

PART TWO

GENERAL DESIGN GUIDELINES

CHAPTER 4

CLIMATIC CONSIDERATIONS

This chapter discusses the existing climate characteristics at Fort Lewis and the application of this information to site and building design.

SECTION A

DETAILED ANALYSIS

The temperate climate of Fort Lewis is characterized by warm, generally dry summers and mild, wet winters. The weather and climate are strongly affected by the proximity of the Pacific Ocean and Puget Sound, the imposing barrier of the Cascade Mountains approximately 40 miles to the east and, to a lesser extent, by the Olympic Mountains located about 50 miles to the northwest.

Fall Season

October signals the beginning of fall with a marked increase in precipitation as the Aleutian Low Pressure system replaces the Pacific High as the dominant climatic feature (Fig. F-4-A).



Fig F-4-A

Winter Season

The winter months at Fort Lewis are characterized by an almost continual cloudiness and a majority of winter days measure at least a trace of precipitation. Winter daily low temperatures hover very close to freezing. Occasionally Ft. Lewis will experience a period of extremely cold weather with a southward flow of cold Canadian air. These periods typically last from 7 to 10 days and are also characterized by clear days and nights and northerly winds (Fig. F-4-B).



Fig F-4-B

Spring Season

The spring months of April and May see warming temperatures and less precipitation as the track of the Pacific storms moves gradually northward (Fig. F-4-C).

Summer Season

The agreeable temperatures, along with relatively light precipitation, typical of the warm season, gives Fort Lewis a very pleasant sum-



Fig F-4-C

mer climate. The summer season, which is centered around July and early August, is much appreciated and enjoyed by Fort Lewis residents (Fig. F-4-D).



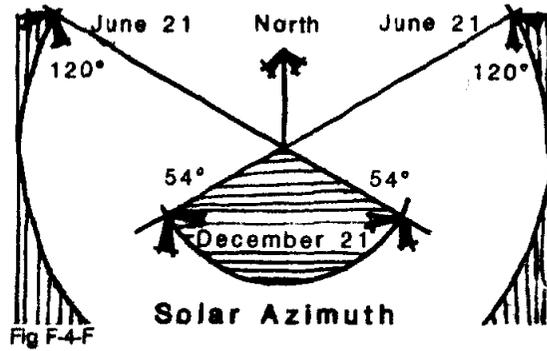
Fig F-4-D

Temperature

January is the coldest month of the year with a mean daily minimum temperature of 32 degrees F. December is traditionally almost as cold as January. The warmest month at Fort Lewis is July, closely followed by August, with a fairly moderate mean daily maximum temperature of 75 degrees F. Daily high temperatures are between 70 degrees and 80

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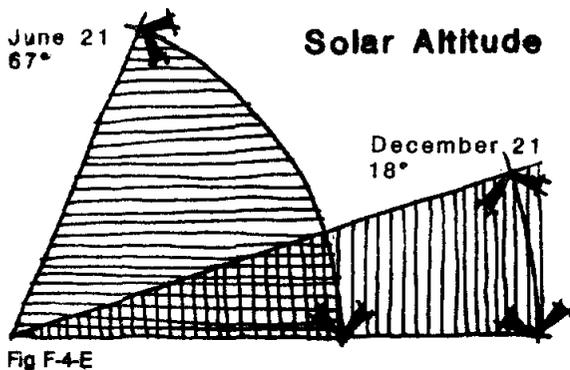
degrees F in the summer and on those occasions when they do rise to 90 degrees or above, the humidity level is usually correspondingly lowered so that uncomfortable heat is rare at Fort Lewis. The absolute maximum temperature recorded at nearby McChord Air Force Base was 100 degrees F whereas the lowest was 6 degrees F.



Sun

The distribution of clear and cloudy days shows a marked seasonal pattern at Fort Lewis, ranging from a relatively sunny 53 percent sky cover in July to a dominantly cloudy 87 percent in December. The only significant daily cycle, with regard to sky cover evidences itself in the late spring and summer months. This pattern is of clearing skies in the evening followed by fog or low stratus clouds in the early morning which normally dissipate by noon.

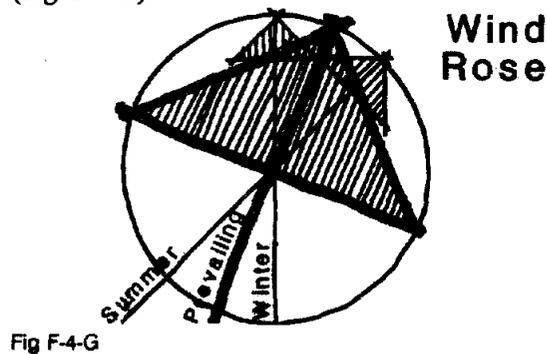
Solar heat can be a welcomed contribution during the great majority of the year. Due to the predominately mild temperatures, shading devices are not critical, nor is the overheating potential a large problem. Solar heat gain, however, is of modest importance due to the fact that the yearly amount of possible sunshine is only 49 percent. Summer and winter sun angles are shown in the following Figures (F-4-E and F-4-F).



Wind

Wind velocities are generally stable throughout the year, with 9.7 miles per hour winter and 8.3 miles per hour summer average wind speeds. The prevailing direction during the year is from the southwest. This predominance is shaded to the south during the primary winter months and to the west during the summer.

Occasionally fierce winter storms can generate strong northwest winds. The Coast Range tends to protect Fort Lewis from the hurricane-force winds accompanying some of the fall and winter Pacific storms along the coast, moderating the local gusts to a maximum of 50 miles per hour. Please refer to the Wind Rose data (Fig F-4-G).



Precipitation

The total annual precipitation at Fort Lewis averages about 41 inches. The predominantly rainy season extends from October to March

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with December and January normally being the wettest months. Approximately 75% of the total annual precipitation falls within this winter wet season. The majority of the rainfall at Fort Lewis is a result of storms common to the middle latitudes, with these disturbances being much more severe in nature during the winter months. It is very common at Fort Lewis to have a summer dry period lasting from two to four weeks with no precipitation, low relative humidity and potential forest fire danger. Local summer afternoon showers and

relatively rare thundershowers occur at Ft. Lewis but do not measurably contribute to the annual precipitation. The average annual snowfall at Fort Lewis is only approximately 9.5 inches; individual amounts of snowfall fluctuate widely and usually melt prior to significant accumulation. There are some winters with no snow, but at the other extreme, a maximum of 8 inches has been recorded at McChord AFB and over 21 inches has fallen in a 24 - hour period at the Seattle-Tacoma Airport (Fig. F-4-H).

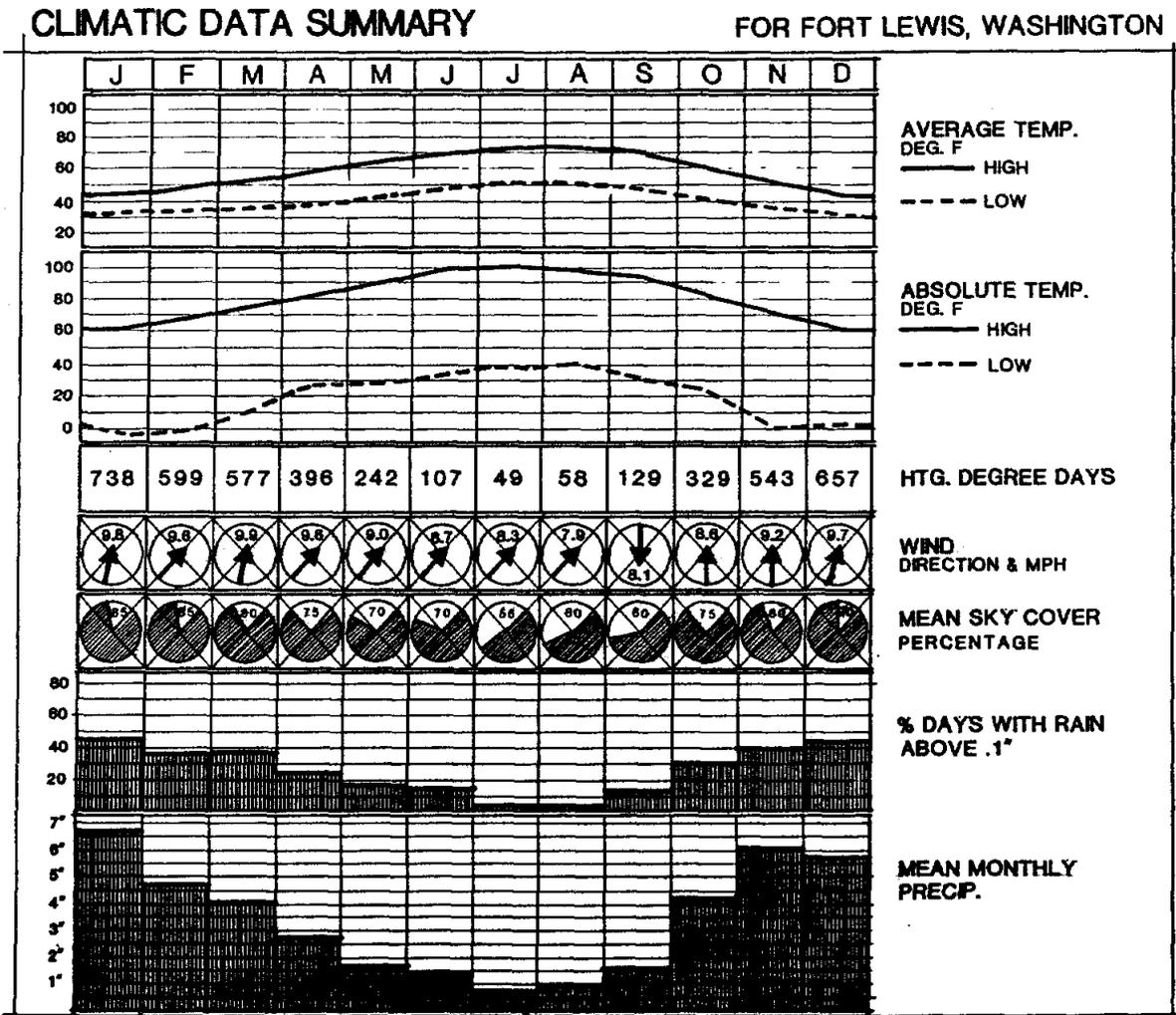


Fig F-4-H

Relative Humidity

The average annual relative humidity at Fort Lewis is 79%. Relative humidity is highest during the winter months with the peak in December at 89% and averaging over 80% for the 6-month wet season from October to March. The humidity gradually declines during the summer with the low average of 69% occurring in July. (Fig F-4-H)

SECTION B Application

Site Design

Site Selection

The climatic criteria with regard to site selections at Fort Lewis are fairly broad and are not as strict as the requirements one might find in cold or hot, arid climates. The temperate climate dictates broader requirements in that a balance needs to be achieved between the cold and warm seasons. The balance established must be based mainly on the needs of winter seasons with minor consideration given to the summer "hot" season. Slopes east of south are preferable when applicable to the specific topography. Wind sheltering during the winter months is of primary importance and breeze utilization during the warm periods should be considered (Fig F-4-I).

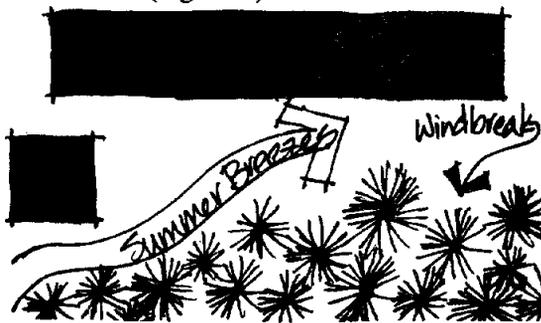


Fig F-4-I

Site Organization

The temperate climate is characterized by relatively modest stresses throughout the year, therefore great flexibility is possible in the layout of the site and arrangement of buildings. An open and free arrangement of structures which responds to the natural setting is preferred.

Public Spaces

Strong consideration should be given to the fact that exterior public spaces can be very important and pleasant if protection from wind and rain is integral to the design of these spaces. Full rain protection is very desirable in public spaces, and minimum uncovered walking distances are preferred. (Fig F-4-J)



Fig F-4-J

Landscape

Indoor and outdoor relationships in residential designs should be carefully considered. Use of outdoor living areas is possible with the use of wind and rain protection. Positive water drainage must be provided away from all structures and site grading must accommodate the run-off from peak precipitation periods.

Vegetation

Evergreen windbreaks are desirable against the most severe winter winds (North), as well as

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the prevailing winter winds (SSW). Where possible tree belts should enhance or concentrate prevailing summer winds from the WSW. In view of the similarity to harsh winter winds, both objectives might not be possible. Lawns and group shade trees are preferable on east and west building exposures.

Building Design

Building Arrangement

As previously discussed in terms of site organization, the temperate climate of Fort Lewis allows a great deal of flexibility in building arrangement. Free formations are possible and allow a complex to better respond to its natural surroundings and programmatic criteria as opposed to being constrained by strict climatic control measures. Exterior entries and spaces can become much more important and pleasant by providing rain protection and southerly exposures (Fig F-4-K).

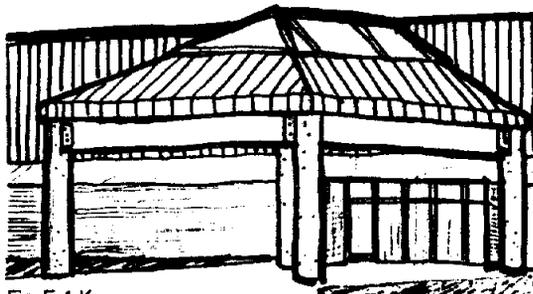


Fig F-4-K

Building Plan

Freedom in plan design is very possible at Fort Lewis and should closely integrate the spatial connections of outdoor and indoor areas. Habitable areas of building should ideally open to the SSE and should be protected from the west.

Form/Volume

As a general rule, the optimum building shape is that which loses the minimum amount of outgoing heat in the winter and accepts the least amount of incoming heat in the hot summer months. In the temperate climate of Fort Lewis, where the temperature range permits more flexible plans to be used, an elongated form is ideal. The thermal stresses on north-south building elongations impose less penalty than in other climates. This climate can therefore allow free form buildings to materialize; however, a rectangular plan elongated in the east-west direction is still hypothetically superior. Volume effect at Fort Lewis is not very important (Fig F-4-L).

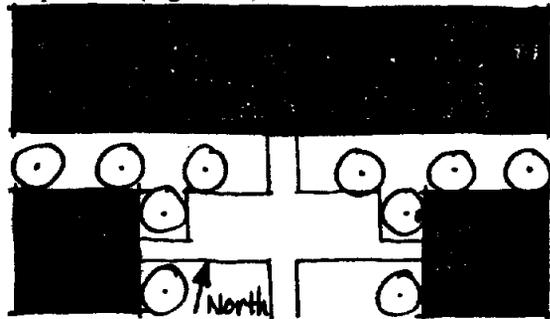


Fig F-4-L

Orientation

As previously discussed, specific orientation is not critical in this climate; however, habitable building areas should ideally be oriented slightly east of south (approx. 18 degrees) for the most balanced heat distribution throughout the year. This is ideal and there is a relatively large latitude from this ideal orientation in the temperate climate. Orientation must also balance the considerations of wind exposure (Fig F-4-L).

Interior arrangement

Provision for adequate summer cross-ventilation should be made in facilities where it is appropriate and allowed. Sun penetration, when

available, is very desirable and maximum use should be made of natural daylight in interior building spaces.

Exterior colors

Medium value colors are desirable in terms of balanced heat gain and solar absorption. Dark colors may be used in recessed areas where direct exposure to summer sun is not excessive (See Building Design Criteria).

Building Elements

Windows and Door Openings

The arrangement of window areas are of critical concern in the temperate climate of Fort Lewis. The specific climatic goal of window placement should be internal heat balance. Exposed southern glass can be effective on a seasonal basis with some shading being necessary in the summer months. Openings should be carefully planned to enhance cross ventilation in appropriate circumstances. Openings should be limited on western exposures to minimize the late afternoon summer heat gain and also minimize the amount of winter heat loss from prevailing winds.

Walls

Absorptive materials and those materials that are particularly susceptible to freeze-thaw action should be avoided. Rain and moisture penetration are very important deteriorating elements at Fort Lewis.

Roof

Roof forms should be relatively straightforward in view of the extended wet season and the

quantity of precipitation received at Fort Lewis. Positive drainage and the elimination of pockets should be carefully controlled. Gutters and downspouts should be sized as required to completely remove rainwater from the structure. Eave and gable ventilation are important considerations with the fairly high relative humidity present at Fort Lewis.

Materials

The temperate climate dictates fairly normal insulative values for building envelope assemblies. A thermally balanced structure would employ a very dense (high in thermal storage capacity) material on the western exposures. Vapor barriers on inside surfaces of the envelope are also critical.

Shading Devices

Building overhangs should be sized to provide shade during the hottest periods over all south exposure glazing. Deciduous trees on the east and west exposures can also be very effective on a seasonal basis. Sunshine is very much a welcomed commodity at Fort Lewis and shading devices should be used to fine tune the thermal balance without eliminating the penetration of sunlight into structures.

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