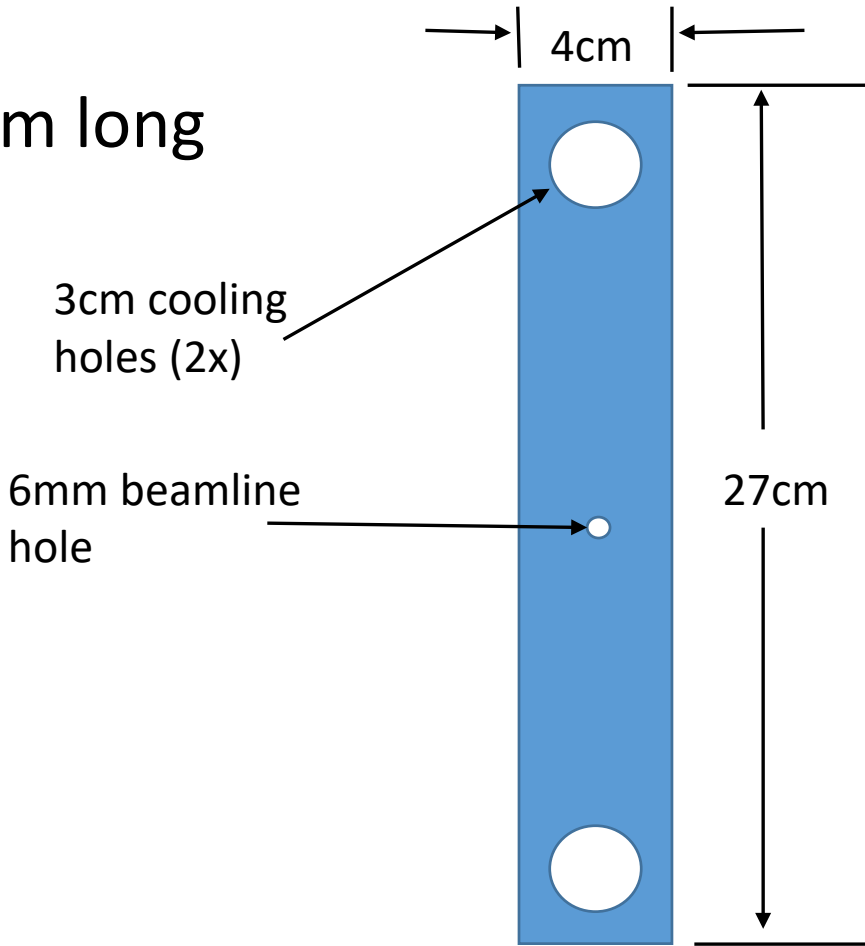
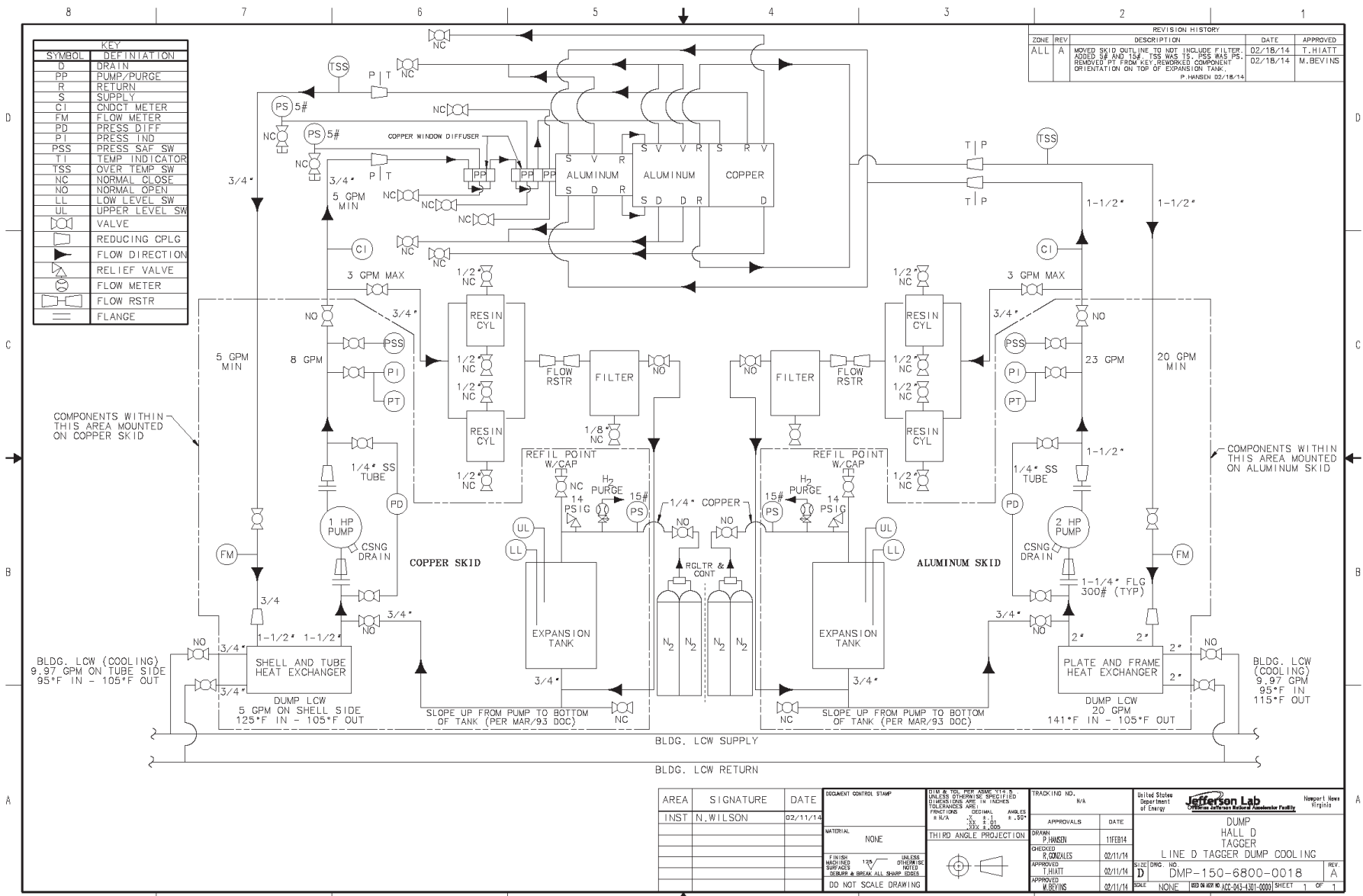


KLF CPS Copper Absorber v1

- 3m long

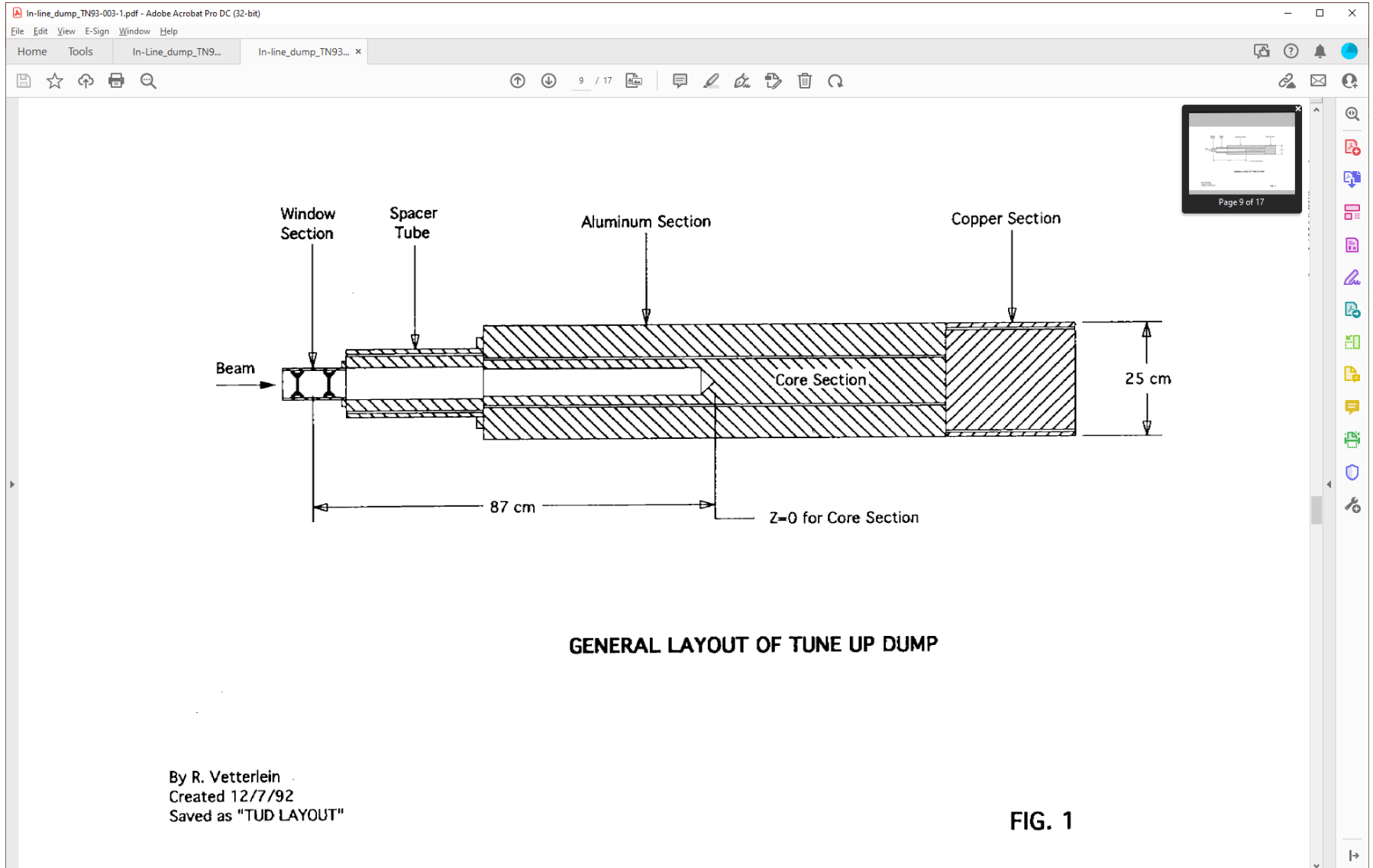


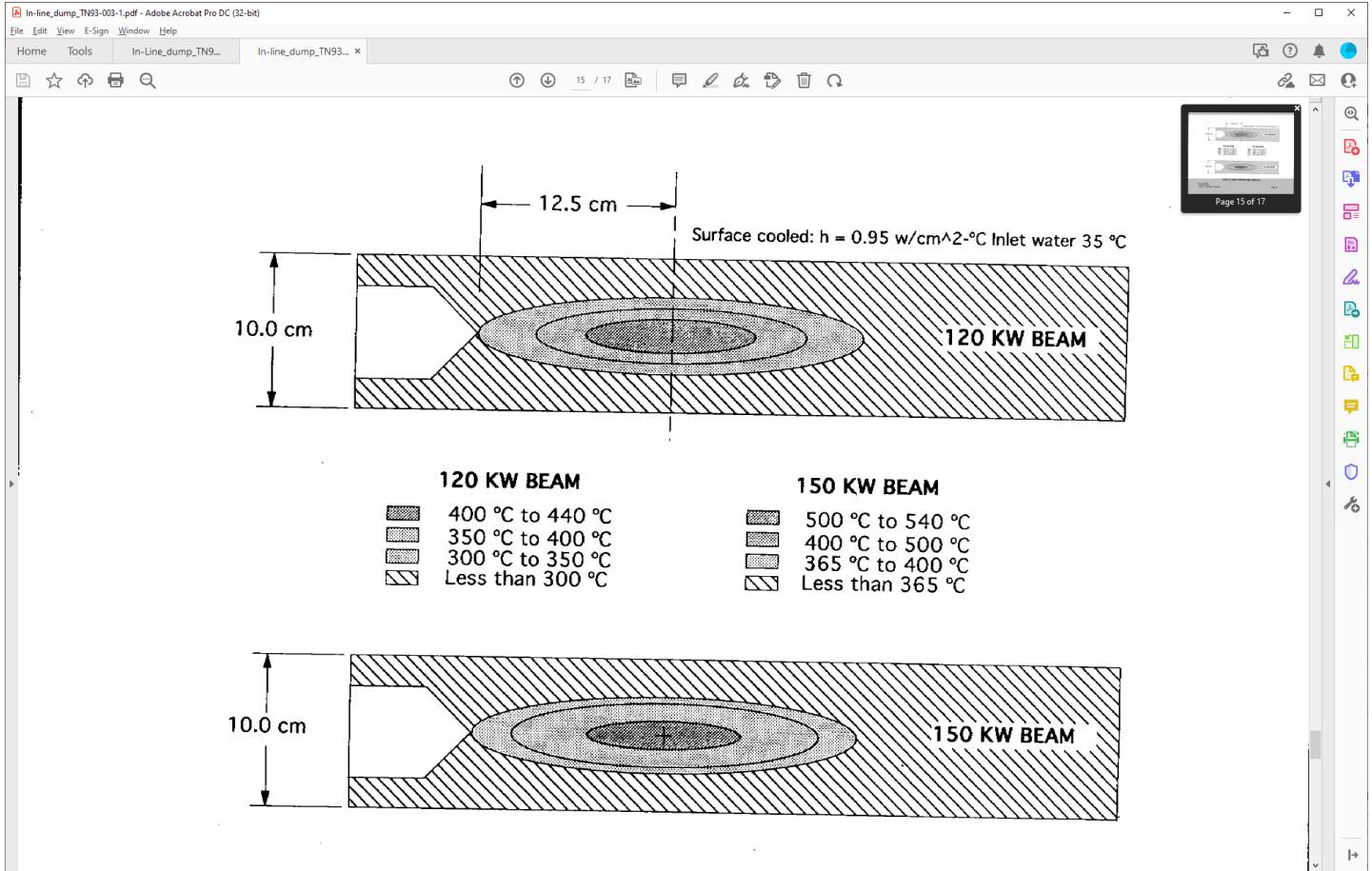
Existing Tagger Dump P&ID



AREA	SIGNATURE	DATE	DOCUMENT CONTROL STAMP	DWG. & TECH. PER. ASSG. V.L.S. UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:	TRACKING NO.	United States Department of Energy	Jefferson Lab Thomas Jefferson National Accelerator Facility	Project Name
INST	N. WILSON	02/11/14	NONE	FRACTIONS 1/16" DECIMALS 0.005" UNLESS OTHERWISE SPECIFIED	APPROVALS			DUMP HALL D TAGGER
MATERIAL				THIS DRAWING IS THE PROPERTY OF JEFFERSON LAB. IT IS TO BE USED ONLY FOR THE PROJECT AND NOT TO BE REPRODUCED OR COPIED IN ANY MANNER WITHOUT THE WRITTEN PERMISSION OF JEFFERSON LAB.	DATE			LINE D TAGGER DUMP COOLING
FINISH					CHECKED			DMP-150-6800-0018
MACHINES					DATE			REV. A
SURFACES					APPROVED			
DO NOT SCALE DRAWING					DATE			

Existing Tagger Dump





Water cooling

CPS Absorber cooling water_v1 - tanabe [Compatibility Mode] - Excel

File Home Insert Page Layout Formulas Data Review View Acrobat Tell me what you want to do... Timothy Whitlatch Share

A29 fx 20

KLing CPS 45KW total, 2 circuits LCW

Units Units Units

d 30 mm 0.098425 ft 0.03 M ID of tube

L 3 m 3000 mm

epsilon 0.000005 ft e/d = 5.08E-05

nu 0.00000929 ft^2/sec at 37°C

Power 45 kW 45000 W

Heat Exchange with water at DP row 28

Twater = 40.38222144 C average

Nud = 223 From Oliver &

K = 0.623 W/MK From White

Pr = 4.84 extrapolate from White ap

f = 0.023334503 friction factor

h = Nud K/D W/M^2 K

h = 4630.966667

q = hA(Tw-Twall) = mCpdeltaT

A = piDL use L for area inside cool

Twall = 91.93341443

$$v = -2 \sqrt{\frac{2g\Delta P d}{0.433 L}} \log_{10} \left(\frac{\epsilon}{3.7d} + \frac{2.51}{\frac{d}{v} \sqrt{\frac{2g\Delta P d}{0.433 L}}} \right)$$

$$\frac{1}{\sqrt{f}} = -2 \log_{10} \left(\frac{\epsilon}{3.7d} + \frac{2.51}{\frac{d}{v} \sqrt{\frac{2g\Delta P d}{0.433 L}}} \right)$$

$$q \left(\frac{\text{gpm}}{\text{circuit}} \right) = v \frac{\pi d^2}{4}$$

$$= v \left(\frac{\text{ft}}{\text{sec}} \right) \frac{\pi d^2 (\text{ft}^2)}{4} \times \frac{\text{gal}}{0.1337 \text{ ft}^3} \times 60 \frac{\text{sec}}{\text{min}}$$

P=mCpdeltaT
3.8 factor= 1kg/s=15.83gpm
Cp = 4.18 KJ/Kg*K
KW=KJ/s=(kg/s)(kj/kg*C)

$$Re = \frac{vd}{\nu}$$

$$\Delta T = \frac{3.8P}{q}$$

DeltaP (psi)	$\sqrt{\frac{2g\Delta P d}{0.433 L}}$ (ft/sec)	$\frac{\epsilon}{3.7d} + \frac{2.51}{\frac{d}{v} \sqrt{\frac{2g\Delta P d}{0.433 L}}}$ (no units)	f (no units)	v (ft/sec)	Re	q (gpm)	DT (deg.C)	V	DP	h
0.14	0.45631317	0.000533	6.546688	0.023332	2.98734	31650.11	10.20016002	16.76444		
20	5.45398555	5.72E-05	8.485699	0.013888	46.28088	490334.2	158.0243164	1.082112		
0.04	0.24390965	0.000985	6.0131	0.027657	1.46653	15538.82	5.00783143	34.14652	1.466653	0.04
20	5.45398555	5.72E-05	8.485699	0.013888	46.28088	490334.2	158.0243164	1.082112	46.28088	20
40	7.71310034	4.44E-05	8.704354	0.013199	67.13756	711305.4	229.2386574	0.745947	67.13756	40
45	8.18097833	4.27E-05	8.739381	0.013093	71.49669	757489.3	244.1227395	0.700467	71.49669	45
50	8.62350834	4.12E-05	8.770157	0.013001	75.62952	801275.7	258.2341515	0.66219	75.62952	50
55	9.04441185	3.99E-05	8.797536	0.01292	79.56854	843008.6	271.6837828	0.629408	79.56854	55
60	9.44658008	3.88E-05	8.822143	0.012848	83.33908	882956.5	284.5581496	0.600932		
65	9.83231229	3.78E-05	8.844448	0.012784	86.96137	921333.7	296.9263142	0.5759		
70	10.2034727	3.69E-05	8.864811	0.012725	90.45186	958314.6	308.8444628	0.553677		
75	10.5615976	3.62E-05	8.88352	0.012672	93.82416	994043.2	320.3590438	0.533776		
80	10.9079711	3.54E-05	8.900799	0.012622	97.08966	1028640	331.5089849	0.515823		
85	11.2436793	3.48E-05	8.916836	0.012577	100.258	1062209	342.3272993	0.499522		
90	11.5696505	3.42E-05	8.931781	0.012535	103.3376	1094836	352.8422756	0.484636		
95	11.8862055	3.37E-05	8.946724	0.012496	106.335	1126507	362.6792758	0.470272		

2 para circuits air-n2 Hx

Fig. 7. Heat transfer results for the fully developed smooth tubes.

Quick Hand Calc

$T_{wall} = 108^\circ\text{C}$
 Cooling hole T_2
 10 cm
 4 cm
 center T_1
 $q = 45000\text{ W}$

$q = \frac{\Delta T}{R} \quad R = \frac{l}{kA}$

$L = 10\text{ cm}$
 $k = 400\text{ W/m}^\circ\text{C}$
 $A = 4\text{ cm} \times 1\text{ m} = 0.04\text{ m}^2$

$R = \frac{1\text{ m}}{400\text{ W/m}^\circ\text{C} (0.04\text{ m}^2)} = 0.00625\text{ }^\circ\text{C/W}$

$\Delta T = qR = 281^\circ\text{C}$
 $T_1 = 381^\circ\text{C}$

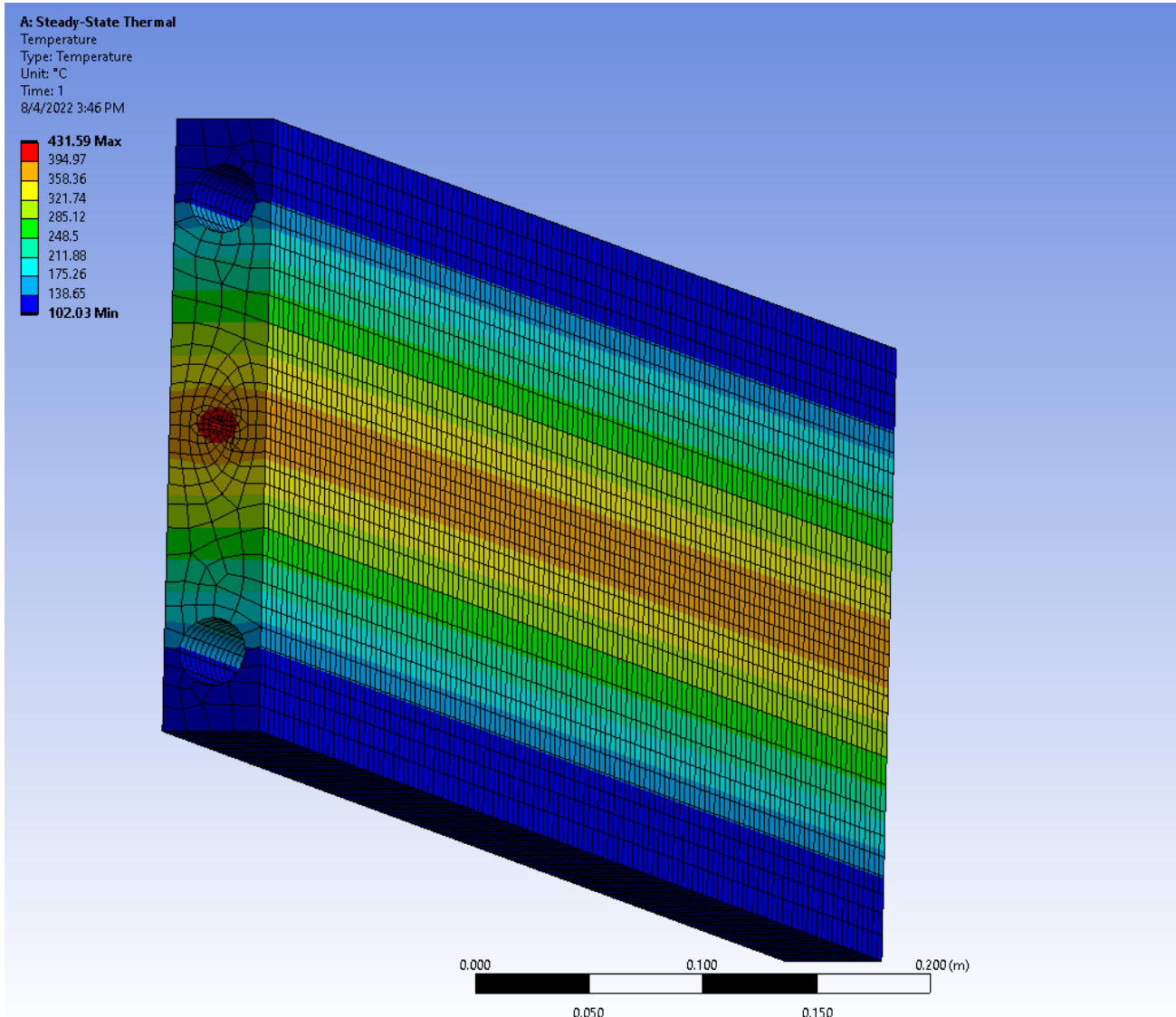
IF 90 kW $\Delta T = 562^\circ \Rightarrow T_1 = 662^\circ\text{C}$

90 kW/m 90 W/mm

0.6 cm hole $\frac{\pi \cdot 6}{2} = 9\text{ mm}$

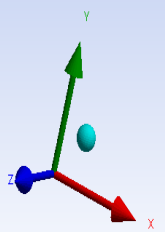
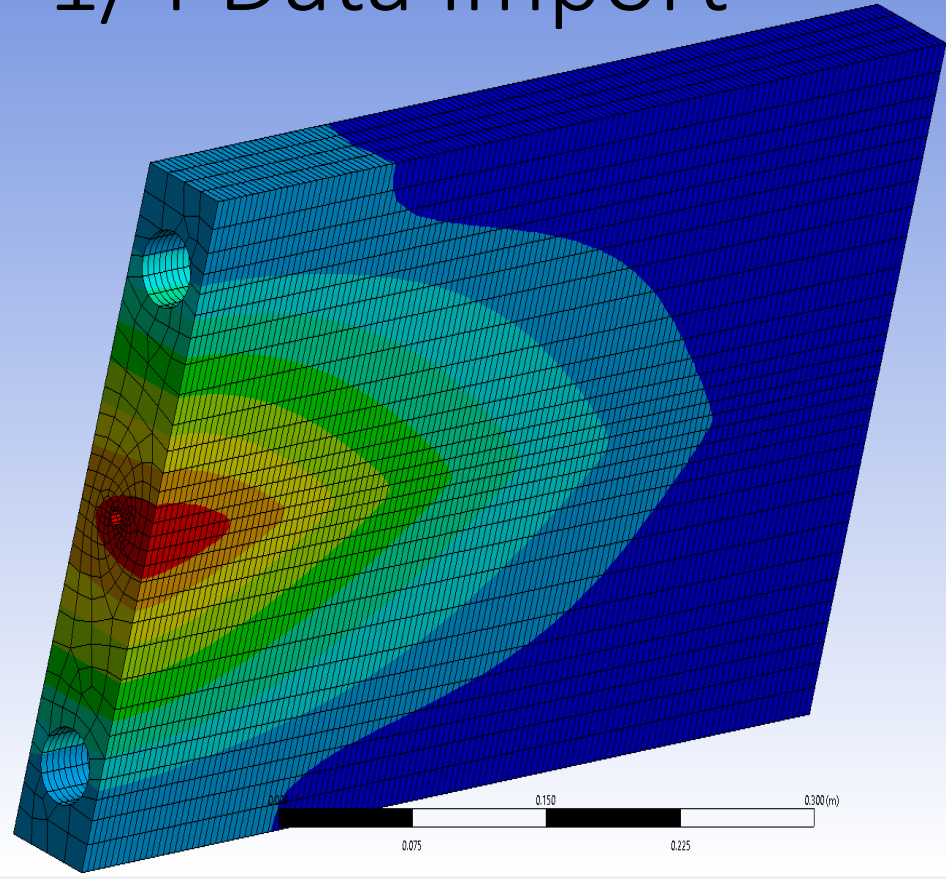
10 W/mm^3

90KW inner hole- 1m long – 5Kw/m² cooling inside 3cm holes



1/4 Data import

B: Steady-State Thermal
Temperature
Type: Temperature
Unit: °C
Time: 1
8/5/2022 1:02 PM



Graph window showing animation controls (Play, Stop, 20 Frames, 2 Sec (Auto), 3 Cycles) and a plot area. The plot area is currently empty, with the y-axis labeled [°C] and the x-axis labeled [s].

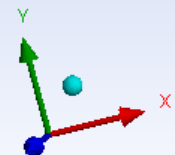
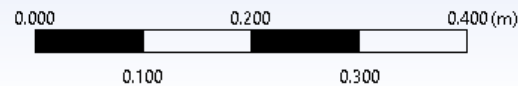
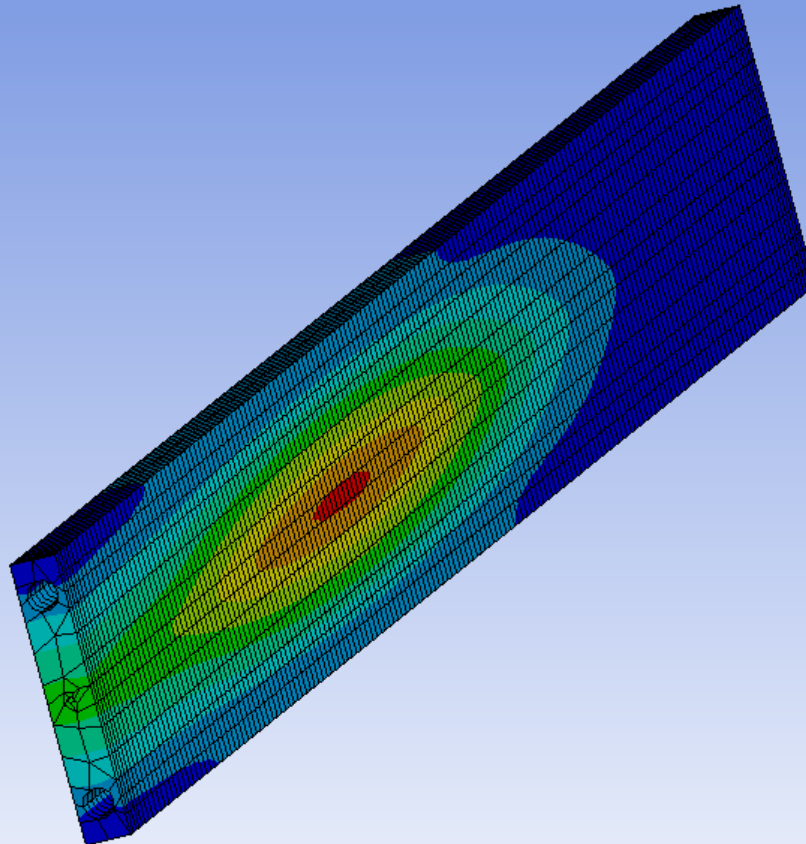
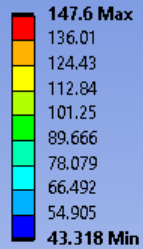
Summer Student Intern Final Presentations - Session 4
now
<https://jab-org.zoomgov.com/my/j75...>
Join Dismiss

All data imported (3.8M nodes – large mesh)

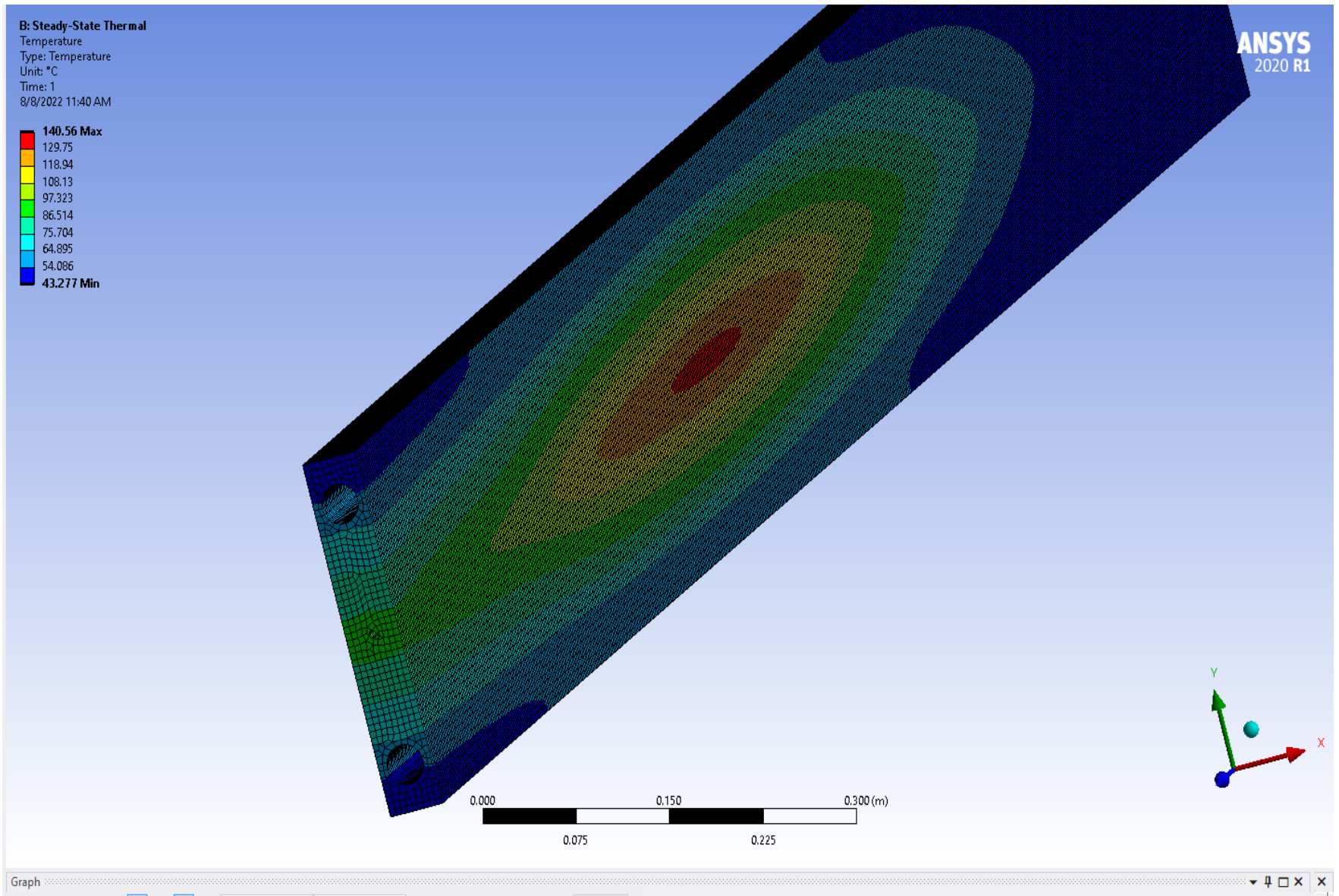
B: Steady-State Thermal

Temperature
Type: Temperature
Unit: °C
Time: 1
8/6/2022 2:02 PM

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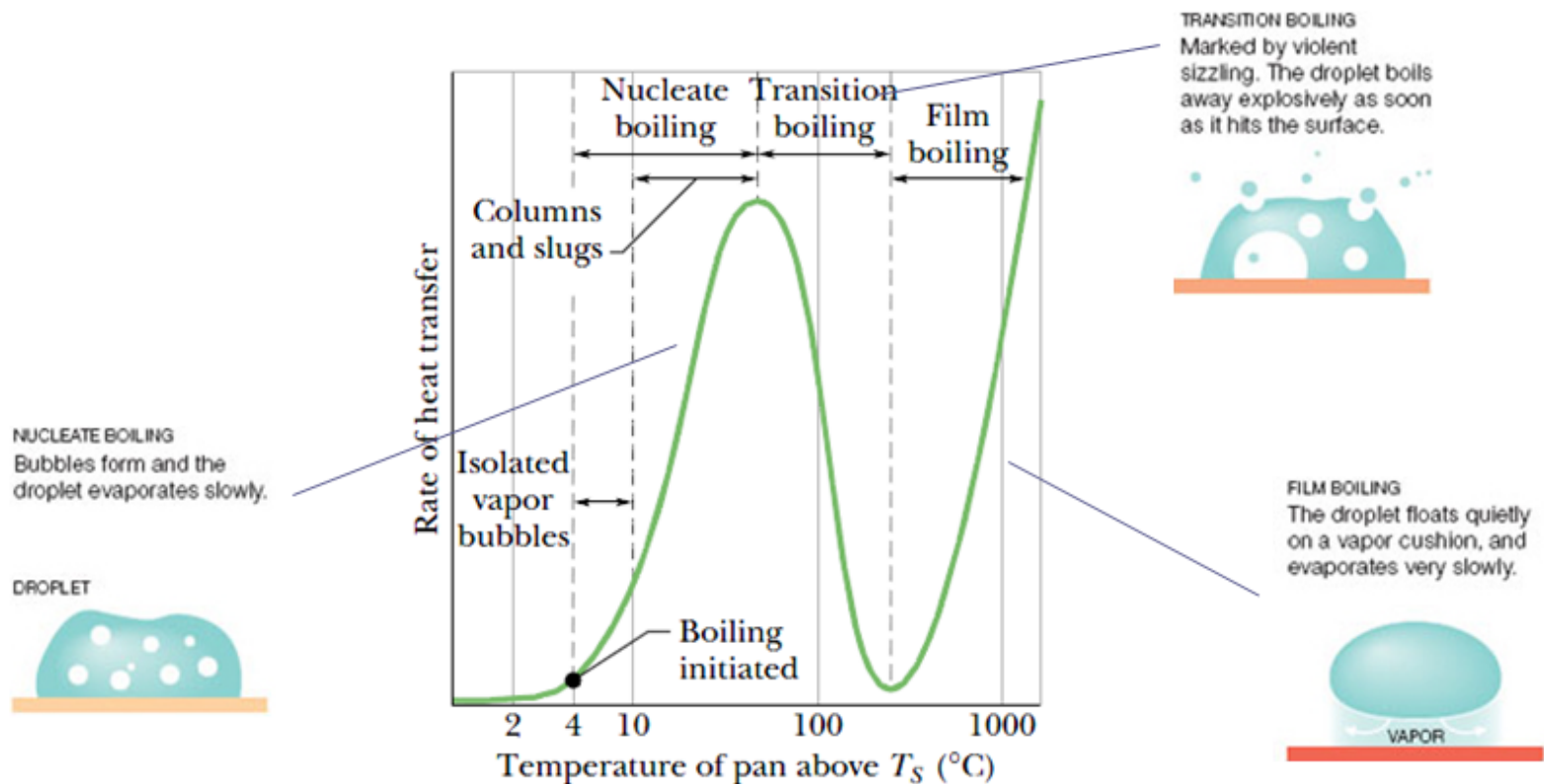
All data imported (3.8M nodes – smaller mesh – 42KW



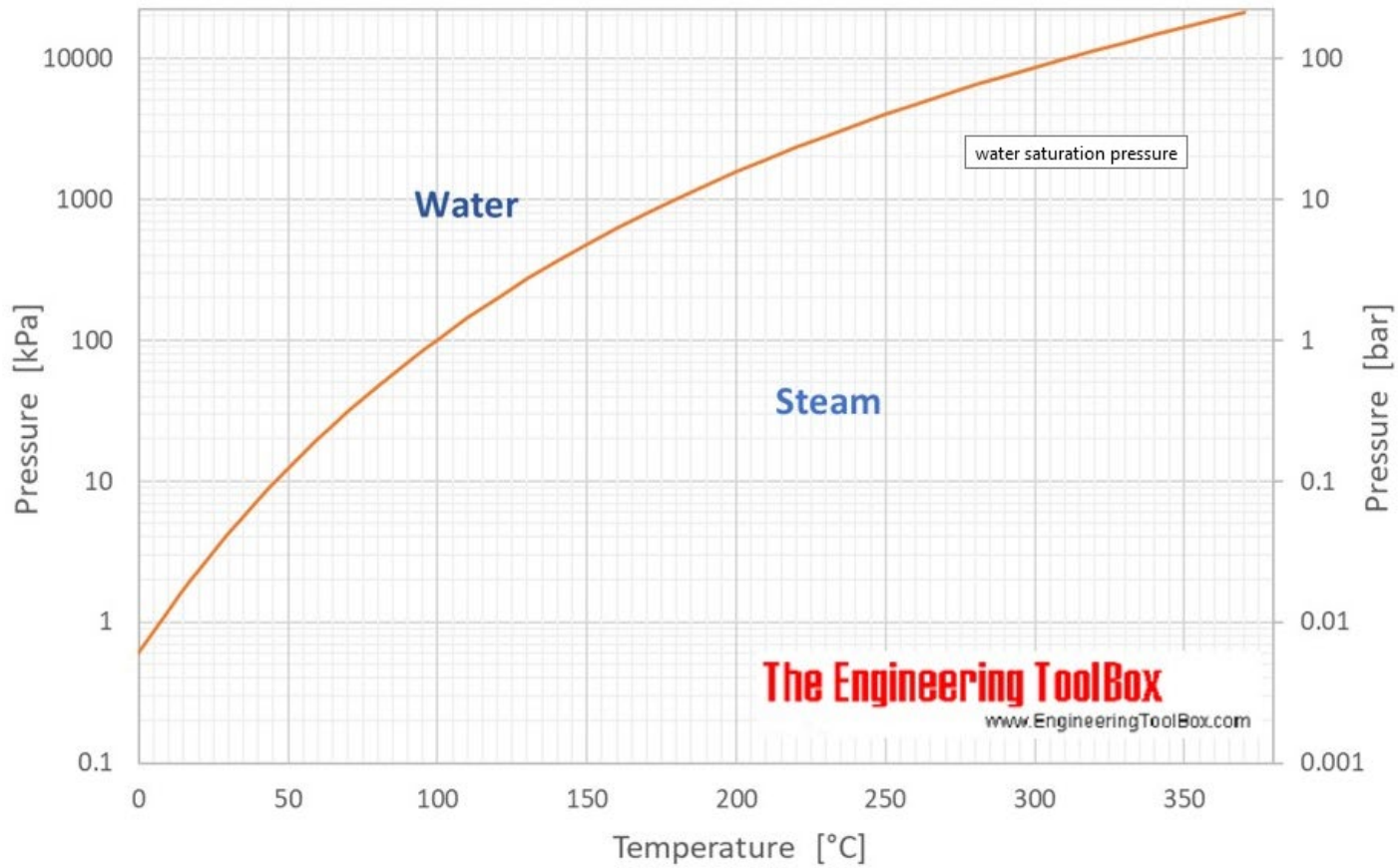
Generic Heat Transfer rate - water

Heat transfer for water (@ 1 atm)

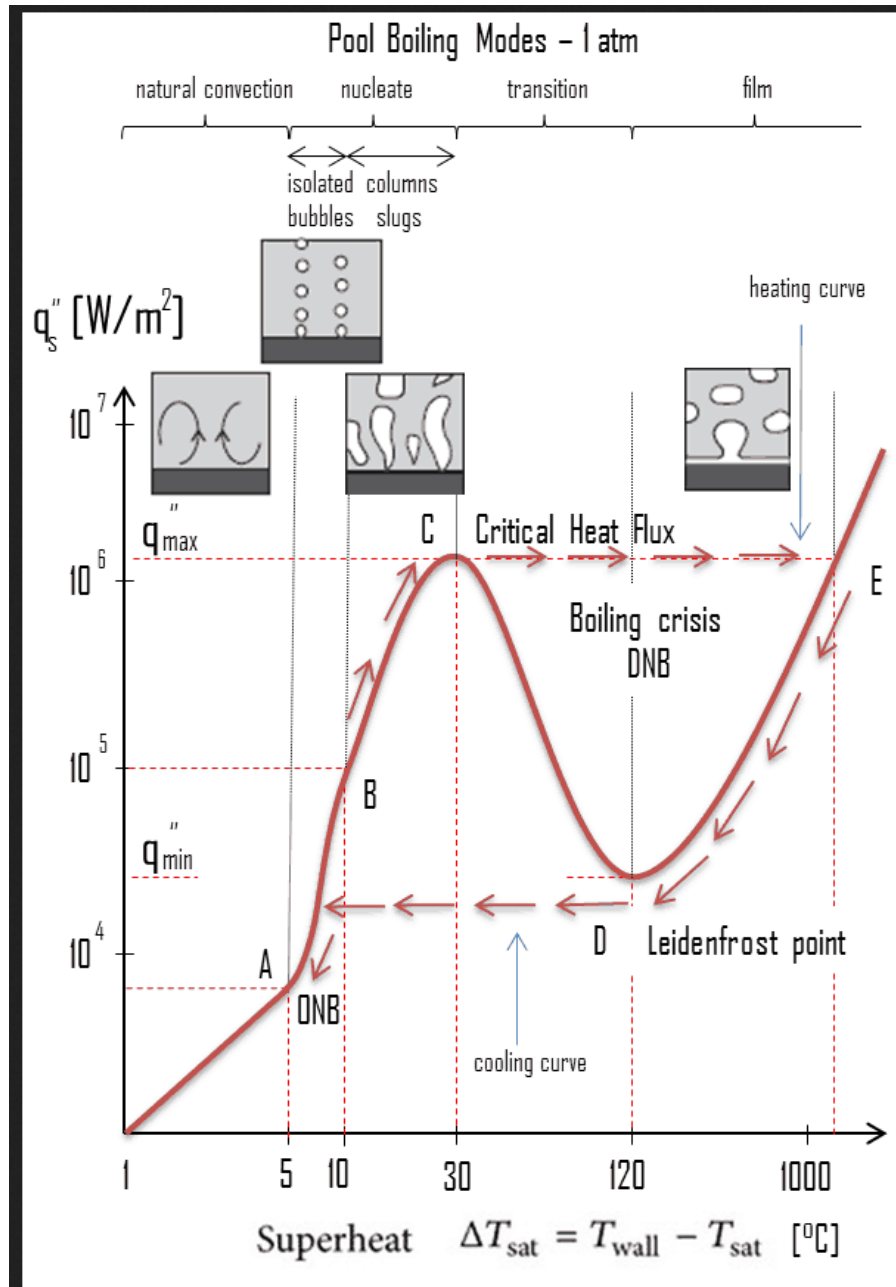
S-shaped graph when heat flux (q'') is compared to temperature.



Water saturation pressure



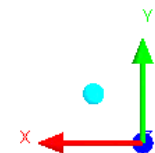
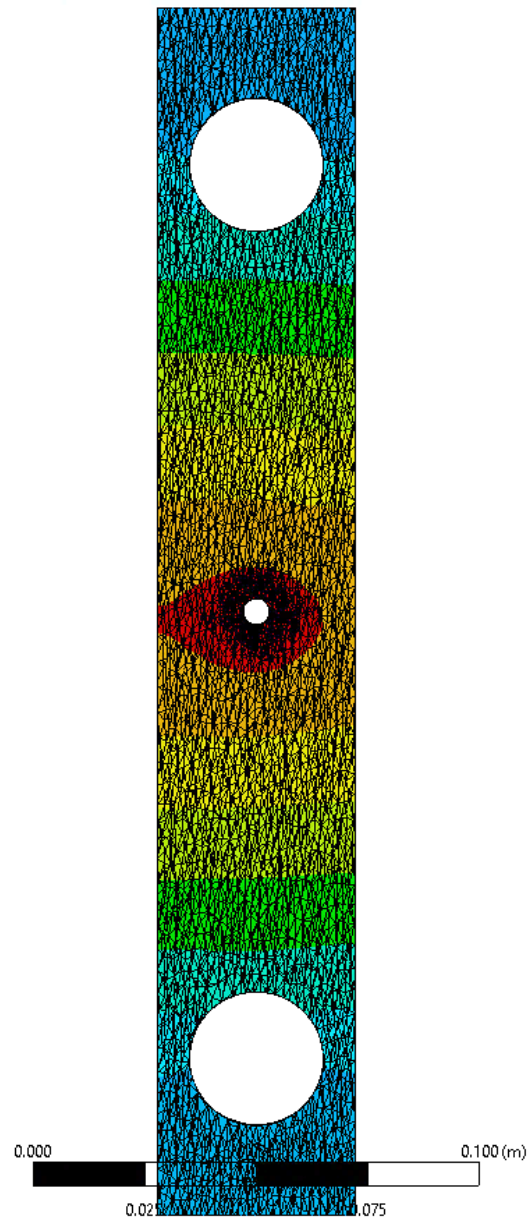
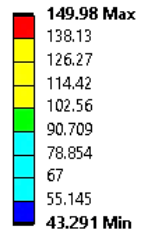
Nucleate Boiling



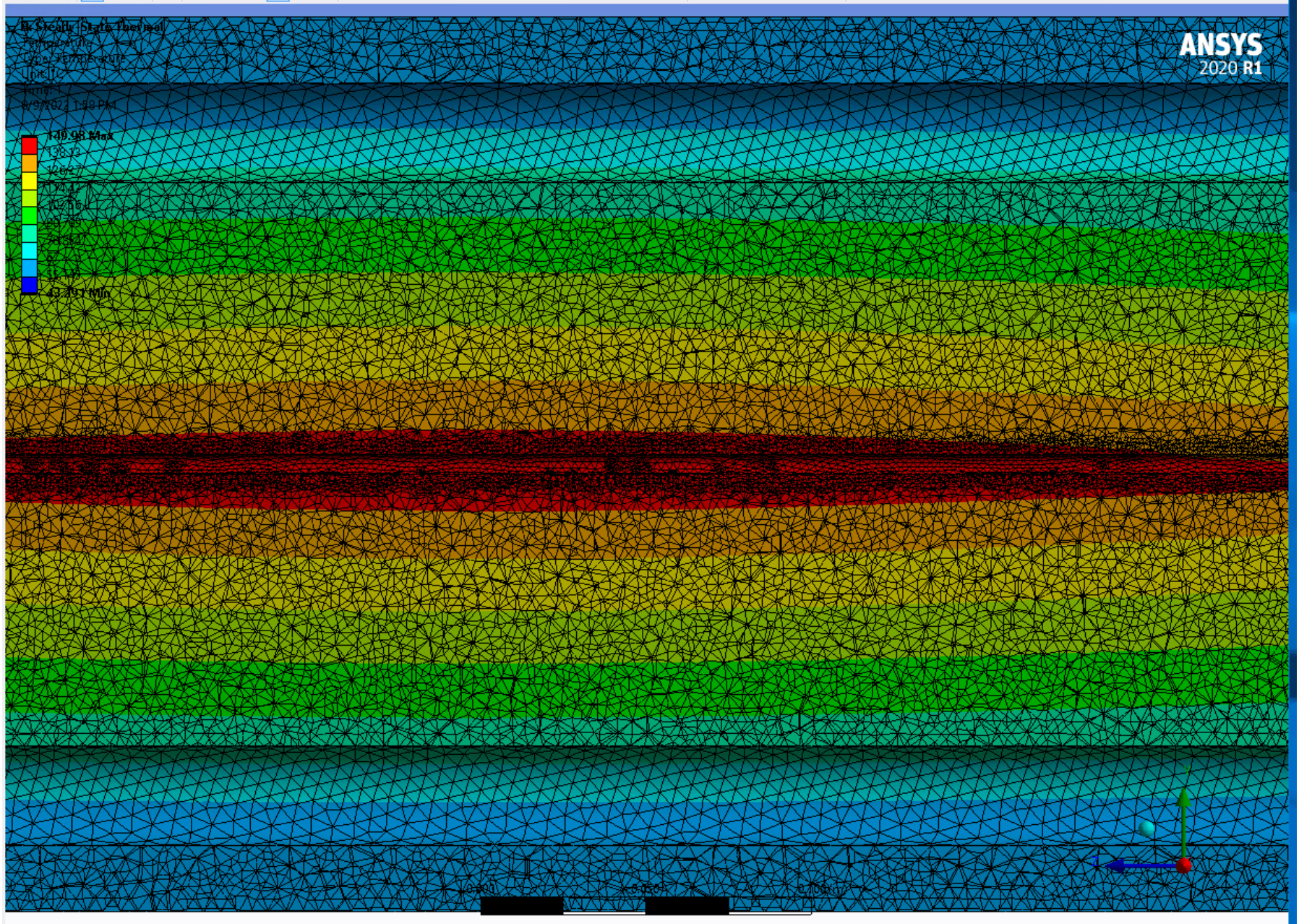
Refined mesh #2 inner hole

B: Steady-State Thermal

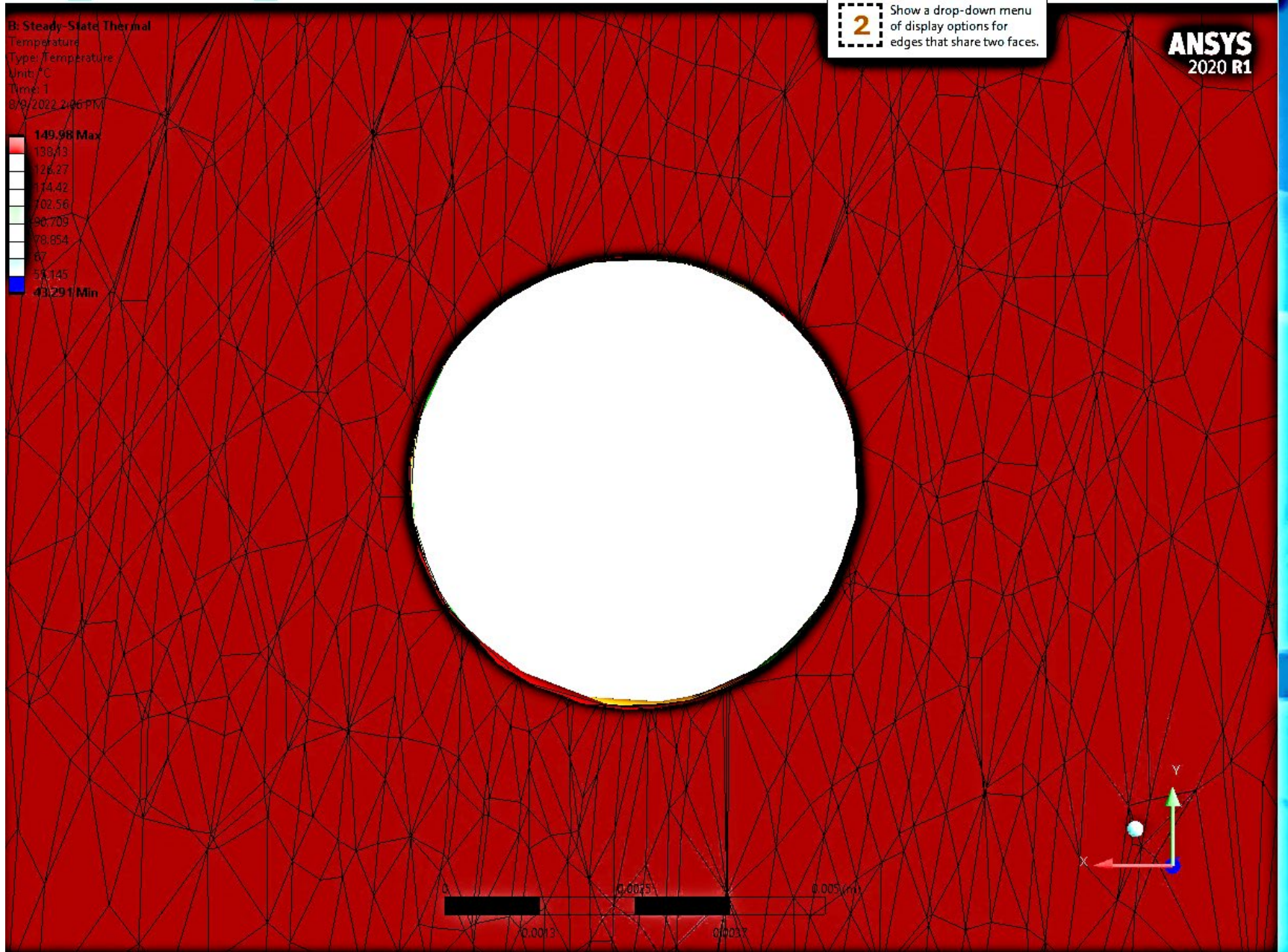
Temperature
Type: Temperature
Unit: °C
Time: 1
8/9/2022 1:42 PM



Refined mesh #2 inner hole



Refined mesh #2 inner hole



Refined Mesh 3– total 44.3KW

Comment

Verdana 2 (10 pt) **B** *I* U | [List Icon] [List Icon] | [Text Icon] [Color Icon] [Image Icon] | [Cut Icon] [Copy Icon] [Paste Icon]

Tue Aug 09, 2022 14:44:45

> Using multiple cores: [Yes]
< Number of cores requested: 24

Maximum source mesh bounding box length: 3.15 (m)
Maximum range used in sorting closest nodes: 0.063 (m)

Number of source nodes: 3754081
Number of target nodes: 5027818

Number of nodes mapped : 5027818
Number of nodes not mapped : 0
Number of nodes outside : 4668992

Percent nodes mapped: 100%
Weight calculation time: 193.857 (s)
Number of variables to interpolate: 1.
Interpolation time: 0.494 (s)

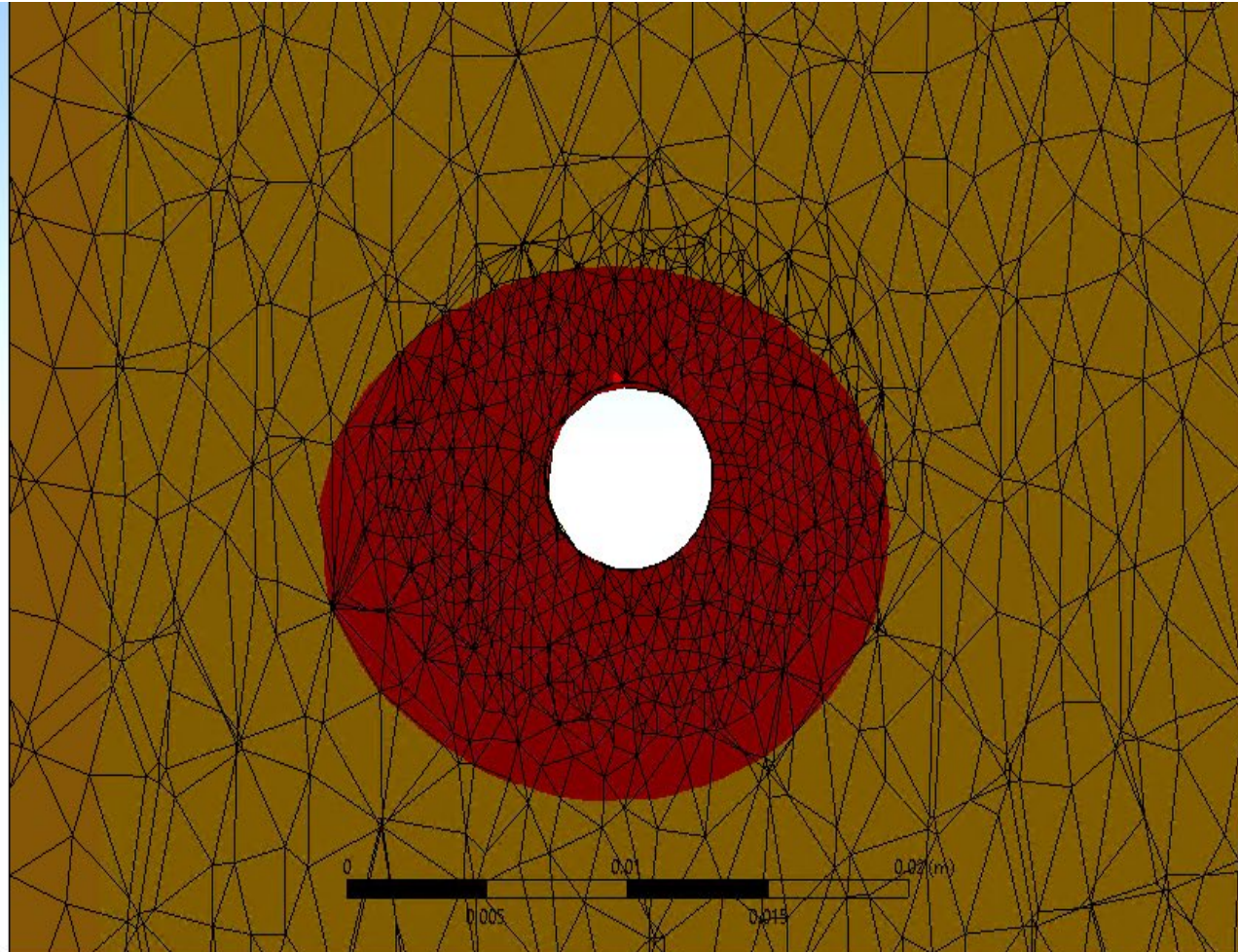
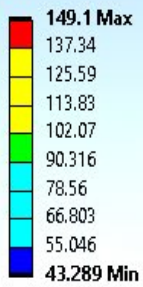
Results:

Row	Target
	Total Heat Rate (W)
1	44325

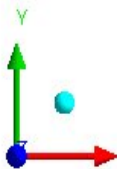
Note: Results reported do not include any Scale or Offset values specified in the worksheet.

Refined Mesh #3

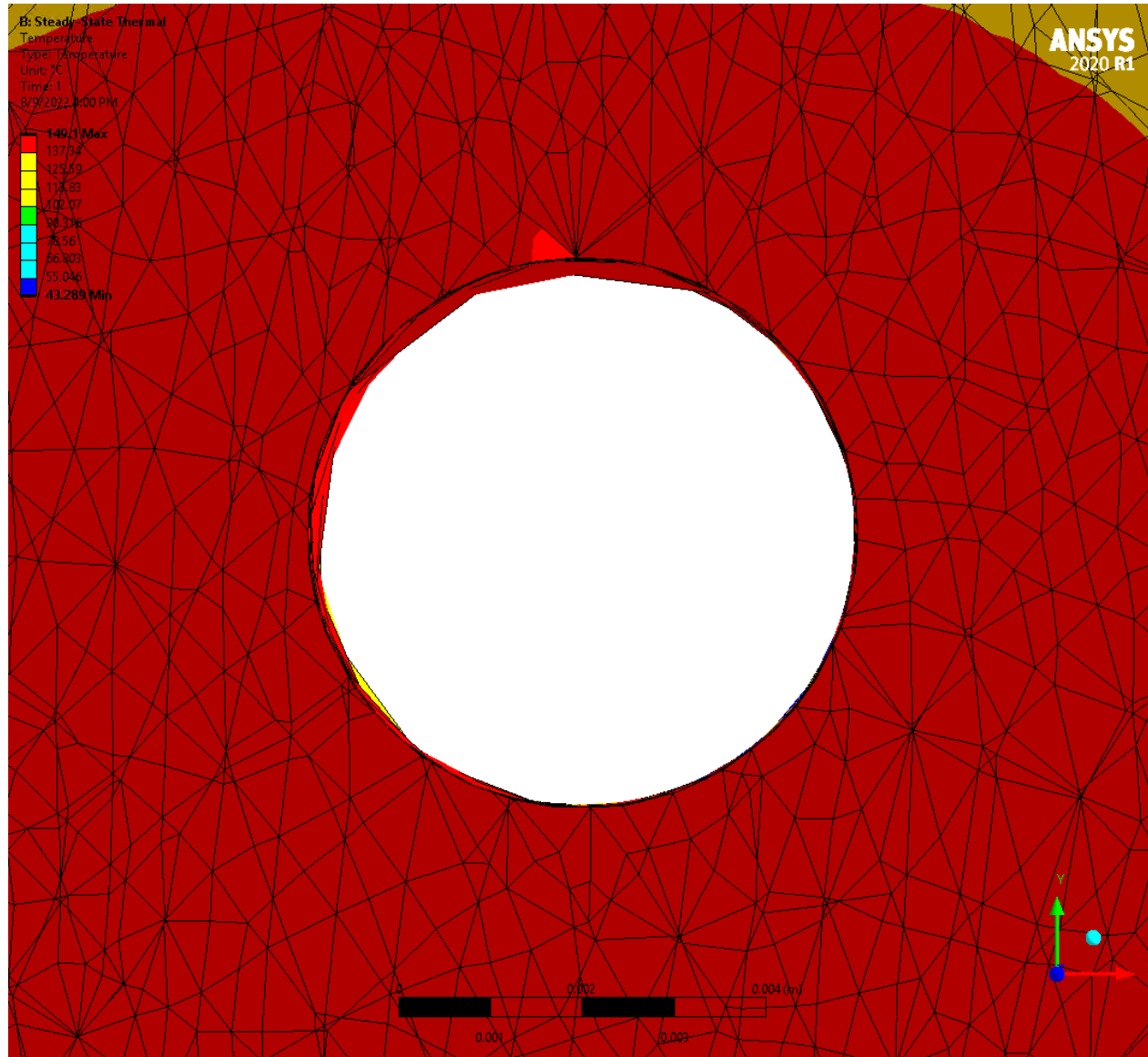
B: Steady-State Thermal
Temperature
Type: Temperature
Unit: °C
Time: 1
8/9/2022 3:45 PM



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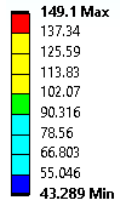


Refined Mesh #3 inner hole

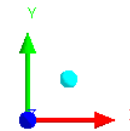
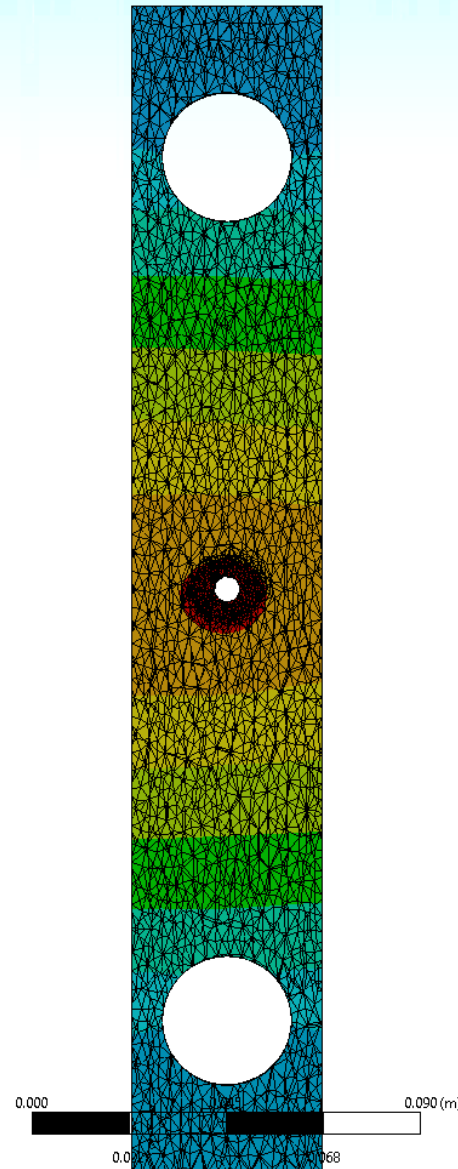


Refined Mesh #3

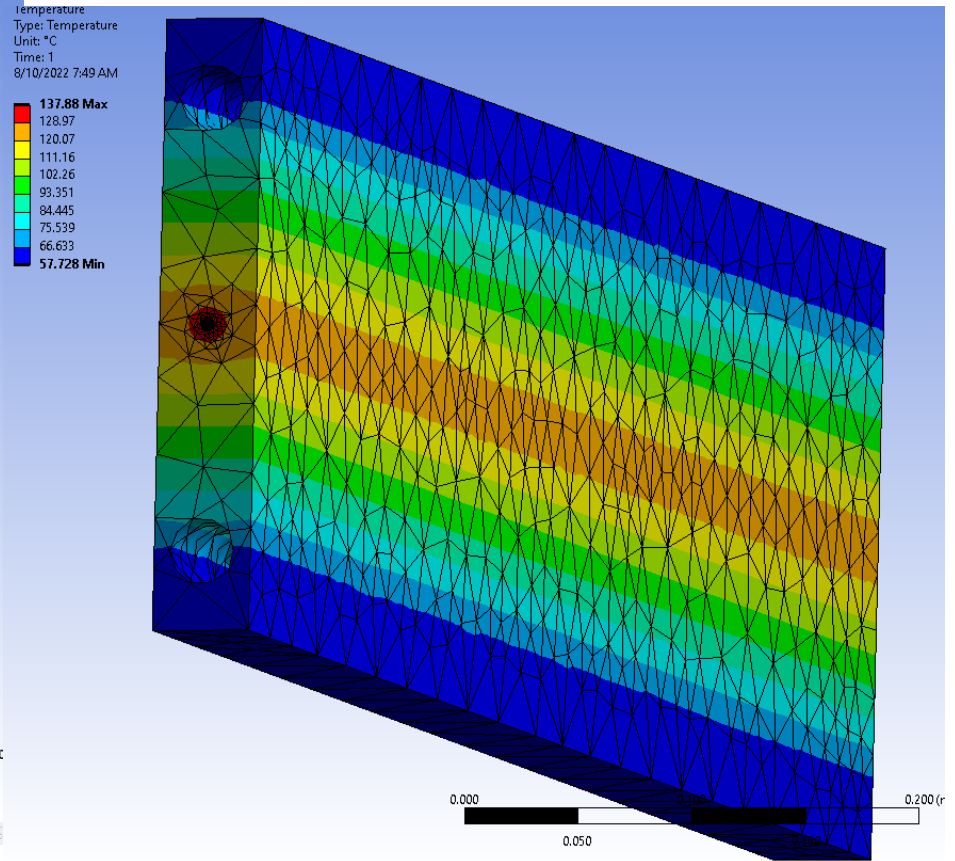
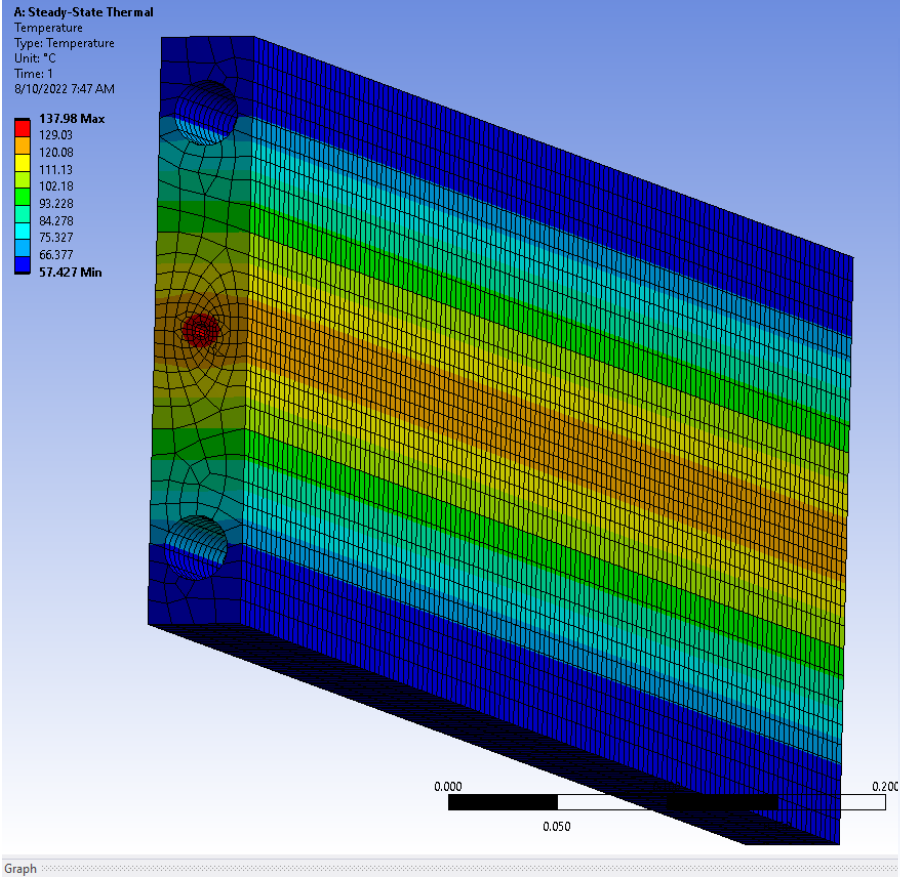
B: Steady-State Thermal
Temperature
Type: Temperature
Unit: °C
Time: 1
8/9/2022 4:00 PM



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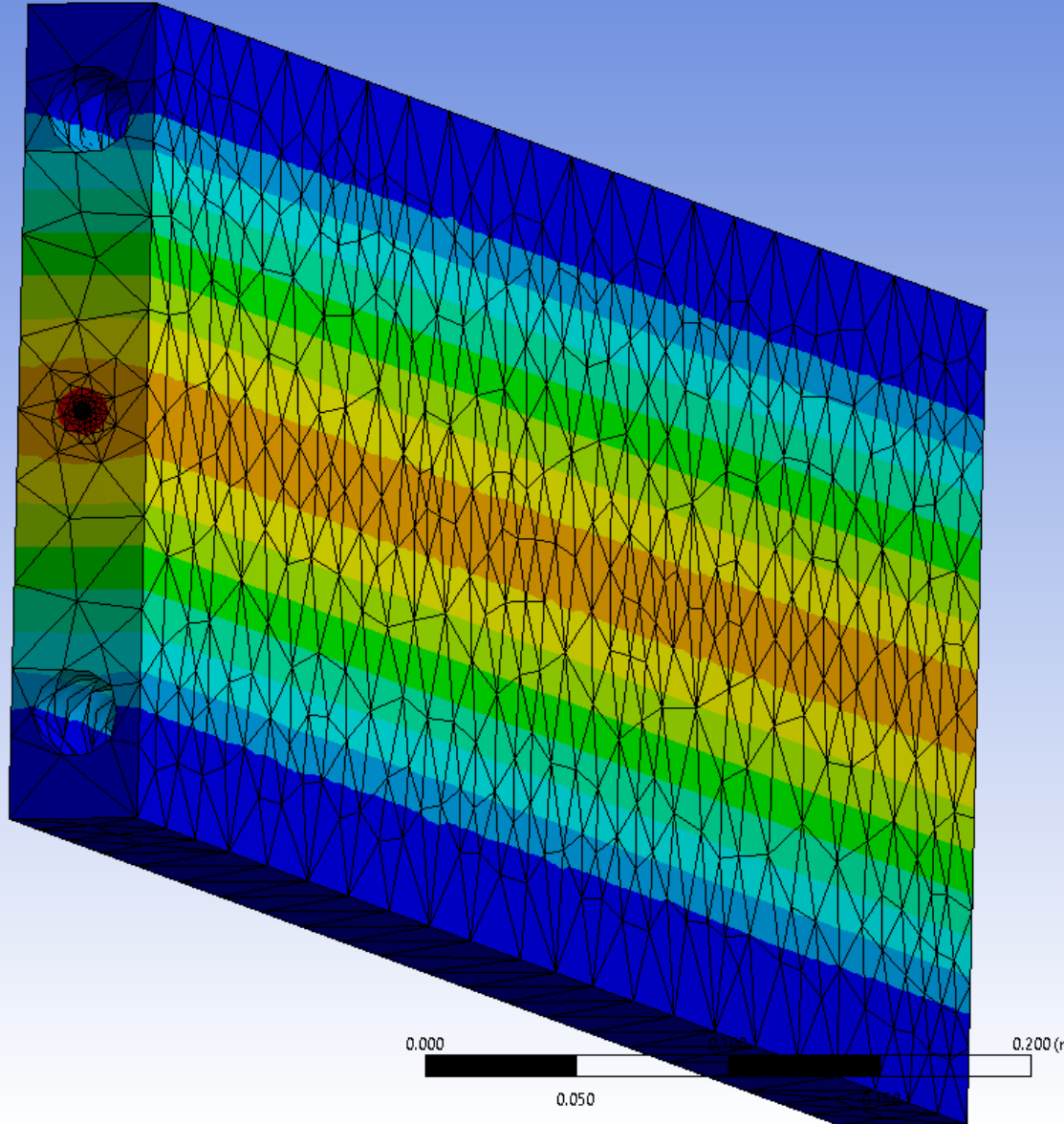
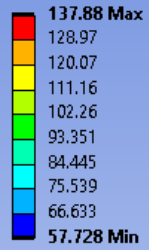


22kw inner hole-1m long 5KW/m²C convection



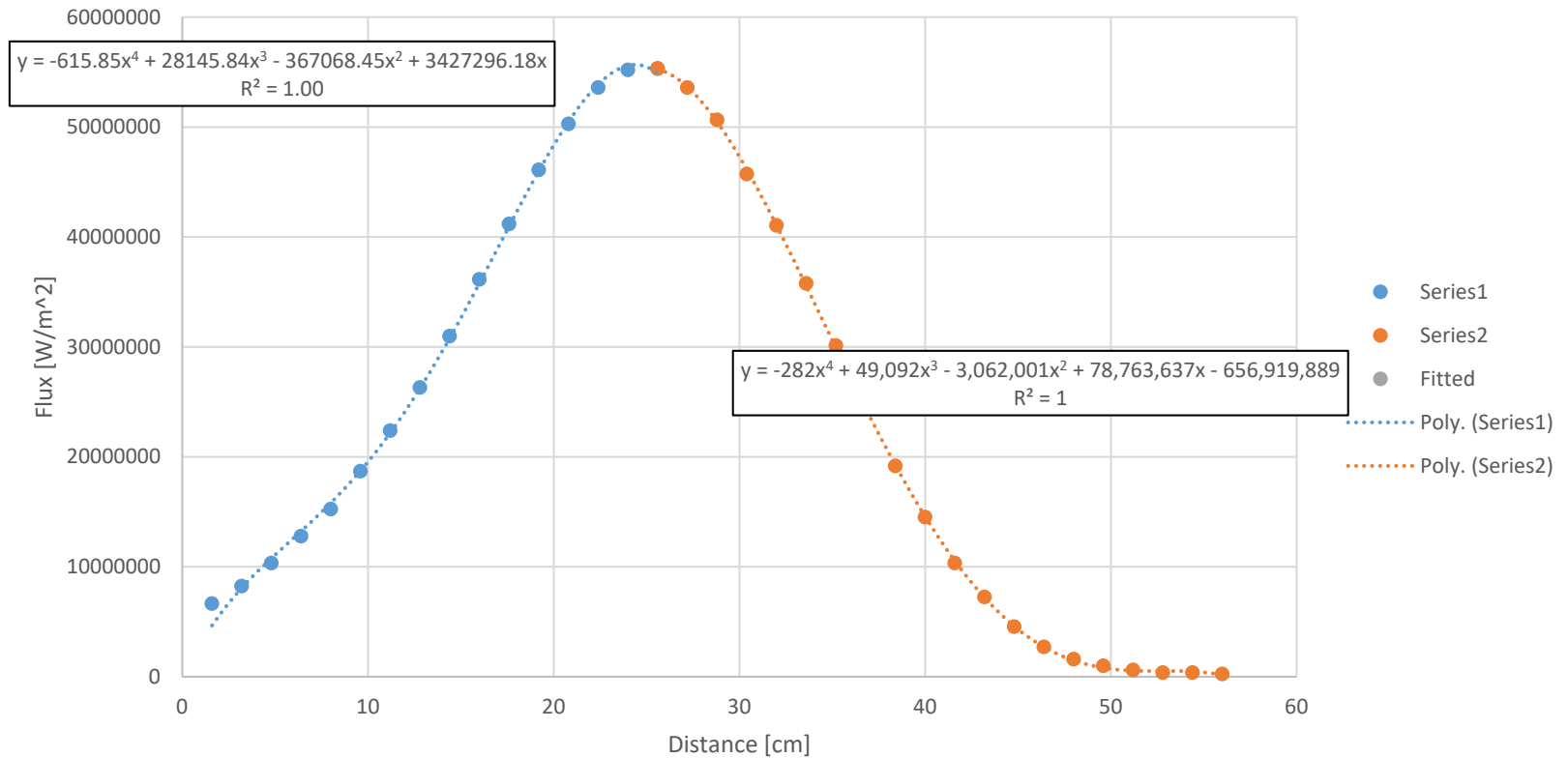
22kw inner hole-1m long 5KW/m²C convection

Temperature
Type: Temperature
Unit: °C
Time: 1
8/10/2022 7:49 AM



Hall C power absorption curve

Rastered Beam Deposited



Hall D CPS with $5.3e7 \text{ W/m}^2$ at center 10 cm – 100KW total – similar to Hall C power

A: Steady-State Thermal

Temperature

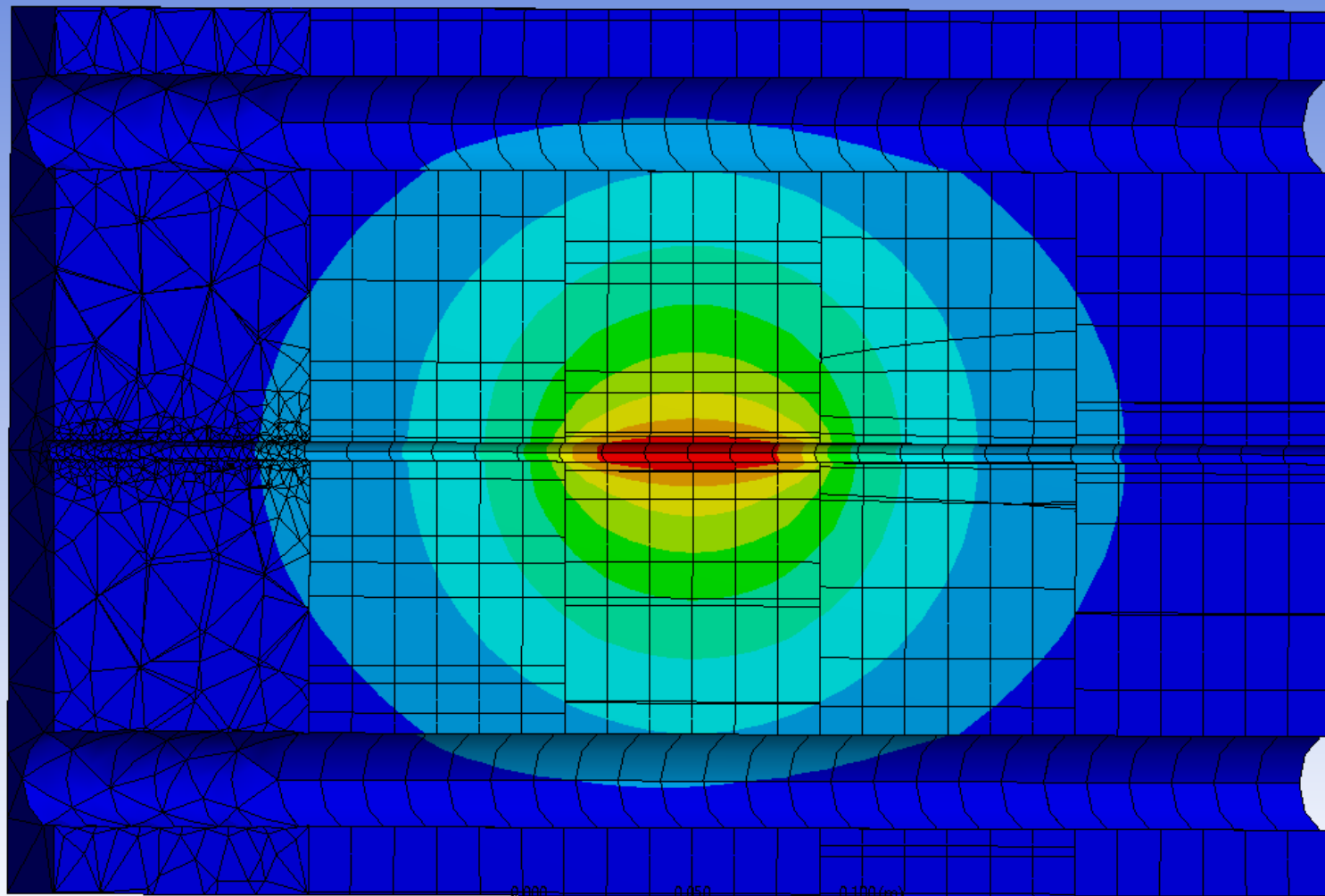
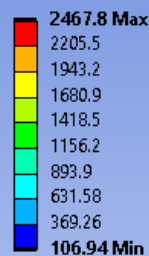
Type: Temperature

Unit: °C

Time: 1

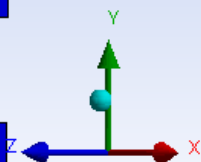
8/13/2022 10:30 AM

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2020 R1



0.000 0.050 0.100(m)

0.025 0.075

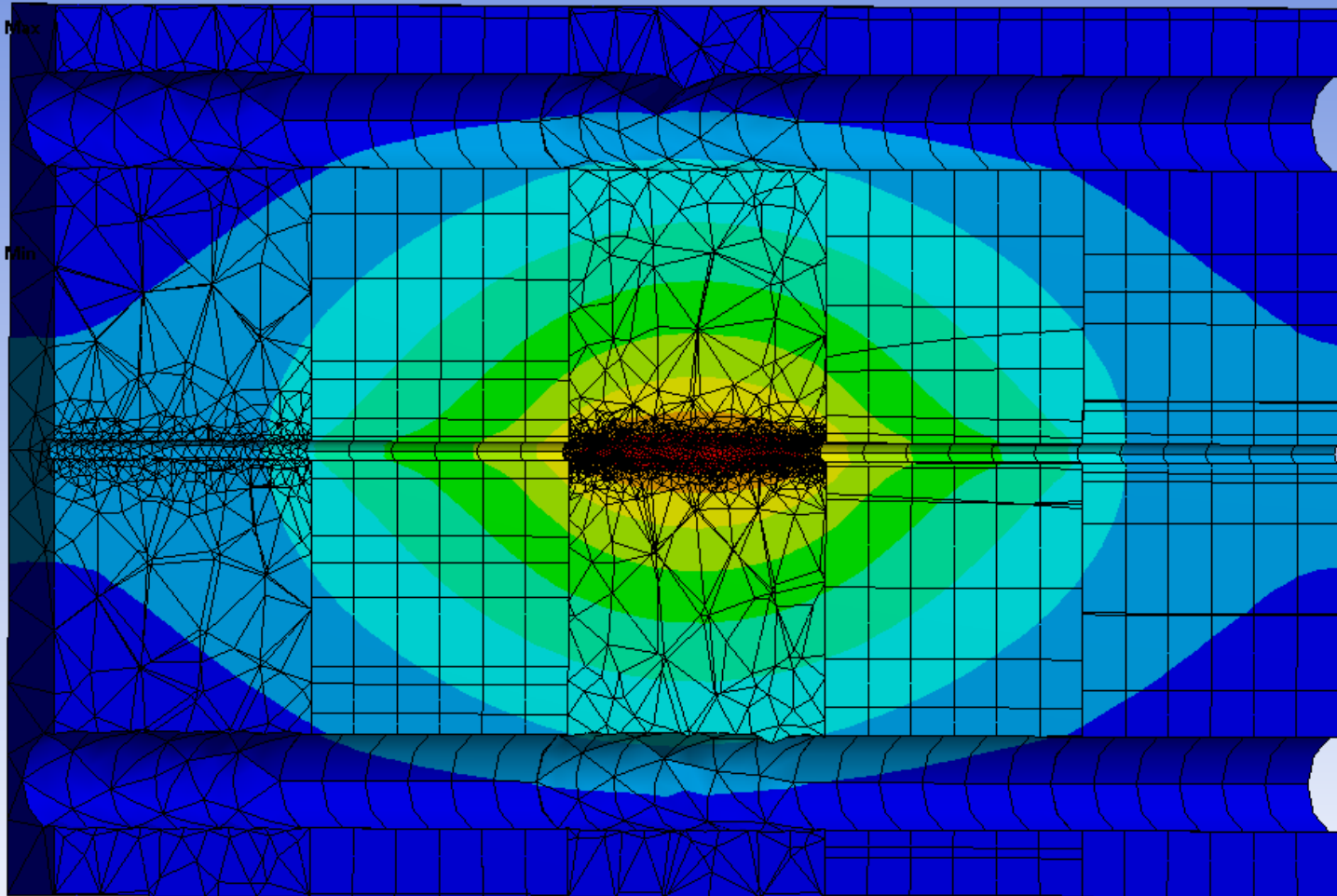
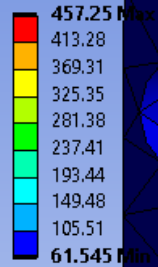


Hall D CPS with $7.7e6 \text{ W/m}^2$ at center 10 cm (15KW), $2.4e6 \text{ W/m}^2$ on each 10cm side – 24KW total

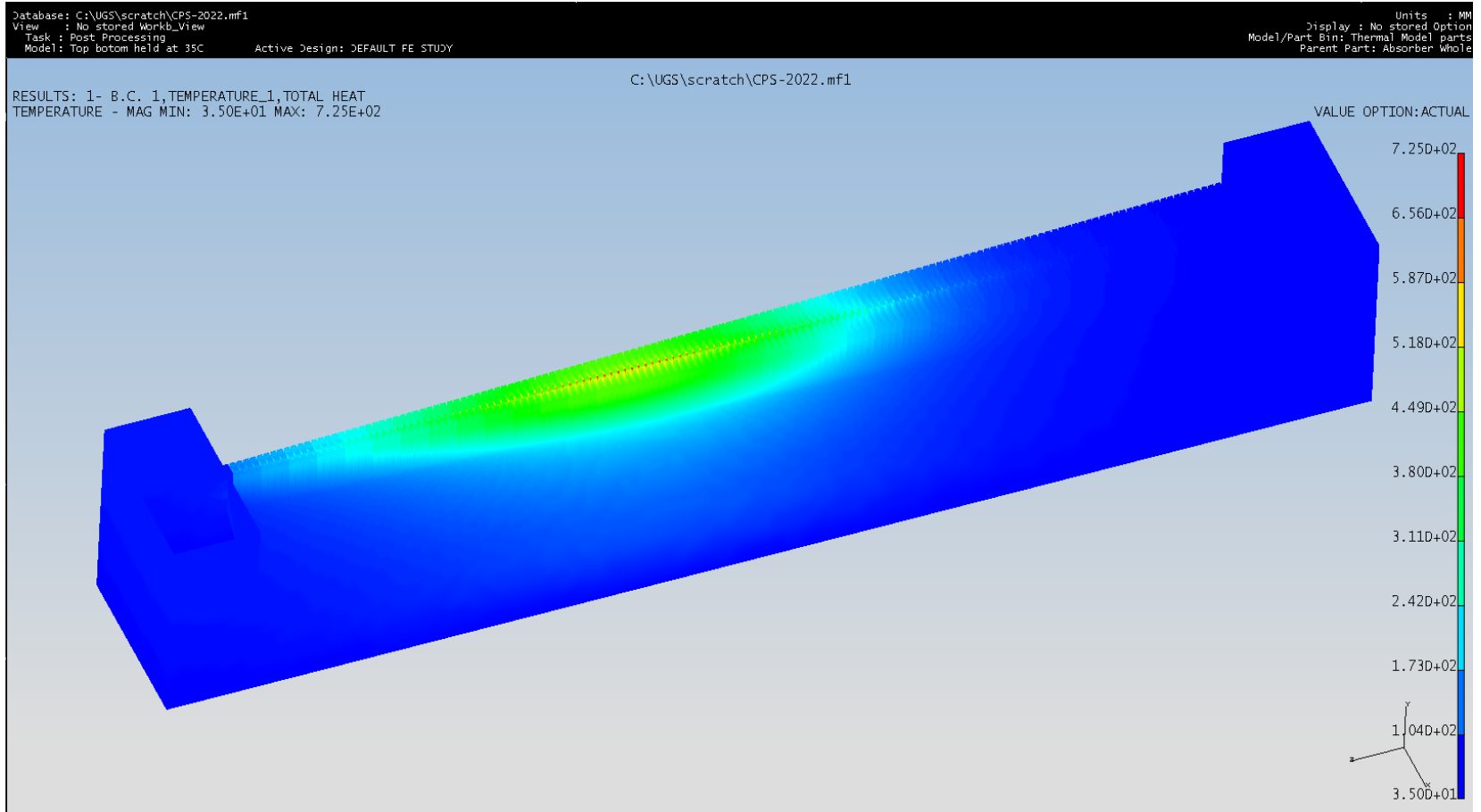
A: Steady-State Thermal

Temperature
Type: Temperature
Unit: °C
Time: 1
8/20/2022 9:40 AM

ANSYS
2020 R1



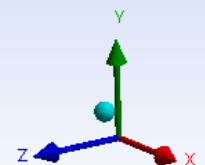
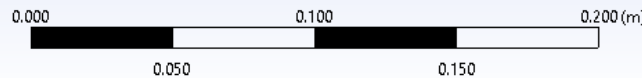
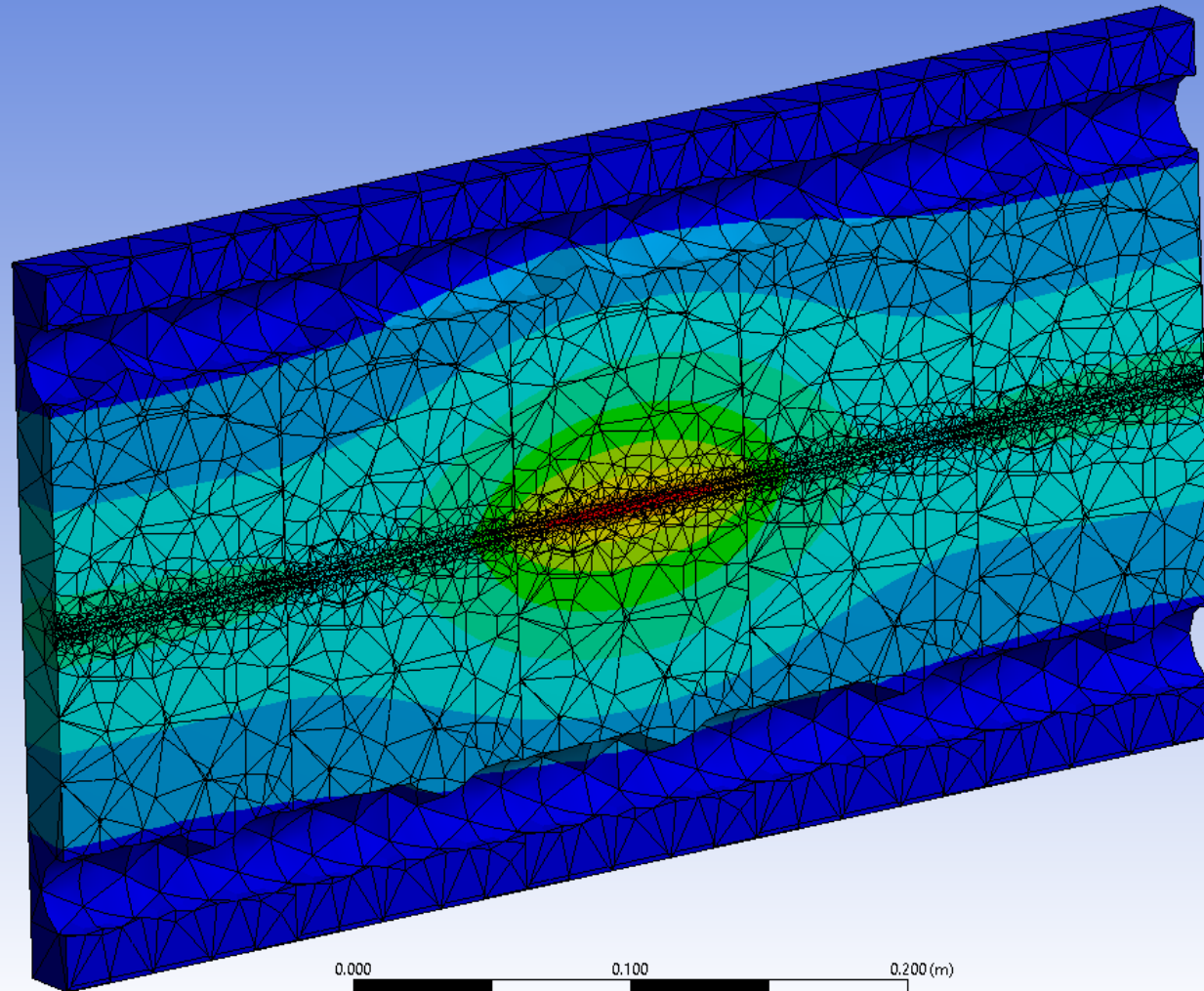
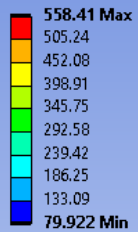
Hall C CPS temp profile



40KW total power using 3mm hole and distribution scaled to Hall C over 50 cm

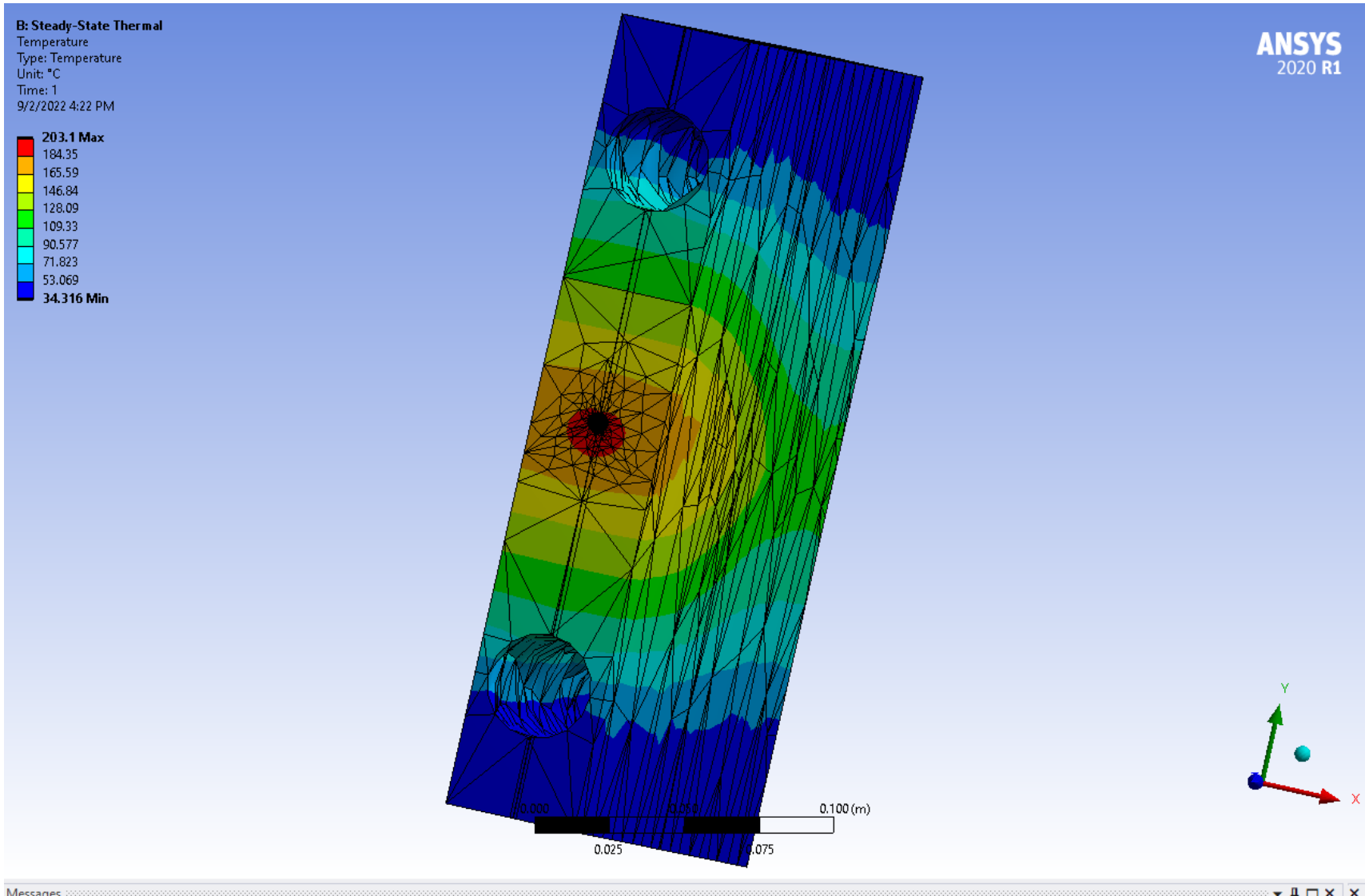
A: Steady-State Thermal

Temperature
Type: Temperature
Unit: °C
Time: 1
9/1/2022 3:12 PM



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2020 R1

Latest segmented hot section 21KW 55cm long



Fine Mesh 7mm hole

