A MODEL FOR COLD CLIMATE DESIGN

695,750 square feet

2000 employees

65% energy efficient

100% fresh air, 24/365

Manitoba Hydro Head Office
Winnipeg, Manitoba, Canada

Project Information

Client
Manitoba Hydro

Size
695,750 ft²

Schedule
2008. Fast-track delivery process for construction in 2.5 years.
Design initiated 2003

Location
Downtown Winnipeg,
Manitoba, Canada

Program
The 22-storey high-rise office building will house 2000 workstations for 2000 employees. Three-storey podium base contains retail and interior street; one level of parking below grade and an 18-storey office tower and two-storey mechanical penthouse above.

Cost
$258.0 million project cost inclusive of base building and interior fit-up construction, professional services, information technology, communications and security infrastructure, furniture, PowerSmart incentives and interest on capital.

Construction Systems
Cast in place concrete frame, with high performance unitized curtain wall facade, sits on caissons connected to the bedrock below. Key components within the building are: raised access floors provide for fresh air delivery system, along with power, data and telecom; geothermal heating and cooling power the radiant slabs and ensures even distribution and consistent temperature throughout year; natural ventilation through a double facade lengthens the shoulder seasons where this application is appropriate.

Principal Materials
Exposed architectural concrete, local Tyndall stone, and granite ensure high durability and ease of maintenance, and were selected for recyclable or reclaimable and favorable life cycle cost qualities. Reclaimed Douglas fir from the former building that occupied the site introduces warmth, character, and expresses the sustainable principles of the project

Project Constraints/Challenges
Located on a full city block, facing Winnipeg's main street. Major constraints/challenges focused on building a large scale energy efficient building with 100% fresh outdoor air 24/365 in a climate that varies 70 degrees Celsius over the course of the year, with temperatures dropping to minus 50 degrees Celsius with windchill and rising over 30 degrees Celsius in summer months. Additional challenges related to creating a building that is connected to the downtown, to activate the city's urban revitalization strategy.

Zoning Constraints
As one of the key initiatives inWinnipeg's Downtown Renewal Objectives this project received the full support of the city and had no zoning constraints. Primary condition was to link into the city's skywalk system to create sheltered pedestrian connections for extreme weather.

A Model For Extreme Climate Design

The new head offices for Manitoba Hydro will create one of the most energy efficient large-scale buildings in the world and establish a model for extreme climate design. Manitoba Hydro is the province of Manitoba's sole supplier of electrical power and natural gas resources. Its new office building will be located in downtown Winnipeg, a city situated at the geographic center of North America and is the coldest large city in the world. Temperatures vary 70 degrees Celsius over the year, dropping to minus 50 degrees Celsius with wind chill factor, rising to plus 30 degrees Celsius during summer months. It also experiences unusually strong southerly winds and an abundance of sunshine throughout the year.

Urban Catalyst

Winnipeg is also challenged by an aging building stock, deteriorating infrastructure, and a history of out-migration of young people. The new head offices will have a significant impact on the the city's urban revitalization strategy by bringing 2000+ employees to downtown Winnipeg. The consolidation of the dispersed workforce, currently located in 12 leased offices in the suburbs, will also have a significant impact on the company's work culture and productivity. To that end, the project prioritizes a healthy, connected and supportive workplace.

60% Energy Savings, 100% Fresh Air, Maximum Daylight

The design of the 695,750 ft^2 office tower is targetting a 60% plus reduction in energy consumption. The new building will save the corporation $15.0 million in annual operating costs. Included in this total terms is $7.0 million in annual lease costs by amalgamating 12 leased Hydro offices to one location. The remainder of savings will be realized through enhanced energy efficiencies, productivity improvements, co-location of employees and other design features. The client also recognizes that the quality of indoor air and natural light is critical to worker productive. Offices will have 100% fresh outdoor air 24/365 and fully glazed building envelope with unobstructed floorplates ensures

Maximum Solar & Wind Exposure

The building occupies a full city block. Its form and massing was generated by solar orientation. Two towers converge at the north and splay open to the south to capture strong prevailing south winds and sunlight. North and south stacked atria fuse the masses together at each end and function as solar collectors, air exchangers, handlers and shafts. The solar chimney, a tall thin slab, intersects the north end of the building at the main entrance. To prevent wind tunnel effects for pedestrians at street level, prevailing winds are tamed by large entrance canopies. Inside a three-storey interior street runs along the solar axis of the building to connect the north and south entrances. Structural and glazing systems emphasize lightness and transparency to mitigate the overall mass and scale of the building and to maximize daylight for the reduction of artificial lighting systems.

A Highrise Community

The project will accommodate 2000 workstations in a 22-storey high-rise office building. The plan organization creates a symbiotic relationship between the building's respiratory system (north and south atria) and the organizing principle of vertical neighbourhoods to encourage communication, clarify orientation and build community in the highrise tower, and to ensure fresh air and maximum exposure to daylight.

The typical floorplate of 20,000ft² net is divided into smaller precincts organized around a series of stacked 6-storey atria. The atria connect to office floors and stairs, encouraging vertical circulation to maximize face-to-face communication and collaboration between people and departments.

Identity & Image: Scale, Energy, Utility, Sustainability

The building's scale and expression references man-made and natural power sources and associations with Canada's North: power dams, boreal forests, and expansive landscapes and skies. References are also embedded in the materiality (stone, glass, concrete) and in the integration of feature elements such as large-scale water fountains and art installations. Every space, detail, material has been selected to ensure the building communicates Manitoba Hydro's commitment to responsible energy consumption, energy reduction goals, and sustainable design practices.

Site

The new head offices for Manitoba Hydro will be located at 360 Portage Avenue in downtown Winnipeg, Manitoba. Winnipeg is, for most Canadians, associated with the 'middle of nowhere' but in fact it is located at the geographic centre of North America.

Winnipeg is a city of extremes: extreme fluctuations of the weather in winter and summer, infestations of mosquitoes and predilection to flooding, strong southerly winds and an abundance of sunshine throughout the year. Downtown Winnipeg itself is challenged by its aging building stock, deteriorating infrastructure, and a history of out-migration of young people.

The new head offices for Manitoba Hydro were conceived as a key participant in the city's urban revitalization strategy.

Middle of Nowhere, Center of North America


WINNIPEG

A Climate of Extremes

Floods

Subject to severe floods - the last was in 1997.

Coldest and Hottest Temperatures

Winnipeg lies in an unprotected arctic trough which channels cold arctic air south, across the Canadian shield and Prairies making it one of the coldest large cities in the world, with temperatures dropping to minus 50 degrees Celsius from mid-November to March and sometimes exceeding plus 30 degrees Celsius in the summer months.

Abundant Sunshine

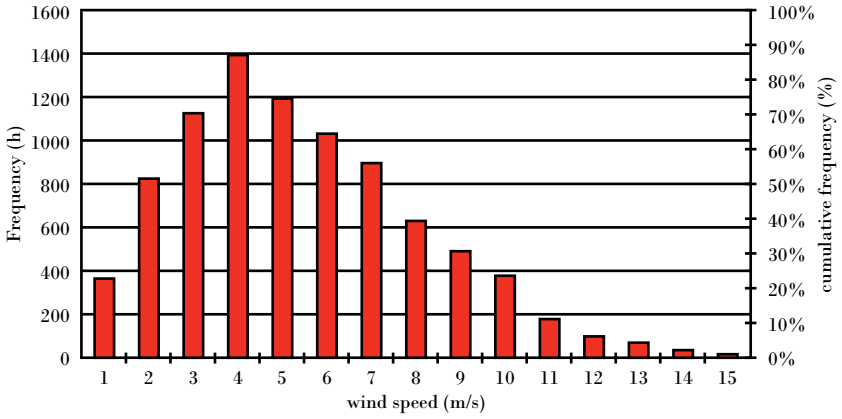
An abundance of sunshine throughout the year. One of the sunniest locations in Canada.

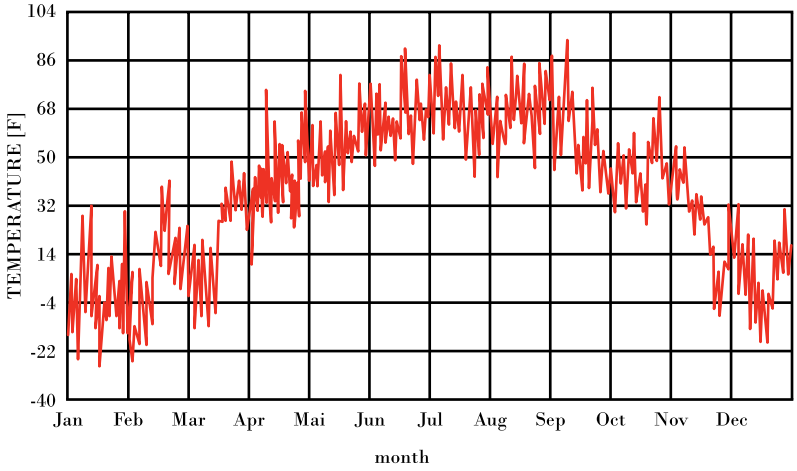
Lots of Precipitation

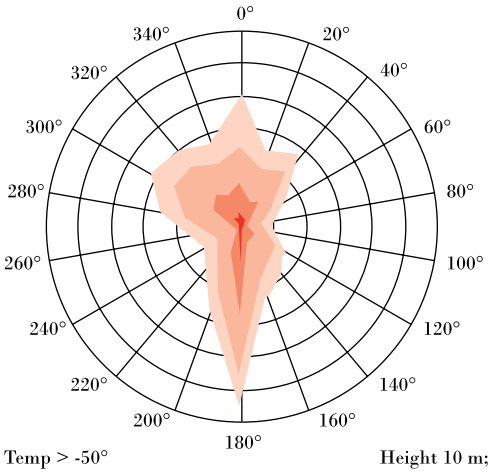
Most precipitation - in rain or snow - than any other Prairie city.

Windiest Intersection in Canada

Winnipeg is subjected to strong southerly winds. Downtown Winnipeg is centered at the intersection of Portage Avenue and Main Street, one kilometer from the Forks of the Red and Assiniboine Rivers, and from here, known as the windiest intersection in Canada, all roads radiate outwards.







Temp > -50°

Height 10 m; wind velocity profile exponent: 0.22

Wind Rose

Objectives

"Manitoba Hydro's new head office building in downtown Winnipeg will be a functional, state-of-the-art energy efficient (Power Smart), cost-effective structure that embodies and demonstrates Manitoba Hydro's commitment to sustainable development. While meeting the business needs of Manitoba Hydro, the office building will have a positive impact on the future of Winnipeg's downtown and be a source of price for Manitobans."

1. Urban Design

Use one building as a tipping point to the positive and proactive stimulus to urban revitalization by connecting the building to the city, and to the image of the city and its skyline

2. Global Standards in Energy Efficiency and Sustainability

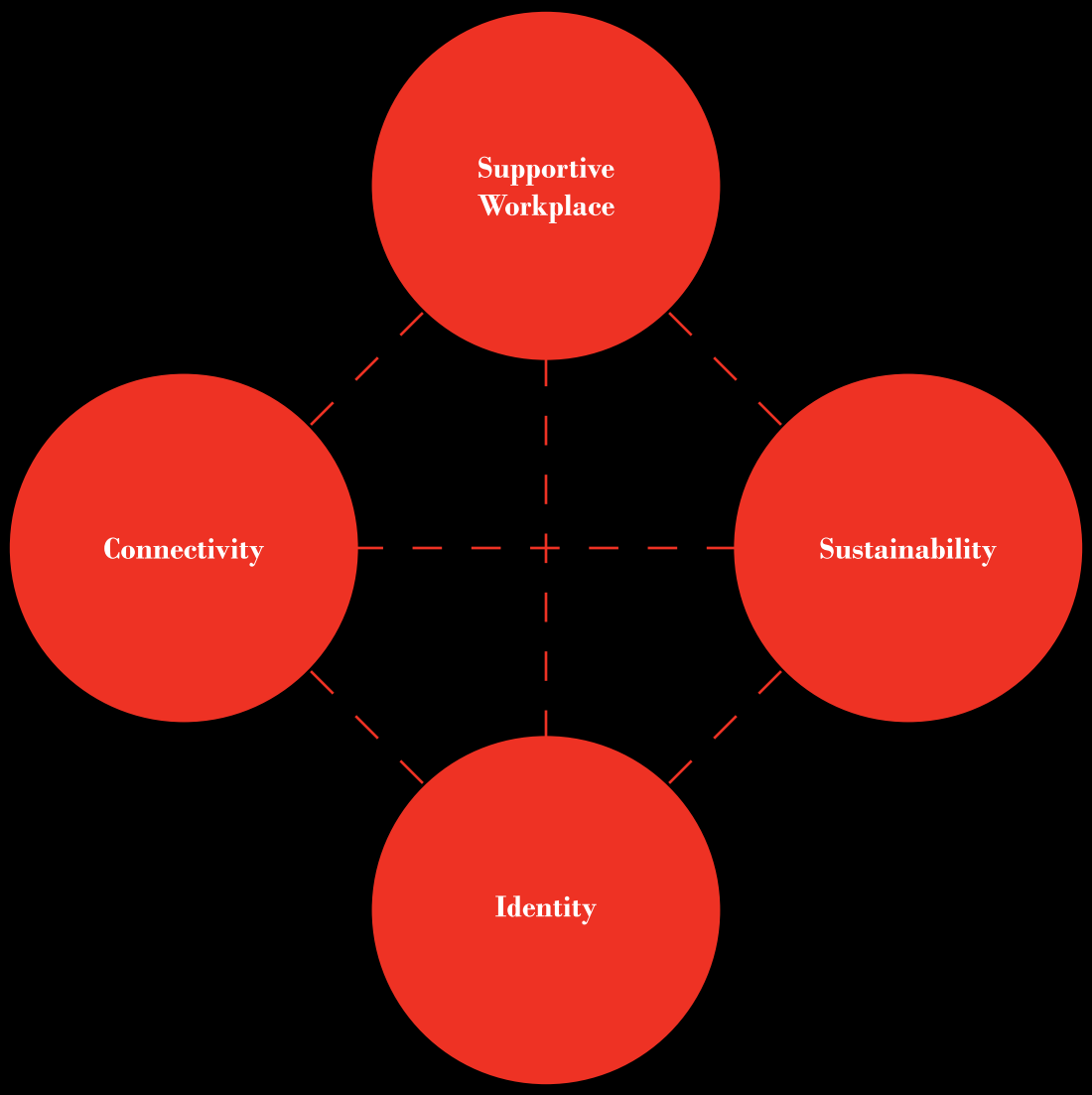
Surpass C-2000 IDP certification requirements and achieve 60% more in energy efficiency than the Model National Energy Code Building and use holistic approach to achieve LEED rating (GOLD).

3. Supportive Workplace

Create a healthy, productive work space with efficiencies of systems and quality of workplace environment; not only efficiencies of area, must drive the design.

4. Identity

Create a visible embodiment and demonstration of Manitoba Hydro's commitment to responsible energy use and to the future development of Winnipeg's downtown.

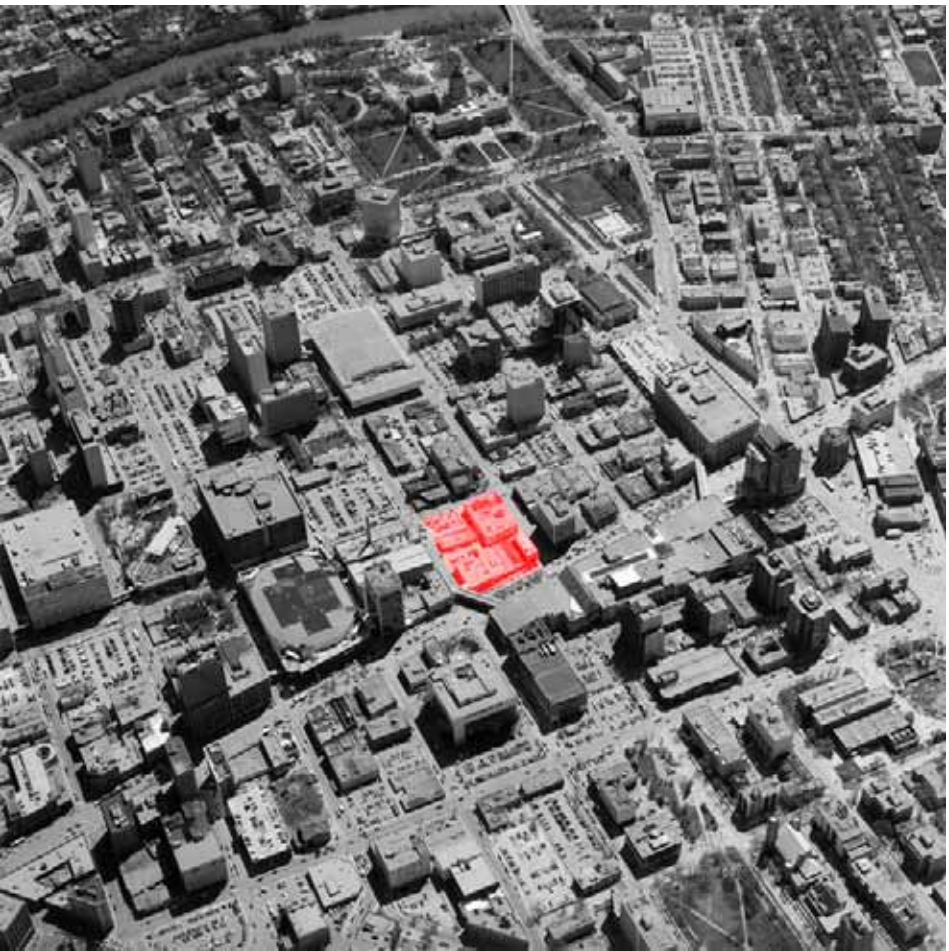

Supportive Workplace
Connectivity
Sustainability
Identity

Context

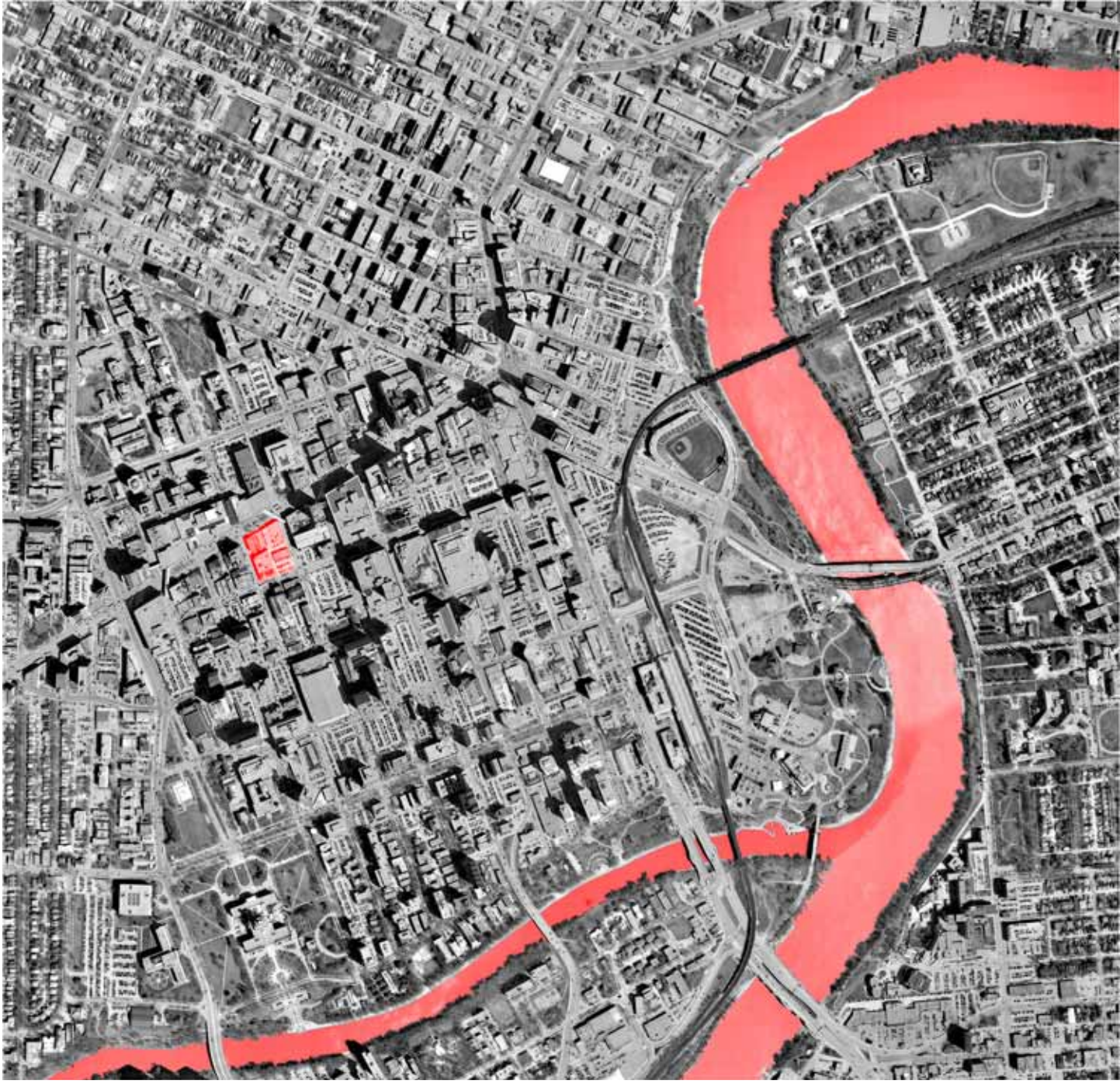
The selected site encompasses a full city block on the south side of Portage Avenue between Carlton and Edmonton Street extending south to Graham Avenue. Portage Avenue is the city's main street and one of the busiest with four lanes of traffic running in each direction and a central boulevard. It is a typical example of the wide thoroughfares that are characteristic of Winnipeg's downtown. The scale is similar to Michigan Avenue in Chicago but the lack of critical urban mass in the downtown makes it feel like a ghost town.

The site is also within proximity to the elevated walkway system that provides sheltered links between buildings during extreme climate conditions. The new building will connect to the Skywalk via a bridge linking it to Portage Place, the city's major retail mall.

Pedestrian and bicycle routes, public transporation and the creation of weather protected walkways were studied in depth to ensure the new building would be plugged into the city's infrastructure to perform as an active, integrated hub in the downtown.



aerial view from north



How do you make a building that activates the city when people don't go outside for at least 6 months of the year?

Integrated Design Process

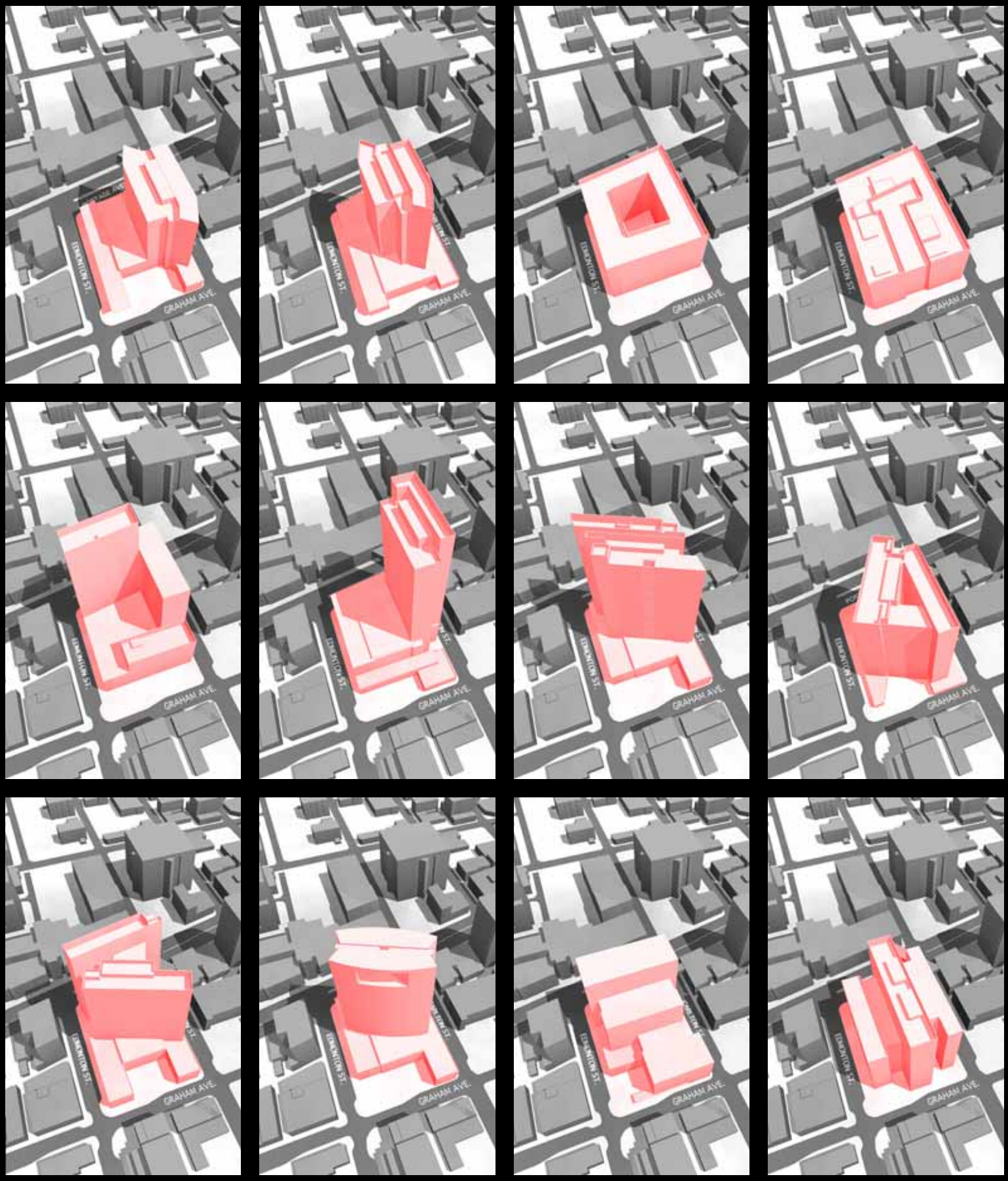
Building = Product of IDP

To ensure not only all goals were embodied in the design and in the right balance, the client mandated that the project use the C-2000 Integrated Design Process (IDP). A Project Charter was developed to identify a common understanding for the overall intent and principles of the project and to form the basis for the initial design direction and for future documents such as the Basis of Design that define criteria to evaluate these principles.

Design Charettes: 15 Schemes, 3 Options

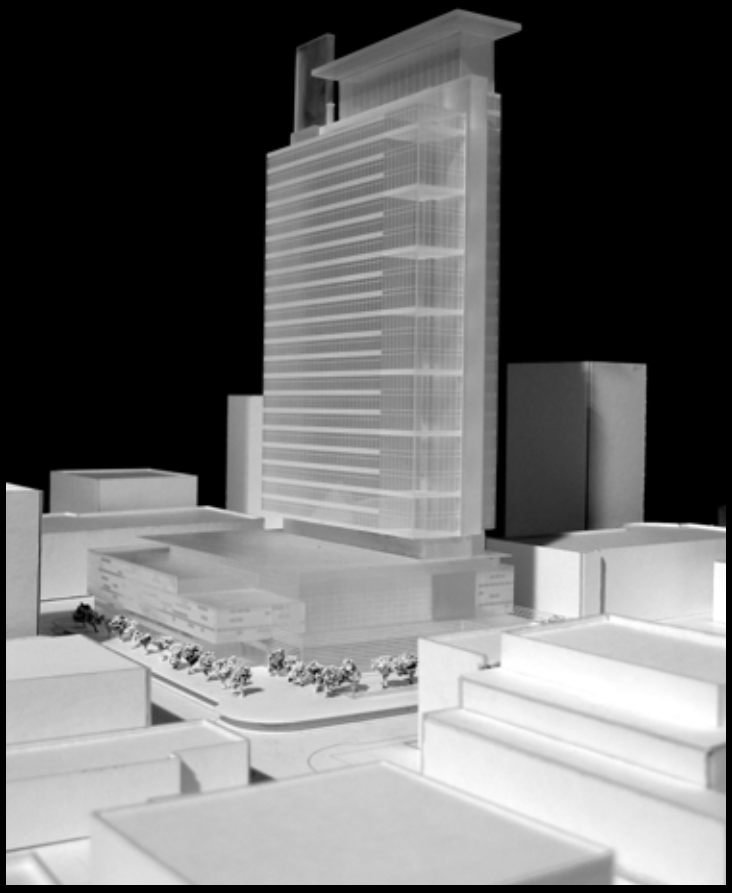
A series of facilitated workshops and design charettes were conducted with the client, design team and a series of specialists such as an energy consultant to ensure all information was available and that decision-making would be highly informed. 15 schemes were initially generated from which 3 were selected. The 3 options were put through a filtering process, evaluated against a relentless checklist and 1 option was selected for development. While each option had similar elements which all met the overall criteria, the decision-making process was based on which option could best delivery their energy requirements.

The design process took nearly a year and throughout the design emphasis was on integrating advanced building systems, passive and active, to achieve a highly livable, adaptable, and efficient work space environment.



various charette schemes

1. Urban Design



option A; 1:500

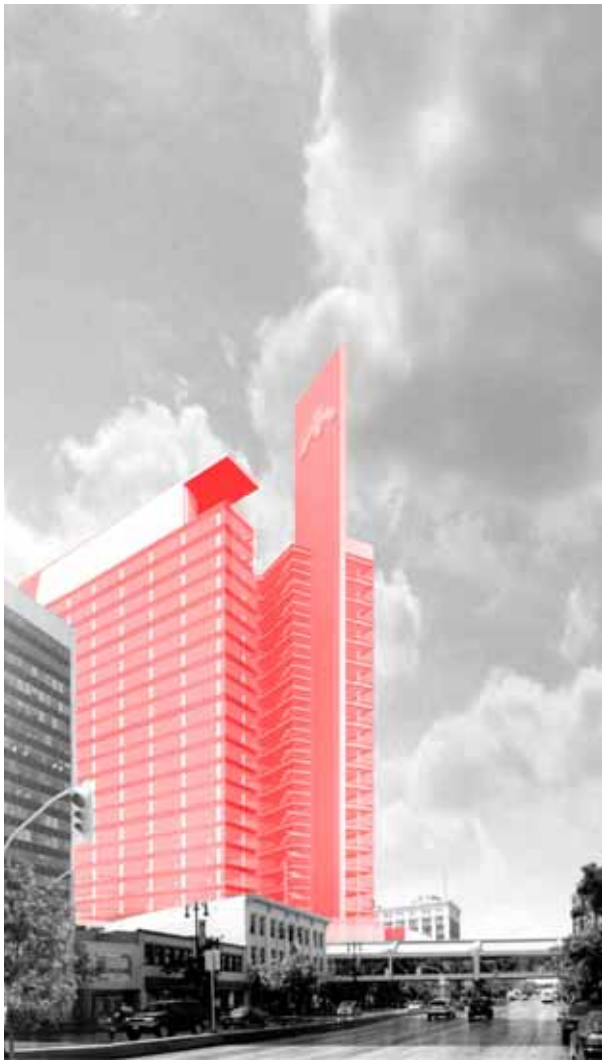
option B; 1:500

option C - final charette pre-design scheme; 1:500

Urban Context Explorations

street view studies eastward from portage ave. and memorial blvd

view from the forks; historical center



street view studies; westward along portage ave.

Orientation and Massing

The building form and orientation capitalize on Winnipeg's extreme climate for passive systems for natural light, ventilation, heating and cooling

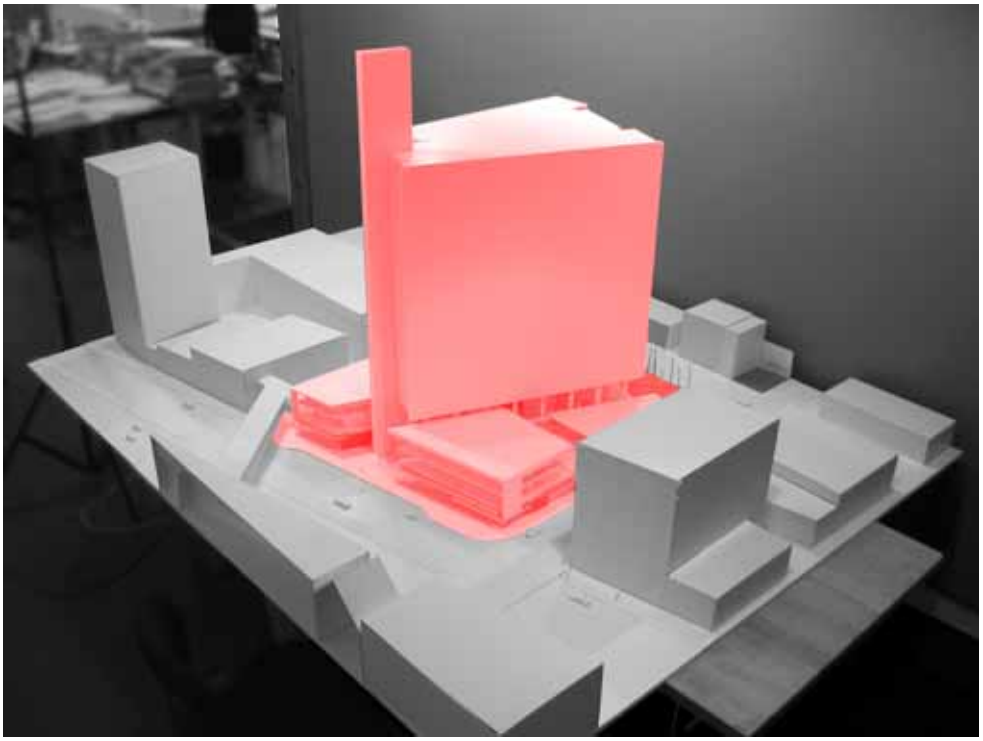
The Building's orientation establishes visual links and axes to the city's Legislative buildings and the historic centre, known as The Forks. The form and orientation was determined by the solar orientation resulting in a building that splays open to the south to capture prevailing gusting winds and southern light.

North and south atria stitch the masses together through their light structure and highly transparent voids. The Solar chimney at the north end of the building joins symbolically the two splayed masses and signifies the entry point along Portage Avenue. This form and orientation optimizes passive systems for ventilation, heating and cooling where the three and six story atria function as solar collectors, air exchangers, air handlers, and air shafts. Optimized solar exposure maximizes the building's south area and minimizes north facing surfaces to take advantage of the sun's passive warming effect on air as it rises through the south atria in the winter months and to reduce thermal loss through the north side of the building

Prevailing winds from the south, although a prime driver for the natural ventilation of the building, needed to be tamed for the pedestrians at grade a large south canopy, slung below the main zinc canopy level mitigates pedestrian wind created by gusts funneled down the south atrium façade, and provides a large protected area.

A connection to the downtown skywalk system is made at the north end of the entry hall proximate to the Solar Chimney.

model view from north



model view from northwest; 1:500

1. Urban Design

study model; 1:100

revit generated model view; north east

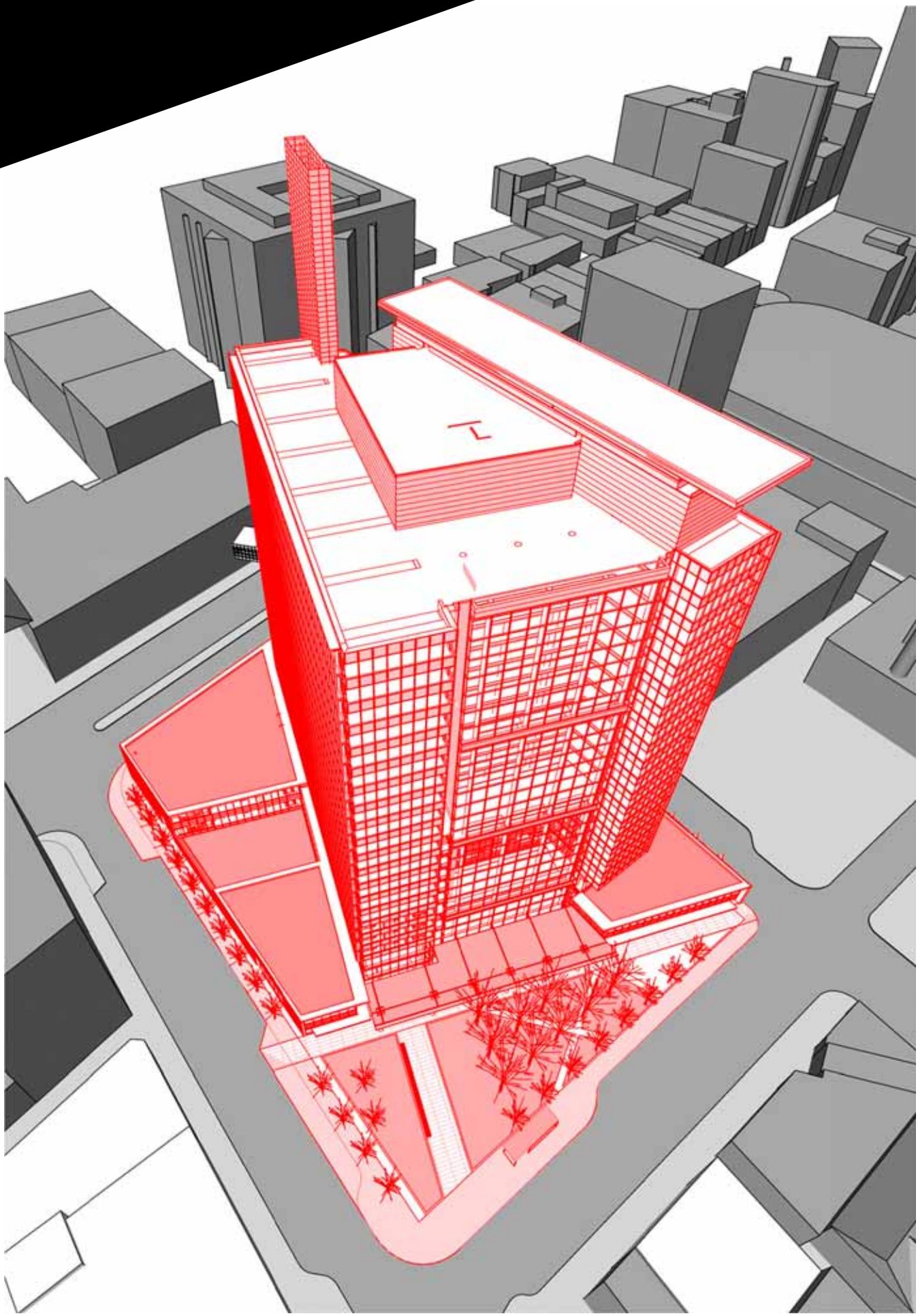
Solar South

A triangular public green space at the south, along Graham Street, marks the south end of the entry hall corridor, its connection to Graham's public transit corridor and the main pedestrian axis through the site.

Retail frontages are set along all four sides with Edmonton Street and Portage maintaining the strongest links to the pedestrian activity at grade.

The three storey entry hall divides the podium mass along the solar axis of the building with a Tyndall stone wall and zinc canopy wrap unifying the east and west podium masses. This two and three storey podium is elevated by continuous retail glazing at grade and dark stone figures marking the exit stairwells.

The client is focusing a knowledge-based retail strategy versus service-based to encourage employees to support the downtown economy. To that end, brand chains will be discouraged.



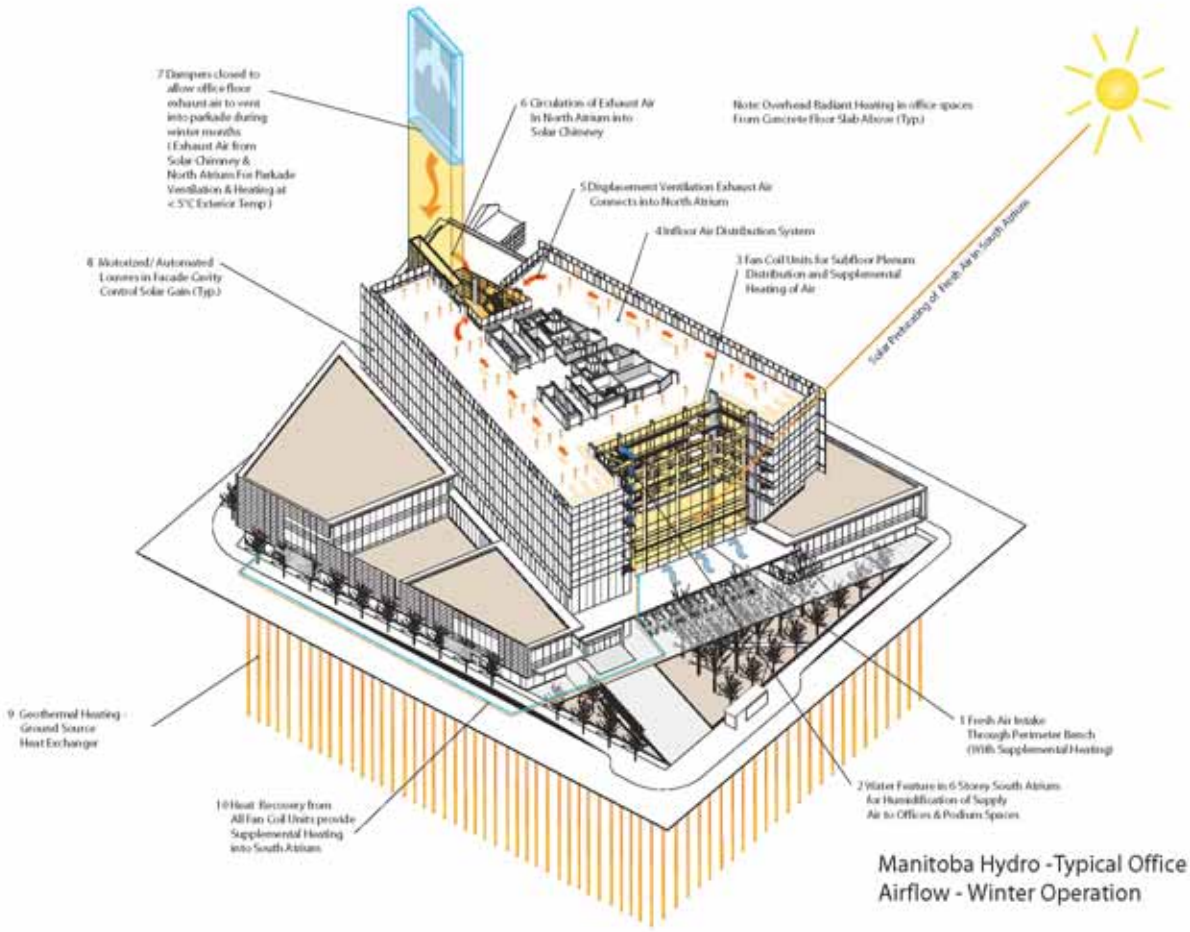
revit generated model view; south west

various study model; 1:100 and 1:200

landscape site study; graham ave.

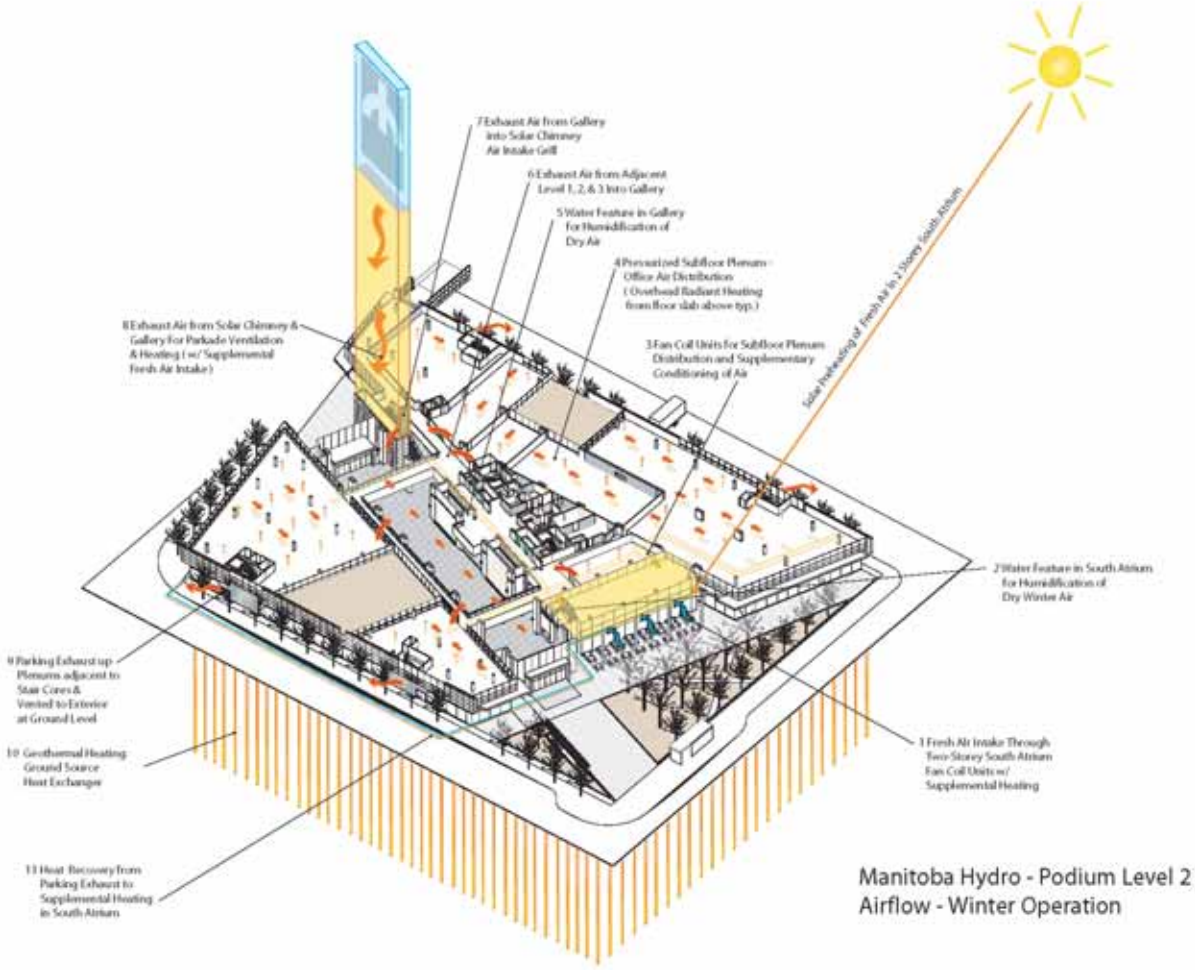
Energy Efficiencies

- 100% of cooling load and 50% of heating load is covered by geothermal heat pump system.
- A living “green” roof with mosses, grasses and lichens.
- Exposed radiant ceiling slabs - maintained at 68 degrees Fahrenheit year round.
- Atria to provide conditioned fresh air.
- A solar chimney to enhance fresh air ventilation.
- Glazing designed to maximize daylight and reduce artificial lighting.
- Energy efficient lighting, pumps and drives.
- A double external wall to reduce heating and cooling requirements in extreme temperatures.

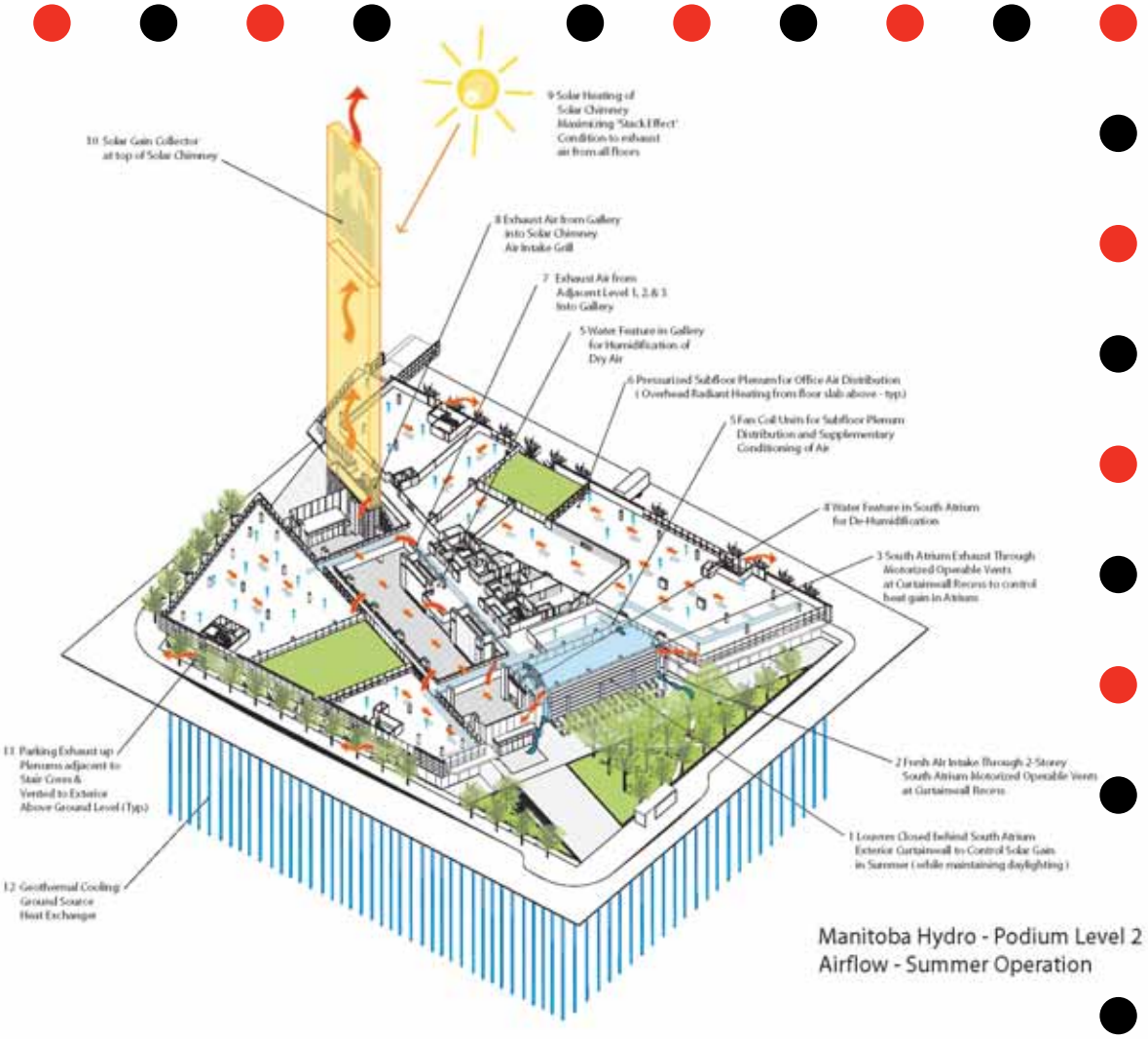


Manitoba Hydro -Typical Office Tower Floor Airflow - Winter Operation

Seasonal Modes



Manitoba Hydro - Podium Level 2
Airflow - Winter Operation

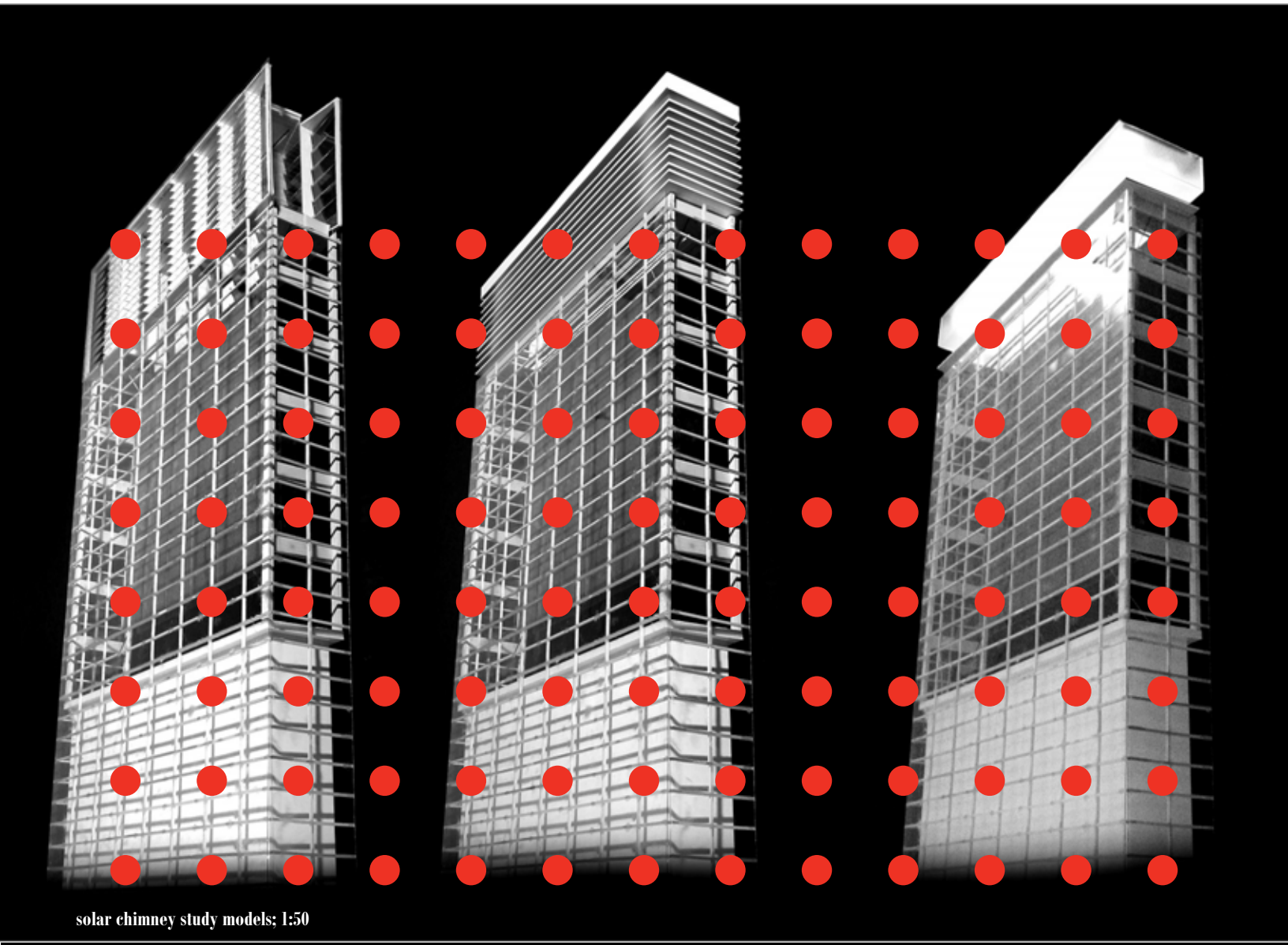


Manitoba Hydro - Podium Level 2
Airflow - Summer Operation

Mechanical Lung

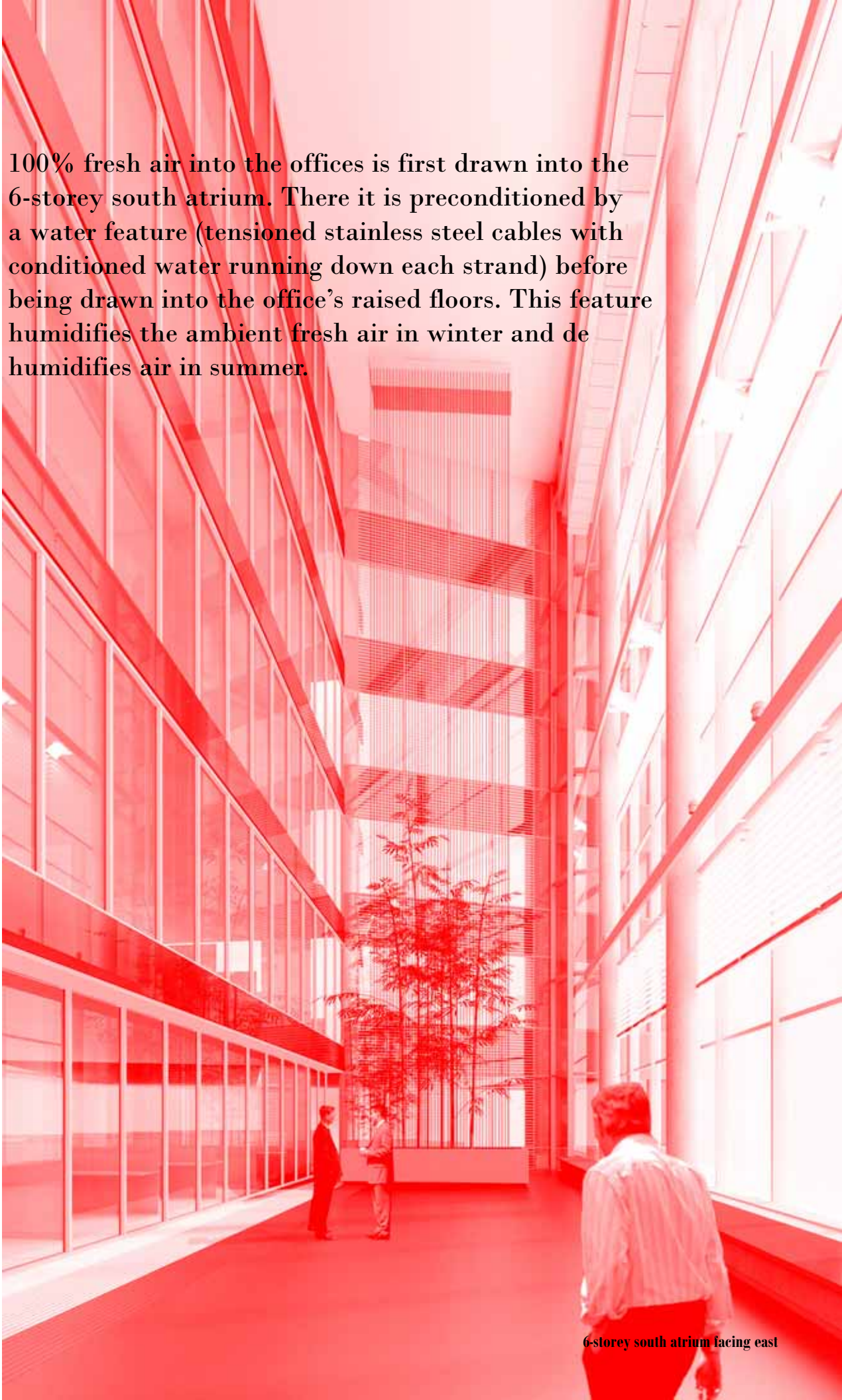
Naturally driven displacement ventilation minimizes the need for a 'forced air' circulation system. Here the south atriums act as the building's "lungs" providing natural displacement ventilation via a raised floor. Fresh air is drawn in on the south side of the atria and is conditioned as it mixes within the volume. The North atriums (and entry gallery) act as collectors for exhaust air before it is drawn up (or down depending on the season) the solar chimney.

During the heating season the parkade is heated with exhaust air routed from the solar chimney.



solar chimney study models; 1:50

- 100% fresh air into the offices is first drawn into the 6-storey south atrium. There it is preconditioned by a water feature (tensioned stainless steel cables with conditioned water running down each strand) before being drawn into the office's raised floors. This feature humidifies the ambient fresh air in winter and de humidifies air in summer.



6-storey south atrium facing east

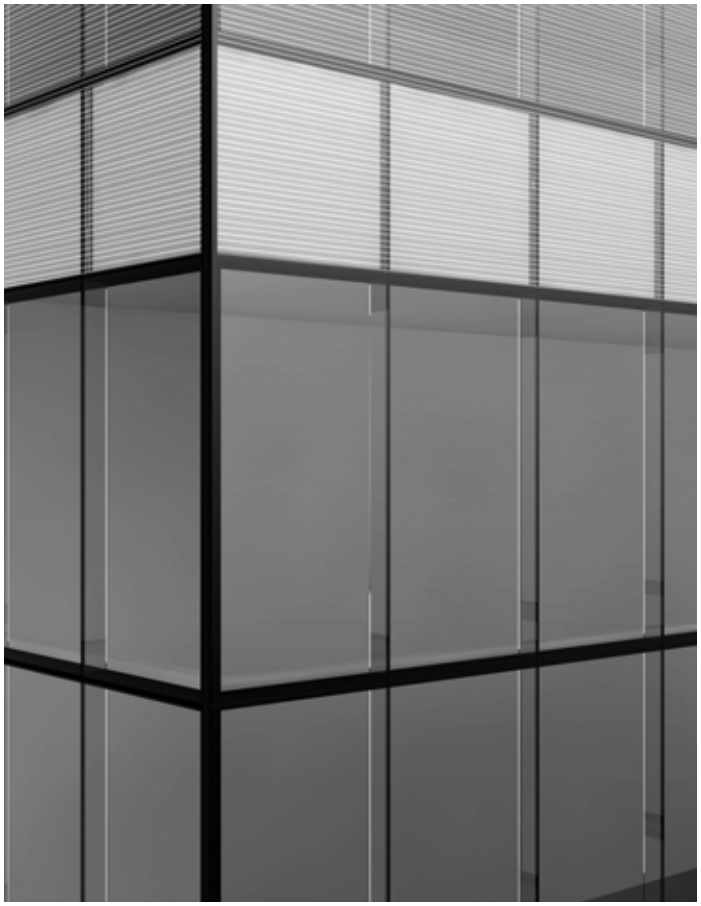
High Performance Building Envelope

A double façade on the west and east facades creates a high performance envelope which reduces heating/cooling loads by providing a tempered buffer to extreme outdoor temperatures. Operable windows on the inner and outer walls of the double façade permit natural ventilation at seasonally appropriate times of the year.

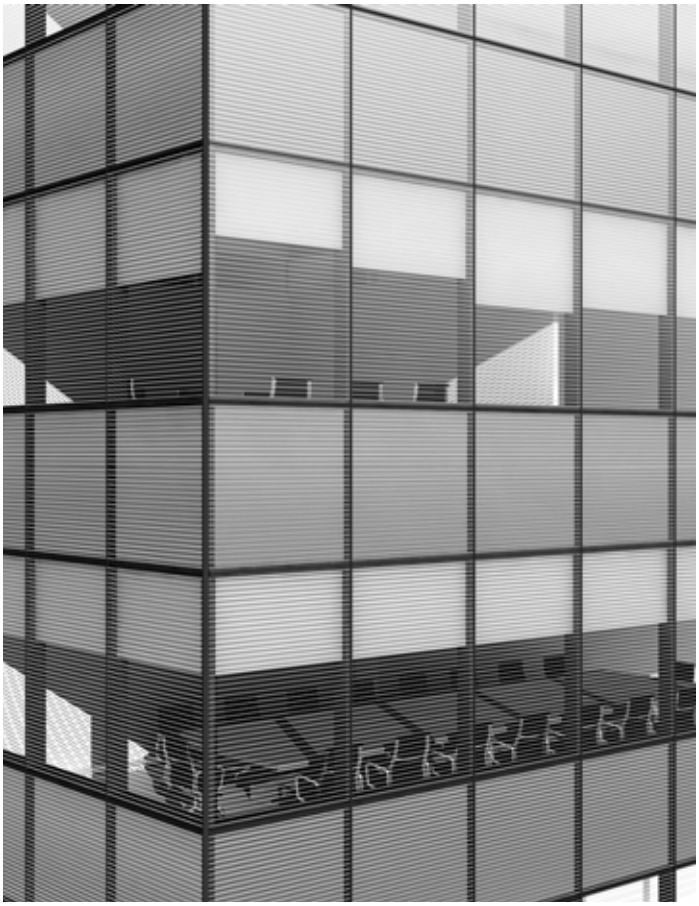
Each tower slab has three distinct exterior faces. These are associated with the two envelope assemblies; Double Wall (east and west facades), and high performance Single Wall. The North and South atrium enclosures, that join the two tower slabs, are paired assemblies as well, using an enlarged double wall cavity as the towers preconditioning space.

The Solar Chimney cladding, is present both externally and internally, accomplished by combining a high performance insulated panel system with a simple single glazed unitized system, whereby the insulated panel would be deleted at interior conditions.

The podium's main cladding systems is primarily a wrap of local limestone, (Tyndal stone) contained within zinc wrap . Secondary systems to this are the entry gallery's clear span glass mullion façade and the retail glazing at grade. The connection between the tower and the podium is made through a recessed system, which has two levels of performance. Under the East tower slab is a high performance glazed assembly and is proximate to occupied Manitoba Hydro space. Under the west tower slab it is typical of the exterior glazing in the tower's double wall assemblies - a simple double glazing IGU assembly.



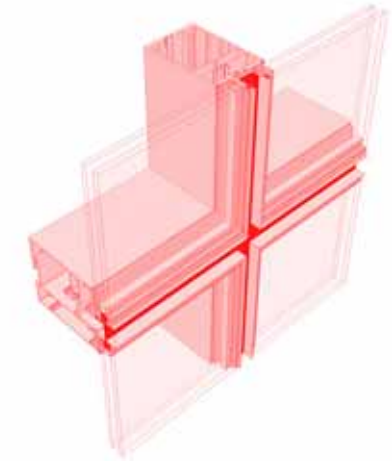
computer model curtain wall studies; podium to tower

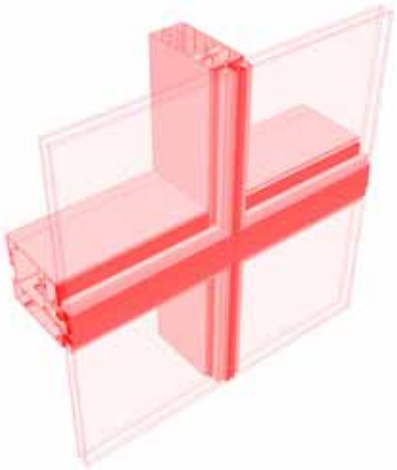


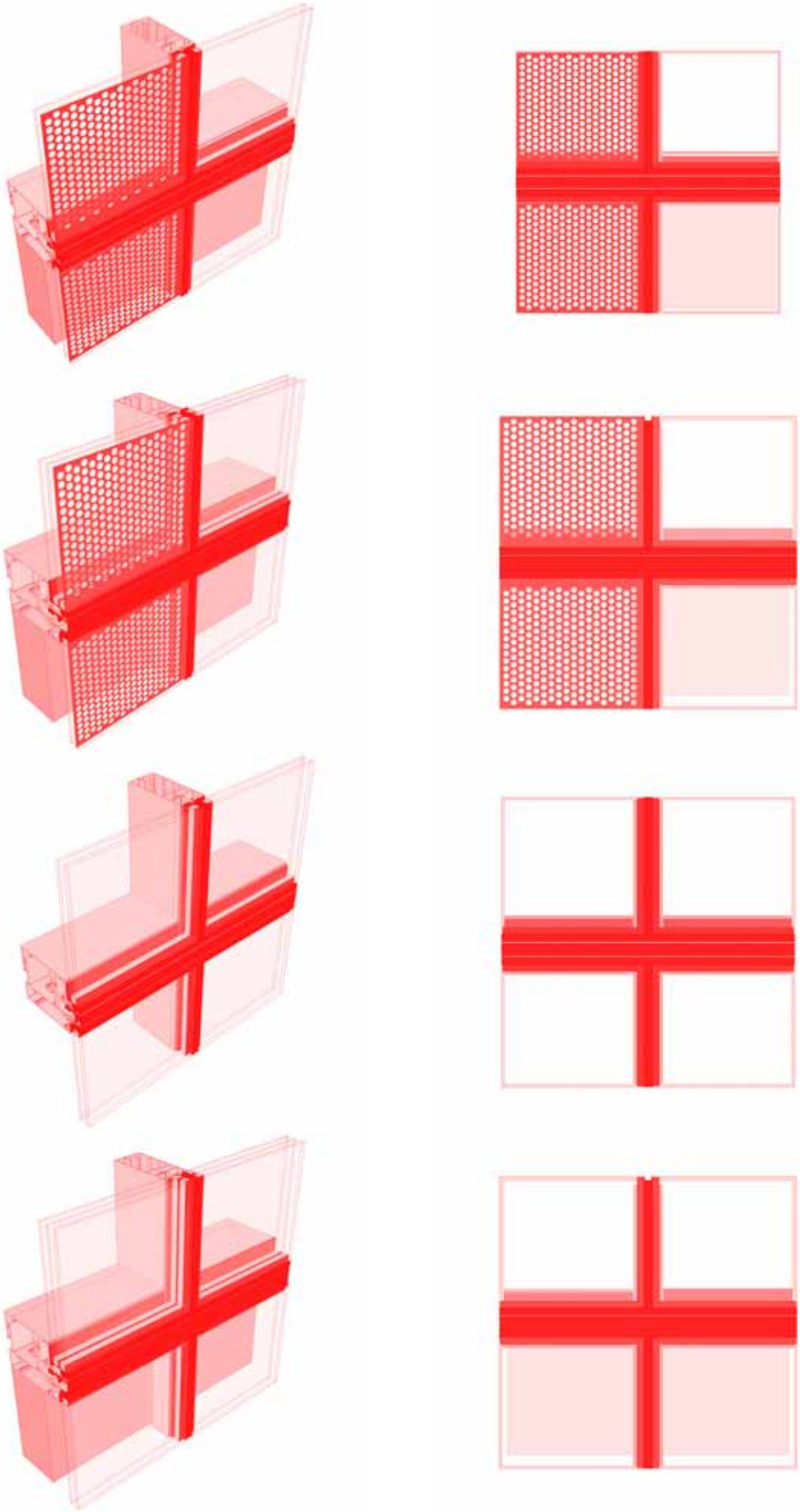
typical tower ends

east and west double facades

south atrium







unitized curtain framing studies

What are the implications to a corporate culture when 2000 employees are relocated from 12 leased offices across the suburbs into one central downtown location?

The major advances in civilization are processes that all but wreck the society in which they occur.

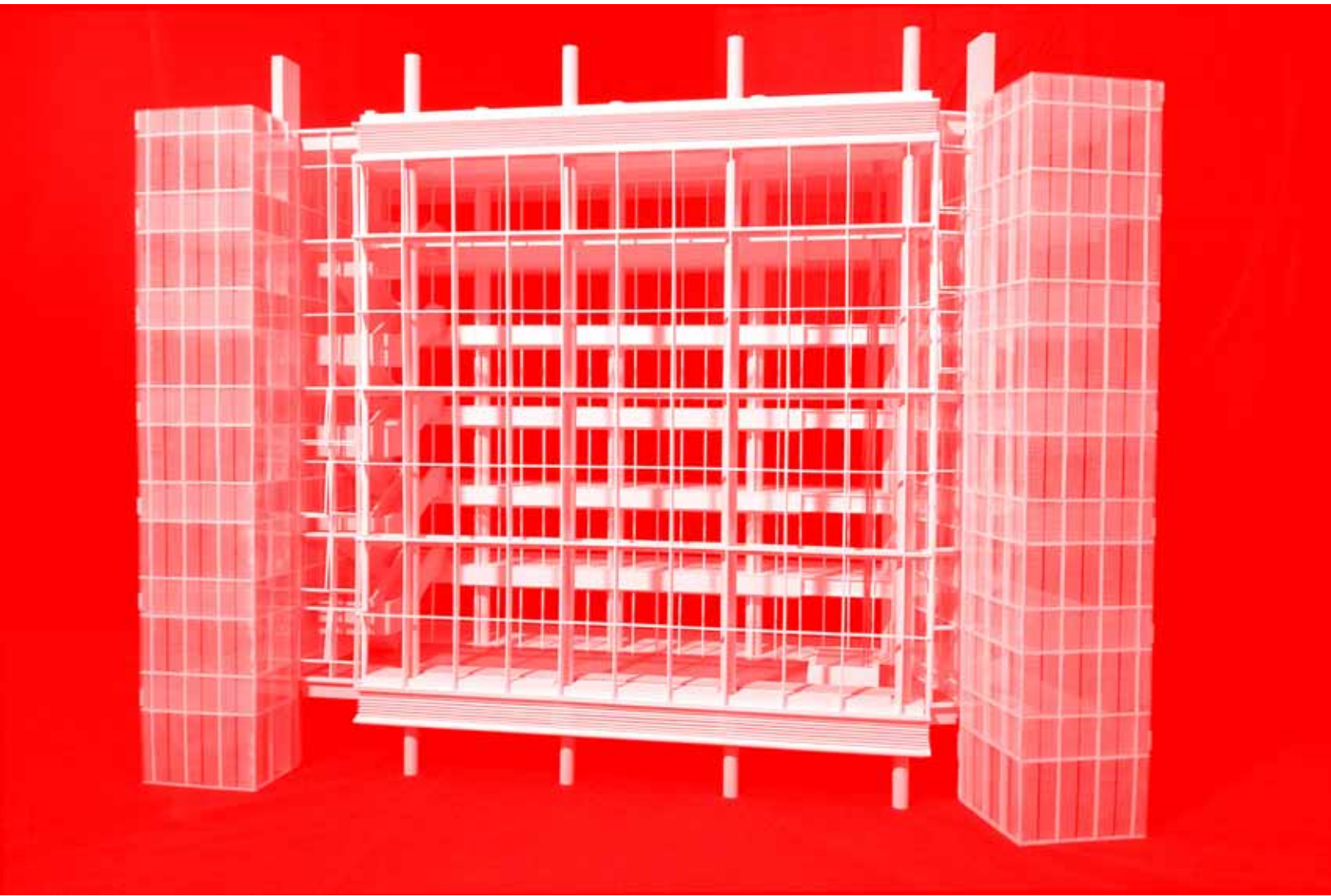
- A.N. Whitehead, from Marshall McLuhan's *The Medium is the Massage*

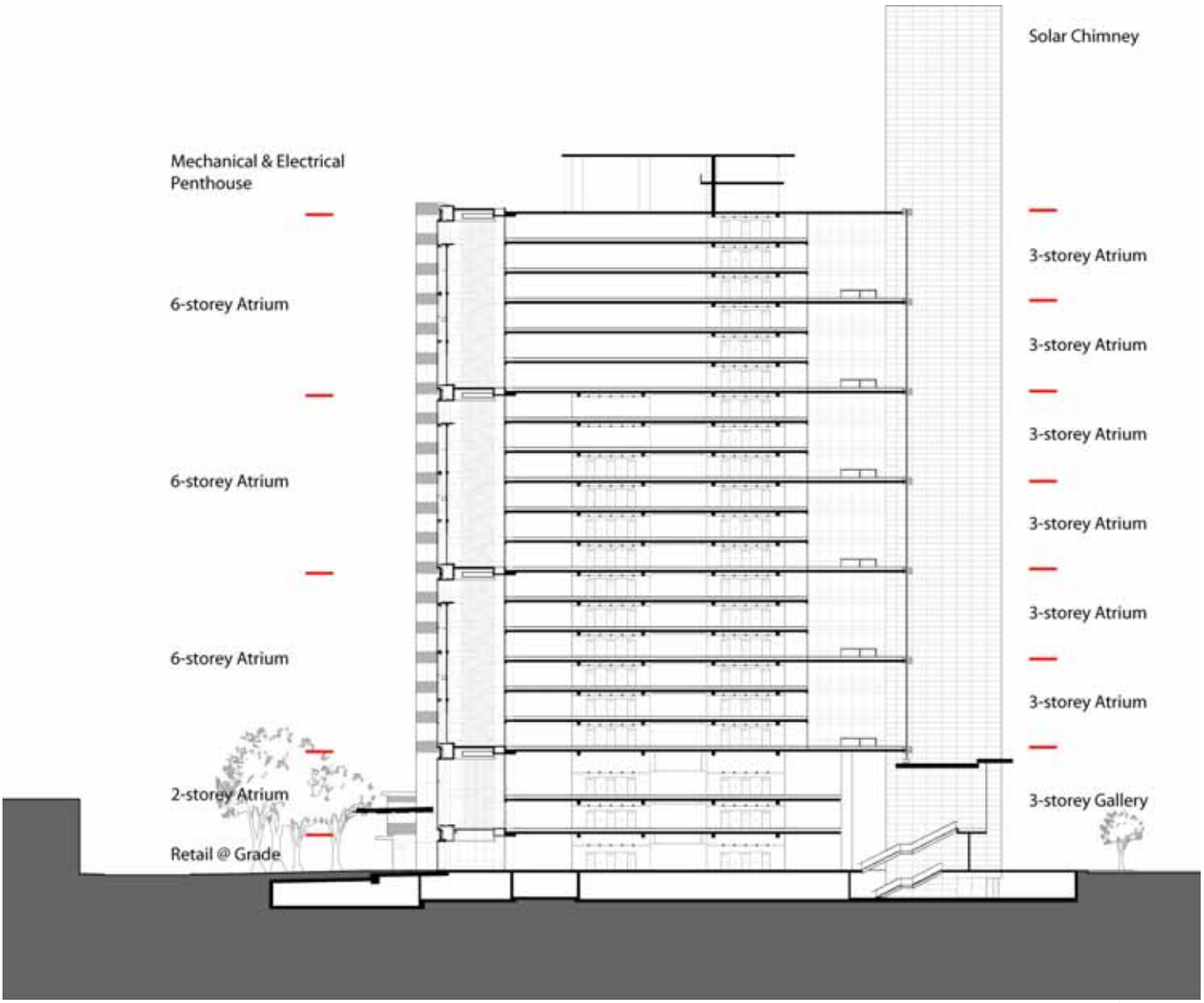
Vertical Neighborhoods

The plan highlights the symbiotic relationship between the building's respiratory system (north and south atria) and the vertical neighborhood organizing principle that enhances communication and orientation and creates a sense of community. The typical floorplate of 20,000ft^2 net is divided into smaller precincts organized around shared atria. Six 3-storey north atria and three 6-storey south atria connect the office floors with vertical circulation provided by generous stairwells. This allows business units and divisions to be kept together, meeting program adjacency requirements, in addition to supporting internal communications, and encouraging interaction.

The 11.5 meter deep, column and grid-free interior office loft space ensures there are no space planning limitations to facilitate change in the corporate organization and to adapt new technologies etc.

study model for 6-storey south atrium; 1:50

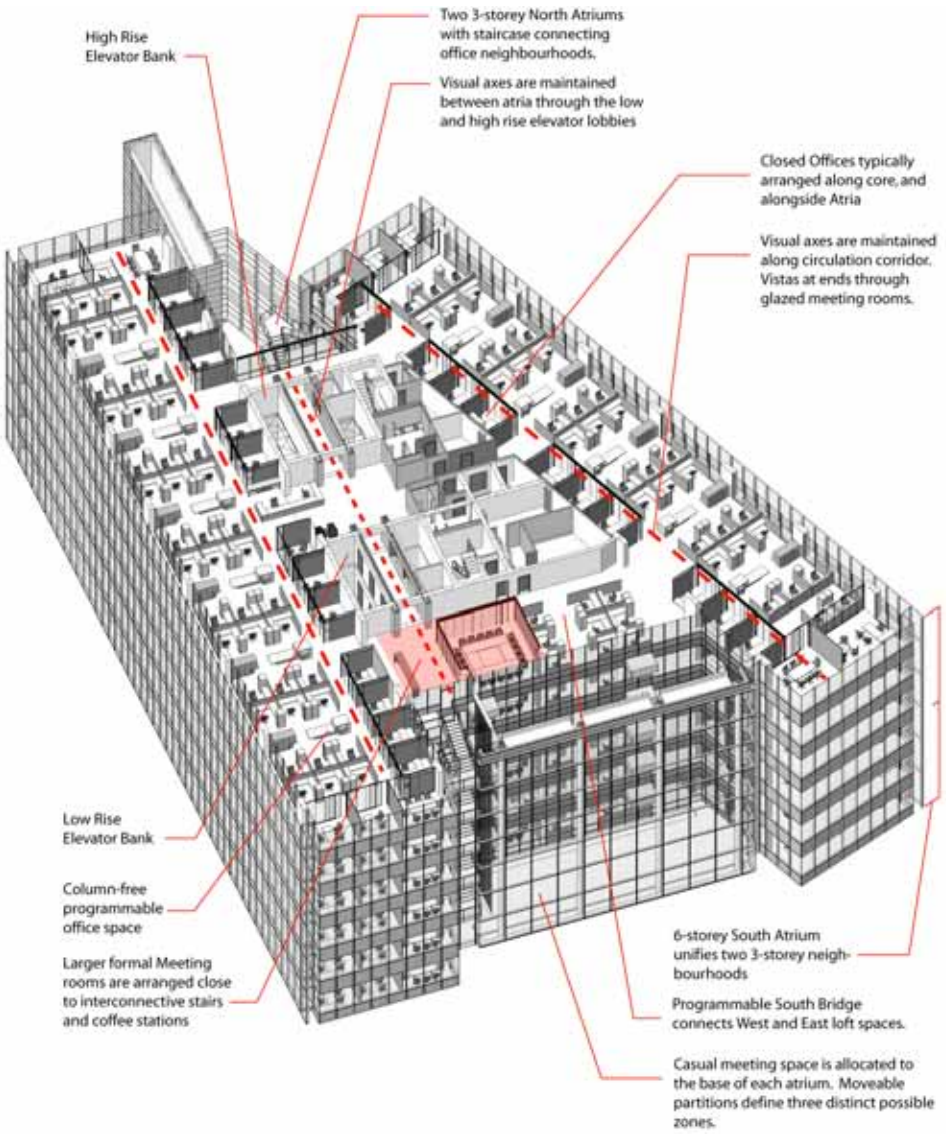




north-south building section facing west

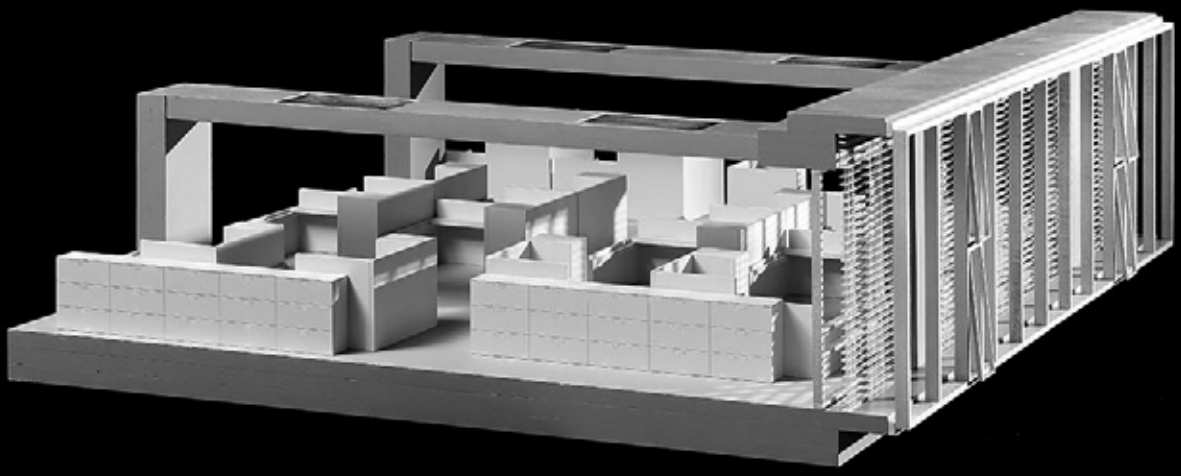
How do you create a supportive workplace with a sense of community in a 22-storey high-rise tower?

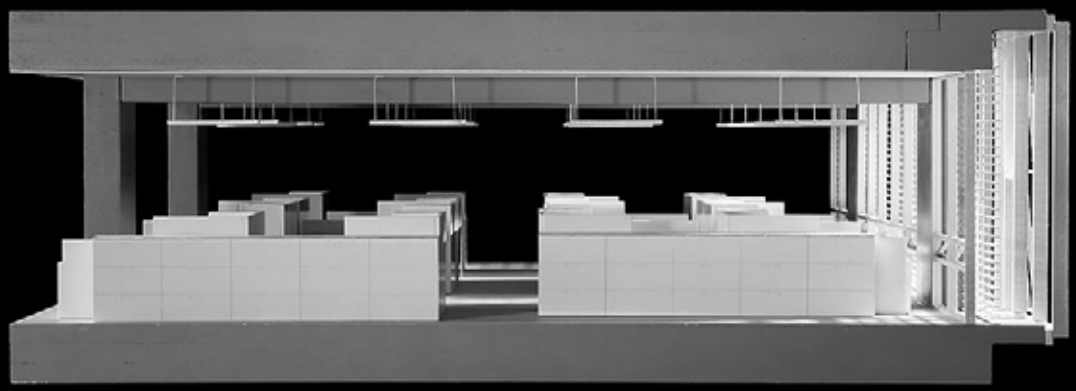
study model for 6-storey south atrium; 1:50



typical 6-storey neighborhood

3. Supportive Workplace





daylighting study model: 1:20

- Access to natural light for daylight autonomy.
- 100% Fresh Air, 24/365
- Individual control in natural ventilation mode.
- Glare control through automated louvre and roller blinds.
- Electronic sound masking delivered through raised floors.
- 20% better than ASHRAE 90.1

office study models

Identity

Power + Utility

The iconic monumentality of the power dam inspired the overall scale of the building's concrete superstructure, and of the public spaces - the entry gallery and the north atria. The reference to the power dam is further evoked with the integration of large-scale water features in both the south atria and the main gallery space. The water features consist of chilled and/or heated water fed down tensioned cables to provide, according to season and climate, dehumidification or humidification of circulated air.

Finally, the retail strategy for the building will focus on supporting knowledge economies as opposed to a service economies.

Consistent with the city's urban revitalization strategy, the building will radiate activity into the downtown, rather than containing it. It will not be a self-sufficient, one-stop shop. There will be no Starbucks, Tim Hortons nor any other big brand retail. For these services, employees will have to venture into the downtown, with the objective to put dollars back into to the city's economy.

At the same time, it will become a destination both as a showcase and information hub on issues of sustainability and energy efficiency. The intent is to lease retail spaces to companies offering specific services, technologies, information and products related to these themes.

- Motorized operable vents at south and north ends of double façade, in conjunction with curtain-wall wings, use site specific predominant south winds of Winnipeg.

- High performance triple glazed unitized curtain-wall assembly

- An opaque ceramic frit pattern over the south façade of the tower, helps minimize solar heat gain into the office space.

- 4m floor to floor heights, along with a stepped perimeter slab edge at the buildings east and west tower facades, increase daylighting for interior office spaces.

- Motorized roller blinds control solar heat gain and glare for south facing office spaces

- A cast-in place concrete structure utilizes 30% fly-ash content in its aggregate. Exposed concrete ceilings utilize radiant hydronic heating and cooling tubes, coupled with the buildings mass, provide comfortable temperature conditions all year round.

- Interior curtain-wall (single glazed curtainwall assembly) separates South and North Atrium volumes from adjacent office space. Low iron glass with a pyrolytic low-e coating mediates temperature differences between office and atrium, while permitting maximum daylight into the workspace.

- Mechanical bench at the base level and top level of each South Atrium preheats/ precools fresh air entering into the atrium, prior to further conditioning in the Atrium and ultimate delivery to the building's workspace through raised-floor displacement ventilation.

- Motorized vents into the Gallery aid in exhaust air from the space during Summer and Natural Ventilation mode.

  Reclaimed Douglas Fir soffit cladding for feature elements on building use lumber reclaimed from an earlier demolished building on site.

- Geothermal wells act as a ground source heat exchange for heating and free cooling of the building.(There are 275 wells @ ±85m in depth)

- Double facade on both west and east facades. Its exterior is a high performance double glazed unitized curtainwall assembly with low iron glass and special low-e coatings to permit maximum light transmission and minimal solar heat gain shading.

- Interconnecting stairs facilitate interdepartmental communication at the six-storey South Atrium. Similar stairs exist in each of the three storey North Atriums.

- Ashlar stone cladding over the 2nd and 3rd floors of the podium utilizes a locally quarried limestone, prominent in Winnipeg buildings.

- Solar thermal mass collector at top of solar chimney, in the form of 160 vertically hung 100mm dia. steel pipes containing thermal phase change wax, enhances stack effect in chimney, further driving exhaust ventilation in Summer and Natural Ventilation modes.

- Motorized operable glass louvres at top of Solar Chimney open to vent tower in Summer and Natural Ventilation mode.

- The remaining un-glazed building skin of the Solar Chimney is an aluminium composite panel with a high level of thermal insulation (RSI= 4.5 m^2 K/W, R= 28 Btu/h.F.ft^2) to help retain any heat contained within the tower exhaust air for heating the parkade level during Winter mode (all heat/cold is reclaimed at exhaust from parkade and cycled back to the mechanical bench in south atrium).

- In Winter mode the exhaust air is connected in the solar chimney and directed downward to heat the parkade.

- Translucent frit further diffuses ambient North light, controlling glare, and maintains the strong signature character of the office tower by matching the opaque frit of the south facade.

- Reclaimed Douglas Fir soffit cladding for feature elements on building use lumber reclaimed from an earlier demolished building on site.

- 4m floor to floor heights, along with a stepped perimeter slab edge at the buildings east and west tower facades, increase daylighting for interior office spaces.

- Triple glazed low iron glass at retail/grade maintains high visibility into retail space while providing low heating and cooling costs for tenants.

- An Intensive Green roof on podium is potentially non irrigated, using only reclaimed water from the mechanical equipment condensate.

- Intergral LED signband within retail glazing system provides energy efficient signage for tenants.

- High performance triple glazed unitized curtainwall assembly, with low iron glass and special low-e coatings to maximize light transmission and minimize Solar Heat Gain into the buildings office space.

- Tower roof provides location for two wind power generation devices for exploration of renewable/ alternative energy sources.

- Alternating, vertically staggered operable vents allow a continuous flow of air in and out of double facade cavity along the length of each tower floor.

- The exterior of the buildings east and west double facades, is a high performance double glazed unitized curtainwall assembly complete with low iron glass and special low e-coatings to permit maximum light transmission (aiding in office daylighting) and minimal solar heat gain shading .

- Motorized operable louvre blinds within double façade, control glare for office workers as well as minimize heat gain within double façade cavity during Summer and Natural Ventilation modes.

Signal Type Legend:
AI - Analog In
AO - Analog Out
CA - Calculation
DI - Digital In
DO - Digital Out
S - Schedule

Equipment Assemblies	Tag	Service	Enable/Disable	Status	Reset	Open/Close	Modulating	Point	
		Signal Type	DO	DI	DO	DO	AO	AI	
Air Handling Units									
	P1-AHU-01	Parkade Make-Up Air	E	Y	N/A	N/A	N/A	N/A	Y
	P1-AHU-02	Parkade Make-Up Air	E	Y	N/A	N/A	N/A	N/A	Y
Operating Dampers									
	L1-CD-01	Not Used	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	L1-CD-02	Solar Tower Slab Damper (from Tower)	E	Y	N/A	O	N	Y	N
	L1-CD-03	Solar Tower Slab Damper (O/A)	E	Y	N/A	C	N	Y	N
Architectural Louvres/Windows									
		Gallery South Ext. Architectural Windows	D	N	N/A	C	N/A	Y	N
		Gallery North Ext. Architectural Windows	D	N	N/A	C	N/A	Y	N
		L02 South Atria Exterior Arch. Windows	D	N	N/A	D	N/A	Y	N
		L02 SW Gallery Transfer Arch. Louvres	E	Y	N/A	O	N/A	Y	Y
		L02 NW Gallery Transfer Arch. Louvres	E	Y	N/A	O	N/A	Y	Y
		L02 NE Gallery Transfer Arch. Louvres	E	Y	N/A	O	N/A	Y	Y
		L02 SE Gallery Transfer Arch. Louvres	E	Y	N/A	O	N/A	Y	Y
		L03 South Atria Exterior Arch. Windows	D	N	N/A	C	N/A	Y	N
		L03 West Clerestory Arch. Windows	D	N	N/A	D	N/A	Y	N
		L03 NW Gallery Transfer Arch. Louvres	E	Y	N/A	O	N/A	Y	Y
		L03 NE Gallery Transfer Arch. Louvres	E	Y	N/A	O	N/A	Y	Y
		L03 SE Gallery Transfer Arch. Louvres	E	Y	N/A	O	N/A	Y	Y
Blinds									
		Gallery South Blinds	E	Y	Y	O/C	N/A	Y	
		Gallery North Blinds	E	Y	Y	O/C	N/A	Y	
		L02 East Blinds	E	Y	Y	O/C	N/A	Y	
		L02 South Blinds	E	Y	Y	O/C	N/A	Y	
		L02 West Blinds	E	Y	Y	O/C	N/A	Y	
		L02 North Blinds	E	Y	Y	O/C	N/A		
		L03 East Blinds	E	Y	Y	O/C	N/A		
		L03 South Blinds	E	Y	Y	O/C	N/A		
		L03 West Blinds	E	Y	Y	O/C			
		L03 North Blinds	E	Y	Y	O/C			
Unit / Cabinet Heaters									
	P1-UH-01	Water Room Heating	E	Y	N/A				
	L1-UH-01	Retail Area Temporary Heat	E	Y	N/A				
	L1-UH-02	Retail Area Temporary Heat	E	Y					
	L1-UH-03	Retail Area Temporary Heat	E	Y					
	L1-UH-04	Retail Area Temporary Heat	E						
	L1-UH-05	Retail Area Temporary Heat							
	L1-UH-06	Retail Area Temporary Heat							
	L1-UH-07	Retail Area Temporary Heat							
	L1-UH-08	Retail Area Temporary Heat							

control strategy for motorized elements in three-storey podium; strategy for 18-storey tower forthcoming.....legible with magnifying glass