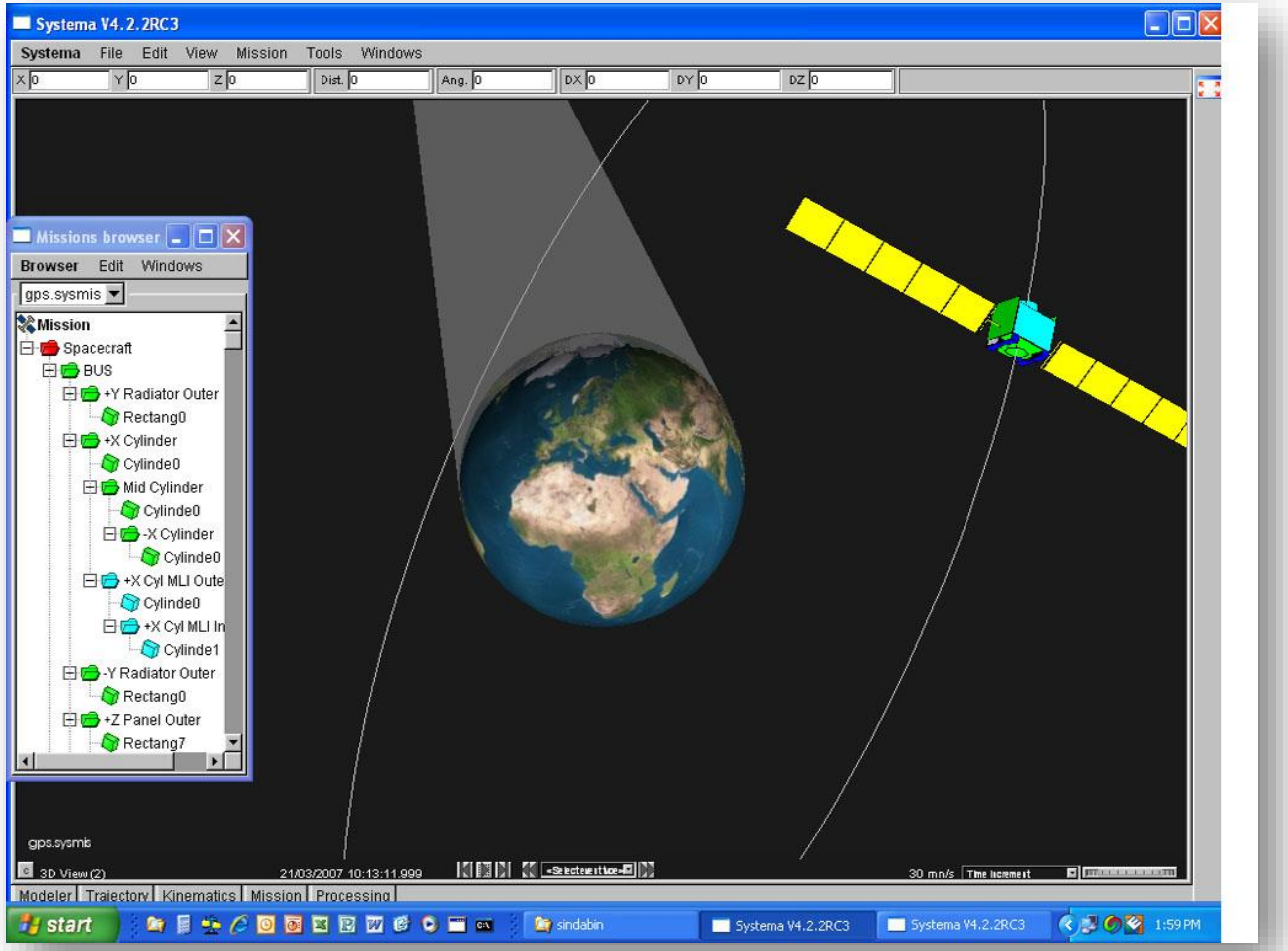
Thermica program



Orbital heat load

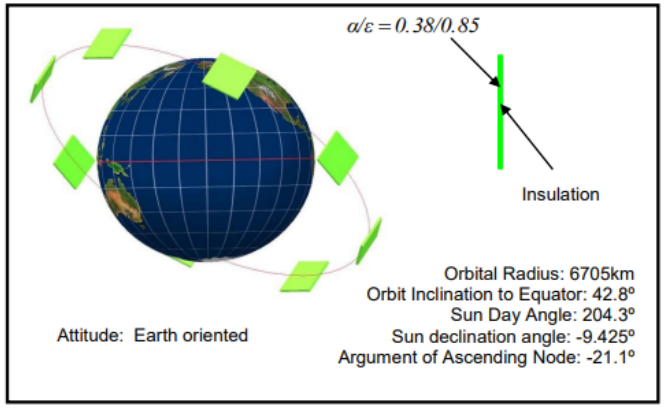
Problem 5

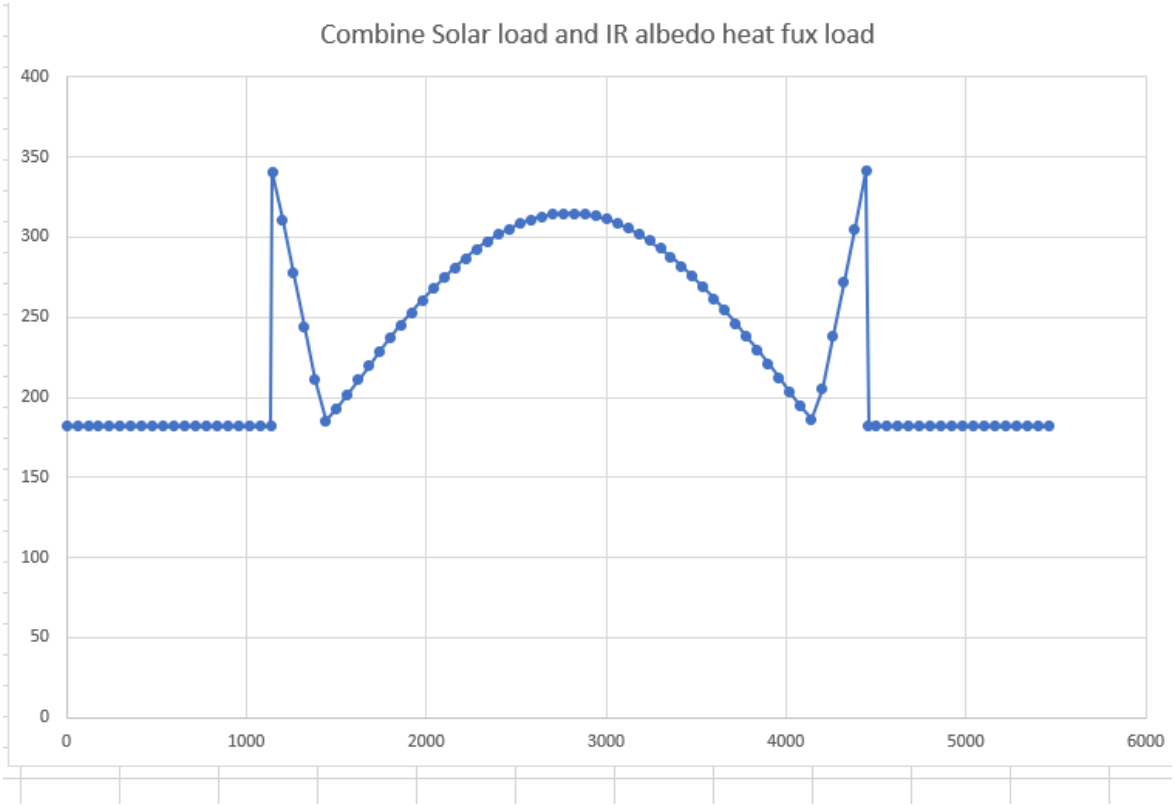
Plate in an Orbit with Eclipse

Model Description:

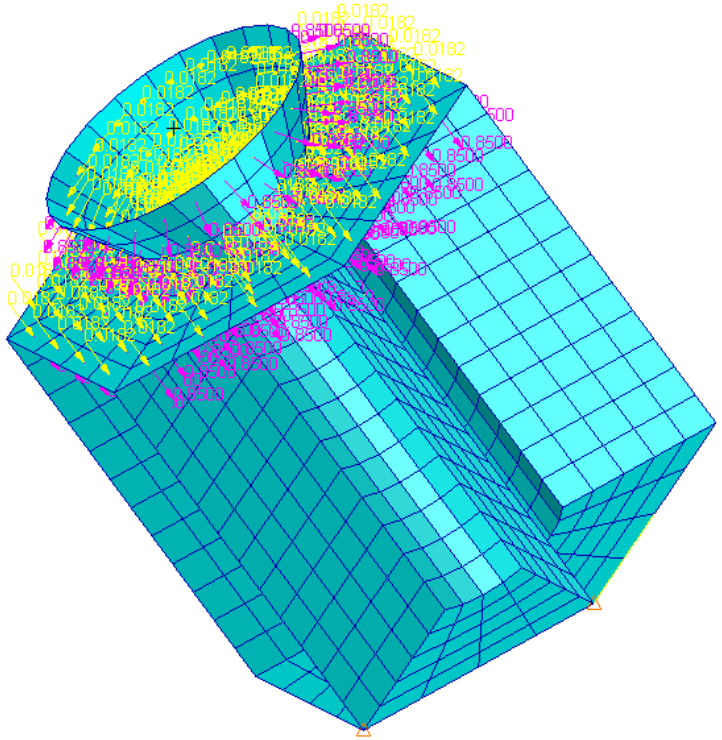
In this problem you will create a model like problem 4. The plate will radiate and absorb heat flux only on one side, the other side is insulated. No active heat is imposed on the plate. The orbit is a round orbit with an eclipse. The attitude is 3 axis stable, and Earth-oriented. A transient run will be made this time. Please note: this problem needs a Fortran compiler. We will add some Fortran logics in the sin file.

Surface Dimension = 1.0 m x 1.0 m x 0.001 m
Ambient Temperature = -273.15 K
The material is Aluminum 6061 T6
Thermal Conductivity = 167 W/m.K
Specific Heat = 880 W/Kg
Density = 2700 Kg/m³
Surface IR Emissivity = 0.85
Surface UV Absorptivity = 0.38



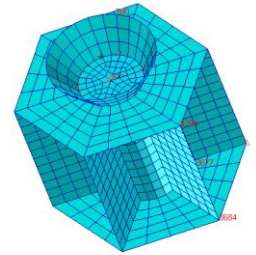


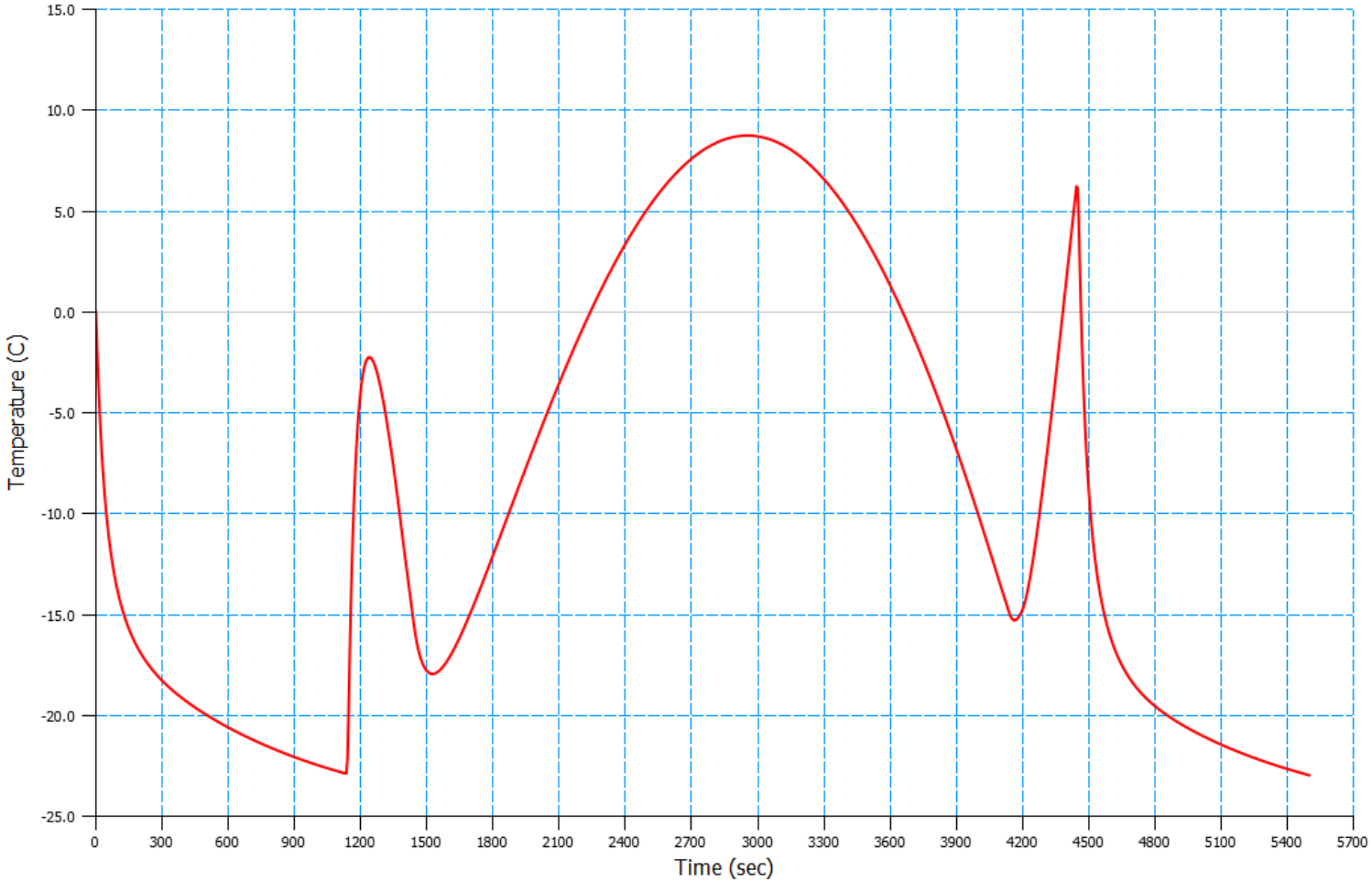
Satellite



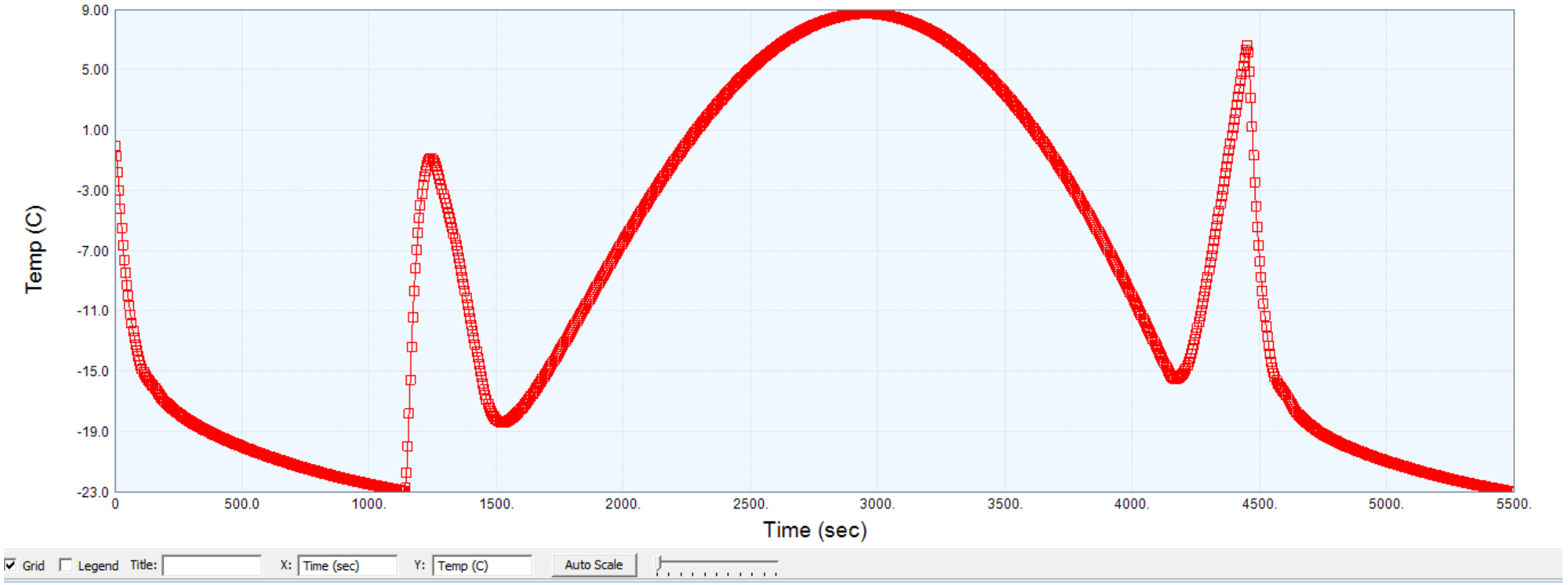
The antenna receive solar heat load ,and radiation to space at -273.15 degrees from top

Temperature as it goes through a cycle (Node 380)





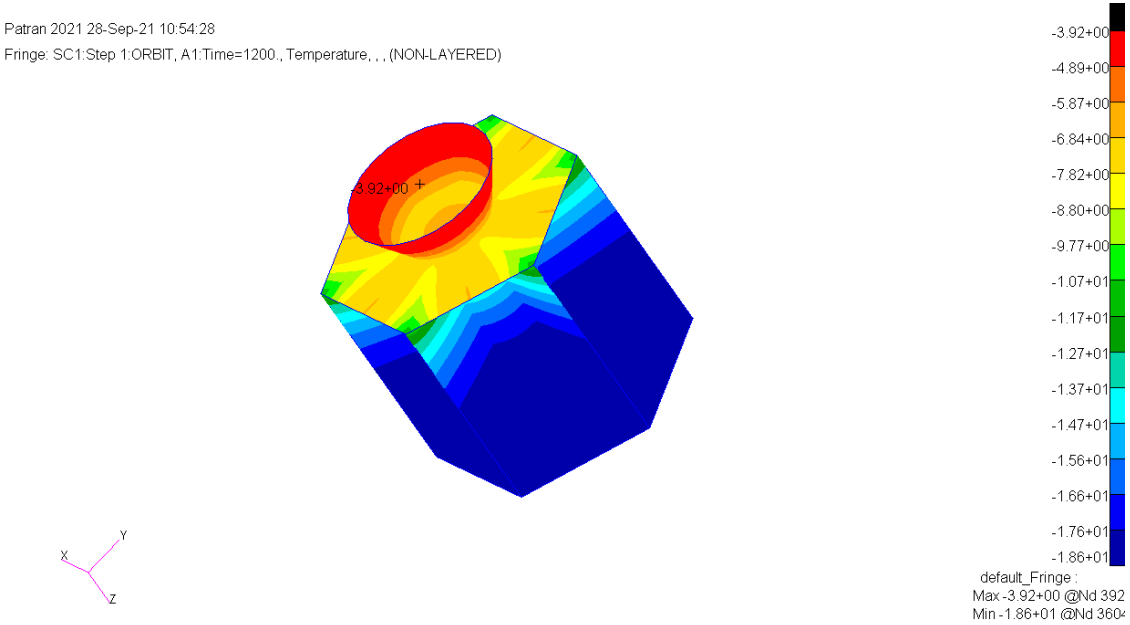
SINDAG run



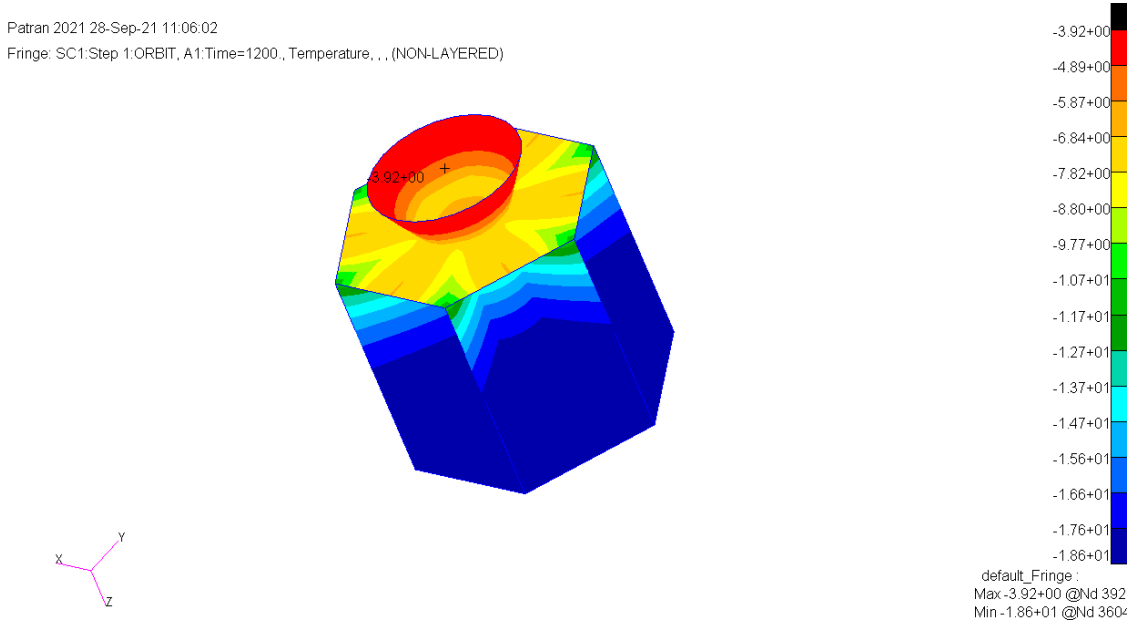
As we can see that the comparison between MSC/NASTRAN thermal and SINDAG is excellent in this transient thermal analysis of satellite model, (peak temp is about 9 degree C in 9 degrees C for MSC/NASTRAN)

Temp in degree C (Time = 1200 sec))

MSC/NASTRAN



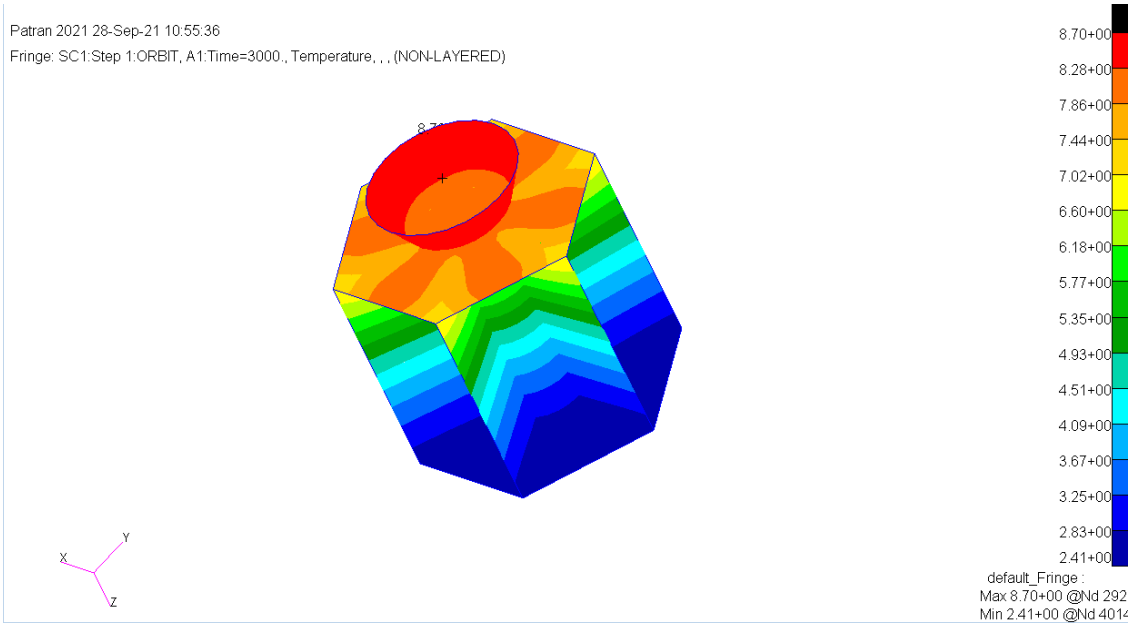
SINDAG result



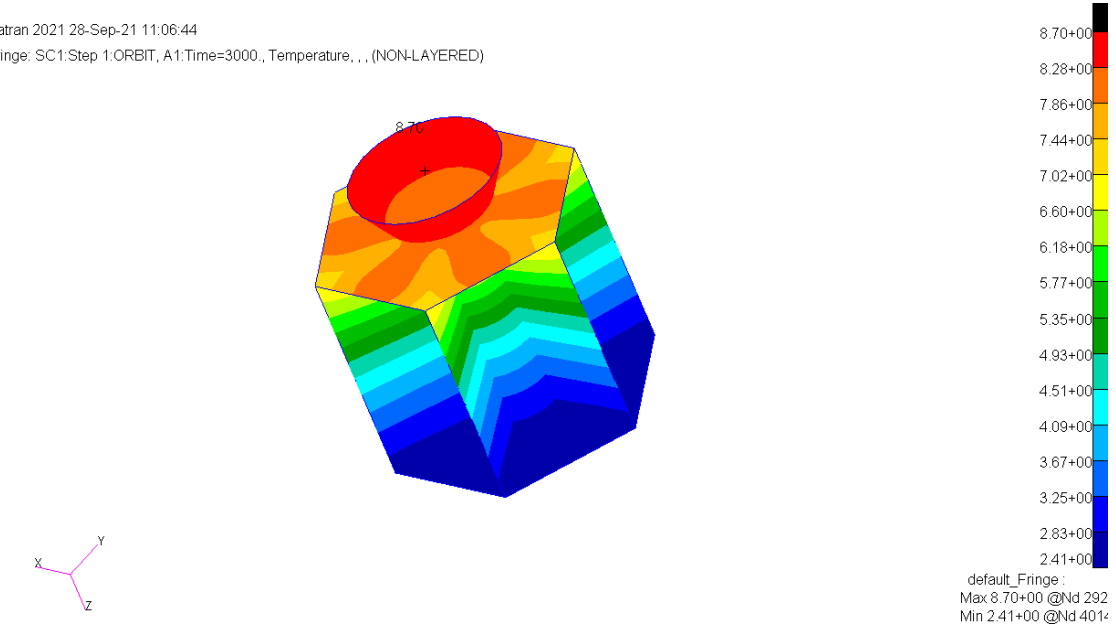
Peak temperature is -3.9 for MSC/NASTRAN and -3.9 for MSC/SINDA

(Time = 3000 sec) in the peak solar power

MSC/NASTRAN



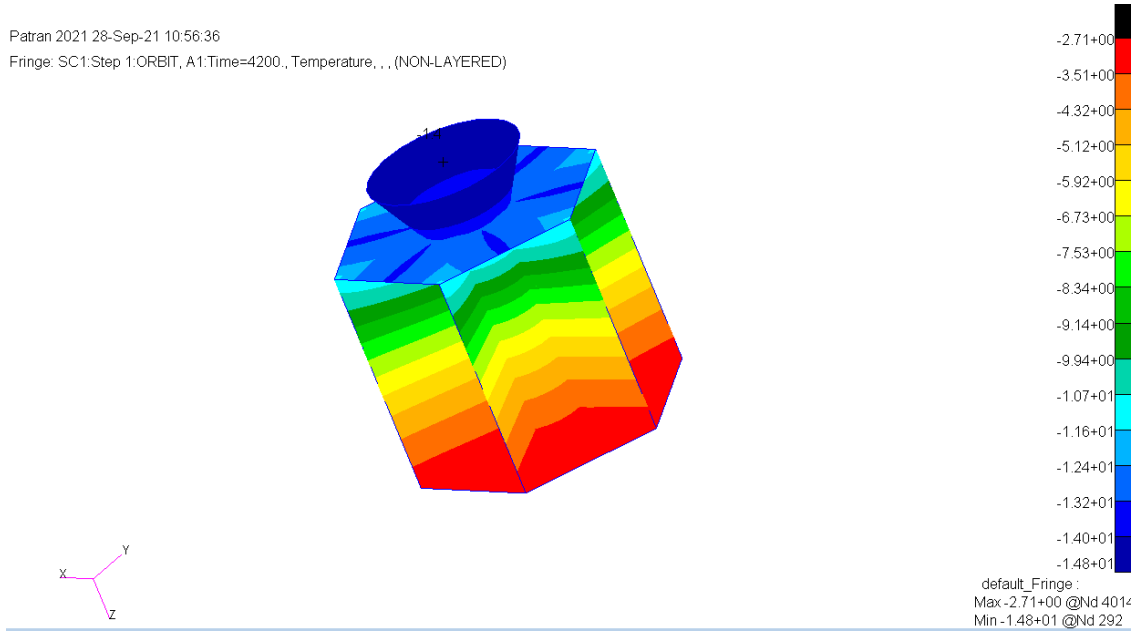
SINDAG result



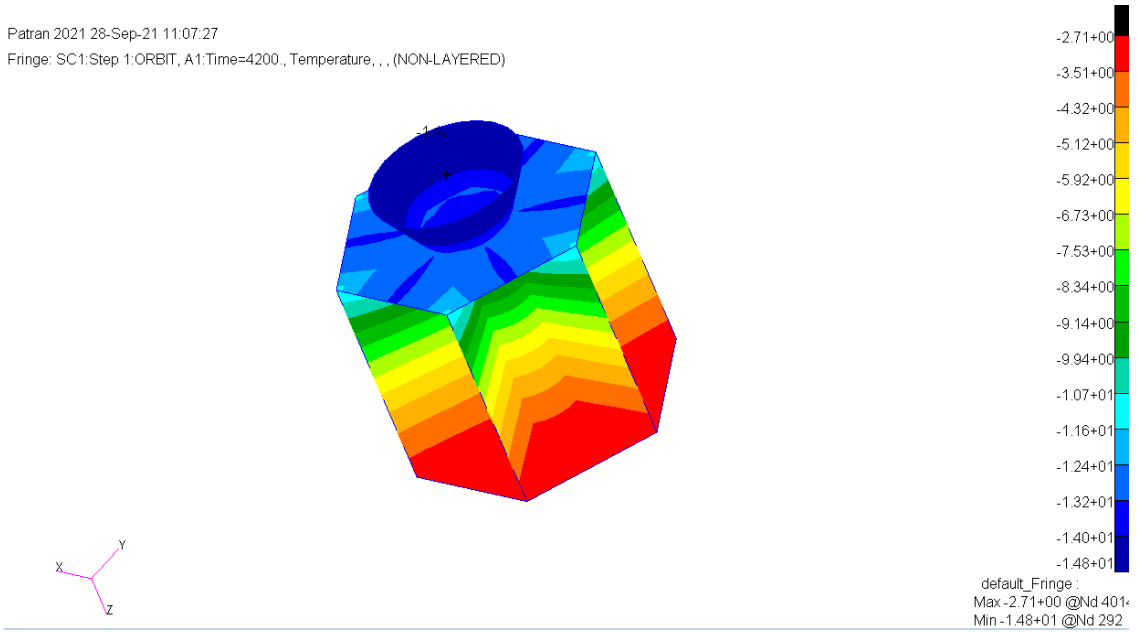
Peak temperature is 8.7 for MSC/NASTRAN and 8.7 for MSC/SINDA

(Time = 4200 sec) in the eclipse

MSC/NASTRAN



SINDAG result



Peak temperature is -2.7 for MSC/NASTRAN and 2.7 for MSC/SINDA

MSC/NASTRAN SOL 400 transient thermal analysis

```
$ Watt/cm2.k4
SOL 400
CEND
$ Direct Text Input for Global Case Control Data
ANALYSIS = HTRAN
TITLE = MSC/NASTRAN JOB CREATED ON 25-SEP-98 AT 21:21:01
ECHO = NONE
SET 77 = 5001
IC = 1
SUBCASE 1
   SUBTITLE=tran_new
   TSTEPNL = 1
   DLOAD = 2
SPC=1
   THERMAL(SORT2,PRINT)=ALL
SPCF=77
$ Direct Text Input for this Subcase
OUTPUT(XYPLOT)
xgrid=yes
ygrid=yes
xtitle=time
ytitle=temp
xyplot temp/3684(T1),380(T1)
BEGIN BULK
$ Direct Text Input for Bulk Data
MDLPRM   HDF5    0
PARAM    TABS    273.15
PARAM,SIGMA,5.67-12
PARAM    PRGPST  NO
TSTEPNL  1       1100    5.      1       ADAPT   2       -10     U
         .01
                 0
$ Dynamic Load Table : solar_load_new
TABLED1  10
*        0.              181.67999       60.             181.67999
*        120.            181.67999       180.            181.67999
*        240.            181.67999       300.            181.67999
*        360.            181.67999       420.            181.67999
*        480.            181.67999       540.            181.67999
*        600.            181.67999       660.            181.67999
*        720.            181.67999       780.            181.67999
*        840.            181.67999       900.            181.67999
*        960.            181.67999       1020.           181.67999
*        1080.           181.67999       1136.           181.67999
*        1145.           340.67001       1200.           310.64999
```

```
$ Radiation Enclosures of Load Set : view_bottom
SPC,1,5001,1,-273.15
temp,1,5001,-273.15
$VIEW     2       101     BOTH
$RADSET   101
TLOAD1    5       3                       10
$LOAD1    6       4                       10
$LOAD     2       1.      1.      5       1.      6
DLOAD     2       1.      1.      5
RADBC,5001,0.5,,100001,thru,100552
$ Normal Heat Flux of Load Set : antenna_top
QBDY3     3       1e-4            100001
QBDY3     3       1e-4            100002
QBDY3     3       1e-4            100003
QBDY3     3       1e-4            100004
QBDY3     3       1e-4            100005
QBDY3     3       1e-4            100006
QBDY3     3       1e-4            100007
QBDY3     3       1e-4            100008
QBDY3     3       1e-4            100009
QBDY3     3       1e-4            100010
QBDY3     3       1e-4            100011
QBDY3     3       1e-4            100012
QBDY3     3       1e-4            100013
QBDY3     3       1e-4            100014
QBDY3     3       1e-4            100015
QBDY3     3       1e-4            100016
```

MSC/SINDAG test deck

```
C MSC Sinda input file created for problem name: satellite_rcnt
      BCD 3THERMAL LPCS
      BCD 9MSC Sinda model  from Patran/Nastran and SindaRAD
      BCD 9  Model name = satellite_rcnt
      END
      BCD 3NODE DATA
          282,   100.0000    ,  0.5141574
          283,   100.0000    ,  0.6089281
          284,   100.0000    ,  0.3351715
          285,   100.0000    ,  0.6837769
          286,   100.0000    ,  0.5147809
          287,   100.0000    ,  0.6090962
          288,   100.0000    ,  0.3346427
          289,   100.0000    ,  0.6699428
          290,   100.0000    ,  0.5152241
          291,   100.0000    ,  0.6091574
          292,   100.0000    ,  0.3342964
          293,   100.0000    ,  0.6840760
          294,   100.0000    ,  0.5147811
          295,   100.0000    ,  0.6090990
          296,   100.0000    ,  0.3346427
          298,   100.0000    ,  0.5141553
          299,   100.0000    ,  0.6089281
          300,   100.0000    ,  0.3351700
          305,   100.0000    ,  0.6837753
          306,   100.0000    ,  0.5147801
          307,   100.0000    ,  0.6090965
          308,   100.0000    ,  0.3346436
          309,   100.0000    ,  0.6699433
          310,   100.0000    ,  0.5152220
          311,   100.0000    ,  0.6091556
          312,   100.0000    ,  0.3342972
          313,   100.0000    ,  0.6840753
          314,   100.0000    ,  0.5147810
          315,   100.0000    ,  0.6090971
          -241153, 4263, 4286,   4.692278
          -241154, 4264, 4286,   2.166580
          -241155, 4265, 4286,   4.060300
          -241156, 4266, 4286,   5.488096
          -241157, 4278, 4286,   5.504487
          -241158, 4279, 4286,   4.095987
          -241159, 4281, 4286,   4.738801
          -241160, 4282, 4286,   4.692272
          -241161, 4283, 4286,   2.166581
          -241162, 4284, 4286,   4.060296
          -241163, 4285, 4286,   5.488082
      END
      BCD 3CONSTANTS DATA
          DRLXCA=0.1000000E-02
          ARLXCA=0.1000000E-02
          NLOOP=5000
          OUTPUT=5.000000
          TIMEND=5500.000
          DTIMEI=5.000000
          GRVCON=9.810000
          SIGMA=0.5670000E-11
          TMPZRO=0.000000
      END
      BCD 3ARRAY DATA
: arrays from finite element model functions
          10  $
            0.000000    ,   181.6800    ,   60.00000    ,   181.6800
            120.0000    ,   181.6800    ,   180.0000    ,   181.6800
            240.0000    ,   181.6800    ,   300.0000    ,   181.6800
            360.0000    ,   181.6800    ,   420.0000    ,   181.6800
            480.0000    ,   181.6800    ,   540.0000    ,   181.6800
            600.0000    ,   181.6800    ,   660.0000    ,   181.6800
            720.0000    ,   181.6800    ,   780.0000    ,   181.6800
            840.0000    ,   181.6800    ,   900.0000    ,   181.6800
            960.0000    ,   181.6800    ,   1020.000    ,   181.6800
            1080.000    ,   181.6800    ,   1136.000    ,   181.6800
```