Appendix A – Sample of Blacksburg TMY2 Data

Date	HH:MM	Datasource	DryBulb {C	DewPoint {	RelHum {%	Atmos Pre	ExtHorRad	ExtDirRad	HorIRSky {	GloHorRad	DirNorRad	DifHorRad	GloHorIllu	DirNorIllu	DifHorIllu	ZenLum {C	WindDir {d
Date	HH:MM	Datasource	Dry Bulb T	Dew Point	Relative Hu	Atmospher	Extraterres	Extraterres	Horizontal	Global Hor	Direct Norr	Diffuse Ho	Global Hor	Direct Norr	Diffuse Ho	Zenith Lum	Wind Direc
1/1/1971	1:00	A7A7A7A7	0.044045	-3.141976	84.83419	96041.84	0	0	279.5599	0	0	0	0	0	0	0	280.4202
1/1/1971	2:00	B8E7B8B8	0.829426	-3.315017	79.92141	96158.18	0	0	280.0984	0	0	0	0	0	0	0	294.1708
1/1/1971	3:00	B8E7B8B8	1.790309	-3.75245	75.00864	96204.33	0	0	281.3386	0	0	0	0	0	0	0	312.5297
1/1/1971	4:00	A7A7A7A7	1.51537	-5.147892	69.28709	96307.19	0	0	278.642	0	0	0	0	0	0	0	324.9324
1/1/1971	5:00	B8E7B8B8	1.698249	-4.916176	68.42189	96407.19	0	0	279.1247	0	0	0	0	0	0	0	301.1891
1/1/1971	6:00	B8E7B8B8	1.277259	-5.205629	68.06728	96507.19	0	0	270.6223	0	0	0	0	0	0	0	276.0905
1/1/1971	7:00	A7A7A7A7	0.866963	-6.247892	67.74126	96607.19	0	0	267.5725	0	0	0	0	0	0	0	242.9115
1/1/1971	8:00	B8E7B8B8	1.507253	-5.497348	67.03943	96710.05	47.30682	47.31	268.2231	10.15	15.03	8.48054	0	0	0	0	253.9736
1/1/1971	9:00	B8E7B8B8	2.030925	-5.138526	65.0966	96810.05	202.0949	202.09	267.6282	85.83	150.44	63.813	9096.434	9556.638	7725.757	1416.866	262.6257
1/1/1971	10:00	A7A7A7A7	2.425782	-5.395008	64.52957	96980.23	411.4715	411.47	269.7058	171.59	135.98	131.6688	18542.19	12058.38	15030.61	3342.787	270.9919
1/1/1971	11:00	B8E7B8B8	2.628433	-4.90373	61.345	96993.71	570.6077	570.61	267.2758	310.19	372	158.8874	32991.62	35494.84	18498.47	3777.501	278.7864
1/1/1971	12:00	B8E7B8B8	2.371379	-4.920068	59.64244	96980.23	668.9074	668.91	265.1989	443.91	532.27	190.0249	46326.42	51496.94	21747.83	4545.299	274.1708
1/1/1971	13:00	A7A7A7A7	3.017604	-5.678523	57.80582	97050.41	697.9668	697.97	262.5271	464.38	723.27	105.7924	48678.24	70748.33	13518.8	2661.178	280.6174
1/1/1971	14:00	B8E7B8B8	3.009812	-5.484313	54.59413	97036.93	657.6217	657.62	261.3931	409.81	654.12	104.1536	43337.63	63778.87	13441.43	2704.527	279.2694
1/1/1971	15:00	B8E7B8B8	3.278991	-6.105261	51.2198	97053.27	549.2767	549.28	261.7975	342.76	656.37	87.16521	36243.62	62287.4	11857.97	2192.414	280.8959
1/1/1971	16:00	A7A7A7A7	3.278639	-7.643632	48.4125	97136.93	380.6907	380.69	257.8839	224.29	630.44	54.45925	23937.01	55703.61	8783.484	1399.903	279.5479
1/1/1971	17:00	B8E7B8B8	2.579599	-7.306273	48.27771	97136.93	165.2388	165.24	255.5089	78.11	425.66	28.61629	8335.268	29425.75	4878.166	642.7489	268.9762
1/1/1971	18:00	B8E7B8B8	1.871735	-7.875643	48.97953	97207.12	31.05199	31.05	251.8928	8.72	31.79	3.972152	0	0	0	0	247.0566
1/1/1971	19:00	A7A7A7A7	0.869367	-9.403319	49.65351	97307.12	0	0	247.9793	0	0	0	0	0	0	0	206.8299
1/1/1971	20:00	B8E7B8B8	0.518337	-8.437103	52.13552	97377.3	0	0	246.4687	0	0	0	0	0	0	0	218.7496
1/1/1971	21:00	B8E7B8B8	0.053298	-8.788015	53.51132	97390.78	0	0	243.824	0	0	0	0	0	0	0	239.3213
1/1/1971	22:00	A7A7A7A7	-0.288967	-9.905292	55.85854	97460.96	0	0	240.208	0	0	0	0	0	0	0	33.67519
1/1/1971	23:00	B8E7B8B8	-0.707382	-8.536364	61.26145	97460.96	0	0	237.0643	0	0	0	0	0	0	0	263.0793
1/1/1971	24:00:00	B8E7B8B8	-1.872096	-8.449843	66.20355	97444.62	0	0	233.824	0	0	0	0	0	0	0	264.1267
1/2/1971	1:00	A7A7A7A7	-2.113214	-8.778774	72.14564	97428.28	0	0	229.3339	0	0	0	0	0	0	0	245.2087
1/2/1971	2:00	B8E7B8B8	-2.063082	-8.186485	70.25185	97428.28	0	0	230.0173	0	0	0	0	0	0	0	248.9394
1/2/1971	3:00	B8E7B8B8	-1.491961	-8.085473	67.81962	97511.95	0	0	231.3542	0	0	0	0	0	0	0	238.6536
1/2/1971	4:00	A7A7A7A7	-0.411119	-8.626797	66.46501	97525.43	0	0	229.9313	0	0	0	0	0	0	0	234.5432
1/2/1971	5:00	B8E7B8B8	-0.430701	-7.585347	65.17496	97595.61	0	0	239.3773	0	0	0	0	0	0	0	222.1331
1/2/1971	6:00	B8E7B8B8	-0.306912	-7.615977	63.69369	97592.75	0	0	243.7524	0	0	0	0	0	0	0	207.0271
1/2/1971	7:00	A7A7A7A7	-0.04401	-8.075391	63.482	97662.93	0	0	248.8226	0	0	0	0	0	0	0	194.4546
1/2/1971	8:00	B8E7B8B8	0.682081	-6.19291	64.72227	97662.93	46.44162	46.44	255.8702	9.62	11.28	8.104738	0	0	0	0	217.8108
1/2/1971	9:00	B8E7B8B8	1.11719	-5.228444	65.09734	97676.41	201.9601	201.96	267.043	85.38	105.48	71.26548	9212.596	7231.906	8289.854	1546.369	219.7157
1/2/1971	10:00	A7A7A7A7	1.799454	-4.833348	65.52884	97776.41	411.4715	411.47	279.3498	157.55	147.3	117.6167	17280.1	13075.13	13710.48	3088.12	226.7339
1/2/1971	11:00	B8E7B8B8	3.327953	-3.232609	63.08627	97689.89	571.6077	571.61	289.1273	225.36	115.21	181.0299	24661.79	10337.99	20647.1	6026.408	215.3121
1/2/1971	12:00	B8E7B8B8	4.426356	-2.315311	59.67228	97660.07	670.0708	670.07	293.2857	272.66	204.32	177.3047	29718.01	19537.59	20629.46	6153.997	194.733
1/2/1971	13:00	A7A7A7A7	5.243677	-1.673913	57.4993	97576.41	699.832	699.83	301.2258	312.91	197.51	214.4348	34189.88	19143.07	24576.31	7160.355	225.9524
1/2/1971	14:00	B8E7B8B8	6.278677	-0.894808	56.11537	97546.6	659.6217	659.62	291.8919	411.48	410.42	218.8395	44288.84	39591.4	25598.39	5241.331	226.7287
1/2/1971	15:00	B8E7B8B8	6.874421	-0.604123	54.16442	97616.78	551.4401	551.44	288.9315	380.32	669.54	118.8307	39865.25	62020.61	15489.94	2362.487	213.4611
1/2/1971	16:00	A7A7A7A7	7.191542	-0.802224	52.10651	97630.26	383.6907	383.69	283.8935	226.69	609.35	61.30991	24055.43	53576.43	9280.279	1324.445	256.0239
1/2/1971	17:00	B8E7B8B8	6.590155	-0.575339	54.97171	97613.92	168.2388	168.24	280.865	79.46	383.02	33.27646	8335.363	23642.09	5452.832	633.2225	241.6869
1/2/1971	18:00	B8E7B8B8	5.809424	-0.920608	57.83766	97667.76	30.70551	30.71	275.3741	7.11	30.03	3.462291	0	0	0	0	238.4119
1/2/1971	19:00	A7A7A7A7	4.837312	-1.234014	61.64643	97681.24	0	0	271.1045	0	0	0	0	0	0	0	199.8117
1/2/1971	20:00	B8E7B8B8	3.958688	-1.161046	68.39656	97735.09	0	0	266.2767	0	0	0	0	0	0	0	202.7934
1/2/1971	21:00	B8E7B8B8	2.692544	-1.64185	74.28148	97705.27	0	0	260.3721	0	0	0	0	0	0	0	208.1852
1/2/1971	22:00	A7A7A7A7	1.331231	-2.235986	80.22284	97705.27	0	0	256.603	0	0	0	0	0	0	0	219.2547
1/2/1971	23:00	B8E7B8B8	1.041383	-2.151511	79.84778	97718.75	0	0	257.0074	0	0	0	0	0	0	0	220.3834
1/2/1971	24:00:00	B8E7B8B8	1.427651	-2.189018	79.71372	97688.93	0	0	256.0638	0	0	0	0	0	0	0	247.1305
1/3/1971	1:00	A7A7A7A7	1.427651	-2.625638	78.93427	97688.93	0	0	256.0924	0	0	0	0	0	0	0	256.3469
1/3/1971	2:00	B8E7B8B8	0.858941	-2.651637	81.88596	97759.11	0	0	252.6601	0	0	0	0	0	0	0	274.7131
1/3/1971	3:00	B8E7B8B8	-0.440733	-3.112284	84.19226	97759.11	0	0	249.2279	0	0	0	0	0	0	0	279.3139
1/3/1971	4:00	A7A7A7A7	-0.719596	-3.608392	86.73957	97759.11	0	0	246.0939	0	0	0	0	0	0	0	5.240315
1/3/1971	5:00	B8E7B8B8	-0.511834	-3.297771	86.20113	97742.78	0	0	252.6799	0	0	0	0	0	0	0	28.99097
1/3/1971	6:00	B8E7B8B8	-0.616164	-3.265095	85.66268	97742.78	0	0	256.863	0	0	0	0	0	0	0	50.04571
1/3/1971	7:00	A7A7A7A7	-0.283696	-3.378428	85.12424	97726.44	0	0	260.7486	0	0	0	0	0	0	0	0.917974
1/3/1971	8:00	B8E7B8B8	0.157077	-2.861151	82.64296	97812.96	46.30682	46.31	267.0012	9.15	5.61	8.451219	0	0	0	0	132.5171
1/3/1971	9:00	B8E7B8B8	0.572747	-2.697572	80.16242	97899.48	201.9601	201.96	270.07	70.25	48	63.07299	7719.672	3438.942	7228.394	1529.865	157.6157
1/3/1971	10:00	A7A7A7A7	0.975732	-2.680001	77.54635	97899.48	411.6348	411.63	277.4288	175.56	125.45	138.2761	18930.95	10703.35	15742.92	3452.89	181.6522
1/3/1971	11:00	B8E7B8B8	1.404321	-2.236504	73.06507	97902.34	572.4729	572.47	275.9372	273.85	252.2	170.861	29254.99	23908.36	19515.1	4035.852	175.6887
1/3/1971	12:00	B8E7B8B8	1.780317	-2.173811	67.88123	97818.68	671.2056	671.21	281.4594	391.67	362.25	218.7299	40918.61	34808.22	24313.5	5289.85	182.4211
1/3/1971	13:00	A7A7A7A7	1.852986	-2.65624	63.39996	97737.87	701.832	701.83	281.9897	370.07	308.76	215.8009	39747.46	30581.56	24487.85	5451.581	167.0219
1/3/1971	14:00	B8E7B8B8	2.535247	-2.310379	60.88936	97737.87	661.7565	661.76	281.0469	353.12	419.28	155.5968	37741.57	40379.09	18715.42	3739.837	155.4028
1/3/1971	15:00	B8E7B8B8	3.399252	-2.418362	58.24323	97670.55	554.4401	554.44	277.6344	334.04	592.16	101.4519	35462.42	55563.9	13407.88	2193.768	155.1317
1/3/1971	16:00	A7A7A7A7	3.408123	-2.693449	56.54141	97670.55	386.6907	386.69	271.537	233.53	639.63	58.10856	25087.54	56983.21	9303.293	1258.115	131.3811
1/3/1971	17:00	B8E7B8B8	4.375016	-2.271121	54.72598	97686.89	171.3736	171.37	282.1691	62.52	200.39	37.4798	6635.636	12074.63	5035.734	718.5287	146.7655
1/3/1971	18:00	B8E7B8B8	5.305655	-2.213259	52.47758	97686.89	33.05199	33.05	293.9464	4.16	8.98	3.347217	0	0	0	0	166.4797
1/3/1971	19:00	A7A7A7A7	5.731228	-2.58514	50.25777	97703.22	0	0	310.0304	0	0	0	0	0	0	0	177.8203
1/3/1971	20:00	B8E7B8B8	4.768191	-2.094675	54.35438	97703.22	0	0	309.1322	0	0	0	0	0	0	0	189.1609
1/3/1971	21:00	B8E7B8B8	3.736623	-1.912786	58.71985	97719.56	0	0	303.785	0	0	0	0	0	0	0	204.8238
1/3/1971	22:00	A7A7A7A7	2.507308	-2.557782	62.27728	97635.9	0	0	296.1975	0	0	0	0	0	0	0	221.5562
1/3/1971	23:00	B8E7B8B8	2.538846	-1.856475	64.02815	97635.9	0	0	297.0839	0	0	0	0	0	0	0	211.5636
1/3/1971	24:00:00	B8E7B8B8	1.919372	-1.854429	64.297	97552.24	0	0	296.7293	0	0	0	0	0	0	0	189.4467
1/4/1971	1:00	A7A7A7A7	1.994738	-2.054082	65.77828	97482.06	0	0	296.4809	0	0	0	0	0	0	0	182.15

Appendix B – Energy Plus Model

```
VERSION,
   1.0.3;                !- Version Identifier
BUILDING,
   Holistic,             !- Building Name
   0,                    !- North Axis {deg}
   Suburbs,              !- Terrain
   .039999999,           !- Loads Convergence Tolerance Value {W}
   .4,                   !- Temperature Convergence Tolerance Value {C}
   FullInteriorAndExterior; !- Solar Distribution
TIMESTEP IN HOUR,
   6;                    !- Time Step in Hour
INSIDE CONVECTION ALGORITHM,
   Detailed;             !- InsideConvectionValue
OUTSIDE CONVECTION ALGORITHM,
   Detailed;             !- OutsideConvectionValue
SKY RADIANCE DISTRIBUTION,
   1;                    !- SkyRadianceValue
SOLUTION ALGORITHM,
   CTF;                  !- SolutionAlgo
Airflow Model,
   COMIS;                !- AirFlowModelValue
ZONE VOLUME CAPACITANCE MULTIPLIER,
    1;                   !- Capacitance Multiplier
RUN CONTROL,
   Yes,                  !- Do the zone sizing calculation
   Yes,                  !- Do the system sizing calculation
   Yes,                  !- Do the plant sizing calculation
   Yes,                  !- Do the design day simulations
   Yes;                  !- Do the weather file simulation
RunPeriod,
    1,                   !- Begin Month
   1,                    !- Begin Day Of Month
   12,                   !- End Month
   31,                   !- End Day Of Month
   UseWeatherFile,       !- Day Of Week For Start Day
   Yes,                  !- Use WeatherFile Holidays/Special Days
   Yes,                  !- Use WeatherFile DaylightSavingPeriod
   No;                   !- Apply Weekend Holiday Rule
Location,
   Blacksburg,           !- LocationName
   37.337,               !- Latitude {deg}
   -80.667,              !- Longitude {deg}
   -5,                   !- TimeZone {hr (decimal)}
   670;                  !- Elevation {m}
DesignDay,
   summer,               !- DesignDayName
   32,                   !- Maximum Dry-Bulb Temperature {C}
   10,                   !- Daily Temperature Range {C}
   23,                   !- Wet-Bulb Temperature At MaxTemp {C}
   99433.54,             !- Barometric Pressure {Pa}
   3.807968,             !- Wind Speed {m/s}
   180,                  !- Wind Direction {deg}
   .98,                  !- Sky Clearness
```

```
   1,                  !- Rain Indicator
   0,                  !- Snow Indicator
   21,                 !- Day Of Month
   7,                  !- Month
   SummerDesignDay,        !- Day Type
   0;                  !- Daylight Saving Time Indicator
DesignDay,
   winter,               !- DesignDayName
   -12,                !- Maximum Dry-Bulb Temperature {C}
   0,                  !- Daily Temperature Range {C}
   -12,                !- Wet-Bulb Temperature At MaxTemp {C}
   99782.25,             !- Barometric Pressure {Pa}
   11.6,               !- Wind Speed {m/s}
   326,                !- Wind Direction {deg}
   0,                  !- Sky Clearness
   0,                  !- Rain Indicator
   0,                  !- Snow Indicator
   21,                 !- Day Of Month
   1,                  !- Month
   WinterDesignDay,        !- Day Type
   0;                  !- Daylight Saving Time Indicator
MATERIAL:REGULAR,
   concreteOut,            !- Name
   Smooth,               !- Roughness
   .0762,              !- Thickness {m}
   1.28,               !- Conductivity {W/m-K}
   2200,               !- Density {kg/m3}
   880,                !- Specific Heat {J/kg-K}
   .9,                 !- Absorptance:Thermal
   .6,                 !- Absorptance:Solar
   .6;                 !- Absorptance:Visible
MATERIAL:REGULAR,
   Polyurethane,           !- Name
   Smooth,               !- Roughness
   .0762,              !- Thickness {m}
   .32,                !- Conductivity {W/m-K}
   1200,               !- Density {kg/m3}
   2090,               !- Specific Heat {J/kg-K}
   .9,                 !- Absorptance:Thermal
   .5,                 !- Absorptance:Solar
   .5;                 !- Absorptance:Visible
MATERIAL:REGULAR,
   concreteIn,             !- Name
   MediumSmooth,           !- Roughness
   0.0762,             !- Thickness {m}
   1.28,               !- Conductivity {W/m-K}
   2200,               !- Density {kg/m3}
   880,                !- Specific Heat {J/kg-K}
   0.9,                !- Absorptance:Thermal
   .6,                 !- Absorptance:Solar
   .6;                 !- Absorptance:Visible
MATERIAL:REGULAR,
   metal Alum,             !- Name
   VerySmooth,             !- Roughness
   .0508,              !- Thickness {m}
   204,                !- Conductivity {W/m-K}
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```
   2707,                    !- Density {kg/m3}
   8960,                    !- Specific Heat {J/kg-K}
   .2,                   !- Absorptance:Thermal
   .2,                   !- Absorptance:Solar
   .2;                   !- Absorptance:Visible
MATERIAL:REGULAR,
   Wood Stud,               !- Name
   MediumRough,             !- Roughness
   .0508,                !- Thickness {m}
   .15,                  !- Conductivity {W/m-K}
   500,                   !- Density {kg/m3}
   2720,                    !- Specific Heat {J/kg-K}
   .9,                   !- Absorptance:Thermal
   .92,                   !- Absorptance:Solar
   .92;                   !- Absorptance:Visible
MATERIAL:REGULAR,
   Glass,                   !- Name
   VerySmooth,              !- Roughness
   0.00635,                 !- Thickness {m}
   0.81,                  !- Conductivity {W/m-K}
   2800,                   !- Density {kg/m3}
   800,                   !- Specific Heat {J/kg-K}
   .9,                   !- Absorptance:Thermal
   0.7,                   !- Absorptance:Solar
   0.7;                   !- Absorptance:Visible
MATERIAL:AIR,
   air,                  !- Name
   .11;                   !- Thermal Resistance {m2-K/W}
MATERIAL:WINDOWGLASS,
   Window glass,            !- Name
   SpectralAverage,         !- Optical Data Type
   ,                     !- Name of Window Glass Spectral Data Set
   .00635,                  !- Thickness {m}
   .95,                   !- Solar Transmittance at Normal Incidence
   .01,                   !- Solar Reflectance at Normal Incidence: Front Side
   .01,                   !- Solar Reflectance at Normal Incidence: Back Side
   .85,                   !- Visible Transmittance at Normal Incidence
   .1,                   !- Visible Reflectance at Normal Incidence: Front Side
   .01,                   !- Visible Reflectance at Normal Incidence: Back Side
   .37,                   !- IR Transmittance at Normal Incidence
   .6,                   !- IR Hemispherical Emissivity: Front Side
   .6,                   !- IR Hemispherical Emissivity: Back Side
   .81;                   !- Conductivity {W/m-K}
MATERIAL:WINDOWGAS,
   air gap  window,         !- Name
   Air,                   !- Gas Type
   .1,                   !- Thickness {m}
   .025;                   !- Conductivity Coefficient A {W/m-K}
CONSTRUCTION,
   Outside Wall,            !- Name
   concreteOut,            !- Outside Layer
   Polyurethane,            !- Layer #2
   concreteIn;             !- Layer #3
CONSTRUCTION,
   Roof,                 !- Name
   concreteOut,            !- Outside Layer
```

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   Polyurethane,           !- Layer #2
   concreteIn;             !- Layer #3
CONSTRUCTION,
   Window,                 !- Name
   Window glass,           !- Outside Layer
   air gap  window,        !- Layer #2
   Window glass;           !- Layer #3
CONSTRUCTION,
   glass door,             !- Name
   Window glass,           !- Outside Layer
   air gap  window,        !- Layer #2
   Window glass;           !- Layer #3
CONSTRUCTION,
   PartitionX,             !- Name
   E1 - 3 / 4 IN PLASTER OR GYP BOARD;  !- Outside Layer
CONSTRUCTION,
   below grade wall,       !- Name
   concreteOut,            !- Outside Layer
   Polyurethane,           !- Layer #2
   concreteIn;             !- Layer #3
CONSTRUCTION,
   1/2 basement Floor In,   !- Name
   concreteOut,            !- Outside Layer
   Polyurethane,           !- Layer #2
   concreteIn;             !- Layer #3
CONSTRUCTION,
   1/2 basement Floor out,  !- Name
   concreteOut,            !- Outside Layer
   Polyurethane,           !- Layer #2
   concreteIn;             !- Layer #3
CONSTRUCTION WITH INTERNAL SOURCE,
   2nd Floor,              !- Name
   1,                      !- Source present after layer N1
   1,                      !- Temperature calculation requested after layer N2
   1,                      !- Dimensions for the CTF calculation
   .0762,                  !- Tube Spacing {m}
   concrete partition1,    !- Outside Layer
   concrete partition2;    !- Layer #2
CONSTRUCTION WITH INTERNAL SOURCE,
   ceiling 1,              !- Name
   1,                      !- Source present after layer N1
   1,                      !- Temperature calculation requested after layer N2
   1,                      !- Dimensions for the CTF calculation
   .0762,                  !- Tube Spacing {m}
   concrete partition2,    !- Outside Layer
   concrete partition1;    !- Layer #2
 CONSTRUCTION,
   Window,                 !- Name
   Window glass,           !- Outside Layer
   air gap  window,        !- Layer #2
   Window glass;           !- Layer #3
ZONE,
   A-NW-1,                 !- Zone Name
   0,                      !- Relative North (to building) {deg}
   0,                      !- X Origin {m}
   0,                      !- Y Origin {m}
```

```
   0,                  !- Z Origin {m}
   1,                  !- Type
   1,                  !- Multiplier
   3,                  !- Ceiling Height {m}
   30;                 !- Volume {m3}
ZONE,
   B-North-1,             !- Zone Name
   0,                  !- Relative North (to building) {deg}
   0,                  !- X Origin {m}
   0,                  !- Y Origin {m}
   0,                  !- Z Origin {m}
   1,                  !- Type
   1,                  !- Multiplier
   3,                  !- Ceiling Height {m}
   90;                 !- Volume {m3}
SurfaceGeometry,
   UpperLeftCorner,        !- SurfaceStartingPosition
   CounterClockWise,       !- VertexEntry
   relative;               !- SurfaceGeometryKey
Surface:HeatTransfer,
   basement floor,         !- User Supplied Surface Name
   FLOOR,                  !- Surface Type
   1nd Floor,              !- Construction Name of the Surface
   Basement,               !- InsideFaceEnvironment
   Ground,                 !- OutsideFaceEnvironment
   ,                       !- OutsideFaceEnvironment Object
   NoSun,                  !- Sun Exposure
   NoWind,                 !- Wind Exposure
   0,                  !- View Factor to Ground
   4,                  !- Number of Surface Vertice Groups -- Number of (X,Y,Z) groups in this surface
   -5,                 !- Vertex 1 X-coordinate {m}
   0,                  !- Vertex 1 Y-coordinate {m}
   -3,                 !- Vertex 1 Z-coordinate {m}
   30,                 !- Vertex 2 X-coordinate {m}
   0,                  !- Vertex 2 Y-coordinate {m}
   -3,                 !- Vertex 2 Z-coordinate {m}
   30,                 !- Vertex 3 X-coordinate {m}
   -10,                !- Vertex 3 Y-coordinate {m}
   -3,                 !- Vertex 3 Z-coordinate {m}
   -5,                 !- Vertex 4 X-coordinate {m}
   -10,                !- Vertex 4 Y-coordinate {m}
   -3;                 !- Vertex 4 Z-coordinate {m}
Surface:HeatTransfer,
   basement wall E,        !- User Supplied Surface Name
   WALL,                   !- Surface Type
   below grade wall,       !- Construction Name of the Surface
   Basement,               !- InsideFaceEnvironment
   Ground,                 !- OutsideFaceEnvironment
   ,                       !- OutsideFaceEnvironment Object
   NoSun,                  !- Sun Exposure
   NoWind,                 !- Wind Exposure
   0,                  !- View Factor to Ground
   4,                  !- Number of Surface Vertice Groups -- Number of (X,Y,Z) groups in this surface
   -5,                 !- Vertex 1 X-coordinate {m}
   -10,                !- Vertex 1 Y-coordinate {m}
   0,                  !- Vertex 1 Z-coordinate {m}
```

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    -5,                 !- Vertex 2 X-coordinate {m}
    -10,                !- Vertex 2 Y-coordinate {m}
    -3,                 !- Vertex 2 Z-coordinate {m}
    -5,                 !- Vertex 3 X-coordinate {m}
    0,                  !- Vertex 3 Y-coordinate {m}
    -3,                 !- Vertex 3 Z-coordinate {m}
    -5,                 !- Vertex 4 X-coordinate {m}
    0,                  !- Vertex 4 Y-coordinate {m}
    0;                  !- Vertex 4 Z-coordinate {m}
Surface:HeatTransfer,
    J ceiling R,            !- User Supplied Surface Name
    CEILING,                !- Surface Type
    ceiling 1,              !- Construction Name of the Surface
    J-Cir-NE-2,             !- InsideFaceEnvironment
    OtherZoneSurface,       !- OutsideFaceEnvironment
    Roof Floor J,           !- OutsideFaceEnvironment Object
    NoSun,                  !- Sun Exposure
    NoWind,                 !- Wind Exposure
    0,                  !- View Factor to Ground
    4,                  !- Number of Surface Vertice Groups -- Number of (X,Y,Z) groups in this surface
    25,                 !- Vertex 1 X-coordinate {m}
    0,                  !- Vertex 1 Y-coordinate {m}
    6,                  !- Vertex 1 Z-coordinate {m}
    25,                 !- Vertex 2 X-coordinate {m}
    -2,                 !- Vertex 2 Y-coordinate {m}
    6,                  !- Vertex 2 Z-coordinate {m}
    30,                 !- Vertex 3 X-coordinate {m}
    -2,                 !- Vertex 3 Y-coordinate {m}
    6,                  !- Vertex 3 Z-coordinate {m}
    30,                 !- Vertex 4 X-coordinate {m}
    0,                  !- Vertex 4 Y-coordinate {m}
    6;                  !- Vertex 4 Z-coordinate {m}
Surface:HeatTransfer,
    Interior Part J10F1,    !- User Supplied Surface Name
    WALL,                   !- Surface Type
    PartitionX,             !- Construction Name of the Surface
    J-Cir-NE-1,             !- InsideFaceEnvironment
    OtherZoneSurface,       !- OutsideFaceEnvironment
    Interior Part K10F1,    !- OutsideFaceEnvironment Object
    NoSun,                  !- Sun Exposure
    NoWind,                 !- Wind Exposure
    0,                  !- View Factor to Ground
    4,                  !- Number of Surface Vertice Groups -- Number of (X,Y,Z) groups in this surface
    25,                 !- Vertex 1 X-coordinate {m}
    -2,                 !- Vertex 1 Y-coordinate {m}
    3,                  !- Vertex 1 Z-coordinate {m}
    25,                 !- Vertex 2 X-coordinate {m}
    -2,                 !- Vertex 2 Y-coordinate {m}
    0,                  !- Vertex 2 Z-coordinate {m}
    30,                 !- Vertex 3 X-coordinate {m}
    -2,                 !- Vertex 3 Y-coordinate {m}
    0,                  !- Vertex 3 Z-coordinate {m}
    30,                 !- Vertex 4 X-coordinate {m}
    -2,                 !- Vertex 4 Y-coordinate {m}
    3;                  !- Vertex 4 Z-coordinate {m}
    -5,                 !- Vertex 1 X-coordinate {m}
```

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   -2,                  !- Vertex 1 Y-coordinate {m}
   0,                   !- Vertex 1 Z-coordinate {m}
   -5,                  !- Vertex 2 X-coordinate {m}
   -8,                  !- Vertex 2 Y-coordinate {m}
   0,                   !- Vertex 2 Z-coordinate {m}
   0,                   !- Vertex 3 X-coordinate {m}
   -8,                  !- Vertex 3 Y-coordinate {m}
   0,                   !- Vertex 3 Z-coordinate {m}
   0,                   !- Vertex 4 X-coordinate {m}
   -2,                  !- Vertex 4 Y-coordinate {m}
   0;                   !- Vertex 4 Z-coordinate {m}
Surface:HeatTransfer:Sub,
   Window A1,             !- User Supplied Surface Name
   WINDOW,                !- Surface Type
   Window,                !- Construction Name of the Surface
   A out wall,            !- Base Surface Name
   ,                    !- OutsideFaceEnvironment Object
   .5,                  !- View Factor to Ground
   ,                    !- Name of shading control
   ,                    !- WindowFrameAndDivider Name
   1,                   !- Multiplier
   4,                   !- Number of Surface Vertice Groups -- Number of (X,Y,Z) groups in this surface
   3.5,                 !- Vertex 1 X-coordinate {m}
   0,                   !- Vertex 1 Y-coordinate {m}
   1.5,                 !- Vertex 1 Z-coordinate {m}
   3.5,                 !- Vertex 2 X-coordinate {m}
   0,                   !- Vertex 2 Y-coordinate {m}
   .25,                 !- Vertex 2 Z-coordinate {m}
   1.5,                 !- Vertex 3 X-coordinate {m}
   0,                   !- Vertex 3 Y-coordinate {m}
   .25,                 !- Vertex 3 Z-coordinate {m}
   1.5,                 !- Vertex 4 X-coordinate {m}
   0,                   !- Vertex 4 Y-coordinate {m}
   1.5;                 !- Vertex 4 Z-coordinate {m}
Surface:HeatTransfer:Sub,
   Window A2,             !- User Supplied Surface Name
   WINDOW,                !- Surface Type
   Window,                !- Construction Name of the Surface
   A out wall2,           !- Base Surface Name
   ,                    !- OutsideFaceEnvironment Object
   .5,                  !- View Factor to Ground
   ,                    !- Name of shading control
   ,                    !- WindowFrameAndDivider Name
   1,                   !- Multiplier
   4,                   !- Number of Surface Vertice Groups -- Number of (X,Y,Z) groups in this surface
   3.5,                 !- Vertex 1 X-coordinate {m}
   0,                   !- Vertex 1 Y-coordinate {m}
   4.5,                 !- Vertex 1 Z-coordinate {m}
   3.5,                 !- Vertex 2 X-coordinate {m}
   0,                   !- Vertex 2 Y-coordinate {m}
   3.25,                !- Vertex 2 Z-coordinate {m}
   1.5,                 !- Vertex 3 X-coordinate {m}
   0,                   !- Vertex 3 Y-coordinate {m}
   3.25,                !- Vertex 3 Z-coordinate {m}
   1.5,                 !- Vertex 4 X-coordinate {m}
   0,                   !- Vertex 4 Y-coordinate {m}
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   4.5;                    !- Vertex 4 Z-coordinate {m}
Surface:HeatTransfer:Sub,
   Window B1,              !- User Supplied Surface Name
   WINDOW,                 !- Surface Type
   Window,                 !- Construction Name of the Surface
   B out wall,             !- Base Surface Name
   ,                       !- OutsideFaceEnvironment Object
   .5,                     !- View Factor to Ground
   ,                       !- Name of shading control
   ,                       !- WindowFrameAndDivider Name
   1,                      !- Multiplier
   4,                      !- Number of Surface Vertice Groups -- Number of (X,Y,Z) groups in this surface
   9,                      !- Vertex 1 X-coordinate {m}
   0,                      !- Vertex 1 Y-coordinate {m}
   1.5,                    !- Vertex 1 Z-coordinate {m}
   9,                      !- Vertex 2 X-coordinate {m}
   0,                      !- Vertex 2 Y-coordinate {m}
   .25,                    !- Vertex 2 Z-coordinate {m}
   6,                      !- Vertex 3 X-coordinate {m}
   0,                      !- Vertex 3 Y-coordinate {m}
   .25,                    !- Vertex 3 Z-coordinate {m}
   6,                      !- Vertex 4 X-coordinate {m}
   0,                      !- Vertex 4 Y-coordinate {m}
   1.5;                    !- Vertex 4 Z-coordinate {m}
ScheduleType,
   people density,         !- ScheduleType Name
   0.0:3.0,                !- range
   DISCRETE;               !- Numeric Type
ScheduleType,
   people activity,        !- ScheduleType Name
   40:235,                 !- range
   CONTINUOUS;             !- Numeric Type
ScheduleType,
   work efficiency,        !- ScheduleType Name
   0.0 : 1.0,              !- range
   CONTINUOUS;             !- Numeric Type
ScheduleType,
   clothing;               !- ScheduleType Name
ScheduleType,
   air velocity,           !- ScheduleType Name
   0.0 : 1.0,              !- range
   CONTINUOUS;             !- Numeric Type
ScheduleType,
   lighting,               !- ScheduleType Name
   0.0 : 1.0,              !- range
   DISCRETE;               !- Numeric Type
ScheduleType,
   air supply,             !- ScheduleType Name
   0.0 : 1.0,              !- range
   DISCRETE;               !- Numeric Type
ScheduleType,
   temperature,            !- ScheduleType Name
   -60:200,                !- range
   CONTINUOUS;             !- Numeric Type
ScheduleType,
   ventilation,            !- ScheduleType Name
```

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   0.0 : 1.0,              !- range
   CONTINUOUS;             !- Numeric Type
ScheduleType,
   cosmis vent,            !- ScheduleType Name
   20:25,                  !- range
   DISCRETE;               !- Numeric Type
ScheduleType,
   air loop,               !- ScheduleType Name
   0.0 : 1.0,              !- range
   CONTINUOUS;             !- Numeric Type
ScheduleType,
   winter heat,            !- ScheduleType Name
   0.0 : 1.0,              !- range
   DISCRETE;               !- Numeric Type
ScheduleType,
   plant loop,             !- ScheduleType Name
   -60:200,                !- range
   CONTINUOUS;             !- Numeric Type
ScheduleType,
   humidity,               !- ScheduleType Name
   30:60,                  !- range
   CONTINUOUS;             !- Numeric Type
ScheduleType,
   temp control,           !- ScheduleType Name
   0:4,                    !- range
   DISCRETE;               !- Numeric Type
ScheduleType,
   Fraction,               !- ScheduleType Name
   0.0 : 1.0,              !- range
   CONTINUOUS;             !- Numeric Type
ScheduleType,
   Any Number;             !- ScheduleType Name
DAYSCHEDULE,
   Saturday,               !- Name
   people density,         !- ScheduleType
   3,                      !- Hour 1
   3,                      !- Hour 2
   3,                      !- Hour 3
   3,                      !- Hour 4
   3,                      !- Hour 5
   3,                      !- Hour 6
   3,                      !- Hour 7
   3,                      !- Hour 8
   3,                      !- Hour 9
   0,                      !- Hour 10
   0,                      !- Hour 11
   0,                      !- Hour 12
   0,                      !- Hour 13
   1,                      !- Hour 14
   1,                      !- Hour 15
   1,                      !- Hour 16
   1,                      !- Hour 17
   2,                      !- Hour 18
   2,                      !- Hour 19
   3,                      !- Hour 20
   3,                      !- Hour 21
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   3,                !- Hour 22
   3,                !- Hour 23
   3;                !- Hour 24
DAYSCHEDULE,
   Work effciency,         !- Name
   Any Number,             !- ScheduleType
   0,                !- Hour 1
   0,                !- Hour 2
   0,                !- Hour 3
   0,                !- Hour 4
   0,                !- Hour 5
   0,                !- Hour 6
   0,                !- Hour 7
   0,                !- Hour 8
   0,                !- Hour 9
   0,                !- Hour 10
   0,                !- Hour 11
   0,                !- Hour 12
   0,                !- Hour 13
   0,                !- Hour 14
   0,                !- Hour 15
   0,                !- Hour 16
   0,                !- Hour 17
   0,                !- Hour 18
   0,                !- Hour 19
   0,                !- Hour 20
   0,                !- Hour 21
   0,                !- Hour 22
   0,                !- Hour 23
   0;                !- Hour 24
DAYSCHEDULE,
   light,             !- Name
   lighting,            !- ScheduleType
   0,                !- Hour 1
   0,                !- Hour 2
   0,                !- Hour 3
   0,                !- Hour 4
   0,                !- Hour 5
   1,                !- Hour 6
   1,                !- Hour 7
   1,                !- Hour 8
   1,                !- Hour 9
   1,                !- Hour 10
   1,                !- Hour 11
   1,                !- Hour 12
   1,                !- Hour 13
   1,                !- Hour 14
   1,                !- Hour 15
   1,                !- Hour 16
   1,                !- Hour 17
   1,                !- Hour 18
   1,                !- Hour 19
   1,                !- Hour 20
   0,                !- Hour 21
   0,                !- Hour 22
   0,                !- Hour 23
```

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   0;                !- Hour 24
DAYSCHEDULE,
   air supply,           !- Name
   air supply,           !- ScheduleType
   1,                !- Hour 1
   1,                !- Hour 2
   1,                !- Hour 3
   1,                !- Hour 4
   1,                !- Hour 5
   1,                !- Hour 6
   1,                !- Hour 7
   1,                !- Hour 8
   1,                !- Hour 9
   1,                !- Hour 10
   1,                !- Hour 11
   1,                !- Hour 12
   1,                !- Hour 13
   1,                !- Hour 14
   1,                !- Hour 15
   1,                !- Hour 16
   1,                !- Hour 17
   1,                !- Hour 18
   1,                !- Hour 19
   1,                !- Hour 20
   1,                !- Hour 21
   1,                !- Hour 22
   1,                !- Hour 23
   1;                !- Hour 24
DAYSCHEDULE,
   temperature,          !- Name
   temperature,          !- ScheduleType
   23,               !- Hour 1
   23,               !- Hour 2
   23,               !- Hour 3
   23,               !- Hour 4
   23,               !- Hour 5
   23,               !- Hour 6
   23,               !- Hour 7
   23,               !- Hour 8
   23,               !- Hour 9
   23,               !- Hour 10
   23,               !- Hour 11
   23,               !- Hour 12
   23,               !- Hour 13
   23,               !- Hour 14
   23,               !- Hour 15
   23,               !- Hour 16
   23,               !- Hour 17
   23,               !- Hour 18
   23,               !- Hour 19
   23,               !- Hour 20
   23,               !- Hour 21
   23,               !- Hour 22
   23,               !- Hour 23
   23;               !- Hour 24
DAYSCHEDULE,
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  plant loop,             !- Name
  temperature,            !- ScheduleType
  50,                     !- Hour 1
  50,                     !- Hour 2
  50,                     !- Hour 3
  50,                     !- Hour 4
  50,                     !- Hour 5
  50,                     !- Hour 6
  50,                     !- Hour 7
  50,                     !- Hour 8
  50,                     !- Hour 9
  50,                     !- Hour 10
  50,                     !- Hour 11
  50,                     !- Hour 12
  50,                     !- Hour 13
  50,                     !- Hour 14
  50,                     !- Hour 15
  50,                     !- Hour 16
  50,                     !- Hour 17
  50,                     !- Hour 18
  50,                     !- Hour 19
  50,                     !- Hour 20
  50,                     !- Hour 21
  50,                     !- Hour 22
  50,                     !- Hour 23
  50;                     !- Hour 24
DAYSCHEDULE,
  temp control,           !- Name
  temp control,           !- ScheduleType
  1,                      !- Hour 1
  1,                      !- Hour 2
  1,                      !- Hour 3
  1,                      !- Hour 4
  1,                      !- Hour 5
  1,                      !- Hour 6
  1,                      !- Hour 7
  1,                      !- Hour 8
  1,                      !- Hour 9
  1,                      !- Hour 10
  1,                      !- Hour 11
  1,                      !- Hour 12
  1,                      !- Hour 13
  1,                      !- Hour 14
  1,                      !- Hour 15
  1,                      !- Hour 16
  1,                      !- Hour 17
  1,                      !- Hour 18
  1,                      !- Hour 19
  1,                      !- Hour 20
  1,                      !- Hour 21
  1,                      !- Hour 22
  1,                      !- Hour 23
  1;                      !- Hour 24

DAYSCHEDULE,
  temp controlS,          !- Name
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   temp control,           !- ScheduleType
   2,                      !- Hour 1
   2,                      !- Hour 2
   2,                      !- Hour 3
   2,                      !- Hour 4
   2,                      !- Hour 5
   2,                      !- Hour 6
   2,                      !- Hour 7
   2,                      !- Hour 8
   2,                      !- Hour 9
   2,                      !- Hour 10
   2,                      !- Hour 11
   2,                      !- Hour 12
   2,                      !- Hour 13
   2,                      !- Hour 14
   2,                      !- Hour 15
   2,                      !- Hour 16
   2,                      !- Hour 17
   2,                      !- Hour 18
   2,                      !- Hour 19
   2,                      !- Hour 20
   2,                      !- Hour 21
   2,                      !- Hour 22
   2,                      !- Hour 23
   2;                      !- Hour 24
DAYSCHEDULE,
   Radiant System Cooling Setpoints,  !- Name
   temperature,            !- ScheduleType
   26,                     !- Hour 1
   26,                     !- Hour 2
   26,                     !- Hour 3
   26,                     !- Hour 4
   26,                     !- Hour 5
   26,                     !- Hour 6
   26,                     !- Hour 7
   26,                     !- Hour 8
   26,                     !- Hour 9
   26,                     !- Hour 10
   26,                     !- Hour 11
   26,                     !- Hour 12
   26,                     !- Hour 13
   26,                     !- Hour 14
   26,                     !- Hour 15
   26,                     !- Hour 16
   26,                     !- Hour 17
   26,                     !- Hour 18
   26,                     !- Hour 19
   26,                     !- Hour 20
   26,                     !- Hour 21
   26,                     !- Hour 22
   26,                     !- Hour 23
   26;                     !- Hour 24
DAYSCHEDULE,
   Radiant System Setpoints,!- Name
   temperature,            !- ScheduleType
   25,                     !- Hour 1
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  25,                !- Hour 2
  25,                !- Hour 3
  25,                !- Hour 4
  25,                !- Hour 5
  25,                !- Hour 6
  25,                !- Hour 7
  25,                !- Hour 8
  25,                !- Hour 9
  25,                !- Hour 10
  25,                !- Hour 11
  25,                !- Hour 12
  25,                !- Hour 13
  25,                !- Hour 14
  25,                !- Hour 15
  25,                !- Hour 16
  25,                !- Hour 17
  25,                !- Hour 18
  25,                !- Hour 19
  25,                !- Hour 20
  25,                !- Hour 21
  25,                !- Hour 22
  25,                !- Hour 23
  25;                !- Hour 24
DAYSCHEDULE,
  Summer Zone Temp Lo Day Sch,  !- Name
  temperature,           !- ScheduleType
  15,                !- Hour 1
  15,                !- Hour 2
  15,                !- Hour 3
  15,                !- Hour 4
  15,                !- Hour 5
  15,                !- Hour 6
  15,                !- Hour 7
  20,                !- Hour 8
  20,                !- Hour 9
  20,                !- Hour 10
  20,                !- Hour 11
  20,                !- Hour 12
  20,                !- Hour 13
  20,                !- Hour 14
  20,                !- Hour 15
  20,                !- Hour 16
  20,                !- Hour 17
  20,                !- Hour 18
  15,                !- Hour 19
  15,                !- Hour 20
  15,                !- Hour 21
  15,                !- Hour 22
  15,                !- Hour 23
  15;                !- Hour 24
DAYSCHEDULE,
  Winter Zone Temp Lo Day Sch,  !- Name
  temperature,           !- ScheduleType
  15,                !- Hour 1
  15,                !- Hour 2
  15,                !- Hour 3
```

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   15,                !- Hour 4
   15,                !- Hour 5
   15,                !- Hour 6
   15,                !- Hour 7
   20,                !- Hour 8
   20,                !- Hour 9
   20,                !- Hour 10
   20,                !- Hour 11
   20,                !- Hour 12
   20,                !- Hour 13
   20,                !- Hour 14
   20,                !- Hour 15
   20,                !- Hour 16
   20,                !- Hour 17
   20,                !- Hour 18
   15,                !- Hour 19
   15,                !- Hour 20
   15,                !- Hour 21
   15,                !- Hour 22
   15,                !- Hour 23
   15;                !- Hour 24
DAYSCHEDULE,
   Summer Zone Temp Hi Day Sch,  !- Name
   temperature,           !- ScheduleType
   30,                !- Hour 1
   30,                !- Hour 2
   30,                !- Hour 3
   30,                !- Hour 4
   30,                !- Hour 5
   30,                !- Hour 6
   30,                !- Hour 7
   30,                !- Hour 8
   24,                !- Hour 9
   24,                !- Hour 10
   24,                !- Hour 11
   24,                !- Hour 12
   24,                !- Hour 13
   24,                !- Hour 14
   24,                !- Hour 15
   24,                !- Hour 16
   24,                !- Hour 17
   30,                !- Hour 18
   30,                !- Hour 19
   30,                !- Hour 20
   30,                !- Hour 21
   30,                !- Hour 22
   30,                !- Hour 23
   30;                !- Hour 24
DAYSCHEDULE,
   Winter Zone Temp Hi Day Sch,  !- Name
   temperature,           !- ScheduleType
   60,                !- Hour 1
   60,                !- Hour 2
   60,                !- Hour 3
   60,                !- Hour 4
   60,                !- Hour 5
```

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   60,                !- Hour 6
   60,                !- Hour 7
   60,                !- Hour 8
   60,                !- Hour 9
   60,                !- Hour 10
   60,                !- Hour 11
   60,                !- Hour 12
   60,                !- Hour 13
   60,                !- Hour 14
   60,                !- Hour 15
   60,                !- Hour 16
   60,                !- Hour 17
   60,                !- Hour 18
   60,                !- Hour 19
   60,                !- Hour 20
   60,                !- Hour 21
   60,                !- Hour 22
   60,                !- Hour 23
   60;                !- Hour 24
WEEKSCHEDULE,
   C,                 !- Name
   Work effciency,          !- Sunday DAYSCHEDULE Name
   Work effciency,          !- Monday DAYSCHEDULE Name
   Work effciency,          !- Tuesday DAYSCHEDULE Name
   Work effciency,          !- Wednesday DAYSCHEDULE Name
   Work effciency,          !- Thursday DAYSCHEDULE Name
   Work effciency,          !- Friday DAYSCHEDULE Name
   Work effciency,          !- Saturday DAYSCHEDULE Name
   Work effciency,          !- Holiday DAYSCHEDULE Name
   Work effciency,          !- SummerDesignDay DAYSCHEDULE Name
   Work effciency,          !- WinterDesignDay DAYSCHEDULE Name
   Work effciency,          !- CustomDay1 DAYSCHEDULE Name
   Work effciency;          !- CustomDay2 DAYSCHEDULE Name
WEEKSCHEDULE,
   G,                 !- Name
   light,             !- Sunday DAYSCHEDULE Name
   light,             !- Monday DAYSCHEDULE Name
   light,             !- Tuesday DAYSCHEDULE Name
   light,             !- Wednesday DAYSCHEDULE Name
   light,             !- Thursday DAYSCHEDULE Name
   light,             !- Friday DAYSCHEDULE Name
   light,             !- Saturday DAYSCHEDULE Name
   light,             !- Holiday DAYSCHEDULE Name
   light,             !- SummerDesignDay DAYSCHEDULE Name
   light,             !- WinterDesignDay DAYSCHEDULE Name
   light,             !- CustomDay1 DAYSCHEDULE Name
   light;             !- CustomDay2 DAYSCHEDULE Name
WEEKSCHEDULE,
   o,                 !- Name
   temperature,           !- Sunday DAYSCHEDULE Name
   temperature,           !- Monday DAYSCHEDULE Name
   temperature,           !- Tuesday DAYSCHEDULE Name
   temperature,           !- Wednesday DAYSCHEDULE Name
   temperature,           !- Thursday DAYSCHEDULE Name
   temperature,           !- Friday DAYSCHEDULE Name
   temperature,           !- Saturday DAYSCHEDULE Name
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   temperature,            !- Holiday DAYSCHEDULE Name
   temperature,            !- SummerDesignDay DAYSCHEDULE Name
   temperature,            !- WinterDesignDay DAYSCHEDULE Name
   temperature,            !- CustomDay1 DAYSCHEDULE Name
   temperature;            !- CustomDay2 DAYSCHEDULE Name
WEEKSCHEDULE,
   p,                 !- Name
   ventilation,            !- Sunday DAYSCHEDULE Name
   ventilation,            !- Monday DAYSCHEDULE Name
   ventilation,            !- Tuesday DAYSCHEDULE Name
   ventilation,            !- Wednesday DAYSCHEDULE Name
   ventilation,            !- Thursday DAYSCHEDULE Name
   ventilation,            !- Friday DAYSCHEDULE Name
   ventilation,            !- Saturday DAYSCHEDULE Name
   ventilation,            !- Holiday DAYSCHEDULE Name
   ventilation,            !- SummerDesignDay DAYSCHEDULE Name
   ventilation,            !- WinterDesignDay DAYSCHEDULE Name
   ventilation,            !- CustomDay1 DAYSCHEDULE Name
   ventilation;            !- CustomDay2 DAYSCHEDULE Name
WEEKSCHEDULE,
   plant loop,             !- Name
   plant loop,             !- Sunday DAYSCHEDULE Name
   plant loop,             !- Monday DAYSCHEDULE Name
   plant loop,             !- Tuesday DAYSCHEDULE Name
   plant loop,             !- Wednesday DAYSCHEDULE Name
   plant loop,             !- Thursday DAYSCHEDULE Name
   plant loop,             !- Friday DAYSCHEDULE Name
   plant loop,             !- Saturday DAYSCHEDULE Name
   plant loop,             !- Holiday DAYSCHEDULE Name
   plant loop,             !- SummerDesignDay DAYSCHEDULE Name
   plant loop,             !- WinterDesignDay DAYSCHEDULE Name
   plant loop,             !- CustomDay1 DAYSCHEDULE Name
   plant loop;             !- CustomDay2 DAYSCHEDULE Name
WEEKSCHEDULE,
   Radiant System Week Sch, !- Name
   Radiant System Setpoints,!- Sunday DAYSCHEDULE Name
   Radiant System Setpoints,!- Monday DAYSCHEDULE Name
   Radiant System Setpoints,!- Tuesday DAYSCHEDULE Name
   Radiant System Setpoints,!- Wednesday DAYSCHEDULE Name
   Radiant System Setpoints,!- Thursday DAYSCHEDULE Name
   Radiant System Setpoints,!- Friday DAYSCHEDULE Name
   Radiant System Setpoints,!- Saturday DAYSCHEDULE Name
   Radiant System Setpoints,!- Holiday DAYSCHEDULE Name
   Radiant System Setpoints,!- SummerDesignDay DAYSCHEDULE Name
   Radiant System Setpoints,!- WinterDesignDay DAYSCHEDULE Name
   Radiant System Setpoints,!- CustomDay1 DAYSCHEDULE Name
   Radiant System Setpoints;!- CustomDay2 DAYSCHEDULE Name
SCHEDULE,
   light,              !- Name
   lighting,             !- ScheduleType
   G,                 !- Name of WEEKSCHEDULE 1
   1,                 !- Start Month 1
   1,                 !- Start Day 1
   12,                !- End Month 1
   31;                !- End Day 1
SCHEDULE,
```

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   Plant loop,             !- Name
   temperature,            !- ScheduleType
   plant loop,             !- Name of WEEKSCHEDULE 1
   1,                      !- Start Month 1
   1,                      !- Start Day 1
   12,                     !- End Month 1
   31;                     !- End Day 1
SCHEDULE,
   temp control,           !- Name
   temp control,           !- ScheduleType
   temp control,           !- Name of WEEKSCHEDULE 1
   1,                      !- Start Month 1
   1,                      !- Start Day 1
   3,                      !- End Month 1
   31,                     !- End Day 1
   temp controlS,          !- Name of WEEKSCHEDULE 2
   4,                      !- Start Month 2
   1,                      !- Start Day 2
   9,                      !- End Month 2
   30,                     !- End Day 2
   temp control,           !- Name of WEEKSCHEDULE 3
   10,                     !- Start Month 3
   1,                      !- Start Day 3
   12,                     !- End Month 3
   31;                     !- End Day 3
SCHEDULE,
   BLDG Sch   1,           !- Name
   Any Number,             !- ScheduleType
   bldg OCCUPANCY,         !- Name of WEEKSCHEDULE 1
   1,                      !- Start Month 1
   1,                      !- Start Day 1
   12,                     !- End Month 1
   31;                     !- End Day 1
SCHEDULE,
   Heating Setpoints,      !- Name
   temperature,            !- ScheduleType
   Winter Zone Temp Lo Week Sch,  !- Name of WEEKSCHEDULE 1
   1,                      !- Start Month 1
   1,                      !- Start Day 1
   5,                      !- End Month 1
   31,                     !- End Day 1
   Summer Zone Temp Lo Week Sch,  !- Name of WEEKSCHEDULE 2
   6,                      !- Start Month 2
   1,                      !- Start Day 2
   8,                      !- End Month 2
   31,                     !- End Day 2
   Winter Zone Temp Lo Week Sch,  !- Name of WEEKSCHEDULE 3
   9,                      !- Start Month 3
   1,                      !- Start Day 3
   12,                     !- End Month 3
   31;                     !- End Day 3
SCHEDULE,
   Radiant Heating Setpoints,  !- Name
   temperature,            !- ScheduleType
   Radiant System Week Sch, !- Name of WEEKSCHEDULE 1
   1,                      !- Start Month 1
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   1,                  !- Start Day 1
   12,                 !- End Month 1
   31;                 !- End Day 1
PEOPLE,
   A-NW-1,               !- Zone Name
   2,                  !- Number of People
   BLDG Sch   1,          !- Number of People SCHEDULE Name (real--fraction)
   .3,                 !- Fraction Radiant
   people activity,       !- Activity level SCHEDULE Name (units W/person, real)
   A1,                 !- PEOPLE Group Name
   ZoneAveraged,          !- MRT Calculation Type
   ,                  !- Surface Name/Angle Factor List Name
   work effciency,        !- Work Efficiency SCHEDULE Name (0.0-1.0,real)
   clothing,             !- Clothing Insulation SCHEDULE Name (real)
   air velocityS,         !- Air Velocity SCHEDULE Name (units m/s, real)
   Fanger,               !- Thermal Comfort Report Type
   Pierce,               !- Thermal Comfort Report Type
   KSU;                  !- Thermal Comfort Report Type
PEOPLE,
   B-North-1,             !- Zone Name
   4,                  !- Number of People
   BLDG Sch   1,          !- Number of People SCHEDULE Name (real--fraction)
   .3,                 !- Fraction Radiant
   people activity,       !- Activity level SCHEDULE Name (units W/person, real)
   B1,                 !- PEOPLE Group Name
   ZoneAveraged,          !- MRT Calculation Type
   ,                  !- Surface Name/Angle Factor List Name
   work effciency,        !- Work Efficiency SCHEDULE Name (0.0-1.0,real)
   clothing,             !- Clothing Insulation SCHEDULE Name (real)
   air velocityS,         !- Air Velocity SCHEDULE Name (units m/s, real)
   Fanger,               !- Thermal Comfort Report Type
   Pierce,               !- Thermal Comfort Report Type
   KSU;                  !- Thermal Comfort Report Type
PEOPLE,
   C-NE-1,               !- Zone Name
   2,                  !- Number of People
   BLDG Sch   1,          !- Number of People SCHEDULE Name (real--fraction)
   .3,                 !- Fraction Radiant
   people activity,       !- Activity level SCHEDULE Name (units W/person, real)
   C1,                 !- PEOPLE Group Name
   ZoneAveraged,          !- MRT Calculation Type
   ,                  !- Surface Name/Angle Factor List Name
   work effciency,        !- Work Efficiency SCHEDULE Name (0.0-1.0,real)
   clothing,             !- Clothing Insulation SCHEDULE Name (real)
   air velocityS,         !- Air Velocity SCHEDULE Name (units m/s, real)
   Fanger,               !- Thermal Comfort Report Type
   Pierce,               !- Thermal Comfort Report Type
   KSU;                  !- Thermal Comfort Report Type
COMIS SIMULATION,
   VENT,                 !- Ventilation simulation control
   NO POL,               !- Pollution simulation control
   NO CONC,              !- Concentration simulation control
   1,                  !- Under-relaxation factor {dimensionless}
   .000001,              !- Absolute flow tolerance {kg/s}
   .00001,             !- Relative flow tolerance {dimensionless}
   .0000002,             !- Error estimate for total flow per zone {kg/s}
```

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   1,                    !- Start number of iterations
   .0001,                !- Limit for laminar flow approximation {Pa}
   0,                    !- Flag for using old pressures
   0,                    !- Flag for pressure initiation
   500,                  !- Maximum number of iterations
   10,                   !- Reference height for recorded wind data {m}
   .14,                  !- Wind velocity profile exponent {dimensionless}
   3ZVent CP Data;       !- COMIS CP ARRAY Name
COMIS Zone Data,
   A-NW-1,               !- Name of Associated Thermal Zone
   ,                     !- Vent Temperature Schedule
   NOVENT;               !- Ventilation Control Mode
COMIS Surface Data,
   Interior Part A1F1,   !- Name of Associated EnergyPlus Surface
   CRdoor,               !- Air Flow Crack or Opening Type
   ,                     !- External Node Name
   1;                    !- Crack Actual Value or Window Open Factor for Ventilation {dimensionless}
COMIS EXTERNAL NODE,
   1,                    !- Name
   1;                    !- Outside Pollutant Concentration Factor {dimensionless}
COMIS STANDARD CONDITIONS FOR CRACK DATA,
   22,                   !- Standard temperature for crack data {C}
   101.32,               !- Standard barometric pressure for crack data {kPa}
   5;                    !- Standard humidity ratio for crack data {g/kg}
COMIS AIR FLOW:Crack,
   CRdoor,               !- Name
   .01,                  !- Air mass flow coefficient {kg/s @ 1Pa}
   .667,                 !- Air mass flow exponent {dimensionless}
   1,                    !- Crack length {m}
   0,                    !- Pollutant #1 Filter Efficiency {dimensionless}
   0,                    !- Pollutant #2 Filter Efficiency {dimensionless}
   0;                    !- Pollutant #3 Filter Efficiency {dimensionless}
COMIS CP ARRAY,
   3ZVent CP Data,       !- Name
   10,                   !- Reference height for CP data {m}
   0;                    !- Wind direction #1 {deg}
COMIS CP VALUES,
   3ZVent CP Data,       !- COMIS CP ARRAY Name
   1,                    !- External Node Name
   1;                    !- Cp value #1 {dimensionless}
ZONE SIZING,
   A-NW-1,               !- Name of a zone
   16,                   !- Zone cooling design supply air temperature {C}
   40,                   !- Zone heating design supply air temperature {C}
   .006,                 !- Zone cooling design supply air humidity ratio {kg-H20/kg-air}
   .004,                 !- Zone heating design supply air humidity ratio {kg-H2O/kg-air}
   flow/person,          !- outside air method
   .000944,              !- outside air flow per person {m3/s}
   ,                     !- outside air flow {m3/s}
   0,                    !- zone sizing factor
   design day,           !- cooling design air flow method
   ,                     !- cooling design air flow rate {m3/s}
   design day,           !- heating design air flow method
   0;                    !- heating design air flow rate {m3/s}
SYSTEM SIZING,
   Typical Terminal Reheat 1,  !- name of an AIR PRIMARY LOOP object
```

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   sensible,              !- type of load to size on
   ,                     !- Design (minimum) outside air volumetric flow rate {m3/s}
   1,                    !- minimum system air flow ratio
   7,                    !- Preheat design set temperature {C}
   13,                   !- Central cooling design supply air temperature {C}
   16,                   !- Central heating design supply air temperature {C}
   noncoincident,          !- Sizing Option
   yes,                  !- Cooling 100% Outside Air
   yes,                  !- Heating 100% Outside Air
   .008,                 !- Central cooling design supply air humidity ratio {kg-H2O/kg-air}
   .006;                 !- Central heating design supply air humidity ratio {kg-H2O/kg-air}
PLANT SIZING,
   Heat Plant loop,        !- name of a PLANT LOOP or CONDENSER LOOP object
   heating,              !- loop type
   50,                   !- Design loop exit temperature {C}
   5;                    !- Design loop delta T {delK}
NODE LIST,
   All Nodes,              !- Node List Name
   fan exhaust 1,          !- Node_ID_1
   heat recovery 2,        !- Node_ID_2
   heat recovery 3,        !- Node_ID_3
   out air 4,             !- Node_ID_4
   out air 5,             !- Node_ID_5
   out air 6,             !- Node_ID_6
   out air 7,             !- Node_ID_7
   out air 8,             !- Node_ID_8
   process12,              !- Node_ID_12
   coil 13,               !- Node_ID_13
   regfan14,              !- Node_ID_14
   regen15,               !- Node_ID_15
   Regen exhaust 16,       !- Node_ID_16
   fan17,                 !- Node_ID_17
   solar 18,              !- Node_ID_18
   solar 19,              !- Node_ID_19
   hot air 20,            !- Node_ID_20
   solar 21,              !- Node_ID_21
   fan 22,                !- Node_ID_22
   solar water 24,         !- Node_ID_24
   solar water 25;         !- Node_ID_25
BRANCH LIST,
   Heating Supply Side Branches,  !- Branch List Name
   Heating Supply Inlet Branch,  !- Branch Name 1
   Heating Purchased Hot Water Branch,  !- Branch Name 2
   Heating Supply Bypass Branch,  !- Branch Name 3
   Heating Supply Outlet Branch;  !- Branch Name 4
BRANCH LIST,
   Heating Demand Side Branches,  !- Branch List Name
   Reheat Inlet Branch,     !- Branch Name 1
   Heat Zone BASEMENT,      !- Branch Name 2
   Heat Zone M1,           !- Branch Name 3
   Heat Zone A1,           !- Branch Name 4
   Heat Zone B1,           !- Branch Name 5
   Heat Zone C1,           !- Branch Name 6
   Heat Zone J1,           !- Branch Name 7
   Heat Zone K1,           !- Branch Name 8
   Heat Zone F1,           !- Branch Name 9
```

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    Heat Zone E1,            !- Branch Name 10
    Heat Zone D1,            !- Branch Name 11
    Heat Zone N1,            !- Branch Name 12
    Heat Zone O1,            !- Branch Name 13
    Heat Zone G1,            !- Branch Name 14
    Heat Zone H1,            !- Branch Name 15
    Heat Zone I1,           !- Branch Name 16
    Heat Zone L1,            !- Branch Name 17
    Heat Zone L2,            !- Branch Name 18
    Heat Zone I2,           !- Branch Name 19
    Heat Zone H2,            !- Branch Name 20
    Heat Zone G2,            !- Branch Name 21
    Heat Zone O2,            !- Branch Name 22
    Heat Zone N2,            !- Branch Name 23
    Heat Zone D2,            !- Branch Name 24
    Heat Zone E2,           !- Branch Name 25
    Heat Zone F2,           !- Branch Name 26
    Heat Zone K2,            !- Branch Name 27
    Heat Zone J2,           !- Branch Name 28
    Heat Zone C2,            !- Branch Name 29
    Heat Zone B2,            !- Branch Name 30
    Heat Zone A2,            !- Branch Name 31
    Heat Zone M2,            !- Branch Name 32
    Heat Zone ROOF,          !- Branch Name 33
    Reheat Bypass Branch,    !- Branch Name 34
    Reheat Outlet Branch;    !- Branch Name 35
  BRANCH LIST,
    Air Loop Branches,       !- Branch List Name
    Air Loop Main Branch;    !- Branch Name 1
  CONNECTOR LIST,
    Heating Supply Side Connectors,  !- Connector List Name
    SPLITTER,                !- Type of Connector 1
    Heating Supply Splitter, !- Name of Connector 1
    MIXER,                   !- Type of Connector 2
    Heating Supply Mixer;    !- Name of Connector 2
  CONNECTOR LIST,
    Heating Demand Side Connectors,  !- Connector List Name
    SPLITTER,                !- Type of Connector 1
    Reheat Splitter,         !- Name of Connector 1
    MIXER,                   !- Type of Connector 2
    Reheat Mixer;            !- Name of Connector 2
  BRANCH,
    Heating Purchased Hot Water Branch,  !- Branch Name
    autosize,                !- Maximum Branch Flow Rate {m3/s}
    purchased:hot water,     !- Comp1 Type
    Solar Water,             !- Comp1 Name
    Solar water 26,          !- Comp1 Inlet Node Name
    Solar water 24,          !- Comp1 Outlet Node Name
    ACTIVE;                  !- Comp1 Branch Control Type
  BRANCH,
    Reheat Inlet Branch,     !- Branch Name
    autosize,                !- Maximum Branch Flow Rate {m3/s}
    PIPE,                    !- Comp1 Type
    Reheat Inlet Pipe,       !- Comp1 Name
    HW Demand Inlet Node,    !- Comp1 Inlet Node Name
    HW Demand Entrance Pipe Outlet Node,  !- Comp1 Outlet Node Name
```

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   PASSIVE;                !- Comp1 Branch Control Type
BRANCH,
   Heating Supply Inlet Branch,  !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   PUMP:VARIABLE SPEED,    !- Comp1 Type
   HW Circ Pump,           !- Comp1 Name
   HW Supply Inlet Node,   !- Comp1 Inlet Node Name
   HW Pump Outlet Node,    !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone M1,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar4,                 !- Comp1 Name
   solar water 30,         !- Comp1 Inlet Node Name
   hot water 1,            !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone A1,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar1,                 !- Comp1 Name
   63,                     !- Comp1 Inlet Node Name
   64,                     !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone B1,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar2,                 !- Comp1 Name
   65,                     !- Comp1 Inlet Node Name
   66,                     !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone C1,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar3,                 !- Comp1 Name
   67,                     !- Comp1 Inlet Node Name
   68,                     !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone J1,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar5,                 !- Comp1 Name
   69,                     !- Comp1 Inlet Node Name
   70,                     !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone K1,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar6,                 !- Comp1 Name
   71,                     !- Comp1 Inlet Node Name
   72,                     !- Comp1 Outlet Node Name
```

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   ACTIVE;               !- Comp1 Branch Control Type
BRANCH,
   Heat Zone F1,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar7,                !- Comp1 Name
   73,                 !- Comp1 Inlet Node Name
   74,                 !- Comp1 Outlet Node Name
   ACTIVE;               !- Comp1 Branch Control Type
BRANCH,
   Heat Zone E1,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar8,                !- Comp1 Name
   75,                 !- Comp1 Inlet Node Name
   76,                 !- Comp1 Outlet Node Name
   ACTIVE;               !- Comp1 Branch Control Type
BRANCH,
   Heat Zone D1,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar9,                !- Comp1 Name
   77,                 !- Comp1 Inlet Node Name
   78,                 !- Comp1 Outlet Node Name
   ACTIVE;               !- Comp1 Branch Control Type
BRANCH,
   Heat Zone N1,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar10,               !- Comp1 Name
   79,                 !- Comp1 Inlet Node Name
   80,                 !- Comp1 Outlet Node Name
   ACTIVE;               !- Comp1 Branch Control Type
BRANCH,
   Heat Zone O1,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar11,               !- Comp1 Name
   81,                 !- Comp1 Inlet Node Name
   82,                 !- Comp1 Outlet Node Name
   ACTIVE;               !- Comp1 Branch Control Type
BRANCH,
   Heat Zone G1,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar12,               !- Comp1 Name
   83,                 !- Comp1 Inlet Node Name
   84,                 !- Comp1 Outlet Node Name
   ACTIVE;               !- Comp1 Branch Control Type
BRANCH,
   Heat Zone H1,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar13,               !- Comp1 Name
   85,                 !- Comp1 Inlet Node Name
   86,                 !- Comp1 Outlet Node Name
```

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   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone I1,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar14,                !- Comp1 Name
   87,                  !- Comp1 Inlet Node Name
   88,                  !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone L1,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar15,                !- Comp1 Name
   89,                  !- Comp1 Inlet Node Name
   90,                  !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone L2,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar16,                !- Comp1 Name
   91,                  !- Comp1 Inlet Node Name
   92,                  !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone I2,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar17,                !- Comp1 Name
   93,                  !- Comp1 Inlet Node Name
   94,                  !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone H2,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar18,                !- Comp1 Name
   95,                  !- Comp1 Inlet Node Name
   96,                  !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone G2,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar19,                !- Comp1 Name
   97,                  !- Comp1 Inlet Node Name
   98,                  !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone O2,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar20,                !- Comp1 Name
   99,                  !- Comp1 Inlet Node Name
   100,                 !- Comp1 Outlet Node Name
```

```
   ACTIVE;               !- Comp1 Branch Control Type
BRANCH,
   Heat Zone N2,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar21,               !- Comp1 Name
   101,                   !- Comp1 Inlet Node Name
   102,                   !- Comp1 Outlet Node Name
   ACTIVE;                !- Comp1 Branch Control Type
BRANCH,
   Heat Zone D2,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar22,               !- Comp1 Name
   103,                   !- Comp1 Inlet Node Name
   104,                   !- Comp1 Outlet Node Name
   ACTIVE;                !- Comp1 Branch Control Type
BRANCH,
   Heat Zone E2,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar23,               !- Comp1 Name
   105,                   !- Comp1 Inlet Node Name
   106,                   !- Comp1 Outlet Node Name
   ACTIVE;                !- Comp1 Branch Control Type
BRANCH,
   Heat Zone F2,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar24,               !- Comp1 Name
   107,                   !- Comp1 Inlet Node Name
   108,                   !- Comp1 Outlet Node Name
   ACTIVE;                !- Comp1 Branch Control Type
BRANCH,
   Heat Zone K2,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar25,               !- Comp1 Name
   109,                   !- Comp1 Inlet Node Name
   110,                   !- Comp1 Outlet Node Name
   ACTIVE;                !- Comp1 Branch Control Type
BRANCH,
   Heat Zone J2,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar26,               !- Comp1 Name
   111,                   !- Comp1 Inlet Node Name
   112,                   !- Comp1 Outlet Node Name
   ACTIVE;                !- Comp1 Branch Control Type
BRANCH,
   Heat Zone C2,          !- Branch Name
   autosize,              !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar27,               !- Comp1 Name
   113,                   !- Comp1 Inlet Node Name
   114,                   !- Comp1 Outlet Node Name
```

```
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone B2,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar28,                !- Comp1 Name
   115,                    !- Comp1 Inlet Node Name
   116,                    !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone A2,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar29,                !- Comp1 Name
   117,                    !- Comp1 Inlet Node Name
   118,                    !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone M2,           !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar30,                !- Comp1 Name
   119,                    !- Comp1 Inlet Node Name
   120,                    !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone ROOF,         !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar31,                !- Comp1 Name
   121,                    !- Comp1 Inlet Node Name
   122,                    !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Heat Zone BASEMENT,     !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- Comp1 Type
   Solar32,                !- Comp1 Name
   123,                    !- Comp1 Inlet Node Name
   124,                    !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Reheat Outlet Branch,   !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   PIPE,                   !- Comp1 Type
   Reheat Outlet Pipe,     !- Comp1 Name
   HW Demand Exit Pipe Inlet Node,  !- Comp1 Inlet Node Name
   HW Demand Outlet Node,  !- Comp1 Outlet Node Name
   PASSIVE;                !- Comp1 Branch Control Type
BRANCH,
   Reheat Bypass Branch,   !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   PIPE,                   !- Comp1 Type
   Reheat Bypass,          !- Comp1 Name
   Reheat Bypass Inlet Node,!- Comp1 Inlet Node Name
   Reheat Bypass Outlet Node,  !- Comp1 Outlet Node Name
```

```
   BYPASS;                  !- Comp1 Branch Control Type
BRANCH,
   Heating Supply Bypass Branch,  !- Branch Name
   autosize,                !- Maximum Branch Flow Rate {m3/s}
   PIPE,                    !- Comp1 Type
   Heating Supply Side Bypass,  !- Comp1 Name
   Heating Supply Bypass Inlet Node ,  !- Comp1 Inlet Node Name
   Heating Supply Bypass Outlet Node,  !- Comp1 Outlet Node Name
   BYPASS;                  !- Comp1 Branch Control Type
BRANCH,
   Heating Supply Outlet Branch,  !- Branch Name
   autosize,                !- Maximum Branch Flow Rate {m3/s}
   PIPE,                    !- Comp1 Type
   Heating Supply Outlet,   !- Comp1 Name
   Heating Supply Exit Pipe Inlet Node,  !- Comp1 Inlet Node Name
   HW Supply Outlet Node,   !- Comp1 Outlet Node Name
   PASSIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Demand Bypass Branch,    !- Branch Name
   autosize,                !- Maximum Branch Flow Rate {m3/s}
   PIPE,                    !- Comp1 Type
   Demand Side Bypass,      !- Comp1 Name
   CW Demand Bypass Inlet Node,  !- Comp1 Inlet Node Name
   CW Demand Bypass Outlet Node,  !- Comp1 Outlet Node Name
   BYPASS;                  !- Comp1 Branch Control Type
BRANCH,
   Cooling Demand Outlet,   !- Branch Name
   autosize,                !- Maximum Branch Flow Rate {m3/s}
   PIPE,                    !- Comp1 Type
   CW Demand Side Outlet Pipe,  !- Comp1 Name
   CW Demand Exit Pipe Inlet Node,  !- Comp1 Inlet Node Name
   CW Demand Outlet Node,   !- Comp1 Outlet Node Name
   PASSIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Supply Bypass Branch,    !- Branch Name
   autosize,                !- Maximum Branch Flow Rate {m3/s}
   PIPE,                    !- Comp1 Type
   Supply Side Bypass,      !- Comp1 Name
   CW Supply Bypass Inlet Node,  !- Comp1 Inlet Node Name
   CW Supply Bypass Outlet Node,  !- Comp1 Outlet Node Name
   BYPASS;                  !- Comp1 Branch Control Type
BRANCH,
   Cooling Supply Outlet,   !- Branch Name
   autosize,                !- Maximum Branch Flow Rate {m3/s}
   PIPE,                    !- Comp1 Type
   Supply Side Outlet Pipe, !- Comp1 Name
   Supply Side Exit Pipe Inlet Node,  !- Comp1 Inlet Node Name
   CW Supply Outlet Node,   !- Comp1 Outlet Node Name
   PASSIVE;                 !- Comp1 Branch Control Type
BRANCH,
   CW Pump Branch,          !- Branch Name
   autosize,                !- Maximum Branch Flow Rate {m3/s}
   PUMP:VARIABLE SPEED,     !- Comp1 Type
   Circ Pump,               !- Comp1 Name
   CW Supply Inlet Node,    !- Comp1 Inlet Node Name
   CW Pump Outlet Node,     !- Comp1 Outlet Node Name
```

```
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Purchased Cooling Branch,!- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   Purchased:Chilled Water, !- Comp1 Type
   Purchased Cooling,      !- Comp1 Name
   Purchased Cooling Inlet Node,  !- Comp1 Inlet Node Name
   Purchased Cooling Outlet Node,  !- Comp1 Outlet Node Name
   ACTIVE;                 !- Comp1 Branch Control Type
BRANCH,
   Air Loop Main Branch,    !- Branch Name
   .8,                     !- Maximum Branch Flow Rate {m3/s}
   OUTSIDE AIR SYSTEM,      !- Comp1 Type
   OA Sys 1,               !- Comp1 Name
   Air Loop Inlet Node,     !- Comp1 Inlet Node Name
   Mixed Air Node,          !- Comp1 Outlet Node Name
   PASSIVE,                !- Comp1 Branch Control Type
   FAN:SIMPLE:ConstVolume,  !- Comp2 Type
   Supply Fan 1,           !- Comp2 Name
   Mixed Air Node,          !- Comp2 Inlet Node Name
   Cooling Coil Air Inlet Node,  !- Comp2 Outlet Node Name
   ACTIVE,                 !- Comp2 Branch Control Type
   COIL:Water:DetailedFlatCooling,  !- Comp3 Type
   Detailed Cooling Coil,   !- Comp3 Name
   Cooling Coil Air Inlet Node,  !- Comp3 Inlet Node Name
   Air Loop Outlet Node,    !- Comp3 Outlet Node Name
   PASSIVE;                !- Comp3 Branch Control Type
BRANCH,
   Cooling Coil Branch,     !- Branch Name
   autosize,               !- Maximum Branch Flow Rate {m3/s}
   COIL:Water:DetailedFlatCooling,  !- Comp1 Type
   Detailed Cooling Coil,   !- Comp1 Name
   Cooling Coil Water Inlet Node,  !- Comp1 Inlet Node Name
   Cooling Coil Water Outlet Node,  !- Comp1 Outlet Node Name
PIPE,
   Reheat Inlet Pipe,       !- PipeName
   HW Demand Inlet Node,    !- Inlet Node Name
   HW Demand Entrance Pipe Outlet Node;  !- Outlet Node Name
PIPE,
   Reheat Outlet Pipe,      !- PipeName
   HW Demand Exit Pipe Inlet Node,  !- Inlet Node Name
   HW Demand Outlet Node;   !- Outlet Node Name
PIPE,
   Reheat Bypass,          !- PipeName
   Reheat Bypass Inlet Node,!- Inlet Node Name
   Reheat Bypass Outlet Node;  !- Outlet Node Name
PIPE,
   Heating Supply Side Bypass,  !- PipeName
   Heating Supply Bypass Inlet Node,  !- Inlet Node Name
   Heating Supply Bypass Outlet Node;  !- Outlet Node Name
PIPE,
   Heating Supply Outlet,   !- PipeName
   Heating Supply Exit Pipe Inlet Node,  !- Inlet Node Name
   HW Supply Outlet Node;   !- Outlet Node Name
PLANT LOOP,
   Heat Plant loop,         !- Plant Loop Name
```

```
  Water,                  !- Fluid Type
  Operation scheme heat,  !- Plant Operation Scheme List Name
  Plant loop,             !- Loop Temperature Setpoint Schedule Name
  98,                     !- Maximum Loop Temperature {C}
  1,                      !- Minimum Loop Temperature {C}
  autosize,               !- Maximum Loop Volumetric Flow Rate {m3/s}
  0,                      !- Minimum Loop Volumetric Flow Rate {m3/s}
  -99999,                 !- volume of the plant loop {m3}
  HW Supply Inlet Node,   !- Plant Side Inlet Node Name
  HW Supply Outlet Node,  !- Plant Side Outlet Node Name
  Heating Supply Side Branches,  !- Plant Side Branch List Name
  Heating Supply Side Connectors,  !- Plant Side Connector List Name
  HW Demand Inlet Node,   !- Demand Side Inlet Node Name
  HW Demand Outlet Node,  !- Demand Side Outlet Nodes Name
  Heating Demand Side Branches,  !- Demand Side Branch List Name
  Heating Demand Side Connectors,  !- Demand Side Connector List Name
  OPTIMAL;                !- Load Distribution Scheme
PLANT OPERATION SCHEMES,
  Operation scheme heat,  !- PlantOperationSchemeName
  Load Range Based Operation,  !- KEY--Control Scheme 1
  Purchased Only,         !- Control Scheme Name 1
  On;                     !- Control Scheme Schedule 1
HEATING LOAD RANGE BASED OPERATION,
  Purchased Only,         !- Name
  0,                      !- Load Range Lower Limit 1 {W}
  1200000,                !- Load Range Upper Limit 1 {W}
  heating plant;          !- Priority Control Equip List Name 1
LOAD RANGE EQUIPMENT LIST,
  heating plant,          !- Equip List Name
  Purchased:Hot Water,    !- KEY--Plant Equip 1
  Solar Water;            !- Equip Name 1
SPLITTER,
  Reheat Splitter,        !- SplitterName
  Reheat Inlet Branch,    !- Inlet Branch Name
  Heat Zone M1,           !- Outlet Branch Name 1
  Heat Zone A1,           !- Outlet Branch Name 2
  Heat Zone B1,           !- Outlet Branch Name 3
  Heat Zone C1,           !- Outlet Branch Name 4
  Heat Zone J1,           !- Outlet Branch Name 5
  Heat Zone K1,           !- Outlet Branch Name 6
  Heat Zone F1,           !- Outlet Branch Name 7
  Heat Zone E1,           !- Outlet Branch Name 8
  Heat Zone D1,           !- Outlet Branch Name 9
  Heat Zone N1,           !- Outlet Branch Name 10
  Heat Zone O1,           !- Outlet Branch Name 11
  Heat Zone G1,           !- Outlet Branch Name 12
  Heat Zone H1,           !- Outlet Branch Name 13
  Heat Zone I1,           !- Outlet Branch Name 14
  Heat Zone L1,           !- Outlet Branch Name 15
  Heat Zone L2,           !- Outlet Branch Name 16
  Heat Zone I2,           !- Outlet Branch Name 17
  Heat Zone H2,           !- Outlet Branch Name 18
  Heat Zone G2,           !- Outlet Branch Name 19
  Heat Zone O2,           !- Outlet Branch Name 20
  Heat Zone N2,           !- Outlet Branch Name 21
  Heat Zone D2,           !- Outlet Branch Name 22
```

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    Heat Zone E2,            !- Outlet Branch Name 23
    Heat Zone F2,            !- Outlet Branch Name 24
    Heat Zone K2,            !- Outlet Branch Name 25
    Heat Zone J2,            !- Outlet Branch Name 26
    Heat Zone C2,            !- Outlet Branch Name 27
    Heat Zone B2,            !- Outlet Branch Name 28
    Heat Zone A2,            !- Outlet Branch Name 29
    Heat Zone M2,            !- Outlet Branch Name 30
    Heat Zone ROOF,          !- Outlet Branch Name 31
    Heat Zone BASEMENT,      !- Outlet Branch Name 32
    Reheat Bypass Branch;    !- Outlet Branch Name 33
  SPLITTER,
    Heating Supply Splitter, !- SplitterName
    Heating Supply Inlet Branch,  !- Inlet Branch Name
    Heating Purchased Hot Water Branch,  !- Outlet Branch Name 1
    Heating Supply Bypass Branch;  !- Outlet Branch Name 2
  MIXER,
    Reheat Mixer,            !- MixerName
    Reheat Outlet Branch,    !- Outlet Branch Name
    Heat Zone M1,            !- Inlet Branch Name 1
    Heat Zone A1,            !- Inlet Branch Name 2
    Heat Zone B1,            !- Inlet Branch Name 3
    Heat Zone C1,            !- Inlet Branch Name 4
    Heat Zone J1,            !- Inlet Branch Name 5
    Heat Zone K1,            !- Inlet Branch Name 6
    Heat Zone E1,            !- Inlet Branch Name 7
    Heat Zone D1,            !- Inlet Branch Name 8
    Heat Zone N1,            !- Inlet Branch Name 9
    Heat Zone O1,            !- Inlet Branch Name 10
    Heat Zone G1,            !- Inlet Branch Name 11
    Heat Zone H1,            !- Inlet Branch Name 12
    Heat Zone I1,            !- Inlet Branch Name 13
    Heat Zone F1,            !- Inlet Branch Name 14
    Heat Zone L1,            !- Inlet Branch Name 15
    Heat Zone L2,            !- Inlet Branch Name 16
    Heat Zone I2,            !- Inlet Branch Name 17
    Heat Zone H2,            !- Inlet Branch Name 18
    Heat Zone G2,            !- Inlet Branch Name 19
    Heat Zone O2,            !- Inlet Branch Name 20
    Heat Zone N2,            !- Inlet Branch Name 21
    Heat Zone D2,            !- Inlet Branch Name 22
    Heat Zone E2,            !- Inlet Branch Name 23
    Heat Zone F2,            !- Inlet Branch Name 24
    Heat Zone K2,            !- Inlet Branch Name 25
    Heat Zone J2,            !- Inlet Branch Name 26
    Heat Zone C2,            !- Inlet Branch Name 27
    Heat Zone B2,            !- Inlet Branch Name 28
    Heat Zone A2,            !- Inlet Branch Name 29
    Heat Zone M2,            !- Inlet Branch Name 30
    Heat Zone ROOF,          !- Inlet Branch Name 31
    Heat Zone BASEMENT,      !- Inlet Branch Name 32
    Reheat Bypass Branch;    !- Inlet Branch Name 33
  MIXER,
    Heating Supply Mixer,    !- MixerName
    Heating Supply Outlet Branch,  !- Outlet Branch Name
    Heating Purchased Hot Water Branch,  !- Inlet Branch Name 1
```

```
   Heating Supply Bypass Branch;  !- Inlet Branch Name 2
AIR PRIMARY LOOP,
   Typical Terminal Reheat 1,  !- Primary Air Loop Name
   Reheat System 1 Controllers,  !- Name: Controller List
   Reheat System 1 Avail List,  !- Name: System Availability Manager List
   .8,                  !- Primary air design volumetric flow rate {m3/s}
   Air Loop Branches,       !- Air Loop Branch List Name
   ,                    !- Air Loop Connector List Name
   Air Loop Inlet Node,     !- ReturnAir AirLoop Inlet Node
   Return Air Mixer Outlet, !- ZoneEquipGroup Outlet Node
   Zone Equipment Inlet Node,  !- SupplyAirPath ZoneEquipGroup Inlet Nodes
   Air Loop Outlet Node;    !- AirLoop Outlet Nodes
CONTROLLER LIST,
   OA Sys 1 Controllers,    !- Name
   CONTROLLER:OUTSIDE AIR,  !- Controller Type 1
   OA Controller 1;         !- Controller Name 1
AIR LOOP EQUIPMENT LIST,
   OA Sys 1 Equipment,      !- Name
   HEAT EXCHANGER:AIR TO AIR:FLAT PLATE,  !- KEY--System Component 1
   OA Heat Recovery 1,      !- Component Name 1
   OUTSIDE AIR MIXER,       !- KEY--System Component 2
   OA Mixing Box 1;         !- Component Name 2
OUTSIDE AIR SYSTEM,
   OA Sys 1,                !- Name
   OA Sys 1 Controllers,    !- Name: Controller List
   OA Sys 1 Equipment,      !- Name of an Air Loop Equipment List
   Reheat System 1 Avail List;  !- Name of a System Availability Manager List
OUTSIDE AIR INLET NODE LIST,
   OutsideAirInletNodes;    !- 1st Node name or node list name
OUTSIDE AIR MIXER,
   OA Mixing Box 1,         !- Name
   Mixed Air Node,          !- Mixed_Air_Node
   Heat Recovery Outlet Node,  !- Outside_Air_Stream_Node
   Relief Air Outlet Node,  !- Relief_Air_Stream_Node
   Air Loop Inlet Node;     !- Return_Air_Stream_Node
SYSTEM AVAILABILITY MANAGER LIST,
   Reheat System 1 Avail List,  !- Name
   SYSTEM AVAILABILITY MANAGER:SCHEDULED,  !- System Availability Manager type 1
   Reheat System 1 Avail;   !- System Availability Manager name 1
SYSTEM AVAILABILITY MANAGER:SCHEDULED,
   Reheat System 1 Avail,   !- Name
   FanAndCoilAvailSched;    !- Schedule name
SET POINT MANAGER:SCHEDULED,
   Supply Air Temp Manager, !- Name
   TEMP,                    !- Control variable
   Seasonal Reset Supply Air Temp Sch,  !- Schedule Name
   Supply Air Temp Nodes;   !- Name of the set point Node List
SET POINT MANAGER:SCHEDULED,
   Mixed Air Temp Manager,  !- Name
   TEMP,                    !- Control variable
   Seasonal Reset Mixed Air Temp Sch,  !- Schedule Name
   Mixed Air Nodes;         !- Name of the set point Node List
CONTROLLER:SIMPLE,
   Main Cooling Coil Controller,  !- Name
   TEMP,                    !- Control variable
   REVERSE,                 !- Action
```

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   FLOW,                    !- Actuator variable
   Air Loop Outlet Node,    !- Control_Node
   Cooling Coil Water Inlet Node,  !- Actuator_Node
   .1,                      !- Controller Convergence Tolerance: delta temp from setpoint temp {C}
   0.01,                    !- Max Actuated Flow {m3/s}
   0;                       !- Min Actuated Flow {m3/s}
CONTROLLER:OUTSIDE AIR,
   OA Controller 1,         !- Name
   ECONOMIZER,              !- EconomizerChoice
   NO RETURN AIR TEMP LIMIT,!- ReturnAirTempLimit
   NO RETURN AIR ENTHALPY LIMIT,  !- ReturnAirEnthalpyLimit
   NO LOCKOUT,              !- Lockout
   FIXED MINIMUM,           !- MinimumLimit
   Mixed Air Node,          !- Control_Node
   Outside Air Inlet Node,  !- Actuated_Node
   .8,                      !- minimum outside air flow rate {m3/s}
   1.3,                     !- maximum outside air flow rate {m3/s}
   19,                      !- temperature limit {C}
   4,                       !- temperature lower limit {C}
   ,                        !- enthalpy limit {J/kg}
   Relief Air Outlet Node,  !- Relief_Air_Outlet_Node
   Air Loop Inlet Node;     !- Return_Air_Node
CONTROLLED ZONE EQUIP CONFIGURATION,
   M-Cir-NW-1,              !- Zone Name
   Equip list 4,            !- List Name: Zone Equipment
   Supply M1q,              !- List Name: Zone Air Inlet Nodes
   ,                        !- List Name: Zone Air Exhaust Nodes
   Sup M1,                  !- Zone Air Node Name
   RETURN M1;               !- Zone Return Air Node Name
CONTROLLED ZONE EQUIP CONFIGURATION,
   A-NW-1,                  !- Zone Name
   Equip list 1,            !- List Name: Zone Equipment
   Supply A1q,              !- List Name: Zone Air Inlet Nodes
   ,                        !- List Name: Zone Air Exhaust Nodes
   Sup A1,                  !- Zone Air Node Name
   RETURN A1;               !- Zone Return Air Node Name
CONTROLLED ZONE EQUIP CONFIGURATION,
   B-North-1,               !- Zone Name
   Equip list 2,            !- List Name: Zone Equipment
   Supply B1q,              !- List Name: Zone Air Inlet Nodes
   ,                        !- List Name: Zone Air Exhaust Nodes
   Sup B1,                  !- Zone Air Node Name
   RETURN B1;               !- Zone Return Air Node Name
CONTROLLED ZONE EQUIP CONFIGURATION,
   C-NE-1,                  !- Zone Name
   Equip list 3,            !- List Name: Zone Equipment
   Supply C1q,              !- List Name: Zone Air Inlet Nodes
   ,                        !- List Name: Zone Air Exhaust Nodes
   Sup C1,                  !- Zone Air Node Name
   RETURN C1;               !- Zone Return Air Node Name
ZONE EQUIPMENT LIST,
   Equip list 1,            !- Name
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- KEY--Zone Equipment Type 1
   Solar1,                  !- Type Name 1
   1,                       !- Cooling Priority
   1,                       !- Heating Priority
```

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   DIRECT AIR,             !- KEY--Zone Equipment Type 2
   Zone supply A1,         !- Type Name 2
   2,                      !- Cooling Priority
   2;                      !- Heating Priority
ZONE EQUIPMENT LIST,
   Equip list 2,           !- Name
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- KEY--Zone Equipment Type 1
   Solar2,                 !- Type Name 1
   1,                      !- Cooling Priority
   1,                      !- Heating Priority
   DIRECT AIR,             !- KEY--Zone Equipment Type 2
   Zone supply B1,         !- Type Name 2
   2,                      !- Cooling Priority
   2;                      !- Heating Priority
ZONE EQUIPMENT LIST,
   Equip list 14,          !- Name
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- KEY--Zone Equipment Type 1
   Solar14,                !- Type Name 1
   1,                      !- Cooling Priority
   1,                      !- Heating Priority
   DIRECT AIR,             !- KEY--Zone Equipment Type 2
   Zone supply I1,         !- Type Name 2
   2,                      !- Cooling Priority
   2;                      !- Heating Priority
   Equip list 32,          !- Name
   LOW TEMP RADIANT SYSTEM:HYDRONIC,  !- KEY--Zone Equipment Type 1
   Solar32,                !- Type Name 1
   1,                      !- Cooling Priority
   1,                      !- Heating Priority
   DIRECT AIR,             !- KEY--Zone Equipment Type 2
   Zone supply BASE,       !- Type Name 2
   2,                      !- Cooling Priority
   2;                      !- Heating Priority
ZONE CONTROL:THERMOSTATIC,
   Temp1,                  !- Thermostat Name
   A-NW-1,                 !- Zone Name
   temp control,           !- Control Type SCHEDULE Name
   Single Heating Setpoint, !- Control Type #1
   heat schedule,          !- Control Type Name #1
   Single Cooling SetPoint, !- Control Type #2
   cool schedule;          !- Control Type Name #2
ZONE CONTROL:THERMOSTATIC,
   Temp2,                  !- Thermostat Name
   B-North-1,              !- Zone Name
   temp control,           !- Control Type SCHEDULE Name
   Single Heating Setpoint, !- Control Type #1
   heat schedule,          !- Control Type Name #1
   Single Cooling SetPoint, !- Control Type #2
   cool schedule;          !- Control Type Name #2
ZONE CONTROL:THERMOSTATIC,
   Temp32,                 !- Thermostat Name
   Basement,               !- Zone Name
   temp control,           !- Control Type SCHEDULE Name
   Single Heating Setpoint, !- Control Type #1
   heat schedule,          !- Control Type Name #1
   Single Cooling SetPoint, !- Control Type #2
```

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   cool schedule;          !- Control Type Name #2
SINGLE HEATING SETPOINT,
   heat schedule,          !- Name
   Heating Setpoints;      !- Setpoint Temperature SCHEDULE Name
ZONE SUPPLY AIR PATH,
   TermReheatSupplyPath,   !- Supply Air Path Name
   Zone Equipment Inlet Node,  !- Supply Air Path Inlet Node
   Zone Splitter,          !- KEY--System Component Type
   Zone Supply Air Splitter;!- Component Name
ZONE RETURN AIR PATH,
   TermReheatReturnPath,   !- Return Air Path Name
   Return Air Mixer Outlet, !- Return Air Path Outlet Node
   Zone Mixer,             !- KEY--System Component Type 1
   Zone Return Air Mixer;  !- Component Name 1
ZONE SPLITTER,
   Zone Supply Air Splitter,!- Splitter Name
   Zone Equipment Inlet Node,  !- Inlet_Node
   Supply A1,              !- Outlet_Node_1
   Supply B1,              !- Outlet_Node_2
   Supply C1,              !- Outlet_Node_3
   Supply D1,              !- Outlet_Node_4
   Supply E1,              !- Outlet_Node_5
   Supply F1,              !- Outlet_Node_6
   Supply G1,              !- Outlet_Node_7
   Supply H1,              !- Outlet_Node_8
   Supply I1,              !- Outlet_Node_9
   Supply J1,              !- Outlet_Node_10
   Supply K1,              !- Outlet_Node_11
   Supply L1,              !- Outlet_Node_12
   Supply M1,              !- Outlet_Node_13
   Supply N1,              !- Outlet_Node_14
   Supply O1,              !- Outlet_Node_15
   Supply A2,              !- Outlet_Node_16
   Supply B2,              !- Outlet_Node_17
   Supply C2,              !- Outlet_Node_18
   Supply D2,              !- Outlet_Node_19
   Supply E2,              !- Outlet_Node_20
   Supply F2,              !- Outlet_Node_21
   Supply G2,              !- Outlet_Node_22
   Supply H2,              !- Outlet_Node_23
   Supply I2,              !- Outlet_Node_24
   Supply J2,              !- Outlet_Node_25
   Supply K2,              !- Outlet_Node_26
   Supply L2,              !- Outlet_Node_27
   Supply M2,              !- Outlet_Node_28
   Supply N2,              !- Outlet_Node_29
   Supply O2,              !- Outlet_Node_30
   Supply ROOF,            !- Outlet_Node_31
   Supply BASEMENT;        !- Outlet_Node_32
ZONE MIXER,
   Zone Return Air Mixer,  !- Mixer Name
   Return Air Mixer Outlet, !- Outlet_Node
   RETURN A1,              !- Inlet_Node_1
   RETURN B1,              !- Inlet_Node_2
   RETURN C1,              !- Inlet_Node_3
   RETURN D1,              !- Inlet_Node_4
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   RETURN E1,            !- Inlet_Node_5
   RETURN F1,            !- Inlet_Node_6
   RETURN G1,            !- Inlet_Node_7
   RETURN H1,            !- Inlet_Node_8
   RETURN I1,            !- Inlet_Node_9
   RETURN J1,            !- Inlet_Node_10
   RETURN K1,            !- Inlet_Node_11
   RETURN L1,            !- Inlet_Node_12
   RETURN M1,            !- Inlet_Node_13
   RETURN N1,            !- Inlet_Node_14
   RETURN O1,            !- Inlet_Node_15
   RETURN A2,            !- Inlet_Node_16
   RETURN B2,            !- Inlet_Node_17
   RETURN C2,            !- Inlet_Node_18
   RETURN D2,            !- Inlet_Node_19
   RETURN E2,            !- Inlet_Node_20
   RETURN F2,            !- Inlet_Node_21
   RETURN G2,            !- Inlet_Node_22
   RETURN H2,            !- Inlet_Node_23
   RETURN I2,            !- Inlet_Node_24
   RETURN J2,            !- Inlet_Node_25
   RETURN K2,            !- Inlet_Node_26
   RETURN L2,            !- Inlet_Node_27
   RETURN M2,            !- Inlet_Node_28
   RETURN N2,            !- Inlet_Node_29
   RETURN O2,            !- Inlet_Node_30
   RETURN ROOF,          !- Inlet_Node_31
   RETURN BASEMENT;      !- Inlet_Node_32
LOW TEMP RADIANT SYSTEM:HYDRONIC,
   Solar1,               !- name of hydronic low temperature radiant system
   air velocity,         !- availability schedule
   A-NW-1,               !- Zone name (name of zone system is serving)
   A floor,              !- Surface name (name of surface system is embedded in)
   .0125,                !- Hydronic tubing inside diameter {m}
   autosize,             !- Hydronic tubing length (total length of pipe embedded in surface) {m}
   MAT,                  !- temperature control type (temperature on which unit is controlled)
   autosize,             !- maximum hot water flow {m3/s}
   63,                   !- heating water inlet node
   64,                   !- heating water outlet node
   2,                    !- heating control throttling range {C}
   Radiant Heating Setpoints,  !- heating control temperature schedule
   Autosize,             !- maximum cold water flow {m3/s}
   1,                    !- cooling water inlet node
   2,                    !- cooling water outlet node
   2,                    !- cooling control throttling range {C}
   Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
   Solar2,               !- name of hydronic low temperature radiant system
   air velocity,         !- availability schedule
   B-North-1,            !- Zone name (name of zone system is serving)
   B floor,              !- Surface name (name of surface system is embedded in)
   .0125,                !- Hydronic tubing inside diameter {m}
   autosize,             !- Hydronic tubing length (total length of pipe embedded in surface) {m}
   MAT,                  !- temperature control type (temperature on which unit is controlled)
   Autosize,             !- maximum hot water flow {m3/s}
   65,                   !- heating water inlet node
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   66,                 !- heating water outlet node
   2,                  !- heating control throttling range {C}
   Radiant Heating Setpoints,  !- heating control temperature schedule
   Autosize,           !- maximum cold water flow {m3/s}
   3,                  !- cooling water inlet node
   4,                  !- cooling water outlet node
   2,                  !- cooling control throttling range {C}
   Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
   Solar3,             !- name of hydronic low temperature radiant system
   air velocity,       !- availability schedule
   C-NE-1,             !- Zone name (name of zone system is serving)
   C floor,            !- Surface name (name of surface system is embedded in)
   .0125,              !- Hydronic tubing inside diameter {m}
   autosize,           !- Hydronic tubing length (total length of pipe embedded in surface) {m}
   MAT,                !- temperature control type (temperature on which unit is controlled)
   Autosize,           !- maximum hot water flow {m3/s}
   67,                 !- heating water inlet node
   68,                 !- heating water outlet node
   2,                  !- heating control throttling range {C}
   Radiant Heating Setpoints,  !- heating control temperature schedule
   Autosize,           !- maximum cold water flow {m3/s}
   5,                  !- cooling water inlet node
   6,                  !- cooling water outlet node
   2,                  !- cooling control throttling range {C}
   Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
   Solar4,             !- name of hydronic low temperature radiant system
   air velocity,       !- availability schedule
   M-Cir-NW-1,         !- Zone name (name of zone system is serving)
   M Floor,            !- Surface name (name of surface system is embedded in)
   0.0125,             !- Hydronic tubing inside diameter {m}
   autosize,           !- Hydronic tubing length (total length of pipe embedded in surface) {m}
   MAT,                !- temperature control type (temperature on which unit is controlled)
   Autosize,           !- maximum hot water flow {m3/s}
   solar water 30,     !- heating water inlet node
   hot water 1,        !- heating water outlet node
   2,                  !- heating control throttling range {C}
   Radiant Heating Setpoints,  !- heating control temperature schedule
   Autosize,           !- maximum cold water flow {m3/s}
   geozone 31,         !- cooling water inlet node
   cold water 1,       !- cooling water outlet node
   2,                  !- cooling control throttling range {C}
   Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
   Solar5,             !- name of hydronic low temperature radiant system
   air velocity,       !- availability schedule
   J-Cir-NE-1,         !- Zone name (name of zone system is serving)
   J Floor,            !- Surface name (name of surface system is embedded in)
   .0125,              !- Hydronic tubing inside diameter {m}
   autosize,           !- Hydronic tubing length (total length of pipe embedded in surface) {m}
   MAT,                !- temperature control type (temperature on which unit is controlled)
   Autosize,           !- maximum hot water flow {m3/s}
   69,                 !- heating water inlet node
   70,                 !- heating water outlet node
   2,                  !- heating control throttling range {C}
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  Radiant Heating Setpoints,  !- heating control temperature schedule
  Autosize,                   !- maximum cold water flow {m3/s}
  7,                          !- cooling water inlet node
  8,                          !- cooling water outlet node
  2,                          !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar6,                     !- name of hydronic low temperature radiant system
  air velocity,               !- availability schedule
  K-cir-east-1,               !- Zone name (name of zone system is serving)
  K Floor,                    !- Surface name (name of surface system is embedded in)
  .0125,                      !- Hydronic tubing inside diameter {m}
  autosize,                   !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                        !- temperature control type (temperature on which unit is controlled)
  autosize,                   !- maximum hot water flow {m3/s}
  71,                         !- heating water inlet node
  72,                         !- heating water outlet node
  2,                          !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  autosize,                   !- maximum cold water flow {m3/s}
  9,                          !- cooling water inlet node
  10,                         !- cooling water outlet node
  2,                          !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar7,                     !- name of hydronic low temperature radiant system
  air velocity,               !- availability schedule
  F-West-1,                   !- Zone name (name of zone system is serving)
  F floor,                    !- Surface name (name of surface system is embedded in)
  0.0125,                     !- Hydronic tubing inside diameter {m}
  autosize,                   !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                        !- temperature control type (temperature on which unit is controlled)
  autosize,                   !- maximum hot water flow {m3/s}
  73,                         !- heating water inlet node
  74,                         !- heating water outlet node
  2,                          !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  autosize,                   !- maximum cold water flow {m3/s}
  11,                         !- cooling water inlet node
  12,                         !- cooling water outlet node
  2,                          !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar8,                     !- name of hydronic low temperature radiant system
  air velocity,               !- availability schedule
  E-Bath-1,                   !- Zone name (name of zone system is serving)
  E floor,                    !- Surface name (name of surface system is embedded in)
  0.0125,                     !- Hydronic tubing inside diameter {m}
  autosize,                   !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                        !- temperature control type (temperature on which unit is controlled)
  autosize,                   !- maximum hot water flow {m3/s}
  75,                         !- heating water inlet node
  76,                         !- heating water outlet node
  2,                          !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  autosize,                   !- maximum cold water flow {m3/s}
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  13,                 !- cooling water inlet node
  14,                 !- cooling water outlet node
  2,                  !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar9,             !- name of hydronic low temperature radiant system
  air velocity,        !- availability schedule
  D-East-1,            !- Zone name (name of zone system is serving)
  D floor,            !- Surface name (name of surface system is embedded in)
  0.0125,             !- Hydronic tubing inside diameter {m}
  autosize,           !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                !- temperature control type (temperature on which unit is controlled)
  Autosize,           !- maximum hot water flow {m3/s}
  77,                 !- heating water inlet node
  78,                 !- heating water outlet node
  2,                  !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  Autosize,           !- maximum cold water flow {m3/s}
  15,                 !- cooling water inlet node
  16,                 !- cooling water outlet node
  2,                  !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar10,            !- name of hydronic low temperature radiant system
  air velocity,        !- availability schedule
  N-cir-west-1,         !- Zone name (name of zone system is serving)
  N Floor,            !- Surface name (name of surface system is embedded in)
  .0125,              !- Hydronic tubing inside diameter {m}
  autosize,           !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                !- temperature control type (temperature on which unit is controlled)
  Autosize,           !- maximum hot water flow {m3/s}
  79,                 !- heating water inlet node
  80,                 !- heating water outlet node
  2,                  !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  0,                  !- maximum cold water flow {m3/s}
  17,                 !- cooling water inlet node
  18,                 !- cooling water outlet node
  2,                  !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar11,            !- name of hydronic low temperature radiant system
  air velocity,        !- availability schedule
  O-cir-SW-1,           !- Zone name (name of zone system is serving)
  O Floor,            !- Surface name (name of surface system is embedded in)
  .0125,              !- Hydronic tubing inside diameter {m}
  autosize,           !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                !- temperature control type (temperature on which unit is controlled)
  Autosize,           !- maximum hot water flow {m3/s}
  81,                 !- heating water inlet node
  82,                 !- heating water outlet node
  2,                  !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  Autosize,           !- maximum cold water flow {m3/s}
  19,                 !- cooling water inlet node
  20,                 !- cooling water outlet node
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  2,                !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar12,             !- name of hydronic low temperature radiant system
  air velocity,        !- availability schedule
  G-SW-1,              !- Zone name (name of zone system is serving)
  G floor,             !- Surface name (name of surface system is embedded in)
  .0125,               !- Hydronic tubing inside diameter {m}
  autosize,            !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                 !- temperature control type (temperature on which unit is controlled)
  Autosize,            !- maximum hot water flow {m3/s}
  83,                  !- heating water inlet node
  84,                  !- heating water outlet node
  2,                   !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  Autosize,            !- maximum cold water flow {m3/s}
  21,                  !- cooling water inlet node
  22,                  !- cooling water outlet node
  2,                   !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar13,             !- name of hydronic low temperature radiant system
  air velocity,        !- availability schedule
  H-South-1,           !- Zone name (name of zone system is serving)
  H floor,             !- Surface name (name of surface system is embedded in)
  0.0125,              !- Hydronic tubing inside diameter {m}
  autosize,            !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                 !- temperature control type (temperature on which unit is controlled)
  autosize,            !- maximum hot water flow {m3/s}
  85,                  !- heating water inlet node
  86,                  !- heating water outlet node
  2,                   !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  autosize,            !- maximum cold water flow {m3/s}
  23,                  !- cooling water inlet node
  24,                  !- cooling water outlet node
  2,                   !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar14,             !- name of hydronic low temperature radiant system
  air velocity,        !- availability schedule
  I-SE-1,              !- Zone name (name of zone system is serving)
  I floor,             !- Surface name (name of surface system is embedded in)
  0.0125,              !- Hydronic tubing inside diameter {m}
  autosize,            !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                 !- temperature control type (temperature on which unit is controlled)
  Autosize,            !- maximum hot water flow {m3/s}
  87,                  !- heating water inlet node
  88,                  !- heating water outlet node
  2,                   !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  Autosize,            !- maximum cold water flow {m3/s}
  25,                  !- cooling water inlet node
  26,                  !- cooling water outlet node
  2,                   !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
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LOW TEMP RADIANT SYSTEM:HYDRONIC,
   Solar15,              !- name of hydronic low temperature radiant system
   air velocity,         !- availability schedule
   L-cir-SE-1,           !- Zone name (name of zone system is serving)
   L Floor,              !- Surface name (name of surface system is embedded in)
   0.0125,               !- Hydronic tubing inside diameter {m}
   autosize,             !- Hydronic tubing length (total length of pipe embedded in surface) {m}
   MAT,                  !- temperature control type (temperature on which unit is controlled)
   Autosize,             !- maximum hot water flow {m3/s}
   89,                   !- heating water inlet node
   90,                   !- heating water outlet node
   2,                    !- heating control throttling range {C}
   Radiant Heating Setpoints,  !- heating control temperature schedule
   Autosize,             !- maximum cold water flow {m3/s}
   27,                   !- cooling water inlet node
   28,                   !- cooling water outlet node
   2,                    !- cooling control throttling range {C}
   Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
   Solar16,              !- name of hydronic low temperature radiant system
   air velocity,         !- availability schedule
   L-cir-SE-2,           !- Zone name (name of zone system is serving)
   L Floor2,             !- Surface name (name of surface system is embedded in)
   0.0125,               !- Hydronic tubing inside diameter {m}
   autosize,             !- Hydronic tubing length (total length of pipe embedded in surface) {m}
   MAT,                  !- temperature control type (temperature on which unit is controlled)
   Autosize,             !- maximum hot water flow {m3/s}
   91,                   !- heating water inlet node
   92,                   !- heating water outlet node
   2,                    !- heating control throttling range {C}
   Radiant Heating Setpoints,  !- heating control temperature schedule
   Autosize,             !- maximum cold water flow {m3/s}
   29,                   !- cooling water inlet node
   30,                   !- cooling water outlet node
   2,                    !- cooling control throttling range {C}
   Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
   Solar17,              !- name of hydronic low temperature radiant system
   air velocity,         !- availability schedule
   I-SE-2,               !- Zone name (name of zone system is serving)
   I floor2,             !- Surface name (name of surface system is embedded in)
   0.0125,               !- Hydronic tubing inside diameter {m}
   autosize,             !- Hydronic tubing length (total length of pipe embedded in surface) {m}
   MAT,                  !- temperature control type (temperature on which unit is controlled)
   Autosize,             !- maximum hot water flow {m3/s}
   93,                   !- heating water inlet node
   94,                   !- heating water outlet node
   2,                    !- heating control throttling range {C}
   Radiant Heating Setpoints,  !- heating control temperature schedule
   Autosize,             !- maximum cold water flow {m3/s}
   31,                   !- cooling water inlet node
   32,                   !- cooling water outlet node
   2,                    !- cooling control throttling range {C}
   Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
   Solar18,              !- name of hydronic low temperature radiant system
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  air velocity,           !- availability schedule
  H-South-2,              !- Zone name (name of zone system is serving)
  H floor2,               !- Surface name (name of surface system is embedded in)
  0.0125,                 !- Hydronic tubing inside diameter {m}
  autosize,               !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                    !- temperature control type (temperature on which unit is controlled)
  Autosize,               !- maximum hot water flow {m3/s}
  95,                  !- heating water inlet node
  96,                  !- heating water outlet node
  2,                   !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  Autosize,               !- maximum cold water flow {m3/s}
  33,                  !- cooling water inlet node
  34,                  !- cooling water outlet node
  2,                   !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar19,                !- name of hydronic low temperature radiant system
  air velocity,           !- availability schedule
  G-SW-2,                 !- Zone name (name of zone system is serving)
  G floor2,               !- Surface name (name of surface system is embedded in)
  0.0125,                 !- Hydronic tubing inside diameter {m}
  autosize,               !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                    !- temperature control type (temperature on which unit is controlled)
  Autosize,               !- maximum hot water flow {m3/s}
  97,                  !- heating water inlet node
  98,                  !- heating water outlet node
  2,                   !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  Autosize,               !- maximum cold water flow {m3/s}
  35,                  !- cooling water inlet node
  36,                  !- cooling water outlet node
  2,                   !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar20,                !- name of hydronic low temperature radiant system
  air velocity,           !- availability schedule
  O-cir-SW-2,             !- Zone name (name of zone system is serving)
  O Floor2,               !- Surface name (name of surface system is embedded in)
  0.0125,                 !- Hydronic tubing inside diameter {m}
  autosize,               !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                    !- temperature control type (temperature on which unit is controlled)
  Autosize,               !- maximum hot water flow {m3/s}
  99,                  !- heating water inlet node
  100,                 !- heating water outlet node
  2,                   !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  Autosize,               !- maximum cold water flow {m3/s}
  37,                  !- cooling water inlet node
  38,                  !- cooling water outlet node
  2,                   !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar21,                !- name of hydronic low temperature radiant system
  air velocity,           !- availability schedule
  N-cir-west-2,           !- Zone name (name of zone system is serving)
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  N Floor2,               !- Surface name (name of surface system is embedded in)
  0.0125,                 !- Hydronic tubing inside diameter {m}
  autosize,               !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                    !- temperature control type (temperature on which unit is controlled)
  autosize,               !- maximum hot water flow {m3/s}
  101,                    !- heating water inlet node
  102,                    !- heating water outlet node
  2,                      !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  autosize,               !- maximum cold water flow {m3/s}
  39,                     !- cooling water inlet node
  40,                     !- cooling water outlet node
  2,                      !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar22,                !- name of hydronic low temperature radiant system
  air velocity,           !- availability schedule
  D-East-2,               !- Zone name (name of zone system is serving)
  D floor2,               !- Surface name (name of surface system is embedded in)
  0.0125,                 !- Hydronic tubing inside diameter {m}
  autosize,               !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                    !- temperature control type (temperature on which unit is controlled)
  autosize,               !- maximum hot water flow {m3/s}
  103,                    !- heating water inlet node
  104,                    !- heating water outlet node
  2,                      !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  autosize,               !- maximum cold water flow {m3/s}
  41,                     !- cooling water inlet node
  42,                     !- cooling water outlet node
  2,                      !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar23,                !- name of hydronic low temperature radiant system
  air velocity,           !- availability schedule
  E-Bath-2,               !- Zone name (name of zone system is serving)
  E floor2,               !- Surface name (name of surface system is embedded in)
  0.0125,                 !- Hydronic tubing inside diameter {m}
  autosize,               !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                    !- temperature control type (temperature on which unit is controlled)
  autosize,               !- maximum hot water flow {m3/s}
  105,                    !- heating water inlet node
  106,                    !- heating water outlet node
  2,                      !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  autosize,               !- maximum cold water flow {m3/s}
  43,                     !- cooling water inlet node
  44,                     !- cooling water outlet node
  2,                      !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar24,                !- name of hydronic low temperature radiant system
  air velocity,           !- availability schedule
  F-West-2,               !- Zone name (name of zone system is serving)
  F floor2,               !- Surface name (name of surface system is embedded in)
  0.0125,                 !- Hydronic tubing inside diameter {m}
```

```
  autosize,              !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                   !- temperature control type (temperature on which unit is controlled)
  autosize,              !- maximum hot water flow {m3/s}
  107,                   !- heating water inlet node
  108,                   !- heating water outlet node
  2,                     !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  autosize,              !- maximum cold water flow {m3/s}
  45,                    !- cooling water inlet node
  46,                    !- cooling water outlet node
  2,                     !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar25,               !- name of hydronic low temperature radiant system
  air velocity,          !- availability schedule
  K-cir-east-2,          !- Zone name (name of zone system is serving)
  K Floor2,              !- Surface name (name of surface system is embedded in)
  0.0125,                !- Hydronic tubing inside diameter {m}
  autosize,              !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                   !- temperature control type (temperature on which unit is controlled)
  autosize,              !- maximum hot water flow {m3/s}
  109,                   !- heating water inlet node
  110,                   !- heating water outlet node
  2,                     !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  autosize,              !- maximum cold water flow {m3/s}
  47,                    !- cooling water inlet node
  48,                    !- cooling water outlet node
  2,                     !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar26,               !- name of hydronic low temperature radiant system
  air velocity,          !- availability schedule
  J-Cir-NE-2,            !- Zone name (name of zone system is serving)
  J Floor2,              !- Surface name (name of surface system is embedded in)
  .0125,                 !- Hydronic tubing inside diameter {m}
  autosize,              !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                   !- temperature control type (temperature on which unit is controlled)
  Autosize,              !- maximum hot water flow {m3/s}
  111,                   !- heating water inlet node
  112,                   !- heating water outlet node
  2,                     !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  Autosize,              !- maximum cold water flow {m3/s}
  49,                    !- cooling water inlet node
  50,                    !- cooling water outlet node
  2,                     !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar27,               !- name of hydronic low temperature radiant system
  air velocity,          !- availability schedule
  C-NE-2,                !- Zone name (name of zone system is serving)
  C floor2,              !- Surface name (name of surface system is embedded in)
  0.0125,                !- Hydronic tubing inside diameter {m}
  autosize,              !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                   !- temperature control type (temperature on which unit is controlled)
```

```
  Autosize,              !- maximum hot water flow {m3/s}
  113,                   !- heating water inlet node
  114,                   !- heating water outlet node
  2,                     !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  Autosize,              !- maximum cold water flow {m3/s}
  51,                    !- cooling water inlet node
  52,                    !- cooling water outlet node
  2,                     !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar28,               !- name of hydronic low temperature radiant system
  air velocity,          !- availability schedule
  B-North-2,             !- Zone name (name of zone system is serving)
  B floor2,              !- Surface name (name of surface system is embedded in)
  0.0125,                !- Hydronic tubing inside diameter {m}
  autosize,              !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                   !- temperature control type (temperature on which unit is controlled)
  Autosize,              !- maximum hot water flow {m3/s}
  115,                   !- heating water inlet node
  116,                   !- heating water outlet node
  2,                     !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  Autosize,              !- maximum cold water flow {m3/s}
  53,                    !- cooling water inlet node
  54,                    !- cooling water outlet node
  2,                     !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar29,               !- name of hydronic low temperature radiant system
  air velocity,          !- availability schedule
  A-NW-2,                !- Zone name (name of zone system is serving)
  A floor2,              !- Surface name (name of surface system is embedded in)
  0.0125,                !- Hydronic tubing inside diameter {m}
  autosize,              !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                   !- temperature control type (temperature on which unit is controlled)
  Autosize,              !- maximum hot water flow {m3/s}
  117,                   !- heating water inlet node
  118,                   !- heating water outlet node
  2,                     !- heating control throttling range {C}
  Radiant Heating Setpoints,  !- heating control temperature schedule
  Autosize,              !- maximum cold water flow {m3/s}
  55,                    !- cooling water inlet node
  56,                    !- cooling water outlet node
  2,                     !- cooling control throttling range {C}
  Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
  Solar30,               !- name of hydronic low temperature radiant system
  air velocity,          !- availability schedule
  M-Cir-NW-2,            !- Zone name (name of zone system is serving)
  M Floor2,              !- Surface name (name of surface system is embedded in)
  .0125,                 !- Hydronic tubing inside diameter {m}
  autosize,              !- Hydronic tubing length (total length of pipe embedded in surface) {m}
  MAT,                   !- temperature control type (temperature on which unit is controlled)
  Autosize,              !- maximum hot water flow {m3/s}
  119,                   !- heating water inlet node
```

```
   120,                !- heating water outlet node
   2,                  !- heating control throttling range {C}
   Radiant Heating Setpoints,  !- heating control temperature schedule
   Autosize,           !- maximum cold water flow {m3/s}
   57,                 !- cooling water inlet node
   58,                 !- cooling water outlet node
   2,                  !- cooling control throttling range {C}
   Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
   Solar31,            !- name of hydronic low temperature radiant system
   air velocity,       !- availability schedule
   Roof,               !- Zone name (name of zone system is serving)
   Roof floor E,       !- Surface name (name of surface system is embedded in)
   0.0125,             !- Hydronic tubing inside diameter {m}
   autosize,           !- Hydronic tubing length (total length of pipe embedded in surface) {m}
   MAT,                !- temperature control type (temperature on which unit is controlled)
   autosize,           !- maximum hot water flow {m3/s}
   121,                !- heating water inlet node
   122,                !- heating water outlet node
   2,                  !- heating control throttling range {C}
   Radiant Heating Setpoints,  !- heating control temperature schedule
   autosize,           !- maximum cold water flow {m3/s}
   59,                 !- cooling water inlet node
   60,                 !- cooling water outlet node
   2,                  !- cooling control throttling range {C}
   Radiant Cooling Setpoints;  !- cooling control temperature schedule
LOW TEMP RADIANT SYSTEM:HYDRONIC,
   Solar32,            !- name of hydronic low temperature radiant system
   air velocity,       !- availability schedule
   Basement,           !- Zone name (name of zone system is serving)
   basement floor,     !- Surface name (name of surface system is embedded in)
   .0125,              !- Hydronic tubing inside diameter {m}
   autosize,           !- Hydronic tubing length (total length of pipe embedded in surface) {m}
   MAT,                !- temperature control type (temperature on which unit is controlled)
   autosize,           !- maximum hot water flow {m3/s}
   123,                !- heating water inlet node
   124,                !- heating water outlet node
   2,                  !- heating control throttling range {C}
   Radiant Heating Setpoints,  !- heating control temperature schedule
   autosize,           !- maximum cold water flow {m3/s}
   61,                 !- cooling water inlet node
   62,                 !- cooling water outlet node
   2,                  !- cooling control throttling range {C}
   Radiant Cooling Setpoints;  !- cooling control temperature schedule
PURCHASED:HOT WATER,
   Solar Water,        !- Purchased Hot Water Name
   solar water 26,     !- Plant_Loop_Inlet_Node
   solar water 24,     !- Plant_Loop_Outlet_Node
   1200000;            !- Nominal Capacity {W}
PUMP:VARIABLE SPEED,
   HW Circ Pump,       !- Pump Name
   HW Supply Inlet Node,  !- Inlet_Node
   HW Pump Outlet Node,   !- Outlet_Node
   autosize,           !- Rated Volumetric Flow Rate {m3/s}
   179352,             !- Rated Pump Head {Pa}
   autosize,           !- Rated Power Consumption {W}
```

```
   .9,                  !- Motor Efficiency
   0,                   !- Fraction of Motor Inefficiencies to Fluid Stream
   0,                   !- Coefficient1 of the Part Load Performance Curve
   1,                   !- Coefficient2 of the Part Load Performance Curve
   0,                   !- Coefficient3 of the Part Load Performance Curve
   0,                   !- Coefficient4 of the Part Load Performance Curve
   0,                   !- This value can be zero and will be defaulted to that if not specified. {m3/s}
   INTERMITTENT;           !- Pump Control Type
FAN:SIMPLE:ConstVolume,
   Supply Fan 1,           !- Fan Name
   FanAndCoilAvailSchedX,   !- Available Schedule
   .7,                  !- Fan Total Efficiency
   600,                  !- Delta Pressure {Pa}
   1.3,                  !- Max Flow Rate {m3/s}
   .9,                  !- Motor Efficiency
   1,                   !- Motor In Airstream Fraction
   Mixed Air Node,         !- Fan_Inlet_Node
   Cooling Coil Air Inlet Node;  !- Fan_Outlet_Node
HEAT EXCHANGER:AIR TO AIR:FLAT PLATE,
   OA Heat Recovery 1,      !- Name
   FanAndCoilAvailSchedDES, !- Available Schedule
   Counter Flow,           !- flow arrangement
   yes,                  !- Economizer lockout
   1,                   !- hA ratio
   .8,                  !- Nominal supply air flow rate {m3/s}
   -12,                  !- Nominal supply air inlet temperature {C}
   15,                   !- Nominal supply air outlet temperature {C}
   .9,                  !- Nominal secondary air flow rate {m3/s}
   22,                   !- Nominal secondary air inlet temperature {C}
   0,                   !- Nominal electric power {W}
   Process Outlet Node,  !- Supply air inlet node
   Heat Recovery Outlet Node,  !- Supply air outlet node
   Relief Air Outlet Node,  !- Secondary air inlet node
   Heat Recovery Secondary Outlet Node;  !- Secondary air outlet node
FluidNames,
   Water,                !- fluid name 1
   GLYCOL;                 !- type of fluid for fluid name 1
FluidPropertyTemperatures,
   GlycolTemperatures,      !- temperature list name
   -35,                  !- temperature 1
   -30,                  !- temperature 2
   -25,                  !- temperature 3
   -20,                  !- temperature 4
   -15,                  !- temperature 5
   -10,                  !- temperature 6
   -5,                   !- temperature 7
   0,                   !- temperature 8
   5,                   !- temperature 9
   10,                   !- temperature 10
   15,                   !- temperature 11
   20,                   !- temperature 12
   25,                   !- temperature 13
   30,                   !- temperature 14
   35,                   !- temperature 15
   40,                   !- temperature 16
   45,                   !- temperature 17
```

```
   50,                  !- temperature 18
   55,                  !- temperature 19
   60,                  !- temperature 20
   65,                  !- temperature 21
   70,                  !- temperature 22
   75,                  !- temperature 23
   80,                  !- temperature 24
   85,                  !- temperature 25
   90,                  !- temperature 26
   95,                  !- temperature 27
   100,                 !- temperature 28
   105,                 !- temperature 29
   110,                 !- temperature 30
   115,                 !- temperature 31
   120,                 !- temperature 32
   125;                 !- temperature 33
FluidPropertyConcentration,
   Water,               !- fluid name (ethylene glycol, etc.)
   SPECIFICHEAT,        !- fluid property type
   GlycolTemperatures,  !- temperatures list name
   0,                   !- concentration {percentage (as a real decimal)}
   0,                   !- property value 1
   0,                   !- property value 2
   0,                   !- property value 3
   0,                   !- property value 4
   0,                   !- property value 5
   0,                   !- property value 6
   0,                   !- property value 7
   4217,                !- property value 8
   4198,                !- property value 9
   4191,                !- property value 10
   4185,                !- property value 11
   4181,                !- property value 12
   4179,                !- property value 13
   4180,                !- property value 14
   4180,                !- property value 15
   4180,                !- property value 16
   4180,                !- property value 17
   4181,                !- property value 18
   4183,                !- property value 19
   4185,                !- property value 20
   4188,                !- property value 21
   4192,                !- property value 22
   4196,                !- property value 23
   4200,                !- property value 24
   4203,                !- property value 25
   4208,                !- property value 26
   4213,                !- property value 27
   4218,                !- property value 28
   4223,                !- property value 29
   4228,                !- property value 30
   4233,                !- property value 31
   4238,                !- property value 32
   4243;                !- property value 33
FluidPropertyConcentration,
   Water,               !- fluid name (ethylene glycol, etc.)
```

```
SPECIFICHEAT,           !- fluid property type
GlycolTemperatures,     !- temperatures list name
1,                      !- concentration {percentage (as a real decimal)}
0,                      !- property value 1
0,                      !- property value 2
0,                      !- property value 3
0,                      !- property value 4
0,                      !- property value 5
0,                      !- property value 6
0,                      !- property value 7
4217,                   !- property value 8
4198,                   !- property value 9
4191,                   !- property value 10
4185,                   !- property value 11
4181,                   !- property value 12
4179,                   !- property value 13
4180,                   !- property value 14
4180,                   !- property value 15
4180,                   !- property value 16
4180,                   !- property value 17
4181,                   !- property value 18
4183,                   !- property value 19
4185,                   !- property value 20
4188,                   !- property value 21
4192,                   !- property value 22
4196,                   !- property value 23
4200,                   !- property value 24
4203,                   !- property value 25
4208,                   !- property value 26
4213,                   !- property value 27
4218,                   !- property value 28
4223,                   !- property value 29
4228,                   !- property value 30
4233,                   !- property value 31
4238,                   !- property value 32
4243;                   !- property value 33
```

Appendix C – Finite Element Model

Solar Collector Model

```
*heading
**
3D Simulation
**PREPRINT,CONTACT=NO,ECHO=NO,MODEL=NO,HISTORY=NO
*Node,nset=n1
 1,0,0,0
 4,76.2E-03,0,0
 5,88.9E-03,0,0
 6,114.3E-03,0,0
```

```
 45,672E-03,0,0
 46,697.4E-03,0,0
 47,710.1E-03,0,0
 50,786.3E-03,0,0
*Node,nset=n2
 181,0,76.2E-03,0
 184,76.2E-03,76.2E-03,0
 185,88.9E-03,76.2E-03,0
 186,114.3E-03,76.2E-03,0
 225,672E-03,76.2E-03,0
 226,697.4E-03,76.2E-03,0
 227,710.1E-03,76.2E-03,0
 230,786.3E-03,76.2E-03,0
*Node,nset=n3
 361,0,152.4E-03,0
 364,76.2E-03,152.4E-03,0
 365,88.9E-03,152.4E-03,0
 366,114.3E-03,152.4E-03,0
 405,672E-03,152.4E-03,0
 406,697.4E-03,152.4E-03,0
 407,710.1E-03,152.4E-03,0
 410,786.3E-03,152.4E-03,0
*Node,nset=n4
 421,0,181.15E-03,0
 424,76.2E-03,181.15E-03,0
 425,88.9E-03,181.15E-03,0
 426,114.3E-03,181.15E-03,0
 465,672E-03,181.15E-03,0
 466,697.4E-03,181.15E-03,0
 467,710.1E-03,181.15E-03,0
 470,786.3E-03,181.15E-03,0
*Node,nset=n5
 481,0,206.55E-03,0
 484,76.2E-03,206.55E-03,0
 485,88.9E-03,206.55E-03,0
 486,114.3E-03,206.55E-03,0
 525,672E-03,206.55E-03,0
 526,697.4E-03,206.55E-03,0
 527,710.1E-03,206.55E-03,0
 530,786.3E-03,206.55E-03,0
**
*Node,nset=n6
 541,0,207.12E-03,0
 544,76.2E-03,207.12E-03,0
 545,88.9E-03,207.12E-03,0
 546,114.3E-03,207.12E-03,0
 585,672E-03,207.12E-03,0
 586,697.4E-03,207.12E-03,0
 587,710.1E-03,207.12E-03,0
 590,786.3E-03,207.12E-03,0
*Node,nset=n7
 601,0,208.71E-03,0
 604,76.2E-03,208.71E-03,0
 605,88.9E-03,208.71E-03,0
 606,114.3E-03,208.71E-03,0
 645,672E-03,208.71E-03,0
```

646,697.4E-03,208.71E-03,0
647,710.1E-03,208.71E-03,0
650,786.3E-03,208.71E-03,0
*Node,nset=n8
661,0,211.09E-03,0
664,76.2E-03,211.09E-03,0
665,88.9E-03,211.09E-03,0
666,114.3E-03,211.09E-03,0
705,672E-03,211.09E-03,0
706,697.4E-03,211.09E-03,0
707,710.1E-03,211.09E-03,0
710,786.3E-03,211.09E-03,0
*Node,nset=n9
721,0,213.32E-03,0
724,76.2E-03,213.32E-03,0
725,88.9E-03,213.32E-03,0
726,114.3E-03,213.32E-03,0
765,672E-03,213.32E-03,0
766,697.4E-03,213.32E-03,0
767,710.1E-03,213.32E-03,0
770,786.3E-03,213.32E-03,0
*Node,nset=n10
781,0,214.48E-03,0
784,76.2E-03,214.48E-03,0
785,88.9E-03,214.48E-03,0
786,114.3E-03,214.48E-03,0
825,672E-03,214.48E-03,0
826,697.4E-03,214.48E-03,0
827,710.1E-03,214.48E-03,0
830,786.3E-03,214.48E-03,0
*Node,nset=n11
841,0,216.71E-03,0
844,76.2E-03,216.71E-03,0
845,88.9E-03,216.71E-03,0
846,114.3E-03,216.71E-03,0
885,672E-03,216.71E-03,0
886,697.4E-03,216.71E-03,0
887,710.1E-03,216.71E-03,0
890,786.3E-03,216.71E-03,0
*Node,nset=n12
901,0,219.09E-03,0
904,76.2E-03,219.09E-03,0
905,88.9E-03,219.09E-03,0
906,114.3E-03,219.09E-03,0
945,672E-03,219.09E-03,0
946,697.4E-03,219.09E-03,0
947,710.1E-03,219.09E-03,0
950,786.3E-03,219.09E-03,0
*Node,nset=n13
961,0,220.68E-03,0
964,76.2E-03,220.68E-03,0
965,88.9E-03,220.68E-03,0
966,114.3E-03,220.68E-03,0
1005,672E-03,220.68E-03,0
1006,697.4E-03,220.68E-03,0
1007,710.1E-03,220.68E-03,0

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 1010,786.3E-03,220.68E-03,0
*Node,nset=n14
 1021,0,221.25E-03,0
 1024,76.2E-03,221.25E-03,0
 1025,88.9E-03,221.25E-03,0
 1026,114.3E-03,221.25E-03,0
 1065,672E-03,221.25E-03,0
 1066,697.4E-03,221.25E-03,0
 1067,710.1E-03,221.25E-03,0
 1070,786.3E-03,221.25E-03,0
*Node,nset=n15
 1081,0,222.25E-03,0
 1084,76.2E-03,222.25E-03,0
 1085,88.9E-03,222.25E-03,0
 1086,114.3E-03,222.25E-03,0
 1125,672E-03,222.25E-03,0
 1126,697.4E-03,222.25E-03,0
 1127,710.1E-03,222.25E-03,0
 1130,786.3E-03,222.25E-03,0
*Node,nset=n16
 1141,0,228.6E-03,0
 1144,76.2E-03,228.6E-03,0
 1145,88.9E-03,228.6E-03,0
 1146,114.3E-03,228.6E-03,0
 1185,672E-03,228.6E-03,0
 1186,697.4E-03,228.6E-03,0
 1187,710.1E-03,228.6E-03,0
 1190,786.3E-03,228.6E-03,0
** Pipe and Water
*Node,nset=p1
 1901,172.04E-03,216.71E-03,0
 1902,173.63E-03,219.09E-03,0
 1903,176.01E-03,220.68E-03,0
 1904,178.63E-03,221.24E-03,0
 1905,181.25E-03,220.68E-03,0
 1906,183.63E-03,219.09E-03,0
 1907,185.22E-03,216.71E-03,0
**
 1908,185.22E-03,211.09E-03,0
 1909,183.63E-03,208.71E-03,0
 1910,181.25E-03,207.12E-03,0
 1911,178.63E-03,206.56E-03,0
 1912,176.01E-03,207.12E-03,0
 1913,173.63E-03,208.71E-03,0
 1914,172.04E-03,211.09E-03,0
**
 1921,172.30E-03,214.48E-03,0
 1922,172.76E-03,216.33E-03,0
 1923,174.14E-03,218.39E-03,0
 1924,176.20E-03,219.77E-03,0
 1925,178.63E-03,220.25E-03,0
 1926,181.06E-03,219.77E-03,0
 1927,183.12E-03,218.39E-03,0
 1928,184.50E-03,216.33E-03,0
 1929,184.96E-03,214.48E-03,0
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 1930,184.96E-03,213.32E-03,0
 1931,184.50E-03,211.31E-03,0
 1932,183.12E-03,209.25E-03,0
 1933,181.06E-03,207.87E-03,0
 1934,178.63E-03,207.39E-03,0
 1935,176.20E-03,207.87E-03,0
 1936,174.14E-03,209.25E-03,0
 1937,172.76E-03,211.31E-03,0
 1938,172.30E-03,213.32E-03,0
**
 1940,175.46E-03,214.48E-03,0
 1941,175.46E-03,214.86E-03,0
 1942,176.52E-03,214.86E-03,0
 1943,177.57E-03,214.86E-03,0
 1944,178.63E-03,214.86E-03,0
 1945,179.68E-03,214.86E-03,0
 1946,180.73E-03,214.86E-03,0
 1947,181.80E-03,214.86E-03,0
 1948,181.80E-03,214.48E-03,0
 1949,181.80E-03,213.32E-03,0
 1950,181.80E-03,212.94E-03,0
 1951,180.73E-03,212.94E-03,0
 1952,179.68E-03,212.94E-03,0
 1953,178.63E-03,212.94E-03,0
 1954,177.57E-03,212.94E-03,0
 1955,176.52E-03,212.94E-03,0
 1956,175.46E-03,212.94E-03,0
 1957,175.46E-03,213.32E-03,0
**
 1958,176.52E-03,213.32E-03,0
 1959,177.57E-03,213.32E-03,0
 1960,178.63E-03,213.32E-03,0
 1961,179.68E-03,213.32E-03,0
 1962,180.73E-03,213.32E-03,0
 1963,180.73E-03,214.48E-03,0
 1964,179.68E-03,214.48E-03,0
 1965,178.63E-03,214.48E-03,0
 1966,177.57E-03,214.48E-03,0
 1967,176.52E-03,214.48E-03,0
** Nodes for concrete grove
*node,nset=g1
 1200,0,247.65E-03,0
 1201,7.657E-03,276.225E-03,0
 1202,28.575E-03,288.061E-03,0
 1203,38.1E-03,288.061E-03,0
 1204,47.625E-03,288.061E-03,0
 1205,68.543E-03,276.225E-03,0
 1206,76.2E-03,247.65E-03,0
 1207,25.4E-03,247.65E-03,0
 1208,25.4E-03,254E-03,0
 1209,31.75E-03,254E-03,0
 1210,38.1E-03,254E-03,0
 1211,44.45E-03,254E-03,0
 1212,50.8E-03,254E-03,0
 1213,50.8E-03,247.65E-03,0
 1214,44.45E-03,247.65E-03,0
```

```
 1215,38.1E-03,247.65E-03,0
 1216,31.75E-03,247.65E-03,0
 1217,31.75E-03,228.6E-03,0
 1218,38.1E-03,228.6E-03,0
 1219,44.45E-03,228.6E-03,0
*ngen,nset=k1
 1,4,1
 4,5,1
 5,6,1
 6,45,1
 45,46,1
 46,47,1
 47,50,1
*ngen,nset=k2
 181,184,1
 184,185,1
 185,186,1
 186,225,1
 225,226,1
 226,227,1
 227,230,1
*ngen,nset=k3
 361,364,1
 364,365,1
 365,366,1
 366,405,1
 405,406,1
 406,407,1
 407,410,1
*ngen,nset=k4
 421,424,1
 424,425,1
 425,426,1
 426,465,1
 465,466,1
 466,467,1
 467,470,1
**
 481,484,1
 484,485,1
 485,486,1
 486,525,1
 525,526,1
 526,527,1
 527,530,1
**
 541,544,1
 544,545,1
 545,546,1
 546,585,1
 585,586,1
 586,587,1
 587,590,1
**
 601,604,1
 604,605,1
```

605,606,1
606,645,1
645,646,1
646,647,1
647,650,1
**
661,664,1
664,665,1
665,666,1
666,705,1
705,706,1
706,707,1
707,710,1
**
721,724,1
724,725,1
725,726,1
726,765,1
765,766,1
766,767,1
767,770,1
**
781,784,1
784,785,1
785,786,1
786,825,1
825,826,1
826,827,1
827,830,1
**
841,844,1
844,845,1
845,846,1
846,885,1
885,886,1
886,887,1
887,890,1
**
901,904,1
904,905,1
905,906,1
906,945,1
945,946,1
946,947,1
947,950,1
**
961,964,1
964,965,1
965,966,1
966,1005,1
1005,1006,1
1006,1007,1
1007,1010,1
**
1021,1024,1
1024,1025,1

```
 1025,1026,1
 1026,1065,1
 1065,1066,1
 1066,1067,1
 1067,1070,1
**
 1081,1084,1
 1084,1085,1
 1085,1086,1
 1086,1125,1
 1125,1126,1
 1126,1127,1
 1127,1130,1
**
 1141,1144,1
 1144,1145,1
 1145,1146,1
 1146,1185,1
 1185,1186,1
 1186,1187,1
 1187,1190,1
**
*nfill,nset=v1
 k1,k2,3,60
*nfill,nset=v2
 k2,k3,3,60
*NCOPY,CHANGE NUMBER=100,SHIFT,NEW SET=p2,OLD SET=p1
 143.0E-03,0,0
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=100,SHIFT,NEW SET=p3,OLD SET=p2
 143.0E-03,0,0
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=100,SHIFT,NEW SET=p4,OLD SET=p3
 143.0E-03,0,0
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=46,SHIFT,NEW SET=G1,OLD SET=G1
 710.1E-03,0,0
 0,0,-3.8,0,149.5,-3.8,0
*nset,nset=all
 p1,v1,v2,k4,p2,p3,p4,g1
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m1,OLD SET=all
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m2,OLD SET=m1
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m3,OLD SET=m2
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m4,OLD SET=m3
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m5,OLD SET=m4
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m6,OLD SET=m5
```

```
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m7,OLD SET=m6
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m8,OLD SET=m7
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m9,OLD SET=m8
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m10,OLD SET=m9
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m11,OLD SET=m10
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m12,OLD SET=m11
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m13,OLD SET=m12
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m14,OLD SET=m13
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m15,OLD SET=m14
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m16,OLD SET=m15
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m17,OLD SET=m16
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m18,OLD SET=m17
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m19,OLD SET=m18
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m20,OLD SET=m19
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m21,OLD SET=m20
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m22,OLD SET=m21
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m23,OLD SET=m22
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m24,OLD SET=m23
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
```

```
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m25,OLD SET=m24
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m26,OLD SET=m25
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m27,OLD SET=m26
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m28,OLD SET=m27
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m29,OLD SET=m28
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m30,OLD SET=m29
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
*NCOPY,CHANGE NUMBER=5000,SHIFT,NEW SET=m31,OLD SET=m30
 0,0,-0.075
 0,0,-3.8,0,149.5,-3.8,0
**
*nset,nset=bgrove,generate
 1200,1219,1
 1246,1265,1
*nset,nset=bconcrete1,generate
 1,50,1
 61,110,1
 121,170,1
*nset,nset=bpoly,generate
 181,230,1
 241,290,1
 301,350,1
 361,410,1
*nset,nset=bconcrete2,generate
 421,425,1
 481,485,1
 541,545,1
 601,605,1
 661,665,1
 721,725,1
 781,785,1
 841,845,1
 901,905,1
 961,965,1
 1021,1025,1
 1081,1085,1
 1141,1145,1
 466,470,1
 526,530,1
 586,590,1
 646,650,1
 706,710,1
 766,770,1
 826,830,1
 886,890,1
```

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 946,950,1
 1006,1010,1
 1066,1070,1
 1126,1130,1
 1186,1190,1
*nset,nset=bglass,generate
 1084,1127,1
 1144,1187,1
*nset,nset=binsul,generate
 425,466,1
 486,525,1
*nset,nset=bwater,generate
 1921,1938,1
 1940,1967,1
 2021,2038,1
 2040,2067,1
 2121,2138,1
 2140,2167,1
 2221,2238,1
 2240,2267,1
*nset,nset=ncopper,generate
 1901,101901,5000
 1902,101902,5000
 1903,101903,5000
 1904,101904,5000
 1905,101905,5000
 1906,101906,5000
 1907,101907,5000
 1908,101908,5000
 1909,101909,5000
 1910,101910,5000
 1911,101911,5000
 1912,101912,5000
 1913,101913,5000
 1914,101914,5000
**
 2001,102001,5000
 2002,102002,5000
 2003,102003,5000
 2004,102004,5000
 2005,102005,5000
 2006,102006,5000
 2007,102007,5000
 2008,102008,5000
 2009,102009,5000
 2010,102010,5000
 2011,102011,5000
 2012,102012,5000
 2013,102013,5000
 2014,102014,5000
**
 2101,102101,5000
 2102,102102,5000
 2103,102103,5000
 2104,102104,5000
 2105,102105,5000
```

2106,102106,5000
2107,102107,5000
2108,102108,5000
2109,102109,5000
2110,102110,5000
2111,102111,5000
2112,102112,5000
2113,102113,5000
2114,102114,5000
**
2201,102201,5000
2202,102202,5000
2203,102203,5000
2204,102204,5000
2205,102205,5000
2206,102206,5000
2207,102207,5000
2208,102208,5000
2209,102209,5000
2210,102210,5000
2211,102211,5000
2212,102212,5000
2213,102213,5000
2214,102214,5000
**
786,100786,5000
787,100787,5000
788,100788,5000
789,100789,5000
790,100790,5000
791,100791,5000
792,100792,5000
793,100793,5000
794,100794,5000
795,100795,5000
796,100796,5000
797,100797,5000
798,100798,5000
799,100799,5000
800,100800,5000
801,100801,5000
802,100802,5000
803,100803,5000
804,100804,5000
805,100805,5000
806,100806,5000
807,100807,5000
808,100808,5000
809,100809,5000
810,100810,5000
811,100811,5000
812,100812,5000
813,100813,5000
814,100814,5000
815,100815,5000
816,100816,5000

```
 817,100817,5000
 818,100818,5000
 819,100819,5000
 820,100820,5000
 821,100821,5000
 822,100822,5000
 823,100823,5000
 824,100824,5000
 825,100825,5000
**
 726,100726,5000
 727,100727,5000
 728,100728,5000
 729,100729,5000
 730,100730,5000
 731,100731,5000
 732,100732,5000
 733,100733,5000
 734,100734,5000
 735,100735,5000
 736,100736,5000
 737,100737,5000
 738,100738,5000
 739,100739,5000
 740,100740,5000
 741,100741,5000
 742,100742,5000
 743,100743,5000
 744,100744,5000
 745,100745,5000
 746,100746,5000
 747,100747,5000
 748,100748,5000
 749,100749,5000
 750,100750,5000
 751,100751,5000
 752,100752,5000
 753,100753,5000
 754,100754,5000
 755,100755,5000
 756,100756,5000
 757,100757,5000
 758,100758,5000
 759,100759,5000
 760,100760,5000
 761,100761,5000
 762,100762,5000
 763,100763,5000
 764,100764,5000
 765,100765,5000
*nset,nset=tcopper,generate
 101901,101914,1
 102001,102014,1
 102101,102114,1
 102201,102214,1
 100786,100825,1
```

```
 100726,100765,1
*nset,nset=bcopper,generate
 1901,1914,1
 2001,2014,1
 2101,2114,1
 2201,2214,1
 786,825,1
 726,765,1
*nset,nset=bair,generate
 546,585,1
 606,645,1
 666,705,1
 846,885,1
 906,945,1
 966,1005,1
 1026,1065,1
*element,elset=concrete1A1,type=dc3d8
 1,5001,5002,5062,5061,1,2,62,61
*elgen,elset=concrete1A1
 1,49,1,1,3,60,50
*element,elset=concrete2A1,type=dc3d8
 301,5361,5362,5422,5421,361,362,422,421
*elgen,elset=concrete2A1
 301,49,1,1
 301,3,1,1,13,60,50
 304,12,60,50
 346,12,60,50
 347,3,1,1,13,60,50
*elset,elset=dummy
 1,
*element,elset=polyA1,type=dc3d8
 151,5181,5182,5242,5241,181,182,242,241
*elgen,elset=polyA1
 151,49,1,1,3,60,50
*element,elset=water1,type=dcc3d8
 1081,6921,6940,6941,6922,1921,1940,1941,1922
 1098,6938,6957,6940,6921,1938,1957,1940,1921
 1118,6956,6955,6958,6957,1956,1955,1958,1957
 1119,6955,6954,6959,6958,1955,1954,1959,1958
 1120,6954,6953,6960,6959,1954,1953,1960,1959
 1121,6953,6952,6961,6960,1953,1952,1961,1960
 1122,6952,6951,6962,6961,1952,1951,1962,1961
 1123,6951,6950,6949,6962,1951,1950,1949,1962
 1124,6940,6967,6942,6941,1940,1967,1942,1941
 1125,6967,6966,6943,6942,1967,1966,1943,1942
 1126,6966,6965,6944,6943,1966,1965,1944,1943
 1127,6965,6964,6945,6944,1965,1964,1945,1944
 1128,6964,6963,6946,6945,1964,1963,1946,1945
 1129,6963,6948,6947,6946,1963,1948,1947,1946
 1130,6957,6958,6967,6940,1957,1958,1967,1940
 1131,6958,6959,6966,6967,1958,1959,1966,1967
 1132,6959,6960,6965,6966,1959,1960,1965,1966
 1133,6960,6961,6964,6965,1960,1961,1964,1965
 1134,6961,6962,6963,6964,1961,1962,1963,1964
 1135,6962,6949,6948,6963,1962,1949,1948,1963
*elgen,elset=water1
```

```
 1081,17,1,1
** Copper plate
** Elements to define copper upper surface
*element,elset=copperplatea1,type=dc3d8
 606,5726,5727,5787,5786,726,727,787,786
 611,5731,5732,5792,5791,731,732,792,791
 621,5741,5742,5802,5801,741,742,802,801
 631,5751,5752,5812,5811,751,752,812,811
 641,5761,5762,5822,5821,761,762,822,821
**
** Copper pipe not coppied
*element,elset=coppera1,type=dc3d8
 1100,5790,6921,6922,6901,790,1921,1922,1901
 1107,6907,6928,6929,5791,1907,1928,1929,791
**
 1200,5800,7021,7022,7001,800,2021,2022,2001
 1207,7007,7028,7029,5801,2007,2028,2029,801
**
 1300,5810,7121,7122,7101,810,2121,2122,2101
 1307,7107,7128,7129,5811,2107,2128,2129,811
**
 1400,5820,7221,7222,7201,820,2221,2222,2201
 1407,7207,7228,7229,5821,2207,2228,2229,821
**
*element,elset=copper2,type=dc3d8
 1101,6901,6922,6923,6902,1901,1922,1923,1902
*element,elset=copper3,type=dc3d8
 1108,6930,5731,5791,6929,1930,731,791,1929
 1109,6931,6908,5731,6930,1931,1908,731,1930
 1116,6938,5730,6914,6937,1938,730,1914,1937
 1117,6921,5790,5730,6938,1921,790,730,1938
 1208,7030,5741,5801,7029,2030,741,801,2029
 1217,7021,5800,5740,7038,2021,800,740,2038
 1209,7031,7008,5741,7030,2031,2008,741,2030
 1216,7038,5740,7014,7037,2038,740,2014,2037
 1308,7130,5751,5811,7129,2130,751,811,2129
 1317,7121,5810,5750,7138,2121,810,750,2138
 1309,7131,7108,5751,7130,2131,2108,751,2130
 1316,7138,5750,7114,7137,2138,750,2114,2137
 1408,7230,5761,5821,7229,2230,761,821,2229
 1417,7221,5820,5760,7238,2221,820,760,2238
 1409,7231,7208,5761,7230,2231,2208,761,2230
 1416,7238,5760,7214,7237,2238,760,2214,2237
*element,elset=copper4,type=dc3d8
 1110,6932,6909,6908,6931,1932,1909,1908,1931
*elgen,elset=copperplatea1
 606,4,1,1
 611,9,1,1
 621,9,1,1
 631,9,1,1
 641,4,1,1
*elgen,elset=copper2
 1101,6,1,1
*elgen,elset=copper4
 1110,6,1,1
*element,elset=glassA1,type=dc3d8
```

```
 904,6084,6085,6145,6144,1084,1085,1145,1144
*elgen,elset=glassA1
 904,43,1,1
*element,elset=insulA1,type=dc3d8
 355,5425,5426,5486,5485,425,426,486,485
*elgen,elset=insulA1
 355,41,1,1
 355,11,60,50
 395,11,60,50
** Plate air elements
*element,elset=air1,type=dc3d8
 856,6026,6027,6087,6086,1026,1027,1087,1086
*element,elset=air2,type=dc3d8
** Irregular air elements
 406,5486,5487,5547,5546,486,487,547,546
 456,5546,5547,5607,5606,546,547,607,606
 506,5606,5607,5667,5666,606,607,667,666
 556,5666,5667,5727,5726,666,667,727,726
 656,5786,5787,5847,5846,786,787,847,846
 706,5846,5847,5907,5906,846,847,907,906
 756,5906,5907,5967,5966,906,907,967,966
 806,5966,5967,6027,6026,966,967,1027,1026
**
 411,5491,5492,5552,5551,491,492,552,551
 461,5551,5552,5612,5611,551,552,612,611
 511,5611,5612,5672,5671,611,612,672,671
 561,5671,5672,5732,5731,671,672,732,731
 661,5791,5792,5852,5851,791,792,852,851
 711,5851,5852,5912,5911,851,852,912,911
 761,5911,5912,5972,5971,911,912,972,971
 811,5971,5972,6032,6031,971,972,1032,1031
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 421,5501,5502,5562,5561,501,502,562,561
 471,5561,5562,5622,5621,561,562,622,621
 521,5621,5622,5682,5681,621,622,682,681
 571,5681,5682,5742,5741,681,682,742,741
 671,5801,5802,5862,5861,801,802,862,861
 721,5861,5862,5922,5921,861,862,922,921
 771,5921,5922,5982,5981,921,922,982,981
 821,5981,5982,6042,6041,981,982,1042,1041
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 431,5511,5512,5572,5571,511,512,572,571
 481,5571,5572,5632,5631,571,572,632,631
 531,5631,5632,5692,5691,631,632,692,691
 581,5691,5692,5752,5751,691,692,752,751
 681,5811,5812,5872,5871,811,812,872,871
 731,5871,5872,5932,5931,871,872,932,931
 781,5931,5932,5992,5991,931,932,992,991
 831,5991,5992,6052,6051,991,992,1052,1051
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 441,5521,5522,5582,5581,521,522,582,581
 491,5581,5582,5642,5641,581,582,642,641
 541,5641,5642,5702,5701,641,642,702,701
 591,5701,5702,5762,5761,701,702,762,761
 691,5821,5822,5882,5881,821,822,882,881
 741,5881,5882,5942,5941,881,882,942,941
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 791,5941,5942,6002,6001,941,942,1002,1001
 841,6001,6002,6062,6061,1001,1002,1062,1061
** Air elements surrounding pipes
** Pipe 1
 1250,5970,6903,6904,6030,970,1903,1904,1030
 1251,5910,6902,6903,5970,910,1902,1903,970
 1252,5850,6901,6902,5910,850,1901,1902,910
 1255,5610,6913,6914,5670,610,1913,1914,670
 1256,5550,6912,6913,5610,550,1912,1913,610
 1257,5490,6911,6912,5550,490,1911,1912,550
 1258,6911,5491,5551,6910,1911,491,551,1910
 1259,6910,5551,5611,6909,1910,551,611,1909
 1260,6909,5611,5671,6908,1909,611,671,1908
 1263,6907,5851,5911,6906,1907,851,911,1906
 1264,6906,5911,5971,6905,1906,911,971,1905
 1265,6905,5971,6031,6904,1905,971,1031,1904
** Triangular air elements surrounding pipes
*element,elset=air2,type=dc3d6
 1253,5790,6901,5850,790,1901,850
 1254,5670,6914,5730,670,1914,730
 1261,6908,5671,5731,1908,671,731
 1262,5791,5851,6907,791,851,1907
*element,elset=air2,type=dc3d8
** Pipe 2
 1350,5980,7003,7004,6040,980,2003,2004,1040
 1351,5920,7002,7003,5980,920,2002,2003,980
 1352,5860,7001,7002,5920,860,2001,2002,920
 1355,5620,7013,7014,5680,620,2013,2014,680
 1356,5560,7012,7013,5620,560,2012,2013,620
 1357,5500,7011,7012,5560,500,2011,2012,560
 1358,7011,5501,5561,7010,2011,501,561,2010
 1359,7010,5561,5621,7009,2010,561,621,2009
 1360,7009,5621,5681,7008,2009,621,681,2008
 1363,7007,5861,5921,7006,2007,861,921,2006
 1364,7006,5921,5981,7005,2006,921,981,2005
 1365,7005,5981,6041,7004,2005,981,1041,2004
** Triangular air elements surrounding pipes
*element,elset=air2,type=dc3d6
 1353,5800,7001,5860,800,2001,860
 1354,5680,7014,5740,680,2014,740
 1361,7008,5681,5741,2008,681,741
 1362,5801,5861,7007,801,861,2007
*element,elset=air2,type=dc3d8
** Pipe 3
 1450,5990,7103,7104,6050,990,2103,2104,1050
 1451,5930,7102,7103,5990,930,2102,2103,990
 1452,5870,7101,7102,5930,870,2101,2102,930
 1455,5630,7113,7114,5690,630,2113,2114,690
 1456,5570,7112,7113,5630,570,2112,2113,630
 1457,5510,7111,7112,5570,510,2111,2112,570
 1458,7111,5511,5571,7110,2111,511,571,2110
 1459,7110,5571,5631,7109,2110,571,631,2109
 1460,7109,5631,5691,7108,2109,631,691,2108
 1463,7107,5871,5931,7106,2107,871,931,2106
 1464,7106,5931,5991,7105,2106,931,991,2105
 1465,7105,5991,6051,7104,2105,991,1051,2104
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** Triangular air elements surrounding pipes
*element,elset=air2,type=dc3d6
 1453,5810,7101,5870,810,2101,870
 1454,5690,7114,5750,690,2114,750
 1461,7108,5691,5751,2108,691,751
 1462,5811,5871,7107,811,871,2107
*element,elset=air2,type=dc3d8
** Pipe 4
 1550,6000,7203,7204,6060,1000,2203,2204,1060
 1551,5940,7202,7203,6000,940,2202,2203,1000
 1552,5880,7201,7202,5940,880,2201,2202,940
 1555,5640,7213,7214,5700,640,2213,2214,700
 1556,5580,7212,7213,5640,580,2212,2213,640
 1557,5520,7211,7212,5580,520,2211,2212,580
 1558,7211,5521,5581,7210,2211,521,581,2210
 1559,7210,5581,5641,7209,2210,581,641,2209
 1560,7209,5641,5701,7208,2209,641,701,2208
 1563,7207,5881,5941,7206,2207,881,941,2206
 1564,7206,5941,6001,7205,2206,941,1001,2205
 1565,7205,6001,6061,7204,2205,1001,1061,2204
** Triangular air elements surrounding pipes
*element,elset=air2,type=dc3d6
 1553,5820,7201,5880,820,2201,880
 1554,5700,7214,5760,700,2214,760
 1561,7208,5701,5761,2208,701,761
 1562,5821,5881,7207,821,881,2207
*elgen,elset=air1
 856,39,1,1
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*elgen,elset=air2
 406,4,1,1
 456,4,1,1
 506,4,1,1
 556,4,1,1
 656,4,1,1
 706,4,1,1
 756,4,1,1
 806,4,1,1
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 411,9,1,1
 461,9,1,1
 511,9,1,1
 561,9,1,1
 661,9,1,1
 711,9,1,1
 761,9,1,1
 811,9,1,1
**
 421,9,1,1
 471,9,1,1
 521,9,1,1
 571,9,1,1
 671,9,1,1
 721,9,1,1
 771,9,1,1
 821,9,1,1
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 431,9,1,1
 481,9,1,1
 531,9,1,1
 581,9,1,1
 681,9,1,1
 731,9,1,1
 781,9,1,1
 831,9,1,1
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 441,4,1,1
 491,4,1,1
 541,4,1,1
 591,4,1,1
 691,4,1,1
 741,4,1,1
 791,4,1,1
 841,4,1,1
*elset,elset=airA1
 air1,air2
**Concrete grove
*element,elset=groveA1,type=dc3d8
 2000,6141,6142,6207,6200,1141,1142,1207,1200
 2001,6200,6207,6208,6201,1200,1207,1208,1201
 2002,6201,6208,6209,6202,1201,1208,1209,1202
 2003,6202,6209,6210,6203,1202,1209,1210,1203
 2004,6203,6210,6211,6204,1203,1210,1211,1204
 2005,6204,6211,6212,6205,1204,1211,1212,1205
 2006,6205,6212,6213,6206,1205,1212,1213,1206
 2007,6206,6213,6143,6144,1206,1213,1143,1144
 2008,6142,6217,6216,6207,1142,1217,1216,1207
 2009,6217,6218,6215,6216,1217,1218,1215,1216
 2010,6218,6219,6214,6215,1218,1219,1214,1215
 2011,6219,6143,6213,6214,1219,1143,1213,1214
 2012,6207,6216,6209,6208,1207,1216,1209,1208
 2013,6216,6215,6210,6209,1216,1215,1210,1209
 2014,6215,6214,6211,6210,1215,1214,1211,1210
 2015,6214,6213,6212,6211,1214,1213,1212,1211
*elgen,elset=grovea1
 2000,2,46,100
 2001,2,46,100
 2002,2,46,100
 2003,2,46,100
 2004,2,46,100
 2005,2,46,100
 2006,2,46,100
 2007,2,46,100
 2008,2,46,100
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 2014,2,46,100
 2015,2,46,100
*ELCOPY,OLD SET=water1,NEW SET=water2,SHIFT NODES=100,ELEMENT SHIFT=100
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*ELCOPY,OLD SET=copper2B,NEW SET=copper2C,SHIFT NODES=100,ELEMENT SHIFT=100
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*ELCOPY,OLD SET=copper4A,NEW SET=copper4B,SHIFT NODES=100,ELEMENT SHIFT=100
*ELCOPY,OLD SET=copper4B,NEW SET=copper4C,SHIFT NODES=100,ELEMENT SHIFT=100
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 water1,water2,water3,water4
*elset,elset=copperbota1
 copper3,copper4,copper4A,copper4B,copper4C
*elset,elset=copperupa1
 coppera1,copper2,copper2a,copper2b,copper2c
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SHIFT=5000
*ELCOPY,OLD SET=concrete1a6,NEW SET=concrete1a7,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete1a7,NEW SET=concrete1a8,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete1a8,NEW SET=concrete1a9,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete1a9,NEW SET=concrete1a10,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete1a10,NEW SET=concrete1a11,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete1a11,NEW SET=concrete1a12,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete1a12,NEW SET=concrete1a13,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete1a13,NEW SET=concrete1a14,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete1a14,NEW SET=concrete1a15,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete1a15,NEW SET=concrete1a16,SHIFT NODES=5000,ELEMENT
SHIFT=5000
```

*ELCOPY,OLD SET=concrete1a16,NEW SET=concrete1a17,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete1a17,NEW SET=concrete1a18,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete1a18,NEW SET=concrete1a19,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete1a19,NEW SET=concrete1a20,SHIFT NODES=5000,ELEMENT
SHIFT=5000
**
*ELCOPY,OLD SET=concrete2A1,NEW SET=concrete2a2,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a2,NEW SET=concrete2a3,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a3,NEW SET=concrete2a4,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a4,NEW SET=concrete2a5,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a5,NEW SET=concrete2a6,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a6,NEW SET=concrete2a7,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a7,NEW SET=concrete2a8,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a8,NEW SET=concrete2a9,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a9,NEW SET=concrete2a10,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a10,NEW SET=concrete2a11,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a11,NEW SET=concrete2a12,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a12,NEW SET=concrete2a13,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a13,NEW SET=concrete2a14,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a14,NEW SET=concrete2a15,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a15,NEW SET=concrete2a16,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a16,NEW SET=concrete2a17,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a17,NEW SET=concrete2a18,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a18,NEW SET=concrete2a19,SHIFT NODES=5000,ELEMENT
SHIFT=5000
*ELCOPY,OLD SET=concrete2a19,NEW SET=concrete2a20,SHIFT NODES=5000,ELEMENT
SHIFT=5000
**
*ELCOPY,OLD SET=glassA1,NEW SET=glassa2,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa2,NEW SET=glassa3,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa3,NEW SET=glassa4,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa4,NEW SET=glassa5,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa5,NEW SET=glassa6,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa6,NEW SET=glassa7,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa7,NEW SET=glassa8,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa8,NEW SET=glassa9,SHIFT NODES=5000,ELEMENT SHIFT=5000

```
*ELCOPY,OLD SET=glassa9,NEW SET=glassa10,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa10,NEW SET=glassa11,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa11,NEW SET=glassa12,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa12,NEW SET=glassa13,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa13,NEW SET=glassa14,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa14,NEW SET=glassa15,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa15,NEW SET=glassa16,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa16,NEW SET=glassa17,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa17,NEW SET=glassa18,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa18,NEW SET=glassa19,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=glassa19,NEW SET=glassa20,SHIFT NODES=5000,ELEMENT SHIFT=5000
**
*ELCOPY,OLD SET=insulA1,NEW SET=insula2,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula2,NEW SET=insula3,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula3,NEW SET=insula4,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula4,NEW SET=insula5,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula5,NEW SET=insula6,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula6,NEW SET=insula7,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula7,NEW SET=insula8,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula8,NEW SET=insula9,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula9,NEW SET=insula10,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula10,NEW SET=insula11,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula11,NEW SET=insula12,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula12,NEW SET=insula13,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula13,NEW SET=insula14,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula14,NEW SET=insula15,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula15,NEW SET=insula16,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula16,NEW SET=insula17,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula17,NEW SET=insula18,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula18,NEW SET=insula19,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=insula19,NEW SET=insula20,SHIFT NODES=5000,ELEMENT SHIFT=5000
**
*ELCOPY,OLD SET=groveA1,NEW SET=grovea2,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea2,NEW SET=grovea3,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea3,NEW SET=grovea4,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea4,NEW SET=grovea5,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea5,NEW SET=grovea6,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea6,NEW SET=grovea7,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea7,NEW SET=grovea8,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea8,NEW SET=grovea9,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea9,NEW SET=grovea10,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea10,NEW SET=grovea11,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea11,NEW SET=grovea12,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea12,NEW SET=grovea13,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea13,NEW SET=grovea14,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea14,NEW SET=grovea15,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea15,NEW SET=grovea16,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea16,NEW SET=grovea17,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea17,NEW SET=grovea18,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea18,NEW SET=grovea19,SHIFT NODES=5000,ELEMENT SHIFT=5000
*ELCOPY,OLD SET=grovea19,NEW SET=grovea20,SHIFT NODES=5000,ELEMENT SHIFT=5000
**
*elset,elset=water
 watera1,watera2,watera3,watera4,watera5,watera6,watera7,watera8,watera9,watera10,watera11
*elset,elset=water
 watera12,watera13,watera14,watera15,watera16,watera17,watera18,watera19,watera20
```

```
*elset,elset=copperup
 copperupa1,copperupa2,copperupa3,copperupa4,copperupa5,copperupa6,copperupa7,copperupa8
*elset,elset=copperup

copperupa9,copperupa10,copperupa11,copperupa12,copperupa13,copperupa14,copperupa15,copperupa16,
copperupa17
*elset,elset=copperup
 copperupa18,copperupa19,copperupa20
*elset,elset=copperplate
 copperplatea1,copperplatea2,copperplatea3,copperplatea4,copperplatea5,copperplatea6,copperplatea7
*elset,elset=copperplate
 copperplatea8,copperplatea9,copperplatea10,copperplatea11,copperplatea12,copperplatea13
*elset,elset=copperplate
 copperplatea14,copperplatea15,copperplatea16,copperplatea17,copperplatea18
*elset,elset=copperplate
 copperplatea19,copperplatea20
*elset,elset=copperbot
 copperbota1,copperbota2,copperbota3,copperbota4,copperbota5,copperbota6,copperbota7,copperbota8
*elset,elset=copperbot
 copperbota9,copperbota10,copperbota11,copperbota12,copperbota13,copperbota14,copperbota15
*elset,elset=copperbot
 copperbota16,copperbota17,copperbota18,copperbota19,copperbota20
*elset,elset=copper
 copperup,copperplate,copperbot
*elset,elset=copperK
 copperupa20,copperplatea20,copperbota20
*elset,elset=poly
 polya1,polya2,polya3,polya4,polya5,polya6,polya7,polya8,polya9,polya10,polya11
*elset,elset=poly
 polya12,polya13,polya14,polya15,polya16,polya17,polya18,polya19,polya20
*elset,elset=air
 aira1,aira2,aira3,aira4,aira5,aira6,aira7,aira8,aira9,aira10,aira11
*elset,elset=air
 aira12,aira13,aira14,aira15,aira16,aira17,aira18,aira19,aira20
*elset,elset=concrete1
 concrete1a1,concrete1a2,concrete1a3,concrete1a4,concrete1a5,concrete1a6,concrete1a7,concrete1a8
*elset,elset=concrete1

concrete1a9,concrete1a10,concrete1a11,concrete1a12,concrete1a13,concrete1a14,concrete1a15,concrete1a
16
*elset,elset=concrete1
 concrete1a17,concrete1a18,concrete1a19,concrete1a20
*elset,elset=concrete2
 concrete2a1,concrete2a2,concrete2a3,concrete2a4,concrete2a5,concrete2a6,concrete2a7,concrete2a8
*elset,elset=concrete2

concrete2a9,concrete2a10,concrete2a11,concrete2a12,concrete2a13,concrete2a14,concrete2a15,concrete2a
16
*elset,elset=concrete2
 concrete2a9,concrete2a17,concrete2a18,concrete2a19,concrete2a20
*elset,elset=glass
 glassa1,glassa2,glassa3,glassa4,glassa5,glassa6,glassa7,glassa8,glassa9,glassa10,glassa11
*elset,elset=glass
 glassa12,glassa13,glassa14,glassa15,glassa16,glassa17,glassa18,glassa19,glassa20
*elset,elset=insul
 insula1,insula2,insula3,insula4,insula5,insula6,insula7,insula8,insula9,insula10,insula11
```

```
*elset,elset=insul
 insula12,insula13,insula14,insula15,insula16,insula17,insula18,insula19,insula20
*elset,elset=grove
 groveA1,grovea2,grovea3,grovea4,grovea5,grovea6,grovea7,grovea8,grovea9,grovea10,grovea11
*elset,elset=grove
 grovea12,grovea13,grovea14,grovea15,grovea16,grovea17,grovea18,grovea19,grovea20
**
*nset,nset=nair,elset=air
*nset,nset=nglass,elset=glass
*nset,nset=npoly,elset=poly
*nset,nset=nconc,elset=concrete1
*nset,nset=nconcs,elset=concrete2
*nset,nset=ninsul,elset=insul
*nset,nset=nair1,elset=air1
*nset,nset=ngrove,elset=grove
*nset,nset=nwater,elset=water
**
*nset,nset=tair,elset=aira20
*nset,nset=tglass,elset=glassa20
*nset,nset=tpoly,elset=polya20
*nset,nset=tconc,elset=concrete1a20
*nset,nset=tconcs,elset=concrete2a20
*nset,nset=tinsul,elset=insula20
*nset,nset=tgrove,elset=grovea20
**nset,nset=tair1,elset=aira20
*nset,nset=twater,elset=watera20
**
*physical constants, stefan boltzmann=5.6698e-08, absolute zero=0
*SURFACE,PROPERTY=RGLRAD1,NAME=RGLRAD,TYPE=ELEMENT
 glass,S3
*SURFACE PROPERTY,NAME=RGLRAD1
*EMISSIVITY
 0.94
*SURFACE,PROPERTY=LCURAD1,NAME=LCURAD,TYPE=ELEMENT
 copperup,S6
 copperplate,S5
*SURFACE PROPERTY,NAME=LCURAD1
*EMISSIVITY
 1
*CONTACT PAIR,INTERACTION=GL_CU1
 LCURAD, RGLRAD
*SURFACE INTERACTION,NAME=GL_CU1
*GAP RADIATION
 0.94,1.0
 1.0,0.0e-3
 0.997,1.0e-3
 0.995,2.0e-3
 0.992,3.0e-3
 0.990,4.0e-3
 0.981,7.35e-3
 0.0,18
*FILM PROPERTY,NAME=GLASSAIR
5.42
*FILM PROPERTY,NAME=CONCRETEINNER
 5
** DEFINING SOLID SECTION PROPERTIES(THICKNESS-MM)
```

```
*SOLID SECTION,MATERIAL=concrete,ELSET=concrete1
*SOLID SECTION,MATERIAL=concrete,ELSET=concrete2
*SOLID SECTION,MATERIAL=poly,ELSET=poly
*SOLID SECTION,MATERIAL=WATER,ELSET=water
*SOLID SECTION,MATERIAL=glass,ELSET=glass
*SOLID SECTION,MATERIAL=insulation,ELSET=insul
*SOLID SECTION,MATERIAL=air,ELSET=air
*SOLID SECTION,MATERIAL=copper,ELSET=copper
*SOLID SECTION,MATERIAL=concrete,ELSET=grove
*MATERIAL,NAME=COPPER
*DENSITY
8954
*CONDUCTIVITY
398
*SPECIFIC HEAT
383
*MATERIAL,NAME=LCURAD1
*DENSITY
8954
*CONDUCTIVITY
398
*SPECIFIC HEAT
383
*MATERIAL,NAME=WATER
*DENSITY
999.7
*CONDUCTIVITY
0.58
*SPECIFIC HEAT
4192
*MATERIAL,NAME=air
*DENSITY
1.247
*CONDUCTIVITY
0.025
*SPECIFIC HEAT
1006
*MATERIAL,NAME=glass
*DENSITY
2800
*CONDUCTIVITY
0.81
*SPECIFIC HEAT
800
*MATERIAL,NAME=RGLRAD1
*DENSITY
2800
*CONDUCTIVITY
0.81
*SPECIFIC HEAT
800
*MATERIAL,NAME=insulation
*DENSITY
240
*CONDUCTIVITY
0.035
```

```
*SPECIFIC HEAT
1.5
*MATERIAL,NAME=concrete
*DENSITY
2200
*CONDUCTIVITY
1.37
*SPECIFIC HEAT
880
*MATERIAL,NAME=poly
*DENSITY
1200
*CONDUCTIVITY
0.32
*SPECIFIC HEAT
2.090
**
*INITIAL CONDITIONS,TYPE=TEMPERATURE
nwater,283,283,283
nair,283,283,283
nglass,283,283,283
npoly,283,283,283
ninsul,283,283,283
ncopper,283,283,283
nconc,283,283,283
nconcs,283,283,283
ngrove,283,283,283
*INITIAL CONDITIONS,TYPE=Mass Flow Rate
nwater,0,0,-1.096
*STEP,INC=50,extrapolation=parabolic,UNSYMM=YES
TRANSIENT ANALYSIS (NONLINEAR DUE TO RADIATION) INCLUDING FORCED
CONVECTION
*HEAT TRANSFER,deltmx=50
 0.0003,3600
*MASS FLOW RATE
nwater,0,0,-1.096
**
*BOUNDARY,OP=NEW,FIXED
bwater,11,,283
bcopper,11,,283
bconcrete1,11,,283
bconcrete2,11,,283
bglass,11,,283
bair,11,,283
binsul,11,,283
bpoly,11,,283
bgrove,11,,283
*DFLUX
glass,S3NU
**glass,S5NU
*FILM
glass,F5,273.4,GLASSAIR
concrete1,F3,298,CONCRETEINNER
**
*EL PRINT,ELSET=DUMMY,FREQUENCY=0
 TEMP,
```

```
*Node Print,NSET=bwater,FREQUENCY=30
 NT,
*Node Print,NSET=nwater,FREQUENCY=30
 NT,
*Node Print,NSET=twater,FREQUENCY=30
 NT,
*Node Print,NSET=bair,FREQUENCY=30
 NT,
*Node Print,NSET=nair,FREQUENCY=30
 NT,
*Node Print,NSET=tair,FREQUENCY=30
 NT,
*Node Print,NSET=bglass,FREQUENCY=30
 NT,
*Node Print,NSET=nglass,FREQUENCY=30
 NT,
*Node Print,NSET=tglass,FREQUENCY=30
 NT,
*Node Print,NSET=bpoly,FREQUENCY=30
 NT,
*Node Print,NSET=npoly,FREQUENCY=30
 NT,
*Node Print,NSET=tpoly,FREQUENCY=30
 NT,
*Node Print,NSET=binsul,FREQUENCY=30
 NT,
*Node Print,NSET=ninsul,FREQUENCY=30
 NT,
*Node Print,NSET=tinsul,FREQUENCY=30
 NT,
*Node Print,NSET=bcopper,FREQUENCY=30
 NT,
*Node Print,NSET=ncopper,FREQUENCY=30
 NT,
*Node Print,NSET=tcopper,FREQUENCY=30
 NT,
*Node Print,NSET=bconcrete1,FREQUENCY=30
 NT,
*Node Print,NSET=nconc,FREQUENCY=30
 NT,
*Node Print,NSET=tconc,FREQUENCY=30
 NT,
*Node Print,NSET=bconcrete2,FREQUENCY=30
 NT,
*Node Print,NSET=nconcs,FREQUENCY=30
 NT,
*Node Print,NSET=tconcs,FREQUENCY=30
 NT,
*Node Print,NSET=bgrove,FREQUENCY=30
 NT,
*Node Print,NSET=ngrove,FREQUENCY=30
 NT,
*Node Print,NSET=tgrove,FREQUENCY=30
 NT,
*END STEP
```

Phase Change Material Model

```
*heading
2D Simulation
*PREPRINT,CONTACT=NO,ECHO=NO,MODEL=NO,HISTORY=NO
*Node,NSET=K1
1,0,0
2,0,0.01
11,0,0.01635
18,0,0.02470
27,0,0.03105
28,0,0.04105
*NODE,NSET=K2
17501,0.1875,0
17502,0.1875,0.01
17511,0.1875,0.01635
17518,0.1875,0.02470
17527,0.1875,0.03105
17528,0.1875,0.04105
*NODE,NSET=W1
12,0,0.01735
17,0,0.02370
*NODE,NSET=W2
17512,0.1875,0.01735
17517,0.1875,0.02370
*NODE,NSET=Y1
18001,-0.01,0.0
18002,-0.01,0.01
18011,-0.01,0.01635
18018,-0.01,0.02470
18027,-0.01,0.03105
18028,-0.01,0.04105
19001,0.1975,0.0
19002,0.1975,0.01
19011,0.1975,0.01635
19012,0.1975,0.01735
19017,0.1975,0.02370
19018,0.1975,0.02470
19027,0.1975,0.03105
19028,0.1975,0.04105
*NODE,NSET=W3
18012,-0.01,0.01735
18017,-0.01,0.02370
*ngen,nset=k1
 2,11,1
 18,27,1
*NGEN,NSET=W4
 12,17,1
*ngen,nset=k2
 17502,17511,1
 17518,17527,1
*NGEN,NSET=W5
 17512,17517,1
*nfill,nset=k3
 k1,k2,350,50
*nfill,nset=W6
```

```
 W4,W5,350,50
*NGEN,NSET=Y1
 18002,18011,1
 18018,18027,1
 19002,19011,1
 19012,19017,1
 19018,19027,1
*NGEN,NSET=W3
 18012,18017,1
*NSET,NSET=NALL
 K1,K2,Y1,K3
*NSET,NSET=BOUND,GENERATE
 1,17501,50
 28,17528,50
 18001,18011,1
 18018,18028,1
 19001,19011,1
 19018,19028,1
**19012,19017,1
*NSET,NSET=WAT,GENERATE
 18011,18018,1
*NSET,NSET=PCM_RESULTS_START,GENERATE
 352,361,1
 368,377,1
*NSET,NSET=PCM_RESULTS_MIDDLE1,GENERATE
 2802,2811,1
 2818,2827,1
*NSET,NSET=PCM_RESULTS_MIDDLE2,GENERATE
 9152,9161,1
 9168,9177,1
*NSET,NSET=PCM_RESULTS_FINISH,GENERATE
 17452,17461,1
 17468,17477,1
*NSET,NSET=WATER_RESULTS_MIDDLE,GENERATE
 2812,2817,1
*NSET,NSET=WATER_RESULTS_FINISH,GENERATE
 17462,17467,1
** INSULATION
*element,type=dc2d4,elset=INS
 1,1,51,52,2
 30,27,77,78,28
 20001,18001,1,2,18002
 20018,18018,18,19,18019
 20051,17501,19001,19002,17502
 20068,17518,19018,19019,17519
** PCM
*element,type=dc2d4,elset=M1a
 2,2,52,53,3
** COPPER
*element,type=dc2d4,elset=M1b
 11,11,61,62,12
 17,17,67,68,18
 20011,18011,11,12,18012
 20017,18017,17,18,18018
 20061,17511,19011,19012,17512
 20067,17517,19017,19018,17518
```

```
** WATER
*element,type=dcc2d4,elset=M1c
 12,12,62,63,13
 20012,18012,12,13,18013
 20062,17512,19012,19013,17513
** PCM
*element,type=dc2d4,elset=M1d
 18,18,68,69,19
*elgen,elset=M1a
 2,9,1,1,350,50,50
*elgen,elset=M1b
 11,350,50,50
 17,350,50,50
*elgen,elset=M1c
 12,5,1,1,350,50,50
 20012,5,1,1
 20062,5,1,1
*elgen,elset=M1d
 18,9,1,1,350,50,50
*ELGEN,ELSET=INS
 1,350,50,50
 30,350,50,50
 20001,10,1,1
 20018,10,1,1
 20051,10,1,1
 20068,10,1,1
*NSET,NSET=NWATER,ELSET=M1C
*NSET,NSET=ALL_PCM,ELSET=M1A
*NSET,NSET=ALL_COPPER,ELSET=M1B
*NSET,NSET=ALL_WATER,ELSET=M1C
*NSET,NSET=ALL_PCM,ELSET=M1D
*NSET,NSET=ALL_INS,ELSET=INS
*ELSET,ELSET=DUMMY,GENERATE
 1,1,1
*ELSET,ELSET=BOUND1,GENERATE
 1,17451,50
*ELSET,ELSET=BOUND2,GENERATE
 30,17480,50
*ELSET,ELSET=BOUND3,GENERATE
 20001,20010,1
 20018,20028,1
*ELSET,ELSET=BOUND4,GENERATE
 20051,20061,1
 20068,20078,1
 20062,20067,1
*FILM PROPERTY,NAME=CONCRETEINNER
 5,298
*SOLID SECTION,ELSET=M1a,MATERIAL=PCM
*SOLID SECTION,ELSET=M1b,MATERIAL=COPPER
*SOLID SECTION,ELSET=M1c,MATERIAL=WATER
*SOLID SECTION,ELSET=M1d,MATERIAL=PCM
*SOLID SECTION,ELSET=INS,MATERIAL=INS
*MATERIAL,NAME= COPPER
*DENSITY
8954
*CONDUCTIVITY
```

```
398
*SPECIFIC HEAT
383.1
*MATERIAL,NAME= WATER
*DENSITY
970.2
*CONDUCTIVITY
0.590
*SPECIFIC HEAT
4186
*MATERIAL,NAME=PCM
*DENSITY
900,288
760,343
*CONDUCTIVITY
0.2
*SPECIFIC HEAT
1800,288
2400,343
*LATENT HEAT
179000,319,334
*MATERIAL,NAME=INS
*DENSITY
1200
*CONDUCTIVITY
0.0032
*SPECIFIC HEAT
2090
**
*PHYSICAL CONSTANTS,ABSOLUTE ZERO=0
**
*INITIAL CONDITIONS, TYPE=TEMPERATURE
 ALL_PCM,298
 ALL_COPPER,298
 ALL_PCM,298
 ALL_INS,298
 NWATER,370
*INITIAL CONDITIONS, TYPE=MASS FLOW RATE
 NWATER,0.0028
**AMPLITUDE,NAME=RAMP
**0.,0.,.05,1,3600,1.
*STEP,INC=50,extrapolation=parabolic,UNSYMM=YES
TRANSIENT ANALYSIS INCLUDING FORCED CONVECTION THROUGH THE MESH
*HEAT TRANSFER,deltmx=50
 5,3600
**AMPLITUDE=RAMP
*BOUNDARY
 WAT,11,11,350
**BOUND,11,,298
*MASS FLOW RATE
NWATER,0.00028,0
*FILM
BOUND1,F1,298,CONCRETEINNER
BOUND2,F3,298,CONCRETEINNER
BOUND3,F4,298,CONCRETEINNER
BOUND4,F2,298,CONCRETEINNER
```

```
*DFLUX
BOUND1,S1,0
BOUND2,S3,0
BOUND3,S4,0
BOUND4,S2,0
**
**
*EL PRINT,ELSET=DUMMY,FREQUENCY=0
 TEMP
*Node Print,NSET=PCM_RESULTS_START,FREQUENCY=20
 NT
*Node Print,NSET=PCM_RESULTS_MIDDLE1,FREQUENCY=20
 NT
*Node Print,NSET=PCM_RESULTS_MIDDLE2,FREQUENCY=20
 NT
*Node Print,NSET=PCM_RESULTS_FINISH,FREQUENCY=20
 NT
*Node Print,NSET=WATER_RESULTS_MIDDLE,FREQUENCY=20
 NT
*Node Print,NSET=WATER_RESULTS_FINISH,FREQUENCY=20
 NT
*Node Print,NSET=ALL_PCM,FREQUENCY=20
 NT
*Node Print,NSET=ALL_COPPER,FREQUENCY=20
 NT
*Node Print,NSET=ALL_WATER,FREQUENCY=20
 NT
*Node Print,NSET=ALL_INS,FREQUENCY=20
 NT
*END STEP
```

Fortran Subroutine

```
      SUBROUTINE DFLUX(FLUX,SOL,KSTEP,KINC,TIME,NOEL,NPT,COORDS,
     1 JLTYP,TEMP,PRESS)
C
      INCLUDE 'ABA_PARAM.INC'
      REAL N_GLASS, N_AIR,N,Q,K_GLASS,SOLAR_INTENSITY, GLASS_THICKNESS
      REAL INCIDENCE_ANGLE, REFRACTION_ANGLE, IABSORBED, ALPHA, RA, TAU1
      REAL TRANSMITTANCE, INTENSITY1, R1, R2, RB
      REAL TAURB, TAU2,INTENSITY2,L
C
      DIMENSION FLUX(2), TIME(2), COORDS(3),N(2),Q(2)
C
C MARWA ENTER ALL UR ANGLES IN RADIANS
        N_GLASS= 1.526
        N(2)= N_GLASS
        N_AIR=1.0
        N(1)=N_AIR
        K_GLASS= 32
        SOLAR_INTENSITY=450
        GLASS_THICKNESS= 0.00635
        L=GLASS_THICKNESS
        INCIDENCE_ANGLE=0.2
        Q(1)= INCIDENCE_ANGLE
```

```
      Q(2)=ASIN((N(1)/N(2))*SIN(Q(1)))
      REFRACTION_ANGLE= Q(2)
      IABSORBED= EXP (-((k_GLASS)*L)/ COS(Q(2)))
           ALPHA=1-IABSORBED
      IF (Q(1).EQ.0) THEN
           RA= ((N(1)-N(2))/(N(1)+N(2)))**2
      TRANSMITTANCE= (1-RA)/(1+RA)
           INTENSITY2= TRANSMITTANCE*SOLAR_INTENSITY
           TAU1= TRANSMITTANCE*IABSORBED
           INTENSITY1=SOLAR_INTENSITY*TAU1
      ENDIF
      IF((Q(1).NE.Q(2)). AND. (Q(1).NE.0). AND. (Q(2).NE.0)) THEN
           R1=(SIN(Q(2)-Q(1))**2)/(SIN(Q(2)+Q(1))**2)
      R2=(TAN(Q(2)-Q(1))**2)/(TAN(Q(2)+Q(1))**2)
      RB=0.5*(R1+R2)
           TAURB=0.5*(((1-R1)/(1+R1))+((1-R2)/(1+R2)))
           INTENSITY2= TAURB*SOLAR_INTENSITY
           TAU2=TAURB*IABSORBED
           INTENSITY1=SOLAR_INTENSITY*TAU2
      ENDIF
      FLUX(1)=INTENSITY1
    RETURN
    END
```

Java Linking Program

```
/**
 * <p>Title: </p>
 * <p>Description: </p>
 * <p>Copyright: Copyright (c) 2002</p>
 * <p>Company: </p>
 * @author unascribed
 * @version 1.0
 */

import java.io.*;
import java.lang.*;
import java.text.*;
import java.util.*;
import java.util.regex.*;

public class FileIO1 {

  protected String sInputFile="collector6size2.inp";
  protected String searchLine="*FILM PROPERTY,NAME=GLASSAIR";
  protected String sFortranSubRoutine="egrove6.f";
  protected String sFileName="TMY.txt";
  modifyFile pIO=null;
  modifyFileHc  mfh=null;

  rFile rf ;
  Pattern p = Pattern.compile("[,\\s]+");

  public FileIO1()
```

```
  {
   pIO = new modifyFile();
   mfh = new modifyFileHc();
   rf= new rFile();

}


  public void writeToInputFile(String sDryBulbTemp) throws Exception
  {


   String replaceString="glass,F5,"+sDryBulbTemp+",GLASSAIR";
          //System.out.println("Dry BITCH:"+replaceString);
   modifyDryBulb mdb=new modifyDryBulb("collector6size2.inp",replaceString);

   try
   {

    pIO.modify(mdb);
   }
   catch(Exception e){e.printStackTrace();}

  }
  public void writeToFsrSolarIntensity(String sSolarIntensity) throws Exception
  {
          String replaceString ='\t'+"SOLAR_INTENSITY="+sSolarIntensity;
          modifyFortranSubroutineSI p=new
modifyFortranSubroutineSI(sFortranSubRoutine,replaceString);
           try
   {
    pIO.modify(p);
   }
   catch(Exception e){e.printStackTrace();}


          }

  public void writeToFortranSubRoutine(String sIncidenceAngle) throws Exception
  {
   String replaceString='\t'+"INCIDENCE_ANGLE="+sIncidenceAngle;
   modifyFortranSubroutine p=new modifyFortranSubroutine(sFortranSubRoutine,replaceString);
   try
   {
    pIO.modify(p);
   }
   catch(Exception e){e.printStackTrace();}
  }


  public void writeInitialConditionPCM(Vector replaceVector)
  {
          try
          {
           FileInputStream fis = new FileInputStream("pcmtrial10auto.inp");
    BufferedReader in = new BufferedReader(new InputStreamReader(fis));
```

```
  StringBuffer sb = new StringBuffer("");
  String sLine="";

  while((sLine=in.readLine())!=null)
  {
        if(sLine.equals("*INITIAL CONDITIONS, TYPE=TEMPERATURE"))
        {
                sb.append(sLine);
                sb.append("\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(0));
                sb.append("\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(1));
                sb.append("\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(0));
                sb.append("\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(2));



                }
                else
                {
                sb.append(sLine);
            }
                sb.append("\n");
        }

        in.close();

  FileOutputStream fos = new FileOutputStream("pcmtrial10auto.inp");
  OutputStreamWriter outWriter = new OutputStreamWriter(fos);

  PrintWriter out = new PrintWriter(outWriter);

  out.write(sb.toString());
  out.close();




}
catch(Exception exp)
{
        System.out.println("87:"+exp.getMessage());
        }


        }

public void writeInitialCondition(Vector replaceVector)
{
        try
```

```
        {
         FileInputStream fis = new FileInputStream("collector6size2.inp");
BufferedReader in = new BufferedReader(new InputStreamReader(fis));
StringBuffer sb = new StringBuffer("");
String sLine="";

while((sLine=in.readLine())!=null)
{
        if(sLine.equals("*INITIAL CONDITIONS,TYPE=TEMPERATURE"))
        {
                sb.append(sLine);
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append(sLine);
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(1));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(2));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(3));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(4));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(5));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(6));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(7));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(8));



                }
                else
                {
                sb.append(sLine);
            }
                sb.append("\r\n");
        }

        in.close();

FileOutputStream fos = new FileOutputStream("collector6size2.inp");
OutputStreamWriter outWriter = new OutputStreamWriter(fos);

PrintWriter out = new PrintWriter(outWriter);
```

```
  out.write(sb.toString());
  out.close();



}
catch(Exception exp)
{
        System.out.println("87:"+exp.getMessage());
        }


        }
public void writeBoundaryCondition(Vector replaceVector)
{
        try
        {
         FileInputStream fis = new FileInputStream("collector6size2.inp");
  BufferedReader in = new BufferedReader(new InputStreamReader(fis));
  StringBuffer sb = new StringBuffer("");
  String sLine="";

  while((sLine=in.readLine())!=null)
  {
        if(sLine.equals("*BOUNDARY,OP=NEW,FIXED"))
        {
                sb.append(sLine);
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append(sLine);
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(4));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(5));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(6));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(1));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(0));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(3));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(2));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(7));
```

```
                    }
                    else
                    {
                    sb.append(sLine);
               }
                    sb.append("\r\n");
          }

          in.close();

  FileOutputStream fos = new FileOutputStream("collector6size2.inp");
  OutputStreamWriter outWriter = new OutputStreamWriter(fos);

  PrintWriter out = new PrintWriter(outWriter);

  out.write(sb.toString());
  out.close();




}
catch(Exception exp)
{
          System.out.println("87:"+exp.getMessage());
          }


          }

public void writeHcDryBulbTemp(String sHc,String sDryBulbTemp) throws Exception
{

String replaceHcDry =sHc+","+sDryBulbTemp;
modifyDryBulbHc mdbhc =new modifyDryBulbHc("collector6size2.inp",replaceHcDry);

try
{
          mfh.modifyHc(mdbhc);
          }
          catch(Exception e)
          {
                    e.printStackTrace();
                    }


}

public String getAvgString(String date,String time, boolean append)
{
          String twMax="";
          String nair="";
          String nglass="";
          String npoly="";
```

```
String ninsul="";
String ncopper="";
String nconc="";
String nconcs="";
String ngrove="";
	String s="";

try
{
	FileReader as = new FileReader("avgStrings.txt");
	BufferedReader bas = new BufferedReader(as);
	String minmaxAvg="";
	String avgLine="";

	FileWriter outFile = new FileWriter("COLLECTORoutputFile.txt",append);

	outFile.write("Date: "+date+'\t');
	outFile.write("Time: "+time+'\n');
	outFile.write("Name"+'\t'+'\t'+"Min"+'\t'+"Max"+'\t'+"Average"+'\n');
	while((avgLine=bas.readLine())!=null)
	{
		Vector v1= new Vector(13);
	StringTokenizer stk = new StringTokenizer(avgLine," ");
	while(stk.hasMoreTokens())
	{
	v1.addElement(stk.nextToken());
	}
		String material=(String)v1.elementAt(11);

	 minmaxAvg=rf.calcAvgMat(avgLine,"collector6size2.dat");

		outFile.write(material+'\t'+'\t'+minmaxAvg+'\n');
		v1.clear();
	if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET TWATER"))
	{
		String[] result =p.split(minmaxAvg);
		minmaxAvg=minmaxAvg.trim();
		twMax=result[1];
		//System.out.println(minmaxAvg);

		} // end of if

	if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NAIR"))
	{
		String[] result =p.split(minmaxAvg);
		minmaxAvg=minmaxAvg.trim();
			//System.out.println(minmaxAvg);
		nair="nair,"+result[2]+","+result[2]+","+result[2];

	} // end of if

	if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NGLASS"))
	{
```

```
                String[] result =p.split(minmaxAvg);
                minmaxAvg=minmaxAvg.trim();
                        //System.out.println(minmaxAvg);
                nglass="nglass,"+result[2]+","+result[2]+","+result[2];

        } //

        if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NPOLY"))
        {
                String[] result =p.split(minmaxAvg);
                minmaxAvg=minmaxAvg.trim();
                        //System.out.println(minmaxAvg);
                npoly="npoly,"+result[2]+","+result[2]+","+result[2];

        } //

        if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NINSUL"))
        {
                String[] result =p.split(minmaxAvg);
                minmaxAvg=minmaxAvg.trim();
                        //System.out.println(minmaxAvg);
                ninsul="ninsul,"+result[2]+","+result[2]+","+result[2];

        } //

        if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NCOPPER"))
        {
                String[] result =p.split(minmaxAvg);
                minmaxAvg=minmaxAvg.trim();
                        //System.out.println(minmaxAvg);
                ncopper="ncopper,"+result[2]+","+result[2]+","+result[2];

        } //

        if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NCONC"))
        {
                String[] result =p.split(minmaxAvg);
                minmaxAvg=minmaxAvg.trim();
                        //System.out.println(minmaxAvg);
                nconc="nconc,"+result[2]+","+result[2]+","+result[2];

        } //

        if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NCONCS"))
        {
                String[] result =p.split(minmaxAvg);
                minmaxAvg=minmaxAvg.trim();
                        //System.out.println(minmaxAvg);
                nconcs="nconcs,"+result[2]+","+result[2]+","+result[2];
```

```
                } //

                if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NGROVE"))
                {
                        String[] result =p.split(minmaxAvg);
                        minmaxAvg=minmaxAvg.trim();
                                //System.out.println(minmaxAvg);
                        ngrove="ngrove,"+result[2]+","+result[2]+","+result[2];


                } //









                        }
                s= twMax+' '+nair+' '+nglass+' '+npoly+' '+ninsul+' '+ncopper+' '+nconc+' '+nconcs+'
'+ngrove;
                //      System.out.println(s);
                        outFile.close();


                }
                catch(Exception e)
                {
                        System.out.println(e.getMessage());
                        }
                return s;
        }

        public void writeNoData(String date,String time,FileWriter outFile)

        {
        try{
         //FileWriter outFile = new FileWriter("PCMoutputFile.txt",appendPCM);
        outFile.write("Date: "+date+'\t');
    outFile.write("Time: "+time+'\n');
    outFile.write("PCM not run for this itteration"+'\n');
        }
        catch(Exception ex)
        {
    System.out.println("IN NODATA FUNCTION"+ex.getMessage());
    }

        }
  public String getAvgStringPCM(String date,String time,FileWriter outFile)
 {
        String twMax="";
        String all_pcm="";
        String all_copper="";
        String all_ins="";
        String pcm_start="";
        String pcm_mid1="";
```

```
String pcm_mid2="";
String pcm_finish="";
String water_mid="";
String water_finish="";
String s="";

try
{
        FileReader as = new FileReader("pcmStrings.txt");
        BufferedReader bas = new BufferedReader(as);
        String minmaxAvg="";
        String avgLine="";

        //FileWriter outFile = new FileWriter("PCMoutputFile.txt",append);

        outFile.write("Date: "+date+'\t');
  outFile.write("Time: "+time+'\n');
  outFile.write("Name"+'\t'+'\t'+"Min"+'\t'+"Max"+'\t'+"Average"+'\n');

        while((avgLine=bas.readLine())!=null)
        {
                Vector v1= new Vector(13);
      StringTokenizer stk = new StringTokenizer(avgLine," ");
      while(stk.hasMoreTokens())
      {
         v1.addElement(stk.nextToken());
      }
                //System.out.println("element at 11: "+v1.elementAt(11));
      String material=(String)v1.elementAt(11);
                //System.out.println("Material in PCM: "+material);


                minmaxAvg=rf.calcAvgMat(avgLine,"pcmtrial10auto.dat");
                //System.out.println("MINMAX in getavgPCM: "+minmaxAvg);
                outFile.write(material+'\t'+'\t'+minmaxAvg+'\n');
                v1.clear();

        if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET ALL_PCM"))
        {
                String[] result =p.split(minmaxAvg);
                minmaxAvg=minmaxAvg.trim();
                        //System.out.println(minmaxAvg);
                //nair="nair,"+result[2]+","+result[2]+","+result[2];
                //nair="bair,11,,"+result[2];

                all_pcm="ALL_PCM,"+result[2];


        } // end of if

        if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET ALL_COPPER"))
        {
                String[] result =p.split(minmaxAvg);
                minmaxAvg=minmaxAvg.trim();
```

```
                        //System.out.println(minmaxAvg);
                    //nglass="nglass,"+result[2]+","+result[2]+","+result[2];
                    all_copper="ALL_COPPER,"+result[2];

                } //

                if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET ALL_INS"))
                {
                    String[] result =p.split(minmaxAvg);
                    minmaxAvg=minmaxAvg.trim();
                        //System.out.println(minmaxAvg);
                    //npoly="npoly,"+result[2]+","+result[2]+","+result[2];
                    all_ins="ALL_INS,"+result[2];

                } //


                 if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET WATER_RESULTS_FINISH"))
                {
                    String[] result =p.split(minmaxAvg);
                    minmaxAvg=minmaxAvg.trim();
                        //System.out.println("Water_results_Finish:"+minmaxAvg);
                    //npoly="npoly,"+result[2]+","+result[2]+","+result[2];
                    water_finish=result[2];
                    //System.out.println("Water_Finish Average:"+water_finish);
                }


                }
                s= all_pcm+' '+all_copper+' '+all_ins+' '+water_finish;
                //System.out.println("String from PCM: "+s);
                outFile.close();


                }
                catch(Exception e)
                {
                    System.out.println(e.getMessage());
                    }
                return s;
        }



 public String getAvgStringForBoundary(String date,String time)
 {
        String twMax="";
        String nair="";
        String nglass="";
        String npoly="";
        String ninsul="";
        String ncopper="";
        String nconc="";
```

```
String nconcs="";
String ngrove="";
        String s="";

try
{
        FileReader as = new FileReader("avgStrings.txt");
        BufferedReader bas = new BufferedReader(as);
        String minmaxAvg="";
        String avgLine="";

/*      FileWriter outFile = new FileWriter("outputFile.txt",false);
                outFile.write("Date"+'\t');
                outFile.write("Time"+'\t');
                outFile.write("<---");
                outFile.write("BWATER");
                outFile.write("--->");
                outFile.write("<---");
                outFile.write("NWATER");
                outFile.write("--->");
                outFile.write("<---");
                outFile.write("TWATER");
                outFile.write("--->");
                outFile.write("<---");
                outFile.write("BAIR");
                outFile.write("--->");
                outFile.write("<---");
                outFile.write("NAIR");
                outFile.write("--->");
                outFile.write("<---");
                outFile.write("TAIR");
                outFile.write("--->");
                outFile.write("<---");
                outFile.write("BGLASS");
                outFile.write("--->");
                outFile.write("<---");
                outFile.write("NGLASS");
                outFile.write("--->");
                outFile.write("<---");
                outFile.write("TGLASS");
                outFile.write("--->");
                outFile.write("<---");
                outFile.write("BPOLY");
                outFile.write("--->");
                outFile.write("<---");
                outFile.write("NPOLY");
                outFile.write("--->");
                outFile.write("<---");
                outFile.write("TPOLY");
                outFile.write("--->");
                outFile.write("<---");
                outFile.write("BINSUL");
                outFile.write("--->");
                outFile.write("<---");
                outFile.write("NINSUL");
                outFile.write("--->");
```

```
                        outFile.write("<---");
                        outFile.write("TINSUL");
                        outFile.write("--->");
                        outFile.write("<---");
                        outFile.write("BCOPPER");
                        outFile.write("--->");
                        outFile.write("<---");
                        outFile.write("NCOPPERR");
                        outFile.write("--->");
                        outFile.write("<---");
                        outFile.write("TCOPPER");
                        outFile.write("--->");
                        outFile.write("<---");
                        outFile.write("BCONCRETE1");
                        outFile.write("--->");
                        outFile.write("<---");
                        outFile.write("NCONC");
                        outFile.write("--->");
                        outFile.write("<---");
                        outFile.write("TCONC");
                        outFile.write("--->");
                        outFile.write("<---");
                        outFile.write("BCONCRETE2");
                        outFile.write("--->");
                        outFile.write("<---");
                        outFile.write("NCONCS");
                        outFile.write("--->");
                        outFile.write("<---");
                        outFile.write("TCONCS");
                        outFile.write("--->");
                        outFile.write("<---");
                        outFile.write("BGROVE");
                        outFile.write("--->");
                        outFile.write("<---");
                        outFile.write("NGROVE");
                        outFile.write("--->");
                        outFile.write("<---");
                        outFile.write("TGROVE");
                        outFile.write("--->"+'\n');
                        outFile.write('\t'+'\t');
                        for(int i=0;i<27;i++)
                        {
                                outFile.write("MIN  AVG  MAX");
                                }outFile.write('\n');*/

                while((avgLine=bas.readLine())!=null)
                {

                 minmaxAvg=rf.calcAvgMat(avgLine,"collector6size2.dat");


        /*      if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET TWATER"))
                {
                        String[] result =p.split(minmaxAvg);
                        minmaxAvg=minmaxAvg.trim();
```

```
                    twMax=result[1];
                    System.out.println(minmaxAvg);

                    } // end of if*/

               if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NAIR"))
               {
                    String[] result =p.split(minmaxAvg);
                    minmaxAvg=minmaxAvg.trim();
                    //          System.out.println(minmaxAvg);
               //          nair="nair,"+result[2]+","+result[2]+","+result[2];
               nair="bair,11,,"+result[2];

               } // end of if

               if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NGLASS"))
               {
                    String[] result =p.split(minmaxAvg);
                    minmaxAvg=minmaxAvg.trim();
                    //          System.out.println(minmaxAvg);
                    //nglass="nglass,"+result[2]+","+result[2]+","+result[2];
                    nglass="bglass,11,,"+result[2];

               } //

               if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NPOLY"))
               {
                    String[] result =p.split(minmaxAvg);
                    minmaxAvg=minmaxAvg.trim();
                    //          System.out.println(minmaxAvg);
                    //npoly="npoly,"+result[2]+","+result[2]+","+result[2];
                    npoly="bpoly,11,,"+result[2];

               } //

               if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NINSUL"))
               {
                    String[] result =p.split(minmaxAvg);
                    minmaxAvg=minmaxAvg.trim();
                    //          System.out.println(minmaxAvg);
                    //ninsul="ninsul,"+result[2]+","+result[2]+","+result[2];
                    ninsul="binsul,11,,"+result[2];

               } //

               if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NCOPPER"))
               {
                    String[] result =p.split(minmaxAvg);
                    minmaxAvg=minmaxAvg.trim();
                    //          System.out.println(minmaxAvg);
                    //ncopper="ncopper,"+result[2]+","+result[2]+","+result[2];
```

```
                ncopper="bcopper,11,,"+result[2];

        } //

        if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NCONC"))
        {
                String[] result =p.split(minmaxAvg);
                minmaxAvg=minmaxAvg.trim();
                //      System.out.println(minmaxAvg);
                //nconc="nconc,"+result[2]+","+result[2]+","+result[2];
                nconc="bconcrete1,11,,"+result[2];

        } //

        if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NCONCS"))
        {
                String[] result =p.split(minmaxAvg);
                minmaxAvg=minmaxAvg.trim();
                //      System.out.println(minmaxAvg);
                //nconcs="nconcs,"+result[2]+","+result[2]+","+result[2];
                nconcs="bconcrete2,11,,"+result[2];


        } //

        if(avgLine.equals("THE FOLLOWING TABLE IS PRINTED FOR NODES
BELONGING TO NODE SET NGROVE"))
        {
                String[] result =p.split(minmaxAvg);
                minmaxAvg=minmaxAvg.trim();
                //      System.out.println(minmaxAvg);
                //ngrove="ngrove,"+result[2]+","+result[2]+","+result[2];
                ngrove="bgrove,11,,"+result[2];


        } //









                }
        s= nair+' '+nglass+' '+npoly+' '+ninsul+' '+ncopper+' '+nconc+' '+nconcs+' '+ngrove;
        //      System.out.println(s);
                //outFile.close();


        }
        catch(Exception e)
        {
                System.out.println(e.getMessage());
                }
        return s;
```

```
	}


	public boolean isSummer(String date)
	{
		StringTokenizer str_tok = new StringTokenizer(date,"/");
		String str="";
		boolean bool=false;
		while(str_tok.hasMoreTokens())
		{
			//str=str_tok.nextToken();
			str=str_tok.nextToken();
			//System.out.println("STR:"+str);
			break;
		}
		int month=Integer.parseInt(str);
		if(month==6 | month==7 |month==8)
		{
		bool=true;

			}
		System.out.println("isSummer: "+ bool);
			return bool;


		}

public String changeMFRXSTR(String str1, String str2)
{
	StringTokenizer str_tok1 = new StringTokenizer(str1,",");
	StringTokenizer str_tok2 = new StringTokenizer(str2,",");
	Vector v1 = new Vector();
	Vector v2 = new Vector();
	double x;
	double y;
	String retStr;

	while(str_tok1.hasMoreTokens())
	{
		v1.addElement(str_tok1.nextToken());

		}

		while(str_tok2.hasMoreTokens())
	{
		v2.addElement(str_tok2.nextToken());

		}


	x=Double.parseDouble((String)v1.elementAt(3));
	x=x+x*0.05;

	y=Double.parseDouble((String)v2.elementAt(3));
	System.out.println("X::"+x);
	if(y==0)
```

```
        {
        y=x;
        System.out.println("Y::"+y);
}
        else
        {
        y=y+y*0.05;}

        retStr="nwater,0,0,"+x+":"+"nair,0,0,"+y;

        v1.clear();
        v2.clear();

        return retStr;



        }



 public void writeMassFlowRate(Vector v, boolean summer)
 {

        double twater =Double.parseDouble((String)v.elementAt(0));
        System.out.println("TWATER::"+twater);
        System.out.println("SUMMER:"+summer);
        if(twater>100.0+273.0 && summer)
        {
        try
        {
         FileInputStream fis = new FileInputStream("collector6size2.inp");
   BufferedReader in = new BufferedReader(new InputStreamReader(fis));
   StringBuffer sb = new StringBuffer("");
   String sLine="";
   String s;
   String xStr="";
   String yStr="";


   while((sLine=in.readLine())!=null)
   {
        if(sLine.equals("*MASS FLOW RATE"))
        {
                sb.append(sLine);
                sb.append("\r\n");
                sLine=in.readLine();
                xStr=sLine;
                sLine=in.readLine();
                yStr=sLine;
                s=changeMFRXSTR(xStr,yStr);
                StringTokenizer stok = new StringTokenizer(s,":");
                xStr=stok.nextToken();
                yStr=stok.nextToken();

                sb.append(xStr);
```

```
                sb.append("\r\n");
                sb.append(yStr);



        /*      sb.append(sLine);
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(1));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(2));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(3));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(4));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(5));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(6));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(7));
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append((String)replaceVector.elementAt(8));*/



                }
                else
                {
                sb.append(sLine);
            }
                sb.append("\r\n");
        }

        in.close();

FileOutputStream fos = new FileOutputStream("collector6size2.inp");
OutputStreamWriter outWriter = new OutputStreamWriter(fos);

PrintWriter out = new PrintWriter(outWriter);

out.write(sb.toString());
out.close();



                }

          catch(Exception exp)
```

```
 {
        System.out.println("551:"+exp.getMessage());
        }

        }

 }

public void writeNwater(String str)
{
        try
        {
         FileInputStream fis = new FileInputStream("collector6size2.inp");
   BufferedReader in = new BufferedReader(new InputStreamReader(fis));
   StringBuffer sb = new StringBuffer("");
   String sLine="";

   while((sLine=in.readLine())!=null)
   {
        if(sLine.equals("*INITIAL CONDITIONS,TYPE=TEMPERATURE"))
        {
                sb.append(sLine);
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append(str);

                        }
                else
                {
                sb.append(sLine);
            }
                sb.append("\r\n");
        }

        in.close();

  FileOutputStream fos = new FileOutputStream("collector6size2.inp");
  OutputStreamWriter outWriter = new OutputStreamWriter(fos);

  PrintWriter out = new PrintWriter(outWriter);

  out.write(sb.toString());
  out.close();




 }
 catch(Exception exp)
 {
        System.out.println("87:"+exp.getMessage());
        }



        }
```

```
public void writeNwaterPCM(String str)
{
        try
        {
         FileInputStream fis = new FileInputStream("pcmtrial10auto.inp");
    BufferedReader in = new BufferedReader(new InputStreamReader(fis));
    StringBuffer sb = new StringBuffer("");
    String sLine="";

    while((sLine=in.readLine())!=null)
    {
        if(sLine.equals("*INITIAL CONDITIONS, TYPE=TEMPERATURE"))
        {
                sb.append(sLine);
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append(sLine);
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append(sLine);
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append(sLine);
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append(sLine);
                sb.append("\r\n");
                sLine=in.readLine();
                sb.append(str);

                        }
                else
                {
                sb.append(sLine);
            }
                sb.append("\r\n");
        }

        in.close();

   FileOutputStream fos = new FileOutputStream("pcmtrial10auto.inp");
   OutputStreamWriter outWriter = new OutputStreamWriter(fos);

   PrintWriter out = new PrintWriter(outWriter);

   out.write(sb.toString());
   out.close();



 }
 catch(Exception exp)
 {
        System.out.println("87:"+exp.getMessage());
```

```
		}



		}


public void writeBwater(String str)
{
		try
		{
		 FileInputStream fis = new FileInputStream("collector6size2.inp");
    BufferedReader in = new BufferedReader(new InputStreamReader(fis));
    StringBuffer sb = new StringBuffer("");
    String sLine="";

    while((sLine=in.readLine())!=null)
    {
		if(sLine.equals("*BOUNDARY,OP=NEW,FIXED"))
		{
			sb.append(sLine);
			sb.append("\n");
			sLine=in.readLine();
			sb.append(str);

				}
			else
			{
			sb.append(sLine);
		}
			sb.append("\n");
		}

		in.close();

   FileOutputStream fos = new FileOutputStream("collector6size2.inp");
   OutputStreamWriter outWriter = new OutputStreamWriter(fos);

   PrintWriter out = new PrintWriter(outWriter);

   out.write(sb.toString());
   out.close();



 }
 catch(Exception exp)
 {
		System.out.println("87:"+exp.getMessage());
		}



		}
```

```
public void writeBwaterPCM(String str)
{
            try
            {
             FileInputStream fis = new FileInputStream("pcmtrial10auto.inp");
    BufferedReader in = new BufferedReader(new InputStreamReader(fis));
    StringBuffer sb = new StringBuffer("");
    String sLine="";

    while((sLine=in.readLine())!=null)
    {
            if(sLine.equals("*BOUNDARY"))
            {
                        sb.append(sLine);
                        sb.append("\n");
                        sLine=in.readLine();
                        sb.append(str);

                                    }
                        else
                        {
                        sb.append(sLine);
                    }
                        sb.append("\n");
            }

            in.close();

   FileOutputStream fos = new FileOutputStream("pcmtrial10auto.inp");
   OutputStreamWriter outWriter = new OutputStreamWriter(fos);

   PrintWriter out = new PrintWriter(outWriter);

   out.write(sb.toString());
   out.close();




 }
 catch(Exception exp)
 {
            System.out.println("87:"+exp.getMessage());
            }



            }
 public static void main(String[] args)
 {
  FileIO pIO = new FileIO();
  utilIO uio = new utilIO();;

  String startDate="";
```

```
   String endDate="";
   String startTime="";
   String endTime="";
   String DirorGlob="";
   String hc="";
   String incidenceAngle="";
   String solarIntensity="";
   String dryBulb="";
   String tMax;
   String boundStr;
   double twaterMax;
   Vector v;
   Vector v1;
   boolean summer;
   Pattern pat = Pattern.compile("[,\\s]+");
   String strCommand ="/usr/local/bin/abq621 job=collector6size2 user=egrove6 queue=smash_hour1";
   String pcmCommand="/usr/local/bin/abq621 job=collector6size2 user=egrove6 queue=smash_hour1";
   UnixCommands uc = new UnixCommands();
   String tavg="";
   double taverage;
   String tavgBound="";
   Vector v2= new Vector(4);
   String pcmAvg="";
   boolean append=false;
   boolean appendPCM=false;
//    try{
//          FileWriter outFile = new FileWriter("PCMoutputFile.txt",appendPCM);
  //        }
//          catch(Exception Ex)
//          {
//                    System.out.println("Creating PCMOutputfile" + ex.getMessage());
//          }



   try
   {
          InputStreamReader isr = new InputStreamReader(System.in);
          BufferedReader br = new BufferedReader(isr);

          System.out.println("Enter Start Date:");
          startDate = br.readLine();

          System.out.println("Enter Start Time:");
          startTime = br.readLine();

          System.out.println("Enter End Date:");
          endDate = br.readLine();

          System.out.println("Enter end Time:");
          endTime = br.readLine();


          System.out.println("Enter D for DirNor or G for GlobalHor:");
                    DirorGlob = br.readLine();
          }
```

```
   catch(Exception exp)
   {
            System.out.println("146:"+exp.getMessage());
            }


   while(!endDate.equals(startDate) || !endTime.equals(startTime))
   {

   hc =uio.getHc(startDate,startTime);
   incidenceAngle = uio.getIncidenceAngle(startDate,startTime,DirorGlob);
   solarIntensity=uio.getSolarIntensity(startDate,startTime,DirorGlob);
   dryBulb=uio.getDrybulbTemp(startDate,startTime);




   try
   {
     pIO.writeToInputFile(dryBulb);
   }
   catch(Exception e){e.printStackTrace();}
   try
   {
     pIO.writeToFortranSubRoutine(incidenceAngle);
   }
   catch(Exception e){e.printStackTrace();}
   try
   {
     pIO.writeHcDryBulbTemp(hc,dryBulb);
   }
   catch(Exception e){e.printStackTrace();}
   try
   {

   pIO.writeToFsrSolarIntensity(solarIntensity);
}
catch(Exception ex)
{
            System.out.println("685:"+ex.getMessage());
            }


/// run abaqus here
try
{


            System.out.println("ABAQUS STRING::"+strCommand);
            uc.RunUnixCommand(strCommand);
}
catch(Exception un)
{
            un.printStackTrace(System.out);
            }
```

```
File f = new File("collector6size2.023");
while(!f.exists())
{
}
while(f.exists())
{           try{
            Thread.sleep(60000);
            System.out.println("One min in COLL");
            }catch(Exception COLLExcept)
            {COLLExcept.printStackTrace(System.out);
            }
            }
System.out.println(".dat FILE ready");



            tMax= pIO.getAvgString(startDate,startTime,append);

    v = new Vector(10);
    v1 = new Vector(8);
            tMax=tMax.trim();


  StringTokenizer str_tok = new StringTokenizer(tMax," ");

  while(str_tok.hasMoreTokens())
  {
            v.addElement(str_tok.nextToken());


            }
   summer=          pIO.isSummer(startDate);
            pIO.writeMassFlowRate(v,summer);
            pIO.writeInitialCondition(v);

  boundStr=pIO.getAvgStringForBoundary(startDate,startTime);
            boundStr= boundStr.trim();

StringTokenizer stk = new StringTokenizer(boundStr," ");
  while(stk.hasMoreTokens())
  {
            v1.addElement(stk.nextToken());
            }

  pIO.writeBoundaryCondition(v1);
  tavg=uio.getTavg(startDate,startTime);
  DecimalFormat df = new DecimalFormat("###.00");
  taverage =273.0+ Double.parseDouble(tavg);

  String tavgStr="";
  tavgStr=df.format(taverage);
  //if(taverage<328)
  //{

  tavg="nwater,"+tavgStr+","+tavgStr+","+tavgStr;
  tavgBound="bwater,11,,"+tavgStr;
```

```
//System.out.println("TAVG:"+tavgStr);

pIO.writeNwater(tavg);
pIO.writeBwater(tavgBound);
        //}

        //else
         double twater =Double.parseDouble((String)v.elementAt(0));
        String twaterstr="";
        twaterstr=df.format(twater);
        try{
        FileWriter outFile = new FileWriter("PCMoutputFile.txt",appendPCM);
        //}
        //catch(Exception ex)
        //{
    //System.out.println("PCMoutputFile.txt"+ex.getMessage());
    //}

        if(twater>60.0+273.0)
        {

        try
                {
                tavg="NWATER,"+twaterstr;
                tavgBound="WAT,11,11,"+twaterstr;
                System.out.println("TAVG and TAVGBOUND in PCM: "+tavg+" &  "+tavgBound);
                pIO.writeNwaterPCM(tavg);
                pIO.writeBwaterPCM(tavgBound);
                uc.RunUnixCommand(pcmCommand);

                File f1 = new File("pcmtrial10auto.023");
                while(!f1.exists())
                {

                        }
                while(f1.exists())
                {
                try{
                Thread.sleep(60000);
                System.out.println(" One min in PCM");
                }catch(Exception PcmExcept)
                {PcmExcept.printStackTrace(System.out);
                }

                }
                //System.out.println("Entering getStringPCM");
                pcmAvg=pIO.getAvgStringPCM(startDate,startTime,outFile);
                //System.out.println("Entering getStringPCM");
                //System.out.println(pcmAvg);
                //append=true;
                StringTokenizer pcmtok = new StringTokenizer(pcmAvg," ");
                while(pcmtok.hasMoreTokens())
                {
                        v2.addElement(pcmtok.nextToken());
                        }
```

```
                    pIO.writeInitialConditionPCM(v2);
                    String s = (String)v2.elementAt(3);
                    System.out.println("NWATER STRING: "+ s);
                    String swater="nwater,"+s+","+s+","+s;
                    //pIO.writeNwater(swater);
                    swater="bwater,11,,"+s;
                    //pIO.writeBwater(swater);

                    }

                    catch(Exception pcmExp)
                    {
                    pcmExp.printStackTrace(System.out);

                                    }


                    }//end of if for PCM

                    else{

                                pIO.writeNoData(startDate,startTime,outFile);
                                }


                    }
          catch(Exception ex)
          {
          System.out.println("PCMoutputFile.txt"+ex.getMessage());
          }



        //twaterMax=Double.parseDouble(tMax);
          String NextDate = uio.getNextDate(startDate,startTime);
         String NextTime = uio.getNextTime(startDate,startTime);


        // System.out.println(startDate+"\t"+startTime+"\t"+hc+"\t"+incidenceAngle+"\t"+dryBulb);
         startDate=NextDate;
         startTime=NextTime;
         append=true;
         appendPCM=true;
         uc.removePcmFiles();

        uc.removeFiles();
                v.clear();
                v1.clear();
                v2.clear();


}// end of while loop

}
}
```