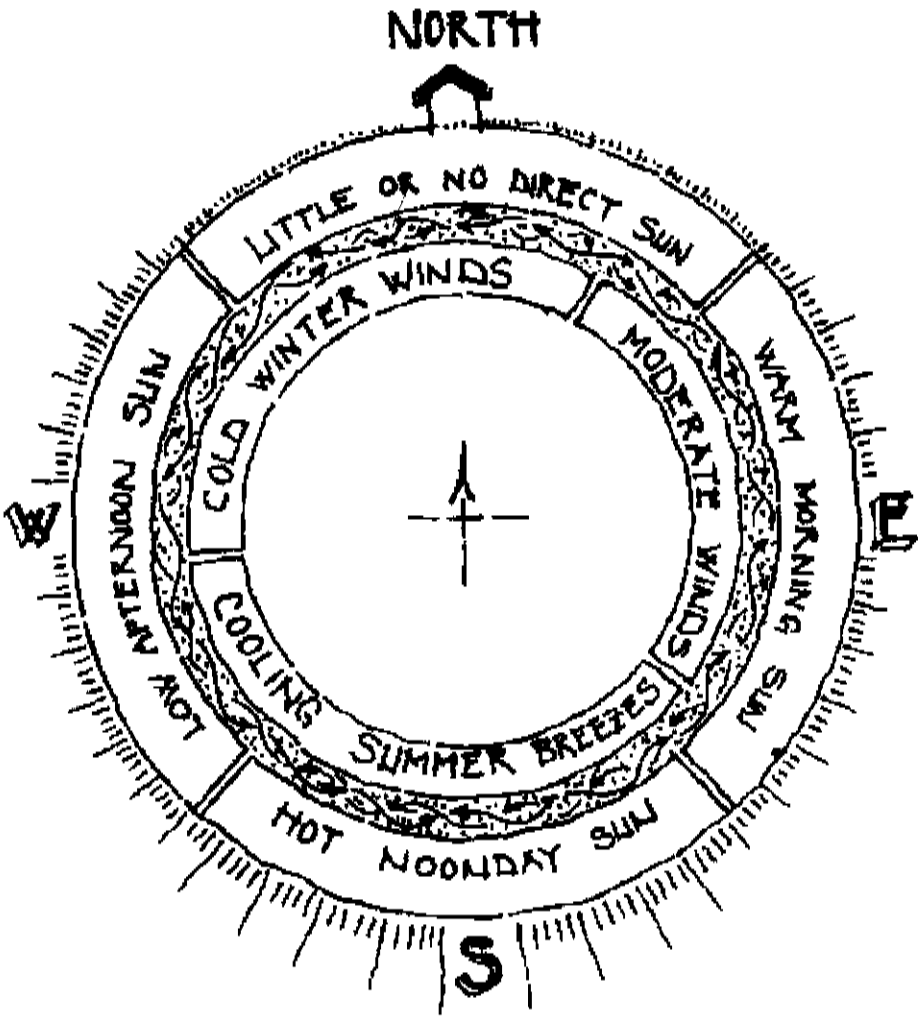
Climate Sensitive Design for the City of Prince George



Produced by the Development Services Department
and the Winter City Committee

The Importance of Climate Sensitive Design

Prince George has warm and relatively dry summers. However, the winter weather is cold, snowy and windy. These two distinct, and contrasting, seasons create the challenge of developing an urban design which is sensitive to a variety of climatic conditions.
Part of that challenge is to exploit the positive elements of each season and minimize the negative. Frequently the design and building techniques implemented in winter cities are simply transplanted from a southern climate where there is no winter. This southern based design often results in the intensification of the negative elements of winter and a minimization of the positive elements of winter.

There are a number of obvious negative effects of not implementing a climate sensitive design, especially in winter. There will be increased energy use to heat or cool indoor environments. There will be increased maintenance and repair required for an outdoor environment which is poorly designed. The most significant negative effects relate to the creation of an urban environment that is at best uninspiring, and at worst unpleasant.

An urban design that is not climate sensitive will affect more than energy consumption and maintenance requirements. It can effect peoples temperament and psyche. The appropriateness of design for the local climate plays a significant role in determining the perceptions of people towards their environment, the climate, and the quality of life in their community.

Poor design which accentuates the negative elements of climate will result in negative experiences, particularly in winter when the potential negative effects are the greatest. People will withdraw indoors from what they perceive to be an inhospitable, uncomfortable winter environment, resulting in reduced social interaction, exercise, and quality of life. This isolation will further create negative perceptions and negative feeling towards the climate and the community. Inversely, design that creates a more positive winter experience will contribute to increased recreational activity, community involvement and interaction, and a more positive outlook towards the community and the environment.

This booklet is designed to serve as a resource to developers, architects, engineers, planners, and others involved in determining the design of development within our community. The booklet offers a simple outline of some of the more basic and practical climate sensitive design ideas and principles. Further information on climate sensitive design may be obtained from any of the books listed in the bibliography.

Negative Elements to be Minimized & Positive Elements to be Enhanced.

Winter's negative elements

Extreme cold
Wind
Slush
Snow storage problems
Sand and salt on roads
Snow drifting
Increased energy use
Ice on roads and walkways
Frost
Decreased daylight hours

Winter's positive elements

Outdoor recreation unique to winter
Use of colour to contrast with white
Reflective nature of ice and snow
Seasonal variety

Summer's negative elements

Overheating
Glare from sun
Storm water runoff

Summer's positive elements

Comfortable outdoor temperature
Reduced energy consumption
Outdoor recreation unique to summer
Flourishing natural environment
Increased daylight hours

Prince George Climatic Summary

The following is an overview of the climatic data available for the City of Prince George. Please refer to the cover diagram.

Solar Access

June 22 (summer solstice)

- Maximum sun elevation is 59 degrees above the southern horizon
- Sunrise and sunset - northeast to northwest
- Daylight hours - 17
- Average sunshine hours – 8.5

December 22 (winter solstice)

- Maximum sun elevation is 19 degrees above the southern horizon
- Sunrise and Sunset – southeast to southwest
- Daylight hours – 8
- Average sunshine house – 1.26

Mean Temperature (Celsius)

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
-12	-6	-2	3.9	9.4	13	15	13	10	5	-3	-8

Mean Monthly Precipitation (mm)

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
59	43	32	30	42	58	58	73	56	61	55	54

Mean Monthly Rainfall (mm)

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
4.6	6	7	19	40	58	58	73	55	51	19	84

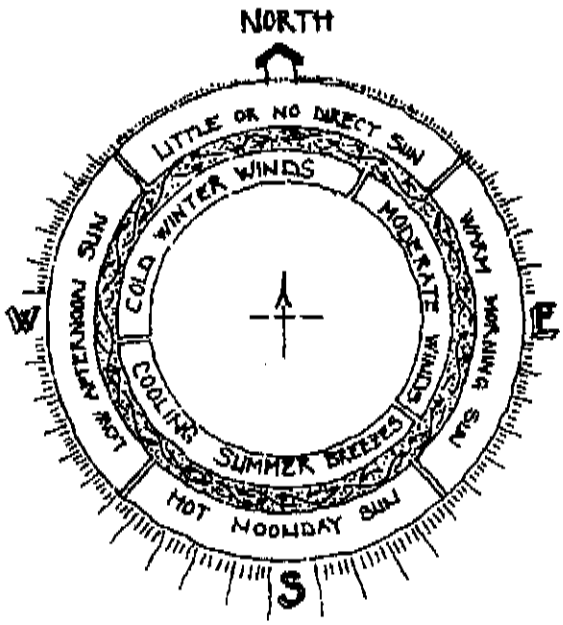
Mean Monthly Snowfall (cm)

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
59	37	25	10	2	0	0	0	1	10	39	49

Average sunshine hours (% of daylight hours)

Jan.	Feb.	Mar.	Apr.	May.	June.
54(22)	89(33)	139(38)	187(45)	255(51)	256(50)

July.	Aug.	Sept.	Oct.	Nov.	Dec.
279(53)	245(53)	158(41)	104(31)	60(22)	39(16)



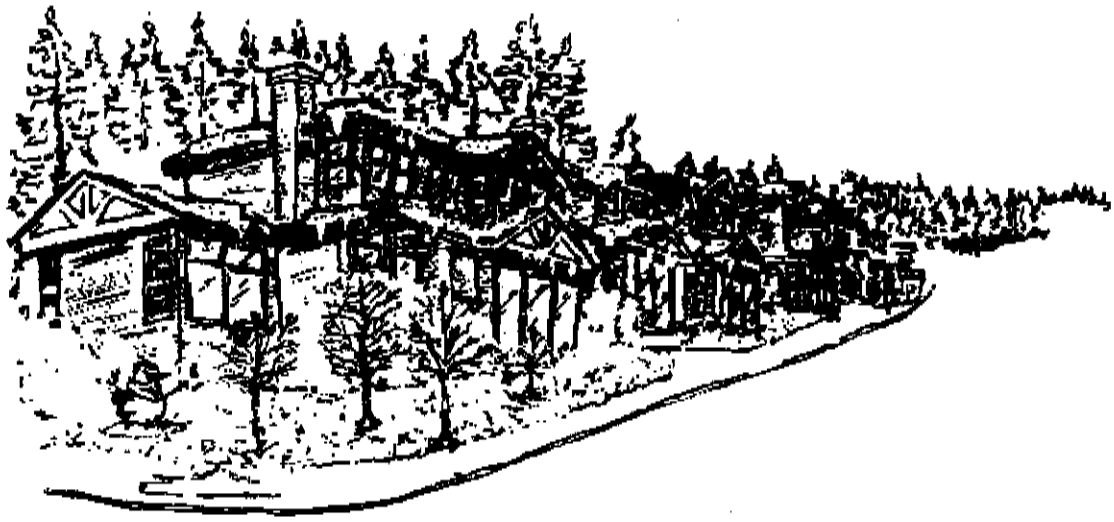
General Principles

Dense and compact developments are generally better suited for a winter climate.

Improve the function of both the indoor and outdoor environment. This involves improving the quality of the outdoor experience in winter, not simply facilitating the separation and isolation of people from the outdoors in winter.

Improve design and function for both the winter and summer season. It is relatively simple to accommodate a single season's climate. The challenge in Prince George is to develop a design which serves to accommodate both seasons.

As previously noted, a design should highlight and accentuate the positive elements of a season and minimize the negative.



Site Design

Snow Storage

Ensure adequate on site space is available for snow storage. If adequate space is not provided on site then the snow will be required to be disposed of elsewhere. Off site disposal of snow will become increasingly expensive as municipal and provincial environmental standards increase.

Required parking spaces may not be used for snow storage purposes. Useable Open Space may be used for snow storage purposes. In this case the useable open space should be landscaped appropriately to withstand the increased snow.

Areas used for snow storage should get a significant amount of solar radiation to facilitate melting of the additional snow in the spring. A sites drainage plan should account for the run off from these areas in spring.

It is better to provide a number of smaller snow storage areas rather than one large area as the snow will melt faster.

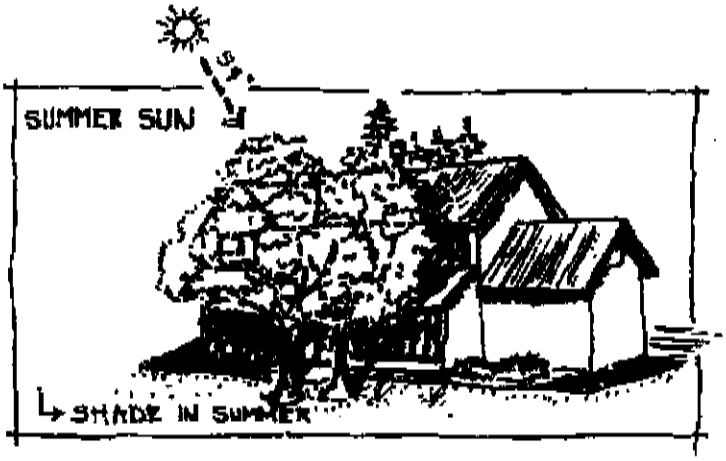
Site Design

Solar Radiation

Utilize the positive effects of solar radiation. Orient buildings, windows, and outdoor areas with a southern exposure to capture the maximum solar radiation in winter. The sun not only warms a building or space. Increased exposure to sunlight has a beneficial psychological effect during the winter months: it warms the spirit.

Avoid or minimize development on north facing slopes as there is minimal solar radiation available.

Avoid creating public spaces for winter use in areas that are shaded from the sun. Shade may be appropriate in summer; however, it is not desirable in winter.



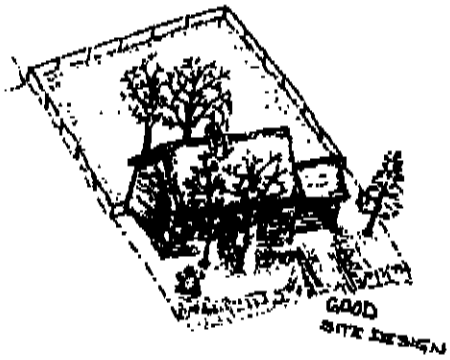
Site Design

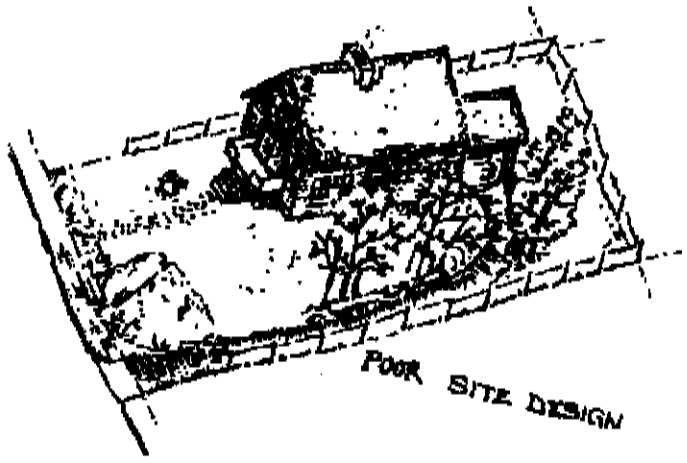
Access, Driveway Design, and Cars

Driveway length and access design must be considered with regard to ice build-up and snow removal. Unnecessarily long driveways result in unnecessarily large amounts of snow clearing and storage requirements. Also, water run-off that weeps across roads or pedestrian areas will freeze at night creating hazardous icy conditions.

Walkways, driveways, and parking areas should be as flat as possible to minimize slipping.

Walkways should be separated from roads and the spray of slush and water from passing cars. Also, this separation will provide greater security to pedestrians from cars driving in poor road conditions.





Site Design

Wind

Avoid developing barriers which will lead to snow drifting on driveways, roads, or pedestrian areas.

Avoid building orientations which will create a wind tunneling effect. Balconies and stepped facades or other irregularities in a buildings surface reduce wind speed.

Using trees and vegetation to buffer buildings from the wind can reduce heat loss in cold weather.

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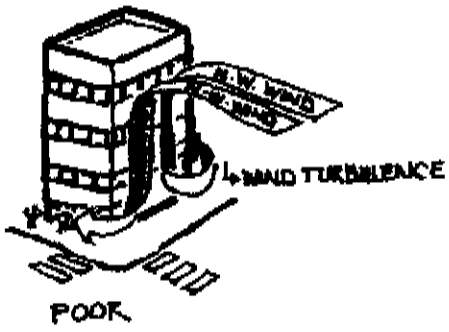
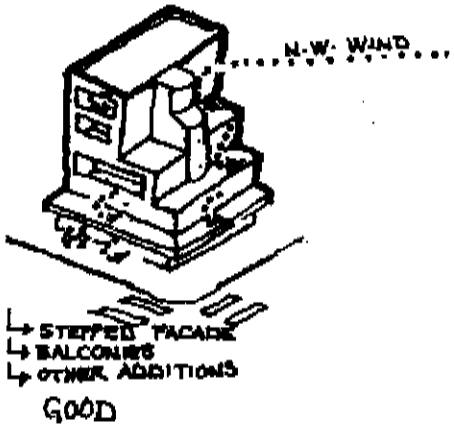


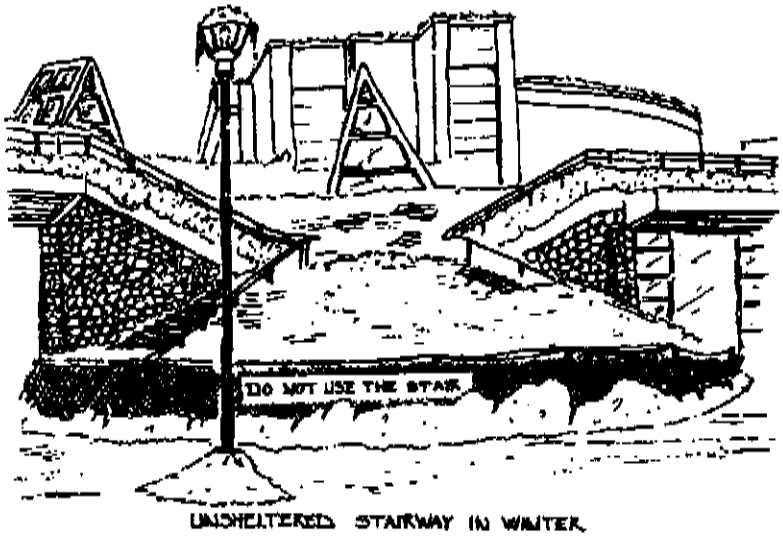


Shelter

Building and landscape design should shield pedestrian or outdoor recreation areas from wind. Evergreen trees serve as good buffers to reduce the speed of wind and create.

The strategic use of shelters such as canopies, arcades, and passages can be beneficial as protection from wind, slush, or snow in high use areas. However, they should not be used to create shaded areas or unnecessarily isolate and separate people from the outdoor environment.

Avoid the use of unsheltered stairways which easily become dangerous with small amounts of snow or ice.



UNSHELTERED STAIRWAY IN WINTER

Building Design

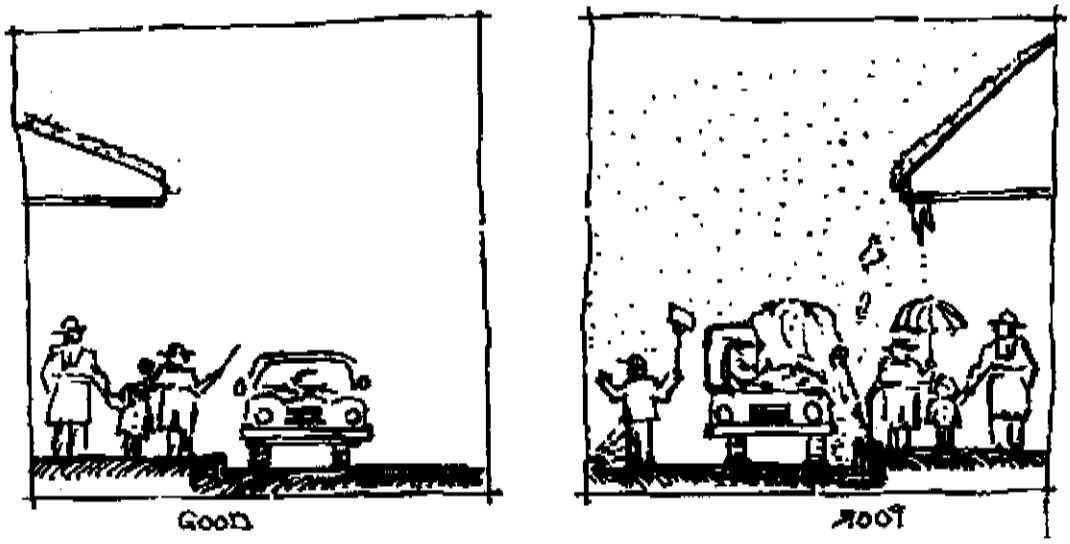
Ramps and stairs need to be covered or protected from snow and ice as a little amount can be problematic for wheelchairs and pedestrians.

A vestibule or transition area from the outside of the building to an interior environment allows people to remove winter apparel and shake off snow before entering the rest of the building. Enclosed vestibules also cut down on drafting into a building when the outside doors are opened. Flooring in this area should be a durable and slip resistant. A grate or drain may also be appropriate for a high traffic entrance.

Roof slope and design should prohibit snow and ice accumulation over, or shedding onto, pedestrian or parking areas.

Maximize the number of windows facing south to maximize solar radiation in winter. This may potentially lead to overheating problems in summer if appropriate shading is not provided.

As noted, building form can influence wind speed and turbulance. Rough surfaces on buildings reduce wind speed and turbulance more than smooth surfaced buildings.



Construction Considerations

Snow Loading

Seasonal snow loading results in increased structural design considerations. As an example, some prefabricated buildings designed for warmer climates do not meet the minimum standards outlined in the BC Building Code and must be structurally reinforced to handle the weight of snow and ice.

An improperly designed or located building may be damaged by unbalanced snow loading.

Energy Efficiency

Thermal insulation, windows, and an air tight building methods are critical to reduce heating costs and conserve energy. Icicles hanging from the roof may be an indication of a poorly insulated roof.

Increased ventilation and "make-up" standards are required for winter months due to air tight building methods and infrequently opened windows and doors.

Thermostats should not be located near building entrances as the interior of the building will tend to be overheated.

General

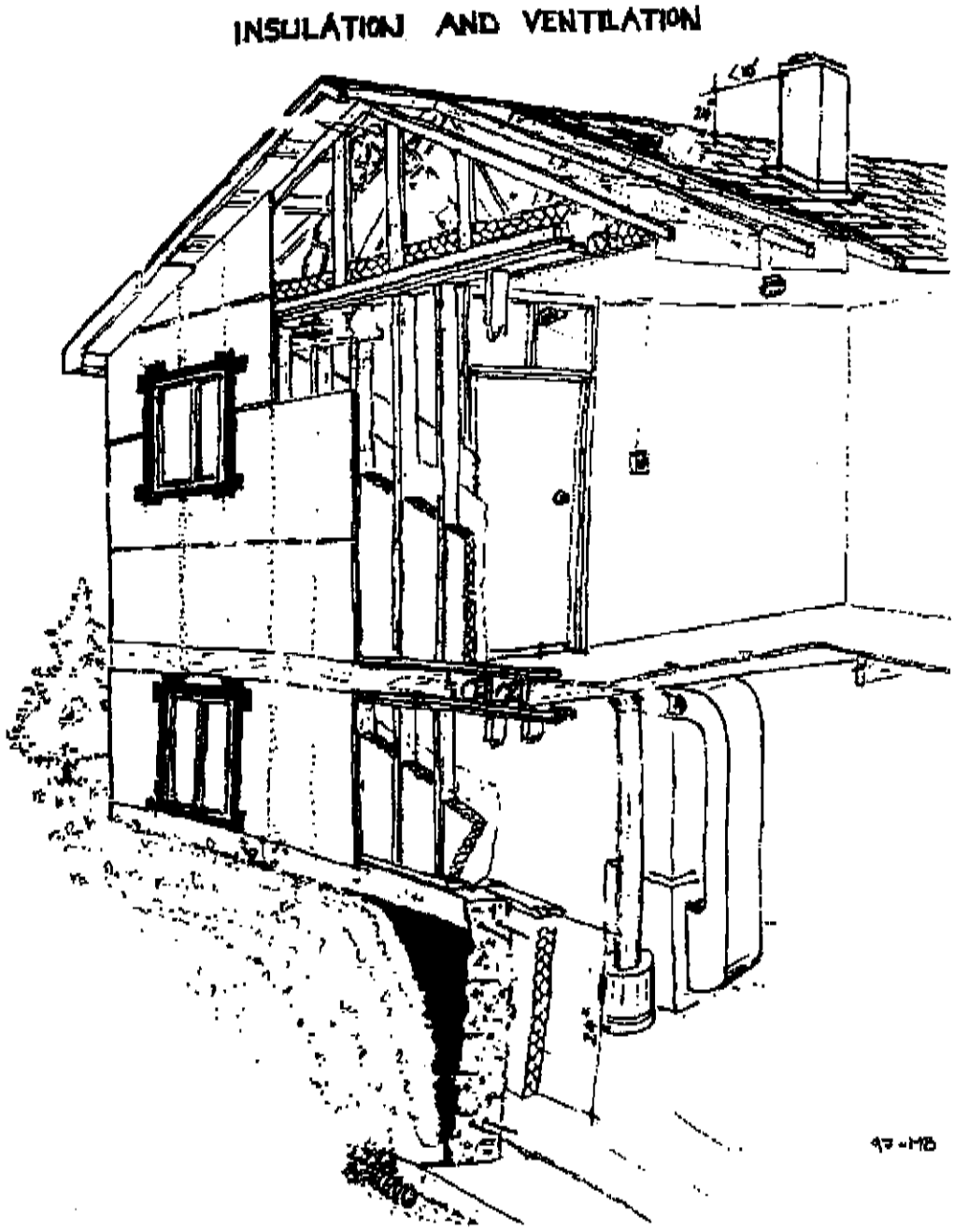
Condensation control is required to prevent damage due to air exfiltration.

Reduced construction season due to winter conditions.

Water and drainage piping must be protected from freeing both inside and outside of a building.

Foundations must be protected from frost damage.

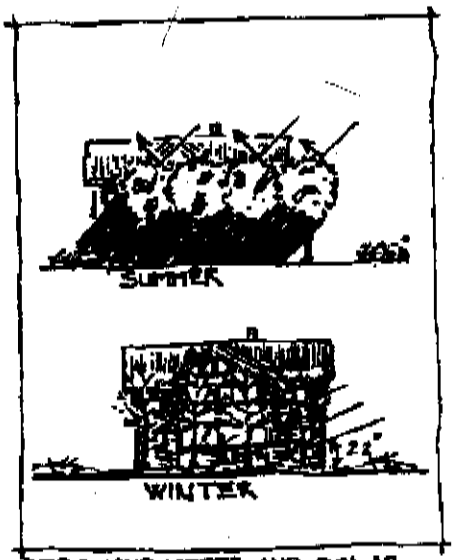
Buildings that are empty for weekends or extended periods should have temperature sensors that will sound an alarm if a heating system fails and the temperature drops below a certain level.



Landscaping and Aesthetics

Plants and Trees

Strategically utilize deciduous trees in landscaping. These trees provide shade from the sun in summer; and loose their leaves in winter, allowing sunlight through to warm buildings or outdoor pedestrian areas. Plant deciduous trees to the southeast and southwest of buildings and outdoor recreation areas. Plant evergreen trees to the northwest of buildings and outdoor recreation areas.



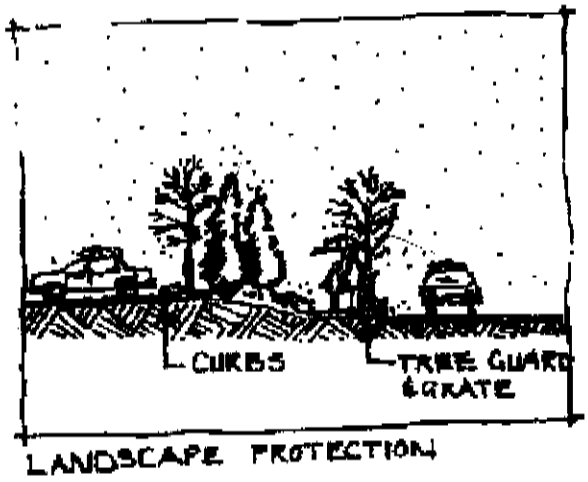
DECIDUOUS TREES AND SOLAR RADIATION

Consider that grassed or landscaped areas that are used for snow storage are subject to damage and poor growth resulting from the late melting snow and ice. Also, grassed or landscaped areas soaked from melting snow or water drip lines are easily damaged by pedestrian traffic.

Plants should be selected for both summer and winter form and color. For example, good winter plants for color are Red or Yellow Dogwood and Blue Spruce. A good plant for shape is the Winger Burning Bush. Appendix "A" is a list of plants and trees that will do well in the local climate. Also, salt hardy plants may be required in certain locations because of exposure to salt used on the roads in winter.

Trees that retain their berries or fruit in winter will attract winter birds and add additional color and texture.

Curbs can protect landscaped areas from damage during snow clearing; however, the curbs themselves must be substantial enough to withstand damage from snow clearing equipment.



Landscaping and Aesthetics

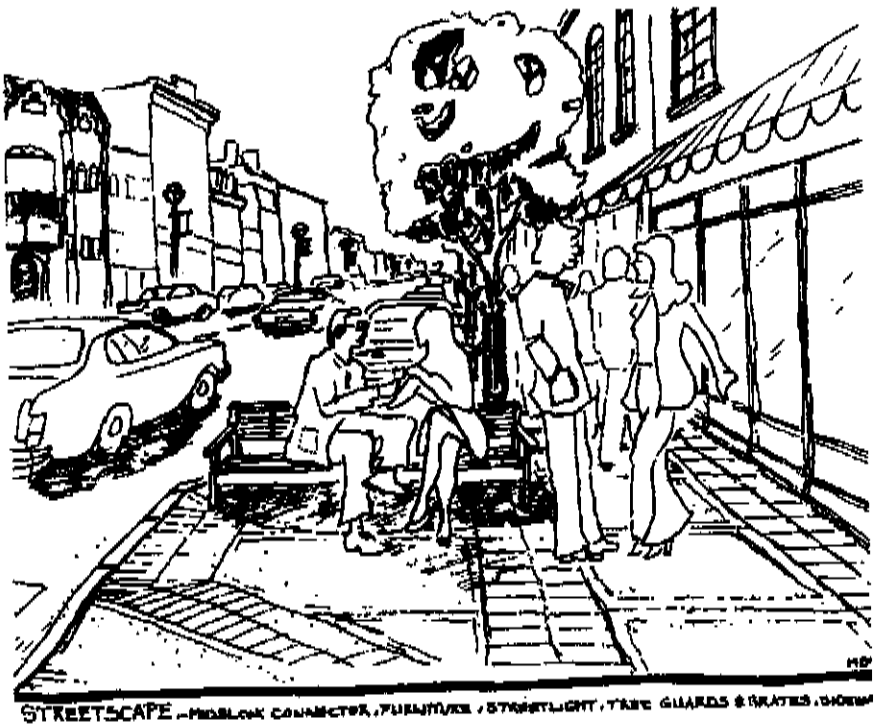
Colors and Lights

Utilize color and lights outside whenever possible in order to offset the reduced daylight and potentially monotonous white of winter. Winter offers many opportunities to be imaginative with the integration of the reflective properties of ice and snow with color and decorative lighting. Features such as ice fountains, banners, lanterns, string lighting, can do much to improve aesthetics.

Furniture

Furniture should be accessible and useable in winter. It should be made of materials that are "warmer" in cold weather such as wood, polyethylene, and vinyl coated metal. Concrete is also acceptable, but not preferred. Exposed metal, or powder coated metal, is not preferred.

COLORS, LIGHTS AND FURNITURE
L- SEE CITY OF PRINCE GEORGE DOWNTOWN STREETSCAPE DESIGN GUIDELINES



STREETSCAPE - MIDBLOCK CONNECTOR, FURNITURE, STREETLIGHT, TREE GUARDS & GRATES, SHOWI

PLANT LIST - Trees and Shrubs hardy to Prince George (Zone 3)

Hedge Plant

Caragana arborescens	(Caragana)
Cornus var.	(Dogwood var.)
Cotoneaster acutifolius	(Peking Cotoneaster)
Juniperus scopulorum	(Pyramidal Juniper)
Lonicera korolkowii	(Zabel's Honeysuckle)
Pinus Mugo Mughus	(Mugo Pine)
Ribes Alpinum	(Alpine Currant)
Thuja occidentalis var.	Varieties of global, pyramid and columnar cedars

Deciduous Conifer Tree

Larix Laricina	(Larch)

Coniferious Trees

*	Picea abies	(Norway Spruce)
*	Picea glauca	(White Spruce)
*	Picea pungens	(Colorado Spruce) var. 'Koster', 'Glauca' & 'Hoops'
	Pinus aristata	Bristlecone Pine
	Pinus nigra	(Austrian Pine)
	Pinus sylvestris	(Scots Pine)
	Pinus contorta latifolia	(Lodgepole Pine)

Tall Coniferous Shrubs (4'-0" to 6'-0" ht.)

	Juniperus scopulorum	(Pyramidal Juniper)
*	Picea glauca albertiana conica	(Alberta Spruce)
	Pinus mugo mughus	(Mugho Pine)
*	Thuja occidentalis var.	(Pyramidal, Global and Columnar Cedars)

Medium Coniferous Shrubs (1'-6" to 3'-6" ht.)

	Juniperus var.	(Various Juniper varieties)
*	Picea var.	(Various Spruce varieties) - Slow growing

Small Coniferous Shrubs (less than 1'-6" ht.)

	Juniperus horizontalis var.	(Horizontal Juniper varieties)
*	Picea nidiformis	(Nest Spruce)
	Pinus mugo pumilio	(Dwarf Mugho Pine)

Evergreen Shrubs (1'-0" to 3'-0" ht.)

Rhododendron Ramapo	Dwarf, mauve coloured Rhododendron

Large Deciduous Shrubs (6'-0" to 10'-0" ht.)

	Amelanchier alnifolia	(Saskatoon)
*	Caragana arborescens	(Siberian Caragana)
	Cotoneaster acutifolius	(Peking Cotoneaster)
*	Elaeagnus commutata	(Silver Birch)
*	Euonymus alata	(Winged Burning Bush)
	Forsythia Meadowlark	(Meadowlark Forsythia)
	Lonicera Zabelli	(Zabel's Honeysuckle)
	Philadelphus virginalus	(Mock Orange)
	Physocarpus opulifolius luteus	(Golden Ninebark)
	Sambucus canadensis	(Golden Elder)
*	Shepherdia argenta	(Silver Buffalo Berry)
	Syringa velutina	(Manchurian Lilac)
	Syringa villosa	(Late Lilac)
	Syringa vulgaris	(Common Lilac)
*	Viburnum opulus compactum	(Dwarf Snowball)

Medium Deciduous Shrubs (4'-0" to 6'-0" ht.)

*	Cornus alba var.	(Variegated Dogwood)
*	Cornus stolonifera	(Red Twig Dogwood)
*	Euonymus alata compactus	(Dwarf Burning Bush)
	Hydrangea arborescens 'Annabelle'	(Annabelle Hydrangea)
	Hydrangea paniculata grandiflora	(Pee Gee Hydrangea)
	Philadelphus lewisii Waterton	(Compact Mock Orange)
	Physocarpus opulifolius compactum	(Dwarf Golden Ninebark)
	Potentilla fruticosa var.	(Varieties of Cinquefoil)
	Prunus cistena	(Purple Leaf Sandcherry)
*	Ribes alpinum	(Alpine Currant)
	Rosa rugosa var.	(Varieties of Shrub Rose)
	Spiraea arguta	Garland Spirea
	Spiraea trilobata	Spirea
*	Symphoricarpos albus	(Snowberry)
*	Viburnum trilobum	(Bush Cranberry)

Small Deciduous Shrubs

*	Andromeda polifolia	(Bog Rosemary)
	Daphne cneorum	(Rock Daphne)
	Daphne mezereum	(February Daphne)
	Potentilla fruticosa var.	(Varieties of Potentilla)
	Rosa rugosa var.	(Shrub Rose varieties)
	Spiraea bumalda var.	(Spirea variety)

Large Deciduous Trees (mature size is greater than 40'-0"ht.)

	Acer negundo	(Box Elder)
	Acer saccharinum	(Silver Maple)
	Betula papyrifera	(Paper Birch)
	Betula pendula	(European White Birch)
	Betula Pendula 'Gracilis'	(Cutleaf Weeping Birch)
	Fraxinus pennsylvanica lanceolata	(Green Ash & Patmore Ash)
*	Populus Var.	(Various varieties of Poplar)
	Prunus padus commutata	(May Day Tree)
	Quercus macrocarpa	(Bur Oak)
	Sorbus aucuparia	(European Mountain Ash)
	Sorbus Aucuparia 'Russica'	(Russian Mountain Ash)
	Tilia americana	(American Linden)
	Tilia cordata	(Little Leaf Linden)
	Ulmus pumilia	(Siberian Elm)
	Ulmus americana Brandon	(Brandon Elm)

Medium Deciduous Trees (20'-0" to 40'-0" ht.)

	Hippophae rhamnoides	(Sea Buckthorn)
	Malus Var.	(selected varieties of Flowering Crabapple)
	Prunus padus	(European Bird Cherry)
	Prunus virginiana Shubert	(Shubert Chokecherry)
	Sorbus americana	(American Mountain Ash)

Small Deciduous Trees (10-0 to 20-0 ht)

	Acer ginnala	(Amur Maple)
	Betula Pendula 'Youngii'	(Young's Weeping Birch)
*	Caragana arborscens pendula	(Shubert Chokecherry)
	Crataegus mordenensis	(Snowbird Hawthorne)
*	Elaeagnus angustifolium	(Russian Olive)
	Prunus Mackii	(Amur Choke Cherry)
	Prunus pensylvania	(Pin Cherry)
	Rhus typhina	(Sumac)
*	Viburnum opulus roseum	(Common Snowball)

Vines

	Clematis jackmani hybrids	(Clematis var.)
	Lonicera dropmore scarlet	(Climbing Honeysuckle)
*	Parthenocissus quinquefolia engelmanii	(Engelmann Virginia Creeper)
*	Parthenocissus quinquefolia	(Virginia Creeper)

Groundcover (up to 1'-6" ht.)

	Arctostaphylos uva-ursi	(Kinnikinnick)
*	Cornus canadensis	(Bunchberry)
	Cytisus decumbens	(Prostrate Broom)
	Genista lydia	(Dwarf Broom)
	Juniperus var.	(Juniper varieties)
*	Paxistima canbyi	(Cliff-Green)
	Thymus lanuginosis	(Mother of Thyme)
*	Vinca minor	(Periwinkle)
	Various Perrenials	

* Suitable for shady areas.