Pratt Institute

LoopLink PRO Design Report

EARTH SENSITIVE SOLUTIONS, LLC

LoopLink PRO

v.1.2.2

BASELINE BUILDINGS -REV2

ENTERING WATER TEMPERATURES

The Entering Water Temperatures defined for all of the equipment operating in this Zone Group are as follows.

EWT_{min} 30 °F **EWT_{max}** 90 °F

ZONE GROUP DESIGN DAY

The Zone Group Design Day is the aggregated load including all consituent zones and hot water elements in the zone group. The Zone Group Design Day is the loading profile for which the ground loop is sized.

	Cooling (kBtuh)	Heating (kBtuh)
8:00AM-12:00PM	3,865.0	16,805.0
12:00PM-4:00PM	4,439.7	16,161.6
4:00PM-8:00PM	4,439.7	15,103.4
8:00PM-8:00AM	2,770.5	16,805.0

SPACE SENSIBLE HEAT FACTOR

The zone group space sensible heat factor is the weighted average space sensible heat factor for all zones in the zone group.

Space Sensible Heat Factor (SHF) 1.02

ZONE GROUP CAPACITY

Zone Group Capacity is the aggregated equipment performance defined across all load elements in the Zone Group. These values represent the performance and efficiency of the entire system connected to the loopfield.

	Cooling	Heating
Total Capacity (kBtuh)	25,829.2	19,886.5
Sensible Capacity (kBtuh)	9,232.5	---
Percent Total Sizing	581.8	118.3
Efficiency (EER/COP)	15.2	3.1
Demand (kW)	291.8	1,573.2

BASELINE BUILDINGS -REV2 ENERGY SUMMARY

ANNUAL ENERGY REQUIREMENTS

The following table describes the annual energy requirements of the Zone Group organized by use.

	Cooling	Heating
Space Conditioning (kBtu)	9,175,401	15,930,824
Hot Water Generation (kBtu)	---	0
Total (kBtu)	9,175,401	15,930,824

ENERGY SOURCES AND SINKS

The following table describes how the annual energy requirements of the Zone Group are distirbuted across system sources and sinks.

	Cooling	Heating
Hybrid System Energy(kBtu)	367,016	318,616
Ground Energy (kBtu)	8,808,385	15,612,208
Net Ground Energy (kBtu)	-6,803,823	

BASELINE BUILDINGS -REV2 ACTIVE GHEX

VERTICAL BORE 1

Active GHEX Type Vertically Bored

GEOMETRY

Rows 22 **Bores Per Row** 22 **Number of Bores** 484

Average C-C Spacing 20.00 ft

Length Per Bore

The required active length for each bore are calculated as follows. The design length is always the longest of the four.

	Cooling	Heating
Y1 LENGTH/BORE (ft)	154	445
Y25 LENGTH/BORE (ft)	138	493
DESIGN LENGTH/BORE (ft)	493	

Length Total

The required active total bore lengths are calculated as follows. The design length is always the longest of the four.

	Cooling	Heating
Y1 TOTAL LENGTH (ft)	74,692	215,574
Y25 TOTAL LENGTH (ft)	66,931	238,557
TOTAL DESIGN LENGTH (ft)	238,557	

FORMATION PROPERTIES

Deep Earth Temperature 58.0 °F

Thermal Conductivity 1.40 Btu/hr ft °F **Thermal Diffusivity** 1.05 Btu/hr ft °F

U-BEND CONFIGURATION

The U-Bend Configuration defines the number and position of u-bends within the bore.

U-Bend Configuration Single U-Bend Typical (B/C)

BOREHOLE DEFINITION

Bore Diameter 6.00 in

Design Path Piping

The design path piping describes the defined type and size of pipe used within the active section of the ground heat exchanger design.

Material HDPE 4710 **Dimension Ratio** 11 **Nominal Diameter** 1.50 in

Thermal Grout Conductivity

The installed bore is assumed to have an annulus filled from bottom to top with a grouting material with the following thermal conductivity.

Thermal Grout Conductivity 1.20 Btu/hr ft °F

TEMPERATURE PENALTIES

Temperature penalty describes the change in the deep earth temperature immediately surrounding the installed loopfield after extended periods of system operation.

Y1 Penalty -0.54 °F **Y25 Penalty** -2.88 °F

CIRCULATING FLUID

Antifreeze Type Propylene Glycol **Antifreeze Concentration** 20 %

Freezing Temperature 19.4 °F

OPERATING TEMPERATURES

EWT_{max} 90.0 °F **EWT_{min}** 30.0 °F

LWT_{max} 99.0 °F **LWT_{min}** 25.0 °F

LOOPFIELD DESIGN FLOW

Baseline Buildings -Rev2 assumes flow is based on Peak Block (Primary-Secondary). Which means, flow is a function of the block flow per ton and the aggregated peak block load for the entire zone group. The interior building loop will be decoupled from the exterior GHEX piping (i.e. - inside flow rate can differ from the outside flow rate).

Block Flow Per Ton 3 gpm

	Cooling	Heating
Total Loopfield Flow (gpm)	1206.4	4566.6
Flow Per Path (gpm)	2.5	9.4
Velocity Per Path (ft/s)	0.4	1.6
Reynold's Number	3,904	4,377
Head Loss /100ft (ft)	0.09	1.20

A head loss table for a Step-Down Step-Up Reverse-Return (SDSU-RR) header is provided in the appendix.