COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF ALASKA FAIRBANKS
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Building Challenges in Alaska

INTRODUCTION

Special considerations for building in Alaska are recommended that are normally not included in structures designed for milder climates in the Lower 48 states. New construction techniques are being developed as the climate continues to change throughout the Arctic.

FOUNDATIONS

1. Consult with an architect, engineer or contractor before building on soils subject to discontinuous permafrost. This traditionally has included most of Interior Alaska and areas west and north of the Alaska range. Wood posts, mud sills or engineered foundations with open crawl spaces are suggested in permafrost soil.
2. In areas where masonry or concrete foundations are used, reinforce against seismic action in accordance with local or state codes. Reinforce masonry chimneys against earthquakes also. Other materials than masonry should be utilized for chimneys.
3. Consult with your local insurance agent and make sure you understand all the definitions in your home policy before building in areas subject to flooding.
4. Foundations should be closed in and the building heated to avoid excessive heaving and settlement of footings during the winter.
5. All masonry and concrete foundations should be properly reinforced to minimize cracking due to heaving and settling of frozen ground and to avoid radon intrusion.
6. Foundation Insulation
   a. A below-grade thermal envelope wall should be insulated to at least the minimum R-value shown in Table 1. More is preferable.
   b. A required R-value for crawl space wall insulation should be maintained for the full height of the wall.
   c. Exterior insulation may extend in a horizontal or diagonal manner out from a wall provided the length of insulation meets or exceeds that which would be placed in a vertical manner.
   d. An insulation material should have appropriate weather resistant properties for the intended use and should be applied as recommended by the insulation manufacturer.

FLOORS

1. In permafrost areas, floors should be constructed over open crawl spaces and insulated to minimize heat loss and permafrost melting and to avoid uneven settling of the building. Also, the closer the floor surface temperature approaches room ambient temperature, the greater the comfort level.
2. Floor insulation:
   a. A thermal envelope floor should be insulated to at least the minimum R-value shown in Table 1. More is preferable.
   b. A rim joist area of a thermal envelope floor should be insulated to the same requirement as given for an envelope floor.
   c. A rim joist area of a non-thermal envelope floor (such as where a crawl space wall is insulated but the floor is not, or a second story floor) should be insulated to the same requirement as given for an above-grade or below-grade envelope wall.

SLAB-ON-GRADE FLOORS

1. A concrete slab-on-grade floor of a conditioned space or enclosed semiconditioned space should be insulated to the minimum R-value shown in Table 1.
2. An insulation material should have appropriate weather-resistant properties for below-grade application and should be applied as recommended by the manufacturer. Insulation damaged during construction should be replaced.
3. Insulation for a thickened edge or grade beam concrete slab floor should extend downward from the top of the slab to the bottom of the footing, then horizontally beneath the footing for its full width. Alternatively, insulation may extend downward from the top of the slab to the bottom of the footing, then diagonally out from the footing.
4. Horizontally placed insulation under the perimeter of a basement concrete slab floor should be continuous around the entire perimeter of the slab and should be a minimum of 24 inches wide. Additionally, a thermal break should be provided between the foundation wall and the slab edge.
5. An uninsulated concrete slab on-grade floor is not recommended for the main living area, as ground temperatures in Alaska are near 33°F. If used as the living area, the entire floor should be insulated with at least two inches of rigid foam plastic insulation. Perimeter insulation is not adequate for Alaska. More than minimum insulation is always preferable.
6. A polyethylene vapor barrier should be placed under all concrete floors poured on grade, or laid on the ground of closed crawl spaces, to minimize the migration and evaporation of excessive moisture from the soil and to prevent possible radon intrusion.

WALLS

1. Above-Grade Walls: An above-grade thermal envelope wall should be insulated to the minimum R-value shown in Table 1. This includes the floor rim joist area.
2. A polyethylene vapor barrier at least 6 mil in thickness should be placed on the interior faces of the studs directly over the insulation (warm side). Be careful to seal all openings made to accommodate plumbing vent stacks, chimneys, electrical wiring, etc.
3. The vapor barrier should be installed on the ceiling first, before any interior partitions are installed. Place the wall vapor barrier on the inside (warm side) on ceiling lap.
4. Use acoustical or equivalent flexible adhesive caulk whenever sealing polyethylene vapor retarder to wood or when joining seams.

CEILING

1. Ceiling insulation: A thermal envelope ceiling should be insulated to at least the minimum R-value shown in Table 1. More is preferable.
2. To minimize condensation stains on the ceiling and glaciering on eaves and valleys, the roof cavity must be kept cool and free of moisture by combining adequate vapor barrier, insulation and vents.
3. A polyethylene vapor barrier should be placed on interior surfaces of the ceiling directly under the insulation, prior to erecting partitions. Leave 8 to 12 inches overhang on the walls for connection to the wall vapor barriers.
4. Be careful to seal all openings in the vapor barrier that may be caused by installing plumbing, electrical outlets, chimneys, etc., with special red tape for vapor barriers.
5. The roof cavity should be ventilated by a combination of vented soffits and louvres at the gable. This prevents a "hot roof," which can cause ice dams.
6. All effort should be made to avoid flat roofs. If a flat roof is unavoidable, be sure the underneath area is insulated and has a vapor barrier.
7. Framing of scuttle openings or stairways into uninsulated attics should be avoided as it will eventually lead to condensation and frosting problems.
8. Openings into a cold attic should be provided through the gable wall from the outside. These replace the need for an attic hatch opening.
9. If an attic must be accessible from the interior of the house for storage purposes, then it should be

RESIDENTIAL ENERGY EFFICIENCY

The following tables are from Cooperative Extension publication HCM-00051, "Alaska Residential Building Manual" and reflect the latest Alaska Building Energy Efficiency Standards.*

IICC 2006 Sections 402.1 through 402.3 describe the prescriptive method for compliance and establish minimum thermal envelope insulation requirements for buildings. Exceeding these minimums is encourage. IECC 2006 Tables 402.1.1 and 402.1.3 shall be replaced with Tables A402.1.1 and A402.1.3, respectively. In these replacement tables, only the zones applicable to Alaska are given. These zones are defined in Chapter 3. When using the Prescriptive Method as the means of compliance, all mandatory measures specified in Section 403 shall also be accomplished.

Table A402.1.1 Insulation and Glazing Minimum R-values by Component

Climate Zone Alaska	Windows & Skylights	Ceiling[a]	Exterior Frame Wall	Floor	Below Grade Wall[b]	Slab[c] & Depth	Crawl Space Wall[b]
Southeast	3	49 or 38	20	30	15/19	15, 4ft	15/19
Southcentral, Aleutians, Kodiak	3	49 or 38	20	30	15/19	15, 4ft	15/19
Interior, Southwest	4	49 or 38	25	38	15/19	15, 4f	15/19
Northwest (Nome, Kotzebue)	4.5	49 or 38	30	38	15/19	15, 4f	15/19
Arctic Slope	5	65 or 52	35	43	NR	NR	NR

a. **The smaller value may be used with a properly sized, energy-heel truss.**

b. **The first R-value applies to continuous insulation, the second to framing cavity insulation; either meets the requirement.**

c. **R-5 shall be added to the required slab edge R-values for heated slabs.**

Table A402.1.3 Insulation and Glazing Maximum U-factors by Component[d]

Climate Zone Alaska	Windows & Skylights	Ceiling[a]	Exterior Frame Wall	Floor	Below Grade Wall[b]	Slab	Crawl Space Wall[c]
Southeast	0.33	0.020	0.053	0.033	0.067/0.053	0.067	c
Southcentral, Aleutians, Kodiak	0.33	0.020	0.053	0.033	0.067/0.053	0.067	c
Interior, Southwest	0.25	0.020	0.040	0.026	0.067/0.053	0.067	c
Northwest (Nome, Kotzebue)	0.22	0.020	0.033	0.026	0.067/0.053	0.067	c
Arctic Slope	0.20	0.015	0.029	0.023	NR	NR	NR

a. The larger factor of 0.0263 (0.0192 for the Arctic Slope) may be used with a properly sized energy-heel truss.

b. The first U-factor applies to continuous insulation, the second to framing cavity insulation; either meets the requirement.

c. See below-grade wall factors.

d. Nonglazing U-factors shall be obtained from measurement, calculation or an approved source.

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* *Building Energy Efficiency Standard, 2007*. See Cooperative Extension publication HCM-00051, *Alaska Residential Building Manual*, Appendix 1. Chapter 4.

adequately insulated, vapor proofed, ventilated and heated to avoid condensation and frosting problems.

10. Make sure that there is adequate insulation at the eaves of gable roofs when using thick insulation in the ceiling.
11. The trusses may be cantilevered so that they extend over the wall 18 to 24 inches on both sides. This allows 12 to 18 inches between the roof deck and the wall plate, providing 9 to 12 inches of clear space over the top for insulating the roof cavity.
12. Lumber sizes of conventional rafters may be increased to provide sufficient ventilation space over the insulation at the eaves. The rafters may also be raised up on a special header, notched into the ceiling joists, instead of setting the rafter onto the wall plate.
13. Do not taper the insulation at the eaves or pull the insulation back from the wall plate, as this increases the heat conduction through the plate, joists and rafters. Condensation and staining of interior finished surfaces may occur adjacent to the header and under the ceiling framing members.
14. Whenever possible, it is recommended that the installation of concealed wiring be avoided in ceilings of cold roof cavities.

INSULATION

The Prescriptive Method establishes minimum thermal envelope insulation requirements for buildings. Exceeding these minimums is encouraged.

The Prescriptive Method does not require extensive calculations. It is the least flexible of the four possible compliance methods. Remember, insulation in the ceiling does not decrease the required insulation in the wall.

The Prescriptive Method does not dictate specific building methods or materials. Any method of constructing a building may be used provided clear compliance with the minimum insulation requirements is shown. For example, to meet a mini-mum R-18 wall insulation requirement, R-19 fiberglass batt in a 2x6 framed wall may be used, or R-13 fiberglass batt in a 2x4 framed wall with R-5 rigid insulation over the framing, or R-18 urethane foamed-in-place between 2x4 framing.

Insulation Minimums

R-value minimums given in this chapter are for insulation installed between or over structural members. Only the insulation R-value is counted. R-value for an air film or a material such as sheetrock, paneling, plywood, siding, or earth backfill, for example, should not be included.

R-value minimums refer to the **installed** R-value. Compression of some insulating products results in a lower R-value. For example, placing a standard R-30 batt into a 2x8 wall compresses the batt from 9 inches down to 7¼ inches. This results in a decreased R-value from the listed R-30 down to approximately R-26. Table 2 shows nominal examples of resultant R-values when fiberglass batts are compressed.

TABLE 2: R-value and Thickness.

Nominal Lumber Size Width (inches)	Actual 12 (inches)	Initial R-value and thickness					
		R-38 9½	R-30 6¾	R-22 6-⅛	R-19 3-⅝	R-13	R-11 3½
		Installed R-value at final thickness					
2 x 12	11½	37					
2 x 10	9¼	32	30				
2 x 8	7¼	27	26				
2 x 6	5½		21	20	18		
2 x 4	3½		14	13	13		
2 x 3	2½					10	9
2 x 2	1½					6	6

Example of resultant R-values when fiberglass batt insulation is compressed into a confined space such as in wall stud or floor joist spaces. Product thickness and density differ among manufacturers and therefore resultant R-values also differ slightly.

INSPECTION

A polyethylene vapor barrier at least 6 mil in thickness should be installed over all interior surfaces directly over the insulation prior to installation of partitions and interior finishes.

It is recommended that no interior finished floor, wall or roof covering be installed until the insulation, vapor barrier, concealed plumbing and electrical wiring have been approved by the prospective homeowner or his authorized representative, consisting of either the building inspector, the finance agency, the energy rater and/or the architect.

VENTILATION

1. Ventilation fans should be installed in the kitchen, bathroom and laundry room. Do not vent fans directly into the roof or crawl space cavities. Instead, vent out of the exterior of the house.
2. If electricity is not available, a simple exhaust duct installed over the cook stove and vented through the roof to the outdoors should be provided. The air flow may be controlled by an adjustable damper.
3. Automatic clothes dryers whether electric or gas heated, should be vented outdoors by an approved vent pipe.
4. Mechanical ventilation, such as a heat recovery ventilation (HRV) unit, is now the norm for new energy efficient housing in Alaska.

WINDOWS

1. Windows for homes in Alaska should be constructed with wood, vinyl or fiberglass frames and sash and fitted with double- or triple-sealed glass. Single glass may be glazed into the sash and fitted on the outside of the sash with a second removable glass pane. Modern energy efficient windows should be used whenever now construction is undertaken.
2. Storm-type windows fitted onto the window frames are not suitable for prolonged periods of subzero temperatures, as migration of moisture around weather-stripping condenses out onto the storm window and will obscure the glass with heavy frost.
3. Window Insulation
   a. An exterior window RO-value (overall R-value, including the frame) should not be less than specified in Table 1.
   b. A sliding glass door should be considered a window for the purpose of determining total allowable glazed area percentage (see paragraph "c" below) and required R-value.
   c. Total window and sliding glass door area should not exceed 15 percent of the total gross above-grade thermal envelope wall area. If more than 15 percent window area is desired. See chapter 4, 5 or 6, which should be used as the method of showing compliance with the overall energy efficiency of a building.*
   d. A window for special architectural or decorative purpose may have an R-value less than required by Table 1 provided it is (1) double glazed or more and (2) total decorative window area does not exceed 5 percent of the allowable window area specified in paragraph "c" up to a maximum of 16 square feet.

DOORS

1. Storm doors and closed entries are desirable for arctic climates.
2. Metal doors with an insulated core and special thermal separators between the inside and the outside shells are excellent for arctic conditions. Adjustable door frames may be necessary to compensate for the continual heaving and settling of the active frost layer of the soils of interior Alaska.
3. Insulation
   a. Door glazing should be minimum double glazed with a ½-inch minimum air space.
   b. A sliding glass door should be considered as a window for the purpose of determining R-value and area requirements.

* *Building Energy Efficiency Standard, 2007*. See Cooperative Extension publication HCM-00051, *Alaska Residential Building Manual*, Appendix 1. Chapter 4.

STORAGE SPACES

1. The placement of closets, kitchen cabinets, and other built-in storages on exterior walls should be avoided wherever possible, or else ventilated well, to minimize condensation and frosting problems.
2. If storage space must be placed along exterior walls, provide adequate ventilation with louvered doors, drapes or other openings. A section of baseboard radiation placed on exterior walls would be a positive aid in maintaining the storage above the dew-point temperature.
3. Avoid storing boxes, magazines and clothing tightly against exterior walls. Install 1-inch x 1-inch firring strips on 2-inch centers on the wall and floor to facilitate natural ventilation.

CHIMNEY

1. The chimney must be tightly sealed at the ceiling penetration to minimize migrating moisture and infiltrating excess heat into the roof cavity.
2. Gas furnaces should be provided with an approved masonry chimney or **all-fuel** pre-fabricated metal chimney.
3. Lightweight uninsulated metal gas vents can result in excess heat formation in a poorly vented roof cavity, particularly a gable roof, resulting in excessive glaciering at the eaves.
4. Beware of using tall masonry chimneys in areas of high seismic risk, which includes much of Alaska.

HEATING

All hot water heating plans should provide for approved zone control valves and balancing cocks for each heating zone. All hot air heating plans should provide for adjustable dampers on each branch duct and adjustable blower pulleys for proper balancing of the air flow to each register. If the prime contractor or subcontractor does not maintain service personnel in Alaska during the winter season, then a local heating contractor should be designated to correct any normal deficiencies in the heating system, such as excess noise, improper balancing, excessive fuel consumption, etc.

SEPTIC TANK

All septic and alternative on-site waste disposal systems are subject to Department of Environmental Conservation regulations and should be installed by a DEC-certified installer. Aerobic compost systems exist that are a low water use, very beneficial alternative to standard septic tank and leach field systems.

FOR MORE INFORMATION

In addition to the "Alaska Residential Building Manual, 7th edition," HCM-00051, there are two manuals available regarding construction on permafrost sites.

The most useful manual for building on a new site is "Design Manual for New Foundations on Permafrost" (September 2000). This is available at www.uaf.edu/ces/energy/housing_energy/resources/PermafrostNewFoundations.pdf or www.cchrc.org/permafrost-technology-foundation-design-manual-new-foundations-permafrost.

Another manual, "Design Manual for Stabilizing Foundations on Permafrost" (July 2001), is aimed at advising owners and engineers who may need to repair a building that is in a state of failure. This manual is available at www.uaf.edu/ces/energy/housing_energy/resources/Permafrost-design-manual.pdf or www.cchrc.org/permafrost-technology-foundation-design-manual-stabilizing-foundations-permafrost.

These two manuals constitute perhaps the best available foundation information for permafrost conditions. Consulting a permafrost engineer is always a wise choice.

www.uaf.edu/ces or 1-877-520-5211

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