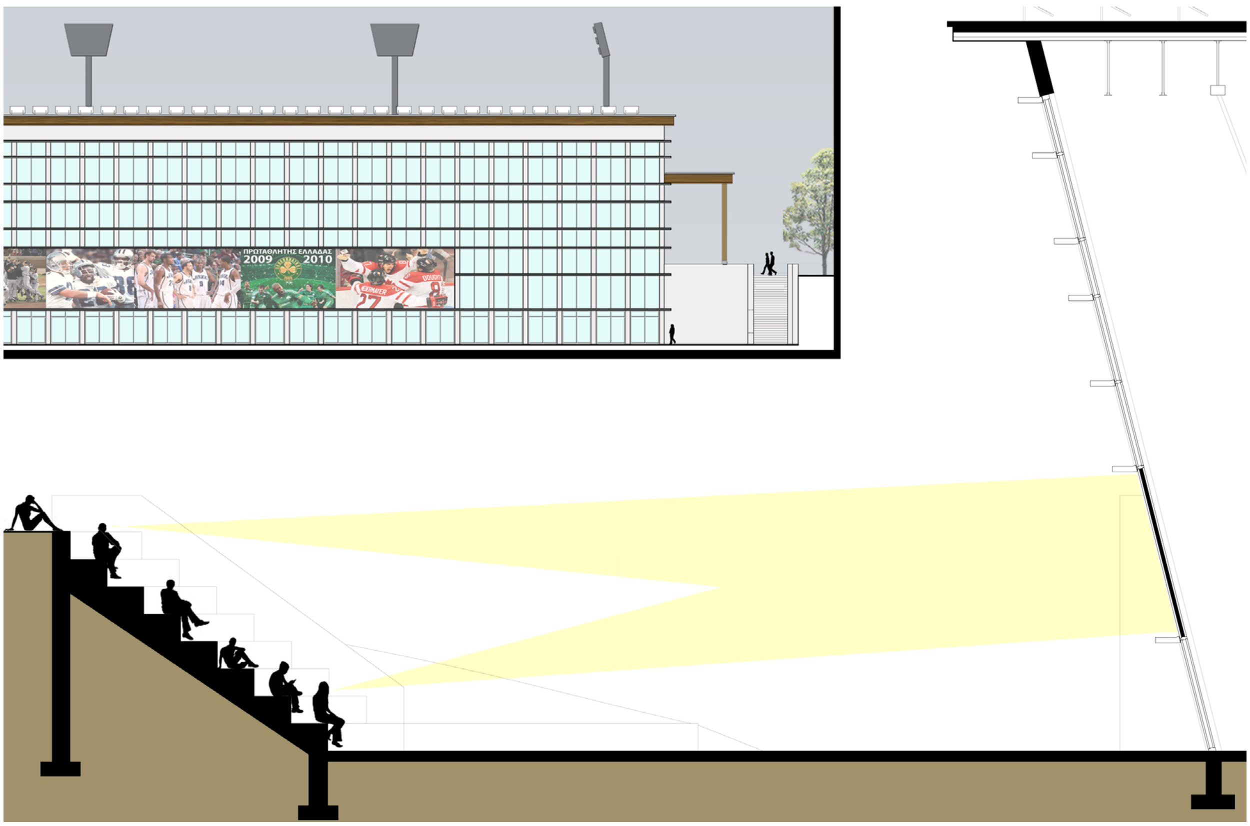
WALL SECTION - TYPE 1
SCALE 1:25

WALL SECTION - TYPE 2
SCALE 1:25

WALL SECTION - TYPE 3
SCALE 1:25

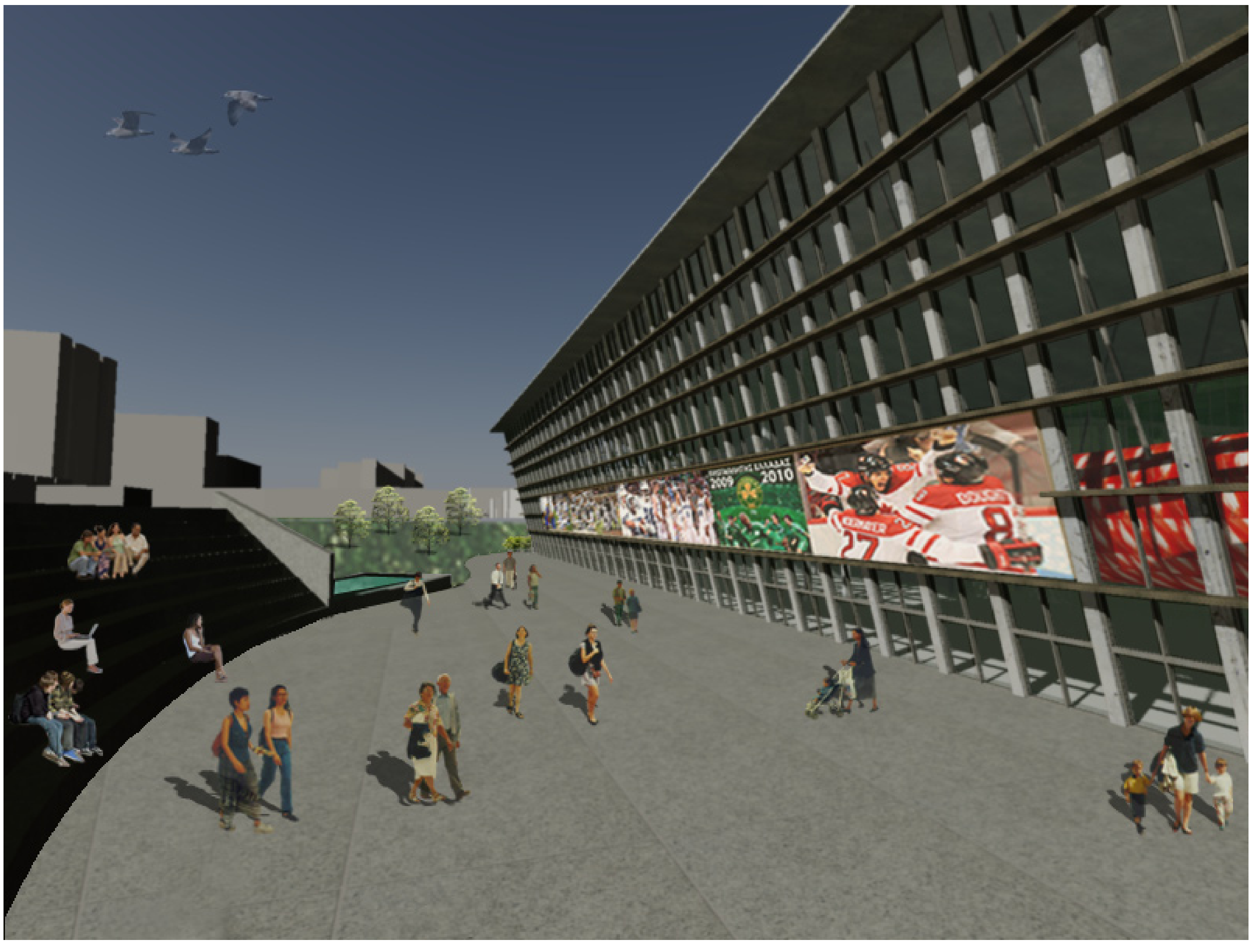
DETAIL 4
SCALE 1:25

5.0 Section Through Public Square Concrete Tiered Seating



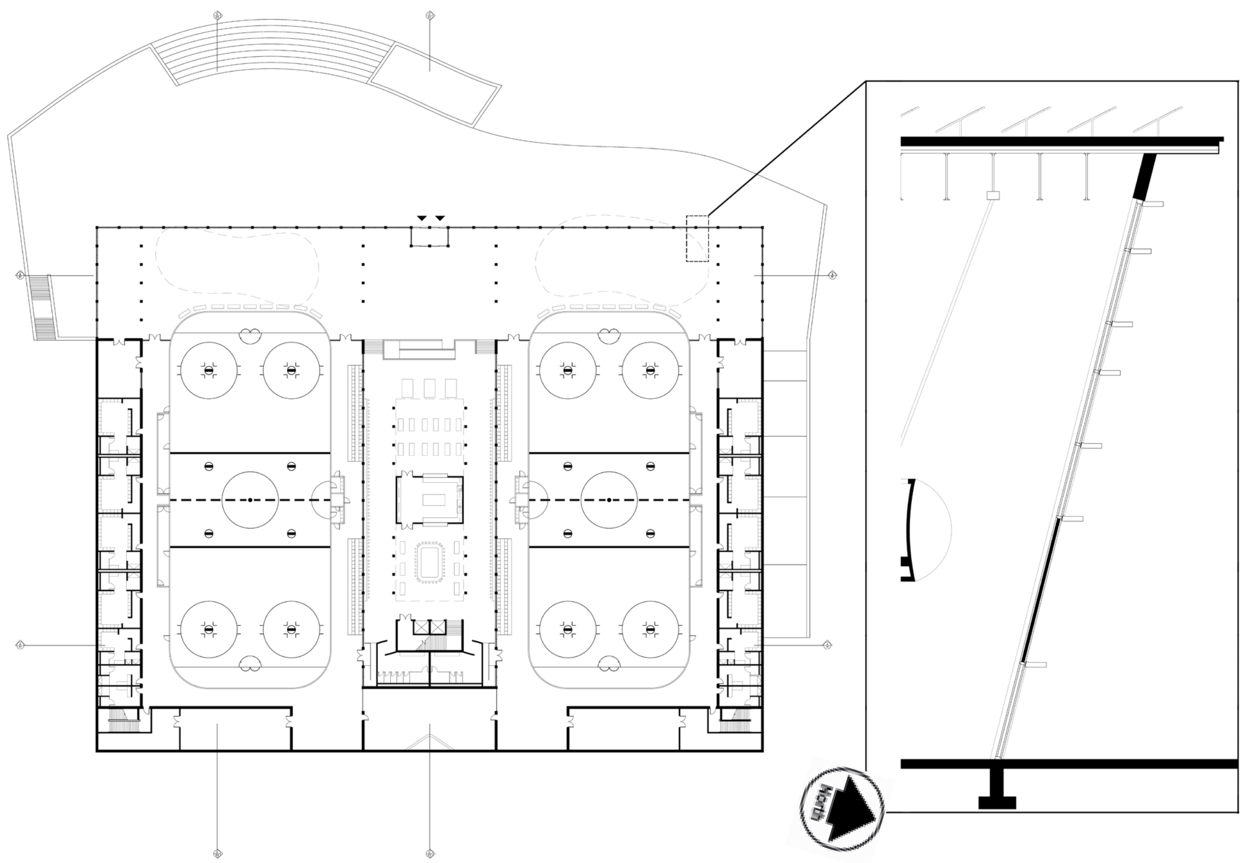
West elevation: building skin duals as display projection screen creating informal interaction between user and building within an out door public square. Informal seating arrangements are provided on a concrete tiered retaining wall. The building become an interactive space with users of the building and users around the building. This provides additional programming space around the building, enlivens the space around the building and provides something that has never been proposed before.

5.0 Public Square Rendering



West elevation: building skin duals as display projection screen creating informal interaction between user and building within out door public square. Informal seating arrangement on concrete tiered retaining wall. This space is also idea for informal or formal markets, events, concerts or gatherings. Program is also visible from the exterior, giving the community full views of the public spaces creating new points of interest and conflict

5.0 Building Flexibility - Building Conversion



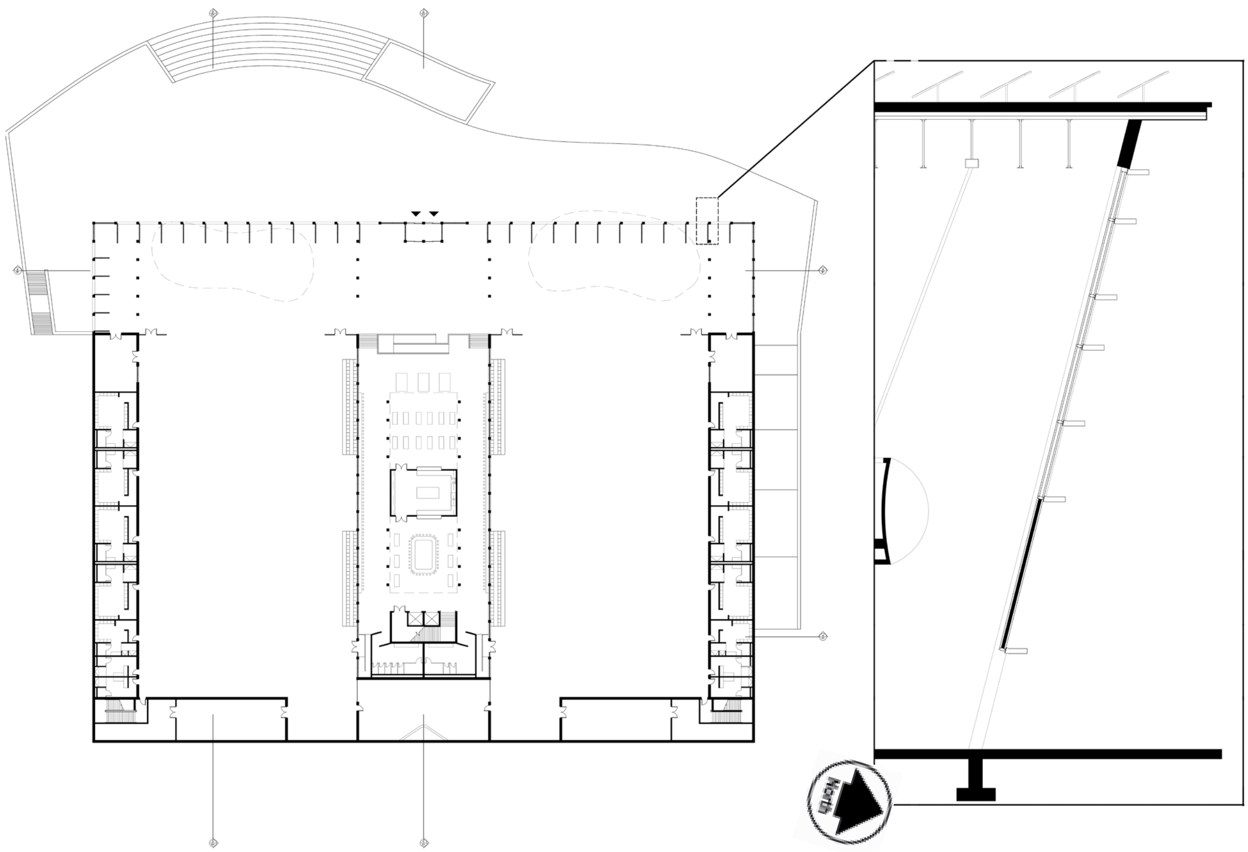
Lower level floor plan (closed winter concept)

Lower level: primarily during the winter month, this building arrangement creates three main zone, ice play surfaces, indoor market space and restaurant view space. This closed concept creates a separation between temperature regulated spaces, while still maintaining direct and indirect view in and around all of the buildings program spaces, allowing for indirect connections.

5.0 Building Flexibility - Building Conversion Concept

Aerial View (Closed Winter Concept)

5.0 Building Flexibility - Building Conversion



Lower Level Floor Plan (Open Summer Concept)

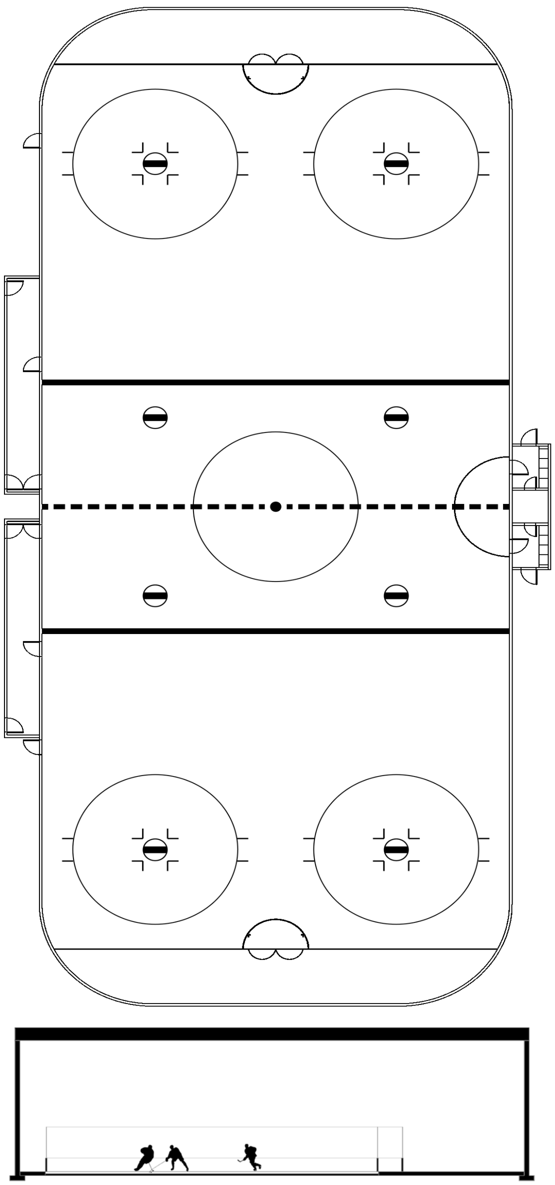
Lower level: during the summer months and off hockey season, the west end walls of the ice surface have the opportunity to open and expand into the market space, the rink boards are easily demountable and stored on site within storage. The west building skin swings open and the indoor market expands into the public square complete opening the building to the exterior elements. This flexibility option allows the building to expand its program to large open spaces if needed as well as providing the option for the opportunity to create unlimited program space.

5.0 Building Flexibility - Building Conversion Concept

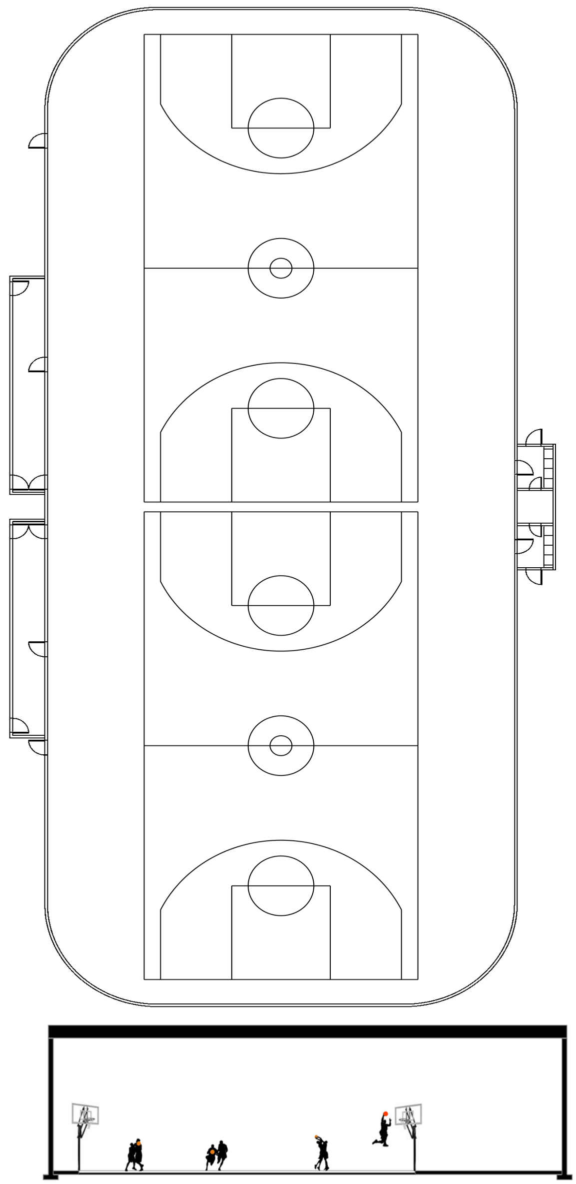
Aerial View (Open Summer Concept)

5.0 Building Flexibility - Interchangeable Rink Surface

Arena Configurations: with the quick demounting of the arena boards and applying a rubber membrane flooring over the ice surface, the arena can be converted into additional programmable spaces.



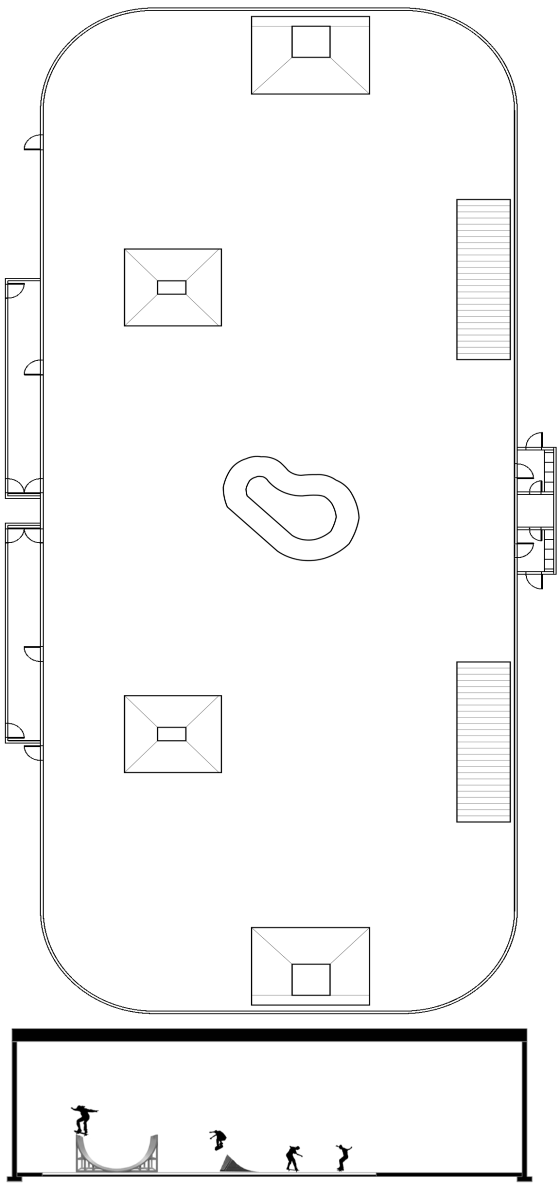
Hockey, Figure Skating, Broom ball, Ringette.
Flex Flooring - Ball Hockey, Soccer



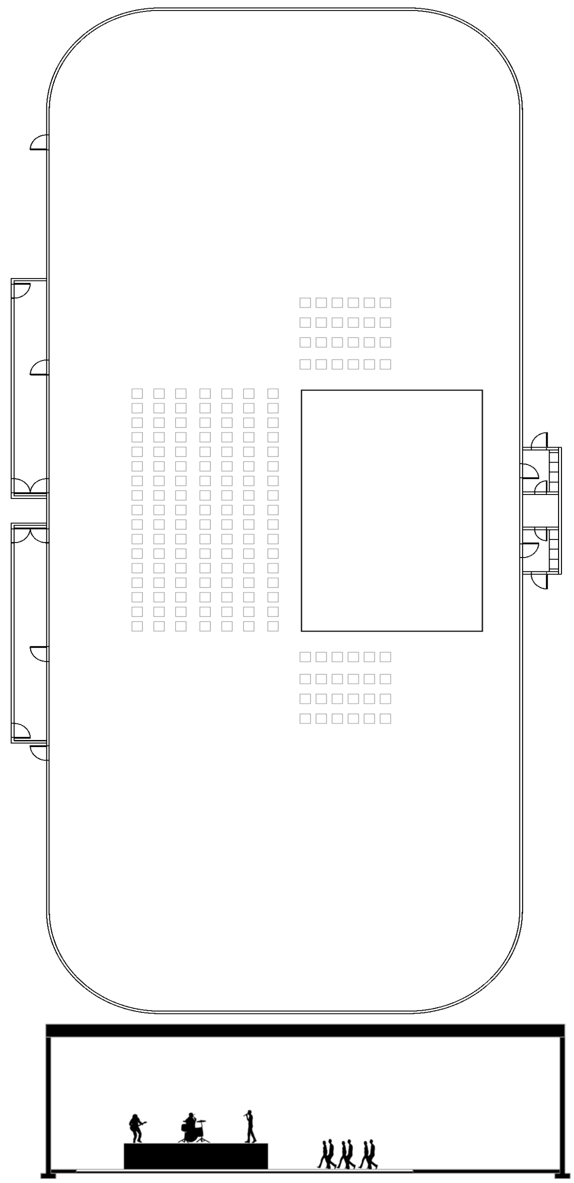
Flex-Flooring - Multiple Basketball Courts

5.0 Building Flexibility - Interchangeable Rink Surface

Arena Configurations: the rink surface area provide ample space in height and in width to serve the needs of almost any activity. The dismantled board system can be stored off site or within the large storage spaces provided.

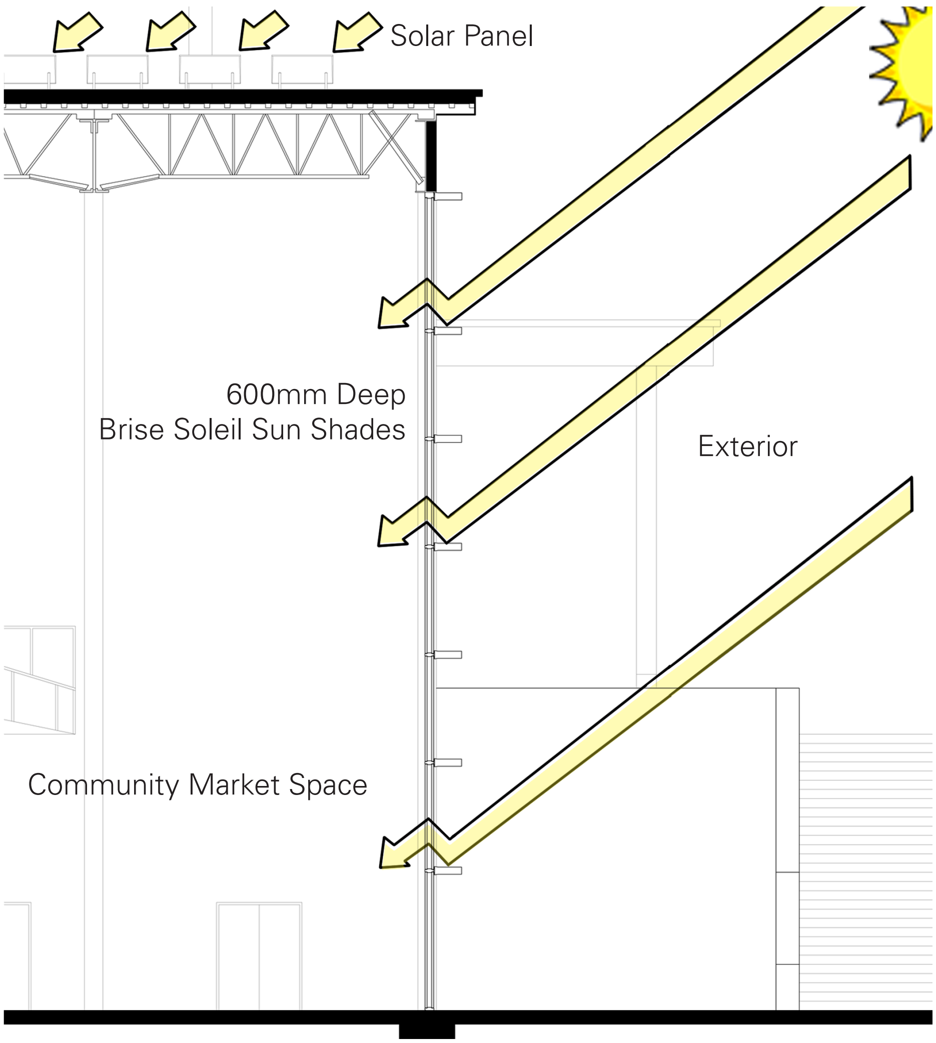


Flex-Flooring - Skating Park Configuration



Flex-Flooring - Concert, Convention, Market

5.0 Sustainable Building Traits



Solar panel collection is an integral part of the building design. Provided solar panels are located on a portion of the roof surface to help subsidies the building's operational costs. With a large flat surface area facing in the east/ west orientation, the upper unused portion of the roof is available to house numerous panels for this use.

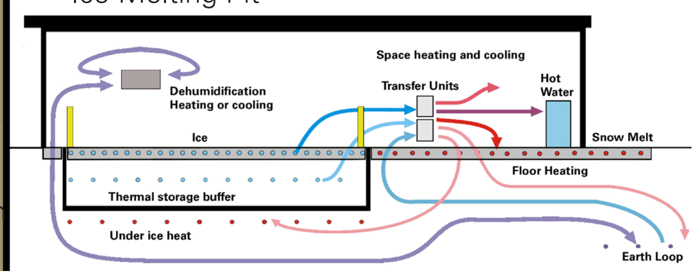
Section Through Market Space at West End

Brise Soleil

As a way to provide indirect natural day lighting into the building the use of 600mm deep pre finished aluminum brise soleil's along the south and west wall glass curtain walls will achieve this goal. By providing natural indirect light and with the transparency of the building will greatly reduce the amount of electric light needed to light the public spaces.

5.0 Sustainable Building Traits

Ice Melting Pit

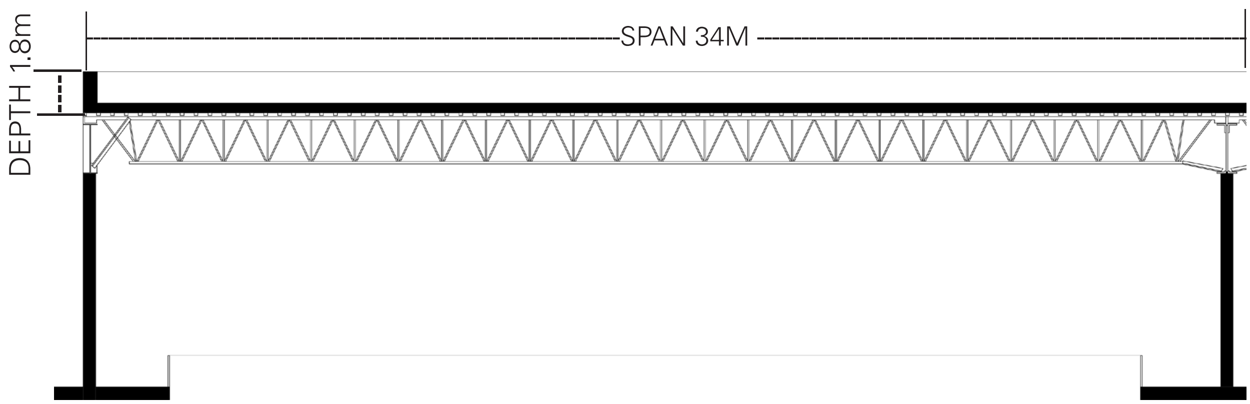


Section Through Rink at East End

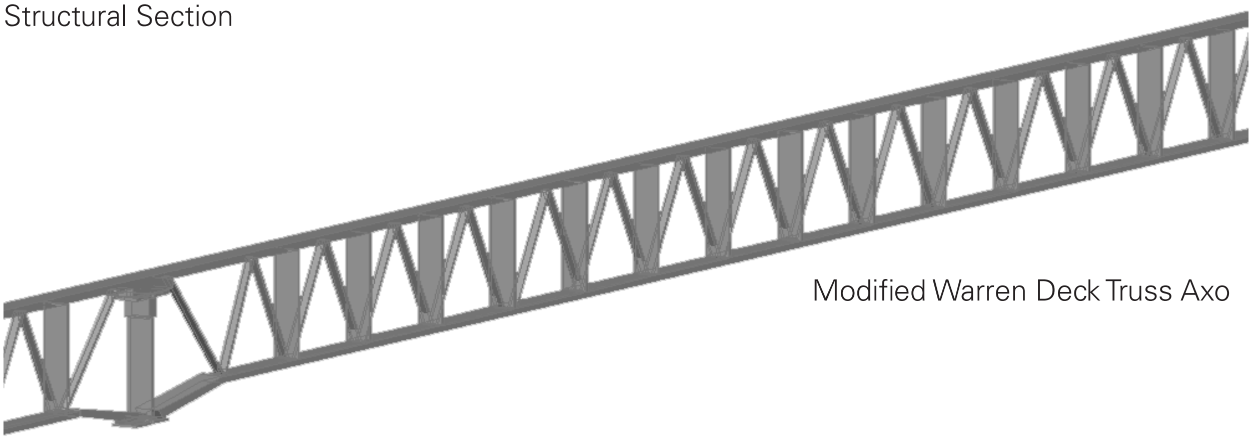
Geothermal Ice Refrigeration

As a opportunity to reduce the carbon footprint of the facility three sustainable concepts have been integrated into the building's design. Thermal mass has been implemented to reduce heat loss from the ice surface by offsetting the building into the landscape. Second the addition of an electric ice melting pit to reduce and recycle water from snow removal from zamboni cleaning and re-uses it over and over again to do the same function. Thirdly geothermal technology is implemented to run the ice refrigeration system from an earth loop system from bore holes in the earth. All three systems will provide beneficial and cost reducing traits aiding in the over all sustainability of the building.

5.0 Building Structure



Structural Section

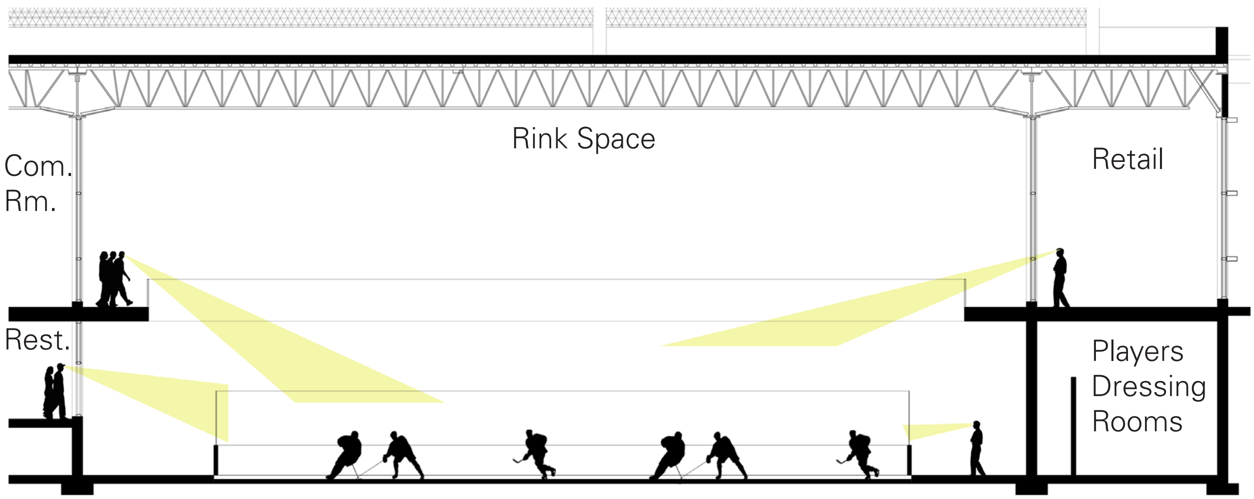


Modified Warren Deck Truss Axo

Structural Concept

Primarily the building structure is 400mm thick highly recycled ash poured concrete. Roof structure is comprise of 1.8m deep modified warren deck truss which has a clear span of 34m. This roof structure is able to support a factored load of 15.3kn/m^2 and a service load of 10.2kN/m^2, which is sufficient to support the green roof/ soccer pitch. Example: the design loads for car parks are often less than the office building they serve (2.4kN/m^2 versus 3.8 kN/m^2), leading to long floor spans of 16-18m. As noted the building materials are made of highly recycled materials reducing the carbon footprint of the building.

5.0 Building Transparency



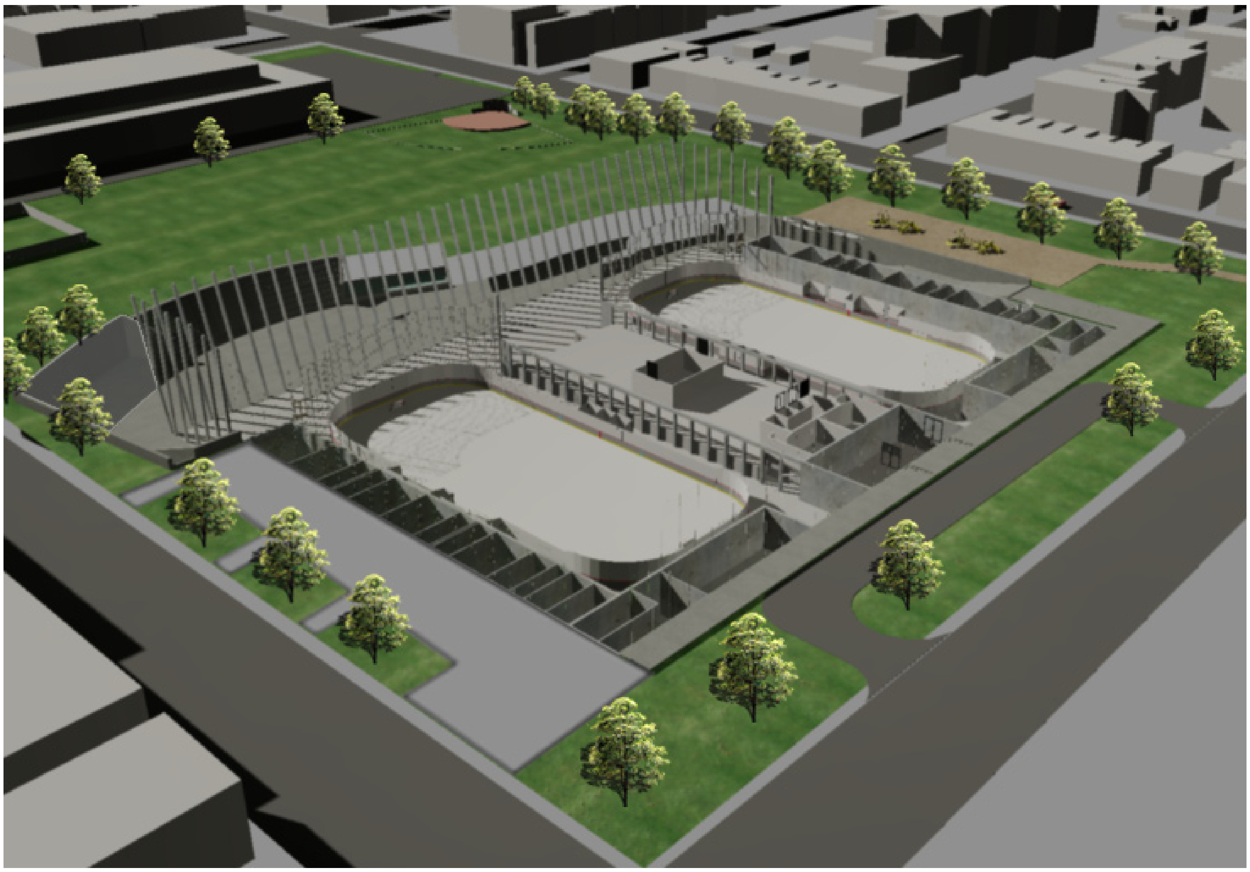
North/South Section Through Rink

An integral part of the building design is transparency. This building will provide multiple unobstructed formal and informal viewing areas through the interior and the exterior of the building as well as providing the opportunity to see what other activities are taking place around the facility.

Indicated within the diagram, users have the opportunity to view the ice surface from multiple levels, above and below grade, as well from within the rink area, from the restaurant/bar, from the community space as well as from the fitness club.

By increasing transparency of the building will showcase activities inside the building to the surrounding community, creating the opportunity for individuals to connect to activities they are normally not associated with. This creates the opportunity for new user groups.

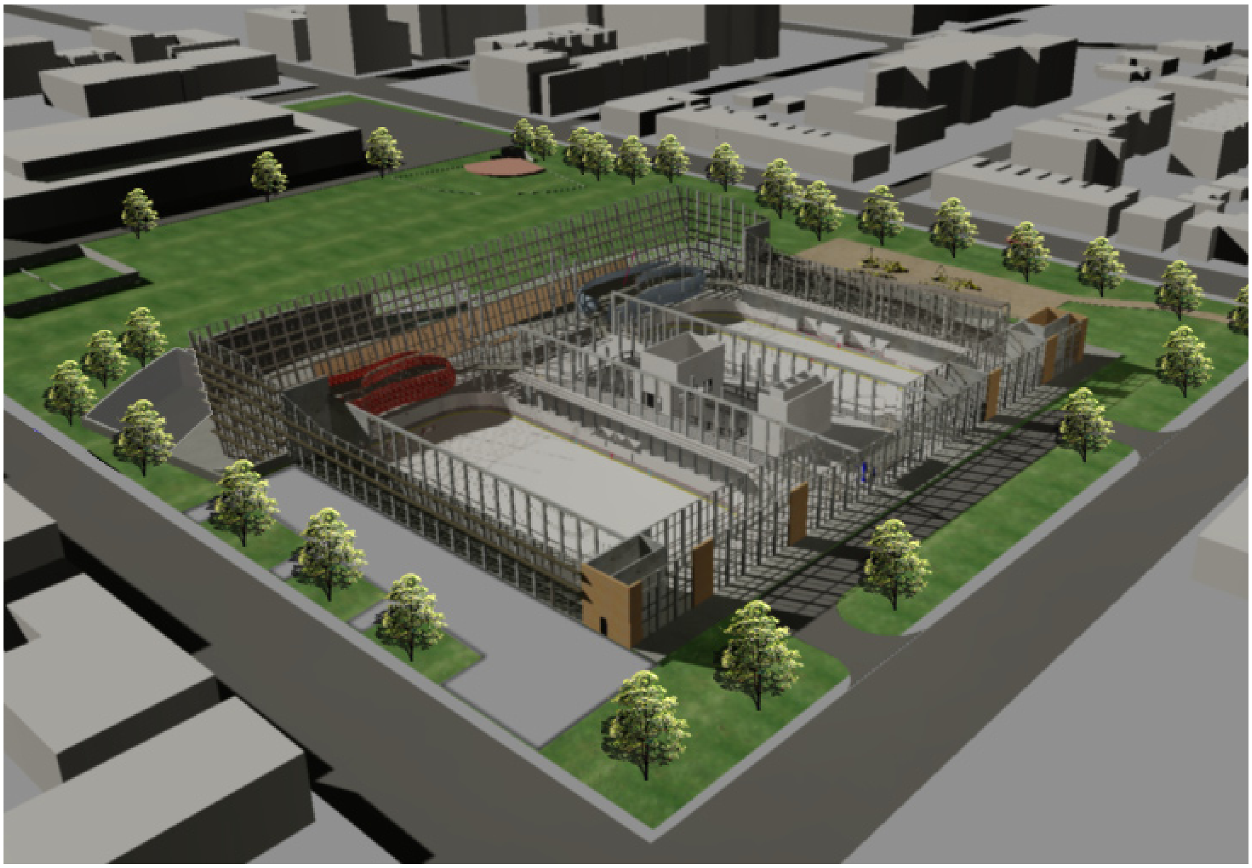
5.0 Building Layering - Lower Level



Lower Level

The lower level of the design proposal sees the location of the two ice surfaces in the centre of the facility, the player dressing rooms to the left and to the right of the ice surfaces, a restaurant in between the ice surfaces, the mechanical, electrical and refrigeration plant to the near side of the building and the building market square to the rear which opens into the sunken public square and park. The lower level is sunken into the landscape to take advantage of the sustainable building trait thermal mass.

5.0 Building Layering - Ground Level



Ground Level

The ground level of the design proposal sees the main entrance off of the street to a central public space, which on looks both arena surfaces from above. The central space then expands out into the market space into two large community pods which float suspended from the roof. To the left side of the building is multiple retail spaces, to the near side is a fitness club and bike storage and to the right is roof access. The building at grade is transparent to view directly or indirectly all of the activities which are taking place from street level.

5.0 Building Layering - Roof Level

Roof Level

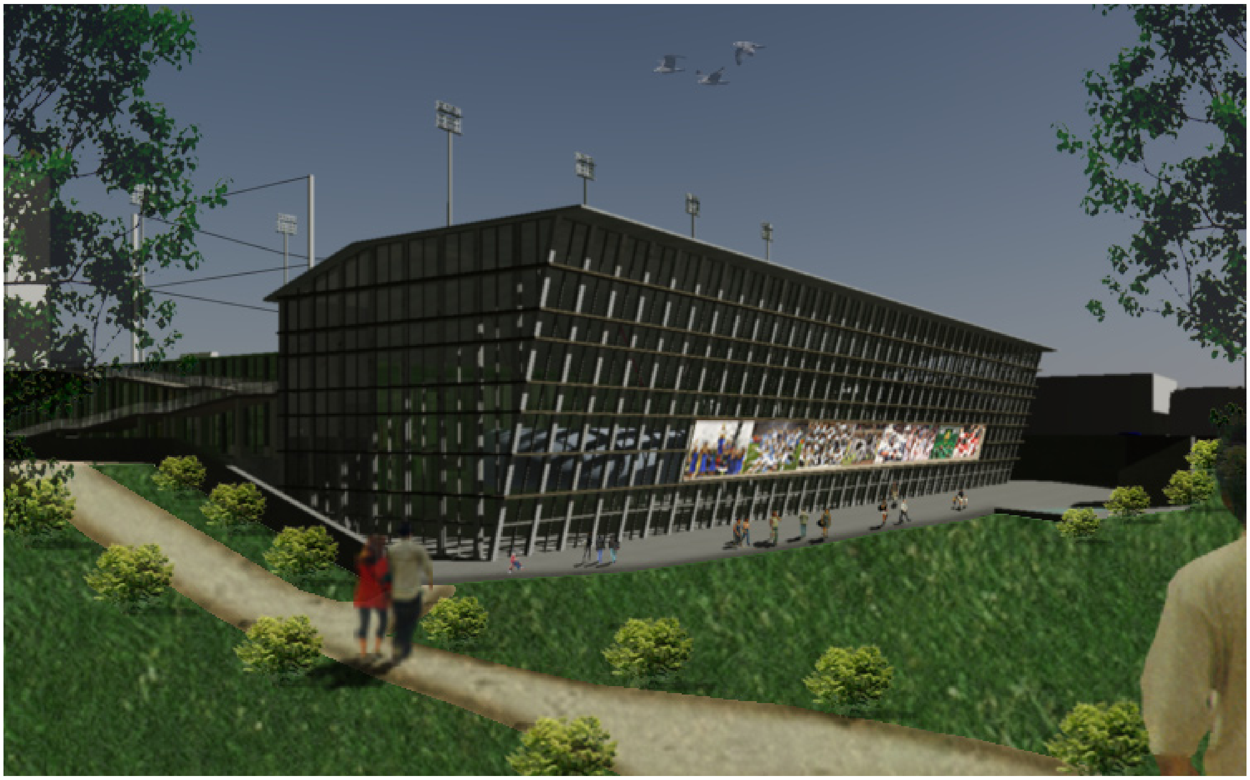
The roof level of the design proposal sees the location of the large soccer field green roof, which is enclosed with a large netting and lighting system. The green roof is used for capturing heat loss and surface water runoff and the additional roof space is used for solar collection which minimizes operational costs to the building. This productive roof space increases the buildings usage introducing new program space which has never truly existing in arena design.

5.0 South East Perspective

South East Perspective

Addressing the need for transparency the program of the building become viewable from the street. This creates informal interaction between the community and the buildings users. In addition to this view, the community is able to see the multi-layering of the programming which happens in and around the building, creating a sense of promoting health and fitness available to community at all times of the year, while providing ample amounts of additional program spaces for the community.

5.0 North West Perspective



North West Perspective

From all views of the building around the site the community is able to interact with the building which is am important trait on prolonging its sustainability. From the view from the north west of the site the community is able to view how the building is integrated into the site. The sunken public square becomes a transition zone between the exterior to the interior of the building. This outdoor space creates interactive spaces with users, the community and the building which never existed in arenas of the past.

6.0 CONCLUSION

The arena has the opportunity to be an extraordinary building type, a building type that could be a leader in sustainability for the future. This reconsideration and redesign of the arena has reconnected the user and the building once again, and it has converted into a destination which provides more than just a place to play hockey. The arena has the opportunity to provide flexible and multi-purpose spaces that will adapt to change and meet the needs of any changing community.

A re-evaluation to the existing program of the building, re-arranging current spaces and layout, and by strategically inserting new and flexible program spaces will increase user interactive and engaging spaces within the building. This will eventually increase the buildings usage as well as expanding its availability to other users.

This design proposal can be deemed successful because it addressing the three pillars of sustainability in its building design. The environment aspect is addressed through green technology, which reduces the environment impact and also providing cost saving features. These traits have greatly reduced operational and maintenance costs making the facility more affordable to additional users. By the building becoming part of the landscape, new and innovative sustainable design traits and additive program spaces have been added to the buildings design.

The economic aspect is address in which the building has become a new source of income generation for the city and for the community. Through the layering of programming (such as the addition of sports spaces for other sports and leagues), fixed and flexible retail spaces through stores. The market squares and providing places to eat and drink at the bar restaurant, will increase the number of people visiting and occupying the building, while generating money for user groups and the city.

Finally the social aspect is addressed by the addition of more public and private spaces through the community pods, the fitness centre, the roof playing field, and connecting all user groups visually, through the buildings transparency to public spaces and through new places of contact.

The arena redesign in this thesis has evolved the arena into a destination in which individuals can play, eat, shop, socialize with others, in an affordable and cost saving facility. The arena redesign provides a healthy environment for all users and provides precedence for other building types alike showcasing sustainability.

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APPENDIX A

Information to Gather On Field Trips

Name of Facility:

Project Location:

Primary Contact:

Year of Construction:

Physical Features:

Intended Users:

Demographics of Area:

Primary Heating Use:

Key Energy Consuming Uses:

Average Expenditures:

- Electricity Breakdown:
- Water:
- Thermal (Natural Gas):

Average Energy Consumptions:

Average Daily Consumptions (Electricity):

Average Daily Consumptions (Natural Gas):

Alternative Energies:

Parking:

Alternative Transportation Available:

Survey Questions

The following survey is intended for educational research only and hard statistics maybe released to provide metric for the area of study Sustainability of Sports Design. This survey will be distributed to Operational and Maintenance Managers at sports arenas, electrical/mechanical and architectural consultants at specific sports arena design firms, and the general public at a sporting event who will not answer all of the technical questions.

1. What is the current architectural trend in design of a multi-purpose sports or community centre?

2. Operational costs to run an arena facility?

a. Average annual estimate and expenditures on electrical and energy consumption?

b. Average annual estimate and expenditures on mechanical consumption? (ie water, and waste)

c. All other operational and maintenance related fees which do not fall under the two previous subtopics

3. Building Efficiencies

a. Are there currently any measures of cost saving within sports arena design?

b. Explain current processes and future possible processes.

4. Measures

a. What could possibly be done to better improve an existing facility?

b. What extent can we retrofit an existing facility?

5. Building Design

a. What type of knowledge of savings and alternative methods are you aware of to run a facility of this design?

b. What possible steps can we do as the public to make these green initiatives viable and important?

6. Affordability

a. Current fees of buildings applied to registration fees? (Facility, rental expenses)

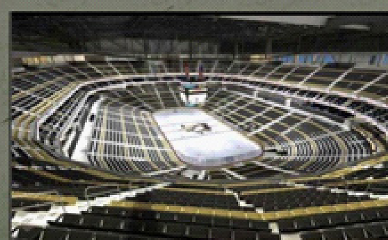
b. Can these fees be reduced?

c. How much will the lower the actual playing costs for the users?

APPENDIX B

Consol Energy Centre

Pittsburgh Pennsylvania



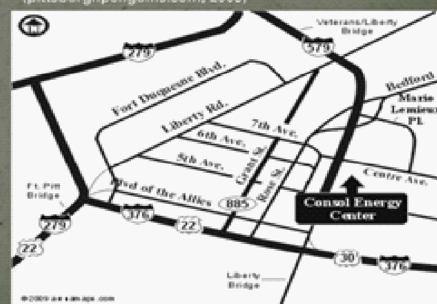
Introduction

- This arena concept is designed specifically for the NHL Pittsburgh Penguins
- Flexible enough for other uses. The facility will integrate with the downtown cityscape, creating stunning views of the city and skyline.
- The design features local materials, chosen to be distinct from the adjacent church, rather than to diminish the historical building.
- Integral to the overall design is the premise that the arena will assist in the ongoing revitalization efforts of the downtown Pittsburgh area and can be used as an example.

Profile of Facility

- Building Name: Consol Energy Centre
- Address: 5th Avenue Center Avenue & Washington Place
- Architect: Populous (formerly HOK Sport Venue Event)
- Client: Sports & Exhibition Authority of Pittsburgh and Allegheny County (Pittsburgh Arena Operating LP/SMG)
- Project Budget: $355 Million
- Visitors: N/A
- Project Completion Date: Fall 2010

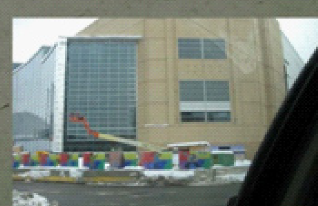
Consol Energy Centre – Pittsburgh Pennsylvania (pittsburghpenguins.com, 2009)



Consol Energy Site Plan – Pittsburgh Pennsylvania (arenamaps.com, 2009)

Design Idea

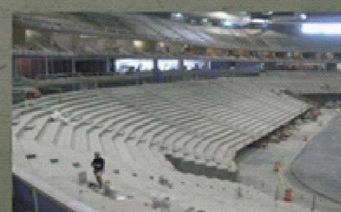
- 710,000 Square Foot New Ice Hockey/multi-purpose arena
- 18,300 seats for hockey, 19,000 for basketball, 14,536 End Stage Concerts and 19,758 Boxing
- Concession concourse with open viewing to playing surface
- Private lounge and 2,000 box seats, 66 Luxury Suites
- The latest state-of-the-art sports venue technology.
- Premium seating and site lines
- Retail corridor
- The arena will also include a concession concourse with open viewing to playing surface, private lounges and suites, premium seating, premium site lines and a retail corridor.
- LEED Gold Certified



Sustainability

- The arena will be LEED gold certified building which will be the only one of its kind in the NHL
- Facility will provide a brightly lit glass atrium along the Washington Place side of the building allowing patrons to view the city streetscape of downtown Pittsburgh and a spacious open concourse both which will bring in more natural light.

- Large amount of green space around the building, recycling, using materials bought locally for construction, the purchase of at least some electricity from "green" power sources, water management, indoor air quality, heating and cooling efficiency, and the selection of environmentally friendly paints.



- Many of the green features might not be readily obvious to fans and the public but they, too, will profit from better air quality, improved heating and cooling, and other environmentally friendly aspects.

What was Learned

- The Consol Energy Center would join 14 other buildings in Pittsburgh as gold-certified
- First LEED gold certified facility in North America
- Arena surface can be retrofitting allowing it to house other events and programs during a specified time frame
- Sustainable building technologies such as energy efficient items which will lower energy costs, natural lighting to minimize day-lighting, and increasing green space which allows for community interaction and engagement
- The entire project is seen as a way of regenerating a community which was lost in the 1950's due to the current arena which exists there today. The original arena is located across the street from the new facility and is part of the master plan to be demolished and integrates new program.


Site Photos

APPENDIX C

A collection of terms will appear frequently through the thesis|project report, there definitions are provided to get a full understand on how they are used while reading through the report. They key terms will highlight important areas of the arena which need attention and will be address in the final design proposal.

Community Arena:	Is defined as "a building (either stand alone or as part of a community centre) that offers one or more ice surfaces used for a variety of purposes other than curling".
Flex Space:	A room or space within a building responsive to change; or having the ability to be adaptable to something else
Life Cycle Status:	Refers to the view of a building over the course of its entire life - in other words, viewing it not just as an operational building, but also taking into account the design, installation, commissioning, operation and decommissioning phases. It is useful to use this view when attempting to improve an operational feature of a building that is related to how a building was designed. For example: overall energy consumption. In the vast majority of cases there is less than sufficient effort put into designing a building to be energy efficient and hence large inefficiencies are incurred in the operational phase. Current research is ongoing in exploring methods of incorporating a whole life cycle view of buildings,

	rather than just focusing on the operational phase as is the current situation.
Sustainability:	Is an outcome of a design philosophy which focuses on increasing the efficiency of resource use — energy, water, and materials — while reducing building impacts on human health and the environment during the building's life cycle, through better setting, design, construction, operation, maintenance, and removal. Though green building is interpreted in many different ways, a common view is that they should be designed and operated to reduce the overall impact of the built environment on human health and the natural environment.
Sustainable Building:	Increasing user involvement and user engagement and reinforcing them using green technology makes for a successful building type