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ATTACHMENT I

DOCUMENT INPUT REFERENCE SHEET (DIRS)

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
DOCUMENT INPUT REFERENCE SHEET

1. Document Identifier No./Rev.:	Change:	Title:
ANL-EBS-MD-000030 REV 00		Ventilation Model

Input Document			4. Input Status	5. Section Used in	6. Input Description	7. TBV/TBD Priority	8. TBV Due To		
	2. Technical Product Input Source Title and Identifier(s) with Version	3. Section					Unqual.	From Uncontrolled Source	Un-confirmed
1	ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.) 1989. *1989 ASHRAE Handbook, Fundamentals I-P Edition.* Atlanta, GA: ASHRAE. TIC: 201565.	p. 3.7	Accepted Data. Handbook value	4.1.1	Stefan-Boltzmann Constant	N/A	N/A	N/A	N/A
2	CRWMS M & O 1995. *Waste Emplacement Management Evaluation Report.* BC0000000-01717-5705-00011 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19970519.0103.	7.2.3.2.3	N/A Ref. only	6.1	Effects of ventilation on emplacement drift thermal condition	N/A	N/A	N/A	N/A
3	CRWMS M & O 1996. *Thermal Loading Study for FY 1996 Vol. I.* B00000000-01717-5705-00044 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19961217.0121.	5.3	N/A Ref. only	6.1 and 6.6	Effects of ventilation on emplacement drift thermal condition	N/A	N/A	N/A	N/A
4	CRWMS M&O 1997a. *Software Qualification Report for ANSYS Revision 5.2SGI,* CSCI: 30013 V5.2SGI. 30013-2003 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19970815.0536.	Entire	N/A Ref. only	3	QA status of software ANSYS Version 5.2	N/A	N/A	N/A	N/A
5	CRWMS M & O 1997b. *Heating and Cooling Scoping Analysis Report.* BC0000000-01717-5705-00007 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19970606.0153.	pp. 75 to 78	N/A Ref. Only	6.1	Effects of ventilation on emplacement drift thermal condition	N/A	N/A	N/A	N/A
6	CRWMS M&O 1998a. *Ground Control System Description Document.* BCA000000-01717-1705-00011 REV 00. Las Vegas, Nevada: CRWMS M&O ACC: MOL.19980825.0286.	1.2.3.1	TBV 334	4.1.2	Average ground surface temperature (18.7° C) and thermal gradient	3	X		

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	2. Technical Product Input Source Title and Identifier(s) with Version	3. Section					Unqual.	From Uncontrolled Source	Un-confirmed
7	CRWMS M&O 1998b. *Repository Ground Support Analysis for Viability Assessment.* BCAA00000-01717-0200-00004 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980512.0714.	Fig. 4-1	TBV3528	4.1.3	Avg. elevations of repository level 1072.3 m at invert.	3			X
8	CRWMS M&O 1998c. *Repository Subsurface Waste Emplacement and Thermal Management Strategy.* B00000000-01717-0200-00173 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980918.0084.	p. II-2 to Section 4.3.11	TBV 3683 TBV 389	4.1.6 4.1.5.2	Ventilation air density at repository level. Estimated level of initial heat output for naval spent fuel WPs	3 3			X X
9	CRWMS M&O 1999a. *Input Transmittal for Thermal Modeling Parameters by Stratigraphic Unit.* Input Tracking No.: SSR-NEP-99261.Ta. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990920.0109.	pp. 1 of 2	TBV 3529	4.1.3 4.1.4	Thermal modeling parameters by stratigraphic unit - thickness, grain density, thermal conductivity, & specific heat. Elevations for ground surface and Tpcpv2 unt	3			X
10	CRWMS M&O 1999b. *Thermal Calculation of the Waste Package with Backfill.* BB0000000-01717-0210-00001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981214.0073.	5.1.3	TBV 3684	4.1.5.1	Waste package thermal properties for Alloy 22 - density, thermal conductivity, specific heat, and emmisivity	3			X
11	CRWMS M&O 1999c. *Enhanced Design Alternative (EDA) II Repository Estimated Waste Package Types and Quantities.* Input Tracking No.: EBS-SR-99325.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991103.0236.	Item1, pp. 25 to 26	TBV 3685	4.1.5.2	Waste package length and diameter	3			X

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11	**(Continued ...)**	Item 2, p. 15 and p. 17	TBV 3686	4.1.5.3	Number & initial heat generation rates of waste packages	3			X
		Item 2, pp. 7 to 9	TBV 3695	4.1.5.4	Decay characteristics of the commercial spent nuclear fuel waste packages	3			X
12	CRWMS M & O 1999e. *Enhanced Design Alternative II Report.* B00000000-01717-5705-00131 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990712.0194.	2nd para of 5.1 5.1.1 5.1.2	N/A Ref. only	6.3.2	General description of EDA II characteristics.	N/A	N/A	N/A	N/A
13	CRWMS M & O 1999f. *ANSYS Calculations in Support of Enhanced Design Alternatives.* B00000000-01717-0210-00074 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990218.0240.	p. VI-6	TBV 3687	5.4	Airflow rate for preclosure ventilation.	3	X		
		p.7	TBV 3688	5.3	Average emplacement drift length for ventilation calculation.				
		Fig. 4	TBV 3689	5.2	WP position in emplacement drift.				
		3.1.7	TBV 3690	5.5	Intake air temperature at emplacement drift entrance.				
14	CRWMS M&O 1999g. *Activity Evaluation, Engineered Barrier System Performance Modeling (WP# 12012383MX).* Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990719.0317.	Entire	N/A Ref. only	2	Activity Evaluation	N/A	N/A	N/A	N/A

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	2. Technical Product Input Source Title and Identifier(s) with Version	3. Section					Unqual.	From Uncontrolled Source	Un-confirmed
15	CRWMS M&O 1999h. *Classification of the MGR Subsurface Ventilation System.* ANL-SVS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0219.	7.1	N/A Ref. only	2	QA classification of subsurface ventilation system.	N/A	N/A	N/A	N/A
16	CRWMS M&O 1999i. *Development Plan for Ventilation Model.* TDP-EBS-MD-000015 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991005.0214.	Entire	N/A Ref. only	2	Development Plan for *Ventilation Model* document	N/A	N/A	N/A	N/A
17	Danko, G.; Blink, J.A.; and Chesnut, D.A. 1998. "Temperature and Moisture Control Using Pre-Closure Ventilation'. *Proceedings of the Eighth International Conference: High-Level Radioactive Waste Management,* pp.762 – 766. La Grange Park, Illinois: American Nuclear Society, Inc. TIC: 237082.	pp. 762 to 766	N/A Ref. only	6.6	Description of a coupled simulation process to estimate heat and moisture effects on emplacement drifts	N/A	N/A	N/A	N/A
18	DOE (U.S. Department of Energy) 1998. *Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program.* DOE/RW-0333P REV 08. Washington, D.C. U.S. Department of Energy. ACC: MOL.19980601.0022.	Entire	N/A Ref. only	2	Quality Assurance Requirements and Description program followed; reference only	N/A	N/A	N/A	N/A
19	Health, C.A. and Wilkins, D.R. 1999. "Direction to Transition to Enhanced Design Alternative II." Letter from C.A. Heath (CRWMS M&O) and D.R. Wilkins (CRWMS M&O) to Distribution, LV.NS.JLY.06/99-026, June 15, 1999, with enclosure. ACC: MOL.19990622.0126, MOL.19990622.0127, and MOL.19990622.0128.	p. 1 p. 1 p.2 p.2	N/A Project baseline	4.1.17 4.1.19 4.1.18 4.2	Emplacement drift spacing. Diameter of waste emplacement drift. Waste package spacing. Heat removal of at least 70% by 50-yr preclosure ventilation.	N/A	N/A	N/A	N/A

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	2. Technical Product Input Source Title and Identifier(s) with Version	3. Section					Unqual.	From Uncontrolled Source	Un-confirmed
20	Holman, J.P. 1997. *Heat Transfer.* 8th Edition. New York, New York: McGraw-Hill, Inc. TIC: 239954	p. 646	TBV 3691	4.1.6	Ventilation air properties at 25° C - thermal conductivity, dynamic viscosity, and Prandtl Number	3	X		
21	Incropera, F.P.; and Dewitt, D. P. 1985. *Fundamentals of Heat and Mass Transfer.* New York, New York: John Wiley & Sons. TIC: 208420.	p. 780	TBV 3532	4.1.4	Emissivity for the Tptpll unit	3	X		

ATTACHMENT II

AVERAGE OVERALL THERMAL DECAY

AVERAGE OVERALL THERMAL DECAY

(1) Estimate of Linear Heat Load Along Emplacement Drift

Waste Package Type		Number of WPs	Fraction of Total	Length (m)	Heat Output Rate (KW)	Drift Length Required (meters)	Total Heat Output (kW)	Linear Heat Load (kW/m)
		Sec. 4.1.5.2		Sec. 4.1.5.2	Sec. 4.1.5.3	see Note 1	see Note 2	
21-PWR	Absorber	4279	0.429	5.305	11.3337	23128.00	48496.90	2.10
21-PWR	Control Ro	87	0.009	5.305	2.3709	470.24	206.27	0.44
12-PWR	Long	158	0.016	5.791	9.5402	930.78	1507.35	1.62
44-BWR	Absorber	2889	0.29	5.275	7.1346	15528.38	20611.86	1.33
24-BWR	Thick Plate	6	0.001	5.245	0.4910	32.07	2.95	0.09
5-DHLW		1249	0.125	3.73	4.0580	4783.67	5068.44	1.06
5-DHLW	Long	414	0.042	5.357	5.8280	2259.20	2412.79	1.07
Naval	Combined	285	0.029	5.888	7.1346 (See Note 2)	1706.58	2033.36	1.19
DOE/Other		598	0.06	5.57	0.7930	3390.66	474.21	0.14
Total		9965	1			52229.56	80814.14	
Average				5.141				**1.5473**

Note 1: Total drift length required for a given type of WPs is determined using:
Total drift length = (Number of WPs)*(WP length + 0.1 m), where 0.1 m is the gap between WPs (see Section 4.1.8).

Note 2: Heat output for Naval packages is not available. Value listed was based on consideration that the Naval package have the similar initial heat output of the 44-BWR packages This consideration was documented in CRWMS M&O 1998c, Section 4.3.11.

(2) Thermal Decay for CSNF

	Time (years)	21-PWR Absorber Plates kW (Sec 4.1.5.4)	21-PWR Control Rods kW (Sec 4.1.5.4)	12-PWR Long kW (Sec 4.1.5.4)	44-BWR Absorber Plates kW (Sec 4.1.5.4)	24-BWR Thick Absorber Plates kW (Sec 4.1.5.4)	Total Heat of All CSNF WP (kW)	Percentage Decay of All CSNF WP (%)
	0.01	11.3337	2.3709	9.5402	7.1346	0.491	70825.33	100.00%
	1	10.9954	2.3285	9.2722	6.9146	0.4829	68696.08	96.99%
	5	9.9653	2.1785	8.4286	6.2682	0.4445	62274.26	87.93%
	10	8.9956	2.0095	7.5901	5.6536	0.403	56201.90	79.35%
	15	8.1887	1.8547	6.8815	5.1467	0.3689	51159.11	72.23%
	20	7.5138	1.7241	6.3149	4.7102	0.3341	46909.07	66.23%
(See Note 3)	25	6.9115	1.6038	5.8009	4.3098	0.3065	43083.23	60.83%
(See Note 3)	26	6.8050	1.5819	5.7089	4.2419	0.3013	42414.93	59.89%
	30	6.3792	1.4942	5.3407	3.9701	0.2806	39741.73	56.11%
	40	5.4984	1.3106	4.5868	3.3915	0.2369	34165.86	48.24%
	50	4.7912	1.1649	3.9792	2.9326	0.2033	29705.11	41.94%
	60	4.2229	1.0443	3.5026	2.5621	0.1754	26117.01	36.88%
	70	3.7685	0.9479	3.1031	2.2625	0.1536	23235.45	32.81%
	80	3.3915	0.8698	2.7908	2.0227	0.1361	20873.24	29.47%
	90	3.0866	0.807	2.5304	1.8264	0.1222	18954.78	26.76%
	100	2.8314	0.7545	2.3024	1.6685	0.1111	17365.94	24.52%
(See Note 3)	125	2.4552	0.6764	1.9895	1.4331	0.0955	15019.79	21.21%
	150	2.079	0.5983	1.6766	1.1977	0.0799	12673.63	17.89%
	200	1.7291	0.5244	1.3818	0.9878	0.0684	10516.93	14.85%
	250	1.5128	0.4796	1.2029	0.8725	0.0622	9226.08	13.03%
	300	1.3654	0.4452	1.0804	0.7889	0.0583	8331.46	11.76%

Note 3: Values for 26 and 125 years are base on linear interpolation.
Values for 25 years were listed to illustrate data interpolation for values of 26 years.
They were not actually used in calculations.

(3) Decay of Linear and Volumetric Heat Load

	Time (years)	Total Heat of All CSNF WP (kW)	Percentage Decay of All CSNF WP (%)	All WP Linear Heat Load (kW/m)	Volumetric Heat Rate (J/yr m^3)
		(page II-3)	(page II-3)	(page II-2)	(See Note 4)
	0.01	70825.3276	100.00%	1.5473	2.54E+10
	1	68696.0805	96.99%	1.5008	2.46E+10
	5	62274.2638	87.93%	1.3605	2.23E+10
	10	56201.9031	79.35%	1.2278	2.02E+10
	15	51159.1129	72.23%	1.1177	1.83E+10
	20	46909.0735	66.23%	1.0248	1.68E+10
(See Note 5)	25	43083.2325	60.83%	0.9412	1.55E+10
	26	42414.9311	59.89%	0.9266	1.52E+10
	30	39741.7253	56.11%	0.8682	1.43E+10
	40	34165.8551	48.24%	0.7464	1.23E+10
	50	29705.1059	41.94%	0.6490	1.07E+10
	60	26117.0133	36.88%	0.5706	9.37E+09
	70	23235.4527	32.81%	0.5076	8.33E+09
	80	20873.2444	29.47%	0.4560	7.49E+09
	90	18954.7764	26.76%	0.4141	6.80E+09
	100	17365.9444	24.52%	0.3794	6.23E+09
	125	15019.7875	21.21%	0.3281	5.39E+09
	150	12673.6306	17.89%	0.2769	4.54E+09
	200	10516.9307	14.85%	0.2298	3.77E+09
	250	9226.0803	13.03%	0.2016	3.31E+09
	300	8331.4641	11.76%	0.1820	2.99E+09

Note 4: Based on Linear heat load values. For example, in year 0.01,
1.5473(kW/m)*[1000(J/s)/kW]*[365*24*60*60(s/yr)]/[(Pi/4)*(1.564 m)^2]
= 2.54E+10 (J/yr-m^3)
Where 1.564 m is the WP diameter (Section 5.1) used in the calculation.

Note 5: Values for 25 years were listed to illustrate data interpolation for values of 26 years. They were not actually used in calculations.

ATTACHMENT III

CONVECTIVE HEAT TRANSFER COEFFICIENTS

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ATTACHMENT IV

CALCULATION SUMMARY SHEETS FOR
CONTINUOUS EMPLACEMENT DRIFT COOLING ANALYSIS

DRIFT SEGMENT # 1 (0 - 100m) Air Quantity, Q = 10 m^3/s 60 MTU/acre

Wall Temperature Results from ANSYS Modeling

Time, Yr	Drift Wall Temperature, C		
	Invert	Springline	Crown
0.00	25.00	25.00	25.00
0.00	27.95	28.45	27.92
1.00	55.68	59.19	55.66
5.00	55.27	58.40	55.24
10.00	53.01	55.87	52.98
15.00	50.67	53.28	50.63
20.00	48.72	51.14	48.69
26.00	46.64	48.84	46.61
30.00	45.44	47.52	45.40
40.00	42.78	44.59	42.75
50.00	40.62	42.20	40.59
60.00	38.81	40.21	38.79
70.00	37.38	38.62	37.36
80.00	36.21	37.34	36.19
90.00	35.26	36.28	35.24
100.00	34.45	35.39	34.43
125.00	33.24	34.05	33.22
150.00	32.05	32.73	32.03
200.00	30.89	31.46	30.87
250.00	30.19	30.68	30.17
300.00	29.70	30.14	29.68

Drift Wall and Air Temperatures, C

Time Afte Emplm't, Y	Ave. Drift Wall Tem	Air Temp at 100 m
0.00	25.00	25.00
0.00	28.10	29.43
1.00	56.85	33.50
5.00	56.30	35.83
10.00	53.95	35.27
15.00	51.52	34.46
20.00	49.51	33.72
26.00	47.36	33.02
30.00	46.12	32.45
40.00	43.37	31.78
50.00	41.14	30.94
60.00	39.27	30.24
70.00	37.79	29.67
80.00	36.58	29.21
90.00	35.59	28.83
100.00	34.76	28.52
125.00	33.50	28.16
150.00	32.27	27.73
200.00	31.07	27.31
250.00	30.35	26.98
300.00	29.84	26.76

Air Temperature and Heat Removal Calculations

Tin =	25	C	D.S =	81.00	m	WP Dia. =	1.56	Ap =	4.91 m^2
Drift L =	600	m	P.G. =	0.10	m	Drift Dia. =	5.50	Aw =	17.28 m^2
Delta L =	100	m	T.L. =	60.00	MTU/ac	Air Dens. =	1.06	kg/m^3	
Cv. Coeff. h=	1.37	W/m^2 K	L.L. =	1.55	kW/m	Air Cp =	1.01	kJ/kg K	

Time Step 1	Tain =	25.00	C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00	+	29.43	) =			27.22
(0-1e-4 yr)	Twout =	28.10	C	Twa = 0.5*(Twin+Twout)	0.5*(	25.00	+	28.10	) =			26.55
	Tpout =	108.97	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.00	+	108.97	) =			89.49
	qw =	Aw x h x { (Twa =	26.55	) -	Tain=	25.00	} =	3.67	kW			
	qp =	Ap x h x { (Tpa =	89.49	) -	Tain=	25.00	} =	43.41	kW			
	Taout =	25.00	+ (qw+qp)	47.08	)/(Q*rho*Cp)	10.62	=	29.43	C	q-rm =		40.34

Time Step 2	Tain =	25.00	C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00	+	33.50	) =			29.25
(1e-4-1 yr)	Twout =	56.85	C	Twa = 0.5*(Twin+Twout)	0.5*(	28.10	+	56.85	) =			42.47
	Tpout =	86.45	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	108.97	+	86.45	) =			97.71
	qw =	Aw x h x { (Twa =	42.47	) -	Tain=	25.00	} =	41.37	kW			
	qp =	Ap x h x { (Tpa =	97.71	) -	Tain=	25.00	} =	48.94	kW			
	Taout =	25.00	+ (qw+qp)	90.31	)/(Q*rho*Cp)	10.62	=	33.50	C	q-rm =		77.38

Time Step 3	Tain =	25.00	C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	35.83	) =			30.41
(1-5 yr)	Twout =	56.30	C	Twa = 0.5*(Twin+Twout)	0.5*(	56.85	+	56.30	) =			56.57
	Tpout =	83.24	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	86.45	+	83.24	) =			84.84
	qw =	Aw x h x { (Twa =	56.57	) -	Tain=	25.00	} =	74.74	kW			
	qp =	Ap x h x { (Tpa =	84.84	) -	Tain=	25.00	} =	40.28	kW			
	Taout =	25.00	+ (qw+qp)	115.02	)/(Q*rho*Cp)	10.62	=	35.83	C	q-rm =		98.56

Time Step 4	Tain =	25.00	C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00	+	35.27	) =			30.13
(5-10 yr)	Twout =	53.95	C	Twa = 0.5*(Twin+Twout)	0.5*(	56.30	+	53.95	) =			55.13
	Tpout =	78.83	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	83.24	+	78.83	) =			81.03
	qw =	Aw x h x { (Twa =	55.13	) -	Tain=	25.00	} =	71.32	kW			
	qp =	Ap x h x { (Tpa =	81.03	) -	Tain=	25.00	} =	37.72	kW			
	Taout =	25.00	+ (qw+qp)	109.04	)/(Q*rho*Cp)	10.62	=	35.27	C	q-rm =		93.43

Time Step 5	Tain =	25.00	C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	34.46	) =			29.73
(10-15 yr)	Twout =	51.52	C	Twa = 0.5*(Twin+Twout)	0.5*(	53.95	+	51.52	) =			52.74
	Tpout =	74.54	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	78.83	+	74.54	) =			76.68
	qw =	Aw x h x { (Twa =	52.74	) -	Tain=	25.00	} =	65.66	kW			
	qp =	Ap x h x { (Tpa =	76.68	) -	Tain=	25.00	} =	34.79	kW			
	Taout =	25.00	+ (qw+qp)	100.45	)/(Q*rho*Cp)	10.62	=	34.46	C	q-rm =		86.08

Time Step 6	Tain =	25.00 C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00 +	33.72) =	29.36				
(15-20 yr)	Twout =	49.51 C	Twa = 0.5*(Twin+Twout)	0.5*(	51.52 +	49.51) =	50.52				
	Tpout =	71.03 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	74.54 +	71.03) =	72.79				
	qw =	Aw x h x { (Twa =	50.52) -	Tain=	25.00 } =	60.41 kW					
	qp =	Ap x h x { (Tpa =	72.79) -	Tain=	25.00 } =	32.17 kW					
	Taout =	25.00 + (qw+qp)	92.58)/(Q*rho*Cp)		10.62 =	33.72 C	q-rm =	79.33			

Time Step 7	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	33.02) =	29.01				
(20-26 yr)	Twout =	47.36 C	Twa = 0.5*(Twin+Twout)	0.5*(	49.51 +	47.36) =	48.44				
	Tpout =	67.20 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	71.03 +	67.20) =	69.12				
	qw =	Aw x h x { (Twa =	48.44) -	Tain=	25.00 } =	55.48 kW					
	qp =	Ap x h x { (Tpa =	69.12) -	Tain=	25.00 } =	29.70 kW					
	Taout =	25.00 + (qw+qp)	85.18)/(Q*rho*Cp)		10.62 =	33.02 C	q-rm =	72.99			

Time Step 8	Tain =	25.00 C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00 +	32.45) =	28.73				
(26-30 yr)	Twout =	46.12 C	Twa = 0.5*(Twin+Twout)	0.5*(	47.36 +	46.12) =	46.74				
	Tpout =	65.01 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	67.20 +	65.01) =	66.11				
	qw =	Aw x h x { (Twa =	46.74) -	Tain=	25.00 } =	51.46 kW					
	qp =	Ap x h x { (Tpa =	66.11) -	Tain=	25.00 } =	27.67 kW					
	Taout =	25.00 + (qw+qp)	79.13)/(Q*rho*Cp)		10.62 =	32.45 C	q-rm =	67.81			

Time Step 9	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	31.78) =	28.39				
(30-40 yr)	Twout =	43.37 C	Twa = 0.5*(Twin+Twout)	0.5*(	46.12 +	43.37) =	44.75				
	Tpout =	60.03 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	65.01 +	60.03) =	62.52				
	qw =	Aw x h x { (Twa =	44.75) -	Tain=	25.00 } =	46.74 kW					
	qp =	Ap x h x { (Tpa =	62.52) -	Tain=	25.00 } =	25.25 kW					
	Taout =	25.00 + (qw+qp)	72.00		10.62 =	31.78 C	q-rm =	61.69			

Time Step 10	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	30.94) =	27.97				
(40-50 yr)	Twout =	41.14 C	Twa = 0.5*(Twin+Twout)	0.5*(	43.37 +	41.14) =	42.26				
	Tpout =	55.93 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	60.03 +	55.93) =	57.98				
	qw =	Aw x h x { (Twa =	42.26) -	Tain=	25.00 } =	40.85 kW					
	qp =	Ap x h x { (Tpa =	57.98) -	Tain=	25.00 } =	22.20 kW					
	Taout =	25.00 + (qw+qp)	63.05)/(Q*rho*Cp)		10.62 =	30.94 C	q-rm =	54.02			

Time Step 11	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	30.24) =	27.62				
(50-60 yr)	Twout =	39.27 C	Twa = 0.5*(Twin+Twout)	0.5*(	41.14 +	39.27) =	40.20				
	Tpout =	52.45 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	55.93 +	52.45) =	54.19				
	qw =	Aw x h x { (Twa =	40.20) -	Tain=	25.00 } =	35.99 kW					
	qp =	Ap x h x { (Tpa =	54.19) -	Tain=	25.00 } =	19.65 kW					
	Taout =	25.00 + (qw+qp)	55.64)/(Q*rho*Cp)		10.62 =	30.24 C	q-rm =	47.67			

Time Step 12	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	29.67) =	27.33				
(60-70 yr)	Twout =	37.79 C	Twa = 0.5*(Twin+Twout)	0.5*(	39.27 +	37.79) =	38.53				
	Tpout =	49.67 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	52.45 +	49.67) =	51.06				
	qw =	Aw x h x { (Twa =	38.53) -	Tain=	25.00 } =	32.02 kW					
	qp =	Ap x h x { (Tpa =	51.06) -	Tain=	25.00 } =	17.54 kW					
	Taout =	25.00 + (qw+qp)	49.56)/(Q*rho*Cp)		10.62 =	29.67 C	q-rm =	42.47			

Time Step 13	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	29.21) =	27.10				
(70-80 yr)	Twout =	36.58 C	Twa = 0.5*(Twin+Twout)	0.5*(	37.79 +	36.58) =	37.18				
	Tpout =	47.38 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	49.67 +	47.38) =	48.53				
	qw =	Aw x h x { (Twa =	37.18) -	Tain=	25.00 } =	28.84 kW					
	qp =	Ap x h x { (Tpa =	48.53) -	Tain=	25.00 } =	15.84 kW					
	Taout =	25.00 + (qw+qp)	44.68)/(Q*rho*Cp)		10.62 =	29.21 C	q-rm =	38.28			

Time Step 14	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	28.83) =	26.91				
(80-90 yr)	Twout =	35.59 C	Twa = 0.5*(Twin+Twout)	0.5*(	36.58 +	35.59) =	36.09				
	Tpout =	45.48 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	47.38 +	45.48) =	46.43				
	qw =	Aw x h x { (Twa =	36.09) -	Tain=	25.00 } =	26.24 kW					
	qp =	Ap x h x { (Tpa =	46.43) -	Tain=	25.00 } =	14.43 kW					
	Taout =	25.00 + (qw+qp)	40.67)/(Q*rho*Cp)		10.62 =	28.83 C	q-rm =	34.85			

Time Step 15	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	28.52) =	26.76				
(90-100 yr)	Twout =	34.76 C	Twa = 0.5*(Twin+Twout)	0.5*(	35.59 +	34.76) =	35.17				
	Tpout =	43.89 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	45.48 +	43.89) =	44.69				
	qw =	Aw x h x { (Twa =	35.17) -	Tain=	25.00 } =	24.09 kW					
	qp =	Ap x h x { (Tpa =	44.69) -	Tain=	25.00 } =	13.25 kW					
	Taout =	25.00 + (qw+qp)	37.34)/(Q*rho*Cp)		10.62 =	28.52 C	q-rm =	31.99			

Time Step 16	Tain =	25.00	C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	28.16	) =	26.58				
(100-125 yr)	Twout =	33.50	C	Twa = 0.5*(Twin+Twout)	0.5*(	34.76	+	33.50	) =	34.13				
	Tpout =	41.50	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	43.89	+	41.50	) =	42.70				
	qw =	Aw x h x { (Twa =	34.13	) -	Tain=	25.00	} =	21.62	kW					
	qp =	Ap x h x { (Tpa =	42.70	) -	Tain=	25.00	} =	11.91	kW					
	Taout =	25.00	+ (qw+qp)	33.53	)/(Q*rho*Cp)	10.62	=	28.16	C	q-rm =	28.73			

Time Step 17	Tain =	25.00	C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	27.73	) =	26.36				
(125-150 yr)	Twout =	32.27	C	wa = 0.5*(Twin+Twout) =	0.5*(	33.50	+	32.27	) =	32.88				
	Tpout =	39.07	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	41.50	+	39.07	) =	40.28				
	qw =	Aw x h x { (Twa =	32.88	) -	Tain=	25.00	} =	18.66	kW					
	qp =	Ap x h x { (Tpa =	40.28	) -	Tain=	25.00	} =	10.29	kW					
	Taout =	25.00	+ (qw+qp)	28.95	)/(Q*rho*Cp)	10.62	=	27.73	C	q-rm =	24.81			

Time Step 18	Tain =	25.00	C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	27.31	) =	26.15				
(150-200 yr)	Twout =	31.07	C	wa = 0.5*(Twin+Twout) =	0.5*(	32.27	+	31.07	) =	31.67				
	Tpout =	36.79	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	39.07	+	36.79	) =	37.93				
	qw =	Aw x h x { (Twa =	31.67	) -	Tain=	25.00	} =	15.79	kW					
	qp =	Ap x h x { (Tpa =	37.93	) -	Tain=	25.00	} =	8.70	kW					
	Taout =	25.00	+ (qw+qp)	24.49	)/(Q*rho*Cp)	10.62	=	27.31	C	q-rm =	20.98			

Time Step 19	Tain =	25.00	C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	26.98	) =	25.99				
(200-250 yr)	Twout =	30.35	C	wa = 0.5*(Twin+Twout) =	0.5*(	31.07	+	30.35	) =	30.71				
	Tpout =	35.40	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	36.79	+	35.40	) =	36.09				
	qw =	Aw x h x { (Twa =	30.71	) -	Tain=	25.00	} =	13.51	kW					
	qp =	Ap x h x { (Tpa =	36.09	) -	Tain=	25.00	} =	7.47	kW					
	Taout =	25.00	+ (qw+qp)	20.98	)/(Q*rho*Cp)	10.62	=	26.98	C	q-rm =	17.98			

Time Step 20	Tain =	25.00	C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	26.76	) =	25.88				
(250-300 yr)	Twout =	29.84	C	wa = 0.5*(Twin+Twout) =	0.5*(	30.35	+	29.84	) =	30.09				
	Tpout =	34.43	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	35.40	+	34.43	) =	34.91				
	qw =	Aw x h x { (Twa =	30.09	) -	Tain=	25.00	} =	12.06	kW					
	qp =	Ap x h x { (Tpa =	34.91	) -	Tain=	25.00	} =	6.67	kW					
	Taout =	25.00	+ (qw+qp)	18.73	)/(Q*rho*Cp)	10.62	=	26.76	C	q-rm =	16.05			

DRIFT SEGMENT # 2 (100-200m) Air Quantity, Q = 10 m^3/s 60 MTU/acre

Wall Temperatures Results from ANSYS Modeling

Time, Yr	Drift Wall Temperature, C		
	Invert	Springline	Crown
0.00	25.00	25.00	25.00
0.00	27.95	28.45	27.92
1.00	61.75	65.20	61.74
5.00	64.42	67.45	64.39
10.00	62.03	64.79	62.00
15.00	59.11	61.63	59.07
20.00	56.58	58.92	56.54
26.00	53.92	56.06	53.88
30.00	52.25	54.28	52.21
40.00	49.01	50.78	48.98
50.00	46.14	47.70	46.11
60.00	43.73	45.10	43.70
70.00	41.80	43.03	41.77
80.00	40.23	41.34	40.20
90.00	38.93	39.94	38.91
100.00	37.85	38.77	37.83
125.00	36.29	37.10	36.27
150.00	34.71	35.39	34.69
200.00	33.16	33.72	33.14
250.00	32.15	32.64	32.13
300.00	31.45	31.89	31.43

Drift Wall and Air Temperatures

Time Afte Emplm't, Y	Ave. Drift Wall Tem	Air Temp at 200 m
0.00	25.00	25.00
0.00	28.10	29.43
1.00	62.90	40.41
5.00	65.42	45.67
10.00	62.94	45.11
15.00	59.94	43.63
20.00	57.34	42.20
26.00	54.62	40.85
30.00	52.91	39.73
40.00	49.59	38.44
50.00	46.65	36.82
60.00	44.18	35.44
70.00	42.20	34.31
80.00	40.59	33.40
90.00	39.26	32.65
100.00	38.15	32.02
125.00	36.55	31.32
150.00	34.93	30.48
200.00	33.34	29.65
250.00	32.31	28.99
300.00	31.59	28.55

Air Temperature and Heat Removal Calculations

Tin =	25.00 C	D.S =	81.00 m	WP Dia. =	1.56	Ap =	4.91 m^2
Drift L =	600.00 m	P.G. =	0.10 m	Drift Dia. =	5.50	Aw =	17.28 m^2
Delta L =	100.00 m	T.L. =	60.00 MTU/ac	Air Dens. =	1.06	kg/m^3	
Cv. Coeff. h=	1.37 W/m^2 K	L.L. =	1.55 kW/m	Air Cp =	1.01	kJ/kg K	

Time Step 1	Tain =	25.00 C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00 +	29.43) =	27.22			
(0-1e-4 yr)	Twout =	28.10 C	Twa = 0.5*(Twin+Twout)	0.5*(	25.00 +	28.10) =	26.55			
	Tpout =	108.97 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.00 +	108.97) =	89.49			
	qw =	Aw x h x { (Twa =	26.55) -	Tain=	25.00 } =	3.67 kW				
	qp =	Ap x h x { (Tpa =	89.49) -	Tain=	25.00 } =	43.41 kW				
	Taout =	25.00 + (qw+qp)	47.08)/(Q*rho*Cp)		10.62 =	29.43 C	q-rm =	40.34		

Time Step 2	Tain =	33.50 C	Taa = 0.5*(Tain+Taout)	0.5*(	33.50 +	40.41) =	36.96			
(1e-4-1 yr)	Twout =	62.90 C	Twa = 0.5*(Twin+Twout)	0.5*(	28.10 +	62.90) =	45.50			
	Tpout =	91.72 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	108.97 +	91.72) =	100.35			
	qw =	Aw x h x { (Twa =	45.50) -	Tain=	33.50 } =	28.40 kW				
	qp =	Ap x h x { (Tpa =	100.35) -	Tain=	33.50 } =	44.99 kW				
	Taout =	33.50 + (qw+qp)	73.39)/(Q*rho*Cp)		10.62 =	40.41 C	q-rm =	62.89		

Time Step 3	Tain =	35.83 C	Taa = 0.5*(Tain+Taout) =	0.5*(	35.83 +	45.67) =	40.75			
(1-5 yr)	Twout =	65.42 C	Twa = 0.5*(Twin+Twout)	0.5*(	62.90 +	65.42) =	64.16			
	Tpout =	91.10 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	91.72 +	91.10) =	91.41			
	qw =	Aw x h x { (Twa =	64.16) -	Tain=	35.83 } =	67.06 kW				
	qp =	Ap x h x { (Tpa =	91.41) -	Tain=	35.83 } =	37.41 kW				
	Taout =	35.83 + (qw+qp)	104.47)/(Q*rho*Cp)		10.62 =	45.67 C	q-rm =	89.52		

Time Step 4	Tain =	35.27 C	Taa = 0.5*(Tain+Taout)	0.5*(	35.27 +	45.11) =	40.19			
(5-10 yr)	Twout =	62.94 C	Twa = 0.5*(Twin+Twout)	0.5*(	65.42 +	62.94) =	64.18			
	Tpout =	86.61 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	91.10 +	86.61) =	88.86			
	qw =	Aw x h x { (Twa =	64.18) -	Tain=	35.27 } =	68.45 kW				
	qp =	Ap x h x { (Tpa =	88.86) -	Tain=	35.27 } =	36.07 kW				
	Taout =	35.27 + (qw+qp)	104.52)/(Q*rho*Cp)		10.62 =	45.11 C	q-rm =	89.56		

Time Step 5	Tain =	34.46 C	Taa = 0.5*(Tain+Taout) =	0.5*(	34.46 +	43.63) =	39.04			
(10-15 yr)	Twout =	59.94 C	Twa = 0.5*(Twin+Twout)	0.5*(	62.94 +	59.94) =	61.44			
	Tpout =	81.89 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	86.61 +	81.89) =	84.25			
	qw =	Aw x h x { (Twa =	61.44) -	Tain=	34.46 } =	63.87 kW				
	qp =	Ap x h x { (Tpa =	84.25) -	Tain=	34.46 } =	33.52 kW				
	Taout =	34.46 + (qw+qp)	97.39)/(Q*rho*Cp)		10.62 =	43.63 C	q-rm =	83.45		

Time Step 6	Tain =	33.72 C	Taa = 0.5*(Tain+Taout)	0.5*(	33.72	+	42.20	) =	37.96		
(15-20 yr)	Twout =	57.34 C	Twa = 0.5*(Twin+Twout)	0.5*(	59.94	+	57.34	) =	58.64		
	Tpout =	77.93 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	81.89	+	77.93	) =	79.91		
	qw =	Aw x h x { (Twa =	58.64) -	Tain=	33.72 } =		59.00 kW				
	qp =	Ap x h x { (Tpa =	79.91) -	Tain=	33.72 } =		31.09 kW				
	Taout =	33.72 + (qw+qp)	90.10)/(Q*rho*Cp)		10.62	=	42.20 C	q-rm =	77.20		

Time Step 7	Tain =	33.02 C	Taa = 0.5*(Tain+Taout) =	0.5*(	33.02	+	40.85	) =	36.93		
(20-26 yr)	Twout =	54.62 C	Twa = 0.5*(Twin+Twout)	0.5*(	57.34	+	54.62	) =	55.98		
	Tpout =	73.65 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	77.93	+	73.65	) =	75.79		
	qw =	Aw x h x { (Twa =	55.98) -	Tain=	33.02 } =		54.36 kW				
	qp =	Ap x h x { (Tpa =	75.79) -	Tain=	33.02 } =		28.79 kW				
	Taout =	33.02 + (qw+qp)	83.15)/(Q*rho*Cp)		10.62	=	40.85 C	q-rm =	71.25		

Time Step 8	Tain =	32.45 C	Taa = 0.5*(Tain+Taout)	0.5*(	32.45	+	39.73	) =	36.09		
(26-30 yr)	Twout =	52.91 C	Twa = 0.5*(Twin+Twout)	0.5*(	54.62	+	52.91	) =	53.77		
	Tpout =	71.07 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	73.65	+	71.07	) =	72.36		
	qw =	Aw x h x { (Twa =	53.77) -	Tain=	32.45 } =		50.46 kW				
	qp =	Ap x h x { (Tpa =	72.36) -	Tain=	32.45 } =		26.87 kW				
	Taout =	32.45 + (qw+qp)	77.33)/(Q*rho*Cp)		10.62	=	39.73 C	q-rm =	66.26		

Time Step 9	Tain =	31.78 C	Taa = 0.5*(Tain+Taout) =	0.5*(	31.78	+	38.44	) =	35.11		
(30-40 yr)	Twout =	49.59 C	Twa = 0.5*(Twin+Twout)	0.5*(	52.91	+	49.59	) =	51.25		
	Tpout =	65.66 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	71.07	+	65.66	) =	68.36		
	qw =	Aw x h x { (Twa =	51.25) -	Tain=	31.78 } =		46.10 kW				
	qp =	Ap x h x { (Tpa =	68.36) -	Tain=	31.78 } =		24.63 kW				
	Taout =	31.78 + (qw+qp)	70.72)/(Q*rho*Cp)		10.62	=	38.44 C	q-rm =	60.60		

Time Step 10	Tain =	30.94 C	Taa = 0.5*(Tain+Taout) =	0.5*(	30.94	+	36.82	) =	33.88		
(40-50 yr)	Twout =	46.65 C	Twa = 0.5*(Twin+Twout)	0.5*(	49.59	+	46.65	) =	48.12		
	Tpout =	60.97 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	65.66	+	60.97	) =	63.32		
	qw =	Aw x h x { (Twa =	48.12) -	Tain=	30.94 } =		40.68 kW				
	qp =	Ap x h x { (Tpa =	63.32) -	Tain=	30.94 } =		21.80 kW				
	Taout =	30.94 + (qw+qp)	62.48)/(Q*rho*Cp)		10.62	=	36.82 C	q-rm =	53.54		

Time Step 11	Tain =	30.24 C	Taa = 0.5*(Tain+Taout) =	0.5*(	30.24	+	35.44	) =	32.84		
(50-60 yr)	Twout =	44.18 C	Twa = 0.5*(Twin+Twout)	0.5*(	46.65	+	44.18	) =	45.41		
	Tpout =	56.98 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	60.97	+	56.98	) =	58.98		
	qw =	Aw x h x { (Twa =	45.41) -	Tain=	30.24 } =		35.93 kW				
	qp =	Ap x h x { (Tpa =	58.98) -	Tain=	30.24 } =		19.34 kW				
	Taout =	30.24 + (qw+qp)	55.27)/(Q*rho*Cp)		10.62	=	35.44 C	q-rm =	47.36		

Time Step 12	Tain =	29.67 C	Taa = 0.5*(Tain+Taout) =	0.5*(	29.67	+	34.31	) =	31.99		
(60-70 yr)	Twout =	42.20 C	Twa = 0.5*(Twin+Twout)	0.5*(	44.18	+	42.20	) =	43.19		
	Tpout =	53.77 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	56.98	+	53.77	) =	55.37		
	qw =	Aw x h x { (Twa =	43.19) -	Tain=	29.67 } =		32.01 kW				
	qp =	Ap x h x { (Tpa =	55.37) -	Tain=	29.67 } =		17.30 kW				
	Taout =	29.67 + (qw+qp)	49.31)/(Q*rho*Cp)		10.62	=	34.31 C	q-rm =	42.25		

Time Step 13	Tain =	29.21 C	Taa = 0.5*(Tain+Taout) =	0.5*(	29.21	+	33.40	) =	31.30		
(70-80 yr)	Twout =	40.59 C	Twa = 0.5*(Twin+Twout)	0.5*(	42.20	+	40.59	) =	41.39		
	Tpout =	51.13 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	53.77	+	51.13	) =	52.45		
	qw =	Aw x h x { (Twa =	41.39) -	Tain=	29.21 } =		28.85 kW				
	qp =	Ap x h x { (Tpa =	52.45) -	Tain=	29.21 } =		15.65 kW				
	Taout =	29.21 + (qw+qp)	44.49)/(Q*rho*Cp)		10.62	=	33.40 C	q-rm =	38.13		

Time Step 14	Tain =	28.83 C	Taa = 0.5*(Tain+Taout) =	0.5*(	28.83	+	32.65	) =	30.74		
(80-90 yr)	Twout =	39.26 C	Twa = 0.5*(Twin+Twout)	0.5*(	40.59	+	39.26	) =	39.92		
	Tpout =	48.93 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	51.13	+	48.93	) =	50.03		
	qw =	Aw x h x { (Twa =	39.92) -	Tain=	28.83 } =		26.26 kW				
	qp =	Ap x h x { (Tpa =	50.03) -	Tain=	28.83 } =		14.27 kW				
	Taout =	28.83 + (qw+qp)	40.53)/(Q*rho*Cp)		10.62	=	32.65 C	q-rm =	34.73		

Time Step 15	Tain =	28.52 C	Taa = 0.5*(Tain+Taout) =	0.5*(	28.52	+	32.02	) =	30.27		
(90-100 yr)	Twout =	38.15 C	Twa = 0.5*(Twin+Twout)	0.5*(	39.26	+	38.15	) =	38.70		
	Tpout =	47.09 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	48.93	+	47.09	) =	48.01		
	qw =	Aw x h x { (Twa =	38.70) -	Tain=	28.52 } =		24.12 kW				
	qp =	Ap x h x { (Tpa =	48.01) -	Tain=	28.52 } =		13.12 kW				
	Taout =	28.52 + (qw+qp)	37.24)/(Q*rho*Cp)		10.62	=	32.02 C	q-rm =	31.91		

Time Step 16	Tain =	28.16	C	Taa = 0.5*(Tain+Taout) =	0.5*(	28.16	+	31.32	) =	29.74			
(100-125 yr)	Twout =	36.55	C	Twa = 0.5*(Twin+Twout)	0.5*(	38.15	+	36.55	) =	37.35			
	Tpout =	44.40	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	47.09	+	44.40	) =	45.75			
	qw =	Aw x h x { (Twa =	37.35	) - Tain=	28.16	} =	21.77	kW					
	qp =	Ap x h x { (Tpa =	45.75	) - Tain=	28.16	} =	11.84	kW					
	Taout =	28.16	+ (qw+qp)	33.61	)/(Q*rho*Cp)	10.62	=	31.32	C	q-rm =	28.80		

Time Step 17	Tain =	27.73	C	Taa = 0.5*(Tain+Taout) =	0.5*(	27.73	+	30.48	) =	29.10			
(125-150 yr)	Twout =	34.93	C	wa = 0.5*(Twin+Twout) =	0.5*(	36.55	+	34.93	) =	35.74			
	Tpout =	41.62	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	44.40	+	41.62	) =	43.01			
	qw =	Aw x h x { (Twa =	35.74	) - Tain=	27.73	} =	18.98	kW					
	qp =	Ap x h x { (Tpa =	43.01	) - Tain=	27.73	} =	10.29	kW					
	Taout =	27.73	+ (qw+qp)	29.27	)/(Q*rho*Cp)	10.62	=	30.48	C	q-rm =	25.08		

Time Step 18	Tain =	27.31	C	Taa = 0.5*(Tain+Taout) =	0.5*(	27.31	+	29.65	) =	28.48			
(150-200 yr)	Twout =	33.34	C	wa = 0.5*(Twin+Twout) =	0.5*(	34.93	+	33.34	) =	34.14			
	Tpout =	38.97	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	41.62	+	38.97	) =	40.29			
	qw =	Aw x h x { (Twa =	34.14	) - Tain=	27.31	} =	16.17	kW					
	qp =	Ap x h x { (Tpa =	40.29	) - Tain=	27.31	} =	8.74	kW					
	Taout =	27.31	+ (qw+qp)	24.91	)/(Q*rho*Cp)	10.62	=	29.65	C	q-rm =	21.35		

Time Step 19	Tain =	26.98	C	Taa = 0.5*(Tain+Taout) =	0.5*(	26.98	+	28.99	) =	27.98			
(200-250 yr)	Twout =	32.31	C	wa = 0.5*(Twin+Twout) =	0.5*(	33.34	+	32.31	) =	32.82			
	Tpout =	37.29	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	38.97	+	37.29	) =	38.13			
	qw =	Aw x h x { (Twa =	32.82	) - Tain=	26.98	} =	13.84	kW					
	qp =	Ap x h x { (Tpa =	38.13	) - Tain=	26.98	} =	7.51	kW					
	Taout =	26.98	+ (qw+qp)	21.35	)/(Q*rho*Cp)	10.62	=	28.99	C	q-rm =	18.30		

Time Step 20	Tain =	26.76	C	Taa = 0.5*(Tain+Taout) =	0.5*(	26.76	+	28.55	) =	27.66			
(250-300 yr)	Twout =	31.59	C	wa = 0.5*(Twin+Twout) =	0.5*(	32.31	+	31.59	) =	31.95			
	Tpout =	36.12	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	37.29	+	36.12	) =	36.71			
	qw =	Aw x h x { (Twa =	31.95	) - Tain=	26.76	} =	12.27	kW					
	qp =	Ap x h x { (Tpa =	36.71	) - Tain=	26.76	} =	6.69	kW					
	Taout =	26.76	+ (qw+qp)	18.97	)/(Q*rho*Cp)	10.62	=	28.55	C	q-rm =	16.25		

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DRIFT SEGMENT # 3 (200-300m) Air Quantity, Q = 10 m^3/s 60 MTU/acre

Wall Temperature Results from ANSYS Modeling

Time, Yr	Drift Wall Temperature, C		
	Invert	Springline	Crown
0.00	25.00	25.00	25.00
0.00	27.95	28.45	27.92
1.00	66.69	70.09	66.67
5.00	72.68	75.61	72.65
10.00	70.63	73.29	70.59
15.00	67.26	69.70	67.22
20.00	64.19	66.46	64.15
26.00	61.00	63.09	60.97
30.00	58.89	60.87	58.85
40.00	55.12	56.85	55.09
50.00	51.60	53.12	51.57
60.00	48.60	49.95	48.57
70.00	46.18	47.39	46.15
80.00	44.21	45.30	44.19
90.00	42.58	43.58	42.56
100.00	41.21	42.13	41.20
125.00	39.34	40.14	39.32
150.00	37.39	38.06	37.37
200.00	35.45	36.01	35.43
250.00	34.13	34.63	34.12
300.00	33.22	33.67	33.20

Drift Wall and Air Temperatures, C

Time Afte Emplm't, Y	Ave. Drift wall Temp	Air Temp at 300 m
0.00	25.00	25.00
0.00	28.10	29.43
1.00	67.81	46.03
5.00	73.65	54.51
10.00	71.50	54.46
15.00	68.06	52.49
20.00	64.94	50.44
26.00	61.69	48.48
30.00	59.53	46.84
40.00	55.68	44.97
50.00	52.10	42.64
60.00	49.04	40.61
70.00	46.57	38.92
80.00	44.57	37.56
90.00	42.91	36.45
100.00	41.51	35.52
125.00	39.60	34.49
150.00	37.61	33.26
200.00	35.63	32.03
250.00	34.29	31.03
300.00	33.36	30.36

Air temperature and Heat Removal Calculations

Tin =	25 C	D.S =	81 m	WP Dia. =	1.564	Ap =	4.91345	m^2
Drift L =	600 m	P.G. =	0.1 m	Drift Dia. =	5.5	Aw =	17.2788	m^2
Delta L =	100 m	T.L. =	60 MTU/ac	Air Dens. =	1.0561	kg/m^3		
Cv. Coeff. h=	1.37 W/m^2 K	L.L. =	1.55 kW/m	Air Cp =	1.0057	kJ/kg K		

Time Step 1	Tain =	25 C	Taa = 0.5*(Tain+Taout)	0.5*(	25	+	29.4328	) =		27.2164
(0-1e-4 yr)	Twout =	28.1037 C	Twa = 0.5*(Twin+Twout)	0.5*(	25	+	28.1037	) =		26.5518
	Tpout =	108.972 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70	+	108.972	) =		89.486
	qw =	Aw x h x { (Twa =	26.551833) -	Tain=	25 } =		3.67348	kW		
	qp =	Ap x h x { (Tpa =	89.486) -	Tain=	25 } =		43.4083	kW		
	Taout =	25 + (qw+qp)	47.081769)/(Q*rho*Cp)		10.6211977	=	29.4328	C	q-rm =	40.3432
Time Step 2	Tain =	40.413 C	Taa = 0.5*(Tain+Taout)	0.5*(	40.413	+	46.0294	) =		43.2212
(1e-4-1 yr)	Twout =	67.8136 C	Twa = 0.5*(Twin+Twout)	0.5*(	28.1037	+	67.8136	) =		47.9586
	Tpout =	96.0203 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	108.972	+	96.0203	) =		102.496
	qw =	Aw x h x { (Twa =	47.958617) -	Tain=	40.4129644 } =		17.862	kW		
	qp =	Ap x h x { (Tpa =	102.49615) -	Tain=	40.4129644 } =		41.7908	kW		
	Taout =	40.413 + (qw+qp)	59.652841)/(Q*rho*Cp)		10.6211977	=	46.0294	C	q-rm =	51.115
Time Step 3	Tain =	45.6659 C	Taa = 0.5*(Tain+Taout) =	0.5*(	45.6659	+	54.5137	) =		50.0898
(1-5 yr)	Twout =	73.6461 C	Twa = 0.5*(Twin+Twout)	0.5*(	67.8136	+	73.6461	) =		70.7299
	Tpout =	98.2409 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	96.0203	+	98.2409	) =		97.1306
	qw =	Aw x h x { (Twa =	70.72985) -	Tain=	45.6659221 } =		59.3311	kW		
	qp =	Ap x h x { (Tpa =	97.1306) -	Tain=	45.6659221 } =		34.6431	kW		
	Taout =	45.6659 + (qw+qp)	93.974157)/(Q*rho*Cp)		10.6211977	=	54.5137	C	q-rm =	80.524
Time Step 4	Tain =	45.1067 C	Taa = 0.5*(Tain+Taout)	0.5*(	45.1067	+	54.4648	) =		49.7858
(5-10 yr)	Twout =	71.5008 C	Twa = 0.5*(Twin+Twout)	0.5*(	73.6461	+	71.5008	) =		72.5735
	Tpout =	94.1044 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	98.2409	+	94.1044	) =		96.1727
	qw =	Aw x h x { (Twa =	72.573467) -	Tain=	45.106728 } =		65.019	kW		
	qp =	Ap x h x { (Tpa =	96.17265) -	Tain=	45.106728 } =		34.3747	kW		
	Taout =	45.1067 + (qw+qp)	99.393647)/(Q*rho*Cp)		10.6211977	=	54.4648	C	q-rm =	85.1679
Time Step 5	Tain =	43.6271 C	Taa = 0.5*(Tain+Taout) =	0.5*(	43.6271	+	52.4947	) =		48.0609
(10-15 yr)	Twout =	68.0586 C	Twa = 0.5*(Twin+Twout)	0.5*(	71.5008	+	68.0586	) =		69.7797
	Tpout =	89.0471 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	94.1044	+	89.0471	) =		91.5758
	qw =	Aw x h x { (Twa =	69.779683) -	Tain=	43.6271006 } =		61.9081	kW		
	qp =	Ap x h x { (Tpa =	91.57575) -	Tain=	43.6271006 } =		32.2763	kW		
	Taout =	43.6271 + (qw+qp)	94.184421)/(Q*rho*Cp)		10.6211977	=	52.4947	C	q-rm =	80.7042

Time Step 6	Tain =	42.1989 C	Taa = 0.5*(Tain+Taout)	0.5*(	42.1989	+	50.4445	) =	46.3217		
(15-20 yr)	Twout =	64.9353 C	Twa = 0.5*(Twin+Twout)	0.5*(	68.0586	+	64.9353	) =	66.497		
	Tpout =	84.6638 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	89.0471	+	84.6638	) =	86.8555		
	qw =	Aw x h x { (Twa =	66.49695) -	Tain=	42.1988961	} =	57.5181	kW			
	qp =	Ap x h x { (Tpa =	86.85545) -	Tain=	42.1988961	} =	30.0602	kW			
	Taout =	42.1989 + (qw+qp)	87.578348)/(Q*rho*Cp)		10.6211977	=	50.4445	C	q-rm =	75.0436

Time Step 7	Tain =	40.8484 C	Taa = 0.5*(Tain+Taout) =	0.5*(	40.8484	+	48.4831	) =	44.6657		
(20-26 yr)	Twout =	61.6866 C	Twa = 0.5*(Twin+Twout)	0.5*(	64.9353	+	61.6866	) =	63.311		
	Tpout =	79.9753 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	84.6638	+	79.9753	) =	82.3196		
	qw =	Aw x h x { (Twa =	63.310983) -	Tain=	40.8483967	} =	53.1732	kW			
	qp =	Ap x h x { (Tpa =	82.31955) -	Tain=	40.8483967	} =	27.916	kW			
	Taout =	40.8484 + (qw+qp)	81.089219)/(Q*rho*Cp)		10.6211977	=	48.4831	C	q-rm =	69.4833

Time Step 8	Tain =	39.7308 C	Taa = 0.5*(Tain+Taout)	0.5*(	39.7308	+	46.8412	) =	43.286		
(26-30 yr)	Twout =	59.5339 C	Twa = 0.5*(Twin+Twout)	0.5*(	61.6866	+	59.5339	) =	60.6103		
	Tpout =	77.0186 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	79.9753	+	77.0186	) =	78.497		
	qw =	Aw x h x { (Twa =	60.61025) -	Tain=	39.7308063	} =	49.4256	kW			
	qp =	Ap x h x { (Tpa =	78.49695) -	Tain=	39.7308063	} =	26.0951	kW			
	Taout =	39.7308 + (qw+qp)	75.520761)/(Q*rho*Cp)		10.6211977	=	46.8412	C	q-rm =	64.7118

Time Step 9	Tain =	38.4375 C	Taa = 0.5*(Tain+Taout) =	0.5*(	38.4375	+	44.9712	) =	41.7044		
(30-40 yr)	Twout =	55.6848 C	Twa = 0.5*(Twin+Twout)	0.5*(	59.5339	+	55.6848	) =	57.6093		
	Tpout =	71.1996 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	77.0186	+	71.1996	) =	74.1091		
	qw =	Aw x h x { (Twa =	57.609317) -	Tain=	38.4375451	} =	45.3832	kW			
	qp =	Ap x h x { (Tpa =	74.1091) -	Tain=	38.4375451	} =	24.012	kW			
	Taout =	38.4375 + (qw+qp)	69.395277)/(Q*rho*Cp)		10.6211977	=	44.9712	C	q-rm =	59.463

Time Step 10	Tain =	36.8185 C	Taa = 0.5*(Tain+Taout) =	0.5*(	36.8185	+	42.6365	) =	39.7275		
(40-50 yr)	Twout =	52.095 C	Twa = 0.5*(Twin+Twout)	0.5*(	55.6848	+	52.095	) =	53.8899		
	Tpout =	65.9695 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	71.1996	+	65.9695	) =	68.5846		
	qw =	Aw x h x { (Twa =	53.889883) -	Tain=	36.8184743	} =	40.4113	kW			
	qp =	Ap x h x { (Tpa =	68.58455) -	Tain=	36.8184743	} =	21.3831	kW			
	Taout =	36.8185 + (qw+qp)	61.794374)/(Q*rho*Cp)		10.6211977	=	42.6365	C	q-rm =	52.95

Time Step 11	Tain =	35.4419 C	Taa = 0.5*(Tain+Taout) =	0.5*(	35.4419	+	40.6052	) =	38.0236		
(50-60 yr)	Twout =	49.0374 C	Twa = 0.5*(Twin+Twout)	0.5*(	52.095	+	49.0374	) =	50.5662		
	Tpout =	61.478 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	65.9695	+	61.478	) =	63.7238		
	qw =	Aw x h x { (Twa =	50.566217) -	Tain=	35.4419423	} =	35.802	kW			
	qp =	Ap x h x { (Tpa =	63.72375) -	Tain=	35.4419423	} =	19.0377	kW			
	Taout =	35.4419 + (qw+qp)	54.839727)/(Q*rho*Cp)		10.6211977	=	40.6052	C	q-rm =	46.9908

Time Step 12	Tain =	34.309 C	Taa = 0.5*(Tain+Taout) =	0.5*(	34.309	+	38.9236	) =	36.6163		
(60-70 yr)	Twout =	46.5723 C	Twa = 0.5*(Twin+Twout)	0.5*(	49.0374	+	46.5723	) =	47.8049		
	Tpout =	57.844 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	61.478	+	57.844	) =	59.661		
	qw =	Aw x h x { (Twa =	47.804883) -	Tain=	34.3090212	} =	31.9473	kW			
	qp =	Ap x h x { (Tpa =	59.661) -	Tain=	34.3090212	} =	17.0655	kW			
	Taout =	34.309 + (qw+qp)	49.012772)/(Q*rho*Cp)		10.6211977	=	38.9236	C	q-rm =	41.9978

Time Step 13	Tain =	33.3957 C	Taa = 0.5*(Tain+Taout) =	0.5*(	33.3957	+	37.5637	) =	35.4797		
(70-80 yr)	Twout =	44.5663 C	Twa = 0.5*(Twin+Twout)	0.5*(	46.5723	+	44.5663	) =	45.5693		
	Tpout =	54.8584 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	57.844	+	54.8584	) =	56.3512		
	qw =	Aw x h x { (Twa =	45.5693) -	Tain=	33.3956727	} =	28.8173	kW			
	qp =	Ap x h x { (Tpa =	56.3512) -	Tain=	33.3956727	} =	15.4523	kW			
	Taout =	33.3957 + (qw+qp)	44.269637)/(Q*rho*Cp)		10.6211977	=	37.5637	C	q-rm =	37.9335

Time Step 14	Tain =	32.6453 C	Taa = 0.5*(Tain+Taout) =	0.5*(	32.6453	+	36.4461	) =	34.5457		
(80-90 yr)	Twout =	42.9074 C	Twa = 0.5*(Twin+Twout)	0.5*(	44.5663	+	42.9074	) =	43.7369		
	Tpout =	52.3651 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	54.8584	+	52.3651	) =	53.6118		
	qw =	Aw x h x { (Twa =	43.73685) -	Tain=	32.6452935	} =	26.2558	kW			
	qp =	Ap x h x { (Tpa =	53.61175) -	Tain=	32.6452935	} =	14.1134	kW			
	Taout =	32.6453 + (qw+qp)	40.369241)/(Q*rho*Cp)		10.6211977	=	36.4461	C	q-rm =	34.5914

Time Step 15	Tain =	32.0217 C	Taa = 0.5*(Tain+Taout) =	0.5*(	32.0217	+	35.5156	) =	33.7686		
(90-100 yr)	Twout =	41.5142 C	Twa = 0.5*(Twin+Twout)	0.5*(	42.9074	+	41.5142	) =	42.2108		
	Tpout =	50.271 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	52.3651	+	50.271	) =	51.3181		
	qw =	Aw x h x { (Twa =	42.210833) -	Tain=	32.0217152	} =	24.1196	kW			
	qp =	Ap x h x { (Tpa =	51.31805) -	Tain=	32.0217152	} =	12.9892	kW			
	Taout =	32.0217 + (qw+qp)	37.108768)/(Q*rho*Cp)		10.6211977	=	35.5156	C	q-rm =	31.7975

Time Step 16	Tain =	31.3209	C	Taa = 0.5*(Tain+Taout) =	0.5*(	31.3209	+	34.4862	) =	32.9036			
(100-125 yr)	Twout =	39.5995	C	Twa = 0.5*(Twin+Twout)	0.5*(	41.5142	+	39.5995	) =	40.5569			
	Tpout =	47.2999	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	50.271	+	47.2999	) =	48.7855			
	qw =	Aw x h x { (Twa =	40.556867	) -	Tain=	31.3209462	} =	21.8632	kW				
	qp =	Ap x h x { (Tpa =	48.78545	) -	Tain=	31.3209462	} =	11.7561	kW				
	Taout =	31.3209	+ (qw+qp)	33.619284	)/(Q*rho*Cp)	10.6211977	=	34.49	C	q-rm =	28.8075		

Time Step 17	Tain =	30.48	C	Taa = 0.5*(Tain+Taout) =	0.5*(	30.48	+	33.26	) =	31.87			
(125-150 yr)	Twout =	37.61	C	wa = 0.5*(Twin+Twout) =	0.5*(	39.60	+	37.61	) =	38.60			
	Tpout =	44.18	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	47.30	+	44.18	) =	45.74			
	qw =	Aw x h x { (Twa =	38.60	) -	Tain=	30.48	} =	19.23	kW				
	qp =	Ap x h x { (Tpa =	45.74	) -	Tain=	30.48	} =	10.27	kW				
	Taout =	30.48	+ (qw+qp)	29.50	)/(Q*rho*Cp)	10.62	=	33.26	C	q-rm =	25.28		

Time Step 18	Tain =	29.65	C	Taa = 0.5*(Tain+Taout) =	0.5*(	29.65	+	32.03	) =	30.84			
(150-200 yr)	Twout =	35.63	C	wa = 0.5*(Twin+Twout) =	0.5*(	37.61	+	35.63	) =	36.62			
	Tpout =	41.18	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	44.18	+	41.18	) =	42.68			
	qw =	Aw x h x { (Twa =	36.62	) -	Tain=	29.65	} =	16.50	kW				
	qp =	Ap x h x { (Tpa =	42.68	) -	Tain=	29.65	} =	8.77	kW				
	Taout =	29.65	+ (qw+qp)	25.27	)/(Q*rho*Cp)	10.62	=	32.03	C	q-rm =	21.65		

Time Step 19	Tain =	28.99	C	Taa = 0.5*(Tain+Taout) =	0.5*(	28.99	+	31.03	) =	30.01			
(200-250 yr)	Twout =	34.29	C	wa = 0.5*(Twin+Twout) =	0.5*(	35.63	+	34.29	) =	34.96			
	Tpout =	39.21	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	41.18	+	39.21	) =	40.20			
	qw =	Aw x h x { (Twa =	34.96	) -	Tain=	28.99	} =	14.15	kW				
	qp =	Ap x h x { (Tpa =	40.20	) -	Tain=	28.99	} =	7.55	kW				
	Taout =	28.99	+ (qw+qp)	21.69	)/(Q*rho*Cp)	10.62	=	31.03	C	q-rm =	18.59		

Time Step 20	Tain =	28.55	C	Taa = 0.5*(Tain+Taout) =	0.5*(	28.55	+	30.36	) =	29.45			
(250-300 yr)	Twout =	33.36	C	wa = 0.5*(Twin+Twout) =	0.5*(	34.29	+	33.36	) =	33.83			
	Tpout =	37.84	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	39.21	+	37.84	) =	38.53			
	qw =	Aw x h x { (Twa =	33.83	) -	Tain=	28.55	} =	12.50	kW				
	qp =	Ap x h x { (Tpa =	38.53	) -	Tain=	28.55	} =	6.72	kW				
	Taout =	28.55	+ (qw+qp)	19.21	)/(Q*rho*Cp)	10.62	=	30.36	C	q-rm =	16.46		

DRIFT SEGMENT # 4 (300-400m) Air Quantity, Q = 10 m^3/s 60 MTU/acre

Wall Temperature Results from ANSYS Modeling

Time, Yr	Drift Wall Temperature, C		
	Invert	Springline	Crown
0.00	25.00	25.00	25.00
0.00	27.95	28.45	27.92
1.00	70.70	74.05	70.68
5.00	80.05	82.90	80.02
10.00	78.76	81.33	78.72
15.00	75.10	77.46	75.06
20.00	71.57	73.77	71.52
26.00	67.89	69.92	67.85
30.00	65.35	67.28	65.31
40.00	61.09	62.78	61.06
50.00	56.98	58.47	56.95
60.00	53.42	54.75	53.40
70.00	50.52	51.71	50.49
80.00	48.15	49.24	48.13
90.00	46.21	47.19	46.19
100.00	44.57	45.48	44.55
125.00	42.39	43.18	42.37
150.00	40.09	40.76	40.07
200.00	37.78	38.33	37.76
250.00	36.15	36.63	36.13
300.00	35.02	35.46	35.00

Drift Wall and Air Temperatures, C

Time Afte Emplm't, Y	Ave. Drift Wall Tem	Air Temp at 400 m
0.00	25.00	25.00
0.00	28.10	29.43
1.00	71.81	50.59
5.00	80.99	62.41
10.00	79.60	63.30
15.00	75.87	61.04
20.00	72.29	58.45
26.00	68.55	55.92
30.00	65.98	53.78
40.00	61.64	51.37
50.00	57.47	48.38
60.00	53.86	45.72
70.00	50.91	43.51
80.00	48.51	41.71
90.00	46.53	40.23
100.00	44.87	39.00
125.00	42.65	37.65
150.00	40.31	36.06
200.00	37.96	34.44
250.00	36.30	33.10
300.00	35.16	32.19

Air Temperature and Heat Calculations

Tin =	25.00 C	D.S =	81.00 m	WP Dia. =	1.56	Ap =	4.91	m^2
Drift L =	600.00 m	P.G. =	0.10 m	Drift Dia. =	5.50	Aw =	17.28	m^2
Delta L =	100.00 m	T.L. =	60.00 MTU/ac	Air Dens. =	1.06	kg/m^3		
Cv. Coeff. h=	1.37 W/m^2 K	L.L. =	1.55 kW/m	Air Cp =	1.01	kJ/kg K		

Time Step 1	Tain =	25.00 C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00	+	29.43	) =		27.22
(0-1e-4 yr)	Twout =	28.10 C	Twa = 0.5*(Twin+Twout)	0.5*(	25.00	+	28.10	) =		26.55
	Tpout =	108.97 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.00	+	108.97	) =		89.49
	qw =	Aw x h x { (Twa =	26.55) -	Tain=	25.00 } =		3.67 kW			
	qp =	Ap x h x { (Tpa =	89.49) -	Tain=	25.00 } =		43.41 kW			
	Taout =	25.00 + (qw+qp)	47.08)/(Q*rho*Cp)		10.62	=	29.43 C		q-rm =	40.34

Time Step 2	Tain =	46.03 C	Taa = 0.5*(Tain+Taout)	0.5*(	46.03	+	50.59	) =		48.31
(1e-4-1 yr)	Twout =	71.81 C	Twa = 0.5*(Twin+Twout)	0.5*(	28.10	+	71.81	) =		49.96
	Tpout =	99.53 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	108.97	+	99.53	) =		104.25
	qw =	Aw x h x { (Twa =	49.96) -	Tain=	46.03 } =		9.30 kW			
	qp =	Ap x h x { (Tpa =	104.25) -	Tain=	46.03 } =		39.19 kW			
	Taout =	46.03 + (qw+qp)	48.49)/(Q*rho*Cp)		10.62	=	50.59 C		q-rm =	41.55

Time Step 3	Tain =	54.51 C	Taa = 0.5*(Tain+Taout) =	0.5*(	54.51	+	62.41	) =		58.46
(1-5 yr)	Twout =	80.99 C	Twa = 0.5*(Twin+Twout)	0.5*(	71.81	+	80.99	) =		76.40
	Tpout =	104.69 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	99.53	+	104.69	) =		102.11
	qw =	Aw x h x { (Twa =	76.40) -	Tain=	54.51 } =		51.81 kW			
	qp =	Ap x h x { (Tpa =	102.11) -	Tain=	54.51 } =		32.04 kW			
	Taout =	54.51 + (qw+qp)	83.85)/(Q*rho*Cp)		10.62	=	62.41 C		q-rm =	71.85

Time Step 4	Tain =	54.46 C	Taa = 0.5*(Tain+Taout)	0.5*(	54.46	+	63.30	) =		58.88
(5-10 yr)	Twout =	79.60 C	Twa = 0.5*(Twin+Twout)	0.5*(	80.99	+	79.60	) =		80.30
	Tpout =	101.24 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	104.69	+	101.24	) =		102.96
	qw =	Aw x h x { (Twa =	80.30) -	Tain=	54.46 } =		61.15 kW			
	qp =	Ap x h x { (Tpa =	102.96) -	Tain=	54.46 } =		32.65 kW			
	Taout =	54.46 + (qw+qp)	93.79)/(Q*rho*Cp)		10.62	=	63.30 C		q-rm =	80.37

Time Step 5	Tain =	52.49 C	Taa = 0.5*(Tain+Taout) =	0.5*(	52.49	+	61.04	) =		56.77
(10-15 yr)	Twout =	75.87 C	Twa = 0.5*(Twin+Twout)	0.5*(	79.60	+	75.87	) =		77.74
	Tpout =	95.99 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	101.24	+	95.99	) =		98.61
	qw =	Aw x h x { (Twa =	77.74) -	Tain=	52.49 } =		59.76 kW			
	qp =	Ap x h x { (Tpa =	98.61) -	Tain=	52.49 } =		31.04 kW			
	Taout =	52.49 + (qw+qp)	90.80)/(Q*rho*Cp)		10.62	=	61.04 C		q-rm =	77.80

Time Step 6	Tain =	50.44 C	Taa = 0.5*(Tain+Taout)	0.5*(	50.44 +	58.45) =	54.45				
(15-20 yr)	Twout =	72.29 C	Twa = 0.5*(Twin+Twout)	0.5*(	75.87 +	72.29) =	74.08				
	Tpout =	91.23 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	95.99 +	91.23) =	93.61				
	qw =	Aw x h x { (Twa =	74.08) -	Tain=	50.44 } =	55.95 kW					
	qp =	Ap x h x { (Tpa =	93.61) -	Tain=	50.44 } =	29.06 kW					
	Taout =	50.44 + (qw+qp)	85.01)/(Q*rho*Cp)		10.62 =	58.45 C	q-rm =	72.84			
Time Step 7	Tain =	48.48 C	Taa = 0.5*(Tain+Taout) =	0.5*(	48.48 +	55.92) =	52.20				
(20-26 yr)	Twout =	68.55 C	Twa = 0.5*(Twin+Twout)	0.5*(	72.29 +	68.55) =	70.42				
	Tpout =	86.16 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	91.23 +	86.16) =	88.69				
	qw =	Aw x h x { (Twa =	70.42) -	Tain=	48.48 } =	51.93 kW					
	qp =	Ap x h x { (Tpa =	88.69) -	Tain=	48.48 } =	27.07 kW					
	Taout =	48.48 + (qw+qp)	79.00)/(Q*rho*Cp)		10.62 =	55.92 C	q-rm =	67.69			
Time Step 8	Tain =	46.84 C	Taa = 0.5*(Tain+Taout)	0.5*(	46.84 +	53.78) =	50.31				
(26-30 yr)	Twout =	65.98 C	Twa = 0.5*(Twin+Twout)	0.5*(	68.55 +	65.98) =	67.27				
	Tpout =	82.84 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	86.16 +	82.84) =	84.50				
	qw =	Aw x h x { (Twa =	67.27) -	Tain=	46.84 } =	48.36 kW					
	qp =	Ap x h x { (Tpa =	84.50) -	Tain=	46.84 } =	25.35 kW					
	Taout =	46.84 + (qw+qp)	73.71)/(Q*rho*Cp)		10.62 =	53.78 C	q-rm =	63.16			
Time Step 9	Tain =	44.97 C	Taa = 0.5*(Tain+Taout) =	0.5*(	44.97 +	51.37) =	48.17				
(30-40 yr)	Twout =	61.64 C	Twa = 0.5*(Twin+Twout)	0.5*(	65.98 +	61.64) =	63.81				
	Tpout =	76.65 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	82.84 +	76.65) =	79.74				
	qw =	Aw x h x { (Twa =	63.81) -	Tain=	44.97 } =	44.60 kW					
	qp =	Ap x h x { (Tpa =	79.74) -	Tain=	44.97 } =	23.41 kW					
	Taout =	44.97 + (qw+qp)	68.01)/(Q*rho*Cp)		10.62 =	51.37 C	q-rm =	58.28			
Time Step 10	Tain =	42.64 C	Taa = 0.5*(Tain+Taout) =	0.5*(	42.64 +	48.38) =	45.51				
(40-50 yr)	Twout =	57.47 C	Twa = 0.5*(Twin+Twout)	0.5*(	61.64 +	57.47) =	59.56				
	Tpout =	70.92 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	76.65 +	70.92) =	73.78				
	qw =	Aw x h x { (Twa =	59.56) -	Tain=	42.64 } =	40.05 kW					
	qp =	Ap x h x { (Tpa =	73.78) -	Tain=	42.64 } =	20.97 kW					
	Taout =	42.64 + (qw+qp)	61.02)/(Q*rho*Cp)		10.62 =	48.38 C	q-rm =	52.28			
Time Step 11	Tain =	40.61 C	Taa = 0.5*(Tain+Taout) =	0.5*(	40.61 +	45.72) =	43.16				
(50-60 yr)	Twout =	53.86 C	Twa = 0.5*(Twin+Twout)	0.5*(	57.47 +	53.86) =	55.66				
	Tpout =	65.95 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.92 +	65.95) =	68.44				
	qw =	Aw x h x { (Twa =	55.66) -	Tain=	40.61 } =	35.64 kW					
	qp =	Ap x h x { (Tpa =	68.44) -	Tain=	40.61 } =	18.73 kW					
	Taout =	40.61 + (qw+qp)	54.38)/(Q*rho*Cp)		10.62 =	45.72 C	q-rm =	46.59			
Time Step 12	Tain =	38.92 C	Taa = 0.5*(Tain+Taout) =	0.5*(	38.92 +	43.51) =	41.22				
(60-70 yr)	Twout =	50.91 C	Twa = 0.5*(Twin+Twout)	0.5*(	53.86 +	50.91) =	52.38				
	Tpout =	61.90 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	65.95 +	61.90) =	63.92				
	qw =	Aw x h x { (Twa =	52.38) -	Tain=	38.92 } =	31.86 kW					
	qp =	Ap x h x { (Tpa =	63.92) -	Tain=	38.92 } =	16.83 kW					
	Taout =	38.92 + (qw+qp)	48.69)/(Q*rho*Cp)		10.62 =	43.51 C	q-rm =	41.72			
Time Step 13	Tain =	37.56 C	Taa = 0.5*(Tain+Taout) =	0.5*(	37.56 +	41.71) =	39.64				
(70-80 yr)	Twout =	48.51 C	Twa = 0.5*(Twin+Twout)	0.5*(	50.91 +	48.51) =	49.71				
	Tpout =	58.56 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	61.90 +	58.56) =	60.23				
	qw =	Aw x h x { (Twa =	49.71) -	Tain=	37.56 } =	28.75 kW					
	qp =	Ap x h x { (Tpa =	60.23) -	Tain=	37.56 } =	15.26 kW					
	Taout =	37.56 + (qw+qp)	44.00)/(Q*rho*Cp)		10.62 =	41.71 C	q-rm =	37.71			
Time Step 14	Tain =	36.45 C	Taa = 0.5*(Tain+Taout) =	0.5*(	36.45 +	40.23) =	38.34				
(80-90 yr)	Twout =	46.53 C	Twa = 0.5*(Twin+Twout)	0.5*(	48.51 +	46.53) =	47.52				
	Tpout =	55.78 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	58.56 +	55.78) =	57.17				
	qw =	Aw x h x { (Twa =	47.52) -	Tain=	36.45 } =	26.21 kW					
	qp =	Ap x h x { (Tpa =	57.17) -	Tain=	36.45 } =	13.95 kW					
	Taout =	36.45 + (qw+qp)	40.16)/(Q*rho*Cp)		10.62 =	40.23 C	q-rm =	34.41			
Time Step 15	Tain =	35.52 C	Taa = 0.5*(Tain+Taout) =	0.5*(	35.52 +	39.00) =	37.26				
(90-100 yr)	Twout =	44.87 C	Twa = 0.5*(Twin+Twout)	0.5*(	46.53 +	44.87) =	45.70				
	Tpout =	53.45 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	55.78 +	53.45) =	54.62				
	qw =	Aw x h x { (Twa =	45.70) -	Tain=	35.52 } =	24.11 kW					
	qp =	Ap x h x { (Tpa =	54.62) -	Tain=	35.52 } =	12.86 kW					
	Taout =	35.52 + (qw+qp)	36.96)/(Q*rho*Cp)		10.62 =	39.00 C	q-rm =	31.67			

Time Step 16	Tain =	34.49	C	Taa = 0.5*(Tain+Taout) =	0.5*(	34.49	+	37.65	) =	36.07			
(100-125 yr)	Twout =	42.65	C	Twa = 0.5*(Twin+Twout)	0.5*(	44.87	+	42.65	) =	43.76			
	Tpout =	50.21	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	53.45	+	50.21	) =	51.83			
	qw =	Aw x h x { (Twa =	43.76	) - Tain=	34.49	} =	21.95	kW					
	qp =	Ap x h x { (Tpa =	51.83	) - Tain=	34.49	} =	11.67	kW					
	Taout =	34.49	+ (qw+qp)	33.62	)/(Q*rho*Cp)	10.62	=	37.65	C	q-rm =	28.81		

Time Step 17	Tain =	33.26	C	Taa = 0.5*(Tain+Taout) =	0.5*(	33.26	+	36.06	) =	34.66			
(125-150 yr)	Twout =	40.31	C	wa = 0.5*(Twin+Twout) =	0.5*(	42.65	+	40.31	) =	41.48			
	Tpout =	46.77	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	50.21	+	46.77	) =	48.49			
	qw =	Aw x h x { (Twa =	41.48	) - Tain=	33.26	} =	19.45	kW					
	qp =	Ap x h x { (Tpa =	48.49	) - Tain=	33.26	} =	10.25	kW					
	Taout =	33.26	+ (qw+qp)	29.70	)/(Q*rho*Cp)	10.62	=	36.06	C	q-rm =	25.45		

Time Step 18	Tain =	32.03	C	Taa = 0.5*(Tain+Taout) =	0.5*(	32.03	+	34.44	) =	33.24			
(150-200 yr)	Twout =	37.96	C	wa = 0.5*(Twin+Twout) =	0.5*(	40.31	+	37.96	) =	39.13			
	Tpout =	43.42	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	46.77	+	43.42	) =	45.10			
	qw =	Aw x h x { (Twa =	39.13	) - Tain=	32.03	} =	16.81	kW					
	qp =	Ap x h x { (Tpa =	45.10	) - Tain=	32.03	} =	8.80	kW					
	Taout =	32.03	+ (qw+qp)	25.61	)/(Q*rho*Cp)	10.62	=	34.44	C	q-rm =	21.94		

Time Step 19	Tain =	31.03	C	Taa = 0.5*(Tain+Taout) =	0.5*(	31.03	+	33.10	) =	32.07			
(200-250 yr)	Twout =	36.30	C	wa = 0.5*(Twin+Twout) =	0.5*(	37.96	+	36.30	) =	37.13			
	Tpout =	41.16	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	43.42	+	41.16	) =	42.29			
	qw =	Aw x h x { (Twa =	37.13	) - Tain=	31.03	} =	14.44	kW					
	qp =	Ap x h x { (Tpa =	42.29	) - Tain=	31.03	} =	7.58	kW					
	Taout =	31.03	+ (qw+qp)	22.02	)/(Q*rho*Cp)	10.62	=	33.10	C	q-rm =	18.87		

Time Step 20	Tain =	30.36	C	Taa = 0.5*(Tain+Taout) =	0.5*(	30.36	+	32.19	) =	31.27			
(250-300 yr)	Twout =	35.16	C	wa = 0.5*(Twin+Twout) =	0.5*(	36.30	+	35.16	) =	35.73			
	Tpout =	39.58	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	41.16	+	39.58	) =	40.37			
	qw =	Aw x h x { (Twa =	35.73	) - Tain=	30.36	} =	12.72	kW					
	qp =	Ap x h x { (Tpa =	40.37	) - Tain=	30.36	} =	6.74	kW					
	Taout =	30.36	+ (qw+qp)	19.46	)/(Q*rho*Cp)	10.62	=	32.19	C	q-rm =	16.67		

Sheet E Page 1

DRIFT SEGMENT # 5 (400-500m) Air Quantity, Q = 10 m^3/s 60 MTU/acre

Wall Temperature Results from ANSYS Modeling

Time, Yr	Drift Wall Temperature, C		
	Invert	Springline	Crown
0.00	25.00	25.00	25.00
0.00	27.95	28.45	27.92
1.00	73.88	77.20	73.87
5.00	86.61	89.39	86.58
10.00	86.39	88.89	86.35
15.00	82.63	84.92	82.59
20.00	78.71	80.85	78.67
26.00	74.59	76.56	74.55
30.00	71.65	73.53	71.61
40.00	66.93	68.59	66.90
50.00	62.27	63.74	62.24
60.00	58.18	59.49	58.15
70.00	54.83	56.00	54.80
80.00	52.08	53.15	52.06
90.00	49.81	50.78	49.79
100.00	47.91	48.80	47.89
125.00	45.42	46.21	45.40
150.00	42.80	43.46	42.78
200.00	40.13	40.68	40.11
250.00	38.18	38.67	38.17
300.00	36.83	37.27	36.81

Drift Wall and Air Temperatures, C

Time Afte Emplm't, Y	Ave. Drift Wall Tem	Air Temp at 500 m
0.00	25.00	25.00
0.00	28.10	29.43
1.00	74.98	54.30
5.00	87.52	69.40
10.00	87.21	71.57
15.00	83.38	69.26
20.00	79.41	66.21
26.00	75.23	63.16
30.00	72.26	60.55
40.00	67.47	57.64
50.00	62.75	54.04
60.00	58.61	50.79
70.00	55.21	48.06
80.00	52.43	45.83
90.00	50.12	43.99
100.00	48.20	42.46
125.00	45.68	40.81
150.00	43.01	38.87
200.00	40.30	36.88
250.00	38.34	35.20
300.00	36.97	34.04

Air Temperature and Heat Removal Calculations

Tin =	25.00	C	D.S =	81.00	m	WP Dia. =	1.56	Ap =	4.91 m^2
Drift L =	600.00	m	P.G. =	0.10	m	Drift Dia. =	5.50	Aw =	17.28 m^2
Delta L =	100.00	m	T.L. =	60.00	MTU/ac	Air Dens. =	1.06	kg/m^3	
Cv. Coeff. h=	1.37	W/m^2 K	L.L. =	1.55	kW/m	Air Cp =	1.01	kJ/kg K	

Time Step 1	Tain =	25.00	C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00	+	29.43	) =	27.22
(0-1e-4 yr)	Twout =	28.10	C	Twa = 0.5*(Twin+Twout)	0.5*(	25.00	+	28.10	) =	26.55
	Tpout =	108.97	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.00	+	108.97	) =	89.49
	qw =	Aw x h x { (Twa =	26.55	) - Tain=	25.00	} =	3.67	kW		
	qp =	Ap x h x { (Tpa =	89.49	) - Tain=	25.00	} =	43.41	kW		
	Taout =	25.00	+ (qw+qp)	47.08	)/(Q*rho*Cp)	10.62	=	29.43	C	q-rm =	40.34

Time Step 2	Tain =	50.59	C	Taa = 0.5*(Tain+Taout)	0.5*(	50.59	+	54.30	) =	52.45
(1e-4-1 yr)	Twout =	74.98	C	Twa = 0.5*(Twin+Twout)	0.5*(	28.10	+	74.98	) =	51.54
	Tpout =	102.56	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	108.97	+	102.56	) =	105.77
	qw =	Aw x h x { (Twa =	51.54	) - Tain=	50.59	} =	2.25	kW		
	qp =	Ap x h x { (Tpa =	105.77	) - Tain=	50.59	} =	37.14	kW		
	Taout =	50.59	+ (qw+qp)	39.39	)/(Q*rho*Cp)	10.62	=	54.30	C	q-rm =	33.75

Time Step 3	Tain =	62.41	C	Taa = 0.5*(Tain+Taout) =	0.5*(	62.41	+	69.40	) =	65.91
(1-5 yr)	Twout =	87.52	C	Twa = 0.5*(Twin+Twout)	0.5*(	74.98	+	87.52	) =	81.25
	Tpout =	110.48	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	102.56	+	110.48	) =	106.52
	qw =	Aw x h x { (Twa =	81.25	) - Tain=	62.41	} =	44.61	kW		
	qp =	Ap x h x { (Tpa =	106.52	) - Tain=	62.41	} =	29.69	kW		
	Taout =	62.41	+ (qw+qp)	74.31	)/(Q*rho*Cp)	10.62	=	69.40	C	q-rm =	63.67

Time Step 4	Tain =	63.30	C	Taa = 0.5*(Tain+Taout)	0.5*(	63.30	+	71.57	) =	67.43
(5-10 yr)	Twout =	87.21	C	Twa = 0.5*(Twin+Twout)	0.5*(	87.52	+	87.21	) =	87.37
	Tpout =	108.00	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	110.48	+	108.00	) =	109.24
	qw =	Aw x h x { (Twa =	87.37	) - Tain=	63.30	} =	56.98	kW		
	qp =	Ap x h x { (Tpa =	109.24	) - Tain=	63.30	} =	30.93	kW		
	Taout =	63.30	+ (qw+qp)	87.91	)/(Q*rho*Cp)	10.62	=	71.57	C	q-rm =	75.33

Time Step 5	Tain =	61.04	C	Taa = 0.5*(Tain+Taout) =	0.5*(	61.04	+	69.26	) =	65.15
(10-15 yr)	Twout =	83.38	C	Twa = 0.5*(Twin+Twout)	0.5*(	87.21	+	83.38	) =	85.29
	Tpout =	102.70	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	108.00	+	102.70	) =	105.35
	qw =	Aw x h x { (Twa =	85.29	) - Tain=	61.04	} =	57.41	kW		
	qp =	Ap x h x { (Tpa =	105.35	) - Tain=	61.04	} =	29.83	kW		
	Taout =	61.04	+ (qw+qp)	87.23	)/(Q*rho*Cp)	10.62	=	69.26	C	q-rm =	74.75

Time Step 6	Tain =	58.45 C	Taa = 0.5*(Tain+Taout)	0.5*(	58.45 +	66.21) =	62.33				
(15-20 yr)	Twout =	79.41 C	Twa = 0.5*(Twin+Twout)	0.5*(	83.38 +	79.41) =	81.40				
	Tpout =	97.64 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	102.70 +	97.64) =	100.17				
	qw =	Aw x h x { (Twa =	81.40) -	Tain=	58.45 } =	54.32 kW					
	qp =	Ap x h x { (Tpa =	100.17) -	Tain=	58.45 } =	28.09 kW					
	Taout =	58.45 + (qw+qp)	82.41)/(Q*rho*Cp)		10.62 =	66.21 C	q-rm =	70.61			

Time Step 7	Tain =	55.92 C	Taa = 0.5*(Tain+Taout) =	0.5*(	55.92 +	63.16) =	59.54				
(20-26 yr)	Twout =	75.23 C	Twa = 0.5*(Twin+Twout)	0.5*(	79.41 +	75.23) =	77.32				
	Tpout =	92.20 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	97.64 +	92.20) =	94.92				
	qw =	Aw x h x { (Twa =	77.32) -	Tain=	55.92 } =	50.66 kW					
	qp =	Ap x h x { (Tpa =	94.92) -	Tain=	55.92 } =	26.25 kW					
	Taout =	55.92 + (qw+qp)	76.91)/(Q*rho*Cp)		10.62 =	63.16 C	q-rm =	65.90			

Time Step 8	Tain =	53.78 C	Taa = 0.5*(Tain+Taout)	0.5*(	53.78 +	60.55) =	57.17				
(26-30 yr)	Twout =	72.26 C	Twa = 0.5*(Twin+Twout)	0.5*(	75.23 +	72.26) =	73.75				
	Tpout =	88.55 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	92.20 +	88.55) =	90.37				
	qw =	Aw x h x { (Twa =	73.75) -	Tain=	53.78 } =	47.27 kW					
	qp =	Ap x h x { (Tpa =	90.37) -	Tain=	53.78 } =	24.63 kW					
	Taout =	53.78 + (qw+qp)	71.90)/(Q*rho*Cp)		10.62 =	60.55 C	q-rm =	61.61			

Time Step 9	Tain =	51.37 C	Taa = 0.5*(Tain+Taout) =	0.5*(	51.37 +	57.64) =	54.51				
(30-40 yr)	Twout =	67.47 C	Twa = 0.5*(Twin+Twout)	0.5*(	72.26 +	67.47) =	69.87				
	Tpout =	81.99 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	88.55 +	81.99) =	85.27				
	qw =	Aw x h x { (Twa =	69.87) -	Tain=	51.37 } =	43.78 kW					
	qp =	Ap x h x { (Tpa =	85.27) -	Tain=	51.37 } =	22.82 kW					
	Taout =	51.37 + (qw+qp)	66.59)/(Q*rho*Cp)		10.62 =	57.64 C	q-rm =	57.06			

Time Step 10	Tain =	48.38 C	Taa = 0.5*(Tain+Taout) =	0.5*(	48.38 +	54.04) =	51.21				
(40-50 yr)	Twout =	62.75 C	Twa = 0.5*(Twin+Twout)	0.5*(	67.47 +	62.75) =	65.11				
	Tpout =	75.81 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	81.99 +	75.81) =	78.90				
	qw =	Aw x h x { (Twa =	65.11) -	Tain=	48.38 } =	39.60 kW					
	qp =	Ap x h x { (Tpa =	78.90) -	Tain=	48.38 } =	20.54 kW					
	Taout =	48.38 + (qw+qp)	60.15)/(Q*rho*Cp)		10.62 =	54.04 C	q-rm =	51.54			

Time Step 11	Tain =	45.72 C	Taa = 0.5*(Tain+Taout) =	0.5*(	45.72 +	50.79) =	48.26				
(50-60 yr)	Twout =	58.61 C	Twa = 0.5*(Twin+Twout)	0.5*(	62.75 +	58.61) =	60.68				
	Tpout =	70.38 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	75.81 +	70.38) =	73.09				
	qw =	Aw x h x { (Twa =	60.68) -	Tain=	45.72 } =	35.40 kW					
	qp =	Ap x h x { (Tpa =	73.09) -	Tain=	45.72 } =	18.42 kW					
	Taout =	45.72 + (qw+qp)	53.82)/(Q*rho*Cp)		10.62 =	50.79 C	q-rm =	46.12			

Time Step 12	Tain =	43.51 C	Taa = 0.5*(Tain+Taout) =	0.5*(	43.51 +	48.06) =	45.78				
(60-70 yr)	Twout =	55.21 C	Twa = 0.5*(Twin+Twout)	0.5*(	58.61 +	55.21) =	56.91				
	Tpout =	65.93 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.38 +	65.93) =	68.15				
	qw =	Aw x h x { (Twa =	56.91) -	Tain=	43.51 } =	31.73 kW					
	qp =	Ap x h x { (Tpa =	68.15) -	Tain=	43.51 } =	16.59 kW					
	Taout =	43.51 + (qw+qp)	48.32)/(Q*rho*Cp)		10.62 =	48.06 C	q-rm =	41.40			

Time Step 13	Tain =	41.71 C	Taa = 0.5*(Tain+Taout) =	0.5*(	41.71 +	45.83) =	43.77				
(70-80 yr)	Twout =	52.43 C	Twa = 0.5*(Twin+Twout)	0.5*(	55.21 +	52.43) =	53.82				
	Tpout =	62.25 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	65.93 +	62.25) =	64.09				
	qw =	Aw x h x { (Twa =	53.82) -	Tain=	41.71 } =	28.68 kW					
	qp =	Ap x h x { (Tpa =	64.09) -	Tain=	41.71 } =	15.07 kW					
	Taout =	41.71 + (qw+qp)	43.74)/(Q*rho*Cp)		10.62 =	45.83 C	q-rm =	37.48			

Time Step 14	Tain =	40.23 C	Taa = 0.5*(Tain+Taout) =	0.5*(	40.23 +	43.99) =	42.11				
(80-90 yr)	Twout =	50.12 C	Twa = 0.5*(Twin+Twout)	0.5*(	52.43 +	50.12) =	51.28				
	Tpout =	59.18 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	62.25 +	59.18) =	60.72				
	qw =	Aw x h x { (Twa =	51.28) -	Tain=	40.23 } =	26.16 kW					
	qp =	Ap x h x { (Tpa =	60.72) -	Tain=	40.23 } =	13.79 kW					
	Taout =	40.23 + (qw+qp)	39.95)/(Q*rho*Cp)		10.62 =	43.99 C	q-rm =	34.23			

Time Step 15	Tain =	39.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	39.00 +	42.46) =	40.73				
(90-100 yr)	Twout =	48.20 C	Twa = 0.5*(Twin+Twout)	0.5*(	50.12 +	48.20) =	49.16				
	Tpout =	56.61 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	59.18 +	56.61) =	57.89				
	qw =	Aw x h x { (Twa =	49.16) -	Tain=	39.00 } =	24.06 kW					
	qp =	Ap x h x { (Tpa =	57.89) -	Tain=	39.00 } =	12.72 kW					
	Taout =	39.00 + (qw+qp)	36.79)/(Q*rho*Cp)		10.62 =	42.46 C	q-rm =	31.52			

Time Step 16	Tain =	37.65	C	Taa = 0.5*(Tain+Taout) =	0.5*(	37.65	+	40.81	) =	39.23				
(100-125 yr)	Twout =	45.68	C	Twa = 0.5*(Twin+Twout)	0.5*(	48.20	+	45.68	) =	46.94				
	Tpout =	53.10	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	56.61	+	53.10	) =	54.85				
	qw =	Aw x h x { (Twa =	46.94	) -	Tain=	37.65	} =	21.98	kW					
	qp =	Ap x h x { (Tpa =	54.85	) -	Tain=	37.65	} =	11.58	kW					
	Taout =	37.65	+ (qw+qp)	33.56	)/(Q*rho*Cp)	10.62	=	40.81	C	q-rm =	28.76			

Time Step 17	Tain =	36.06	C	Taa = 0.5*(Tain+Taout) =	0.5*(	36.06	+	38.87	) =	37.46				
(125-150 yr)	Twout =	43.01	C	wa = 0.5*(Twin+Twout) =	0.5*(	45.68	+	43.01	) =	44.35				
	Tpout =	49.37	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	53.10	+	49.37	) =	51.24				
	qw =	Aw x h x { (Twa =	44.35	) -	Tain=	36.06	} =	19.63	kW					
	qp =	Ap x h x { (Tpa =	51.24	) -	Tain=	36.06	} =	10.22	kW					
	Taout =	36.06	+ (qw+qp)	29.84	)/(Q*rho*Cp)	10.62	=	38.87	C	q-rm =	25.57			

Time Step 18	Tain =	34.44	C	Taa = 0.5*(Tain+Taout) =	0.5*(	34.44	+	36.88	) =	35.66				
(150-200 yr)	Twout =	40.30	C	wa = 0.5*(Twin+Twout) =	0.5*(	43.01	+	40.30	) =	41.66				
	Tpout =	45.69	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	49.37	+	45.69	) =	47.53				
	qw =	Aw x h x { (Twa =	41.66	) -	Tain=	34.44	} =	17.09	kW					
	qp =	Ap x h x { (Tpa =	47.53	) -	Tain=	34.44	} =	8.81	kW					
	Taout =	34.44	+ (qw+qp)	25.90	)/(Q*rho*Cp)	10.62	=	36.88	C	q-rm =	22.19			

Time Step 19	Tain =	33.10	C	Taa = 0.5*(Tain+Taout) =	0.5*(	33.10	+	35.20	) =	34.15				
(200-250 yr)	Twout =	38.34	C	wa = 0.5*(Twin+Twout) =	0.5*(	40.30	+	38.34	) =	39.32				
	Tpout =	43.13	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	45.69	+	43.13	) =	44.41				
	qw =	Aw x h x { (Twa =	39.32	) -	Tain=	33.10	} =	14.72	kW					
	qp =	Ap x h x { (Tpa =	44.41	) -	Tain=	33.10	} =	7.61	kW					
	Taout =	33.10	+ (qw+qp)	22.33	)/(Q*rho*Cp)	10.62	=	35.20	C	q-rm =	19.14			

Time Step 20	Tain =	32.19	C	Taa = 0.5*(Tain+Taout) =	0.5*(	32.19	+	34.04	) =	33.12				
(250-300 yr)	Twout =	36.97	C	wa = 0.5*(Twin+Twout) =	0.5*(	38.34	+	36.97	) =	37.65				
	Tpout =	41.34	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	43.13	+	41.34	) =	42.23				
	qw =	Aw x h x { (Twa =	37.65	) -	Tain=	32.19	} =	12.93	kW					
	qp =	Ap x h x { (Tpa =	42.23	) -	Tain=	32.19	} =	6.76	kW					
	Taout =	32.19	+ (qw+qp)	19.69	)/(Q*rho*Cp)	10.62	=	34.04	C	q-rm =	16.87			

DRIFT SEGMENT # 6 (500-600m) Air Quantity, Q = 10 m^3/s 60MTU/acre

Wall Temperature Results from ANSYS Modeling

Time, Yr	Drift Wall Temperature, C		
	Invert	Springline	Crown
0.00	25.00	25.00	25.00
0.00	27.95	28.45	27.92
1.00	76.53	79.82	76.51
5.00	92.38	95.10	92.36
10.00	93.49	95.92	93.45
15.00	89.84	92.07	89.80
20.00	85.61	87.69	85.56
26.00	81.09	83.01	81.04
30.00	77.78	79.61	77.73
40.00	72.64	74.26	72.60
50.00	67.48	68.92	67.45
60.00	62.89	64.18	62.86
70.00	59.09	60.25	59.07
80.00	55.97	57.02	55.95
90.00	53.38	54.34	53.36
100.00	51.21	52.10	51.19
125.00	48.45	49.23	48.43
150.00	45.51	46.17	45.50
200.00	42.50	43.05	42.48
250.00	40.24	40.73	40.23
300.00	38.65	39.09	38.64

Drift Wall and Air Temperatures

Time Afte Emplm't, Y	Ave. Drift Wall Tem	Air Temp at 600 m
0.00	25.00	25.00
0.00	28.10	29.43
1.00	77.62	57.32
5.00	93.28	75.57
10.00	94.28	79.27
15.00	90.57	77.11
20.00	86.29	73.71
26.00	81.71	70.20
30.00	78.37	67.15
40.00	73.17	63.78
50.00	67.95	59.62
60.00	63.31	55.80
70.00	59.47	52.57
80.00	56.31	49.92
90.00	53.70	47.73
100.00	51.50	45.90
125.00	48.70	43.96
150.00	45.73	41.68
200.00	42.67	39.34
250.00	40.40	37.34
300.00	38.79	35.92

Air Temperature and Heat Removal Calculations

Tin =	25.00 C	D.S =	81.00 m	WP Dia. =	1.56	Ap =	4.91	m^2
Drift L =	600.00 m	P.G. =	0.10 m	Drift Dia. =	5.50	Aw =	17.28	m^2
Delta L =	100.00 m	T.L. =	60.00 MTU/ac	Air Dens. =	1.06	kg/m^3		
Cv. Coeff. h=	1.37 W/m^2 K	L.L. =	1.55 kW/m	Air Cp =	1.01	kJ/kg K		

Time Step 1	Tain =	25.00	C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00	+	29.43	) =	27.22		
(0-1e-4 yr)	Twout =	28.10	C	Twa = 0.5*(Twin+Twout)	0.5*(	25.00	+	28.10	) =	26.55		
	Tpout =	108.97	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.00	+	108.97	) =	89.49		
	qw =	Aw x h x { (Twa =	26.55	) - Tain=	25.00	} =	3.67	kW				
	qp =	Ap x h x { (Tpa =	89.49	) - Tain=	25.00	} =	43.41	kW				
	Taout =	25.00	+ (qw+qp)	47.08	)/(Q*rho*Cp)	10.62	=	29.43	C	q-rm =	40.34	

Time Step 2	Tain =	54.30	C	Taa = 0.5*(Tain+Taout)	0.5*(	54.30	+	57.32	) =	55.81		
(1e-4-1 yr)	Twout =	77.62	C	Twa = 0.5*(Twin+Twout)	0.5*(	28.10	+	77.62	) =	52.86		
	Tpout =	104.88	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	108.97	+	104.88	) =	106.93		
	qw =	Aw x h x { (Twa =	52.86	) - Tain=	54.30	} =	-3.41	kW				
	qp =	Ap x h x { (Tpa =	106.93	) - Tain=	54.30	} =	35.42	kW				
	Taout =	54.30	+ (qw+qp)	32.01	)/(Q*rho*Cp)	10.62	=	57.32	C	q-rm =	27.43	

Time Step 3	Tain =	69.40	C	Taa = 0.5*(Tain+Taout) =	0.5*(	69.40	+	75.57	) =	72.49		
(1-5 yr)	Twout =	93.28	C	Twa = 0.5*(Twin+Twout)	0.5*(	77.62	+	93.28	) =	85.45		
	Tpout =	115.57	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	104.88	+	115.57	) =	110.23		
	qw =	Aw x h x { (Twa =	85.45	) - Tain=	69.40	} =	37.98	kW				
	qp =	Ap x h x { (Tpa =	110.23	) - Tain=	69.40	} =	27.48	kW				
	Taout =	69.40	+ (qw+qp)	65.46	)/(Q*rho*Cp)	10.62	=	75.57	C	q-rm =	56.09	

Time Step 4	Tain =	71.57	C	Taa = 0.5*(Tain+Taout)	0.5*(	71.57	+	79.27	) =	75.42		
(5-10 yr)	Twout =	94.28	C	Twa = 0.5*(Twin+Twout)	0.5*(	93.28	+	94.28	) =	93.78		
	Tpout =	114.35	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	115.57	+	114.35	) =	114.96		
	qw =	Aw x h x { (Twa =	93.78	) - Tain=	71.57	} =	52.58	kW				
	qp =	Ap x h x { (Tpa =	114.96	) - Tain=	71.57	} =	29.20	kW				
	Taout =	71.57	+ (qw+qp)	81.78	)/(Q*rho*Cp)	10.62	=	79.27	C	q-rm =	70.08	

Time Step 5	Tain =	69.26	C	Taa = 0.5*(Tain+Taout) =	0.5*(	69.26	+	77.11	) =	73.19		
(10-15 yr)	Twout =	90.57	C	Twa = 0.5*(Twin+Twout)	0.5*(	94.28	+	90.57	) =	92.43		
	Tpout =	109.17	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	114.35	+	109.17	) =	111.76		
	qw =	Aw x h x { (Twa =	92.43	) - Tain=	69.26	} =	54.85	kW				
	qp =	Ap x h x { (Tpa =	111.76	) - Tain=	69.26	} =	28.61	kW				
	Taout =	69.26	+ (qw+qp)	83.46	)/(Q*rho*Cp)	10.62	=	77.11	C	q-rm =	71.51	

Time Step 6	Tain =	66.21 C	Taa = 0.5*(Tain+Taout)	0.5*(	66.21 +	73.71) =	69.96			
(15-20 yr)	Twout =	86.29 C	Twa = 0.5*(Twin+Twout)	0.5*(	90.57 +	86.29) =	88.43			
	Tpout =	103.86 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	109.17 +	103.86) =	106.52			
	qw =	Aw x h x { (Twa =	88.43) -	Tain=	66.21 } =	52.60 kW				
	qp =	Ap x h x { (Tpa =	106.52) -	Tain=	66.21 } =	27.13 kW				
	Taout =	66.21 + (qw+qp)	79.74)/(Q*rho*Cp)		10.62 =	73.71 C	q-rm =	68.32		

Time Step 7	Tain =	63.16 C	Taa = 0.5*(Tain+Taout) =	0.5*(	63.16 +	70.20) =	66.68			
(20-26 yr)	Twout =	81.71 C	Twa = 0.5*(Twin+Twout)	0.5*(	86.29 +	81.71) =	84.00			
	Tpout =	98.09 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	103.86 +	98.09) =	100.98			
	qw =	Aw x h x { (Twa =	84.00) -	Tain=	63.16 } =	49.33 kW				
	qp =	Ap x h x { (Tpa =	100.98) -	Tain=	63.16 } =	25.45 kW				
	Taout =	63.16 + (qw+qp)	74.79)/(Q*rho*Cp)		10.62 =	70.20 C	q-rm =	64.08		

Time Step 8	Tain =	60.55 C	Taa = 0.5*(Tain+Taout)	0.5*(	60.55 +	67.15) =	63.85			
(26-30 yr)	Twout =	78.37 C	Twa = 0.5*(Twin+Twout)	0.5*(	81.71 +	78.37) =	80.04			
	Tpout =	94.12 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	98.09 +	94.12) =	96.11			
	qw =	Aw x h x { (Twa =	80.04) -	Tain=	60.55 } =	46.15 kW				
	qp =	Ap x h x { (Tpa =	96.11) -	Tain=	60.55 } =	23.93 kW				
	Taout =	60.55 + (qw+qp)	70.08)/(Q*rho*Cp)		10.62 =	67.15 C	q-rm =	60.05		

Time Step 9	Tain =	57.64 C	Taa = 0.5*(Tain+Taout) =	0.5*(	57.64 +	63.78) =	60.71			
(30-40 yr)	Twout =	73.17 C	Twa = 0.5*(Twin+Twout)	0.5*(	78.37 +	73.17) =	75.77			
	Tpout =	87.24 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	94.12 +	87.24) =	90.68			
	qw =	Aw x h x { (Twa =	75.77) -	Tain=	57.64 } =	42.91 kW				
	qp =	Ap x h x { (Tpa =	90.68) -	Tain=	57.64 } =	22.24 kW				
	Taout =	57.64 + (qw+qp)	65.15)/(Q*rho*Cp)		10.62 =	63.78 C	q-rm =	55.82		

Time Step 10	Tain =	54.04 C	Taa = 0.5*(Tain+Taout) =	0.5*(	54.04 +	59.62) =	56.83			
(40-50 yr)	Twout =	67.95 C	Twa = 0.5*(Twin+Twout)	0.5*(	73.17 +	67.95) =	70.56			
	Tpout =	80.63 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	87.24 +	80.63) =	83.94			
	qw =	Aw x h x { (Twa =	70.56) -	Tain=	54.04 } =	39.09 kW				
	qp =	Ap x h x { (Tpa =	83.94) -	Tain=	54.04 } =	20.12 kW				
	Taout =	54.04 + (qw+qp)	59.21)/(Q*rho*Cp)		10.62 =	59.62 C	q-rm =	50.74		

Time Step 11	Tain =	50.79 C	Taa = 0.5*(Tain+Taout) =	0.5*(	50.79 +	55.80) =	53.30			
(50-60 yr)	Twout =	63.31 C	Twa = 0.5*(Twin+Twout)	0.5*(	67.95 +	63.31) =	65.63			
	Tpout =	74.77 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	80.63 +	74.77) =	77.70			
	qw =	Aw x h x { (Twa =	65.63) -	Tain=	50.79 } =	35.12 kW				
	qp =	Ap x h x { (Tpa =	77.70) -	Tain=	50.79 } =	18.12 kW				
	Taout =	50.79 + (qw+qp)	53.24)/(Q*rho*Cp)		10.62 =	55.80 C	q-rm =	45.62		

Time Step 12	Tain =	48.06 C	Taa = 0.5*(Tain+Taout) =	0.5*(	48.06 +	52.57) =	50.31			
(60-70 yr)	Twout =	59.47 C	Twa = 0.5*(Twin+Twout)	0.5*(	63.31 +	59.47) =	61.39			
	Tpout =	69.93 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	74.77 +	69.93) =	72.35			
	qw =	Aw x h x { (Twa =	61.39) -	Tain=	48.06 } =	31.56 kW				
	qp =	Ap x h x { (Tpa =	72.35) -	Tain=	48.06 } =	16.35 kW				
	Taout =	48.06 + (qw+qp)	47.92)/(Q*rho*Cp)		10.62 =	52.57 C	q-rm =	41.06		

Time Step 13	Tain =	45.83 C	Taa = 0.5*(Tain+Taout) =	0.5*(	45.83 +	49.92) =	47.87			
(70-80 yr)	Twout =	56.31 C	Twa = 0.5*(Twin+Twout)	0.5*(	59.47 +	56.31) =	57.89			
	Tpout =	65.92 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	69.93 +	65.92) =	67.92			
	qw =	Aw x h x { (Twa =	57.89) -	Tain=	45.83 } =	28.56 kW				
	qp =	Ap x h x { (Tpa =	67.92) -	Tain=	45.83 } =	14.88 kW				
	Taout =	45.83 + (qw+qp)	43.44)/(Q*rho*Cp)		10.62 =	49.92 C	q-rm =	37.22		

Time Step 14	Tain =	43.99 C	Taa = 0.5*(Tain+Taout) =	0.5*(	43.99 +	47.73) =	45.86			
(80-90 yr)	Twout =	53.70 C	Twa = 0.5*(Twin+Twout)	0.5*(	56.31 +	53.70) =	55.00			
	Tpout =	62.56 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	65.92 +	62.56) =	64.24			
	qw =	Aw x h x { (Twa =	55.00) -	Tain=	43.99 } =	26.08 kW				
	qp =	Ap x h x { (Tpa =	64.24) -	Tain=	43.99 } =	13.63 kW				
	Taout =	43.99 + (qw+qp)	39.71)/(Q*rho*Cp)		10.62 =	47.73 C	q-rm =	34.03		

Time Step 15	Tain =	42.46 C	Taa = 0.5*(Tain+Taout) =	0.5*(	42.46 +	45.90) =	44.18			
(90-100 yr)	Twout =	51.50 C	Twa = 0.5*(Twin+Twout)	0.5*(	53.70 +	51.50) =	52.60			
	Tpout =	59.75 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	62.56 +	59.75) =	61.15			
	qw =	Aw x h x { (Twa =	52.60) -	Tain=	42.46 } =	24.00 kW				
	qp =	Ap x h x { (Tpa =	61.15) -	Tain=	42.46 } =	12.58 kW				
	Taout =	42.46 + (qw+qp)	36.59)/(Q*rho*Cp)		10.62 =	45.90 C	q-rm =	31.35		

Time Step 16	Tain =	40.81	C	Taa = 0.5*(Tain+Taout) =	0.5*(	40.81	+	43.96	) =	42.39		
(100-125 yr)	Twout =	48.70	C	Twa = 0.5*(Twin+Twout)	0.5*(	51.50	+	48.70	) =	50.10		
	Tpout =	55.99	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	59.75	+	55.99	) =	57.87		
	qw =	Aw x h x { (Twa =	50.10	) - Tain=	40.81	} =	21.99	kW				
	qp =	Ap x h x { (Tpa =	57.87	) - Tain=	40.81	} =	11.48	kW				
	Taout =	40.81 + (qw+qp)	33.48	)/(Q*rho*Cp)	10.62	=	43.96	C	q-rm =	28.68		

Time Step 17	Tain =	38.87	C	Taa = 0.5*(Tain+Taout) =	0.5*(	38.87	+	41.68	) =	40.28		
(125-150 yr)	Twout =	45.73	C	wa = 0.5*(Twin+Twout) =	0.5*(	48.70	+	45.73	) =	47.21		
	Tpout =	51.98	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	55.99	+	51.98	) =	53.99		
	qw =	Aw x h x { (Twa =	47.21	) - Tain=	38.87	} =	19.76	kW				
	qp =	Ap x h x { (Tpa =	53.99	) - Tain=	38.87	} =	10.18	kW				
	Taout =	38.87 + (qw+qp)	29.94	)/(Q*rho*Cp)	10.62	=	41.68	C	q-rm =	25.66		

Time Step 18	Tain =	36.88	C	Taa = 0.5*(Tain+Taout) =	0.5*(	36.88	+	39.34	) =	38.11		
(150-200 yr)	Twout =	42.67	C	wa = 0.5*(Twin+Twout) =	0.5*(	45.73	+	42.67	) =	44.20		
	Tpout =	47.99	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	51.98	+	47.99	) =	49.98		
	qw =	Aw x h x { (Twa =	44.20	) - Tain=	36.88	} =	17.33	kW				
	qp =	Ap x h x { (Tpa =	49.98	) - Tain=	36.88	} =	8.82	kW				
	Taout =	36.88 + (qw+qp)	26.15	)/(Q*rho*Cp)	10.62	=	39.34	C	q-rm =	22.41		

Time Step 19	Tain =	35.20	C	Taa = 0.5*(Tain+Taout) =	0.5*(	35.20	+	37.34	) =	36.27		
(200-250 yr)	Twout =	40.40	C	wa = 0.5*(Twin+Twout) =	0.5*(	42.67	+	40.40	) =	41.54		
	Tpout =	45.13	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	47.99	+	45.13	) =	46.56		
	qw =	Aw x h x { (Twa =	41.54	) - Tain=	35.20	} =	14.99	kW				
	qp =	Ap x h x { (Tpa =	46.56	) - Tain=	35.20	} =	7.64	kW				
	Taout =	35.20 + (qw+qp)	22.63	)/(Q*rho*Cp)	10.62	=	37.34	C	q-rm =	19.39		

Time Step 20	Tain =	34.04	C	Taa = 0.5*(Tain+Taout) =	0.5*(	34.04	+	35.92	) =	34.98		
(250-300 yr)	Twout =	38.79	C	wa = 0.5*(Twin+Twout) =	0.5*(	40.40	+	38.79	) =	39.60		
	Tpout =	43.11	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	45.13	+	43.11	) =	44.12		
	qw =	Aw x h x { (Twa =	39.60	) - Tain=	34.04	} =	13.14	kW				
	qp =	Ap x h x { (Tpa =	44.12	) - Tain=	34.04	} =	6.78	kW				
	Taout =	34.04 + (qw+qp)	19.93	)/(Q*rho*Cp)	10.62	=	35.92	C	q-rm =	17.07		

DRIFT SEGMENT # 1 (0-100m) Air Quantity, Q = 15 m^3/s 60 MTU/acre

Wall Temperature Results from ANSYS Modeling

Time, Yr	Drift Wall Temperature, C		
	Invert	Springline	Crown
0.00	25.00	25.00	25.00
0.00	27.93	28.43	27.90
1.00	47.04	50.28	47.02
5.00	46.25	49.16	46.23
10.00	44.53	47.17	44.51
15.00	42.83	45.23	42.80
20.00	41.44	43.66	41.41
26.00	39.95	41.96	39.92
30.00	39.10	40.99	39.07
40.00	37.22	38.86	37.19
50.00	35.70	37.13	35.68
60.00	34.43	35.69	34.41
70.00	33.43	34.55	33.41
80.00	32.63	33.63	32.61
90.00	31.96	32.87	31.94
100.00	31.41	32.24	31.39
125.00	30.57	31.29	30.55
150.00	29.75	30.36	29.73
200.00	28.96	29.47	28.95
250.00	28.49	28.93	28.47
300.00	28.16	28.55	28.14

Drift Wall and Air Temperatures, C

Time Afte Emplm't, Y	Ave. drift Wall Tem	Air Temp at 100 m
0.00	25.00	25.00
0.00	28.09	29.07
1.00	48.11	31.66
5.00	47.21	32.62
10.00	45.40	32.12
15.00	43.62	31.53
20.00	42.17	31.00
26.00	40.61	30.51
30.00	39.72	30.11
40.00	37.76	29.64
50.00	36.17	29.05
60.00	34.84	28.56
70.00	33.80	28.16
80.00	32.95	27.84
90.00	32.26	27.58
100.00	31.68	27.37
125.00	30.81	27.12
150.00	29.95	26.83
200.00	29.12	26.54
250.00	28.63	26.32
300.00	28.28	26.18

Air Temperature and Heat Removal Calculations

Tin =	25 C	D.S =	81 m	WP Dia. =	1.564	Ap =	4.91345	m^2
Drift L =	600 m	P.G. =	0.1 m	Drift Dia. =	5.5	Aw =	17.2788	m^2
Delta L =	100 m	T.L. =	60 MTU/ac	Air Dens. =	1.0561	kg/m^3		
Cv. Coeff. h=	1.89 W/m^2 K	L.L. =	1.55 kW/m	Air Cp =	1.0057	kJ/kg K		

Time Step 1	Tain =	25.00 C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00	+	29.07	) =	27.03		
(0-1e-4 yr)	Twout =	28.09 C	Twa = 0.5*(Twin+Twout)	0.5*(	25.00	+	28.09	) =	26.54		
	Tpout =	108.79 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.00	+	108.79	) =	89.39		
	qw =	Aw x h x { (Twa =	26.54) -	Tain=	25.00 } =		5.04 kW				
	qp =	Ap x h x { (Tpa =	89.39) -	Tain=	25.00 } =		59.80 kW				
	Taout =	25.00 + (qw+qp)	64.84)/(Q*rho*Cp)		15.93	=	29.07 C		q-rm =	56.31	

Time Step 2	Tain =	25.00 C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00	+	31.66	) =	28.33		
(1e-4-1 yr)	Twout =	48.11 C	Twa = 0.5*(Twin+Twout)	0.5*(	28.09	+	48.11	) =	38.10		
	Tpout =	77.66 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	108.79	+	77.66	) =	93.22		
	qw =	Aw x h x { (Twa =	38.10) -	Tain=	25.00 } =		42.78 kW				
	qp =	Ap x h x { (Tpa =	93.22) -	Tain=	25.00 } =		63.35 kW				
	Taout =	25.00 + (qw+qp)	106.13)/(Q*rho*Cp)		15.93	=	31.66 C		q-rm =	92.16	

Time Step 3	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	32.62	) =	28.81		
(1-5 yr)	Twout =	47.21 C	Twa = 0.5*(Twin+Twout)	0.5*(	48.11	+	47.21	) =	47.66		
	Tpout =	74.26 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	77.66	+	74.26	) =	75.96		
	qw =	Aw x h x { (Twa =	47.66) -	Tain=	25.00 } =		74.01 kW				
	qp =	Ap x h x { (Tpa =	75.96) -	Tain=	25.00 } =		47.32 kW				
	Taout =	25.00 + (qw+qp)	121.33)/(Q*rho*Cp)		15.93	=	32.62 C		q-rm =	105.36	

Time Step 4	Tain =	25.00 C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00	+	32.12	) =	28.56		
(5-10 yr)	Twout =	45.40 C	Twa = 0.5*(Twin+Twout)	0.5*(	47.21	+	45.40	) =	46.31		
	Tpout =	70.30 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	74.26	+	70.30	) =	72.28		
	qw =	Aw x h x { (Twa =	46.31) -	Tain=	25.00 } =		69.59 kW				
	qp =	Ap x h x { (Tpa =	72.28) -	Tain=	25.00 } =		43.90 kW				
	Taout =	25.00 + (qw+qp)	113.49)/(Q*rho*Cp)		15.93	=	32.12 C		q-rm =	98.55	

Time Step 5	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	31.53	) =	28.27		
(10-15 yr)	Twout =	43.62 C	Twa = 0.5*(Twin+Twout)	0.5*(	45.40	+	43.62	) =	44.51		
	Tpout =	66.56 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.30	+	66.56	) =	68.43		
	qw =	Aw x h x { (Twa =	44.51) -	Tain=	25.00 } =		63.72 kW				
	qp =	Ap x h x { (Tpa =	68.43) -	Tain=	25.00 } =		40.33 kW				
	Taout =	25.00 + (qw+qp)	104.05)/(Q*rho*Cp)		15.93	=	31.53 C		q-rm =	90.35	

Time Step 6	Tain =	25.00 C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00 +	31.00) =	28.00				
(15-20 yr)	Twout =	42.17 C	Twa = 0.5*(Twin+Twout)	0.5*(	43.62 +	42.17) =	42.90				
	Tpout =	63.52 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	66.56 +	63.52) =	65.04				
	qw =	Aw x h x { (Twa =	42.90) -	Tain=	25.00 } =	58.44 kW					
	qp =	Ap x h x { (Tpa =	65.04) -	Tain=	25.00 } =	37.18 kW					
	Taout =	25.00 + (qw+qp)	95.63)/(Q*rho*Cp)		15.93 =	31.00 C	q-rm =	83.04			

Time Step 7	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	30.51) =	27.75				
(20-26 yr)	Twout =	40.61 C	Twa = 0.5*(Twin+Twout)	0.5*(	42.17 +	40.61) =	41.39				
	Tpout =	60.23 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	63.52 +	60.23) =	61.88				
	qw =	Aw x h x { (Twa =	41.39) -	Tain=	25.00 } =	53.53 kW					
	qp =	Ap x h x { (Tpa =	61.88) -	Tain=	25.00 } =	34.24 kW					
	Taout =	25.00 + (qw+qp)	87.77)/(Q*rho*Cp)		15.93 =	30.51 C	q-rm =	76.22			

Time Step 8	Tain =	25.00 C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00 +	30.11) =	27.55				
(26-30 yr)	Twout =	39.72 C	Twa = 0.5*(Twin+Twout)	0.5*(	40.61 +	39.72) =	40.17				
	Tpout =	58.34 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	60.23 +	58.34) =	59.29				
	qw =	Aw x h x { (Twa =	40.17) -	Tain=	25.00 } =	49.53 kW					
	qp =	Ap x h x { (Tpa =	59.29) -	Tain=	25.00 } =	31.84 kW					
	Taout =	25.00 + (qw+qp)	81.37)/(Q*rho*Cp)		15.93 =	30.11 C	q-rm =	70.66			

Time Step 9	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	29.64) =	27.32				
(30-40 yr)	Twout =	37.76 C	Twa = 0.5*(Twin+Twout)	0.5*(	39.72 +	37.76) =	38.74				
	Tpout =	54.09 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	58.34 +	54.09) =	56.22				
	qw =	Aw x h x { (Twa =	38.74) -	Tain=	25.00 } =	44.87 kW					
	qp =	Ap x h x { (Tpa =	56.22) -	Tain=	25.00 } =	28.99 kW					
	Taout =	25.00 + (qw+qp)	73.85)/(Q*rho*Cp)		15.93 =	29.64 C	q-rm =	64.13			

Time Step 10	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	29.05) =	27.02				
(40-50 yr)	Twout =	36.17 C	Twa = 0.5*(Twin+Twout)	0.5*(	37.76 +	36.17) =	36.96				
	Tpout =	50.60 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	54.09 +	50.60) =	52.34				
	qw =	Aw x h x { (Twa =	36.96) -	Tain=	25.00 } =	39.06 kW					
	qp =	Ap x h x { (Tpa =	52.34) -	Tain=	25.00 } =	25.39 kW					
	Taout =	25.00 + (qw+qp)	64.45)/(Q*rho*Cp)		15.93 =	29.05 C	q-rm =	55.97			

Time Step 11	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	28.56) =	26.78				
(50-60 yr)	Twout =	34.84 C	Twa = 0.5*(Twin+Twout)	0.5*(	36.17 +	34.84) =	35.50				
	Tpout =	47.65 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	50.60 +	47.65) =	49.13				
	qw =	Aw x h x { (Twa =	35.50) -	Tain=	25.00 } =	34.31 kW					
	qp =	Ap x h x { (Tpa =	49.13) -	Tain=	25.00 } =	22.41 kW					
	Taout =	25.00 + (qw+qp)	56.71)/(Q*rho*Cp)		15.93 =	28.56 C	q-rm =	49.25			

Time Step 12	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	28.16) =	26.58				
(60-70 yr)	Twout =	33.80 C	Twa = 0.5*(Twin+Twout)	0.5*(	34.84 +	33.80) =	34.32				
	Tpout =	45.31 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	47.65 +	45.31) =	46.48				
	qw =	Aw x h x { (Twa =	34.32) -	Tain=	25.00 } =	30.44 kW					
	qp =	Ap x h x { (Tpa =	46.48) -	Tain=	25.00 } =	19.95 kW					
	Taout =	25.00 + (qw+qp)	50.39)/(Q*rho*Cp)		15.93 =	28.16 C	q-rm =	43.75			

Time Step 13	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	27.84) =	26.42				
(70-80 yr)	Twout =	32.95 C	Twa = 0.5*(Twin+Twout)	0.5*(	33.80 +	32.95) =	33.38				
	Tpout =	43.39 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	45.31 +	43.39) =	44.35				
	qw =	Aw x h x { (Twa =	33.38) -	Tain=	25.00 } =	27.36 kW					
	qp =	Ap x h x { (Tpa =	44.35) -	Tain=	25.00 } =	17.97 kW					
	Taout =	25.00 + (qw+qp)	45.32)/(Q*rho*Cp)		15.93 =	27.84 C	q-rm =	39.36			

Time Step 14	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	27.58) =	26.29				
(80-90 yr)	Twout =	32.26 C	Twa = 0.5*(Twin+Twout)	0.5*(	32.95 +	32.26) =	32.61				
	Tpout =	41.79 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	43.39 +	41.79) =	42.59				
	qw =	Aw x h x { (Twa =	32.61) -	Tain=	25.00 } =	24.84 kW					
	qp =	Ap x h x { (Tpa =	42.59) -	Tain=	25.00 } =	16.33 kW					
	Taout =	25.00 + (qw+qp)	41.18)/(Q*rho*Cp)		15.93 =	27.58 C	q-rm =	35.76			

Time Step 15	Tain =	25.00 C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00 +	27.37) =	26.18				
(90-100 yr)	Twout =	31.68 C	Twa = 0.5*(Twin+Twout)	0.5*(	32.26 +	31.68) =	31.97				
	Tpout =	40.46 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	41.79 +	40.46) =	41.13				
	qw =	Aw x h x { (Twa =	31.97) -	Tain=	25.00 } =	22.76 kW					
	qp =	Ap x h x { (Tpa =	41.13) -	Tain=	25.00 } =	14.98 kW					
	Taout =	25.00 + (qw+qp)	37.74)/(Q*rho*Cp)		15.93 =	27.37 C	q-rm =	32.77			

Time Step 16	Tain =	25.00	C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	27.12	) =	26.06		
(100-125 yr)	Twout =	30.81	C	Twa = 0.5*(Twin+Twout)	0.5*(	31.68	+	30.81	) =	31.24		
	Tpout =	38.47	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	40.46	+	38.47	) =	39.47		
	qw =	Aw x h x { (Twa =	31.24	) - Tain=	25.00	} =	20.39	kW				
	qp =	Ap x h x { (Tpa =	39.47	) - Tain=	25.00	} =	13.44	kW				
	Taout =	25.00	+ (qw+qp)	33.83	)/(Q*rho*Cp)	15.93	=	27.12	C	q-rm =	29.37	

Time Step 17	Tain =	25.00	C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	26.83	) =	25.91		
(125-150 yr)	Twout =	29.95	C	wa = 0.5*(Twin+Twout) =	0.5*(	30.81	+	29.95	) =	30.38		
	Tpout =	36.45	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	38.47	+	36.45	) =	37.46		
	qw =	Aw x h x { (Twa =	30.38	) - Tain=	25.00	} =	17.56	kW				
	qp =	Ap x h x { (Tpa =	37.46	) - Tain=	25.00	} =	11.57	kW				
	Taout =	25.00	+ (qw+qp)	29.13	)/(Q*rho*Cp)	15.93	=	26.83	C	q-rm =	25.30	

Time Step 18	Tain =	25.00	C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	26.54	) =	25.77		
(150-200 yr)	Twout =	29.12	C	wa = 0.5*(Twin+Twout) =	0.5*(	29.95	+	29.12	) =	29.54		
	Tpout =	34.57	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	36.45	+	34.57	) =	35.51		
	qw =	Aw x h x { (Twa =	29.54	) - Tain=	25.00	} =	14.81	kW				
	qp =	Ap x h x { (Tpa =	35.51	) - Tain=	25.00	} =	9.76	kW				
	Taout =	25.00	+ (qw+qp)	24.57	)/(Q*rho*Cp)	15.93	=	26.54	C	q-rm =	21.34	

Time Step 19	Tain =	25.00	C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	26.32	) =	25.66		
(200-250 yr)	Twout =	28.63	C	wa = 0.5*(Twin+Twout) =	0.5*(	29.12	+	28.63	) =	28.88		
	Tpout =	33.44	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	34.57	+	33.44	) =	34.00		
	qw =	Aw x h x { (Twa =	28.88	) - Tain=	25.00	} =	12.66	kW				
	qp =	Ap x h x { (Tpa =	34.00	) - Tain=	25.00	} =	8.36	kW				
	Taout =	25.00	+ (qw+qp)	21.02	)/(Q*rho*Cp)	15.93	=	26.32	C	q-rm =	18.25	

Time Step 20	Tain =	25.00	C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	26.18	) =	25.59		
(250-300 yr)	Twout =	28.28	C	wa = 0.5*(Twin+Twout) =	0.5*(	28.63	+	28.28	) =	28.45		
	Tpout =	32.64	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	33.44	+	32.64	) =	33.04		
	qw =	Aw x h x { (Twa =	28.45	) - Tain=	25.00	} =	11.28	kW				
	qp =	Ap x h x { (Tpa =	33.04	) - Tain=	25.00	} =	7.46	kW				
	Taout =	25.00	+ (qw+qp)	18.75	)/(Q*rho*Cp)	15.93	=	26.18	C	q-rm =	16.28	

DRIFT SEGMENT # 2 (100-200m) Air Quality, Q = 15 m^3/s 60MTU/acre

Drift Temperature Results fron ANSYS Modeling

Time, Yr	Drift Wall Temperature, C		
	Invert	Springline	Crown
0.00	25.00	25.00	25.00
0.00	27.93	28.43	27.90
1.00	52.23	55.44	52.21
5.00	53.06	55.91	53.03
10.00	51.06	53.65	51.03
15.00	48.88	51.24	48.85
20.00	47.04	49.21	47.01
26.00	45.11	47.09	45.08
30.00	43.91	45.78	43.88
40.00	41.60	43.22	41.58
50.00	39.56	40.97	39.53
60.00	37.85	39.09	37.83
70.00	36.49	37.59	36.46
80.00	35.38	36.38	35.36
90.00	34.48	35.38	34.46
100.00	33.73	34.56	33.71
125.00	32.65	33.37	32.63
150.00	31.56	32.16	31.54
200.00	30.49	30.99	30.47
250.00	29.80	30.24	29.79
300.00	29.33	29.73	29.32

Drift Wall and Air Temperatures, C

Time Afte Emplm't, Y	Ave. Drift Wall Tem	Air Temp at 200 m
0.00	25.00	25.00
0.00	28.09	29.07
1.00	53.29	37.23
5.00	54.00	39.76
10.00	51.91	39.07
15.00	49.65	37.95
20.00	47.75	36.91
26.00	45.76	35.95
30.00	44.53	35.15
40.00	42.13	34.23
50.00	40.02	33.09
60.00	38.26	32.12
70.00	36.85	31.33
80.00	35.71	30.69
90.00	34.77	30.17
100.00	34.00	29.74
125.00	32.88	29.26
150.00	31.75	28.68
200.00	30.65	28.11
250.00	29.94	27.66
300.00	29.46	27.37

Air Temperature and Heat Removal Calculations

Tin =	25	C	D.S =	81	m	WP Dia. =	1.564	Ap =	4.91345 m^2
Drift L =	600	m	P.G. =	0.1	m	Drift Dia. =	5.5	Aw =	17.2788 m^2
Delta L =	100	m	T.L. =	60	MTU/ac	Air Dens. =	1.0561	kg/m^3	
Cv. Coeff. h=	1.89	W/m^2 K	L.L. =	1.55	kW/m	Air Cp =	1.0057	kJ/kg K	

Time Step 1	Tain =	25.00	C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00	+	29.07	) =		27.03
(0-1e-4 yr)	Twout =	28.09	C	Twa = 0.5*(Twin+Twout)	0.5*(	25.00	+	28.09	) =		26.54
	Tpout =	108.79	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.00	+	108.79	) =		89.39
	qw =	Aw x h x { (Twa =	26.54	) - Tain=	25.00	} =	5.04	kW			
	qp =	Ap x h x { (Tpa =	89.39	) - Tain=	25.00	} =	59.80	kW			
	Taout =	25.00	+ (qw+qp)	64.84	)/(Q*rho*Cp)	15.93	=	29.07	C	q-rm =	56.31

Time Step 2	Tain =	31.66	C	Taa = 0.5*(Tain+Taout)	0.5*(	31.66	+	37.23	) =		34.45
(1e-4-1 yr)	Twout =	53.29	C	Twa = 0.5*(Twin+Twout)	0.5*(	28.09	+	53.29	) =		40.69
	Tpout =	82.20	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	108.79	+	82.20	) =		95.50
	qw =	Aw x h x { (Twa =	40.69	) - Tain=	31.66	} =	29.48	kW			
	qp =	Ap x h x { (Tpa =	95.50	) - Tain=	31.66	} =	59.28	kW			
	Taout =	31.66	+ (qw+qp)	88.76	)/(Q*rho*Cp)	15.93	=	37.23	C	q-rm =	77.08

Time Step 3	Tain =	32.62	C	Taa = 0.5*(Tain+Taout) =	0.5*(	32.62	+	39.76	) =		36.19
(1-5 yr)	Twout =	54.00	C	Twa = 0.5*(Twin+Twout)	0.5*(	53.29	+	54.00	) =		53.65
	Tpout =	80.12	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	82.20	+	80.12	) =		81.16
	qw =	Aw x h x { (Twa =	53.65	) - Tain=	32.62	} =	68.68	kW			
	qp =	Ap x h x { (Tpa =	81.16	) - Tain=	32.62	} =	45.08	kW			
	Taout =	32.62	+ (qw+qp)	113.76	)/(Q*rho*Cp)	15.93	=	39.76	C	q-rm =	98.79

Time Step 4	Tain =	32.12	C	Taa = 0.5*(Tain+Taout)	0.5*(	32.12	+	39.07	) =		35.60
(5-10 yr)	Twout =	51.91	C	Twa = 0.5*(Twin+Twout)	0.5*(	54.00	+	51.91	) =		52.96
	Tpout =	75.96	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	80.12	+	75.96	) =		78.04
	qw =	Aw x h x { (Twa =	52.96	) - Tain=	32.12	} =	68.04	kW			
	qp =	Ap x h x { (Tpa =	78.04	) - Tain=	32.12	} =	42.64	kW			
	Taout =	32.12	+ (qw+qp)	110.68	)/(Q*rho*Cp)	15.93	=	39.07	C	q-rm =	96.11

Time Step 5	Tain =	31.53	C	Taa = 0.5*(Tain+Taout) =	0.5*(	31.53	+	37.95	) =		34.74
(10-15 yr)	Twout =	49.65	C	Twa = 0.5*(Twin+Twout)	0.5*(	51.91	+	49.65	) =		50.78
	Tpout =	71.86	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	75.96	+	71.86	) =		73.91
	qw =	Aw x h x { (Twa =	50.78	) - Tain=	31.53	} =	62.88	kW			
	qp =	Ap x h x { (Tpa =	73.91	) - Tain=	31.53	} =	39.36	kW			
	Taout =	31.53	+ (qw+qp)	102.23	)/(Q*rho*Cp)	15.93	=	37.95	C	q-rm =	88.78

Time Step 6 (15-20 yr)	Tain =	31.00 C	Taa = 0.5*(Tain+Taout)	0.5*(	31.00 +	36.91) =	33.96			
	Twout =	47.75 C	Twa = 0.5*(Twin+Twout)	0.5*(	49.65 +	47.75) =	48.70			
	Tpout =	68.46 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	71.86 +	68.46) =	70.16			
	qw =	Aw x h x { (Twa =	48.70) -	Tain=	31.00 } =	57.81 kW				
	qp =	Ap x h x { (Tpa =	70.16) -	Tain=	31.00 } =	36.36 kW				
	Taout =	31.00 + (qw+qp)	94.17)/(Q*rho*Cp)		15.93 =	36.91 C	q-rm =	81.78		

Time Step 7 (20-26 yr)	Tain =	30.51 C	Taa = 0.5*(Tain+Taout) =	0.5*(	30.51 +	35.95) =	33.23			
	Twout =	45.76 C	Twa = 0.5*(Twin+Twout)	0.5*(	47.75 +	45.76) =	46.76			
	Tpout =	64.83 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	68.46 +	64.83) =	66.65			
	qw =	Aw x h x { (Twa =	46.76) -	Tain=	30.51 } =	53.07 kW				
	qp =	Ap x h x { (Tpa =	66.65) -	Tain=	30.51 } =	33.56 kW				
	Taout =	30.51 + (qw+qp)	86.63)/(Q*rho*Cp)		15.93 =	35.95 C	q-rm =	75.22		

Time Step 8 (26-30 yr)	Tain =	30.11 C	Taa = 0.5*(Tain+Taout)	0.5*(	30.11 +	35.15) =	32.63			
	Twout =	44.53 C	Twa = 0.5*(Twin+Twout)	0.5*(	45.76 +	44.53) =	45.15			
	Tpout =	62.66 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	64.83 +	62.66) =	63.75			
	qw =	Aw x h x { (Twa =	45.15) -	Tain=	30.11 } =	49.11 kW				
	qp =	Ap x h x { (Tpa =	63.75) -	Tain=	30.11 } =	31.24 kW				
	Taout =	30.11 + (qw+qp)	80.35)/(Q*rho*Cp)		15.93 =	35.15 C	q-rm =	69.77		

Time Step 9 (30-40 yr)	Tain =	29.64 C	Taa = 0.5*(Tain+Taout) =	0.5*(	29.64 +	34.23) =	31.93			
	Twout =	42.13 C	Twa = 0.5*(Twin+Twout)	0.5*(	44.53 +	42.13) =	43.33			
	Tpout =	58.07 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	62.66 +	58.07) =	60.37			
	qw =	Aw x h x { (Twa =	43.33) -	Tain=	29.64 } =	44.72 kW				
	qp =	Ap x h x { (Tpa =	60.37) -	Tain=	29.64 } =	28.54 kW				
	Taout =	29.64 + (qw+qp)	73.26)/(Q*rho*Cp)		15.93 =	34.23 C	q-rm =	63.62		

Time Step 10 (40-50 yr)	Tain =	29.05 C	Taa = 0.5*(Tain+Taout) =	0.5*(	29.05 +	33.09) =	31.07			
	Twout =	40.02 C	Twa = 0.5*(Twin+Twout)	0.5*(	42.13 +	40.02) =	41.08			
	Tpout =	54.15 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	58.07 +	54.15) =	56.11			
	qw =	Aw x h x { (Twa =	41.08) -	Tain=	29.05 } =	39.29 kW				
	qp =	Ap x h x { (Tpa =	56.11) -	Tain=	29.05 } =	25.13 kW				
	Taout =	29.05 + (qw+qp)	64.43)/(Q*rho*Cp)		15.93 =	33.09 C	q-rm =	55.95		

Time Step 11 (50-60 yr)	Tain =	28.56 C	Taa = 0.5*(Tain+Taout) =	0.5*(	28.56 +	32.12) =	30.34			
	Twout =	38.26 C	Twa = 0.5*(Twin+Twout)	0.5*(	40.02 +	38.26) =	39.14			
	Tpout =	50.82 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	54.15 +	50.82) =	52.48			
	qw =	Aw x h x { (Twa =	39.14) -	Tain=	28.56 } =	34.55 kW				
	qp =	Ap x h x { (Tpa =	52.48) -	Tain=	28.56 } =	22.22 kW				
	Taout =	28.56 + (qw+qp)	56.77)/(Q*rho*Cp)		15.93 =	32.12 C	q-rm =	49.29		

Time Step 12 (60-70 yr)	Tain =	28.16 C	Taa = 0.5*(Tain+Taout) =	0.5*(	28.16 +	31.33) =	29.75			
	Twout =	36.85 C	Twa = 0.5*(Twin+Twout)	0.5*(	38.26 +	36.85) =	37.55			
	Tpout =	48.15 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	50.82 +	48.15) =	49.49			
	qw =	Aw x h x { (Twa =	37.55) -	Tain=	28.16 } =	30.66 kW				
	qp =	Ap x h x { (Tpa =	49.49) -	Tain=	28.16 } =	19.80 kW				
	Taout =	28.16 + (qw+qp)	50.46)/(Q*rho*Cp)		15.93 =	31.33 C	q-rm =	43.82		

Time Step 13 (70-80 yr)	Tain =	27.84 C	Taa = 0.5*(Tain+Taout) =	0.5*(	27.84 +	30.69) =	29.27			
	Twout =	35.71 C	Twa = 0.5*(Twin+Twout)	0.5*(	36.85 +	35.71) =	36.28			
	Tpout =	45.97 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	48.15 +	45.97) =	47.06			
	qw =	Aw x h x { (Twa =	36.28) -	Tain=	27.84 } =	27.54 kW				
	qp =	Ap x h x { (Tpa =	47.06) -	Tain=	27.84 } =	17.85 kW				
	Taout =	27.84 + (qw+qp)	45.39)/(Q*rho*Cp)		15.93 =	30.69 C	q-rm =	39.41		

Time Step 14 (80-90 yr)	Tain =	27.58 C	Taa = 0.5*(Tain+Taout) =	0.5*(	27.58 +	30.17) =	28.88			
	Twout =	34.77 C	Twa = 0.5*(Twin+Twout)	0.5*(	35.71 +	34.77) =	35.24			
	Tpout =	44.17 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	45.97 +	44.17) =	45.07			
	qw =	Aw x h x { (Twa =	35.24) -	Tain=	27.58 } =	25.00 kW				
	qp =	Ap x h x { (Tpa =	45.07) -	Tain=	27.58 } =	16.24 kW				
	Taout =	27.58 + (qw+qp)	41.24)/(Q*rho*Cp)		15.93 =	30.17 C	q-rm =	35.81		

Time Step 15 (90-100 yr)	Tain =	27.37 C	Taa = 0.5*(Tain+Taout) =	0.5*(	27.37 +	29.74) =	28.56			
	Twout =	34.00 C	Twa = 0.5*(Twin+Twout)	0.5*(	34.77 +	34.00) =	34.38			
	Tpout =	42.66 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	44.17 +	42.66) =	43.41			
	qw =	Aw x h x { (Twa =	34.38) -	Tain=	27.37 } =	22.91 kW				
	qp =	Ap x h x { (Tpa =	43.41) -	Tain=	27.37 } =	14.90 kW				
	Taout =	27.37 + (qw+qp)	37.81)/(Q*rho*Cp)		15.93 =	29.74 C	q-rm =	32.83		

Time Step 16	Tain =	27.12	C	Taa = 0.5*(Tain+Taout) =	0.5*(	27.12	+	29.26	) =	28.19				
(100-125 yr)	Twout =	32.88	C	Twa = 0.5*(Twin+Twout)	0.5*(	34.00	+	32.88	) =	33.44				
	Tpout =	40.46	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	42.66	+	40.46	) =	41.56				
	qw =	Aw x h x { (Twa =	33.44	) - Tain=	27.12	} =	20.63	kW						
	qp =	Ap x h x { (Tpa =	41.56	) - Tain=	27.12	} =	13.41	kW						
	Taout =	27.12 + (qw+qp)	34.03	)/(Q*rho*Cp)	15.93	=	29.26	C	q-rm =	29.55				

Time Step 17	Tain =	26.83	C	Taa = 0.5*(Tain+Taout) =	0.5*(	26.83	+	28.68	) =	27.76				
(125-150 yr)	Twout =	31.75	C	wa = 0.5*(Twin+Twout) =	0.5*(	32.88	+	31.75	) =	32.32				
	Tpout =	38.19	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	40.46	+	38.19	) =	39.32				
	qw =	Aw x h x { (Twa =	32.32	) - Tain=	26.83	} =	17.93	kW						
	qp =	Ap x h x { (Tpa =	39.32	) - Tain=	26.83	} =	11.60	kW						
	Taout =	26.83 + (qw+qp)	29.53	)/(Q*rho*Cp)	15.93	=	28.68	C	q-rm =	25.64				

Time Step 18	Tain =	26.54	C	Taa = 0.5*(Tain+Taout) =	0.5*(	26.54	+	28.11	) =	27.33				
(150-200 yr)	Twout =	30.65	C	wa = 0.5*(Twin+Twout) =	0.5*(	31.75	+	30.65	) =	31.20				
	Tpout =	36.05	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	38.19	+	36.05	) =	37.12				
	qw =	Aw x h x { (Twa =	31.20	) - Tain=	26.54	} =	15.22	kW						
	qp =	Ap x h x { (Tpa =	37.12	) - Tain=	26.54	} =	9.82	kW						
	Taout =	26.54 + (qw+qp)	25.03	)/(Q*rho*Cp)	15.93	=	28.11	C	q-rm =	21.74				

Time Step 19	Tain =	26.32	C	Taa = 0.5*(Tain+Taout) =	0.5*(	26.32	+	27.66	) =	26.99				
(200-250 yr)	Twout =	29.94	C	wa = 0.5*(Twin+Twout) =	0.5*(	30.65	+	29.94	) =	30.30				
	Tpout =	34.71	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	36.05	+	34.71	) =	35.38				
	qw =	Aw x h x { (Twa =	30.30	) - Tain=	26.32	} =	12.99	kW						
	qp =	Ap x h x { (Tpa =	35.38	) - Tain=	26.32	} =	8.41	kW						
	Taout =	26.32 + (qw+qp)	21.40	)/(Q*rho*Cp)	15.93	=	27.66	C	q-rm =	18.59				

Time Step 20	Tain =	26.18	C	Taa = 0.5*(Tain+Taout) =	0.5*(	26.18	+	27.37	) =	26.77				
(250-300 yr)	Twout =	29.46	C	wa = 0.5*(Twin+Twout) =	0.5*(	29.94	+	29.46	) =	29.70				
	Tpout =	33.78	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	34.71	+	33.78	) =	34.25				
	qw =	Aw x h x { (Twa =	29.70	) - Tain=	26.18	} =	11.51	kW						
	qp =	Ap x h x { (Tpa =	34.25	) - Tain=	26.18	} =	7.49	kW						
	Taout =	26.18 + (qw+qp)	19.01	)/(Q*rho*Cp)	15.93	=	27.37	C	q-rm =	16.50				

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DRIFT SEGMENT # 3 (200-300m) Air Quantity, Q = 15 m^3/s 60 MTU/acre

Drift Wall Temperature Results from ANSYS Modeling

Time, Yr	Drift Wall Temperature, C		
	Invert	Springline	Crown
0.00	25.00	25.00	25.00
0.00	27.93	28.43	27.90
1.00	56.57	59.75	56.55
5.00	59.40	62.19	59.38
10.00	57.42	59.96	57.39
15.00	54.81	57.13	54.78
20.00	52.54	54.68	52.51
26.00	50.20	52.15	50.17
30.00	48.66	50.50	48.62
40.00	45.94	47.53	45.91
50.00	43.40	44.80	43.38
60.00	41.26	42.49	41.24
70.00	39.54	40.64	39.52
80.00	38.14	39.13	38.12
90.00	37.00	37.90	36.98
100.00	36.04	36.87	36.02
125.00	34.74	35.46	34.72
150.00	33.38	33.98	33.36
200.00	32.04	32.54	32.03
250.00	31.14	31.57	31.12
300.00	30.52	30.92	30.50

Drift Wall and Air Temperatures, C

Time Afte Emplm't, Y	Ave. Drift Wall Tem	Air Temp at 300 m
0.00	25.00	25.00
0.00	28.09	29.07
1.00	57.62	41.89
5.00	60.32	46.38
10.00	58.26	45.81
15.00	55.57	44.25
20.00	53.24	42.73
26.00	50.84	41.31
30.00	49.26	40.13
40.00	46.46	38.79
50.00	43.86	37.12
60.00	41.66	35.69
70.00	39.90	34.50
80.00	38.47	33.55
90.00	37.29	32.77
100.00	36.31	32.12
125.00	34.97	31.41
150.00	33.57	30.56
200.00	32.20	29.71
250.00	31.28	29.03
300.00	30.65	28.58

Air Temperature and Heat Removal Calculations

Tin =	25.00 C	D.S =	81.00 m	WP Dia. =	1.56	Ap =	4.91 m^2
Drift L =	600.00 m	P.G.=	0.10 m	Drift Dia. =	5.50	Aw =	17.28 m^2
Delta L =	100.00 m	T.L. =	60.00 MTU/ac	Air Dens. =	1.06	kg/m^3	
Cv. Coeff. h=	1.89 W/m^2 K	L.L. =	1.55 kW/m	Air Cp =	1.01	kJ/kg K	

Time Step 1	Tain =	25.00 C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00 +	29.07) =	27.03			
(0-1e-4 yr)	Twout =	28.09 C	Twa = 0.5*(Twin+Twout)	0.5*(	25.00 +	28.09) =	26.54			
	Tpout =	108.79 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.00 +	108.79) =	89.39			
	qw =	Aw x h x { (Twa =	26.54) -	Tain=	25.00 } =	5.04 kW				
	qp =	Ap x h x { (Tpa =	89.39) -	Tain=	25.00 } =	59.80 kW				
	Taout =	25.00 + (qw+qp)	64.84)/(Q*rho*Cp)		15.93 =	29.07 C	q-rm =	56.31		

Time Step 2	Tain =	37.23 C	Taa = 0.5*(Tain+Taout)	0.5*(	37.23 +	41.89) =	39.56			
(1e-4-1 yr)	Twout =	57.62 C	Twa = 0.5*(Twin+Twout)	0.5*(	28.09 +	57.62) =	42.85			
	Tpout =	86.01 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	108.79 +	86.01) =	97.40			
	qw =	Aw x h x { (Twa =	42.85) -	Tain=	37.23 } =	18.36 kW				
	qp =	Ap x h x { (Tpa =	97.40) -	Tain=	37.23 } =	55.87 kW				
	Taout =	37.23 + (qw+qp)	74.23)/(Q*rho*Cp)		15.93 =	41.89 C	q-rm =	64.46		

Time Step 3	Tain =	39.76 C	Taa = 0.5*(Tain+Taout) =	0.5*(	39.76 +	46.38) =	43.07			
(1-5 yr)	Twout =	60.32 C	Twa = 0.5*(Twin+Twout)	0.5*(	57.62 +	60.32) =	58.97			
	Tpout =	85.63 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	86.01 +	85.63) =	85.82			
	qw =	Aw x h x { (Twa =	58.97) -	Tain=	39.76 } =	62.76 kW				
	qp =	Ap x h x { (Tpa =	85.82) -	Tain=	39.76 } =	42.78 kW				
	Taout =	39.76 + (qw+qp)	105.53)/(Q*rho*Cp)		15.93 =	46.38 C	q-rm =	91.64		

Time Step 4	Tain =	39.07 C	Taa = 0.5*(Tain+Taout)	0.5*(	39.07 +	45.81) =	42.44			
(5-10 yr)	Twout =	58.26 C	Twa = 0.5*(Twin+Twout)	0.5*(	60.32 +	58.26) =	59.29			
	Tpout =	81.50 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	85.63 +	81.50) =	83.57			
	qw =	Aw x h x { (Twa =	59.29) -	Tain=	39.07 } =	66.03 kW				
	qp =	Ap x h x { (Tpa =	83.57) -	Tain=	39.07 } =	41.32 kW				
	Taout =	39.07 + (qw+qp)	107.35)/(Q*rho*Cp)		15.93 =	45.81 C	q-rm =	93.22		

Time Step 5	Tain =	37.95 C	Taa = 0.5*(Tain+Taout) =	0.5*(	37.95 +	44.25) =	41.10			
(10-15 yr)	Twout =	55.57 C	Twa = 0.5*(Twin+Twout)	0.5*(	58.26 +	55.57) =	56.92			
	Tpout =	77.08 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	81.50 +	77.08) =	79.29			
	qw =	Aw x h x { (Twa =	56.92) -	Tain=	37.95 } =	61.94 kW				
	qp =	Ap x h x { (Tpa =	79.29) -	Tain=	37.95 } =	38.39 kW				
	Taout =	37.95 + (qw+qp)	100.34)/(Q*rho*Cp)		15.93 =	44.25 C	q-rm =	87.13		

Time Step 6	Tain =	36.91 C	Taa = 0.5*(Tain+Taout)	0.5*(	36.91	+	42.73	) =	39.82			
(15-20 yr)	Twout =	53.24 C	Twa = 0.5*(Twin+Twout)	0.5*(	55.57	+	53.24	) =	54.41			
	Tpout =	73.34 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	77.08	+	73.34	) =	75.21			
	qw =	Aw x h x { (Twa =	54.41) -	Tain=	36.91 } =		57.13 kW					
	qp =	Ap x h x { (Tpa =	75.21) -	Tain=	36.91 } =		35.57 kW					
	Taout =	36.91 + (qw+qp)	92.70)/(Q*rho*Cp)		15.93	=	42.73 C		q-rm =	80.50		

Time Step 7	Tain =	35.95 C	Taa = 0.5*(Tain+Taout) =	0.5*(	35.95	+	41.31	) =	38.63			
(20-26 yr)	Twout =	50.84 C	Twa = 0.5*(Twin+Twout)	0.5*(	53.24	+	50.84	) =	52.04			
	Tpout =	69.39 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	73.34	+	69.39	) =	71.37			
	qw =	Aw x h x { (Twa =	52.04) -	Tain=	35.95 } =		52.56 kW					
	qp =	Ap x h x { (Tpa =	71.37) -	Tain=	35.95 } =		32.89 kW					
	Taout =	35.95 + (qw+qp)	85.46)/(Q*rho*Cp)		15.93	=	41.31 C		q-rm =	74.21		

Time Step 8	Tain =	35.15 C	Taa = 0.5*(Tain+Taout)	0.5*(	35.15	+	40.13	) =	37.64			
(26-30 yr)	Twout =	49.26 C	Twa = 0.5*(Twin+Twout)	0.5*(	50.84	+	49.26	) =	50.05			
	Tpout =	66.92 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	69.39	+	66.92	) =	68.16			
	qw =	Aw x h x { (Twa =	50.05) -	Tain=	35.15 } =		48.66 kW					
	qp =	Ap x h x { (Tpa =	68.16) -	Tain=	35.15 } =		30.65 kW					
	Taout =	35.15 + (qw+qp)	79.31)/(Q*rho*Cp)		15.93	=	40.13 C		q-rm =	68.87		

Time Step 9	Tain =	34.23 C	Taa = 0.5*(Tain+Taout) =	0.5*(	34.23	+	38.79	) =	36.51			
(30-40 yr)	Twout =	46.46 C	Twa = 0.5*(Twin+Twout)	0.5*(	49.26	+	46.46	) =	47.86			
	Tpout =	62.03 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	66.92	+	62.03	) =	64.48			
	qw =	Aw x h x { (Twa =	47.86) -	Tain=	34.23 } =		44.50 kW					
	qp =	Ap x h x { (Tpa =	64.48) -	Tain=	34.23 } =		28.08 kW					
	Taout =	34.23 + (qw+qp)	72.58)/(Q*rho*Cp)		15.93	=	38.79 C		q-rm =	63.03		

Time Step 10	Tain =	33.09 C	Taa = 0.5*(Tain+Taout) =	0.5*(	33.09	+	37.12	) =	35.11			
(40-50 yr)	Twout =	43.86 C	Twa = 0.5*(Twin+Twout)	0.5*(	46.46	+	43.86	) =	45.16			
	Tpout =	57.69 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	62.03	+	57.69	) =	59.86			
	qw =	Aw x h x { (Twa =	45.16) -	Tain=	33.09 } =		39.42 kW					
	qp =	Ap x h x { (Tpa =	59.86) -	Tain=	33.09 } =		24.86 kW					
	Taout =	33.09 + (qw+qp)	64.28)/(Q*rho*Cp)		15.93	=	37.12 C		q-rm =	55.82		

Time Step 11	Tain =	32.12 C	Taa = 0.5*(Tain+Taout) =	0.5*(	32.12	+	35.69	) =	33.90			
(50-60 yr)	Twout =	41.66 C	Twa = 0.5*(Twin+Twout)	0.5*(	43.86	+	41.66	) =	42.76			
	Tpout =	53.99 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	57.69	+	53.99	) =	55.84			
	qw =	Aw x h x { (Twa =	42.76) -	Tain=	32.12 } =		34.74 kW					
	qp =	Ap x h x { (Tpa =	55.84) -	Tain=	32.12 } =		22.02 kW					
	Taout =	32.12 + (qw+qp)	56.77)/(Q*rho*Cp)		15.93	=	35.69 C		q-rm =	49.29		

Time Step 12	Tain =	31.33 C	Taa = 0.5*(Tain+Taout) =	0.5*(	31.33	+	34.50	) =	32.92			
(60-70 yr)	Twout =	39.90 C	Twa = 0.5*(Twin+Twout)	0.5*(	41.66	+	39.90	) =	40.78			
	Tpout =	51.01 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	53.99	+	51.01	) =	52.50			
	qw =	Aw x h x { (Twa =	40.78) -	Tain=	31.33 } =		30.86 kW					
	qp =	Ap x h x { (Tpa =	52.50) -	Tain=	31.33 } =		19.66 kW					
	Taout =	31.33 + (qw+qp)	50.52)/(Q*rho*Cp)		15.93	=	34.50 C		q-rm =	43.87		

Time Step 13	Tain =	30.69 C	Taa = 0.5*(Tain+Taout) =	0.5*(	30.69	+	33.55	) =	32.12			
(70-80 yr)	Twout =	38.47 C	Twa = 0.5*(Twin+Twout)	0.5*(	39.90	+	38.47	) =	39.18			
	Tpout =	48.57 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	51.01	+	48.57	) =	49.79			
	qw =	Aw x h x { (Twa =	39.18) -	Tain=	30.69 } =		27.72 kW					
	qp =	Ap x h x { (Tpa =	49.79) -	Tain=	30.69 } =		17.73 kW					
	Taout =	30.69 + (qw+qp)	45.46)/(Q*rho*Cp)		15.93	=	33.55 C		q-rm =	39.47		

Time Step 14	Tain =	30.17 C	Taa = 0.5*(Tain+Taout) =	0.5*(	30.17	+	32.77	) =	31.47			
(80-90 yr)	Twout =	37.29 C	Twa = 0.5*(Twin+Twout)	0.5*(	38.47	+	37.29	) =	37.88			
	Tpout =	46.55 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	48.57	+	46.55	) =	47.56			
	qw =	Aw x h x { (Twa =	37.88) -	Tain=	30.17 } =		25.16 kW					
	qp =	Ap x h x { (Tpa =	47.56) -	Tain=	30.17 } =		16.15 kW					
	Taout =	30.17 + (qw+qp)	41.31)/(Q*rho*Cp)		15.93	=	32.77 C		q-rm =	35.87		

Time Step 15	Tain =	29.74 C	Taa = 0.5*(Tain+Taout) =	0.5*(	29.74	+	32.12	) =	30.93			
(90-100 yr)	Twout =	36.31 C	Twa = 0.5*(Twin+Twout)	0.5*(	37.29	+	36.31	) =	36.80			
	Tpout =	44.86 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	46.55	+	44.86	) =	45.70			
	qw =	Aw x h x { (Twa =	36.80) -	Tain=	29.74 } =		23.05 kW					
	qp =	Ap x h x { (Tpa =	45.70) -	Tain=	29.74 } =		14.82 kW					
	Taout =	29.74 + (qw+qp)	37.87)/(Q*rho*Cp)		15.93	=	32.12 C		q-rm =	32.89		

Time Step 16	Tain =	29.26	C	Taa = 0.5*(Tain+Taout) =	0.5*(	29.26	+	31.41	) =	30.33				
(100-125 yr)	Twout =	34.97	C	Twa = 0.5*(Twin+Twout)	0.5*(	36.31	+	34.97	) =	35.64				
	Tpout =	42.46	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	44.86	+	42.46	) =	43.66				
	qw =	Aw x h x { (Twa =	35.64	) -	Tain=	29.26	} =	20.85	kW					
	qp =	Ap x h x { (Tpa =	43.66	) -	Tain=	29.26	} =	13.37	kW					
	Taout =	29.26	+ (qw+qp)	34.22	)/(Q*rho*Cp)	15.93	=	31.41	C	q-rm =	29.71			

Time Step 17	Tain =	28.68	C	Taa = 0.5*(Tain+Taout) =	0.5*(	28.68	+	30.56	) =	29.62				
(125-150 yr)	Twout =	33.57	C	wa = 0.5*(Twin+Twout) =	0.5*(	34.97	+	33.57	) =	34.27				
	Tpout =	39.94	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	42.46	+	39.94	) =	41.20				
	qw =	Aw x h x { (Twa =	34.27	) -	Tain=	28.68	} =	18.26	kW					
	qp =	Ap x h x { (Tpa =	41.20	) -	Tain=	28.68	} =	11.62	kW					
	Taout =	28.68	+ (qw+qp)	29.89	)/(Q*rho*Cp)	15.93	=	30.56	C	q-rm =	25.95			

Time Step 18	Tain =	28.11	C	Taa = 0.5*(Tain+Taout) =	0.5*(	28.11	+	29.71	) =	28.91				
(150-200 yr)	Twout =	32.20	C	wa = 0.5*(Twin+Twout) =	0.5*(	33.57	+	32.20	) =	32.89				
	Tpout =	37.55	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	39.94	+	37.55	) =	38.74				
	qw =	Aw x h x { (Twa =	32.89	) -	Tain=	28.11	} =	15.59	kW					
	qp =	Ap x h x { (Tpa =	38.74	) -	Tain=	28.11	} =	9.87	kW					
	Taout =	28.11	+ (qw+qp)	25.47	)/(Q*rho*Cp)	15.93	=	29.71	C	q-rm =	22.11			

Time Step 19	Tain =	27.66	C	Taa = 0.5*(Tain+Taout) =	0.5*(	27.66	+	29.03	) =	28.35				
(200-250 yr)	Twout =	31.28	C	wa = 0.5*(Twin+Twout) =	0.5*(	32.20	+	31.28	) =	31.74				
	Tpout =	36.00	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	37.55	+	36.00	) =	36.78				
	qw =	Aw x h x { (Twa =	31.74	) -	Tain=	27.66	} =	13.32	kW					
	qp =	Ap x h x { (Tpa =	36.78	) -	Tain=	27.66	} =	8.46	kW					
	Taout =	27.66	+ (qw+qp)	21.78	)/(Q*rho*Cp)	15.93	=	29.03	C	q-rm =	18.91			

Time Step 20	Tain =	27.37	C	Taa = 0.5*(Tain+Taout) =	0.5*(	27.37	+	28.58	) =	27.97				
(250-300 yr)	Twout =	30.65	C	wa = 0.5*(Twin+Twout) =	0.5*(	31.28	+	30.65	) =	30.96				
	Tpout =	34.94	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	36.00	+	34.94	) =	35.47				
	qw =	Aw x h x { (Twa =	30.96	) -	Tain=	27.37	} =	11.73	kW					
	qp =	Ap x h x { (Tpa =	35.47	) -	Tain=	27.37	} =	7.52	kW					
	Taout =	27.37	+ (qw+qp)	19.26	)/(Q*rho*Cp)	15.93	=	28.58	C	q-rm =	16.72			

DRIFT SEGMENT # 4 (300-400m) Air Quantity, Q = 15 m^3/s 60 MTU/acre

Drift Wall Temperature Results from ANSIS Modeling

Time	Drift Wall Temperatures, C		
	Invert	Springline	Crown
0.00	25.00	25.00	25.00
0.00	27.93	28.43	27.90
1.00	60.20	63.35	60.18
5.00	65.25	67.99	65.23
10.00	63.56	66.04	63.52
15.00	60.62	62.89	60.59
20.00	57.95	60.05	57.91
26.00	55.21	57.13	55.18
30.00	53.33	55.15	53.30
40.00	50.23	51.81	50.20
50.00	47.23	48.62	47.20
60.00	44.67	45.89	44.65
70.00	42.59	43.68	42.57
80.00	40.91	41.89	40.89
90.00	39.52	40.42	39.50
100.00	38.36	39.19	38.35
125.00	36.84	37.55	36.82
150.00	35.23	35.83	35.21
200.00	33.62	34.12	33.61
250.00	32.50	32.93	32.48
300.00	31.73	32.12	31.71

Drift Wall and Air Temperatures, C

Time Afte Emplm't, Y	Ave. Drift Wall Tem	Air Temp at 400 m
0.00	25.00	25.00
0.00	28.09	29.07
1.00	61.24	45.79
5.00	66.16	52.47
10.00	64.37	52.30
15.00	61.36	50.41
20.00	58.63	48.45
26.00	55.84	46.60
30.00	53.93	45.04
40.00	50.75	43.30
50.00	47.68	41.15
60.00	45.07	39.25
70.00	42.95	37.67
80.00	41.23	36.40
90.00	39.81	35.36
100.00	38.63	34.50
125.00	37.07	33.57
150.00	35.42	32.45
200.00	33.78	31.34
250.00	32.64	30.42
300.00	31.85	29.80

Air Temperature and Heat Removal Calculations

Tin =	25.00 C	D.S =	81.00 m	WP Dia. =	1.56	Ap =	4.91	m^2
Drift L =	600.00 m	P.G. =	0.10 m	Drift Dia. =	5.50	Aw =	17.28	m^2
Delta L =	100.00 m	T.L. =	60.00 MTU/ac	Air Dens. =	1.06	kg/m^3		
Cv. Coeff. h=	1.89 W/m^2 K	L.L. =	1.55 kW/m	Air Cp =	1.01	kJ/kg K		

Time Step 1	Tain =	25.00	C	Taa = 0.5*(Tain+Taout) =	0.5*(	25.00	+	29.07	) =		27.03
(0-1e-4 yr)	Twout =	28.09	C	wa = 0.5*(Twin+Twout) =	0.5*(	25.00	+	28.09	) =		26.54
	Tpout =	108.79	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.00	+	108.79	) =		89.39
	qw =	Aw x h x { (Twa =	26.54	) - Tain=	25.00	} =	5.04	kW			
	qp =	Ap x h x { (Tpa =	89.39	) - Tain=	25.00	} =	59.80	kW			
	Taout =	25.00	+ (qw+qp)	64.84	)/(Q*rho*Cp)	15.93	=	29.07	C	q-rm =	56.31

Time Step 2	Tain =	41.89	C	Taa = 0.5*(Tain+Taout) =	0.5*(	41.89	+	45.79	) =		43.84
(1e-4-1 yr)	Twout =	61.24	C	wa = 0.5*(Twin+Twout) =	0.5*(	28.09	+	61.24	) =		44.66
	Tpout =	89.21	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	108.79	+	89.21	) =		99.00
	qw =	Aw x h x { (Twa =	44.66	) - Tain=	41.89	} =	9.05	kW			
	qp =	Ap x h x { (Tpa =	99.00	) - Tain=	41.89	} =	53.03	kW			
	Taout =	41.89	+ (qw+qp)	62.08	)/(Q*rho*Cp)	15.93	=	45.79	C	q-rm =	53.91

Time Step 3	Tain =	46.38	C	Taa = 0.5*(Tain+Taout) =	0.5*(	46.38	+	52.47	) =		49.43
(1-5 yr)	Twout =	66.16	C	wa = 0.5*(Twin+Twout) =	0.5*(	61.24	+	66.16	) =		63.70
	Tpout =	90.74	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	89.21	+	90.74	) =		89.97
	qw =	Aw x h x { (Twa =	63.70	) - Tain=	46.38	} =	56.56	kW			
	qp =	Ap x h x { (Tpa =	89.97	) - Tain=	46.38	} =	40.48	kW			
	Taout =	46.38	+ (qw+qp)	97.04	)/(Q*rho*Cp)	15.93	=	52.47	C	q-rm =	84.27

Time Step 4	Tain =	45.81	C	Taa = 0.5*(Tain+Taout) =	0.5*(	45.81	+	52.30	) =		49.06
(5-10 yr)	Twout =	64.37	C	wa = 0.5*(Twin+Twout) =	0.5*(	66.16	+	64.37	) =		65.26
	Tpout =	86.89	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	90.74	+	86.89	) =		88.82
	qw =	Aw x h x { (Twa =	65.26	) - Tain=	45.81	} =	63.53	kW			
	qp =	Ap x h x { (Tpa =	88.82	) - Tain=	45.81	} =	39.94	kW			
	Taout =	45.81	+ (qw+qp)	103.47	)/(Q*rho*Cp)	15.93	=	52.30	C	q-rm =	89.85

Time Step 5	Tain =	44.25	C	Taa = 0.5*(Tain+Taout) =	0.5*(	44.25	+	50.41	) =		47.33
(10-15 yr)	Twout =	61.36	C	wa = 0.5*(Twin+Twout) =	0.5*(	64.37	+	61.36	) =		62.87
	Tpout =	82.23	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	86.89	+	82.23	) =		84.56
	qw =	Aw x h x { (Twa =	62.87	) - Tain=	44.25	} =	60.82	kW			
	qp =	Ap x h x { (Tpa =	84.56	) - Tain=	44.25	} =	37.44	kW			
	Taout =	44.25	+ (qw+qp)	98.25	)/(Q*rho*Cp)	15.93	=	50.41	C	q-rm =	85.32

Time Step 6	Tain =	42.73	C	Taa = 0.5*(Tain+Taout) =		0.5*(	42.73	+	48.45	) =		45.59		
(15-20 yr)	Twout =	58.63	C	wa = 0.5*(Twin+Twout) =		0.5*(	61.36	+	58.63	) =		60.00		
	Tpout =	78.16	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	82.23	+	78.16	) =		80.19		
	qw =	Aw x h x { (Twa =	60.00	) -	Tain=	42.73	} =	56.39	kW					
	qp =	Ap x h x { (Tpa =	80.19	) -	Tain=	42.73	} =	34.79	kW					
	Taout =	42.73	+ (qw+qp)	91.18	)/(Q*rho*Cp)		15.93	=	48.45	C	q-rm =	79.18		
Time Step 7	Tain =	41.31	C	Taa = 0.5*(Tain+Taout) =		0.5*(	41.31	+	46.60	) =		43.95		
(20-26 yr)	Twout =	55.84	C	wa = 0.5*(Twin+Twout) =		0.5*(	58.63	+	55.84	) =		57.24		
	Tpout =	73.89	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	78.16	+	73.89	) =		76.03		
	qw =	Aw x h x { (Twa =	57.24	) -	Tain=	41.31	} =	52.01	kW					
	qp =	Ap x h x { (Tpa =	76.03	) -	Tain=	41.31	} =	32.24	kW					
	Taout =	41.31	+ (qw+qp)	84.25	)/(Q*rho*Cp)		15.93	=	46.60	C	q-rm =	73.16		
Time Step 8	Tain =	40.13	C	Taa = 0.5*(Tain+Taout) =		0.5*(	40.13	+	45.04	) =		42.59		
(26-30 yr)	Twout =	53.93	C	wa = 0.5*(Twin+Twout) =		0.5*(	55.84	+	53.93	) =		54.88		
	Tpout =	71.15	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	73.89	+	71.15	) =		72.52		
	qw =	Aw x h x { (Twa =	54.88	) -	Tain=	40.13	} =	48.18	kW					
	qp =	Ap x h x { (Tpa =	72.52	) -	Tain=	40.13	} =	30.08	kW					
	Taout =	40.13	+ (qw+qp)	78.26	)/(Q*rho*Cp)		15.93	=	45.04	C	q-rm =	67.96		
Time Step 9	Tain =	38.79	C	Taa = 0.5*(Tain+Taout) =		0.5*(	38.79	+	43.30	) =		41.05		
(30-40 yr)	Twout =	50.75	C	wa = 0.5*(Twin+Twout) =		0.5*(	53.93	+	50.75	) =		52.34		
	Tpout =	65.96	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	71.15	+	65.96	) =		68.55		
	qw =	Aw x h x { (Twa =	52.34	) -	Tain=	38.79	} =	44.24	kW					
	qp =	Ap x h x { (Tpa =	68.55	) -	Tain=	38.79	} =	27.64	kW					
	Taout =	38.79	+ (qw+qp)	71.88	)/(Q*rho*Cp)		15.93	=	43.30	C	q-rm =	62.42		
Time Step 10	Tain =	37.12	C	Taa = 0.5*(Tain+Taout) =		0.5*(	37.12	+	41.15	) =		39.13		
(40-50 yr)	Twout =	47.68	C	wa = 0.5*(Twin+Twout) =		0.5*(	50.75	+	47.68	) =		49.22		
	Tpout =	61.22	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	65.96	+	61.22	) =		63.59		
	qw =	Aw x h x { (Twa =	49.22	) -	Tain=	37.12	} =	39.49	kW					
	qp =	Ap x h x { (Tpa =	63.59	) -	Tain=	37.12	} =	24.58	kW					
	Taout =	37.12	+ (qw+qp)	64.07	)/(Q*rho*Cp)		15.93	=	41.15	C	q-rm =	55.63		
Time Step 11	Tain =	35.69	C	Taa = 0.5*(Tain+Taout) =		0.5*(	35.69	+	39.25	) =		37.47		
(50-60 yr)	Twout =	45.07	C	wa = 0.5*(Twin+Twout) =		0.5*(	47.68	+	45.07	) =		46.38		
	Tpout =	57.16	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	61.22	+	57.16	) =		59.19		
	qw =	Aw x h x { (Twa =	46.38	) -	Tain=	35.69	} =	34.92	kW					
	qp =	Ap x h x { (Tpa =	59.19	) -	Tain=	35.69	} =	21.83	kW					
	Taout =	35.69	+ (qw+qp)	56.75	)/(Q*rho*Cp)		15.93	=	39.25	C	q-rm =	49.28		
Time Step 12	Tain =	34.50	C	Taa = 0.5*(Tain+Taout) =		0.5*(	34.50	+	37.67	) =		36.09		
(60-70 yr)	Twout =	42.95	C	wa = 0.5*(Twin+Twout) =		0.5*(	45.07	+	42.95	) =		44.01		
	Tpout =	53.87	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	57.16	+	53.87	) =		55.52		
	qw =	Aw x h x { (Twa =	44.01	) -	Tain=	34.50	} =	31.05	kW					
	qp =	Ap x h x { (Tpa =	55.52	) -	Tain=	34.50	} =	19.52	kW					
	Taout =	34.50	+ (qw+qp)	50.57	)/(Q*rho*Cp)		15.93	=	37.67	C	q-rm =	43.91		
Time Step 13	Tain =	33.55	C	Taa = 0.5*(Tain+Taout) =		0.5*(	33.55	+	36.40	) =		34.98		
(70-80 yr)	Twout =	41.23	C	wa = 0.5*(Twin+Twout) =		0.5*(	42.95	+	41.23	) =		42.09		
	Tpout =	51.18	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	53.87	+	51.18	) =		52.52		
	qw =	Aw x h x { (Twa =	42.09	) -	Tain=	33.55	} =	27.89	kW					
	qp =	Ap x h x { (Tpa =	52.52	) -	Tain=	33.55	} =	17.62	kW					
	Taout =	33.55	+ (qw+qp)	45.51	)/(Q*rho*Cp)		15.93	=	36.40	C	q-rm =	39.52		
Time Step 14	Tain =	32.77	C	Taa = 0.5*(Tain+Taout) =		0.5*(	32.77	+	35.36	) =		34.06		
(80-90 yr)	Twout =	39.81	C	wa = 0.5*(Twin+Twout) =		0.5*(	41.23	+	39.81	) =		40.52		
	Tpout =	48.94	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	51.18	+	48.94	) =		50.06		
	qw =	Aw x h x { (Twa =	40.52	) -	Tain=	32.77	} =	25.33	kW					
	qp =	Ap x h x { (Tpa =	50.06	) -	Tain=	32.77	} =	16.06	kW					
	Taout =	32.77	+ (qw+qp)	41.39	)/(Q*rho*Cp)		15.93	=	35.36	C	q-rm =	35.94		
Time Step 15	Tain =	32.12	C	Taa = 0.5*(Tain+Taout) =		0.5*(	32.12	+	34.50	) =		33.31		
(90-100 yr)	Twout =	38.63	C	wa = 0.5*(Twin+Twout) =		0.5*(	39.81	+	38.63	) =		39.22		
	Tpout =	47.06	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	48.94	+	47.06	) =		48.00		
	qw =	Aw x h x { (Twa =	39.22	) -	Tain=	32.12	} =	23.20	kW					
	qp =	Ap x h x { (Tpa =	48.00	) -	Tain=	32.12	} =	14.75	kW					
	Taout =	32.12	+ (qw+qp)	37.95	)/(Q*rho*Cp)		15.93	=	34.50	C	q-rm =	32.95		

Time Step 16	Tain =	31.41	C	Taa = 0.5*(Tain+Taout) =		0.5*(	31.41	+	33.57	) =		32.49
(100-125 yr)	Twout =	37.07	C	wa = 0.5*(Twin+Twout) =		0.5*(	38.63	+	37.07	) =		37.85
	Tpout =	44.46	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	47.06	+	44.46	) =		45.76
	qw =	Aw x h x { (Twa =	37.85	) -	Tain=	31.41	} =	21.05	kW			
	qp =	Ap x h x { (Tpa =	45.76	) -	Tain=	31.41	} =	13.33	kW			
	Taout =	31.41	+ (qw+qp)	34.38	)/(Q*rho*Cp)		15.93	=	33.57	C	q-rm =	29.86

Time Step 17	Tain =	30.56	C	Taa = 0.5*(Tain+Taout) =		0.5*(	30.56	+	32.45	) =		31.51
(125-150 yr)	Twout =	35.42	C	wa = 0.5*(Twin+Twout) =		0.5*(	37.07	+	35.42	) =		36.25
	Tpout =	41.72	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	44.46	+	41.72	) =		43.09
	qw =	Aw x h x { (Twa =	36.25	) -	Tain=	30.56	} =	18.58	kW			
	qp =	Ap x h x { (Tpa =	43.09	) -	Tain=	30.56	} =	11.64	kW			
	Taout =	30.56	+ (qw+qp)	30.22	)/(Q*rho*Cp)		15.93	=	32.45	C	q-rm =	26.24

Time Step 18	Tain =	29.71	C	Taa = 0.5*(Tain+Taout) =		0.5*(	29.71	+	31.34	) =		30.52
(150-200 yr)	Twout =	33.78	C	wa = 0.5*(Twin+Twout) =		0.5*(	35.42	+	33.78	) =		34.60
	Tpout =	39.08	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	41.72	+	39.08	) =		40.40
	qw =	Aw x h x { (Twa =	34.60	) -	Tain=	29.71	} =	15.97	kW			
	qp =	Ap x h x { (Tpa =	40.40	) -	Tain=	29.71	} =	9.92	kW			
	Taout =	29.71	+ (qw+qp)	25.89	)/(Q*rho*Cp)		15.93	=	31.34	C	q-rm =	22.48

Time Step 19	Tain =	29.03	C	Taa = 0.5*(Tain+Taout) =		0.5*(	29.03	+	30.42	) =		29.73
(200-250 yr)	Twout =	32.64	C	wa = 0.5*(Twin+Twout) =		0.5*(	33.78	+	32.64	) =		33.21
	Tpout =	37.32	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	39.08	+	37.32	) =		38.20
	qw =	Aw x h x { (Twa =	33.21	) -	Tain=	29.03	} =	13.65	kW			
	qp =	Ap x h x { (Tpa =	38.20	) -	Tain=	29.03	} =	8.52	kW			
	Taout =	29.03	+ (qw+qp)	22.17	)/(Q*rho*Cp)		15.93	=	30.42	C	q-rm =	19.25

Time Step 20	Tain =	28.58	C	Taa = 0.5*(Tain+Taout) =		0.5*(	28.58	+	29.80	) =		29.19
(250-300 yr)	Twout =	31.85	C	wa = 0.5*(Twin+Twout) =		0.5*(	32.64	+	31.85	) =		32.25
	Tpout =	36.11	C	Tpa = 0.5*(Tpin+Tpout) =		0.5*(	37.32	+	36.11	) =		36.72
	qw =	Aw x h x { (Twa =	32.25	) -	Tain=	28.58	} =	11.98	kW			
	qp =	Ap x h x { (Tpa =	36.72	) -	Tain=	28.58	} =	7.56	kW			
	Taout =	28.58	+ (qw+qp)	19.54	)/(Q*rho*Cp)		15.93	=	29.80	C	q-rm =	16.96

DRIFT SEGMENT # 5 (400-500m) Air Quantity, Q = 15 m^3/s 60 MTU/acre

Drift Wall Temperature Results from ANSIS Modeling

Time	Drift Wall Temperatures, C		
	Invert	Springline	Crown
0.00	25.00	25.00	25.00
0.00	27.93	28.43	27.90
1.00	63.23	66.36	63.22
5.00	70.61	73.31	70.58
10.00	69.43	71.87	69.40
15.00	66.28	68.51	66.25
20.00	63.24	65.30	63.20
26.00	60.14	62.03	60.11
30.00	57.94	59.73	57.90
40.00	54.48	56.03	54.44
50.00	51.05	52.42	51.02
60.00	48.07	49.28	48.05
70.00	45.64	46.72	45.61
80.00	43.66	44.64	43.64
90.00	42.04	42.93	42.02
100.00	40.68	41.50	40.67
125.00	38.95	39.66	38.93
150.00	37.08	37.68	37.07
200.00	35.23	35.72	35.21
250.00	33.88	34.31	33.86
300.00	32.95	33.34	32.93

Drift Wall and Air Temperatures, C

Time Afte Emplm't, Y	Ave. Drift Wall Tem	Air Temp at 500 m
0.00	25.00	25.00
0.00	28.09	29.07
1.00	64.27	49.05
5.00	71.50	58.03
10.00	70.24	58.53
15.00	67.01	56.43
20.00	63.91	54.08
26.00	60.76	51.81
30.00	58.52	49.89
40.00	54.98	47.77
50.00	51.50	45.15
60.00	48.47	42.81
70.00	45.99	40.85
80.00	43.98	39.26
90.00	42.33	37.96
100.00	40.95	36.88
125.00	39.18	35.73
150.00	37.28	34.37
200.00	35.39	32.99
250.00	34.02	31.84
300.00	33.07	31.05

Air Temperature and Heat Removal Calculations

Tin =	25.00	C	D.S =	81.00	m	WP Dia. =	1.56	Ap =	4.91 m^2
Drift L =	600.00	m	P.G. =	0.10	m	Drift Dia. =	5.50	Aw =	17.28 m^2
Delta L =	100.00	m	T.L. =	60.00	MTU/ac	Air Dens. =	1.06	kg/m^3	
Cv. Coeff. h=	1.89	W/m^2 K	L.L. =	1.55	kW/m	Air Cp =	1.01	kJ/kg K	

Time Step 1	Tain =	25.00	C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00	+	29.07	) =	27.03		
(0-1e-4 yr)	Twout =	28.09	C	Twa = 0.5*(Twin+Twout)	0.5*(	25.00	+	28.09	) =	26.54		
	Tpout =	108.79	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.00	+	108.79	) =	89.39		
	qw =	Aw x h x { (Twa =	26.54	) - Tain=	25.00	} =	5.04	kW				
	qp =	Ap x h x { (Tpa =	89.39	) - Tain=	25.00	} =	59.80	kW				
	Taout =	25.00	+ (qw+qp)	64.84	)/(Q*rho*Cp)	15.93	=	29.07	C	q-rm =	56.31	

Time Step 2	Tain =	45.79	C	Taa = 0.5*(Tain+Taout)	0.5*(	45.79	+	49.05	) =	47.42		
(1e-4-1 yr)	Twout =	64.27	C	Twa = 0.5*(Twin+Twout)	0.5*(	28.09	+	64.27	) =	46.18		
	Tpout =	91.88	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	108.79	+	91.88	) =	100.34		
	qw =	Aw x h x { (Twa =	46.18	) - Tain=	45.79	} =	1.27	kW				
	qp =	Ap x h x { (Tpa =	100.34	) - Tain=	45.79	} =	50.65	kW				
	Taout =	45.79	+ (qw+qp)	51.93	)/(Q*rho*Cp)	15.93	=	49.05	C	q-rm =	45.09	

Time Step 3	Tain =	52.47	C	Taa = 0.5*(Tain+Taout) =	0.5*(	52.47	+	58.03	) =	55.25		
(1-5 yr)	Twout =	71.50	C	Twa = 0.5*(Twin+Twout)	0.5*(	64.27	+	71.50	) =	67.89		
	Tpout =	95.43	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	91.88	+	95.43	) =	93.66		
	qw =	Aw x h x { (Twa =	67.89	) - Tain=	52.47	} =	50.34	kW				
	qp =	Ap x h x { (Tpa =	93.66	) - Tain=	52.47	} =	38.25	kW				
	Taout =	52.47	+ (qw+qp)	88.58	)/(Q*rho*Cp)	15.93	=	58.03	C	q-rm =	76.92	

Time Step 4	Tain =	52.30	C	Taa = 0.5*(Tain+Taout)	0.5*(	52.30	+	58.53	) =	55.41		
(5-10 yr)	Twout =	70.24	C	Twa = 0.5*(Twin+Twout)	0.5*(	71.50	+	70.24	) =	70.87		
	Tpout =	92.09	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	95.43	+	92.09	) =	93.76		
	qw =	Aw x h x { (Twa =	70.87	) - Tain=	52.30	} =	60.62	kW				
	qp =	Ap x h x { (Tpa =	93.76	) - Tain=	52.30	} =	38.50	kW				
	Taout =	52.30	+ (qw+qp)	99.12	)/(Q*rho*Cp)	15.93	=	58.53	C	q-rm =	86.07	

Time Step 5	Tain =	50.41	C	Taa = 0.5*(Tain+Taout) =	0.5*(	50.41	+	56.43	) =	53.42		
(10-15 yr)	Twout =	67.01	C	Twa = 0.5*(Twin+Twout)	0.5*(	70.24	+	67.01	) =	68.62		
	Tpout =	87.26	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	92.09	+	87.26	) =	89.68		
	qw =	Aw x h x { (Twa =	68.62	) - Tain=	50.41	} =	59.47	kW				
	qp =	Ap x h x { (Tpa =	89.68	) - Tain=	50.41	} =	36.46	kW				
	Taout =	50.41	+ (qw+qp)	95.93	)/(Q*rho*Cp)	15.93	=	56.43	C	q-rm =	83.30	

Time Step 6	Tain =	48.45 C	Taa = 0.5*(Tain+Taout)	0.5*(	48.45 +	54.08) =	51.27				
(15-20 yr)	Twout =	63.91 C	Twa = 0.5*(Twin+Twout)	0.5*(	67.01 +	63.91) =	65.46				
	Tpout =	82.92 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	87.26 +	82.92) =	85.09				
	qw =	Aw x h x { (Twa =	65.46) -	Tain=	48.45 } =	55.54 kW					
	qp =	Ap x h x { (Tpa =	85.09) -	Tain=	48.45 } =	34.02 kW					
	Taout =	48.45 + (qw+qp)	89.56)/(Q*rho*Cp)		15.93 =	54.08 C	q-rm =	77.77			

Time Step 7	Tain =	46.60 C	Taa = 0.5*(Tain+Taout) =	0.5*(	46.60 +	51.81) =	49.20				
(20-26 yr)	Twout =	60.76 C	Twa = 0.5*(Twin+Twout)	0.5*(	63.91 +	60.76) =	62.34				
	Tpout =	78.34 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	82.92 +	78.34) =	80.63				
	qw =	Aw x h x { (Twa =	62.34) -	Tain=	46.60 } =	51.40 kW					
	qp =	Ap x h x { (Tpa =	80.63) -	Tain=	46.60 } =	31.60 kW					
	Taout =	46.60 + (qw+qp)	83.00)/(Q*rho*Cp)		15.93 =	51.81 C	q-rm =	72.07			

Time Step 8	Tain =	45.04 C	Taa = 0.5*(Tain+Taout)	0.5*(	45.04 +	49.89) =	47.46				
(26-30 yr)	Twout =	58.52 C	Twa = 0.5*(Twin+Twout)	0.5*(	60.76 +	58.52) =	59.64				
	Tpout =	75.32 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	78.34 +	75.32) =	76.83				
	qw =	Aw x h x { (Twa =	59.64) -	Tain=	45.04 } =	47.68 kW					
	qp =	Ap x h x { (Tpa =	76.83) -	Tain=	45.04 } =	29.52 kW					
	Taout =	45.04 + (qw+qp)	77.20)/(Q*rho*Cp)		15.93 =	49.89 C	q-rm =	67.04			

Time Step 9	Tain =	43.30 C	Taa = 0.5*(Tain+Taout) =	0.5*(	43.30 +	47.77) =	45.53				
(30-40 yr)	Twout =	54.98 C	Twa = 0.5*(Twin+Twout)	0.5*(	58.52 +	54.98) =	56.75				
	Tpout =	69.85 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	75.32 +	69.85) =	72.58				
	qw =	Aw x h x { (Twa =	56.75) -	Tain=	43.30 } =	43.93 kW					
	qp =	Ap x h x { (Tpa =	72.58) -	Tain=	43.30 } =	27.19 kW					
	Taout =	43.30 + (qw+qp)	71.12)/(Q*rho*Cp)		15.93 =	47.77 C	q-rm =	61.76			

Time Step 10	Tain =	41.15 C	Taa = 0.5*(Tain+Taout) =	0.5*(	41.15 +	45.15) =	43.15				
(40-50 yr)	Twout =	51.50 C	Twa = 0.5*(Twin+Twout)	0.5*(	54.98 +	51.50) =	53.24				
	Tpout =	64.76 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	69.85 +	64.76) =	67.30				
	qw =	Aw x h x { (Twa =	53.24) -	Tain=	41.15 } =	39.50 kW					
	qp =	Ap x h x { (Tpa =	67.30) -	Tain=	41.15 } =	24.29 kW					
	Taout =	41.15 + (qw+qp)	63.80)/(Q*rho*Cp)		15.93 =	45.15 C	q-rm =	55.40			

Time Step 11	Tain =	39.25 C	Taa = 0.5*(Tain+Taout) =	0.5*(	39.25 +	42.81) =	41.03				
(50-60 yr)	Twout =	48.47 C	Twa = 0.5*(Twin+Twout)	0.5*(	51.50 +	48.47) =	49.98				
	Tpout =	60.34 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	64.76 +	60.34) =	62.55				
	qw =	Aw x h x { (Twa =	49.98) -	Tain=	39.25 } =	35.06 kW					
	qp =	Ap x h x { (Tpa =	62.55) -	Tain=	39.25 } =	21.64 kW					
	Taout =	39.25 + (qw+qp)	56.69)/(Q*rho*Cp)		15.93 =	42.81 C	q-rm =	49.23			

Time Step 12	Tain =	37.67 C	Taa = 0.5*(Tain+Taout) =	0.5*(	37.67 +	40.85) =	39.26				
(60-70 yr)	Twout =	45.99 C	Twa = 0.5*(Twin+Twout)	0.5*(	48.47 +	45.99) =	47.23				
	Tpout =	56.73 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	60.34 +	56.73) =	58.53				
	qw =	Aw x h x { (Twa =	47.23) -	Tain=	37.67 } =	31.20 kW					
	qp =	Ap x h x { (Tpa =	58.53) -	Tain=	37.67 } =	19.37 kW					
	Taout =	37.67 + (qw+qp)	50.57)/(Q*rho*Cp)		15.93 =	40.85 C	q-rm =	43.91			

Time Step 13	Tain =	36.40 C	Taa = 0.5*(Tain+Taout) =	0.5*(	36.40 +	39.26) =	37.83				
(70-80 yr)	Twout =	43.98 C	Twa = 0.5*(Twin+Twout)	0.5*(	45.99 +	43.98) =	44.98				
	Tpout =	53.77 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	56.73 +	53.77) =	55.25				
	qw =	Aw x h x { (Twa =	44.98) -	Tain=	36.40 } =	28.02 kW					
	qp =	Ap x h x { (Tpa =	55.25) -	Tain=	36.40 } =	17.50 kW					
	Taout =	36.40 + (qw+qp)	45.53)/(Q*rho*Cp)		15.93 =	39.26 C	q-rm =	39.53			

Time Step 14	Tain =	35.36 C	Taa = 0.5*(Tain+Taout) =	0.5*(	35.36 +	37.96) =	36.66				
(80-90 yr)	Twout =	42.33 C	Twa = 0.5*(Twin+Twout)	0.5*(	43.98 +	42.33) =	43.15				
	Tpout =	51.32 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	53.77 +	51.32) =	52.55				
	qw =	Aw x h x { (Twa =	43.15) -	Tain=	35.36 } =	25.44 kW					
	qp =	Ap x h x { (Tpa =	52.55) -	Tain=	35.36 } =	15.96 kW					
	Taout =	35.36 + (qw+qp)	41.40)/(Q*rho*Cp)		15.93 =	37.96 C	q-rm =	35.95			

Time Step 15	Tain =	34.50 C	Taa = 0.5*(Tain+Taout) =	0.5*(	34.50 +	36.88) =	35.69				
(90-100 yr)	Twout =	40.95 C	Twa = 0.5*(Twin+Twout)	0.5*(	42.33 +	40.95) =	41.64				
	Tpout =	49.27 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	51.32 +	49.27) =	50.29				
	qw =	Aw x h x { (Twa =	41.64) -	Tain=	34.50 } =	23.31 kW					
	qp =	Ap x h x { (Tpa =	50.29) -	Tain=	34.50 } =	14.66 kW					
	Taout =	34.50 + (qw+qp)	37.97)/(Q*rho*Cp)		15.93 =	36.88 C	q-rm =	32.97			

Time Step 16	Tain =	33.57	C	Taa = 0.5*(Tain+Taout) =	0.5*(	33.57	+	35.73	) =	34.65			
(100-125 yr)	Twout =	39.18	C	Twa = 0.5*(Twin+Twout)	0.5*(	40.95	+	39.18	) =	40.06			
	Tpout =	46.48	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	49.27	+	46.48	) =	47.87			
	qw =	Aw x h x { (Twa =	40.06	) - Tain=	33.57	} =	21.22	kW					
	qp =	Ap x h x { (Tpa =	47.87	) - Tain=	33.57	} =	13.29	kW					
	Taout =	33.57	+ (qw+qp)	34.51	)/(Q*rho*Cp)	15.93	=	35.73	C	q-rm =	29.97		

Time Step 16	Tain =	33.57	C	Taa = 0.5*(Tain+Taout) =	0.5*(	33.57	+	35.73	) =	34.65			
(100-125 yr)	Twout =	39.18	C	wa = 0.5*(Twin+Twout) =	0.5*(	40.95	+	39.18	) =	40.06			
	Tpout =	46.48	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	49.27	+	46.48	) =	47.87			
	qw =	Aw x h x { (Twa =	40.06	) - Tain=	33.57	} =	21.22	kW					
	qp =	Ap x h x { (Tpa =	47.87	) - Tain=	33.57	} =	13.29	kW					
	Taout =	33.57	+ (qw+qp)	34.51	)/(Q*rho*Cp)	15.93	=	35.73	C	q-rm =	29.97		

Time Step 17	Tain =	32.45	C	Taa = 0.5*(Tain+Taout) =	0.5*(	32.45	+	34.37	) =	33.41			
(125-150 yr)	Twout =	37.28	C	wa = 0.5*(Twin+Twout) =	0.5*(	39.18	+	37.28	) =	38.23			
	Tpout =	43.50	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	46.48	+	43.50	) =	44.99			
	qw =	Aw x h x { (Twa =	38.23	) - Tain=	32.45	} =	18.85	kW					
	qp =	Ap x h x { (Tpa =	44.99	) - Tain=	32.45	} =	11.64	kW					
	Taout =	32.45	+ (qw+qp)	30.50	)/(Q*rho*Cp)	15.93	=	34.37	C	q-rm =	26.48		

Time Step 18	Tain =	31.34	C	Taa = 0.5*(Tain+Taout) =	0.5*(	31.34	+	32.99	) =	32.16			
(150-200 yr)	Twout =	35.39	C	wa = 0.5*(Twin+Twout) =	0.5*(	37.28	+	35.39	) =	36.33			
	Tpout =	40.63	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	43.50	+	40.63	) =	42.07			
	qw =	Aw x h x { (Twa =	36.33	) - Tain=	31.34	} =	16.31	kW					
	qp =	Ap x h x { (Tpa =	42.07	) - Tain=	31.34	} =	9.96	kW					
	Taout =	31.34	+ (qw+qp)	26.28	)/(Q*rho*Cp)	15.93	=	32.99	C	q-rm =	22.82		

Time Step 19	Tain =	30.42	C	Taa = 0.5*(Tain+Taout) =	0.5*(	30.42	+	31.84	) =	31.13			
(200-250 yr)	Twout =	34.02	C	wa = 0.5*(Twin+Twout) =	0.5*(	35.39	+	34.02	) =	34.70			
	Tpout =	38.66	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	40.63	+	38.66	) =	39.65			
	qw =	Aw x h x { (Twa =	34.70	) - Tain=	30.42	} =	13.98	kW					
	qp =	Ap x h x { (Tpa =	39.65	) - Tain=	30.42	} =	8.57	kW					
	Taout =	30.42	+ (qw+qp)	22.55	)/(Q*rho*Cp)	15.93	=	31.84	C	q-rm =	19.58		

Time Step 20	Tain =	29.80	C	Taa = 0.5*(Tain+Taout) =	0.5*(	29.80	+	31.05	) =	30.43			
(250-300 yr)	Twout =	33.07	C	wa = 0.5*(Twin+Twout) =	0.5*(	34.02	+	33.07	) =	33.54			
	Tpout =	37.29	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	38.66	+	37.29	) =	37.98			
	qw =	Aw x h x { (Twa =	33.54	) - Tain=	29.80	} =	12.21	kW					
	qp =	Ap x h x { (Tpa =	37.98	) - Tain=	29.80	} =	7.59	kW					
	Taout =	29.80	+ (qw+qp)	19.80	)/(Q*rho*Cp)	15.93	=	31.05	C	q-rm =	17.19		

DRIFT SEGMENT # 6 (500-600m) Air Quantity, Q = 15 m^3/s 60 MTU/acre

Drift WallTemperature Results from ANSYS Modeling

Time	Drift Wall Temperature, C		
	Invert	Springline	Crown
0.00	25.00	25.00	25.00
0.00	27.93	28.43	27.90
1.00	65.77	68.88	65.75
5.00	75.48	78.13	75.46
10.00	75.06	77.45	75.02
15.00	71.80	73.98	71.76
20.00	68.44	70.47	68.40
26.00	64.99	66.85	64.96
30.00	62.48	64.24	62.44
40.00	58.67	60.21	58.64
50.00	54.84	56.19	54.81
60.00	51.47	52.66	51.44
70.00	48.69	49.76	48.66
80.00	46.42	47.39	46.40
90.00	44.56	45.44	44.54
100.00	43.00	43.81	42.98
125.00	41.05	41.76	41.04
150.00	38.97	39.56	38.95
200.00	36.85	37.35	36.84
250.00	35.29	35.72	35.27
300.00	34.19	34.58	34.17

Drift Wall and Air Temperatures, C

Time Afte Emplm't, Y	Ave.Drift Wall Tem	Air Temp at 600 m
0.00	25.00	25.00
0.00	28.09	29.07
1.00	66.80	51.77
5.00	76.36	63.08
10.00	75.84	64.45
15.00	72.51	62.30
20.00	69.11	59.59
26.00	65.60	56.94
30.00	63.06	54.67
40.00	59.18	52.18
50.00	55.28	49.13
60.00	51.86	46.36
70.00	49.04	44.02
80.00	46.74	42.12
90.00	44.84	40.56
100.00	43.26	39.27
125.00	41.28	37.90
150.00	39.16	36.30
200.00	37.01	34.66
250.00	35.42	33.28
300.00	34.31	32.31

Air Temperature and Heat Removal Calculations

Tin =	25.00 C	D.S =	81.00 m	WP Dia. =	1.56	Ap =	4.91	m^2
Drift L =	600.00 m	P.G. =	0.10 m	Drift Dia. =	5.50	Aw =	17.28	m^2
Delta L =	100.00 m	T.L. =	60.00 MTU/ac	Air Dens. =	1.06	kg/m^3		
Cv. Coeff. h=	1.89 W/m^2 K	L.L. =	1.55 kW/m	Air Cp =	1.01	kJ/kg K		

Time Step 1	Tain =	25.00 C	Taa = 0.5*(Tain+Taout)	0.5*(	25.00 +	29.07) =	27.03			
(0-1e-4 yr)	Twout =	28.09 C	Twa = 0.5*(Twin+Twout)	0.5*(	25.00 +	28.09) =	26.54			
	Tpout =	108.79 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	70.00 +	108.79) =	89.39			
	qw =	Aw x h x { (Twa =	26.54) -	Tain=	25.00 } =	5.04	kW			
	qp =	Ap x h x { (Tpa =	89.39) -	Tain=	25.00 } =	59.80	kW			
	Taout =	25.00 + (qw+qp)	64.84)/(Q*rho*Cp)		15.93 =	29.07	C	q-rm =	56.31	

Time Step 2	Tain =	49.05 C	Taa = 0.5*(Tain+Taout)	0.5*(	49.05 +	51.77) =	50.41			
(1e-4-1 yr)	Twout =	66.80 C	Twa = 0.5*(Twin+Twout)	0.5*(	28.09 +	66.80) =	47.44			
	Tpout =	94.12 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	108.79 +	94.12) =	101.46			
	qw =	Aw x h x { (Twa =	47.44) -	Tain=	49.05 } =	-5.24	kW			
	qp =	Ap x h x { (Tpa =	101.46) -	Tain=	49.05 } =	48.67	kW			
	Taout =	49.05 + (qw+qp)	43.42)/(Q*rho*Cp)		15.93 =	51.77	C	q-rm =	37.71	

Time Step 3	Tain =	58.03 C	Taa = 0.5*(Tain+Taout) =	0.5*(	58.03 +	63.08) =	60.55			
(1-5 yr)	Twout =	76.36 C	Twa = 0.5*(Twin+Twout)	0.5*(	66.80 +	76.36) =	71.58			
	Tpout =	99.73 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	94.12 +	99.73) =	96.93			
	qw =	Aw x h x { (Twa =	71.58) -	Tain=	58.03 } =	44.24	kW			
	qp =	Ap x h x { (Tpa =	96.93) -	Tain=	58.03 } =	36.12	kW			
	Taout =	58.03 + (qw+qp)	80.36)/(Q*rho*Cp)		15.93 =	63.08	C	q-rm =	69.78	

Time Step 4	Tain =	58.53 C	Taa = 0.5*(Tain+Taout)	0.5*(	58.53 +	64.45) =	61.49			
(5-10 yr)	Twout =	75.84 C	Twa = 0.5*(Twin+Twout)	0.5*(	76.36 +	75.84) =	76.10			
	Tpout =	97.09 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	99.73 +	97.09) =	98.41			
	qw =	Aw x h x { (Twa =	76.10) -	Tain=	58.53 } =	57.39	kW			
	qp =	Ap x h x { (Tpa =	98.41) -	Tain=	58.53 } =	37.04	kW			
	Taout =	58.53 + (qw+qp)	94.43)/(Q*rho*Cp)		15.93 =	64.45	C	q-rm =	82.00	

Time Step 5	Tain =	56.43 C	Taa = 0.5*(Tain+Taout) =	0.5*(	56.43 +	62.30) =	59.37			
(10-15 yr)	Twout =	72.51 C	Twa = 0.5*(Twin+Twout)	0.5*(	75.84 +	72.51) =	74.18			
	Tpout =	92.20 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	97.09 +	92.20) =	94.64			
	qw =	Aw x h x { (Twa =	74.18) -	Tain=	56.43 } =	57.95	kW			
	qp =	Ap x h x { (Tpa =	94.64) -	Tain=	56.43 } =	35.48	kW			
	Taout =	56.43 + (qw+qp)	93.43)/(Q*rho*Cp)		15.93 =	62.30	C	q-rm =	81.13	

Time Step 6	Tain =	54.08 C	Taa = 0.5*(Tain+Taout)	0.5*(	54.08	+	59.59	) =	56.84		
(15-20 yr)	Twout =	69.11 C	Twa = 0.5*(Twin+Twout)	0.5*(	72.51	+	69.11	) =	70.81		
	Tpout =	87.60 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	92.20	+	87.60	) =	89.90		
	qw =	Aw x h x { (Twa =	70.81) -	Tain=	54.08 } =		54.65 kW				
	qp =	Ap x h x { (Tpa =	89.90) -	Tain=	54.08 } =		33.27 kW				
	Taout =	54.08 + (qw+qp)	87.92)/(Q*rho*Cp)		15.93 =		59.59 C	q-rm =	76.34		

Time Step 7	Tain =	51.81 C	Taa = 0.5*(Tain+Taout) =	0.5*(	51.81	+	56.94	) =	54.37		
(20-26 yr)	Twout =	65.60 C	Twa = 0.5*(Twin+Twout)	0.5*(	69.11	+	65.60	) =	67.35		
	Tpout =	82.73 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	87.60	+	82.73	) =	85.17		
	qw =	Aw x h x { (Twa =	67.35) -	Tain=	51.81 } =		50.77 kW				
	qp =	Ap x h x { (Tpa =	85.17) -	Tain=	51.81 } =		30.98 kW				
	Taout =	51.81 + (qw+qp)	81.74)/(Q*rho*Cp)		15.93 =		56.94 C	q-rm =	70.98		

Time Step 8	Tain =	49.89 C	Taa = 0.5*(Tain+Taout)	0.5*(	49.89	+	54.67	) =	52.28		
(26-30 yr)	Twout =	63.06 C	Twa = 0.5*(Twin+Twout)	0.5*(	65.60	+	63.06	) =	64.33		
	Tpout =	79.45 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	82.73	+	79.45	) =	81.09		
	qw =	Aw x h x { (Twa =	64.33) -	Tain=	49.89 } =		47.16 kW				
	qp =	Ap x h x { (Tpa =	81.09) -	Tain=	49.89 } =		28.98 kW				
	Taout =	49.89 + (qw+qp)	76.14)/(Q*rho*Cp)		15.93 =		54.67 C	q-rm =	66.11		

Time Step 9	Tain =	47.77 C	Taa = 0.5*(Tain+Taout) =	0.5*(	47.77	+	52.18	) =	49.97		
(30-40 yr)	Twout =	59.18 C	Twa = 0.5*(Twin+Twout)	0.5*(	63.06	+	59.18	) =	61.12		
	Tpout =	73.71 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	79.45	+	73.71	) =	76.58		
	qw =	Aw x h x { (Twa =	61.12) -	Tain=	47.77 } =		43.60 kW				
	qp =	Ap x h x { (Tpa =	76.58) -	Tain=	47.77 } =		26.76 kW				
	Taout =	47.77 + (qw+qp)	70.35)/(Q*rho*Cp)		15.93 =		52.18 C	q-rm =	61.09		

Time Step 10	Tain =	45.15 C	Taa = 0.5*(Tain+Taout) =	0.5*(	45.15	+	49.13	) =	47.14		
(40-50 yr)	Twout =	55.28 C	Twa = 0.5*(Twin+Twout)	0.5*(	59.18	+	55.28	) =	57.23		
	Tpout =	68.27 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	73.71	+	68.27	) =	70.99		
	qw =	Aw x h x { (Twa =	57.23) -	Tain=	45.15 } =		39.45 kW				
	qp =	Ap x h x { (Tpa =	70.99) -	Tain=	45.15 } =		24.00 kW				
	Taout =	45.15 + (qw+qp)	63.44)/(Q*rho*Cp)		15.93 =		49.13 C	q-rm =	55.09		

Time Step 11	Tain =	42.81 C	Taa = 0.5*(Tain+Taout) =	0.5*(	42.81	+	46.36	) =	44.58		
(50-60 yr)	Twout =	51.86 C	Twa = 0.5*(Twin+Twout)	0.5*(	55.28	+	51.86	) =	53.57		
	Tpout =	63.51 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	68.27	+	63.51	) =	65.89		
	qw =	Aw x h x { (Twa =	53.57) -	Tain=	42.81 } =		35.15 kW				
	qp =	Ap x h x { (Tpa =	65.89) -	Tain=	42.81 } =		21.44 kW				
	Taout =	42.81 + (qw+qp)	56.58)/(Q*rho*Cp)		15.93 =		46.36 C	q-rm =	49.13		

Time Step 12	Tain =	40.85 C	Taa = 0.5*(Tain+Taout) =	0.5*(	40.85	+	44.02	) =	42.44		
(60-70 yr)	Twout =	49.04 C	Twa = 0.5*(Twin+Twout)	0.5*(	51.86	+	49.04	) =	50.45		
	Tpout =	59.60 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	63.51	+	59.60	) =	61.55		
	qw =	Aw x h x { (Twa =	50.45) -	Tain=	40.85 } =		31.34 kW				
	qp =	Ap x h x { (Tpa =	61.55) -	Tain=	40.85 } =		19.23 kW				
	Taout =	40.85 + (qw+qp)	50.57)/(Q*rho*Cp)		15.93 =		44.02 C	q-rm =	43.91		

Time Step 13	Tain =	39.26 C	Taa = 0.5*(Tain+Taout) =	0.5*(	39.26	+	42.12	) =	40.69		
(70-80 yr)	Twout =	46.74 C	Twa = 0.5*(Twin+Twout)	0.5*(	49.04	+	46.74	) =	47.89		
	Tpout =	56.38 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	59.60	+	56.38	) =	57.99		
	qw =	Aw x h x { (Twa =	47.89) -	Tain=	39.26 } =		28.17 kW				
	qp =	Ap x h x { (Tpa =	57.99) -	Tain=	39.26 } =		17.39 kW				
	Taout =	39.26 + (qw+qp)	45.56)/(Q*rho*Cp)		15.93 =		42.12 C	q-rm =	39.56		

Time Step 14	Tain =	37.96 C	Taa = 0.5*(Tain+Taout) =	0.5*(	37.96	+	40.56	) =	39.26		
(80-90 yr)	Twout =	44.84 C	Twa = 0.5*(Twin+Twout)	0.5*(	46.74	+	44.84	) =	45.79		
	Tpout =	53.71 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	56.38	+	53.71	) =	55.04		
	qw =	Aw x h x { (Twa =	45.79) -	Tain=	37.96 } =		25.57 kW				
	qp =	Ap x h x { (Tpa =	55.04) -	Tain=	37.96 } =		15.86 kW				
	Taout =	37.96 + (qw+qp)	41.43)/(Q*rho*Cp)		15.93 =		40.56 C	q-rm =	35.98		

Time Step 15	Tain =	36.88 C	Taa = 0.5*(Tain+Taout) =	0.5*(	36.88	+	39.27	) =	38.08		
(90-100 yr)	Twout =	43.26 C	Twa = 0.5*(Twin+Twout)	0.5*(	44.84	+	43.26	) =	44.05		
	Tpout =	51.47 C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	53.71	+	51.47	) =	52.59		
	qw =	Aw x h x { (Twa =	44.05) -	Tain=	36.88 } =		23.42 kW				
	qp =	Ap x h x { (Tpa =	52.59) -	Tain=	36.88 } =		14.58 kW				
	Taout =	36.88 + (qw+qp)	38.00)/(Q*rho*Cp)		15.93 =		39.27 C	q-rm =	33.00		

Time Step 16	Tain =	35.73	C	Taa = 0.5*(Tain+Taout) =	0.5*(	35.73	+	37.90	) =	36.82				
(100-125 yr)	Twout =	41.28	C	Twa = 0.5*(Twin+Twout)	0.5*(	43.26	+	41.28	) =	42.27				
	Tpout =	48.50	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	51.47	+	48.50	) =	49.98				
	qw =	Aw x h x { (Twa =	42.27	) -	Tain=	35.73	} =	21.37	kW					
	qp =	Ap x h x { (Tpa =	49.98	) -	Tain=	35.73	} =	13.24	kW					
	Taout =	35.73	+ (qw+qp)	34.60	)/(Q*rho*Cp)	15.93	=	37.90	C	q-rm =	30.05			

Time Step 16	Tain =	35.73	C	Taa = 0.5*(Tain+Taout) =	0.5*(	35.73	+	37.90	) =	36.82				
(100-125 yr)	Twout =	41.28	C	wa = 0.5*(Twin+Twout) =	0.5*(	43.26	+	41.28	) =	42.27				
	Tpout =	48.50	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	51.47	+	48.50	) =	49.98				
	qw =	Aw x h x { (Twa =	42.27	) -	Tain=	35.73	} =	21.37	kW					
	qp =	Ap x h x { (Tpa =	49.98	) -	Tain=	35.73	} =	13.24	kW					
	Taout =	35.73	+ (qw+qp)	34.60	)/(Q*rho*Cp)	15.93	=	37.90	C	q-rm =	30.05			

Time Step 17	Tain =	34.37	C	Taa = 0.5*(Tain+Taout) =	0.5*(	34.37	+	36.30	) =	35.33				
(125-150 yr)	Twout =	39.16	C	wa = 0.5*(Twin+Twout) =	0.5*(	41.28	+	39.16	) =	40.22				
	Tpout =	45.31	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	48.50	+	45.31	) =	46.91				
	qw =	Aw x h x { (Twa =	40.22	) -	Tain=	34.37	} =	19.11	kW					
	qp =	Ap x h x { (Tpa =	46.91	) -	Tain=	34.37	} =	11.64	kW					
	Taout =	34.37	+ (qw+qp)	30.75	)/(Q*rho*Cp)	15.93	=	36.30	C	q-rm =	26.70			

Time Step 18	Tain =	32.99	C	Taa = 0.5*(Tain+Taout) =	0.5*(	32.99	+	34.66	) =	33.82				
(150-200 yr)	Twout =	37.01	C	wa = 0.5*(Twin+Twout) =	0.5*(	39.16	+	37.01	) =	38.09				
	Tpout =	42.21	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	45.31	+	42.21	) =	43.76				
	qw =	Aw x h x { (Twa =	38.09	) -	Tain=	32.99	} =	16.65	kW					
	qp =	Ap x h x { (Tpa =	43.76	) -	Tain=	32.99	} =	10.00	kW					
	Taout =	32.99	+ (qw+qp)	26.65	)/(Q*rho*Cp)	15.93	=	34.66	C	q-rm =	23.14			

Time Step 19	Tain =	31.84	C	Taa = 0.5*(Tain+Taout) =	0.5*(	31.84	+	33.28	) =	32.56				
(200-250 yr)	Twout =	35.42	C	wa = 0.5*(Twin+Twout) =	0.5*(	37.01	+	35.42	) =	36.22				
	Tpout =	40.03	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	42.21	+	40.03	) =	41.12				
	qw =	Aw x h x { (Twa =	36.22	) -	Tain=	31.84	} =	14.31	kW					
	qp =	Ap x h x { (Tpa =	41.12	) -	Tain=	31.84	} =	8.62	kW					
	Taout =	31.84	+ (qw+qp)	22.93	)/(Q*rho*Cp)	15.93	=	33.28	C	q-rm =	19.91			

Time Step 20	Tain =	31.05	C	Taa = 0.5*(Tain+Taout) =	0.5*(	31.05	+	32.31	) =	31.68				
(250-300 yr)	Twout =	34.31	C	wa = 0.5*(Twin+Twout) =	0.5*(	35.42	+	34.31	) =	34.87				
	Tpout =	38.50	C	Tpa = 0.5*(Tpin+Tpout) =	0.5*(	40.03	+	38.50	) =	39.27				
	qw =	Aw x h x { (Twa =	34.87	) -	Tain=	31.05	} =	12.48	kW					
	qp =	Ap x h x { (Tpa =	39.27	) -	Tain=	31.05	} =	7.63	kW					
	Taout =	31.05	+ (qw+qp)	20.11	)/(Q*rho*Cp)	15.93	=	32.31	C	q-rm =	17.46			

ATTACHMENT V

COMPUTER FILES FOR ANSYS RUNS

```
                                                    /BATCH,LIST
!
!###############################################################################
!#                                                                             #
!#                                ANSYS INPUT                                  #
!#                                                                             #
!#       Filename:         amr                                                 #
!#                                                                             #
!#       Input File:       amr.dat                                             #
!#                         th_data.input                                       #
!#                                                                             #
!#       Output File:      amr.out                                             #
!#                                                                             #
!#       Description:      2D ANSYS Model for Analysis and Modeling Report for #
!#                         SR/LA (amr)                                         #
!#                         Emplacement mode:         Center-in-drift           #
!#                         Drift diameter:           5.5 meters                #
!#                         Drift spacing:            81 meters                 #
!#                         WP diameter:              1.564 meters              #
!#                         Units modeled:            All                       #
!#                                                                             #
!#       Code Version:     ANSYS Revision 5.2                                  #
!#                                                                             #
!#                                                                             #
!###############################################################################
!
/COM,ANSYS MEDIA REV. 5.2
!
/FILNAM,amr               !       Jobname to use for all subsequent files
/TITLE,2D Model (DS:81m;DD:5.5m)
/UNITS,SI
/SHOW
!
/NOPR
*ABB,SAVE_DB ,SAVE
*ABB,RESUM_DB,RESUME
*ABB,QUIT     ,Fnc_/EXIT
*ABB,SHFR     ,/SHOW,FILE,,,8
*ABB,SHFV     ,/SHOW,FILE,,1
*ABB,X11C     ,/SHOW,X11C,,,8
*ABB,X11      ,/SHOW,X11,,1
*ABB,REPLOT   ,/REPLOT
*ABB,K1       ,/PNUM,KP,1
*ABB,K0       ,/PNUM,KP,0
*ABB,POWRGRPH,Fnc_/GRAPHICS
*ABB,ANSYSWEB,Fnc_HomePage
/GO
!
/FDELE,EMAT,DELE
/FDELE,ESAV,DELE
/FDELE,EROT,DELE
/FDELE,DSUB,DELE
/FDELE,TRI,DELE
/FDELE,OSAV,DELE
/FDELE,PAGE,DELE
!
/PREP7
!
!       Define element types
!
ET,1,PLANE55              !       4-node, 2-D thermal solid element
ET,2,LINK32               !       2-D conduction bar
R,1,1.0
ET,3,MATRIX50             !       Superelement for radiation
KEYOPT,3,1,1              !       Superelement behavior: radiation substructure
KEYOPT,3,6,0              !
!
/INPUT,th_data,input,,1,0 !       Read material properties
!
!       Parameters for model generation
!
ORIG=0.0
X1=5.5
X2=40.5
Y1=5.5
R1=2.75
RW=0.782
!
RECTNG,ORIG,X1,ORIG,Y1,
PCIRC,R1, ,0,90,
ASBA,1,2
```

```
ASEL,S,AREA,,3
ARSYM,Y,ALL
PCIRC,RW,,0,90,
PCIRC,RW,,0,-90,
!
RECTNG,ORIG,X1,       Y1,Tptpll_u,
RECTNG,ORIG,X1,Tptpll_u,  Tptpmn,
RECTNG,ORIG,X1,  Tptpmn,  Tptpul,
RECTNG,ORIG,X1,  Tptpul,   Tptrl,
RECTNG,ORIG,X1,   Tptrl,   Tptrn,
RECTNG,ORIG,X1,   Tptrn,  Tptrv1,
RECTNG,ORIG,X1,  Tptrv1,  Tptrv2,
RECTNG,ORIG,X1,  Tptrv2,  Tptrv3,
RECTNG,ORIG,X1,  Tptrv3,   Tpbt2,
RECTNG,ORIG,X1,   Tpbt2,     Tpp,
RECTNG,ORIG,X1,     Tpp,   Tpbt3,
RECTNG,ORIG,X1,   Tpbt3,     Tpy,
RECTNG,ORIG,X1,     Tpy,   Tpbt4,
RECTNG,ORIG,X1,   Tpbt4,  Tpcpv1,
RECTNG,ORIG,X1,  Tpcpv1,  Tpcpv2,
RECTNG,ORIG,X1,  Tpcpv2,  Tpcpv3,
RECTNG,ORIG,X1,      -Y1,Tptpll_l,
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RECTNG,ORIG,X1,  Tptpln,  Tptpv3,
RECTNG,ORIG,X1,  Tptpv3,  Tptpv2,
RECTNG,ORIG,X1,  Tptpv2,  Tptpv1,
RECTNG,ORIG,X1,  Tptpv1,   Tpbt1,
RECTNG,ORIG,X1,   Tpbt1,     Tac,
!
RECTNG,  X1,X2,     ORIG,       Y1,
RECTNG,  X1,X2,       Y1,Tptpll_u,
RECTNG,  X1,X2,Tptpll_u,  Tptpmn,
RECTNG,  X1,X2,  Tptpmn,  Tptpul,
RECTNG,  X1,X2,  Tptpul,   Tptrl,
RECTNG,  X1,X2,   Tptrl,   Tptrn,
RECTNG,  X1,X2,   Tptrn,  Tptrv1,
RECTNG,  X1,X2,  Tptrv1,  Tptrv2,
RECTNG,  X1,X2,  Tptrv2,  Tptrv3,
RECTNG,  X1,X2,  Tptrv3,   Tpbt2,
RECTNG,  X1,X2,   Tpbt2,     Tpp,
RECTNG,  X1,X2,     Tpp,   Tpbt3,
RECTNG,  X1,X2,   Tpbt3,     Tpy,
RECTNG,  X1,X2,     Tpy,   Tpbt4,
RECTNG,  X1,X2,   Tpbt4,  Tpcpv1,
RECTNG,  X1,X2,  Tpcpv1,  Tpcpv2,
RECTNG,  X1,X2,  Tpcpv2,  Tpcpv3,
RECTNG,  X1,X2,     ORIG,      -Y1,
RECTNG,  X1,X2,       -Y1,Tptpll_l,
RECTNG,  X1,X2,Tptpll_l,  Tptpln,
RECTNG,  X1,X2,  Tptpln,  Tptpv3,
RECTNG,  X1,X2,  Tptpv3,  Tptpv2,
RECTNG,  X1,X2,  Tptpv2,  Tptpv1,
RECTNG,  X1,X2,  Tptpv1,   Tpbt1,
RECTNG,  X1,X2,   Tpbt1,     Tac,
ALLSEL
!
AGLUE,ALL
/TRIAD,RBOT
APLOT
SAVE
!
!       Meshing
!
TYPE,1,                          !       Mesh the waste package
MAT,23,
ESYS,0,
ESHAPE,2,0
MOPT,EXPND,1,
MOPT,TRANS,2,
MOPT,IESZ,0,
ESIZE,0.5,0,
AMESH,2,53,51
!
LCCAT,3,260                      !       Concatenates lines
LCCAT,4,6
!
TYPE,1,                          !       Mesh Tptpll unit
MAT,16,
ESYS,0,
LSEL,S,LINE,,10,308,298
LESIZE,ALL,,,12
```

```
LSEL,S,LINE,,3,6,3
LSEL,A,LINE,,1,4,3
LSEL,A,LINE,,7,9,2
LSEL,A,LINE,,260
LESIZE,ALL,,,6
LSEL,S,LINE,,213
LESIZE,ALL,,,20
ESIZE,1,0,
AMESH,1,102,101
AMESH,55,78,23
ESIZE,1.5,0
AMESH,54,56,2
AMESH,79,80,1
!
TYPE,1,                    !       Mesh Tptpmn unit
MAT,15,
ESYS,0,
ESIZE,2.5,0,
AMESH,57,81,24
!
TYPE,1,                    !       Mesh Tptpul unit
MAT,14,
ESYS,0,
ESIZE,5.0,0,
AMESH,58,82,24
!
TYPE,1,                    !       Mesh Tptrl unit
MAT,13,
ESYS,0,
ESIZE,5.0,0,
AMESH,59,83,24
!
TYPE,1,                    !       Mesh Tptrn unit
MAT,12,
ESYS,0,
ESIZE,5.0,0,
AMESH,60,84,24
!
TYPE,1,                    !       Mesh Tptrv1 unit
MAT,11,
ESYS,0,
ESIZE,7.5,0,
AMESH,61,85,24
!
TYPE,1,                    !       Mesh Tptrv2 unit
MAT,10,
ESYS,0,
ESIZE,7.5,0,
AMESH,62,86,24
!
TYPE,1,                    !       Mesh Tptrv3 unit
MAT,9,
ESYS,0,
ESIZE,7.5,0,
AMESH,63,87,24
!
TYPE,1,                    !       Mesh Tpbt2 unit
MAT,8,
ESYS,0,
ESIZE,7.5,0,
AMESH,64,88,24
!
TYPE,1,                    !       Mesh Tpp unit
MAT,7,
ESYS,0,
ESIZE,7.5,0,
AMESH,65,89,24
!
TYPE,1,                    !       Mesh Tpbt3 unit
MAT,6,
ESYS,0,
ESIZE,7.5,0,
AMESH,66,90,24
!
TYPE,1,                    !       Mesh Tpy unit
MAT,5,
ESYS,0,
ESIZE,7.5,0,
AMESH,67,91,24
!
TYPE,1,                    !       Mesh Tpbt4 unit
```

```
MAT,4,
ESYS,0,
ESIZE,10.0,0,
AMESH,68,92,24
!
TYPE,1,                          !      Mesh Tpcpv1 unit
MAT,3,
ESYS,0,
ESIZE,10.0,0,
AMESH,69,93,24
!
TYPE,1,                          !      Mesh Tpcpv2 unit
MAT,2,
ESYS,0,
ESIZE,10.0,0,
AMESH,70,94,24
!
TYPE,1,                          !      Mesh Tpcpv3 unit
MAT,1,
ESYS,0,
ESIZE,10.0,0,
AMESH,71,95,24
!
TYPE,1,                          !      Mesh Tptpln unit
MAT,17,
ESYS,0,
ESIZE,5.0,0,
AMESH,72,96,24
!
TYPE,1,                          !      Mesh Tptpv3 unit
MAT,18,
ESYS,0,
ESIZE,5.0,0,
AMESH,73,97,24
!
TYPE,1,                          !      Mesh Tptpv2 unit
MAT,19,
ESYS,0,
ESIZE,5.0,0,
AMESH,74,98,24
!
TYPE,1,                          !      Mesh Tptpv1 unit
MAT,20,
ESYS,0,
ESIZE,7.5,0,
AMESH,75,99,24
!
TYPE,1,                          !      Mesh Tpbt1 unit
MAT,21,
ESYS,0,
ESIZE,7.5,0,
AMESH,76,100,24
!
TYPE,1,                          !      Mesh the Tac unit
MAT,22,
ESYS,0,
ESIZE,10.0,0,
AMESH,77,101,24
!
TYPE,2,                          !      Define link elements for radiation surface
ESYS,0,
LSEL,S,LINE,,11                  !      WP
LSEL,A,LINE,,209
LSEL,A,LINE,,10                  !      Drift wall
LSEL,A,LINE,,308
NSLL,S,1
ESURF,ALL
PLOT
!
/AUX12                           !      Generate superelement for thermal
EMIS,16,0.9,                     !      radiation calculation
EMIS,23,0.87,
STEF,1.7878,
GEOM,1,0,
SPACE, ,
ESEL,S,TYPE,,2,2
NSLE,S
VTYPE,0, ,
MPRINT,0
WRITE,amr                        !      Save radiation matrices
FINISH
```

```
!
/PREP7
TYPE,3,
REAL,1,
ESYS,0,
SE,amr
!
ESEL,S,TYPE,,2,2
EDELE,ALL
ALLSEL
SAVE
!
FINISH
/EXIT
```

```
!
!       File Name:      th_data.input
!
!       Lithostratigraphic Units and Their Coordinates
!
!       -       Y - Coordinates
!
Tpcpv3=346.23           !       Top of the layer
Tpcpv2=231.93
Tpcpv1=226.44
Tpbt4=221.75
Tpy=221.22
Tpbt3=214.17
Tpp=209.59
Tpbt2=195.50
Tptrv3=185.81
Tptrv2=181.23
Tptrv1=180.70
Tptrn=179.64
Tptrl=132.79
Tptpul=123.81
Tptpmn=46.13
Tptpll_u=16.19
Tptpll_l=-90.02
Tptpln=-137.75           !       Bottom of the layer
Tptpv3=-158.36
Tptpv2=-161.35
Tptpv1=-172.62
Tpbt1=-175.97
Tac=-260.34
!
!       Rock Mass Thermal Properties
!
!       -       Grain Density (kg/m^3)
!
MP,DENS,1,2470          !       Tpcpv3 unit
MP,DENS,2,2470          !       Tpcpv2 unit
MP,DENS,3,2380          !       Tpcpv1 unit
MP,DENS,4,2340          !       Tpbt4 unit
MP,DENS,5,2400          !       Tpy unit
MP,DENS,6,2370          !       Tpbt3 unit
MP,DENS,7,2260          !       Tpp unit
MP,DENS,8,2370          !       Tpbt2 unit
MP,DENS,9,2510          !       Tptrv3 unit
MP,DENS,10,2510         !       Tptrv2 unit
MP,DENS,11,2510         !       Tptrv1 unit
MP,DENS,12,2550         !       Tptrn unit
MP,DENS,13,2510         !       Tptrl unit
MP,DENS,14,2510         !       Tptpul unit
MP,DENS,15,2530         !       Tptpmn unit
MP,DENS,16,2540         !       Tptpll unit
MP,DENS,17,2560         !       Tptpln unit
MP,DENS,18,2360         !       Tptpv3 unit
MP,DENS,19,2360         !       Tptpv2 unit
MP,DENS,20,2360         !       Tptpv1 unit
MP,DENS,21,2310         !       Tpbt1 unit
MP,DENS,22,2240         !       Tac unit (value for Tac(v) unit)
!
MPTEMP,1,15,100,100.1,300 !  Temperature table for temperature
!                                  dependent thermal conductivity (degree C)
!
!       -       Thermal Conductivity (J/yr-m-K)
!
MPDATA,KXX,1,1,3.09E7,3.09E7,1.70E7,1.70E7          !       Tpcpv3 unit
MPDATA,KXX,2,1,3.09E7,3.09E7,1.70E7,1.70E7          !       Tpcpv2 unit
MPDATA,KXX,3,1,3.37E7,3.37E7,1.58E7,1.58E7          !       Tpcpv1 unit
MPDATA,KXX,4,1,1.58E7,1.58E7,1.10E7,1.10E7          !       Tpbt4 unit
MPDATA,KXX,5,1,3.06E7,3.06E7,1.39E7,1.39E7          !       Tpy unit
MPDATA,KXX,6,1,3.22E7,3.22E7,1.45E7,1.45E7          !       Tpbt3 unit
MPDATA,KXX,7,1,2.59E7,2.59E7,1.10E7,1.10E7          !       Tpp unit
MPDATA,KXX,8,1,2.11E7,2.11E7,0.73E7,0.73E7          !       Tpbt2 unit
MPDATA,KXX,9,1,3.15E7,3.15E7,1.17E7,1.17E7          !       Tptrv3 unit
MPDATA,KXX,10,1,3.15E7,3.15E7,1.17E7,1.17E7                 !       Tptrv2 unit
MPDATA,KXX,11,1,3.15E7,3.15E7,1.17E7,1.17E7                 !       Tptrv1 unit
MPDATA,KXX,12,1,5.11E7,5.11E7,3.34E7,3.34E7                 !       Tptrn unit
MPDATA,KXX,13,1,4.98E7,4.98E7,2.81E7,2.81E7                 !       Tptrl unit
MPDATA,KXX,14,1,5.68E7,5.68E7,2.24E7,2.24E7                 !       Tptpul unit
MPDATA,KXX,15,1,7.35E7,7.35E7,4.92E7,4.92E7                 !       Tptpmn unit
MPDATA,KXX,16,1,6.37E7,6.37E7,3.78E7,3.78E7                 !       Tptpll unit
MPDATA,KXX,17,1,5.80E7,5.80E7,4.48E7,4.48E7                 !       Tptpln unit
MPDATA,KXX,18,1,6.56E7,6.56E7,5.33E7,5.33E7                 !       Tptpv3 unit
```

```
MPDATA,KXX,19,1,6.56E7,6.56E7,5.33E7,5.33E7                    !       Tptpv2 unit
MPDATA,KXX,20,1,6.56E7,6.56E7,5.33E7,5.33E7                    !       Tptpv1 unit
MPDATA,KXX,21,1,4.13E7,4.13E7,2.21E7,2.21E7                    !       Tpbt1 unit
MPDATA,KXX,22,1,3.69E7,3.69E7,1.83E7,1.83E7                    !       Tac unit (values for Tac(v) unit)
!
MPTEMP,1,15,95,95.1,114,114.1,300 !  Temperature table for temperature
!                                          dependent specific heat (degree C)
!
!       -       Specific Heat (J/kg-K)
!
MPDATA,C,1,1,857,857,4570,4570,857,857                         !       Tpcpv3 unit
MPDATA,C,2,1,857,857,4570,4570,857,857                         !       Tpcpv2 unit
MPDATA,C,3,1,1037,1037,6048,6048,1037,1037          !       Tpcpv1 unit
MPDATA,C,4,1,1077,1077,21976,21976,1077,1077                   !       Tpbt4 unit
MPDATA,C,5,1,849,849,16172,16172,849,849            !       Tpy unit
MPDATA,C,6,1,1016,1016,20669,20669,1016,1016                   !       Tpbt3 unit
MPDATA,C,7,1,1330,1330,25560,25560,1330,1330                   !       Tpp unit
MPDATA,C,8,1,1224,1224,23878,23878,1224,1224                   !       Tpbt2 unit
MPDATA,C,9,1,834,834,5137,5137,834,834                         !       Tptrv3 unit
MPDATA,C,10,1,834,834,5137,5137,834,834                        !       Tptrv2 unit
MPDATA,C,11,1,834,834,5137,5137,834,834                        !       Tptrv1 unit
MPDATA,C,12,1,866,866,5629,5629,866,866                        !       Tptrn unit
MPDATA,C,13,1,882,882,5693,5693,882,882                        !       Tptrl unit
MPDATA,C,14,1,883,883,5694,5694,883,883                        !       Tptpul unit
MPDATA,C,15,1,948,948,4568,4568,948,948                        !       Tptpmn unit
MPDATA,C,16,1,900,900,4663,4663,900,900                        !       Tptpll unit
MPDATA,C,17,1,865,865,4523,4523,865,865                        !       Tptpln unit
MPDATA,C,18,1,984,984,1958,1958,984,984                        !       Tptpv3 unit
MPDATA,C,19,1,984,984,1958,1958,984,984                        !       Tptpv2 unit
MPDATA,C,20,1,984,984,1958,1958,984,984                        !       Tptpv1 unit
MPDATA,C,21,1,1057,1057,21076,21076,1057,1057                  !       Tpbt1 unit
MPDATA,C,22,1,1201,1201,23863,23863,1201,1201                  !       Tac unit (values for Tac(v) unit)
!
!       -       Emissivity
!
MP,EMIS,16,0.9          !       Tptpll unit
!
!
!       Waste Package Thermal Properties
!
MP,DENS,23,8690         !       Density (kg/m^3)
MP,KXX, 23,39.48E7      !       Thermal conductivity (J/yr-m-K)
MP,C,   23,435.25!      Specific heat (J/kg-K)
MP,EMIS,23,0.87         !       Emissivity
!
```

```
/BATCH,LIST
!
!#############################################################################
!#                                                                           #
!#                                ANSYS INPUT                                #
!#                                                                           #
!#       Filename:         amr-101                                           #
!#                                                                           #
!#       Input File:       amr-101.dat                                       #
!#                         th_data.input                                     #
!#                                                                           #
!#       Output File:      amr-101.out                                       #
!#                                                                           #
!#       Description:      2D ANSYS Model for Analysis and Modeling Report for #
!#                         SR/LA (amr)                                       #
!#                         Linear heat load:          1.55 kW/m              #
!#                         Emplacement mode:          Center-in-drift        #
!#                         Drift diameter:            5.5 meters             #
!#                         Drift spacing:             81 meters              #
!#                         WP diameter:               1.564 meters           #
!#                         WP length:                 5.305 meters           #
!#                         Air Flow Rate:             10 m^3/s (10)          #
!#                         Intake Air Temp.:          25 degree C            #
!#                         Segment No:                1 (1)                  #
!#                         Units modeled:             All                    #
!#                                                                           #
!#       Code Version:     ANSYS Revision 5.2                                #
!#                                                                           #
!#                                                                           #
!#############################################################################
!
/COM,ANSYS MEDIA REV. 5.2
!
/FILNAM,amr-101           !       Jobname to use for all subsequent files
RESUME,amr,db,,
/TITLE,2D Model (LL:1.55kW/m;DS:81m;DD:5.5m;VT:300yr;FR:10m^/s;SN:1)
/UNITS,SI
/SHOW
!
/NOPR
*ABB,SAVE_DB ,SAVE
*ABB,RESUM_DB,RESUME
*ABB,QUIT    ,Fnc_/EXIT
*ABB,SHFR    ,/SHOW,FILE,,,8
*ABB,SHFV    ,/SHOW,FILE,,1
*ABB,X11C    ,/SHOW,X11C,,,8
*ABB,X11     ,/SHOW,X11,,1
*ABB,REPLOT  ,/REPLOT
*ABB,K1      ,/PNUM,KP,1
*ABB,K0      ,/PNUM,KP,0
*ABB,POWRGRPH,Fnc_/GRAPHICS
*ABB,ANSYSWEB,Fnc_HomePage
/GO
!
/FDELE,EMAT,DELE
/FDELE,ESAV,DELE
/FDELE,EROT,DELE
/FDELE,DSUB,DELE
/FDELE,TRI,DELE
/FDELE,OSAV,DELE
/FDELE,PAGE,DELE
!
/SOLU                           !       Solution phase
ANTYPE,TRANS                    !       Transient analysis
NROPT,AUTO                      !       Programchosen Newton-Raphson option
TOFFST,273                      !       Specify the temperature offset: 273 K
TINTP,0.005, , ,0.5,0.5,0.2     !       Use defaults of transient integration
!                                       parameters
OUTPR,NSOL,LAST,                !       Solution printout at last substep
OUTRES,NSOL,LAST,               !       Solution data written to database
!
IC,ALL,TEMP,25,                 !       Initial temperature at all nodes
NSEL,S,LOC,Y,Tpcpv3             !       Select all nodes on top surface
D,ALL,TEMP,18.7
NSEL,S,LOC,Y,Tac          !       Select all nodes on bottom surface
D,ALL,TEMP,32.40
ALLSEL
SAVE
!
!               Load step number 1
TIMINT,OFF                      !       Turn off transient effects at the
```

```
!                                       first load step
TIME,1e-10
AUTOTS,1
DELTIM,1e-12,1e-12,1e-9,0
KBC,0
LSWRITE,1,
!
TIMINT,ON                          !    Turn on transient effects at the
!                                       rest of load steps
!
!                Load step number 2
TIME,1e-6
AUTOTS,1
DELTIM,1e-8,1e-8,1e-7,0
KBC,1
ESEL,S,MAT,,23,
NSLE,S
D,ALL,TEMP,70.0
ALLSEL
LSWRITE,2,
!
!                Load step number 3
TIME,1e-4
AUTOTS,1
DELTIM,1e-8,1e-8,1e-5,0
ESEL,S,MAT,,23,
NSLE,S
DDELE,ALL,TEMP
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.54e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,3,
!
!                Load step number 4
TIME,1
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.46e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,4,
!
!                Load step number 5
TIME,5
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,5,
!
!                Load step number 6
TIME,10
AUTOTS,1
DELTIM,0.0005,0.0005,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.02e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,6,
!
!                Load step number 7
```

```
TIME,15
AUTOTS,1
DELTIM,0.00001,0.00001,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.83e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,7,
!
!                  Load step number 8
TIME,20
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.68e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,8,
!
!                  Load step number 9
TIME,26
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.52e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,9,
!
!                  Load step number 10
TIME,30
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.43e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,10,
!
!                  Load step number 11
TIME,40
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,11,
!
!                  Load step number 12
TIME,50
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.07e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
```

```
LSWRITE,12,
!
!                  Load step number 13
TIME,60
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,9.37e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,13,
!
!                  Load step number 14
TIME,70
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,8.33e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,14,
!
!                  Load step number 15
TIME,80
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,7.49e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,15,
!
!                  Load step number 16
TIME,90
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.80e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,16,
!
!                  Load step number 17
TIME,100
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.23e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,17,
!
!                  Load step number 18
TIME,125
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,5.39e9,
ALLSEL
LSEL,S,LINE,,10,308,298
```

```
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,18,
!
!                  Load step number 19
TIME,150
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,4.54e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,19,
!
!                  Load step number 20
TIME,200
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.77e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,20,
!
!                  Load step number 21
TIME,250
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.31e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,21,
!
!                  Load step number 22
TIME,300
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.99e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,22,
!
ALLSEL
LSSOLVE,1,22,1,                    !       Solve with 22 load steps
FINISH
/EXIT
```

```
/BATCH,LIST
!
!###############################################################################
!#                                                                             #
!#                                ANSYS INPUT                                  #
!#                                                                             #
!#       Filename:         amr-102                                             #
!#                                                                             #
!#       Input File:       amr-102                                             #
!#                         th_data.input                                       #
!#                                                                             #
!#       Output File:      amr-102.out                                         #
!#                                                                             #
!#       Description:      2D ANSYS Model for Analysis and Modeling Report for #
!#                         SR/LA (amr)                                         #
!#                         Linear heat load:1.55 kW/m                          #
!#                         Emplacement mode:          Center-in-drift          #
!#                         Drift diameter:            5.5 meters               #
!#                         Drift spacing:             81 meters                #
!#                         WP diameter:               1.564 meters             #
!#                         WP length:                 5.305 meters             #
!#                         Air Flow Rate:             10 m^3/s (10)            #
!#                         Intake Air Temp.:          25 degree C              #
!#                         Segment No:                2 (2)                    #
!#                         Units modeled:             All                      #
!#                                                                             #
!#       Code Version:     ANSYS Revision 5.2                                  #
!#                                                                             #
!#                                                                             #
!###############################################################################
!
/COM,ANSYS MEDIA REV. 5.2
!
/FILNAM,amr-102           !       Jobname to use for all subsequent files
RESUME,amr,db,,
/TITLE,2D Model (LL:1.55kW/m;DS:81m;DD:5.5m;VT:300yr;FR:10m^/s;SN:2)
/UNITS,SI
/SHOW
!
/NOPR
*ABB,SAVE_DB ,SAVE
*ABB,RESUM_DB,RESUME
*ABB,QUIT     ,Fnc_/EXIT
*ABB,SHFR     ,/SHOW,FILE,,,8
*ABB,SHFV     ,/SHOW,FILE,,1
*ABB,X11C     ,/SHOW,X11C,,,8
*ABB,X11      ,/SHOW,X11,,1
*ABB,REPLOT   ,/REPLOT
*ABB,K1       ,/PNUM,KP,1
*ABB,K0       ,/PNUM,KP,0
*ABB,POWRGRPH,Fnc_/GRAPHICS
*ABB,ANSYSWEB,Fnc_HomePage
/GO
!
/FDELE,EMAT,DELE
/FDELE,ESAV,DELE
/FDELE,EROT,DELE
/FDELE,DSUB,DELE
/FDELE,TRI,DELE
/FDELE,OSAV,DELE
/FDELE,PAGE,DELE
!
/SOLU                           !       Solution phase
ANTYPE,TRANS                    !       Transient analysis
NROPT,AUTO                      !       Programchosen Newton-Raphson option
TOFFST,273                      !       Specify the temperature offset: 273 K
TINTP,0.005, , ,0.5,0.5,0.2     !       Use defaults of transient integration
!                                       parameters
OUTPR,NSOL,LAST,                !       Solution printout at last substep
OUTRES,NSOL,LAST,               !       Solution data written to database
!
IC,ALL,TEMP,25,                 !       Initial temperature at all nodes
NSEL,S,LOC,Y,Tpcpv3             !       Select all nodes on top surface
D,ALL,TEMP,18.7
NSEL,S,LOC,Y,Tac          !       Select all nodes on bottom surface
D,ALL,TEMP,32.40
ALLSEL
SAVE
!
!               Load step number 1
TIMINT,OFF                      !       Turn off transient effects at the
```

```
!                                       first load step
TIME,1e-10
AUTOTS,1
DELTIM,1e-12,1e-12,1e-9,0
KBC,0
LSWRITE,1,
!
TIMINT,ON                          !    Turn on transient effects at the
!                                       rest of load steps
!
!                 Load step number 2
TIME,1e-6
AUTOTS,1
DELTIM,1e-8,1e-8,1e-7,0
KBC,1
ESEL,S,MAT,,23,
NSLE,S
D,ALL,TEMP,70.0
ALLSEL
LSWRITE,2,
!
!                 Load step number 3
TIME,1e-4
AUTOTS,1
DELTIM,1e-8,1e-8,1e-5,0
ESEL,S,MAT,,23,
NSLE,S
DDELE,ALL,TEMP
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.54e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,3,
!
!                 Load step number 4
TIME,1
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.46e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,33.50
ALLSEL
LSWRITE,4,
!
!                 Load step number 5
TIME,5
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,35.83
ALLSEL
LSWRITE,5,
!
!                 Load step number 6
TIME,10
AUTOTS,1
DELTIM,0.0005,0.0005,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.02e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,35.27
ALLSEL
LSWRITE,6,
!
!                 Load step number 7
```

```
TIME,15
AUTOTS,1
DELTIM,0.00001,0.00001,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.83e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,34.46
ALLSEL
LSWRITE,7,
!
!                 Load step number 8
TIME,20
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.68e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,33.72
ALLSEL
LSWRITE,8,
!
!                 Load step number 9
TIME,26
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.52e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,33.02
ALLSEL
LSWRITE,9,
!
!                 Load step number 10
TIME,30
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.43e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,32.45
ALLSEL
LSWRITE,10,
!
!                 Load step number 11
TIME,40
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,31.78
ALLSEL
LSWRITE,11,
!
!                 Load step number 12
TIME,50
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.07e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,30.94
ALLSEL
```

```
LSWRITE,12,
!
!                  Load step number 13
TIME,60
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,9.37e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,30.24
ALLSEL
LSWRITE,13,
!
!                  Load step number 14
TIME,70
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,8.33e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,29.67
ALLSEL
LSWRITE,14,
!
!                  Load step number 15
TIME,80
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,7.49e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,29.21
ALLSEL
LSWRITE,15,
!
!                  Load step number 16
TIME,90
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.80e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,28.83
ALLSEL
LSWRITE,16,
!
!                  Load step number 17
TIME,100
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.23e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,28.52
ALLSEL
LSWRITE,17,
!
!                  Load step number 18
TIME,125
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,5.39e9,
ALLSEL
LSEL,S,LINE,,10,308,298
```

```
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,28.16
ALLSEL
LSWRITE,18,
!
!                Load step number 19
TIME,150
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,4.54e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,27.73
ALLSEL
LSWRITE,19,
!
!                Load step number 20
TIME,200
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.77e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,27.31
ALLSEL
LSWRITE,20,
!
!                Load step number 21
TIME,250
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.31e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,26.98
ALLSEL
LSWRITE,21,
!
!                Load step number 22
TIME,300
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.99e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,26.76
ALLSEL
LSWRITE,22,
!
ALLSEL
LSSOLVE,1,22,1,                    !        Solve with 22 load steps
FINISH
/EXIT
```

```
/BATCH,LIST
!
!#############################################################################
!#                                                                           #
!#                                ANSYS INPUT                                #
!#                                                                           #
!#       Filename:         amr-103                                           #
!#                                                                           #
!#       Input File:       amr-103.dat                                       #
!#                         th_data.input                                     #
!#                                                                           #
!#       Output File:      amr-103.out                                       #
!#                                                                           #
!#       Description:      2D ANSYS Model for Analysis and Modeling Report for #
!#                         SR/LA (amr)                                       #
!#                         Linear heat load:          1.55 kW/m              #
!#                         Emplacement mode:          Center-in-drift        #
!#                         Drift diameter:            5.5 meters             #
!#                         Drift spacing:             81 meters              #
!#                         WP diameter:               1.564 meters           #
!#                         WP length:                 5.305 meters           #
!#                         Air Flow Rate:             10 m^3/s (10)          #
!#                         Intake Air Temp.:          25 degree C            #
!#                         Segment No:                3 (3)                  #
!#                         Units modeled:             All                    #
!#                                                                           #
!#       Code Version:     ANSYS Revision 5.2                                #
!#                                                                           #
!#                                                                           #
!#############################################################################
!
/COM,ANSYS MEDIA REV. 5.2
!
/FILNAM,amr-103           !       Jobname to use for all subsequent files
RESUME,amr,db,,
/TITLE,2D Model (LL:1.55kW/m;DS:81m;DD:5.5m;VT:300yr;FR:10m^/s;SN:3)
/UNITS,SI
/SHOW
!
/NOPR
*ABB,SAVE_DB ,SAVE
*ABB,RESUM_DB,RESUME
*ABB,QUIT    ,Fnc_/EXIT
*ABB,SHFR    ,/SHOW,FILE,,,8
*ABB,SHFV    ,/SHOW,FILE,,1
*ABB,X11C    ,/SHOW,X11C,,,8
*ABB,X11     ,/SHOW,X11,,1
*ABB,REPLOT  ,/REPLOT
*ABB,K1      ,/PNUM,KP,1
*ABB,K0      ,/PNUM,KP,0
*ABB,POWRGRPH,Fnc_/GRAPHICS
*ABB,ANSYSWEB,Fnc_HomePage
/GO
!
/FDELE,EMAT,DELE
/FDELE,ESAV,DELE
/FDELE,EROT,DELE
/FDELE,DSUB,DELE
/FDELE,TRI,DELE
/FDELE,OSAV,DELE
/FDELE,PAGE,DELE
!
/SOLU                           !       Solution phase
ANTYPE,TRANS                    !       Transient analysis
NROPT,AUTO                      !       Programchosen Newton-Raphson option
TOFFST,273                      !       Specify the temperature offset: 273 K
TINTP,0.005, , ,0.5,0.5,0.2     !       Use defaults of transient integration
!                                       parameters
OUTPR,NSOL,LAST,                !       Solution printout at last substep
OUTRES,NSOL,LAST,               !       Solution data written to database
!
IC,ALL,TEMP,25,                 !       Initial temperature at all nodes
NSEL,S,LOC,Y,Tpcpv3             !       Select all nodes on top surface
D,ALL,TEMP,18.7
NSEL,S,LOC,Y,Tac          !       Select all nodes on bottom surface
D,ALL,TEMP,32.40
ALLSEL
SAVE
!
!               Load step number 1
TIMINT,OFF                      !       Turn off transient effects at the
```

```
!                                       first load step
TIME,1e-10
AUTOTS,1
DELTIM,1e-12,1e-12,1e-9,0
KBC,0
LSWRITE,1,
!
TIMINT,ON                          !    Turn on transient effects at the
!                                       rest of load steps
!
!                 Load step number 2
TIME,1e-6
AUTOTS,1
DELTIM,1e-8,1e-8,1e-7,0
KBC,1
ESEL,S,MAT,,23,
NSLE,S
D,ALL,TEMP,70.0
ALLSEL
LSWRITE,2,
!
!                 Load step number 3
TIME,1e-4
AUTOTS,1
DELTIM,1e-8,1e-8,1e-5,0
ESEL,S,MAT,,23,
NSLE,S
DDELE,ALL,TEMP
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.54e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,3,
!
!                 Load step number 4
TIME,1
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.46e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,40.41
ALLSEL
LSWRITE,4,
!
!                 Load step number 5
TIME,5
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,45.67
ALLSEL
LSWRITE,5,
!
!                 Load step number 6
TIME,10
AUTOTS,1
DELTIM,0.0005,0.0005,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.02e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,45.11
ALLSEL
LSWRITE,6,
!
!                 Load step number 7
```

```
TIME,15
AUTOTS,1
DELTIM,0.00001,0.00001,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.83e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,43.63
ALLSEL
LSWRITE,7,
!
!                  Load step number 8
TIME,20
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.68e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,42.20
ALLSEL
LSWRITE,8,
!
!                  Load step number 9
TIME,26
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.52e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,40.85
ALLSEL
LSWRITE,9,
!
!                  Load step number 10
TIME,30
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.43e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,39.73
ALLSEL
LSWRITE,10,
!
!                  Load step number 11
TIME,40
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,38.44
ALLSEL
LSWRITE,11,
!
!                  Load step number 12
TIME,50
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.07e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,36.82
ALLSEL
```

```
LSWRITE,12,
!
!                  Load step number 13
TIME,60
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,9.37e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,35.44
ALLSEL
LSWRITE,13,
!
!                  Load step number 14
TIME,70
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,8.33e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,34.31
ALLSEL
LSWRITE,14,
!
!                  Load step number 15
TIME,80
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,7.49e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,33.40
ALLSEL
LSWRITE,15,
!
!                  Load step number 16
TIME,90
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.80e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,32.65
ALLSEL
LSWRITE,16,
!
!                  Load step number 17
TIME,100
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.23e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,32.02
ALLSEL
LSWRITE,17,
!
!                  Load step number 18
TIME,125
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,5.39e9,
ALLSEL
LSEL,S,LINE,,10,308,298
```

```
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,31.32
ALLSEL
LSWRITE,18,
!
!                  Load step number 19
TIME,150
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,4.54e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,30.48
ALLSEL
LSWRITE,19,
!
!                  Load step number 20
TIME,200
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.77e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,29.65
ALLSEL
LSWRITE,20,
!
!                  Load step number 21
TIME,250
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.31e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,28.99
ALLSEL
LSWRITE,21,
!
!                  Load step number 22
TIME,300
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.99e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,28.55
ALLSEL
LSWRITE,22,
!
ALLSEL
LSSOLVE,1,22,1,                    !       Solve with 22 load steps
FINISH
/EXIT
```

```
/BATCH,LIST
!
!#############################################################################
!#                                                                           #
!#                                ANSYS INPUT                                #
!#                                                                           #
!#       Filename:         amr-104                                           #
!#                                                                           #
!#       Input File:       amr-104.dat                                       #
!#                         th_data.input                                     #
!#                                                                           #
!#       Output File:      amr-104.out                                       #
!#                                                                           #
!#       Description:      2D ANSYS Model for Analysis and Modeling Report for #
!#                         SR/LA (amr)                                       #
!#                         Linear heat load:          1.55 kW/m              #
!#                         Emplacement mode:          Center-in-drift        #
!#                         Drift diameter:            5.5 meters             #
!#                         Drift spacing:             81 meters              #
!#                         WP diameter:               1.564 meters           #
!#                         WP length:                 5.305 meters           #
!#                         Air Flow Rate:             10 m^3/s (10)          #
!#                         Intake Air Temp.:          25 degree C            #
!#                         Segment No:                4 (4)                  #
!#                         Units modeled:             All                    #
!#                                                                           #
!#       Code Version:     ANSYS Revision 5.2                                #
!#                                                                           #
!#                                                                           #
!#############################################################################
!
/COM,ANSYS MEDIA REV. 5.2
!
/FILNAM,amr-104            !        Jobname to use for all subsequent files
RESUME,amr,db,,
/TITLE,2D Model (LL:1.55kW/m;DS:81m;DD:5.5m;VT:300yr;FR:10m^/s;SN:4)
/UNITS,SI
/SHOW
!
/NOPR
*ABB,SAVE_DB ,SAVE
*ABB,RESUM_DB,RESUME
*ABB,QUIT    ,Fnc_/EXIT
*ABB,SHFR    ,/SHOW,FILE,,,8
*ABB,SHFV    ,/SHOW,FILE,,1
*ABB,X11C    ,/SHOW,X11C,,,8
*ABB,X11     ,/SHOW,X11,,1
*ABB,REPLOT  ,/REPLOT
*ABB,K1      ,/PNUM,KP,1
*ABB,K0      ,/PNUM,KP,0
*ABB,POWRGRPH,Fnc_/GRAPHICS
*ABB,ANSYSWEB,Fnc_HomePage
/GO
!
/FDELE,EMAT,DELE
/FDELE,ESAV,DELE
/FDELE,EROT,DELE
/FDELE,DSUB,DELE
/FDELE,TRI,DELE
/FDELE,OSAV,DELE
/FDELE,PAGE,DELE
!
/SOLU                              !        Solution phase
ANTYPE,TRANS                       !        Transient analysis
NROPT,AUTO                         !        Programchosen Newton-Raphson option
TOFFST,273                         !        Specify the temperature offset: 273 K
TINTP,0.005, , ,0.5,0.5,0.2        !        Use defaults of transient integration
!                                           parameters
OUTPR,NSOL,LAST,                !       Solution printout at last substep
OUTRES,NSOL,LAST,               !       Solution data written to database
!
IC,ALL,TEMP,25,                    !        Initial temperature at all nodes
NSEL,S,LOC,Y,Tpcpv3                !        Select all nodes on top surface
D,ALL,TEMP,18.7
NSEL,S,LOC,Y,Tac           !        Select all nodes on bottom surface
D,ALL,TEMP,32.40
ALLSEL
SAVE
!
!               Load step number 1
TIMINT,OFF                         !        Turn off transient effects at the
```

```
!                                       first load step
TIME,1e-10
AUTOTS,1
DELTIM,1e-12,1e-12,1e-9,0
KBC,0
LSWRITE,1,
!
TIMINT,ON                       !       Turn on transient effects at the
!                                       rest of load steps
!
!               Load step number 2
TIME,1e-6
AUTOTS,1
DELTIM,1e-8,1e-8,1e-7,0
KBC,1
ESEL,S,MAT,,23,
NSLE,S
D,ALL,TEMP,70.0
ALLSEL
LSWRITE,2,
!
!               Load step number 3
TIME,1e-4
AUTOTS,1
DELTIM,1e-8,1e-8,1e-5,0
ESEL,S,MAT,,23,
NSLE,S
DDELE,ALL,TEMP
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.54e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,3,
!
!               Load step number 4
TIME,1
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.46e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,46.03
ALLSEL
LSWRITE,4,
!
!               Load step number 5
TIME,5
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,54.51
ALLSEL
LSWRITE,5,
!
!               Load step number 6
TIME,10
AUTOTS,1
DELTIM,0.0005,0.0005,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.02e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,54.46
ALLSEL
LSWRITE,6,
!
!               Load step number 7
```

```
TIME,15
AUTOTS,1
DELTIM,0.00001,0.00001,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.83e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,52.49
ALLSEL
LSWRITE,7,
!
!                  Load step number 8
TIME,20
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.68e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,50.44
ALLSEL
LSWRITE,8,
!
!                  Load step number 9
TIME,26
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.52e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,48.48
ALLSEL
LSWRITE,9,
!
!                  Load step number 10
TIME,30
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.43e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,46.84
ALLSEL
LSWRITE,10,
!
!                  Load step number 11
TIME,40
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,44.97
ALLSEL
LSWRITE,11,
!
!                  Load step number 12
TIME,50
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.07e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,42.64
ALLSEL
```

```
LSWRITE,12,
!
!                Load step number 13
TIME,60
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,9.37e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,40.61
ALLSEL
LSWRITE,13,
!
!                Load step number 14
TIME,70
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,8.33e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,38.92
ALLSEL
LSWRITE,14,
!
!                Load step number 15
TIME,80
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,7.49e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,37.56
ALLSEL
LSWRITE,15,
!
!                Load step number 16
TIME,90
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.80e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,36.45
ALLSEL
LSWRITE,16,
!
!                Load step number 17
TIME,100
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.23e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,35.52
ALLSEL
LSWRITE,17,
!
!                Load step number 18
TIME,125
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,5.39e9,
ALLSEL
LSEL,S,LINE,,10,308,298
```

```
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,34.49
ALLSEL
LSWRITE,18,
!
!                  Load step number 19
TIME,150
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,4.54e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,33.26
ALLSEL
LSWRITE,19,
!
!                  Load step number 20
TIME,200
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.77e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,32.03
ALLSEL
LSWRITE,20,
!
!                  Load step number 21
TIME,250
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.31e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,31.03
ALLSEL
LSWRITE,21,
!
!                  Load step number 22
TIME,300
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.99e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,30.36
ALLSEL
LSWRITE,22,
!
ALLSEL
LSSOLVE,1,22,1,                    !       Solve with 22 load steps
FINISH
/EXIT
```

```
/BATCH,LIST
!
!#############################################################################
!#                                                                           #
!#                                ANSYS INPUT                                #
!#                                                                           #
!#       Filename:         amr-105                                           #
!#                                                                           #
!#       Input File:       amr-105.dat                                       #
!#                         th_data.input                                     #
!#                                                                           #
!#       Output File:      amr-105.out                                       #
!#                                                                           #
!#       Description:      2D ANSYS Model for Analysis and Modeling Report for #
!#                         SR/LA (amr)                                       #
!#                         Linear heat load:          1.55 kW/m              #
!#                         Emplacement mode:          Center-in-drift        #
!#                         Drift diameter:            5.5 meters             #
!#                         Drift spacing:             81 meters              #
!#                         WP diameter:               1.564 meters           #
!#                         WP length:                 5.305 meters           #
!#                         Air Flow Rate:             10 m^3/s (10)          #
!#                         Intake Air Temp.:          25 degree C            #
!#                         Segment No:                5 (5)                  #
!#                         Units modeled:             All                    #
!#                                                                           #
!#       Code Version:     ANSYS Revision 5.2                                #
!#                                                                           #
!#                                                                           #
!#############################################################################
!
/COM,ANSYS MEDIA REV. 5.2
!
/FILNAM,amr-105           !       Jobname to use for all subsequent files
RESUME,amr,db,,
/TITLE,2D Model (LL:1.55kW/m;DS:81m;DD:5.5m;VT:300yr;FR:10m^/s;SN:5)
/UNITS,SI
/SHOW
!
/NOPR
*ABB,SAVE_DB ,SAVE
*ABB,RESUM_DB,RESUME
*ABB,QUIT     ,Fnc_/EXIT
*ABB,SHFR     ,/SHOW,FILE,,,8
*ABB,SHFV     ,/SHOW,FILE,,1
*ABB,X11C     ,/SHOW,X11C,,,8
*ABB,X11      ,/SHOW,X11,,1
*ABB,REPLOT   ,/REPLOT
*ABB,K1       ,/PNUM,KP,1
*ABB,K0       ,/PNUM,KP,0
*ABB,POWRGRPH,Fnc_/GRAPHICS
*ABB,ANSYSWEB,Fnc_HomePage
/GO
!
/FDELE,EMAT,DELE
/FDELE,ESAV,DELE
/FDELE,EROT,DELE
/FDELE,DSUB,DELE
/FDELE,TRI,DELE
/FDELE,OSAV,DELE
/FDELE,PAGE,DELE
!
/SOLU                           !       Solution phase
ANTYPE,TRANS                    !       Transient analysis
NROPT,AUTO                      !       Programchosen Newton-Raphson option
TOFFST,273                      !       Specify the temperature offset: 273 K
TINTP,0.005, , ,0.5,0.5,0.2     !       Use defaults of transient integration
!                                       parameters
OUTPR,NSOL,LAST,                !       Solution printout at last substep
OUTRES,NSOL,LAST,               !       Solution data written to database
!
IC,ALL,TEMP,25,                 !       Initial temperature at all nodes
NSEL,S,LOC,Y,Tpcpv3             !       Select all nodes on top surface
D,ALL,TEMP,18.7
NSEL,S,LOC,Y,Tac          !       Select all nodes on bottom surface
D,ALL,TEMP,32.40
ALLSEL
SAVE
!
!               Load step number 1
TIMINT,OFF                      !       Turn off transient effects at the
```

```
!                                       first load step
TIME,1e-10
AUTOTS,1
DELTIM,1e-12,1e-12,1e-9,0
KBC,0
LSWRITE,1,
!
TIMINT,ON                          !    Turn on transient effects at the
!                                       rest of load steps
!
!                Load step number 2
TIME,1e-6
AUTOTS,1
DELTIM,1e-8,1e-8,1e-7,0
KBC,1
ESEL,S,MAT,,23,
NSLE,S
D,ALL,TEMP,70.0
ALLSEL
LSWRITE,2,
!
!                Load step number 3
TIME,1e-4
AUTOTS,1
DELTIM,1e-8,1e-8,1e-5,0
ESEL,S,MAT,,23,
NSLE,S
DDELE,ALL,TEMP
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.54e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,3,
!
!                Load step number 4
TIME,1
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.46e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,50.59
ALLSEL
LSWRITE,4,
!
!                Load step number 5
TIME,5
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,62.41
ALLSEL
LSWRITE,5,
!
!                Load step number 6
TIME,10
AUTOTS,1
DELTIM,0.0005,0.0005,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.02e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,63.30
ALLSEL
LSWRITE,6,
!
!                Load step number 7
```

```
TIME,15
AUTOTS,1
DELTIM,0.00001,0.00001,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.83e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,61.04
ALLSEL
LSWRITE,7,
!
!                  Load step number 8
TIME,20
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.68e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,58.45
ALLSEL
LSWRITE,8,
!
!                  Load step number 9
TIME,26
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.52e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,55.92
ALLSEL
LSWRITE,9,
!
!                  Load step number 10
TIME,30
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.43e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,53.78
ALLSEL
LSWRITE,10,
!
!                  Load step number 11
TIME,40
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,51.37
ALLSEL
LSWRITE,11,
!
!                  Load step number 12
TIME,50
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.07e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,48.38
ALLSEL
```

```
LSWRITE,12,
!
!                  Load step number 13
TIME,60
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,9.37e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,45.72
ALLSEL
LSWRITE,13,
!
!                  Load step number 14
TIME,70
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,8.33e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,43.51
ALLSEL
LSWRITE,14,
!
!                  Load step number 15
TIME,80
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,7.49e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,41.71
ALLSEL
LSWRITE,15,
!
!                  Load step number 16
TIME,90
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.80e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,40.23
ALLSEL
LSWRITE,16,
!
!                  Load step number 17
TIME,100
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.23e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,39.00
ALLSEL
LSWRITE,17,
!
!                  Load step number 18
TIME,125
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,5.39e9,
ALLSEL
LSEL,S,LINE,,10,308,298
```

```
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,37.65
ALLSEL
LSWRITE,18,
!
!                Load step number 19
TIME,150
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,4.54e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,36.06
ALLSEL
LSWRITE,19,
!
!                Load step number 20
TIME,200
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.77e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,34.44
ALLSEL
LSWRITE,20,
!
!                Load step number 21
TIME,250
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.31e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,33.10
ALLSEL
LSWRITE,21,
!
!                Load step number 22
TIME,300
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.99e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,32.19
ALLSEL
LSWRITE,22,
!
ALLSEL
LSSOLVE,1,22,1,                    !       Solve with 22 load steps
FINISH
/EXIT
```

```
/BATCH,LIST
!
!#############################################################################
!#                                                                           #
!#                                ANSYS INPUT                                #
!#                                                                           #
!#       Filename:         amr-106                                           #
!#                                                                           #
!#       Input File:       amr-106.dat                                       #
!#                         th_data.input                                     #
!#                                                                           #
!#       Output File:      amr-106.out                                       #
!#                                                                           #
!#       Description:      2D ANSYS Model for Analysis and Modeling Report for #
!#                         SR/LA (amr)                                       #
!#                         Linear heat load:          1.55 kW/m              #
!#                         Emplacement mode:          Center-in-drift        #
!#                         Drift diameter:            5.5 meters             #
!#                         Drift spacing:             81 meters              #
!#                         WP diameter:               1.564 meters           #
!#                         WP length:                 5.305 meters           #
!#                         Air Flow Rate:             10 m^3/s (10)          #
!#                         Intake Air Temp.:          25 degree C            #
!#                         Segment No:                6 (6)                  #
!#                         Units modeled:             All                    #
!#                                                                           #
!#       Code Version:     ANSYS Revision 5.2                                #
!#                                                                           #
!#                                                                           #
!#############################################################################
!
/COM,ANSYS MEDIA REV. 5.2
!
/FILNAM,amr-106            !        Jobname to use for all subsequent files
RESUME,amr,db,,
/TITLE,2D Model (LL:1.55kW/m;DS:81m;DD:5.5m;VT:300yr;FR:10m^/s;SN:6)
/UNITS,SI
/SHOW
!
/NOPR
*ABB,SAVE_DB ,SAVE
*ABB,RESUM_DB,RESUME
*ABB,QUIT    ,Fnc_/EXIT
*ABB,SHFR    ,/SHOW,FILE,,,8
*ABB,SHFV    ,/SHOW,FILE,,1
*ABB,X11C    ,/SHOW,X11C,,,8
*ABB,X11     ,/SHOW,X11,,1
*ABB,REPLOT  ,/REPLOT
*ABB,K1      ,/PNUM,KP,1
*ABB,K0      ,/PNUM,KP,0
*ABB,POWRGRPH,Fnc_/GRAPHICS
*ABB,ANSYSWEB,Fnc_HomePage
/GO
!
/FDELE,EMAT,DELE
/FDELE,ESAV,DELE
/FDELE,EROT,DELE
/FDELE,DSUB,DELE
/FDELE,TRI,DELE
/FDELE,OSAV,DELE
/FDELE,PAGE,DELE
!
/SOLU                              !        Solution phase
ANTYPE,TRANS                       !        Transient analysis
NROPT,AUTO                         !        Programchosen Newton-Raphson option
TOFFST,273                         !        Specify the temperature offset: 273 K
TINTP,0.005, , ,0.5,0.5,0.2        !        Use defaults of transient integration
!                                           parameters
OUTPR,NSOL,LAST,                !       Solution printout at last substep
OUTRES,NSOL,LAST,               !       Solution data written to database
!
IC,ALL,TEMP,25,                    !        Initial temperature at all nodes
NSEL,S,LOC,Y,Tpcpv3                !        Select all nodes on top surface
D,ALL,TEMP,18.7
NSEL,S,LOC,Y,Tac           !        Select all nodes on bottom surface
D,ALL,TEMP,32.40
ALLSEL
SAVE
!
!               Load step number 1
TIMINT,OFF                         !        Turn off transient effects at the
```

```
!                                       first load step
TIME,1e-10
AUTOTS,1
DELTIM,1e-12,1e-12,1e-9,0
KBC,0
LSWRITE,1,
!
TIMINT,ON                          !    Turn on transient effects at the
!                                       rest of load steps
!
!                Load step number 2
TIME,1e-6
AUTOTS,1
DELTIM,1e-8,1e-8,1e-7,0
KBC,1
ESEL,S,MAT,,23,
NSLE,S
D,ALL,TEMP,70.0
ALLSEL
LSWRITE,2,
!
!                Load step number 3
TIME,1e-4
AUTOTS,1
DELTIM,1e-8,1e-8,1e-5,0
ESEL,S,MAT,,23,
NSLE,S
DDELE,ALL,TEMP
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.54e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,25
ALLSEL
LSWRITE,3,
!
!                Load step number 4
TIME,1
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.46e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,54.30
ALLSEL
LSWRITE,4,
!
!                Load step number 5
TIME,5
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,69.40
ALLSEL
LSWRITE,5,
!
!                Load step number 6
TIME,10
AUTOTS,1
DELTIM,0.0005,0.0005,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.02e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,71.57
ALLSEL
LSWRITE,6,
!
!                Load step number 7
```

```
TIME,15
AUTOTS,1
DELTIM,0.00001,0.00001,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.83e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,69.26
ALLSEL
LSWRITE,7,
!
!                  Load step number 8
TIME,20
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.68e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,66.21
ALLSEL
LSWRITE,8,
!
!                  Load step number 9
TIME,26
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.52e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,63.16
ALLSEL
LSWRITE,9,
!
!                  Load step number 10
TIME,30
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.43e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,60.55
ALLSEL
LSWRITE,10,
!
!                  Load step number 11
TIME,40
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,57.64
ALLSEL
LSWRITE,11,
!
!                  Load step number 12
TIME,50
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.07e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,54.04
ALLSEL
```

```
LSWRITE,12,
!
!                  Load step number 13
TIME,60
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,9.37e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,50.79
ALLSEL
LSWRITE,13,
!
!                  Load step number 14
TIME,70
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,8.33e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,48.06
ALLSEL
LSWRITE,14,
!
!                  Load step number 15
TIME,80
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,7.49e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,45.83
ALLSEL
LSWRITE,15,
!
!                  Load step number 16
TIME,90
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.80e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,43.99
ALLSEL
LSWRITE,16,
!
!                  Load step number 17
TIME,100
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.23e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,42.46
ALLSEL
LSWRITE,17,
!
!                  Load step number 18
TIME,125
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,5.39e9,
ALLSEL
LSEL,S,LINE,,10,308,298
```

```
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,40.81
ALLSEL
LSWRITE,18,
!
!                Load step number 19
TIME,150
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,4.54e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,38.87
ALLSEL
LSWRITE,19,
!
!                Load step number 20
TIME,200
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.77e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,36.88
ALLSEL
LSWRITE,20,
!
!                Load step number 21
TIME,250
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.31e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,35.20
ALLSEL
LSWRITE,21,
!
!                Load step number 22
TIME,300
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.99e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,4.32e7,,34.04
ALLSEL
LSWRITE,22,
!
ALLSEL
LSSOLVE,1,22,1,                    !       Solve with 22 load steps
FINISH
/EXIT
```

```
/BATCH,LIST
!
!#############################################################################
!#                                                                           #
!#                              ANSYS INPUT                                  #
!#                                                                           #
!#       Filename:         amr-151                                           #
!#                                                                           #
!#       Input File:       amr-151.dat                                       #
!#                         th_data.input                                     #
!#                                                                           #
!#       Output File:      amr-151.out                                       #
!#                                                                           #
!#       Description:      2D ANSYS Model for Analysis and Modeling Report for #
!#                         SR/LA (amr)                                       #
!#                         Linear heat load:          1.55 kW/m              #
!#                         Emplacement mode:          Center-in-drift        #
!#                         Drift diameter:            5.5 meters             #
!#                         Drift spacing:             81 meters              #
!#                         WP diameter:               1.564 meters           #
!#                         WP length:                 5.305 meters           #
!#                         Air Flow Rate:             15 m^3/s (15)          #
!#                         Intake Air Temp.:          25 degree C            #
!#                         Segment No:                1 (1)                  #
!#                         Units modeled:             All                    #
!#                                                                           #
!#       Code Version:     ANSYS Revision 5.2                                #
!#                                                                           #
!#                                                                           #
!#############################################################################
!
/COM,ANSYS MEDIA REV. 5.2
!
/FILNAM,amr-151           !       Jobname to use for all subsequent files
RESUME,amr,db,,
/TITLE,2D Model (LL:1.55kW/m;DS:81m;DD:5.5m;VT:300yr;FR:15m^/s;SN:1)
/UNITS,SI
/SHOW
!
/NOPR
*ABB,SAVE_DB ,SAVE
*ABB,RESUM_DB,RESUME
*ABB,QUIT    ,Fnc_/EXIT
*ABB,SHFR    ,/SHOW,FILE,,,8
*ABB,SHFV    ,/SHOW,FILE,,1
*ABB,X11C    ,/SHOW,X11C,,,8
*ABB,X11     ,/SHOW,X11,,1
*ABB,REPLOT  ,/REPLOT
*ABB,K1      ,/PNUM,KP,1
*ABB,K0      ,/PNUM,KP,0
*ABB,POWRGRPH,Fnc_/GRAPHICS
*ABB,ANSYSWEB,Fnc_HomePage
/GO
!
/FDELE,EMAT,DELE
/FDELE,ESAV,DELE
/FDELE,EROT,DELE
/FDELE,DSUB,DELE
/FDELE,TRI,DELE
/FDELE,OSAV,DELE
/FDELE,PAGE,DELE
!
/SOLU                          !       Solution phase
ANTYPE,TRANS                   !       Transient analysis
NROPT,AUTO                     !       Programchosen Newton-Raphson option
TOFFST,273                     !       Specify the temperature offset: 273 K
TINTP,0.005, , ,0.5,0.5,0.2    !       Use defaults of transient integration
!                                      parameters
OUTPR,NSOL,LAST,               !      Solution printout at last substep
OUTRES,NSOL,LAST,              !      Solution data written to database
!
IC,ALL,TEMP,25,                !       Initial temperature at all nodes
NSEL,S,LOC,Y,Tpcpv3            !       Select all nodes on top surface
D,ALL,TEMP,18.7
NSEL,S,LOC,Y,Tac          !       Select all nodes on bottom surface
D,ALL,TEMP,32.40
ALLSEL
SAVE
!
!              Load step number 1
TIMINT,OFF                     !       Turn off transient effects at the
```

```
!                                          first load step
TIME,1e-10
AUTOTS,1
DELTIM,1e-12,1e-12,1e-9,0
KBC,0
LSWRITE,1,
!
TIMINT,ON                          !       Turn on transient effects at the
!                                          rest of load steps
!
!                 Load step number 2
TIME,1e-6
AUTOTS,1
DELTIM,1e-8,1e-8,1e-7,0
KBC,1
ESEL,S,MAT,,23,
NSLE,S
D,ALL,TEMP,70.0
ALLSEL
LSWRITE,2,
!
!                 Load step number 3
TIME,1e-4
AUTOTS,1
DELTIM,1e-8,1e-8,1e-5,0
ESEL,S,MAT,,23,
NSLE,S
DDELE,ALL,TEMP
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.54e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,3,
!
!                 Load step number 4
TIME,1
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.46e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,4,
!
!                 Load step number 5
TIME,5
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,5,
!
!                 Load step number 6
TIME,10
AUTOTS,1
DELTIM,0.0005,0.0005,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.02e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,6,
!
!                 Load step number 7
```

```
TIME,15
AUTOTS,1
DELTIM,0.00001,0.00001,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.83e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,7,
!
!                  Load step number 8
TIME,20
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.68e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,8,
!
!                  Load step number 9
TIME,26
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.52e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,9,
!
!                  Load step number 10
TIME,30
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.43e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,10,
!
!                  Load step number 11
TIME,40
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,11,
!
!                  Load step number 12
TIME,50
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.07e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
```

```
LSWRITE,12,
!
!                  Load step number 13
TIME,60
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,9.37e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,13,
!
!                  Load step number 14
TIME,70
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,8.33e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,14,
!
!                  Load step number 15
TIME,80
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,7.49e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,15,
!
!                  Load step number 16
TIME,90
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.80e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,16,
!
!                  Load step number 17
TIME,100
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.23e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,17,
!
!                  Load step number 18
TIME,125
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,5.39e9,
ALLSEL
LSEL,S,LINE,,10,308,298
```

```
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,18,
!
!                  Load step number 19
TIME,150
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,4.54e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,19,
!
!                  Load step number 20
TIME,200
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.77e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,20,
!
!                  Load step number 21
TIME,250
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.31e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,21,
!
!                  Load step number 22
TIME,300
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.99e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,22,
!
ALLSEL
LSSOLVE,1,22,1,                    !       Solve with 22 load steps
FINISH
/EXIT
```

```
/BATCH,LIST
!
!#############################################################################
!#                                                                           #
!#                                ANSYS INPUT                                #
!#                                                                           #
!#       Filename:         amr-152                                           #
!#                                                                           #
!#       Input File:       amr-152.dat                                       #
!#                         th_data.input                                     #
!#                                                                           #
!#       Output File:      amr-152.out                                       #
!#                                                                           #
!#       Description:      2D ANSYS Model for Analysis and Modeling Report for #
!#                         SR/LA (amr)                                       #
!#                         Linear heat load:         1.55 kW/m               #
!#                         Emplacement mode:         Center-in-drift         #
!#                         Drift diameter:           5.5 meters              #
!#                         Drift spacing:            81 meters               #
!#                         WP diameter:              1.564 meters            #
!#                         WP length:                5.305 meters            #
!#                         Air Flow Rate:           15 m^3/s (15)            #
!#                         Intake Air Temp.:        25 degree C              #
!#                         Segment No:              2 (2)                    #
!#                         Units modeled:            All                     #
!#                                                                           #
!#       Code Version:     ANSYS Revision 5.2                                #
!#                                                                           #
!#                                                                           #
!#############################################################################
!
/COM,ANSYS MEDIA REV. 5.2
!
/FILNAM,amr-152            !        Jobname to use for all subsequent files
RESUME,amr,db,,
/TITLE,2D Model (LL:1.55kW/m;DS:81m;DD:5.5m;VT:300yr;FR:15m^/s;SN:2)
/UNITS,SI
/SHOW
!
/NOPR
*ABB,SAVE_DB ,SAVE
*ABB,RESUM_DB,RESUME
*ABB,QUIT    ,Fnc_/EXIT
*ABB,SHFR    ,/SHOW,FILE,,,8
*ABB,SHFV    ,/SHOW,FILE,,1
*ABB,X11C    ,/SHOW,X11C,,,8
*ABB,X11     ,/SHOW,X11,,1
*ABB,REPLOT  ,/REPLOT
*ABB,K1      ,/PNUM,KP,1
*ABB,K0      ,/PNUM,KP,0
*ABB,POWRGRPH,Fnc_/GRAPHICS
*ABB,ANSYSWEB,Fnc_HomePage
/GO
!
/FDELE,EMAT,DELE
/FDELE,ESAV,DELE
/FDELE,EROT,DELE
/FDELE,DSUB,DELE
/FDELE,TRI,DELE
/FDELE,OSAV,DELE
/FDELE,PAGE,DELE
!
/SOLU                              !        Solution phase
ANTYPE,TRANS                       !        Transient analysis
NROPT,AUTO                         !        Programchosen Newton-Raphson option
TOFFST,273                         !        Specify the temperature offset: 273 K
TINTP,0.005, , ,0.5,0.5,0.2        !        Use defaults of transient integration
!                                           parameters
OUTPR,NSOL,LAST,                !       Solution printout at last substep
OUTRES,NSOL,LAST,               !       Solution data written to database
!
IC,ALL,TEMP,25,                    !        Initial temperature at all nodes
NSEL,S,LOC,Y,Tpcpv3                !        Select all nodes on top surface
D,ALL,TEMP,18.7
NSEL,S,LOC,Y,Tac           !        Select all nodes on bottom surface
D,ALL,TEMP,32.40
ALLSEL
SAVE
!
!               Load step number 1
TIMINT,OFF                         !        Turn off transient effects at the
```

```
!                                       first load step
TIME,1e-10
AUTOTS,1
DELTIM,1e-12,1e-12,1e-9,0
KBC,0
LSWRITE,1,
!
TIMINT,ON                          !    Turn on transient effects at the
!                                       rest of load steps
!
!               Load step number 2
TIME,1e-6
AUTOTS,1
DELTIM,1e-8,1e-8,1e-7,0
KBC,1
ESEL,S,MAT,,23,
NSLE,S
D,ALL,TEMP,70.0
ALLSEL
LSWRITE,2,
!
!               Load step number 3
TIME,1e-4
AUTOTS,1
DELTIM,1e-8,1e-8,1e-5,0
ESEL,S,MAT,,23,
NSLE,S
DDELE,ALL,TEMP
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.54e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,3,
!
!               Load step number 4
TIME,1
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.46e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,31.66
ALLSEL
LSWRITE,4,
!
!               Load step number 5
TIME,5
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,32.62
ALLSEL
LSWRITE,5,
!
!               Load step number 6
TIME,10
AUTOTS,1
DELTIM,0.0005,0.0005,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.02e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,32.12
ALLSEL
LSWRITE,6,
!
!               Load step number 7
```

```
TIME,15
AUTOTS,1
DELTIM,0.00001,0.00001,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.83e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,31.53
ALLSEL
LSWRITE,7,
!
!                Load step number 8
TIME,20
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.68e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,31.00
ALLSEL
LSWRITE,8,
!
!                Load step number 9
TIME,26
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.52e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,30.51
ALLSEL
LSWRITE,9,
!
!                Load step number 10
TIME,30
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.43e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,30.11
ALLSEL
LSWRITE,10,
!
!                Load step number 11
TIME,40
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,29.64
ALLSEL
LSWRITE,11,
!
!                Load step number 12
TIME,50
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.07e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,29.05
ALLSEL
```

```
LSWRITE,12,
!
!                   Load step number 13
TIME,60
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,9.37e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,28.56
ALLSEL
LSWRITE,13,
!
!                   Load step number 14
TIME,70
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,8.33e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,28.16
ALLSEL
LSWRITE,14,
!
!                   Load step number 15
TIME,80
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,7.49e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,27.84
ALLSEL
LSWRITE,15,
!
!                   Load step number 16
TIME,90
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.80e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,27.58
ALLSEL
LSWRITE,16,
!
!                   Load step number 17
TIME,100
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.23e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,27.37
ALLSEL
LSWRITE,17,
!
!                   Load step number 18
TIME,125
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,5.39e9,
ALLSEL
LSEL,S,LINE,,10,308,298
```

```
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,27.12
ALLSEL
LSWRITE,18,
!
!                Load step number 19
TIME,150
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,4.54e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,26.83
ALLSEL
LSWRITE,19,
!
!                Load step number 20
TIME,200
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.77e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,26.54
ALLSEL
LSWRITE,20,
!
!                Load step number 21
TIME,250
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.31e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,26.32
ALLSEL
LSWRITE,21,
!
!                Load step number 22
TIME,300
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.99e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,26.18
ALLSEL
LSWRITE,22,
!
ALLSEL
LSSOLVE,1,22,1,                    !       Solve with 22 load steps
FINISH
/EXIT
```

```
/BATCH,LIST
!
!#############################################################################
!#                                                                           #
!#                              ANSYS INPUT                                  #
!#                                                                           #
!#       Filename:         amr-153                                           #
!#                                                                           #
!#       Input File:       amr-153.dat                                       #
!#                         th_data.input                                     #
!#                                                                           #
!#       Output File:      amr-153.out                                       #
!#                                                                           #
!#       Description:      2D ANSYS Model for Analysis and Modeling Report for #
!#                         SR/LA (amr)                                       #
!#                         Linear heat load:         1.55 kW/m               #
!#                         Emplacement mode:         Center-in-drift         #
!#                         Drift diameter:           5.5 meters              #
!#                         Drift spacing:            81 meters               #
!#                         WP diameter:              1.564 meters            #
!#                         WP length:                5.305 meters            #
!#                         Air Flow Rate:            15 m^3/s (15)           #
!#                         Intake Air Temp.:         25 degree C             #
!#                         Segment No:               3 (3)                   #
!#                         Units modeled:            All                     #
!#                                                                           #
!#       Code Version:     ANSYS Revision 5.2                                #
!#                                                                           #
!#                                                                           #
!#############################################################################
!
/COM,ANSYS MEDIA REV. 5.2
!
/FILNAM,amr-153           !       Jobname to use for all subsequent files
RESUME,amr,db,,
/TITLE,2D Model (LL:1.55kW/m;DS:81m;DD:5.5m;VT:300yr;FR:15m^/s;SN:3)
/UNITS,SI
/SHOW
!
/NOPR
*ABB,SAVE_DB ,SAVE
*ABB,RESUM_DB,RESUME
*ABB,QUIT    ,Fnc_/EXIT
*ABB,SHFR    ,/SHOW,FILE,,,8
*ABB,SHFV    ,/SHOW,FILE,,1
*ABB,X11C    ,/SHOW,X11C,,,8
*ABB,X11     ,/SHOW,X11,,1
*ABB,REPLOT  ,/REPLOT
*ABB,K1      ,/PNUM,KP,1
*ABB,K0      ,/PNUM,KP,0
*ABB,POWRGRPH,Fnc_/GRAPHICS
*ABB,ANSYSWEB,Fnc_HomePage
/GO
!
/FDELE,EMAT,DELE
/FDELE,ESAV,DELE
/FDELE,EROT,DELE
/FDELE,DSUB,DELE
/FDELE,TRI,DELE
/FDELE,OSAV,DELE
/FDELE,PAGE,DELE
!
/SOLU                             !       Solution phase
ANTYPE,TRANS                      !       Transient analysis
NROPT,AUTO                        !       Programchosen Newton-Raphson option
TOFFST,273                        !       Specify the temperature offset: 273 K
TINTP,0.005, , ,0.5,0.5,0.2       !       Use defaults of transient integration
!                                         parameters
OUTPR,NSOL,LAST,                  !       Solution printout at last substep
OUTRES,NSOL,LAST,                 !       Solution data written to database
!
IC,ALL,TEMP,25,                   !       Initial temperature at all nodes
NSEL,S,LOC,Y,Tpcpv3               !       Select all nodes on top surface
D,ALL,TEMP,18.7
NSEL,S,LOC,Y,Tac          !       Select all nodes on bottom surface
D,ALL,TEMP,32.40
ALLSEL
SAVE
!
!               Load step number 1
TIMINT,OFF                        !       Turn off transient effects at the
```

```
!                                       first load step
TIME,1e-10
AUTOTS,1
DELTIM,1e-12,1e-12,1e-9,0
KBC,0
LSWRITE,1,
!
TIMINT,ON                          !    Turn on transient effects at the
!                                       rest of load steps
!
!               Load step number 2
TIME,1e-6
AUTOTS,1
DELTIM,1e-8,1e-8,1e-7,0
KBC,1
ESEL,S,MAT,,23,
NSLE,S
D,ALL,TEMP,70.0
ALLSEL
LSWRITE,2,
!
!               Load step number 3
TIME,1e-4
AUTOTS,1
DELTIM,1e-8,1e-8,1e-5,0
ESEL,S,MAT,,23,
NSLE,S
DDELE,ALL,TEMP
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.54e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,3,
!
!               Load step number 4
TIME,1
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.46e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,37.23
ALLSEL
LSWRITE,4,
!
!               Load step number 5
TIME,5
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,39.76
ALLSEL
LSWRITE,5,
!
!               Load step number 6
TIME,10
AUTOTS,1
DELTIM,0.0005,0.0005,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.02e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,39.07
ALLSEL
LSWRITE,6,
!
!               Load step number 7
```

```
TIME,15
AUTOTS,1
DELTIM,0.00001,0.00001,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.83e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,37.95
ALLSEL
LSWRITE,7,
!
!                Load step number 8
TIME,20
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.68e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,36.91
ALLSEL
LSWRITE,8,
!
!                Load step number 9
TIME,26
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.52e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,35.95
ALLSEL
LSWRITE,9,
!
!                Load step number 10
TIME,30
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.43e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,35.15
ALLSEL
LSWRITE,10,
!
!                Load step number 11
TIME,40
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,34.23
ALLSEL
LSWRITE,11,
!
!                Load step number 12
TIME,50
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.07e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,33.09
ALLSEL
```

```
LSWRITE,12,
!
!                   Load step number 13
TIME,60
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,9.37e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,32.12
ALLSEL
LSWRITE,13,
!
!                   Load step number 14
TIME,70
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,8.33e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,31.33
ALLSEL
LSWRITE,14,
!
!                   Load step number 15
TIME,80
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,7.49e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,30.69
ALLSEL
LSWRITE,15,
!
!                   Load step number 16
TIME,90
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.80e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,30.17
ALLSEL
LSWRITE,16,
!
!                   Load step number 17
TIME,100
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.23e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,29.74
ALLSEL
LSWRITE,17,
!
!                   Load step number 18
TIME,125
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,5.39e9,
ALLSEL
LSEL,S,LINE,,10,308,298
```

```
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,29.26
ALLSEL
LSWRITE,18,
!
!                Load step number 19
TIME,150
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,4.54e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,28.68
ALLSEL
LSWRITE,19,
!
!                Load step number 20
TIME,200
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.77e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,28.11
ALLSEL
LSWRITE,20,
!
!                Load step number 21
TIME,250
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.31e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,27.66
ALLSEL
LSWRITE,21,
!
!                Load step number 22
TIME,300
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.99e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,27.37
ALLSEL
LSWRITE,22,
!
ALLSEL
LSSOLVE,1,22,1,                    !       Solve with 22 load steps
FINISH
/EXIT
```

```
/BATCH,LIST
!
!#############################################################################
!#                                                                           #
!#                                ANSYS INPUT                                #
!#                                                                           #
!#       Filename:         amr-154                                           #
!#                                                                           #
!#       Input File:       amr-154.dat                                       #
!#                         th_data.input                                     #
!#                                                                           #
!#       Output File:      amr-154.out                                       #
!#                                                                           #
!#       Description:      2D ANSYS Model for Analysis and Modeling Report for #
!#                         SR/LA (amr)                                       #
!#                         Linear heat load:          1.55 kW/m              #
!#                         Emplacement mode:          Center-in-drift        #
!#                         Drift diameter:            5.5 meters             #
!#                         Drift spacing:             81 meters              #
!#                         WP diameter:               1.564 meters           #
!#                         WP length:                 5.305 meters           #
!#                         Air Flow Rate:             15 m^3/s (15)          #
!#                         Intake Air Temp.:          25 degree C            #
!#                         Segment No:                4 (4)                  #
!#                         Units modeled:             All                    #
!#                                                                           #
!#       Code Version:     ANSYS Revision 5.2                                #
!#                                                                           #
!#                                                                           #
!#############################################################################
!
/COM,ANSYS MEDIA REV. 5.2
!
/FILNAM,amr-154           !       Jobname to use for all subsequent files
RESUME,amr,db,,
/TITLE,2D Model (LL:1.55kW/m;DS:81m;DD:5.5m;VT:300yr;FR:15m^/s;SN:4)
/UNITS,SI
/SHOW
!
/NOPR
*ABB,SAVE_DB ,SAVE
*ABB,RESUM_DB,RESUME
*ABB,QUIT    ,Fnc_/EXIT
*ABB,SHFR    ,/SHOW,FILE,,,8
*ABB,SHFV    ,/SHOW,FILE,,1
*ABB,X11C    ,/SHOW,X11C,,,8
*ABB,X11     ,/SHOW,X11,,1
*ABB,REPLOT  ,/REPLOT
*ABB,K1      ,/PNUM,KP,1
*ABB,K0      ,/PNUM,KP,0
*ABB,POWRGRPH,Fnc_/GRAPHICS
*ABB,ANSYSWEB,Fnc_HomePage
/GO
!
/FDELE,EMAT,DELE
/FDELE,ESAV,DELE
/FDELE,EROT,DELE
/FDELE,DSUB,DELE
/FDELE,TRI,DELE
/FDELE,OSAV,DELE
/FDELE,PAGE,DELE
!
/SOLU                           !       Solution phase
ANTYPE,TRANS                    !       Transient analysis
NROPT,AUTO                      !       Programchosen Newton-Raphson option
TOFFST,273                      !       Specify the temperature offset: 273 K
TINTP,0.005, , ,0.5,0.5,0.2     !       Use defaults of transient integration
!                                       parameters
OUTPR,NSOL,LAST,                !       Solution printout at last substep
OUTRES,NSOL,LAST,               !       Solution data written to database
!
IC,ALL,TEMP,25,                 !       Initial temperature at all nodes
NSEL,S,LOC,Y,Tpcpv3             !       Select all nodes on top surface
D,ALL,TEMP,18.7
NSEL,S,LOC,Y,Tac          !       Select all nodes on bottom surface
D,ALL,TEMP,32.40
ALLSEL
SAVE
!
!               Load step number 1
TIMINT,OFF                      !       Turn off transient effects at the
```

```
!                                       first load step
TIME,1e-10
AUTOTS,1
DELTIM,1e-12,1e-12,1e-9,0
KBC,0
LSWRITE,1,
!
TIMINT,ON                          !    Turn on transient effects at the
!                                       rest of load steps
!
!                Load step number 2
TIME,1e-6
AUTOTS,1
DELTIM,1e-8,1e-8,1e-7,0
KBC,1
ESEL,S,MAT,,23,
NSLE,S
D,ALL,TEMP,70.0
ALLSEL
LSWRITE,2,
!
!                Load step number 3
TIME,1e-4
AUTOTS,1
DELTIM,1e-8,1e-8,1e-5,0
ESEL,S,MAT,,23,
NSLE,S
DDELE,ALL,TEMP
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.54e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,3,
!
!                Load step number 4
TIME,1
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.46e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,41.89
ALLSEL
LSWRITE,4,
!
!                Load step number 5
TIME,5
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,46.38
ALLSEL
LSWRITE,5,
!
!                Load step number 6
TIME,10
AUTOTS,1
DELTIM,0.0005,0.0005,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.02e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,45.81
ALLSEL
LSWRITE,6,
!
!                Load step number 7
```

```
TIME,15
AUTOTS,1
DELTIM,0.00001,0.00001,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.83e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,44.25
ALLSEL
LSWRITE,7,
!
!                Load step number 8
TIME,20
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.68e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,42.73
ALLSEL
LSWRITE,8,
!
!                Load step number 9
TIME,26
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.52e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,41.31
ALLSEL
LSWRITE,9,
!
!                Load step number 10
TIME,30
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.43e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,40.13
ALLSEL
LSWRITE,10,
!
!                Load step number 11
TIME,40
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,38.79
ALLSEL
LSWRITE,11,
!
!                Load step number 12
TIME,50
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.07e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,37.12
ALLSEL
```

```
LSWRITE,12,
!
!                   Load step number 13
TIME,60
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,9.37e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,35.69
ALLSEL
LSWRITE,13,
!
!                   Load step number 14
TIME,70
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,8.33e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,34.50
ALLSEL
LSWRITE,14,
!
!                   Load step number 15
TIME,80
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,7.49e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,33.55
ALLSEL
LSWRITE,15,
!
!                   Load step number 16
TIME,90
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.80e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,32.77
ALLSEL
LSWRITE,16,
!
!                   Load step number 17
TIME,100
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.23e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,32.12
ALLSEL
LSWRITE,17,
!
!                   Load step number 18
TIME,125
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,5.39e9,
ALLSEL
LSEL,S,LINE,,10,308,298
```

```
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,31.41
ALLSEL
LSWRITE,18,
!
!                Load step number 19
TIME,150
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,4.54e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,30.56
ALLSEL
LSWRITE,19,
!
!                Load step number 20
TIME,200
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.77e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,29.71
ALLSEL
LSWRITE,20,
!
!                Load step number 21
TIME,250
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.31e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,29.03
ALLSEL
LSWRITE,21,
!
!                Load step number 22
TIME,300
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.99e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,28.58
ALLSEL
LSWRITE,22,
!
ALLSEL
LSSOLVE,1,22,1,                    !       Solve with 22 load steps
FINISH
/EXIT
```

```
/BATCH,LIST
!
!#############################################################################
!#                                                                           #
!#                                ANSYS INPUT                                #
!#                                                                           #
!#       Filename:         amr-155                                           #
!#                                                                           #
!#       Input File:       amr-155.dat                                       #
!#                         th_data.input                                     #
!#                                                                           #
!#       Output File:      amr-155.out                                       #
!#                                                                           #
!#       Description:      2D ANSYS Model for Analysis and Modeling Report for #
!#                         SR/LA (amr)                                       #
!#                         Linear heat load:          1.55 kW/m              #
!#                         Emplacement mode:          Center-in-drift        #
!#                         Drift diameter:            5.5 meters             #
!#                         Drift spacing:             81 meters              #
!#                         WP diameter:               1.564 meters           #
!#                         WP length:                 5.305 meters           #
!#                         Air Flow Rate:             15 m^3/s (15)          #
!#                         Intake Air Temp.:          25 degree C            #
!#                         Segment No:                5 (5)                  #
!#                         Units modeled:             All                    #
!#                                                                           #
!#       Code Version:     ANSYS Revision 5.2                                #
!#                                                                           #
!#                                                                           #
!#############################################################################
!
/COM,ANSYS MEDIA REV. 5.2
!
/FILNAM,amr-155           !       Jobname to use for all subsequent files
RESUME,amr,db,,
/TITLE,2D Model (LL:1.55kW/m;DS:81m;DD:5.5m;VT:300yr;FR:15m^/s;SN:5)
/UNITS,SI
/SHOW
!
/NOPR
*ABB,SAVE_DB ,SAVE
*ABB,RESUM_DB,RESUME
*ABB,QUIT    ,Fnc_/EXIT
*ABB,SHFR    ,/SHOW,FILE,,,8
*ABB,SHFV    ,/SHOW,FILE,,1
*ABB,X11C    ,/SHOW,X11C,,,8
*ABB,X11     ,/SHOW,X11,,1
*ABB,REPLOT  ,/REPLOT
*ABB,K1      ,/PNUM,KP,1
*ABB,K0      ,/PNUM,KP,0
*ABB,POWRGRPH,Fnc_/GRAPHICS
*ABB,ANSYSWEB,Fnc_HomePage
/GO
!
/FDELE,EMAT,DELE
/FDELE,ESAV,DELE
/FDELE,EROT,DELE
/FDELE,DSUB,DELE
/FDELE,TRI,DELE
/FDELE,OSAV,DELE
/FDELE,PAGE,DELE
!
/SOLU                             !       Solution phase
ANTYPE,TRANS                      !       Transient analysis
NROPT,AUTO                        !       Programchosen Newton-Raphson option
TOFFST,273                        !       Specify the temperature offset: 273 K
TINTP,0.005, , ,0.5,0.5,0.2       !       Use defaults of transient integration
!                                         parameters
OUTPR,NSOL,LAST,                  !       Solution printout at last substep
OUTRES,NSOL,LAST,                 !       Solution data written to database
!
IC,ALL,TEMP,25,                   !       Initial temperature at all nodes
NSEL,S,LOC,Y,Tpcpv3               !       Select all nodes on top surface
D,ALL,TEMP,18.7
NSEL,S,LOC,Y,Tac          !       Select all nodes on bottom surface
D,ALL,TEMP,32.40
ALLSEL
SAVE
!
!               Load step number 1
TIMINT,OFF                        !       Turn off transient effects at the
```

```
!                                       first load step
TIME,1e-10
AUTOTS,1
DELTIM,1e-12,1e-12,1e-9,0
KBC,0
LSWRITE,1,
!
TIMINT,ON                          !    Turn on transient effects at the
!                                       rest of load steps
!
!                 Load step number 2
TIME,1e-6
AUTOTS,1
DELTIM,1e-8,1e-8,1e-7,0
KBC,1
ESEL,S,MAT,,23,
NSLE,S
D,ALL,TEMP,70.0
ALLSEL
LSWRITE,2,
!
!                 Load step number 3
TIME,1e-4
AUTOTS,1
DELTIM,1e-8,1e-8,1e-5,0
ESEL,S,MAT,,23,
NSLE,S
DDELE,ALL,TEMP
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.54e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,3,
!
!                 Load step number 4
TIME,1
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.46e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,45.79
ALLSEL
LSWRITE,4,
!
!                 Load step number 5
TIME,5
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,52.47
ALLSEL
LSWRITE,5,
!
!                 Load step number 6
TIME,10
AUTOTS,1
DELTIM,0.0005,0.0005,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.02e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,52.30
ALLSEL
LSWRITE,6,
!
!                 Load step number 7
```

```
TIME,15
AUTOTS,1
DELTIM,0.00001,0.00001,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.83e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,50.41
ALLSEL
LSWRITE,7,
!
!                Load step number 8
TIME,20
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.68e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,48.45
ALLSEL
LSWRITE,8,
!
!                Load step number 9
TIME,26
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.52e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,46.60
ALLSEL
LSWRITE,9,
!
!                Load step number 10
TIME,30
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.43e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,45.04
ALLSEL
LSWRITE,10,
!
!                Load step number 11
TIME,40
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,43.30
ALLSEL
LSWRITE,11,
!
!                Load step number 12
TIME,50
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.07e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,41.15
ALLSEL
```

```
LSWRITE,12,
!
!                Load step number 13
TIME,60
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,9.37e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,39.25
ALLSEL
LSWRITE,13,
!
!                Load step number 14
TIME,70
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,8.33e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,37.67
ALLSEL
LSWRITE,14,
!
!                Load step number 15
TIME,80
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,7.49e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,36.40
ALLSEL
LSWRITE,15,
!
!                Load step number 16
TIME,90
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.80e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,35.36
ALLSEL
LSWRITE,16,
!
!                Load step number 17
TIME,100
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.23e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,34.50
ALLSEL
LSWRITE,17,
!
!                Load step number 18
TIME,125
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,5.39e9,
ALLSEL
LSEL,S,LINE,,10,308,298
```

```
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,33.57
ALLSEL
LSWRITE,18,
!
!                Load step number 19
TIME,150
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,4.54e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,32.45
ALLSEL
LSWRITE,19,
!
!                Load step number 20
TIME,200
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.77e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,31.34
ALLSEL
LSWRITE,20,
!
!                Load step number 21
TIME,250
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.31e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,30.42
ALLSEL
LSWRITE,21,
!
!                Load step number 22
TIME,300
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.99e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,29.80
ALLSEL
LSWRITE,22,
!
ALLSEL
LSSOLVE,1,22,1,                    !       Solve with 22 load steps
FINISH
/EXIT
```

```
/BATCH,LIST
!
!#############################################################################
!#                                                                           #
!#                                ANSYS INPUT                                #
!#                                                                           #
!#       Filename:         amr-156                                           #
!#                                                                           #
!#       Input File:       amr-156.dat                                       #
!#                         th_data.input                                     #
!#                                                                           #
!#       Output File:      amr-156.out                                       #
!#                                                                           #
!#       Description:      2D ANSYS Model for Analysis and Modeling Report for #
!#                         SR/LA (amr)                                       #
!#                         Linear heat load:          1.55 kW/m              #
!#                         Emplacement mode:          Center-in-drift        #
!#                         Drift diameter:            5.5 meters             #
!#                         Drift spacing:             81 meters              #
!#                         WP diameter:               1.564 meters           #
!#                         WP length:                 5.305 meters           #
!#                         Air Flow Rate:             15 m^3/s (15)          #
!#                         Intake Air Temp.:          25 degree C            #
!#                         Segment No:                6 (6)                  #
!#                         Units modeled:             All                    #
!#                                                                           #
!#       Code Version:     ANSYS Revision 5.2                                #
!#                                                                           #
!#                                                                           #
!#############################################################################
!
/COM,ANSYS MEDIA REV. 5.2
!
/FILNAM,amr-156           !       Jobname to use for all subsequent files
RESUME,amr,db,,
/TITLE,2D Model (LL:1.55kW/m;DS:81m;DD:5.5m;VT:300yr;FR:15m^/s;SN:6)
/UNITS,SI
/SHOW
!
/NOPR
*ABB,SAVE_DB ,SAVE
*ABB,RESUM_DB,RESUME
*ABB,QUIT     ,Fnc_/EXIT
*ABB,SHFR     ,/SHOW,FILE,,,8
*ABB,SHFV     ,/SHOW,FILE,,1
*ABB,X11C     ,/SHOW,X11C,,,8
*ABB,X11      ,/SHOW,X11,,1
*ABB,REPLOT   ,/REPLOT
*ABB,K1       ,/PNUM,KP,1
*ABB,K0       ,/PNUM,KP,0
*ABB,POWRGRPH,Fnc_/GRAPHICS
*ABB,ANSYSWEB,Fnc_HomePage
/GO
!
/FDELE,EMAT,DELE
/FDELE,ESAV,DELE
/FDELE,EROT,DELE
/FDELE,DSUB,DELE
/FDELE,TRI,DELE
/FDELE,OSAV,DELE
/FDELE,PAGE,DELE
!
/SOLU                           !       Solution phase
ANTYPE,TRANS                    !       Transient analysis
NROPT,AUTO                      !       Programchosen Newton-Raphson option
TOFFST,273                      !       Specify the temperature offset: 273 K
TINTP,0.005, , ,0.5,0.5,0.2     !       Use defaults of transient integration
!                                       parameters
OUTPR,NSOL,LAST,                !       Solution printout at last substep
OUTRES,NSOL,LAST,               !       Solution data written to database
!
IC,ALL,TEMP,25,                 !       Initial temperature at all nodes
NSEL,S,LOC,Y,Tpcpv3             !       Select all nodes on top surface
D,ALL,TEMP,18.7
NSEL,S,LOC,Y,Tac          !       Select all nodes on bottom surface
D,ALL,TEMP,32.40
ALLSEL
SAVE
!
!               Load step number 1
TIMINT,OFF                      !       Turn off transient effects at the
```

```
!                                       first load step
TIME,1e-10
AUTOTS,1
DELTIM,1e-12,1e-12,1e-9,0
KBC,0
LSWRITE,1,
!
TIMINT,ON                          !    Turn on transient effects at the
!                                       rest of load steps
!
!                  Load step number 2
TIME,1e-6
AUTOTS,1
DELTIM,1e-8,1e-8,1e-7,0
KBC,1
ESEL,S,MAT,,23,
NSLE,S
D,ALL,TEMP,70.0
ALLSEL
LSWRITE,2,
!
!                  Load step number 3
TIME,1e-4
AUTOTS,1
DELTIM,1e-8,1e-8,1e-5,0
ESEL,S,MAT,,23,
NSLE,S
DDELE,ALL,TEMP
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.54e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,25
ALLSEL
LSWRITE,3,
!
!                  Load step number 4
TIME,1
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.46e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,49.05
ALLSEL
LSWRITE,4,
!
!                  Load step number 5
TIME,5
AUTOTS,1
DELTIM,0.0005,0.0005,0.25,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,58.03
ALLSEL
LSWRITE,5,
!
!                  Load step number 6
TIME,10
AUTOTS,1
DELTIM,0.0005,0.0005,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.02e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,58.53
ALLSEL
LSWRITE,6,
!
!                  Load step number 7
```

```
TIME,15
AUTOTS,1
DELTIM,0.00001,0.00001,0.5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.83e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,56.43
ALLSEL
LSWRITE,7,
!
!                Load step number 8
TIME,20
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.68e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,54.08
ALLSEL
LSWRITE,8,
!
!                Load step number 9
TIME,26
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.52e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,51.81
ALLSEL
LSWRITE,9,
!
!                Load step number 10
TIME,30
AUTOTS,1
DELTIM,0.00001,0.00001,0.75,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.43e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,49.89
ALLSEL
LSWRITE,10,
!
!                Load step number 11
TIME,40
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.23e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,47.77
ALLSEL
LSWRITE,11,
!
!                Load step number 12
TIME,50
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,1.07e10,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,45.15
ALLSEL
```

```
LSWRITE,12,
!
!                   Load step number 13
TIME,60
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,9.37e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,42.81
ALLSEL
LSWRITE,13,
!
!                   Load step number 14
TIME,70
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,8.33e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,40.85
ALLSEL
LSWRITE,14,
!
!                   Load step number 15
TIME,80
AUTOTS,1
DELTIM,0.00001,0.00001,1,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,7.49e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,39.26
ALLSEL
LSWRITE,15,
!
!                   Load step number 16
TIME,90
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.80e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,37.96
ALLSEL
LSWRITE,16,
!
!                   Load step number 17
TIME,100
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,6.23e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,36.88
ALLSEL
LSWRITE,17,
!
!                   Load step number 18
TIME,125
AUTOTS,1
DELTIM,0.00001,0.00001,2,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,5.39e9,
ALLSEL
LSEL,S,LINE,,10,308,298
```

```
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,35.73
ALLSEL
LSWRITE,18,
!
!                Load step number 19
TIME,150
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,4.54e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,34.37
ALLSEL
LSWRITE,19,
!
!                Load step number 20
TIME,200
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.77e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,32.99
ALLSEL
LSWRITE,20,
!
!                Load step number 21
TIME,250
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,3.31e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,31.84
ALLSEL
LSWRITE,21,
!
!                Load step number 22
TIME,300
AUTOTS,1
DELTIM,0.00001,0.00001,5,0
KBC,0
ESEL,S,MAT,,23,
BFE,ALL,HGEN,,2.99e9,
ALLSEL
LSEL,S,LINE,,10,308,298
LSEL,A,LINE,,11,209,198
SFL,ALL,CONV,5.96e7,,31.05
ALLSEL
LSWRITE,22,
!
ALLSEL
LSSOLVE,1,22,1,                    !       Solve with 22 load steps
FINISH
/EXIT
```