COLD CLIMATE HOUSING RESEARCH CENTER
CCHRC

Home Maintenance Manual

Sustainable Northern Shelter Home

Anaktuvuk Pass, Alaska

Cold Climate Housing
Research Center

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Cold Climate Housing
Research Center

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About Your Home

The purpose of this manual is to assist you (the home occupant) in maintaining your home, and also to help you understand the building materials, appliances, and equipment that make this home unique. It includes copies of manufacturers' installation, operation, and/or maintenance instructions have been included within this manual for your use.

This house has some systems that are interconnected and the proper monitoring of the major parts of these systems is critical to the normal functioning of the house. We highly recommend you thoroughly read this manual in order to learn how to properly use and maintain the unique features of this house so that the house works efficiently.

A Prototype House

One of the important things to remember about your house is that it is a prototype house. The residents of Anaktuvuk Pass, TNHA, and the Cold Climate Housing Research Center (CCHRC) collaborated in its design and construction in order to see if a more affordable, energy efficient and durable home could be created in Anaktuvuk Pass. Originally, the first house was to be constructed in Toolik Station and monitored for a year before being replicated in Anaktuvuk Pass. Because the need for housing was so great in Anaktuvuk Pass, former Mayor George Paneak requested that the house be built there. Since it is the first house of its kind to be built, it is necessary to monitor the different building components and systems to see if they are performing as predicted. This is handled by small sensors that send data, e.g., temperature or CO_2 levels, back to CCHRC via the Internet. Occasionally, employees of CCHRC may visit to verify data, check on monitoring devices, and ask questions regarding your comfort and use of the house. More information regarding this is provided in the *Monitoring and Data Collection* section of this manual.

Water & Waste Water

Fresh Water Tank

- Fresh water in this house is obtained by truck delivery.

- The holding tank capacity is 300 gallons.

Fill and Overflow

- The fill valve is on the south side of the house near the main entrance.

- There is an overflow pipe that comes out just above the fill valve.

Tank Maintenance

- The tank should be checked periodically to make sure no cracks or leaks have developed. This is not expected to occur, but should be checked since the floor under the tank is wood and would be damaged by water.

Water Pump

For your own safety, please review all Cautionary Remarks listed in the manufacturer's installation manual.

Pump Brand

- The water is pumped from the holding tank using a FLOJET® 4524-500 "Quad" AC Pump with Variable Speed Drive.

- The motor responds to increase the flow as water is needed in the home, such as when the toilet is flushed, or the kitchen sink is in use. You will hear the pump come on when this occurs.

Pump Manual

(http://www.flojet.com/products/beverage/04524_series_quad_pump_w_vsd_module_04524_series_quad_vsd/iid_3499/index.htm)

Water Heater

For your own safety, please review all Cautionary Remarks listed in the manufacturer's installation manual.

Water Heater Brand and Location

- The water is heated by a Bosch Ariston GL8Ti electric water heater. It is located in the attic space just above the bathroom.

Maintenance

- **At least once a year the anode rod in the heater should be serviced. Failure to do this could cause the tank to fail and leak.** Please refer to the manufacturer's maintenance instructions (starting on page 7 of the installation manual) for instructions on how to do this.

- **Scale deposits can affect the heating capability of the element and can even cause it to burn out.**

- Periodically, the element should be descaled either chemically or manually. Please refer to the manufacturer's maintenance instructions (starting on page 7 of the installation manual) for instructions on how to do this.

Macerating Pump

For your own safety, please review all Cautionary Remarks listed in the manufacturer's installation manual.

Plumbing Location

- The plumbing system in this house was placed in the interior walls of the house in order to make the pipes easily accessible for repairs, keep plumbing within the heated space, and so as not to diminish the amount of insulation in the floor by running plumbing through it.

Pump Operations

- All wastewater runs to a Sanibest 013 Grinder Pump located behind the toilet. This is a macerating pump. Water and organic waste matter from the kitchen sink, bathroom sink, toilet, shower, and washing machine flow to the macerator chamber and are reduced to slurry by blades rotating at 3600 RPM.

- Centrifugal force causes the reduced solids to be ejected through a grill into the container where it is picked up by a impeller pump mounted beneath the motor. Then the unit pumps the effluent out of the house into the Lifewater Sewage Treatment Plant (STP).

- **The normal operating cycle for the Sanibest takes about 10-20 seconds. This accounts for the rumbling noise heard after the toilet has been flushed.**

Pump Maintenance

- The toilet works as a conventional flushing toilet and needs no maintenance in normal use. However, there is nothing wrong with cleaning out the macerating unit once a year. Do not use bleach and be careful not to let water enter the electrical cord opening.

- **According to the Cautionary Notes in the Usage section of the *SFA Sanibest Installation and Maintenance Instruction Manual* (p. 3):**

  "Do not discharge any acids, alkaloids, solvents painting, paint strippers, food waste, plastic bags, metal such as nails, hairpins, wood, building materials, kitty litter, or anything that could halt or damage or corrode the unit. Disregarding the above might damage the macerating unit and shall void your warranty."

- **Do not hang bleach blocks or hydrochloride cleaners in the toilet tank. These solutions have been shown to deteriorate the plastic and neoprene components of the flush and fill valves, and may cause leaks. In the event of a power loss do not use the toilet or any other sanitary fixture connected to the macerating unit since it will not work until the power is restored.**

- If you decide to winterize your plumbing before leaving for long periods of time, e.g., vacation, maintenance, power failure, please follow the instructions located in the provided *SFA Sanibest Installation and Maintenance Instruction Manual*.

- In addition to these instructions, be sure that if you decide to use a plumber's anti-freeze, **use only an antifreeze containing Propylene glycol** and use it sparingly, no more than a gallon. This is the only antifreeze that will not kill the microbes that process the sewage.

Lifewater Sewage System

It is critical to the proper functioning of all plumbing in the house that you read the *ExtremeSTP Operations & Maintenance Instructions* provided for you in this manual.

Overview

- Located behind your house is the Lifewater Extreme Sewage Treatment Plant (STP).

- It is probably the most sensitive and critical system of your house. Although it requires the most attention, it is very reliable and requires relatively low maintenance. **(See manufacturer's instructions at the end of this section.)**

- It was selected instead of connecting to the city sewage system because of its affordability, and was chosen instead of a flush-and-haul system because of its ability to handle the treatment of waste without having to be pumped as regularly as the flush-and-haul system.

- The Lifewater Extreme STP is an above-ground sewage treatment plant (STP) designed for cold climates. It is a multi-compartment, super-insulated, single tank that creates an optimum environment for the growth of bacteria that break down the sewage.

How it Works

- ExtremeSTP models XSTP150, XSTP500, XSTP750, and XSTP900 sewage treatment plants are built to operate above ground in an arctic environment without need of a building or other enclosure.

- XSTP models have a super-insulated, 3-compartment tank. The tank is made of foam insulation sandwiched between fiberglass on the inside and outside.

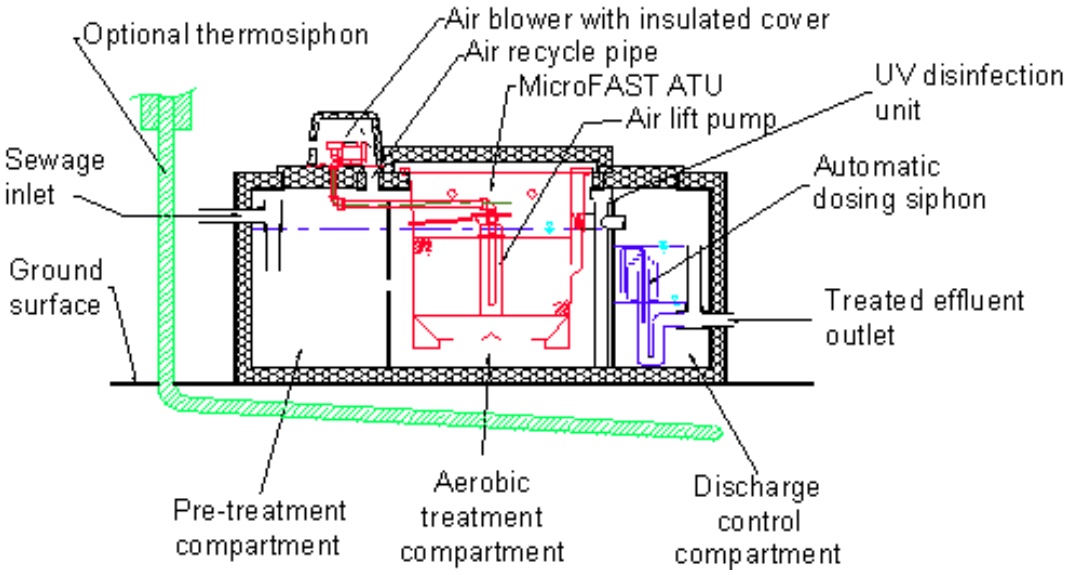
- The first compartment pretreats the sewage by retaining floating and settling solids.

- In the second or "aerobic treatment compartment," a Bio-Microbics FAST® (fixed activated sludge treatment) inserts aerobically (with oxygen) treats the wastewater and a UV (ultraviolet) light disinfects the effluent.

- The third compartment provides effluent flow control. Treated effluent is retained in this compartment until the water rises to a predetermined level, then an automatic dosing siphon (that has no moving parts) allows the water to discharge out of the system at about 30 GPM (gallons per minute) for about one minute.

- "Even at -60°F, when warm water is discharged at this rate and quantity, it does not freeze at the point of discharge but rather flows away from the system before soaking into the natural vegetative mat, into the ground, or freezing on top of the ground. Thus ice buildup at the point of discharge is minimized or eliminated." (*Lifewater ExtremeSTP Cold Climate Sewage Treatment System*, p. 15)

Below is a cross section drawing of the STP:



Heating & Ventilation

Oil Stove

Primary Heating Source

- The main source of heat for this house is the Toyotomi OM-22 Oil Miser Direct Vent Oil Heating System. This Oil Miser is 90% efficient, is thermostatically controlled, and has programmable temperature settings and a "shut-off" safety mode.

- **Please read the *Toyotomi Oil Miser Installation and Operation Instruction Manual* provided in order to learn how to properly program and maintain your heater.**

Wood Stove

Secondary Heating Source

- The secondary source of heat in this house is the Vermont Castings Dutchwest Wood Stove (Model CDW247001).

- A wood stove was placed in the house based on the desire of the residents of Anaktuvuk Pass that were involved in the design of this house and for the security of having a second source of heat if necessary.

- Only seasoned wood should be burned in this stove. Additionally, periodically sweep the chimney to remove creosote. **Please read through the manufacturer's owner manual for proper operation and maintenance.**

Why Ventilation is Important

Your House is a System

A house can be viewed as a complex system in which performance is based on the sum of many different parts. How all these components work together will profoundly affect the quality of the indoor living environment and how successfully the home functions in relation to both the climate and its inhabitants. In today's energy conscious approach to homebuilding, current building practice follows the mantra that it is not possible to make a house too tight, it is only possible to under-ventilate it.

Balancing Incoming Fresh Air with Outgoing Stale Air

The goal in ventilating is to find the ideal balance between adequately sized air exchanges (based on occupant needs and to insure healthy living conditions), yet maximizing energy savings by not to over ventilating. Good ventilation becomes especially important in well-insulated and sealed houses.

Problems of Under Ventilating

Ventilation rids your home of excessive indoor moisture. **Excess moisture can lead to mold growth, health problems, and structural damage.** Ventilation also controls the levels of pollutants that can build up indoors, especially in winter. These include carbon monoxide, allergens, off-gassing from paints and carpets, and soil gases, to name a few. Depending on the choice of system, ventilation can also provide a range of air filtration options.

The simple fact is that in Alaska's climate, living spaces tend to become an oasis of heat and moisture where the occupants spend most of their time during the winter. In these extremes, insuring that a home has good indoor air quality is especially important.

Fresh Air Intake and Ductwork

Intake Ductwork

- Since the main and secondary producers of heat for this house are source heaters (heat produced in a single location), a system of ductwork is installed in the attic to bring fresh air in from outside, distribute warm air throughout the house, and allow stale air to exit the house.

- The fresh air intake is located on the front of the house (see below). The air that comes into the house through this is slightly warmed as it passes through ductwork located above the arctic entry. Then it drops into the living room through a vent located in the ceiling above the oil stove and in front of the wood stove.

- You may feel cold air coming through this vent, but it is essential to allow fresh air into the house for the proper functioning of the oil and wood stoves and to keep carbon dioxide levels low in the house.

- **Do not block or close this vent.** This air will be warmed by the oil or wood stove before being distributed throughout the house.

Air Distribution in your Home

- After the fresh air is heated by the oil or wood stove, it is pulled through a vent located in the ceiling above the wood stove.

- This warmed air is pulled through the vent by a Panasonic FV-40NLF1 Inline Fan. The fan is located in the attic just above the arctic entry and can be accessed through the hatch in the ceiling.

Fan Maintenance and Operation

- This fan pushes the warm air through a series of ducts and distributes the air to each bedroom through vents located near the base of the wall. **Do not block or close these vents** as this will will prevent warm air from being distributed into the bedroom in which it is located and may make the temperature of that room cooler than desired and the air quality of the room unhealthy.

- The Panasonic Inline Fan has an air filter that removes dirt, dust, and other particles from the air before distributing it to the bedrooms.

- **This filter should be inspected once a month and will need to be changed at least every three months.** There are replacement filters in the attic, near the fan itself. You can order these filters on-line or purchase them at any major hardware store.

Stale Air Removal and Qingok

How the Qingok Works

- In this house, stale, moisture-laden indoor air is vented out of the house in two ways. One way is through the Qingok in the ceiling in the kitchen.

- The Qingok is a vent that was used in traditional homes in Anaktuvuk Pass in the past. Based on the ideas and desires expressed during community design meetings, the Qingok was placed in the house instead of other forms of ventilation.

- It is a passive vent that uses “the stack effect” to allow stale, moisture-laden indoor air out of the house. The stack effect is the natural movement of air into and out of buildings.

- Since the air outside during the heating season is colder and dryer than the warm, moist air inside, the warm stale air in the house will rise to the higher parts of the house and exit. The Qingok provides the easiest way for this air to escape.

Operating the Qingok

- The Qingok in your house has a damper (sliding door) that allows you to open it to the desired position allowing different amounts of air to vent. When you are cooking, especially if it involves a lot of boiling, it is advisable to open the Qingok damper and allow the moist air to escape. If there are a large number of people in your house, it would also be advisable to open the Qingok damper. Increase the opening of the Qingok and the length of time it is open in proportion to the amount of moisture in the air.

- It is important to the health of your house and its occupants to allow stale, moisture-laden air out of the house.

Additional Ventilation in the Bathroom

- In addition to the Qingok, this house has another form of indoor air ventilation. This second system is unique to this house. If it proves a successful way of removing stale air from your house, the system will be used in future homes.

- This ventilation is connected to the STP outside your house, which requires a constant supply of air from outside the STP. The microbes that process the sewage in the STP prefer to be in a warm, moist environment. The air that we are trying to vent out of the house is warm and moist. As a result, there is a fan in the STP that pulls a small amount (22cfm) of stale air out of the house.

- This fan is on a timer and is set to come on at specific intervals throughout each hour. This air is pulled into the STP through a vent located in the bathroom. One advantage to the vent being in the bathroom is that it should help remove the moisture-laden air that occurs as a result of hot water use in the shower and sink.

- Because of this location, it is important that when the bathroom is not being used, the door to the bathroom remain open. This will allow stale air to move more freely out of the house.

Building Envelope

Building Envelope
Floor, Walls, and Roof

Introduction
The walls, roof, and floor system of this house are all similarly constructed and are comprised of a unique construction technique that is being tested and monitored by CCHRC. The differences between them lies in the size and/or type of structural member, e.g., 4- or 6-inch metal studs, wood trusses, and the amount of insulation (all systems are R-60 or higher).

Wall Structure
The walls of this house are framed with 4-inch light-gauge steel studs and sheathed with 3/8-inch CD plywood on the interior side of the studs. Demilec's soy-based polyurethane foam insulation was then spray-applied to the back of the plywood and around the steel studs, encasing them in the foam insulation. An additional five inches of spray-foam insulation was applied outside the studs. This additional foam is the reason why the walls look uneven on the exterior of the house.

Insulation
- There are three reasons why this insulation was chosen:
    1. The steel studs will conduct cold, even when there is insulation between them. That is why many stud-framed homes have cold spots along the walls, and it can cause condensation. By spraying foam insulation on the outside of the studs, it is difficult for the cold air outside to get inside.
    2. Since the spray insulation is continuous all the way around the house, it forms an envelope that is nearly impenetrable. In more conventional walls, water, cold, wind and snow can find their way inside through cracks, joints, and even nails. But this wall has none of those weak spots. It forms a continuous barrier against rain, wind, and snow.
    3. The insulation is sprayed to such a great thickness to give the maximum R-value for the home. Even a six-inch stud will not hold

enough insulation to keep a house warm in Anaktuvuk Pass. The foam insulation in the walls in this home are nine inches thick, which gives the wall an R-value of 60.

- The spray-applied foam insulation is durable, fire-resistant, and resistant to water, but it is vulnerable to UV rays from the sun and is not water-proof.

Exterior Coatings

- An elastomeric coating by Demilec was sprayed on the exterior of the walls to protect the foam from UV rays and water damage. This coating is similar to the liner you sometimes see in truck beds.

- The elastomeric coating is very tough; it can resist scratching, puncture, harsh weather, and is waterproof.

- On top of the elastomeric coating is Fuller O-Brien Weatherking II Latex Exterior Paint (the color is “Sanderling”). You can repaint the home any color you like and it will not damage the elastomeric coating or the spray foam insulation. If for any reason over the life of the home you notice that the foam insulation is exposed or the coating has somehow been compromised, be sure to re-coat the foam insulation to protect it from the sun exposure.

Interior

- Plywood was placed on the inside face of the wall studs and the bottom of the roof trusses. Plywood was used instead of gypsum wallboard (dry-wall) because it adds shear strength to the home, is more durable, and is less likely to grow mold. Drywall is more prone to mold growth because of the paper backing on it and because it is more prone to hold moisture.

- Plywood does not provide as adequate a fire barrier for houses as dry-wall does, so a non-toxic, low VOC (volatile organic compound) intumes-cent (fire-retardant paint), Blazelok TPR-2 by Demilec, was applied to the interior face of the plywood (see more information about this paint at the end of this section).

- The intumescent paint has been applied to slow down the burning process of the plywood walls and allow the home occupants time to get out of the house safely if there is a house fire.

- For aesthetic reasons, drywall "mud" was applied over the intumescent paint to create a smooth interior surface on the walls and ceiling.

- Finally an interior low VOC paint was painted on top of the drywall "mud." You can repaint the interior walls and it will not affect the intumescent paint. The interior paint is Regency Interior Paint (the color is "Arizona White"). The bathroom and kitchen were painted with a semi-gloss finish, all other rooms with a satin finish.

- If the drywall "mud" chips or cracks as homes tend to do while settling, and you decide to patch it, **please do not to remove the intumescent paint without replacing it.**

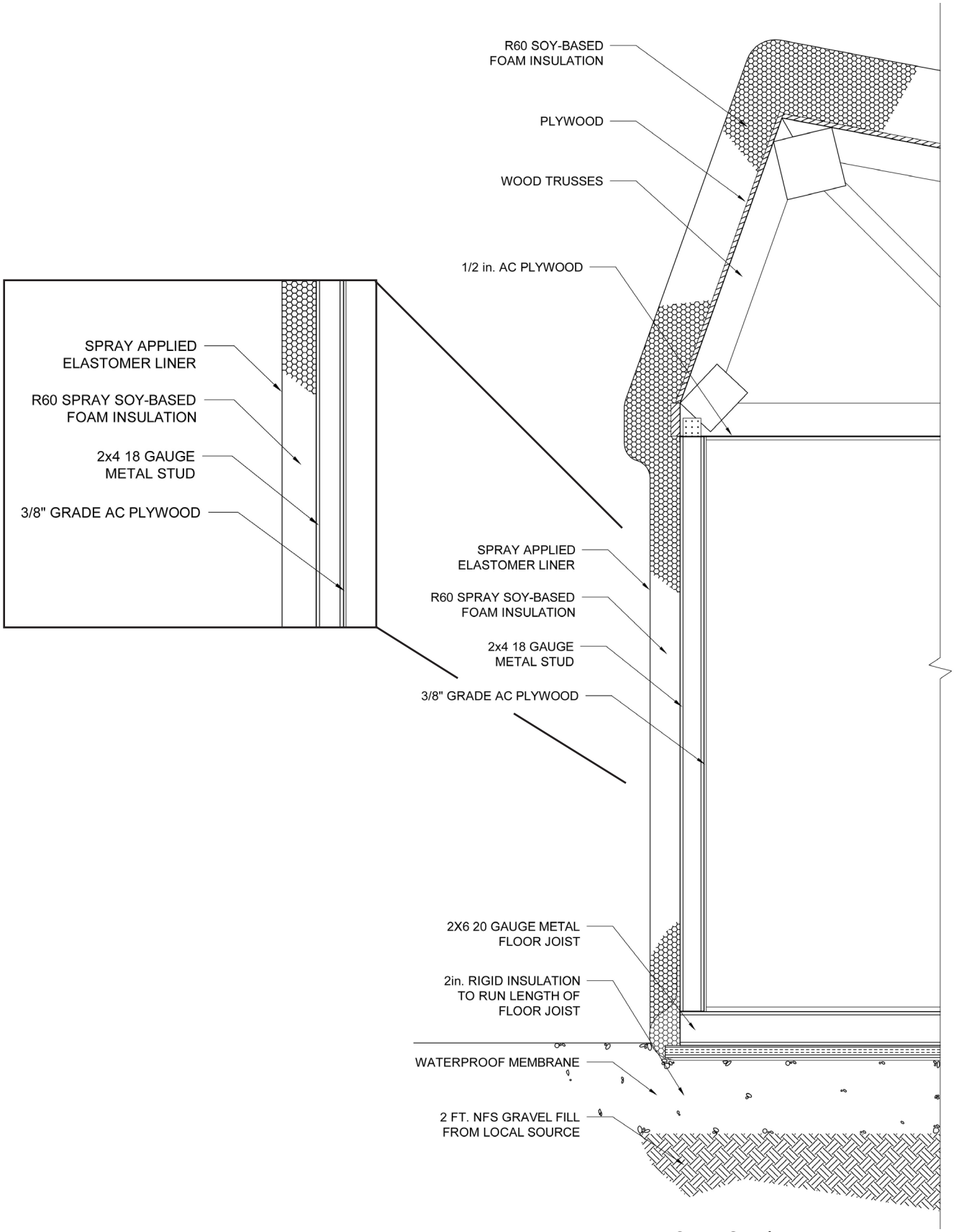
Sod and Earth Berming

- Outside of the building envelope, cut sod has been placed on the roof and earth has been bermed against the sides of the house. This was done for a variety of reasons:

- Sod homes were the primary type of construction in generations past.

- Sod has excellent insulative properties which is especially important in helping to keep your cold storage room cool.

- Earth berming allowed for the creation of a house shape that was more suited for allowing wind to scour snow around the house, preventing it from drifting where it was not desired.



House Cross Section

Interior Finishes

Flooring

Type of Flooring

- The floor finish of this house is Armstrong's Marmorette with Naturcoat. This is sheet linoleum flooring that looks a lot like vinyl flooring, but is made from linseed oil instead of petroleum oil.

- It not only looks nicer, but it is more durable, better for the quality of indoor air, and the production of it is better for the environment.

- Typical vinyl flooring has a lifespan of 10 years. Linoleum flooring has a lifespan of closer to 40 years.

- Some discoloration may occur as the floor is exposed to light, this is natural and will stop eventually.

Maintenance

- Although it is more durable, it is made out of natural materials and **harsh chemicals should not be used on this floor**. Use a diluted neutral detergent instead.

- **Please read and follow the manufacturer's maintenance instructions provided in this manual in order to make your flooring last longer and so as not to void your warranty.**

Lighting

Lighting

Fixture and Lighting Types

This house has a variety of light fixtures and light bulbs in place. Each light fixture is supplied with either a LED (light-emitting diode) bulb or a CFL (compact fluorescent light) bulb.

- LED and CFL bulbs use far less energy than “regular” incandescent bulbs.

- In order to keep the energy consumption low for this house, even simple things, like using these types of bulbs, can greatly reduce your power bill.

Tube Lights

- The tube lights in this house (they look similar to more common flores-cent tube lights) are actually LED tube lights. They were purchased from Green Energy Management, LLC (www.greenenergymgmt.com).

- Unlike fluorescent tube lights, LED tube lights do not need to “warm up” and should be bright as soon as they are turned on. LED light bulbs perform very well in cold temperatures and this should increase their lifespan.

- The LED tube lights in this house should have a lifespan of 50,000-100,000 hours. This brand of LED tube light has been tested down to -40˚F (this is the coldest testing temperature we found for any LED tube lights on the market today).

- The performance of these lights will be monitored throughout the win-ter. Two spare tube lights have been supplied with the house.

LED Lighting in the Dining and Living Room

- The light bulbs in the ceiling of the dining/living room are LED bulbs. These lights are OPTILED Dimmable PAR 30 LED bulbs and should have a

long lifespan. If they need to be replaced you can order them through Brown's Electric in Fairbanks, Alaska or order them on-line at www.optiledtech.com.

- These lights can be replaced with other light bulbs, but we advise using LED lights for their energy savings or consulting CCHRC or Brown's Electric for other options.

CFL Bulbs

- All other light fixtures have CFL bulbs. CFL bulbs are sold at most major stores where light bulbs are sold.

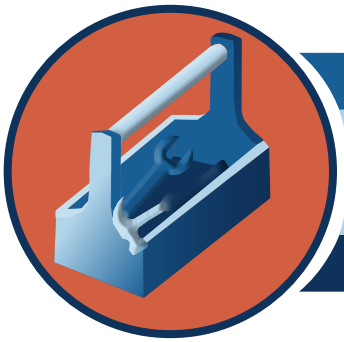
- CFL bulbs will be dimmer when you first turn the lights on, but will brighten to customary levels as soon as they warm up. This can take a few seconds to a couple of minutes depending on usage and ambient air temperature.

Sustainable Energy

Sustainable Energy

- The wind generator and solar photovoltaic (solar PV) systems were donated and installed by the Yukon River Inter-Tribal Watershed Council (YRITWC). This house uses these power supplies in addition to being tied into the City of Anaktuvuk Pass electric grid.

- Although the wind and solar systems are relatively low maintenance, **it is important that you read and understand the operations and maintenance manual provided to you by the YRITWC.** If you have any questions regarding these systems, please contact the YRITWC. You can find the organization contact information in the operations and maintenance manual they have provided you, or by visiting www.yritwc.org.



Miscellaneous

Clothes Washer and Dryer

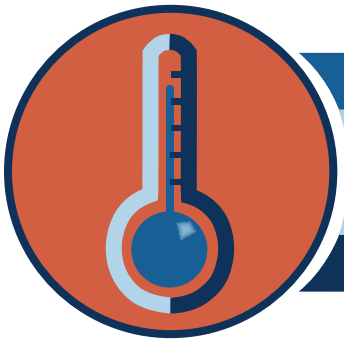
Machine Brand

- The washer and dryer provided in the house are from the Whirlpool Duet Sport Fabric Care System.

Efficiency

- Both the clothes washer and the dryer are highly efficient, conserving water and energy. The clothes washer is ENERGY STAR Qualified. Please refer to the manufacturer's use and care guide for operation and maintenance instructions.

- **It is very important to spread the use of the washing machine out over time in order to properly maintain your macerating pump and STP system.** The macerating pump and STP system can be overwhelmed by doing too many loads of laundry in a short time frame. It may require a change of habit (try one load of laundry per day) but it is vital to the proper disposal of waste water from your home.



Data Collection

Building Monitors and Data Collection

Introduction

- CCHRC and GW Scientific are monitoring your house to ensure that the house is performing safely and efficiently and to understand how all of the systems in the prototype house work so that future houses will perform even better.

- The monitoring is housed in two large white boxes filled with wires and dataloggers. One box is on the STP and the other is in the attic.

- The boxes send data wirelessly to an antenna at Nunamiut School where it is relayed to CCHRC. Some of the data from the house, the STP, and the alternative energy project can be seen on the CCHRC website, http://www.gwscientific.com/cchrc/sns/anaktuvuk-pass/index.shtml.

STP Monitoring Box

- The box on the STP monitors how efficiently the STP uses electricity and if the temperatures inside the STP are warm enough to process the contents properly.

Attic Monitoring Box

- The box in the attic is monitoring the interior of the house, including the temperature, humidity and carbon dioxide (the air you breathe out) level. These data points will tell us how comfortable the house is and whether the ventilation is adequate.

- Sensors are on the walls in the bedroom, bathroom, kitchen, garage, and cold storage. You can look at the digital display on each sensor to see what the temperature and humidity in that room are. The bedroom and kitchen sensors will also tell you the carbon dioxide level in parts per million.

House Sensors

- Most of the other sensors in the house are monitoring temperatures. These temperatures tell us how well the walls of the house keep in the heat and whether fresh air is coming into the house.

- The most visible sensor in the house is beside the Toyo heater. Inside the box is a sensor that records when the heater is on or off. This will help us to determine how much oil the house uses in a year.

Maintenance

- We plan to monitor the house and STP for two years. In those two years we may visit occasionally to fix a sensor or double check that everything is working.

- You should not have to do anything with the monitoring system, but please be careful not to disturb the wires in the attic.

- We will share any updates or reports that are generated from the monitoring of your house with you as they become available.

Please direct all correspondence to:

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