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NOTEBOOK NO. 850
ISSUED TO Goodluck Ofoegbu
ON February 06 **20**07
DEPARTMENT CNWRA
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Initial Entry
By: Goodluck Ofoegbu (Technical Lead)
Date: February 07, 2007

Analysis to Assess Self-Arresting Potential of Thermally Induced Degradation of Emplacement Drifts

The analyses described in this notebook are being performed to address an NRC staff inquiry regarding whether thermally induced drift degradation would self arrest because of changing thermal conditions at the drift roof caused by the degradation. The self arrest would occur if the changing thermal conditions cause thermal stress to decrease below values needed to initiate rock failure. Two effects of drift degradation that may contribute to reduced thermal stress in the drift roof were identified. First, the accumulated rubble may insulate the waste package and reduce the heat flux to the surrounding rock. Second, vertical extension of the drift roof increases the distance between the roof and the heat source, and thus may cause the roof temperature to decrease below values needed to initiate rock failure.

Simplified thermal-hydrological analyses performed by Scott Painter (as documented in CNWRA Scietific Notebook Number 282E, Entry of January 26, 2007) to examine the phenomena indicate temperature at the drift roof may decrease enough to cause a self arrest of thermally induced drift degradation. The analyses, however, were not detailed enough to quantify the amount of degradation prior to any self arrest.

A new set of finite element analyses will be performed as described in this notebook. The objective of the analyses is to quantify the amount and rate of thermally induced degradation of the roof area of emplacement drifts. A finite element model based on the concepts described in figure 1 will be developed to perform a series of iterative thermal and thermomechanical analyses. The emplacement drift will be represented in the model by the octahedron ABCDEFGH; and rock above the emplacement drift that may be subjected to spalling will be discretized into layers labeled b1, b2, b3, etc. (24 such layers are shown in figure 1, but there will be more). For thermal analysis: the heat source will be represented by the red rectangle FGIJ; and in-drift space will be discretized into layers labeled a1, a2, a3, etc., which may represent either air or rubble at various stages of the analysis. The in-drift space a1, a2, etc. will grow as the rock b1, b2, etc. spalls. The model described in figure 1 is part of a larger drift-scale model that extends approximately 700 m vertically from the water table (approximately 350 m below the drift axis) to the ground surface, and 81 m horizontally between adjacent pillar centers. Only half of the horizontal extent will be explicitly included in the model because of an assumed vertical symmetry plane through the drift axis.

Rock temperature, including any effects of drift degradation on temperature, will be calculated in the thermal analysis; whereas rock spallation will be calculated in the thermomechanical analysis. The layers a1, a2, a3, etc. initially will be assigned thermal properties of air with a thermal conductivity suitable to represent radiative heat transfer. At the failure of b1 (from thermomechanical analysis), for example, a1 will be assigned the thermal properties of rubble and b1 (re-designated a6) will be assigned the thermal properties of air. The analysis will proceed iteratively until the thermomechanical analysis indicates no overstress in the drift roof. Both the rate and amount of thermally induced degradation of the drift roof can be calculated from the iterative analysis. The thermal and thermomechanical analyses will be performed using the finite element program ABAQUS, Version 6.6.

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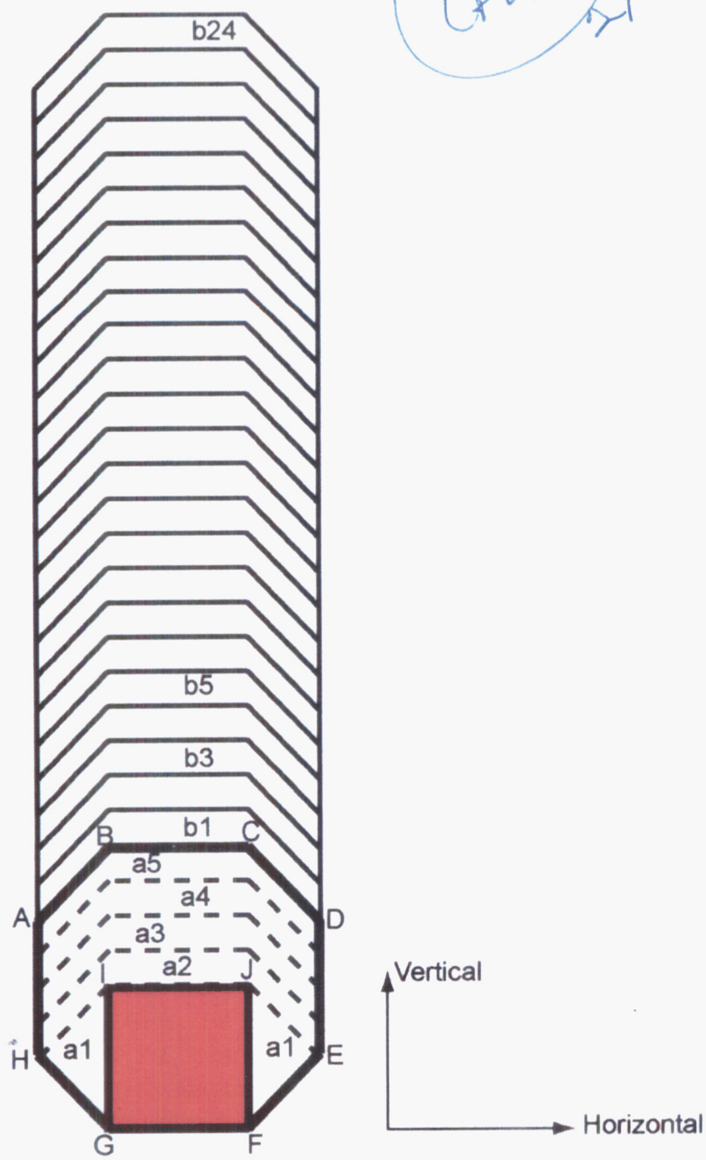

Figure 1. Concepts for A Finite Element Model for Iterative Thermal and Thermomechanical Analyses of Drift Degradation

The following features of the proposed analyses are noted.

1. Thermal analysis will be based on heat conduction with thermal-hydrological effects accounted for using temperature-dependent thermal conductivity (representing coupling of conductivity and saturation) and specific heat (representing latent heat effects). Also, the effects of radiation will be included through an equivalent thermal conductivity assigned to the air layers.

2. Rock bulking (i.e., volumetric bulking of rock after it breaks up to form rubble) will not be included in the model. Excluding bulking from the model is necessary to maintain the same thickness and shape for air, rubble, and rock layers. Therefore, a bulking factor will need to be applied to the calculated amounts of rubble to estimate rubble amounts

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for performance assessment.

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3. Rubble will not be included in the mechanical model because the system is not expected to deform enough to generate any mechanical effect from rubble. Any failed rock will be removed from the mechanical system, thereby increasing the amount of in-drift space.

The following should be factored into any consideration of the potential for self arresting of thermally induced drift degradation.

1. Previous analyses indicate a fraction of drifts would be subjected to overstress in the sidewall that would be persistent for a long time irrespective of thermal loading. The occurrence of overstress in the sidewall indicates potential progressive spallation of the sidewall area and may ultimately cause instability of the roof. Such instability is independent of the roof temperature.

2. The overstress analysis has hitherto been based on comparing the induced stress against the peak strength of the rock. Delayed failure of rock, however, could occur at stresses as low as approximately 60 percent of the peak strength.

3. Seismic ground motions with a peak ground velocity of 20–30 cm/s could cause rock failure, irrespective of DOE analyses that indicate a threshold velocity of 100 cm/s to initiate failure of lithophysal rocks.

Calculations performed as part of the analyses will be documented in this scientific notebook. Entries may be made by any of the following investigators.

Investigator's Name	Initials	Signature
Goodluck Ofoegbu	GAO	[signature]
Roman Kazban	RVK	[signature]

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Material Properties

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Thermal Conductivity of Host Rock

ThermalConductivity (J/s-m-K)	ThermalConductivity (J/yr-m-K)	Temperature (C)	Time (yr)
1.859994222	5.869695E+07	20	0
1.859994222	5.869695E+07	80	0
1.859794635	5.869066E+07	85	0
1.852889835	5.847276E+07	90	0
1.832699848	5.783561E+07	92	0
1.685449662	5.318875E+07	96	0
1.627300152	5.135369E+07	98	0
1.607110165	5.071654E+07	100	0
1.601740141	5.054707E+07	102	0
1.600005778	5.049234E+07	110	0
1.28	4.039373E+07	114	0
1.28	4.039373E+07	120	0
1.28	4.039373E+07	130	0

Thermal Conductivity of Other Materials

ThermalConductivity (J/s-m-K)	ThermalCondtivity (J/yr-m-K)	Material
0.2	6.311520E+06	Rubble
10.0	3.155760E+08	Air
11.1	3.502894E+08	EBS metal

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Specific Heat of Host Rock

Specific heat (J/kg-K)	Temperature (C)	Time (yr)
969	20	0
969	92	0
4741	96	0
4741	112	0
988	116	0
988	120	0

Specific Heat of Other Materials

Material	Specific heat (J/kg-K)
Rubble	Same as host rock
Air	1000
EBS metal	423

Density

Material	Density (kg/m^3)
Host rock	2325
Rubble	2325
Air	1.2
EBS metal	8690

Values of thermal properties and parameters were provided by Scott Painter and Chandrika Manepally based on their thermal-hydrological modeling experience

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These properties will vary with time because of spallation and rubble accumulation. Elements in the drift roof will change property from rock to air to rubble, and in-drift elements will change from air

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to rubble, as the drift roof spalls and rubble accumulates in the drift. The time of change will be calculated from the mechanical model.

Table 3-1. Statistical Description of Unconfined Compressive Strength of Lithophysal Rock Units as a Function of Young's Modulus*			
	Unconfined Compressive Strength (MPa)		
Young's Modulus (GPa)	Lower 95 Percent Confidence Limit	Mean	Upper 95 Percent Confidence Limit
5.0	4.8	13.5	21.5
10.0	7.9	19.1	29.6
15.0	11.1	24.7	37.7
20.0	14.2	30.3	45.8

*Based on data in Bechtel SAIC Company. LLC. "Drift Degradation Analysis." ANL–EBS–MD–000027. Rev 03. Las Vegas, Nevada: Bechtel SAIC Company. LLC. 2004.

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Table from page 3-5 of the report,

Ofoegbu, G., R. Fedors, C. Grossman, S. Hsiung, L. Ibarra, C. Manepally, J. Myers, M. Nataraja, O. Pensado, K. Smart, and D. Wyrick *Revised CNWRA 2006-02, Summary of Current Understanding of Drift Degradation and Its Effects on Performance at a Potential Yucca Mountain Repository.* CNWRA 2006-02 December 2006 San Antonio, TX.: Center for Nuclear Waste Regulatory Analyses: December 2006

The first set of analyses will be performed using Young's Modulus of 20.0 GPa and unconfined compressive strength of 30.3 MPa, which is the mean strength of the highest-grade lithophysal rock (Young's modulus of 20 GPa) as shown in the above table. Information from reference [2] suggests that roof spallation can be expected in emplacement drifts located in this grade of rock.

Reference [2]: Ofoegbu, G.I., B. Dasgupta, and K.J. Smart. "Assessing Effects of Thermal Loading on the Stability of Emplacement Drifts." Proceedings IHLRWM 2006, Las Vegas, NV, April 30 – May 4, 2006. 542–550.

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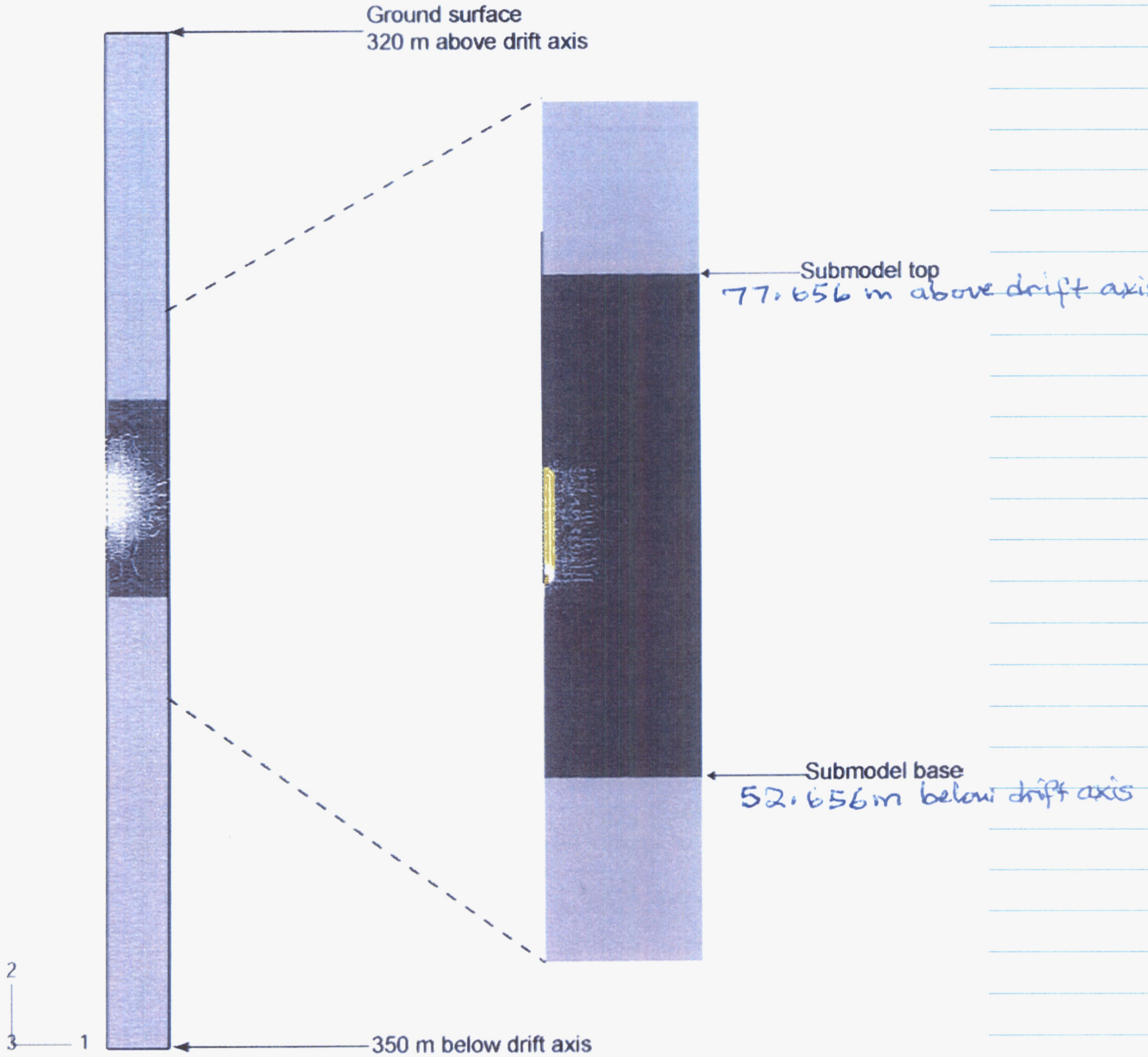
Finite Element Model   Feb 19, 2007



Full Model Geometry

The full model (also referred to as "global model") is a rectangle 670m high and 40.5m wide. The longer dimension is vertical (axis 2) and represents a vertical plane from the water table (350 m below the drift axis) to the ground surface (320 m above the drift axis). Detailed analysis will be performed using a submodel that is a subset of the global model as shown in the figure on page 6.

The thermal boundary ~~and~~ and initial conditions for the global model are

(1) Initial temperature based on the geothermal gradient and surface temperature data as explained on p. 24 of CNWRA Scientific Notebook Number ~~263~~ (initials 2/19/07) 263.

(2) Fixed temperature at the base, calculated using Item 1 information.

(3) Fixed temperature at the ground surface.

(4) Vertical boundaries are zero-flux surfaces based on symmetry (vertical planes through the drift axis and through the middle of the inter-drift pillar).

The mechanical boundary and initial conditions for the global model are

(1) Initial stress is based on a vertical stress gradient of 23.44 MPa/km, which gives a vertical stress of approximately 7.5 MPa at the drift axis; and a horizontal to vertical stress ratio of 0.25 [based on a Poisson's ratio ν of 0.2 using $\nu/(1-\nu)$].

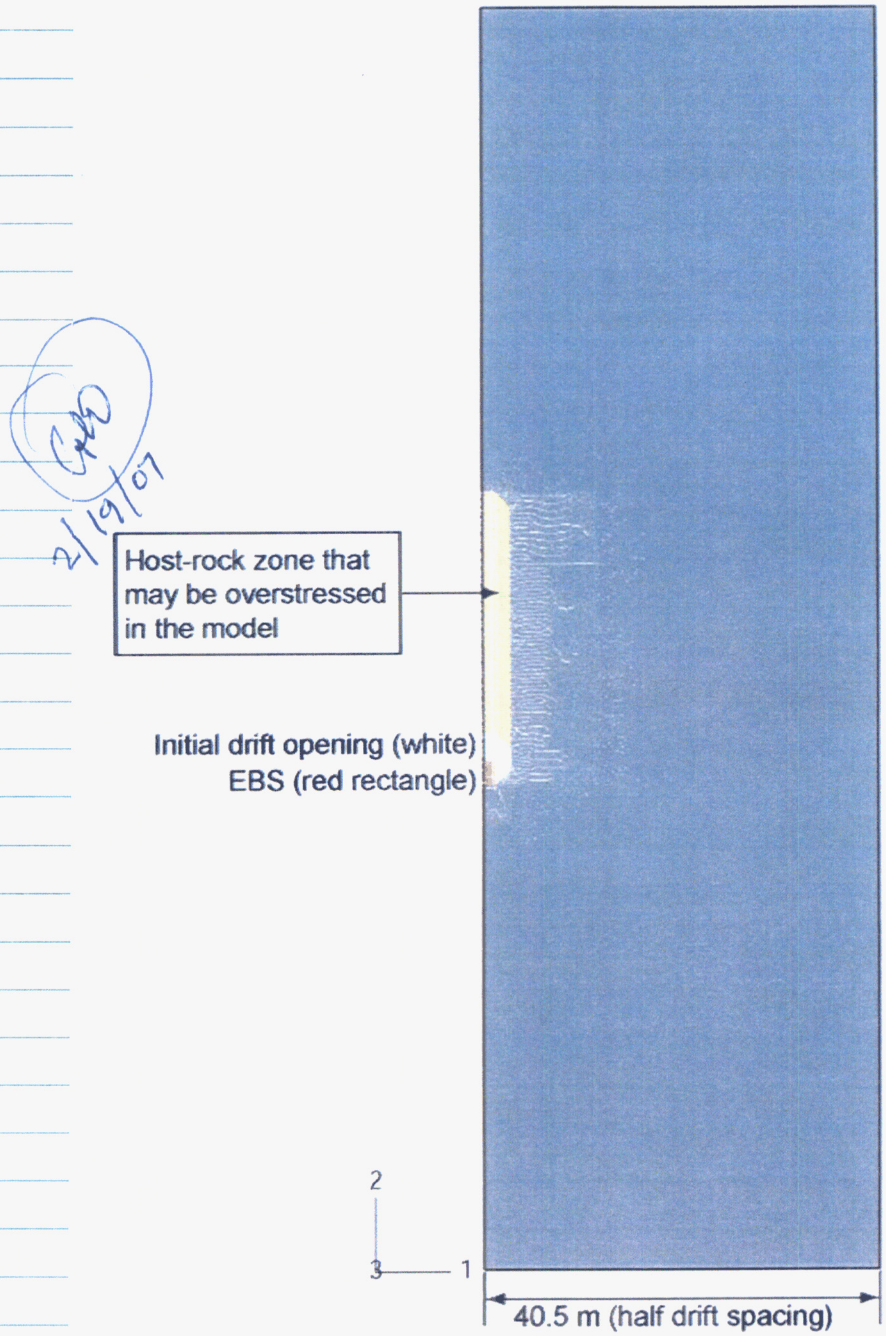
(2) Zero vertical displacement at the base.

(3) Zero horizontal displacement at the vertical boundaries based on symmetry.

(4) Free surface at the ground surface.

The initial conditions and boundary conditions on vertical boundaries of the submodel (figure on p. 6) are the same as for the global model. The temperature history and vertical-displacement history at the top and base boundaries of the submodel are taken from results calculated using the global model.

The submodel geometry is shown in more detail on pages ~~8 and~~ (initials 2/19/07) 8 and 9 ~~9 and~~ (initials 2/19/07). The global model will be used for one thermal and one mechanical analyses to calculate boundary conditions at the top and base of the submodel as explained above. The submodel subsequently



Submodel Geometry

will be used for detailed analysis to calculate progressive spallation.

The red rectangle in the submodel (this page and page 9) represents (half of) the outline of the drip shield. Elements of the red rectangle will be assigned a time-dependent heat source to simulate waste-package heating.

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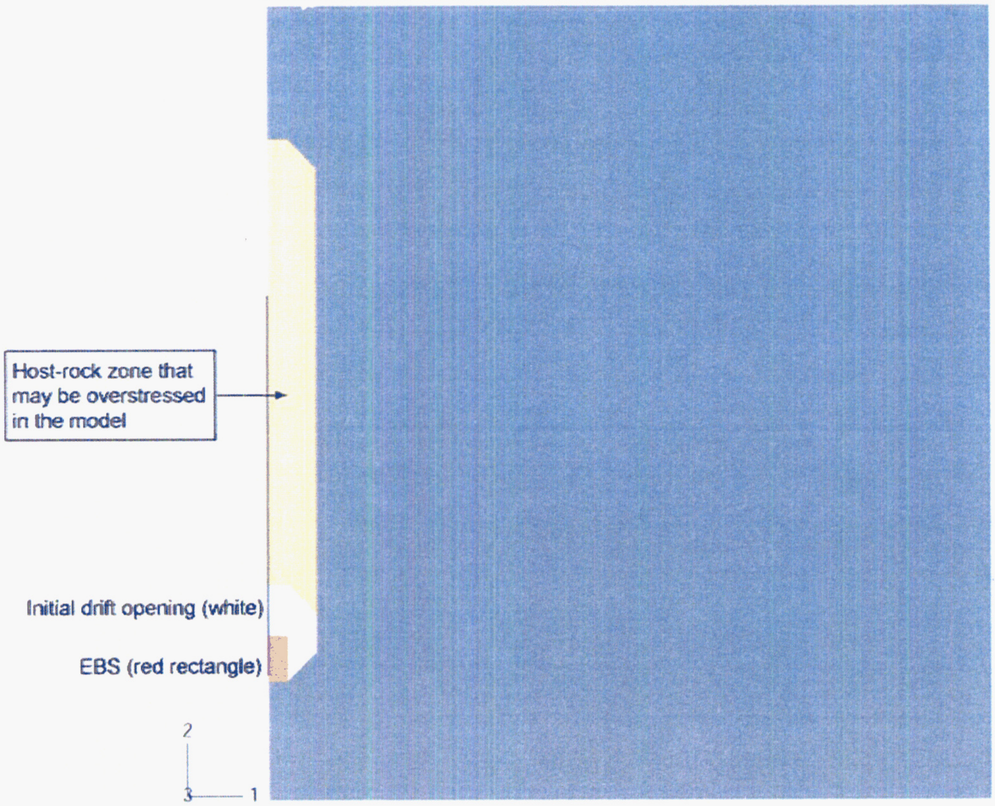

Geometry Details for the Model Active Zone

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The initial in-drift space above and to the sides of the drip shield is represented b the white octahedron (only one-half of the octahed is explicitly included in the model because of symmetr

The part of the host rock within a vertical "chimney-shaped" zone above the drift (see figures on page 8 and this page) will be discretized into layers that can be removed to simulate spallation. Information from reference [2] (page 5 of this notebook) indicates that, for the rock mechanical property set selected on page 5, a thin zone (approximately 20 cm thick) of rock in the roof, covering approximately 25% of the drift perimet will likely experience overstress (stress greater than rock strength) when subjected to drift thermal load. The approach chosen for modelling spallation consists of monitoring the stress evolution in 20-cm thick layers within the chimney-shaped zone in the above figur and removing the overstressed layers, one layer a

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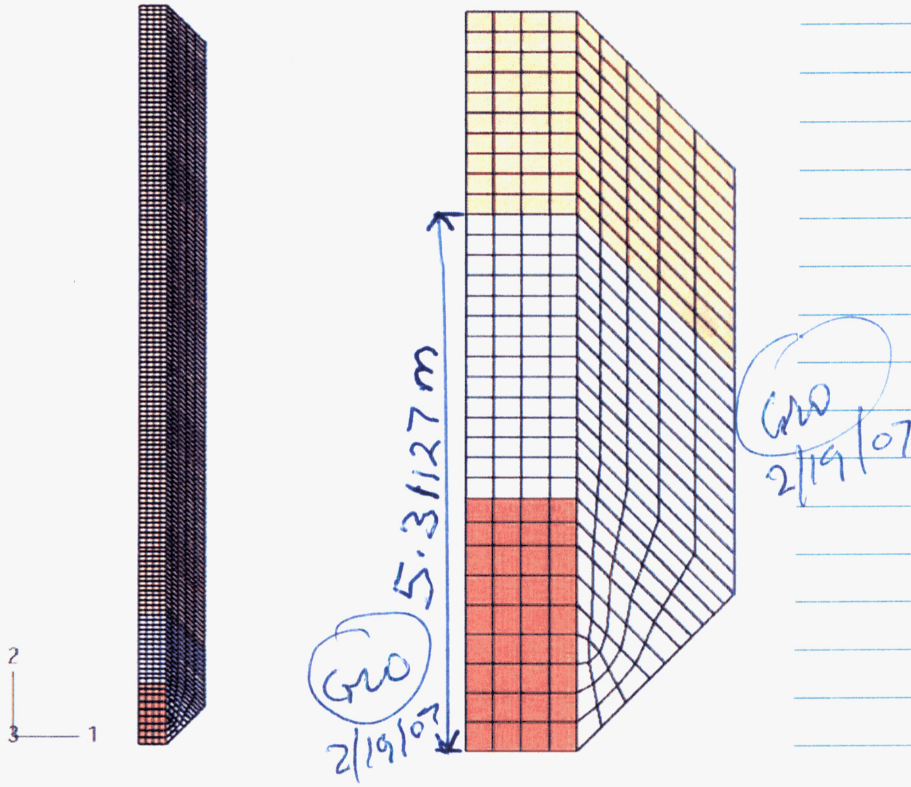

Finite Element Mesh for the Model Active Zone

a time. The finite element model of the in-drift space and overlying chimney-shape zone is shown above. Red elements represent the drip shield and waste package (heat source), white elements represent the initial in-drift space, and the other elements represent rock that may fail by spallation.

Failure of a rock layer by spallation will be determined based on the value of stress-to-strength ratio in the top four (horizontally oriented) elements at the drift roof. The entire layer will be considered to have failed and will be removed if any two of the top four elements develop a stress-to-strength ratio of 1.0 or greater. The calculation of ~~strong~~ GWO 2/19/07 stress-to-strength ratio will be explained subsequently.

The air layers are numbered a001 through ~~a00~~ GWO 2/19/07 a017. Layers a001 through a003 are multilayer zones that occupy the space to the right side of the drip shield elements. Layers a004 through a017 are each an individual layer on

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the top and to the side of the drip shield. Layer a004 is closest to the drip shield, ~~and~~ (GHW 2/19/07) layer a017 is closest to the drift roof, and layers a005 through a016 are in increasing order between a004 and a017. The rock layers that may fail by spallation are numbered b001 through b125, in order with b001 at the drift roof and b125 at the top of the chimney-shaped zone (p. 10).

For the thermal analysis:
(1) the drip shield and waste package elements are assigned the properties of EBS Metal [defined on p. 4]
(2) the air layers are assigned properties of air;
(3) the rock layers are assigned properties of host rock
(4) when a rock layer fails by spallation,
  (4.1) the rock layer is assigned properties of air,
  (4.2) an equivalent ~~rock layer~~ (GHW 2/19/07) air layer or air zone is assigned the properties of rubble
Hence, rock failure by spallation and rubble accumulation in the drift are represented in the thermal analysis

For the mechanical analysis:
(1) all materials (rock, air, and EBS) are initially assigned the rock properties identified on p. 5 and the initial stress ~~defined~~ on p. 7 and the initial stress is statically ~~balanced~~ (GHW 2/19/07) equilibrated against gravitational forces under zero strain,
(2) the EBS and air elements are thereafter removed to simulate drift excavation,
(3) temperature distributions from thermal analysis are imported to every node to calculate thermally induced stresses;
(4) overstressed rock layers in the roof within the chimney-shaped zone (pages 8, 9, and 10) are removed, one layer at a time, to simulate spallation

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Calculation of Overstress — Feb 22, 2007

The Mohr-Coulomb failure criterion defines rock strength in terms of the equation

$$\sigma_1 = q_u + \sigma_3 \tan^2(45° + \phi/2), \quad (1)$$

where σ_1 and σ_3 are the maximum and minimum principal stresses, and ϕ is the friction angle. The unconfined compressive strength, q_u (see table on p. 5), is related to the cohesion parameter, c, and the friction angle through the equation

$$q_u = 2c \tan(45° + \phi/2) \quad (2)$$

Overstress ratio is calculated as σ_1/σ_{LIM}, where σ_{LIM} is the quantity on the right-hand side of Eq. (1). A friction angle of 40° will be used for the calculation based on information in reference [2] (p. 5 of this notebook). An overstress ratio of 1.0 or greater indicates rock subjected to a stress state that would cause instantaneous failure, and a ratio greater than 0.6 but smaller than 1.0 indicates rock that could experience delayed failure, as discussed in more detail on page 4-18 of reference [1] (first reference on p. 5 of this notebook).

The overstress calculation described above will be implemente in the mechanical model using the ABAQUS user subroutine documented below.

```
      SUBROUTINE UVARM(UVAR,DIRECT,T,TIME,DTIME,CMNAME,ORNAME,
     1          NUVARM,NOEL,NPT,LAYER,KSPT,KSTEP,KINC,NDI,NSHR,COORD,
     2          JMAC,JMATYP,MATLAYO,LACCFLA)

      INCLUDE 'ABA_PARAM.INC'
      CHARACTER*80 CMNAME,ORNAME
      CHARACTER*3 FLGRAY(15)
      DIMENSION UVAR(NUVARM),DIRECT(3,3),T(3,3),TIME(2)
      DIMENSION ARRAY(15),JARRAY(15),JMAC(*),JMATYP(*),COORD(*)

      Code MEANHIGHGRADE
          for ABAQUS Version 6.6
          Date:     Feb 13, 2007
          Author:   G.I. Ofoegbu

      Computes rock-load factor (stress/strength ratio)
      using procedure documented in CNWRA Scientific Notebook
      #321, p. 87, and mean strength parameters for high-grade
      lithophysal rock

      Values of principal stress required for the calculation are
      obtained through ABAQUS user-interface subroutine GETVRM

      Externally supplied input parameter:

      FRIC         Friction angle (degrees);
      CPAR         Cohesion parameter (MPa);

      The calculated rock-load factor
      is stored in vector UVAR as follows

      Location in UVAR       Stored Variable
      ----------------       ---------------
            1                load factor at current time

      TOTIME = TIME(2)
      ZTIME = 2.0E-6
      IF (TOTIME .LT. ZTIME) THEN
        UVAR(1) = 0.0
        RETURN
      ENDIF
C
      FRIC = 40.0
      CPAR = 7.06
C
      PI = 3.141592654
      ALPHA = PI/4.0 + (FRIC/2.0)*(PI/180.0)
      TA = DTAN(ALPHA)
C     Obtain current values of principal stress compone
C
      JRCD = 0
      CALL GETVRM('SP',ARRAY,JARRAY,FLGRAY,JRCD,JMAC,JM
     1          MATLAYO,LACCFLA)
C     IF (JRCD .NE. 0) THEN
C       WRITE(6,1000) NOEL,NPT,TIME(2)
C       RETURN
C     END IF
C
      PSMAX = -ARRAY(1)
      PSMIN = -ARRAY(3)
      UVAR(1) = PSMAX/(2.0*CPAR*TA + PSMIN*TA*TA)
      RETURN
C
C----67--1---------2---------3---------4---------5----
C
 1000 FORMAT(/,'ERROR IN UVARM-CALL FOR VARIABLE PE',/
     1        10X,'FOR ELEMENT NUMBER = ',I5,/,
     2        10X,'INTEGRATION POINT  = ',I5,/,
     3        10X,'AT TIME            = ',E12.3)
      END
```

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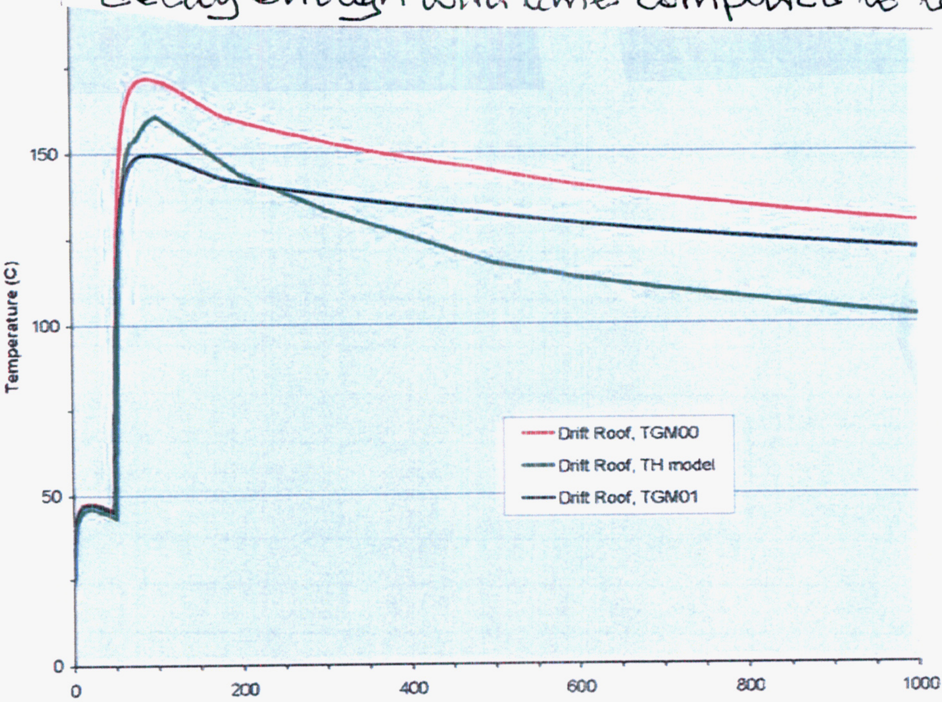
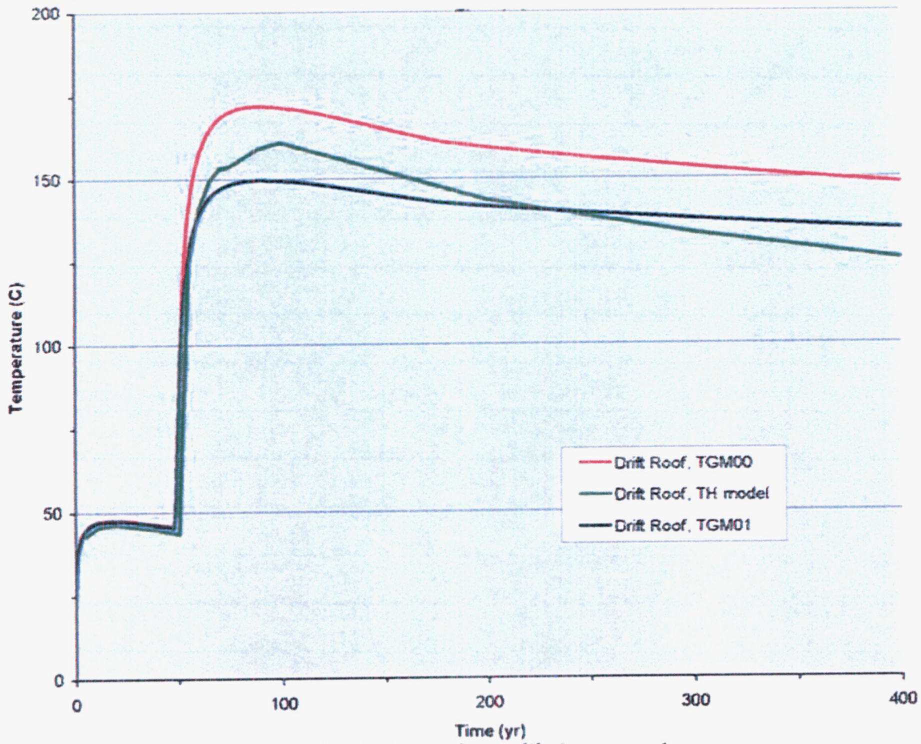
Change of Rock Thermal Conductivity Model   Feb 23, 2007

Temperature at drift wall calculated using heat conduction only does not decay enough with time compared to temperature (at driftwall) calculated from thermal hydrology. The plot on the left compares conduction-only temperature with thermal-hydrology temperature. Model TGM00 used the rock thermal conductivity on p. 4 whereas model TGM01 a constant thermal conductivity of ~1.86 W/m-K (compare with information on p. 4). Model TGM01 will be used for subsequent calculation but will be limited to times shorter than 400 years. (see lower-left plot)





TGM00: Thermal conductivity varies with temperature
TGM01: Constant thermal conductivity

Figure 5 Driftwall Temperature Histories for Inctact Drift Case

From: Scott Painter [mailto:spainter@cnwra.swri.edu]
Sent: Friday, February 16, 2007 5:07 PM
To: Goodluck Ofoegbu
Subject: temperature (C) versus Time (years)

Temperatures from thermal-hydrology calculation by S. Painter

5	43.01374333315806
10	45.345000000000006
15	46.21030624204638
20	46.27817563726818
25	46.01061530256914
30	45.57216436311962
35	45.18713387691777
40	44.795187489414126
50	43.541999999999994
55	125.27
60	140.67000000000002
65	149.20251386156949
70	153.13000000000002
75	153.78291917991382
80	155.64381604272003
85	157.68
90	159.27741624125176
95	160.16736383070605
100	160.81
100	160.81
200	143.44222403371006
300	133.27455292517115
400	125.45218855778543
500	117.60999999999999
600	113.30919625633148
700	110.12140399269924
800	107.36976779671096
900	104.51963468346824
1000	102.22

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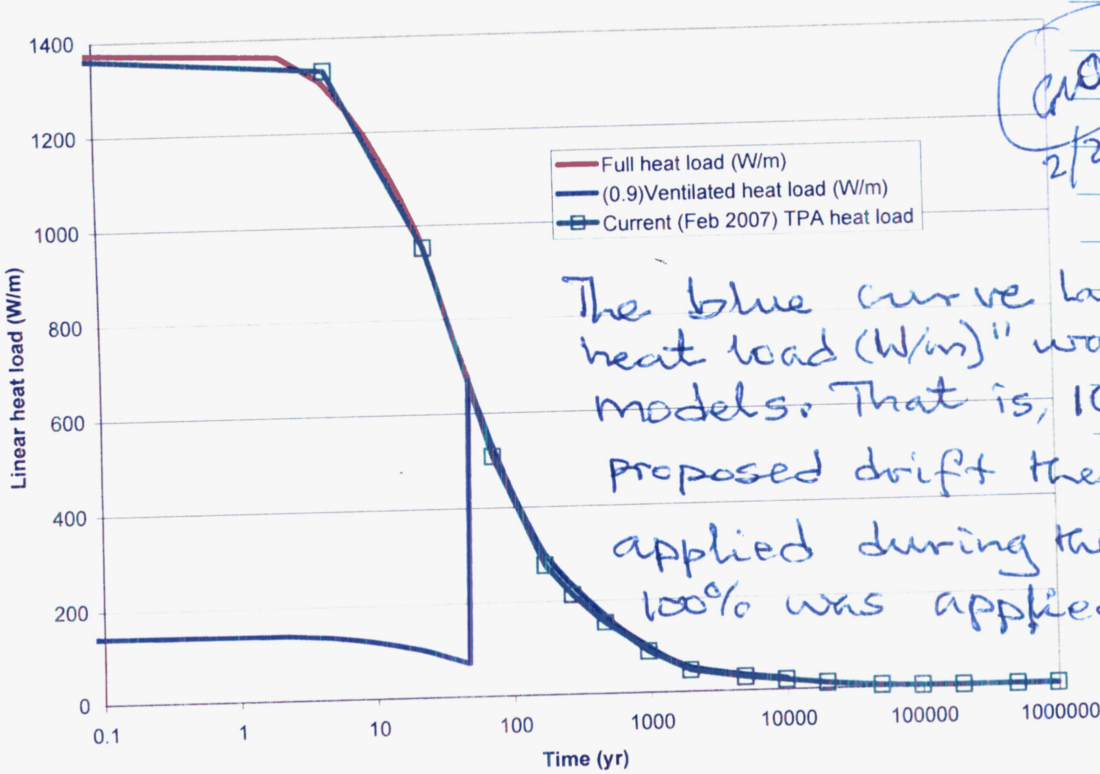
Thermal Load Description February 26, 2007

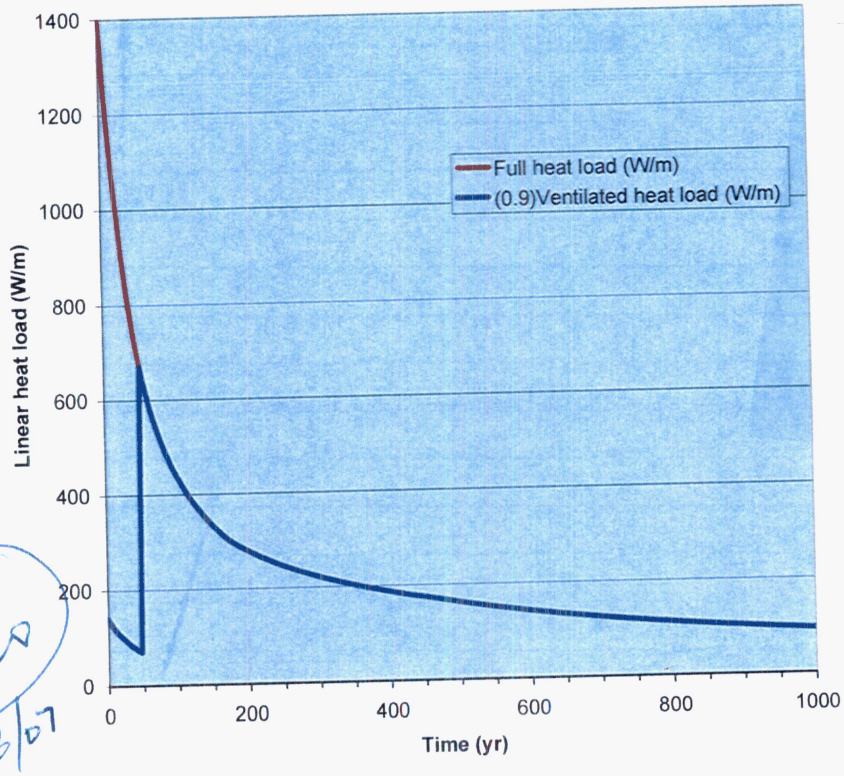
The thermal load used for the models is the same as was described in CNWRA Scientific Notebook Number 633 (pp. 4-5 and 47). The thermal load compares well with the thermal load used ~~in~~ the NRC Total System Performance Assessment code (TPA) as shown the sketch below.



CWO 2/26/07

The blue curve labeled "(0.9)Ventilated heat load (W/m)" was used in the models. That is, 10% of the proposed drift thermal load was applied during the first 50 yrs and 100% was applied thereafter.

Full-model (described on p. 6) analyses ~~were~~ CWO 2/26/07 will be performed for 1000 years, but Submodel (p. 6) analyses will be performed for 250 years. The heat load used for the analyses is shown above and replotted in time scales (instead of log-time scale) CWO 2/26/07 and shown on p. 15. In each plot, the red curve labeled "Full heat load (W/m)" shows the proposed drift thermal load for a potential Yucca Mountain repository. The blue curve, which shows a step increase at 50 years, was used for analyses. The blue curve shows the proposed



drift thermal load with the effects of a proposed forced-ventilation design accounted for by using only 10% of the thermal load during the first 50 years. it is assumed that 90% of the thermal load during the first 50 yrs would be removed through forced ventilation.

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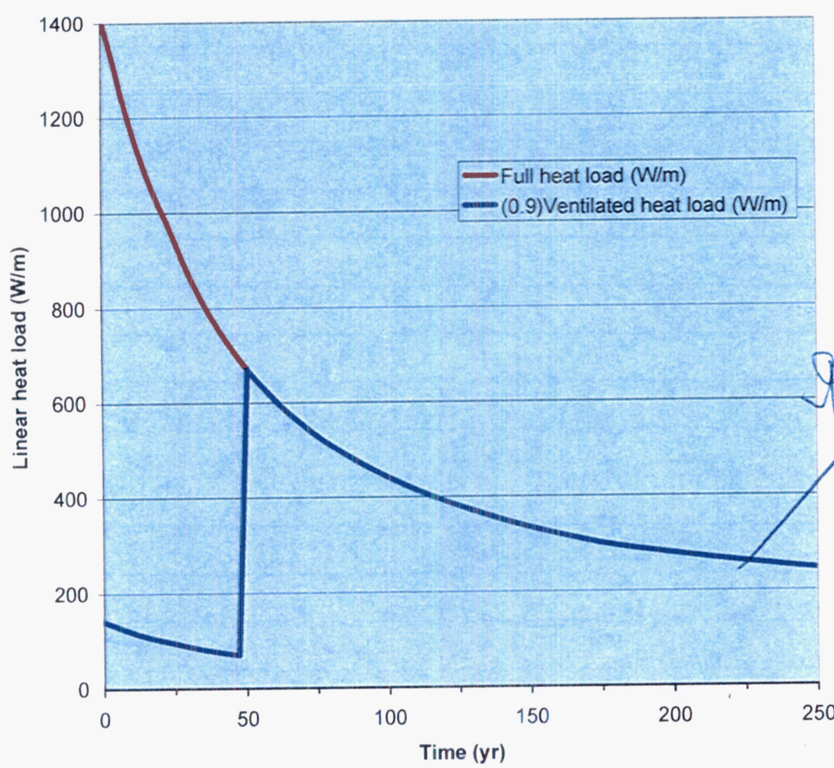

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Input Files February 26, 2007

Add | /array/GOfoegbu/TM2007/FullModel

Remote Name	Size	Type	Modified	Attributes
DrftSrc.def	4,323	DEF File	02/27/2007 03:38:...	-rw-r--r--
gmInitemp.def	720,068	DEF File	02/27/2007 03:22:...	-rw-r--r--
gmMatAssignment.def	179	DEF File	02/14/2007 02:00:...	-rw-r--r--
gmNodes.def	1,826,016	DEF File	02/27/2007 02:02:...	-rw-r--r--
gmNodeSets.def	19,805	DEF File	02/27/2007 02:53:...	-rw-r--r--
MeanHighGrade.f	2,161	F File	02/13/2007 02:27:...	-rw-r--r--
mElements.def	730,291	DEF File	02/15/2007 09:01:...	-rw-r--r--
mgm01.inp	7,767	INP File	02/27/2007 02:55:...	-rw-r--r--
mgm_Elements.def	540,179	DEF File	02/27/2007 02:24:...	-rw-r--r--
mMatAssignment.def	1,712	DEF File	02/22/2007 01:23:...	-rw-r--r--
mMaterials.def	542	DEF File	02/22/2007 01:23:...	-rw-r--r--
tBaseMatAssignment.def	1,537	DEF File	02/27/2007 02:34:...	-rw-r--r--
tBaseMaterials.def	552	DEF File	02/27/2007 02:36:...	-rw-r--r--
tElements.def	730,290	DEF File	02/15/2007 08:52:...	-rw-r--r--
tgm01.inp	6,873	INP File	02/27/2007 02:32:...	-rw-r--r--
tgm_Elements.def	540,176	DEF File	02/27/2007 02:11:...	-rw-r--r--

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The input files for the global model are listed above. The analysis input files

mgm01.inp Mechanical analysis, and
tgm01.inp Thermal analysis

pull in the other files using the ABAQUS "*include" statement.

The input files for the submodel thermal and mechanical analyses are listed on p. 17. The analysis files

ddtherm.inp Thermal analysis
ddmech.inp Mechanical analysis

pull in the other files using the "*include" statement.

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Book No.

Add /array/GOfoegbu/TM2007/Thermal

Remote Name	Size	Type	Modified	Attributes
ddtherm.fil	165,140,...	FIL File	02/23/2007 02:53:...	-rw-r--r--
ddtherm.inp	6,879	INP File	02/23/2007 02:53:...	-rw-r--r--
DrftSrc.def	4,323	DEF File	02/15/2007 05:34:...	-rw-r--r--
smInitemp.def	404,315	DEF File	02/27/2007 03:25:...	-rw-r--r--
smNodes.def	1,039,233	DEF File	02/22/2007 08:43:...	-rw-r--r--
smNodeSets.def	7,771	DEF File	02/22/2007 08:44:...	-rw-r--r--
t0Materials.def	754	DEF File	02/14/2007 02:03:...	-rw-r--r--
tElements.def	730,290	DEF File	02/15/2007 08:52:...	-rw-r--r--
tMatAssignment.def	1,834	DEF File	02/23/2007 01:38:...	-rw-r--r--
tMatAssignment01.def	1,535	DEF File	02/14/2007 02:20:...	-rw-r--r--
tMaterials.def	1,595	DEF File	02/23/2007 02:22:...	-rw-r--r--
tMaterials01.def	552	DEF File	02/19/2007 03:41:...	-rw-r--r--

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Add /array/GOfoegbu/TM2007/Mech

Remote Name	Size	Type	Modified	Attributes
ddmech.inp	7,100	INP File	02/23/2007 03:30:...	-rw-r--r--
ddtherm.fil	165,140,...	FIL File	02/23/2007 02:53:...	-rw-r--r--
MeanHighGrade.f	2,161	F File	02/13/2007 02:27:...	-rw-r--r--
mElements.def	730,291	DEF File	02/15/2007 09:01:...	-rw-r--r--
mMatAssignment.def	1,712	DEF File	02/22/2007 01:23:...	-rw-r--r--
mMaterials.def	542	DEF File	02/22/2007 01:23:...	-rw-r--r--
smInitemp.def	404,315	DEF File	02/27/2007 03:25:...	-rw-r--r--
smNodes.def	1,039,233	DEF File	02/22/2007 08:43:...	-rw-r--r--
smNodeSets.def	7,771	DEF File	02/22/2007 08:44:...	-rw-r--r--

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Submodel analysis input file ddtherm.inp reproduced on p. 18–22, thermal properties definit file tMaterials.def on p. 23–24, and thermal propert assignment file tMatAssignment.def on p. 25.

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ddtherm.inp **Page 1**

```
*Heading
 Thermal analysis submodel ddtherm
**
** Thermal load (defined through DrftSrc.def)
** includes 10% of drift thermal load during the first 50 yrs and
** 100% of the drift thermal load thereafter
** 90% of the thermal load during first 50 yrs is assumed removed
** through ventilation
**
** See CNWRA Scientific Notebook Number 850 for more model information
**
** Calculate temperature distribution for thermal-mechanical analysis
** based on heat conduction with thermal properties modified to account
** for thermal-hydrological effects
**
** Model modified with time to account for change in drift configuration
** owing to thermally induced spallation of the drift roof
**
** This model (the submodel) takes its top and base boundary
** temperature histories from a larger model (global model)
**
***
*** Node Definitions
***
*Include, input=smNodes.def
*Include, input=smNodeSets.def
*Nset, nset=histNodes
245, 643, 256, 699
***
*** Element Definitions
***
*Include, input=tElements.def
***
*** Submodel specification
***
*Submodel
top_submodel, base_submodel,
***
*** Material property assignments and definitions
***
*Include, input=tMatAssignment.def
*Include, input=tMaterials.def
***
*** Initial conditions
*** HeatSource definition
***
*Initial condition, type=temperature, input=smInitemp.def
*Initial condition, type=field, variable=1
allnodes, 0.0
*Amplitude,name=HeatSrc,time=totaltime,input=DrftSrc.def
*Amplitude,name=theTime,time=totaltime
0.0, 0.0, 1000.0, 1000.0
***
** ---------------------------------------------------------------
**
** Step 1: Initial state
**
*Step, name="Initial State"
Initial thermal equilibrium state
*Heat Transfer, end=PERIOD, deltmx=10.
2.0e-6, 2.0e-6
**
** BOUNDARY CONDITIONS
**
*Boundary, step=1, submodel
```

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Re

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```
base_submodel, 11, 11
top_submodel, 11, 11
***
*** Define field variable that holds value of total time
***
*Field, variable=1, amplitude=theTime
allnodes, 1.0
**
** OUTPUT REQUESTS
**
*Restart, write, frequency=999999
**
** FIELD OUTPUT: F-Output-1
**
*Output, field, frequency=999999
*Node Output, nset=allnodes
NT,
**
** HISTORY OUTPUT: H-Output-1
**
*Output, history, frequency=1
*Node output, nset=histNodes
NT,
*El Print, freq=0
*Node Print, freq=0
*Node file, nset=allnodes, frequency=1
NT,
*End Step
**
** ----------------------------------------------------------------
**
** STEP 2: Thermal loading, time 0-25 yr
**
*Step, name="Thermal time 0-25 yr", inc=10000, amplitude=step
Apply thermal loading
*Heat Transfer, end=PERIOD, deltmx=10.
0.1, 25.0, 0.00015, 0.5,
**
** BOUNDARY CONDITIONS
**
*Boundary, step=2, submodel
base_submodel, 11, 11
top_submodel, 11, 11
***
*** Define field variable that holds value of total time
***
*Field, variable=1, amplitude=theTime
allnodes, 1.0
**
** LOADS
**
*Dflux, amplitude=HeatSrc
ebs, BF, 1.0
**
** OUTPUT REQUESTS
**
*Restart, write, frequency=999999
**
** FIELD OUTPUT: F-Output-1
**
*Output, field, frequency=999999
*Node Output, nset=allnodes
NT,
**
** HISTORY OUTPUT: H-Output-1
```

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```
**
*Output, history, frequency=1
*Node output, nset=histNodes
NT,
*El Print, freq=0
*Node Print, freq=0
*Node file, nset=allnodes, frequency=1
NT,
*End Step
**
** ----------------------------------------------------------------
**
** STEP 3: Thermal loading, time 25-50 yr
**
*Step, name="Thermal time 25-50 yr", inc=10000, amplitude=step
Apply thermal loading
*Heat Transfer, end=PERIOD, deltmx=10.
0.5, 25.0, 0.00015, 1.0,
**
** BOUNDARY CONDITIONS
**
*Boundary, step=3, submodel
base_submodel, 11, 11
top_submodel, 11, 11
***
*** Define field variable that holds value of total time
***
*Field, variable=1, amplitude=theTime
allnodes, 1.0
**
** LOADS
**
*Dflux, amplitude=HeatSrc
ebs, BF, 1.0
**
** OUTPUT REQUESTS
**
*Restart, write, frequency=999999
**
** FIELD OUTPUT: F-Output-1
**
*Output, field, frequency=999999
*Node Output, nset=allnodes
NT,
**
** HISTORY OUTPUT: H-Output-1
**
*Output, history, frequency=1
*Node output, nset=histNodes
NT,
*El Print, freq=0
*Node Print, freq=0
*Node file, nset=allnodes, frequency=1
NT,
*End Step
**
** ----------------------------------------------------------------
**
** STEP 4: Thermal loading, time 50-100 yr
**
*Step, name="Thermal time 50-100 yr", inc=10000, amplitude=step
Apply thermal loading
*Heat Transfer, end=PERIOD, deltmx=10.
1.0, 50., 0.00015, 1.0,
**
```

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ddtherm.inp

```
** BOUNDARY CONDITIONS
**
*Boundary, step=4, submodel
base_submodel, 11, 11
top_submodel, 11, 11
***
*** Define field variable that holds value of total time
***
*Field, variable=1, amplitude=theTime
allnodes, 1.0
**
** LOADS
**
*Dflux, amplitude=HeatSrc
ebs, BF, 1.0
**
** OUTPUT REQUESTS
**
*Restart, write, frequency=999999
**
** FIELD OUTPUT: F-Output-1
**
*Output, field, frequency=999999
*Node Output, nset=allnodes
NT,
**
** HISTORY OUTPUT: H-Output-1
**
*Output, history, frequency=1
*Node output, nset=histNodes
NT,
*El Print, freq=0
*Node Print, freq=0
*Node file, nset=allnodes, frequency=1
NT,
*End Step
**
** ----------------------------------------------------------------
**
** STEP 5: Thermal loading, time 100-101 yr
**
*Step, name="Thermal time 100-101 yr", inc=10000, amplitude=step
Apply thermal loading
*Heat Transfer, end=PERIOD, deltmx=10.
0.05, 1.0, 0.00015, 0.1,
**
** BOUNDARY CONDITIONS
**
*Boundary, step=5, submodel
base_submodel, 11, 11
top_submodel, 11, 11
***
*** Define field variable that holds value of total time
***
*Field, variable=1, amplitude=theTime
allnodes, 1.0
**
** LOADS
**
** Name: Load-1   Type: Body heat flux
*Dflux, amplitude=HeatSrc
ebs, BF, 1.0
**
** OUTPUT REQUESTS
**
```

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This step includes material property change for
Layer b001: rock to air
Layer a001: air to rubble
See material property files on p. 23-24 for more information.

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```
*Restart, write, frequency=999999
**
** FIELD OUTPUT: F-Output-1
**
*Output, field, frequency=999999
*Node Output, nset=allnodes
NT,
**
** HISTORY OUTPUT: H-Output-1
**
*Output, history, frequency=1
*Node output, nset=histNodes
NT,
*El Print, freq=0
*Node Print, freq=0
*Node file, nset=allnodes, frequency=1
NT,
*End Step
**
** ----------------------------------------------------------------
**
** STEP 6: Thermal loading, time 101-250 yr
**
*Step, name="Thermal time 101-250 yr", inc=10000, amplitude=step
Apply thermal loading
*Heat Transfer, end=PERIOD, deltmx=10.
0.5, 149., 0.00015, 2.0,
**
** BOUNDARY CONDITIONS
**
*Boundary, step=5, submodel
base_submodel, 11, 11
top_submodel, 11, 11
***
*** Define field variable that holds value of total time
***
*Field, variable=1, amplitude=theTime
allnodes, 1.0
**
** LOADS
**
** Name: Load-1   Type: Body heat flux
*Dflux, amplitude=HeatSrc
ebs, BF, 1.0
**
** OUTPUT REQUESTS
**
*Restart, write, frequency=999999
**
** FIELD OUTPUT: F-Output-1
**
*Output, field, frequency=999999
*Node Output, nset=allnodes
NT,
**
** HISTORY OUTPUT: H-Output-1
**
*Output, history, frequency=1
*Node output, nset=histNodes
NT,
*El Print, freq=0
*Node Print, freq=0
*Node file, nset=allnodes, frequency=1
NT,
*End Step
```

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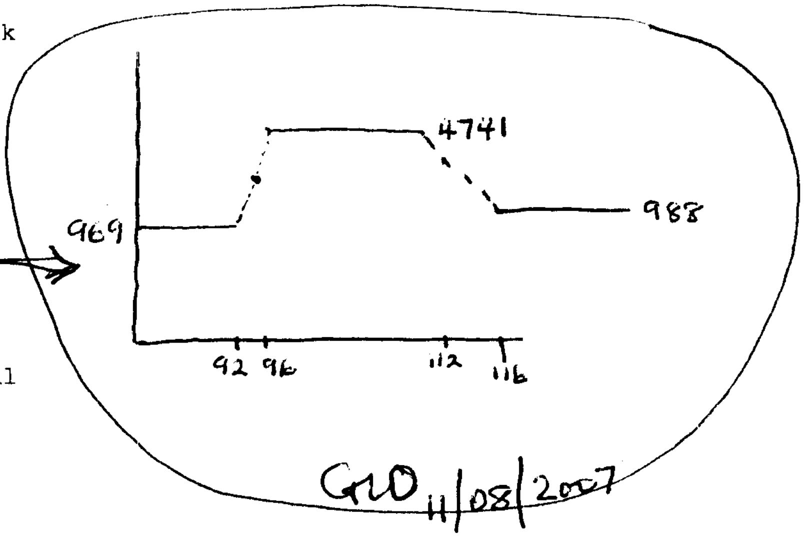
tMaterials.def **Page 1**

```
***
*** Thermal Material Definitions
*** To be expanded as rock layers fail
***
*** Thermal conductivity        J/(yr-m-K)
*** Density                     kg/m^3
*** Specific heat               J/(kg-K)
***
*Material, name=hostrock
*Conductivity
5.869695E7,
*Density
2325.
*Specific Heat
 969.0,   0.0
 969.0,  92.0
4741.0,  96.0
4741.0, 112.0
 988.0, 116.0
 988.0, 150.0
***
*Material, name=ebsmetal
*Conductivity
3.502894E8,
*Density
8690.
*Specific Heat
423.,
***
*Material, name=air
*Conductivity
3.155760E8,
*Density
1.2
*Specific heat
1000.0,
***                       Layer b001, rock to air
*Material, name=b001mat
*Conductivity, dependencies=1
5.869695E7, 25.0,   0.0
5.869695E7, 25.0, 100.0
3.155760E8, 25.0, 101.0
*Density, dependencies=1
2325.0, 25.0,   0.0
2325.0, 25.0, 100.0
1.2,    25.0, 101.0
*Specific Heat, dependencies=1
 969.0,   0.0,   0.0
 969.0,  92.0,   0.0
4741.0,  96.0,   0.0
4741.0, 112.0,   0.0
 988.0, 116.0,   0.0
 988.0, 150.0,   0.0
 969.0,   0.0, 100.0
 969.0,  92.0, 100.0
4741.0,  96.0, 100.0
4741.0, 112.0, 100.0
 988.0, 116.0, 100.0
 988.0, 150.0, 100.0
1000.0,   0.0, 101.0
1000.0, 150.0, 101.0
***                       Layer a001, air to rubble
*Material, name=a001mat
*Conductivity, dependencies=1
3.155760E8, 25.0,   0.0
```



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Thermal properties of layer b001 change from "rock" at time 100 to "air" at time 101.

Also below and on p. 23, the thermal properties of layer a001 change from "air" at time 100 to "rubble" at time 101.

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tMaterials.def

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```
3.155760E8, 25.0, 100.0
6.311520E6, 25.0, 101.0
*Density, dependencies=1
1.2,    25.0,   0.0
1.2,    25.0, 100.0
2325,   25.0, 101.0
*Specific heat, dependencies=1
1000.0, 25.0,    0.0
1000.0, 25.0,  100.0
 969.0,   0.0, 101.0
 969.0,  92.0, 101.0
4741.0,  96.0, 101.0
4741.0, 112.0, 101.0
 988.0, 116.0, 101.0
 988.0, 150.0, 101.0
```

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Files tMaterials.def and tMatAssignment.def need to be modified to include changes caused by spallation and rubble accumulation. Examples for b001 (spallation) and a001 (rubble accumulation) are shown. Input file ddtherm.inp also has to be modified to include analysis steps that account for the material changes.

Recorded by: Date Verified by: Date

tMatAssignment.def **Page 1**

```
***
*** Thermal property assignment to elements
*** Will be modified as rock layers fail
***
*** Element set rocklayers includes all host rock layers
*** that have not failed. To be modified as
*** as rock layers fail
***
*Elset, elset=rocklayers
b125,   b124,   b123,   b122,   b121,   b120,   b119,   b118
b117,   b116,   b115,   b114,   b113,   b112,   b111,   b110
b109,   b108,   b107,   b106,   b105,   b104,   b103,   b102
b101,   b100,   b099,   b098,   b097,   b096,   b095,   b094
b093,   b092,   b091,   b090,   b089,   b088,   b087,   b086
b085,   b084,   b083,   b082,   b081,   b080,   b079,   b078
b077,   b076,   b075,   b074,   b073,   b072,   b071,   b070
b069,   b068,   b067,   b066,   b065,   b064,   b063,   b062
b061,   b060,   b059,   b058,   b057,   b056,   b055,   b054
b053,   b052,   b051,   b050,   b049,   b048,   b047,   b046
b045,   b044,   b043,   b042,   b041,   b040,   b039,   b038
b037,   b036,   b035,   b034,   b033,   b032,   b031,   b030
b029,   b028,   b027,   b026,   b025,   b024,   b023,   b022
b021,   b020,   b019,   b018,   b017,   b016,   b015,   b014
b013,   b012,   b011,   b010,   b009,   b008,   b007,   b006
b005,   b004,   b003,   b002
***b005,   b004,   b003,   b002,   b001
*Elset, elset=airlayers
a017, a016, a015, a014, a013, a012, a011, a010
a009, a008, a007, a006, a005, a004, a003, a002
***a001
***
*** Property assignments
***
*** Host rock zones
*Solid Section, elset=rocklayers, material=hostrock
1.,
*SOLID SECTION, ELSET=rock_top, MATERIAL=hostrock
1.,
*SOLID SECTION, ELSET=rock_mid, MATERIAL=hostrock
1.,
*SOLID SECTION, ELSET=rock_bottom, MATERIAL=hostrock
1.,
*** Air zones
*Solid Section, elset=airlayers, material=air
1.,
*** EBS metal zones
*Solid Section, elset=ebs, material=ebsmetal
1.0,
***
*** Property changes to account for rock spallation and rubble
*** accumulation
***
*** b001     rock to air      100-101 yr
*** a001     air to rubble    100-101 yr
***
*Solid Section, elset=b001, material=b001mat
*Solid Section, elset=a001, material=a001mat
```

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ddmech.inp **Page 1**

```
*Heading
 Thermal-mechanical analysis submodel ddmech
**
** Temperature distribution from thermal model ddtherm
**    10% of heat load applied for 50 yr;
**    100% thereafter, to 1000 yr
**
** See CNWRA Scientific Notebook Number 850 for more model information
**
** This model (the submodel) takes its top and base boundary
** displacement histories from a larger model (global model)
**
** Linear-elastic analysis
** Stress distributions post-processed to calculate
**   stress/strength ratio distributions
**
** Elastic stiffness:    High-grade lithophysal rock
** Strength:             Mean strength of high-grade lithophysal rock
** Young's modulus:   2.0E4 MPa
** Friction angle:    40 degrees
** Cohesion:          7.06 MPa
***
*** Node Definitions
***
*Include, input=smNodes.def
*Include, input=smNodeSets.def
***
*** Element Definitions
***
*Include, input=mElements.def
*Elset, elset=histElements, gen
3917, 3920, 1
3908, 3911, 1
***3899, 3902, 1
***
*** Submodel specification
***
*Submodel
top_submodel, base_submodel,
***
*** Material property assignments and definitions
***
*Include, input=mMatAssignment.def
*Include, input=mMaterials.def
**
** BOUNDARY CONDITIONS
**
*Boundary
left_submodel, 1, 1
right_submodel, 1, 1
***
*** Initial conditions
***
*Initial condition, type=temperature, input=smInitemp.def
*Initial condition, type=stress, geostatic
ebs,              0.0, 347.5, -15.7048, -322.5, 0.25, 0.25
airlayers,        0.0, 347.5, -15.7048, -322.5, 0.25, 0.25
rocklayers,       0.0, 347.5, -15.7048, -322.5, 0.25, 0.25
rock_top,         0.0, 347.5, -15.7048, -322.5, 0.25, 0.25
rock_mid,         0.0, 347.5, -15.7048, -322.5, 0.25, 0.25
rock_bottom,      0.0, 347.5, -15.7048, -322.5, 0.25, 0.25
***
** ---------------------------------------------------------------
**
** STEP 1: Init Static Equilibrium
```

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```
**
*Step, name="Init Static Equilibrium", amplitude=STEP
Initial Static Equilibrium
*Static
1.0E-6,1.0E-6
**
** BOUNDARY CONDITIONS
**
*Boundary, step=1, submodel
base_submodel, 2, 2
top_submodel, 2, 2
**
** LOADS
**
** Vertical Body Force (MN/m3)   Type: Body force
*Dload
ebs,              BY, -0.02344
airlayers,        BY, -0.02344
rocklayers,       BY, -0.02344
rock_top,         BY, -0.02344
rock_mid,         BY, -0.02344
rock_bottom,      BY, -0.02344
**
** OUTPUT REQUESTS
**
*Restart, write, frequency=9999
**
** FIELD OUTPUT: F-Output-2
**
*Output, field, frequency=99999
*Element Output
S,UVARM
*Node Output
U
*Output, history, frequency=1
*Element Output, elset=histElements
UVARM
*Node file, freq=0
*El Print, freq=0
*Node Print, freq=0
*End Step
** ----------------------------------------------------------------
**
** STEP 2: End Excavation
**
*Step, name="End Excavation"
End of drift excavation
*Static
1.0E-6,1.0E-6
**
** BOUNDARY CONDITIONS
**
*Boundary, step=2, submodel
base_submodel, 2, 2
top_submodel, 2, 2
**
*Model change, remove
ebs,airlayers,
**
** OUTPUT REQUESTS
**
*Restart, write, frequency=9999
**
** FIELD OUTPUT: F-Output-2
**
```

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```
*Output, field, frequency=99999
*Element Output
S,UVARM
*Node Output
U
*Output, history, frequency=1
*Element Output, elset=histElements
UVARM
*Node file, freq=0
*El Print, freq=0
*Node Print, freq=0
*End Step
** ----------------------------------------------------------------
**
** STEP 3: Thermal-Loaded (End of excavation to 25 yr)
**
*Step, name="Thermal time 0-25 yr", amplitude=step, inc=10000
Apply temperature history
*Static
0.01, 25.0, 0.0015, 0.5
**
** BOUNDARY CONDITIONS
**
*Boundary, step=3, submodel
base_submodel, 2, 2
top_submodel, 2, 2
**
** FIELDS
** Temperature distributions from thermal analysis
**
*Temperature, file=ddtherm, bstep=2, estep=2
**
** OUTPUT REQUESTS
**
*Restart, write, frequency=9999
**
** FIELD OUTPUT: F-Output-2
**
*Output, field, frequency=99999
*Element Output
S,UVARM
*Node Output
U
*Output, history, frequency=1
*Element Output, elset=histElements
UVARM
*Node file, freq=0
*El Print, freq=0
*Node Print, freq=0
*End Step
** ----------------------------------------------------------------
**
** STEP 4: Thermal-Loaded (time 25-50 yr)
**
*Step, name="Thermal time 25-50 yr", amplitude=step, inc=10000
Apply temperature history
*Static
0.5, 25.0, 0.0015, 1.0
**
** BOUNDARY CONDITIONS
**
*Boundary, step=4, submodel
base_submodel, 2, 2
top_submodel, 2, 2
**
```

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```
** FIELDS
** Temperature distributions from thermal analysis
**
*Temperature, file=ddtherm, bstep=3, estep=3
**
** OUTPUT REQUESTS
**
*Restart, write, frequency=9999
**
** FIELD OUTPUT: F-Output-2
**
*Output, field, frequency=99999
*Element Output
S,UVARM
*Node Output
U
*Output, history, frequency=1
*Element Output, elset=histElements
UVARM
*Node file, freq=0
*El Print, freq=0
*Node Print, freq=0
*End Step
** ----------------------------------------------------------------
**
** STEP 5: Thermal-Loaded (time 50-100 yr)
**
*Step, name="Thermal time 50-100 yr", amplitude=step, inc=10000
Apply temperature history
*Static
1.0, 50., 0.0015, 1.0
**
** BOUNDARY CONDITIONS
**
*Boundary, step=5, submodel
base_submodel, 2, 2
top_submodel, 2, 2
**
** FIELDS
** Temperature distributions from thermal analysis
**
*Temperature, file=ddtherm, bstep=4, estep=4
**
** OUTPUT REQUESTS
**
*Restart, write, frequency=9999
**
** FIELD OUTPUT: F-Output-2
**
*Output, field, frequency=99999
*Element Output
S,UVARM
*Node Output
U
*Output, history, frequency=1
*Element Output, elset=histElements
UVARM
*Node file, freq=0
*El Print, freq=0
*Node Print, freq=0
*End Step
** ----------------------------------------------------------------
**
** STEP 6: Thermal-Loaded (time 100-101 yr)
**
```

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```
*Step, name="Thermal time 100-101 yr", amplitude=step, inc=10000
Apply temperature history
*Static
0.05, 1.0, 0.0015, 0.1
**
** BOUNDARY CONDITIONS
**
*Boundary, step=6, submodel
base_submodel, 2, 2
top_submodel, 2, 2
***
*** Rock layer b001 overstressed at end of year 100
***
*Model change, remove
b001,
**
** FIELDS
** Temperature distributions from thermal analysis
**
*Temperature, file=ddtherm, bstep=5, estep=5
**
** OUTPUT REQUESTS
**
*Restart, write, frequency=9999
**
** FIELD OUTPUT: F-Output-2
**
*Output, field, frequency=99999
*Element Output
S,UVARM
*Node Output
U
*Output, history, frequency=1
*Element Output, elset=histElements
UVARM
*Node file, freq=0
*El Print, freq=0
*Node Print, freq=0
*End Step
** ----------------------------------------------------------------
**
** STEP 7: Thermal-Loaded (time 101-250 yr)
**
*Step, name="Thermal time 101-250 yr", amplitude=step, inc=10000
Apply temperature history
*Static
0.5, 149., 0.0015, 2.0
**
** BOUNDARY CONDITIONS
**
*Boundary, step=6, submodel
base_submodel, 2, 2
top_submodel, 2, 2
**
** FIELDS
** Temperature distributions from thermal analysis
**
*Temperature, file=ddtherm, bstep=6, estep=6
**
** OUTPUT REQUESTS
**
*Restart, write, frequency=9999
**
** FIELD OUTPUT: F-Output-2
**
```

Element removed to simulate spallation. The implementation ensures the element removal is distributed linearly over the time interval of the current step.

GW 2/26/07

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```
*Output, field, frequency=99999
*Element Output
S,UVARM
*Node Output
U
*Output, history, frequency=1
*Element Output, elset=histElements
UVARM
*Node file, freq=0
*El Print, freq=0
*Node Print, freq=0
*End Step
```

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mMatAssignment.def Page 1

```
***
*** Mechanical property assignment to elements
***
*** Element set rocklayers includes all host rock layers
*** that have not failed. To be modified as
*** as rock layers fail
***
*Elset, elset=rocklayers
b125,   b124,   b123,   b122,   b121,   b120,   b119,   b118
b117,   b116,   b115,   b114,   b113,   b112,   b111,   b110
b109,   b108,   b107,   b106,   b105,   b104,   b103,   b102
b101,   b100,   b099,   b098,   b097,   b096,   b095,   b094
b093,   b092,   b091,   b090,   b089,   b088,   b087,   b086
b085,   b084,   b083,   b082,   b081,   b080,   b079,   b078
b077,   b076,   b075,   b074,   b073,   b072,   b071,   b070
b069,   b068,   b067,   b066,   b065,   b064,   b063,   b062
b061,   b060,   b059,   b058,   b057,   b056,   b055,   b054
b053,   b052,   b051,   b050,   b049,   b048,   b047,   b046
b045,   b044,   b043,   b042,   b041,   b040,   b039,   b038
b037,   b036,   b035,   b034,   b033,   b032,   b031,   b030
b029,   b028,   b027,   b026,   b025,   b024,   b023,   b022
b021,   b020,   b019,   b018,   b017,   b016,   b015,   b014
b013,   b012,   b011,   b010,   b009,   b008,   b007,   b006
b005,   b004,   b003,   b002,   b001
***
*** Element sets airlayers and ebs include all rock
*** within the drift perimeter. After initial static
*** equilibrium is established, element sets airlayers
*** and ebs will be removed to simulate drift excavation
***
*Elset, elset=airlayers
a017, a016, a015, a014, a013, a012, a011, a010
a009, a008, a007, a006, a005, a004, a003, a002
a001
***
*** Property assignments
***
*** Host rock zones
*Solid Section, elset=rocklayers, material=hostrock
1.,
*SOLID SECTION, ELSET=rock_top, MATERIAL=hostrock
1.,
*SOLID SECTION, ELSET=rock_mid, MATERIAL=hostrock
1.,
*SOLID SECTION, ELSET=rock_bottom, MATERIAL=hostrock
1.,
*** Drift section
*Solid Section, elset=airlayers, material=hostrock
1.,
*Solid Section, elset=ebs, material=hostrock
1.0,
```

The two files shown on this page define and assign mechanical properties. Unlike thermal property files, the mechanical property files remain unchanged through the analysis.

GW 2/26/07 Changes to simulate spallation are made in the main analysis input file as indicated on p. 30.

GW 2/26/07

mMaterials.def Page 1

```
***
*** Mechnical Material Definitions
***
**
** Linear-elastic model
** Parameters from high-grade lithophysal-rock data
**          Mean strength properties
** Stress distributions post-processed to calculate
**    stress/strength ratio distributions
**
** Young's modulus:   2.0E4 MPa
** Friction angle:    40 degrees
** Cohesion:          7.06 MPa
**
*Material, name=hostrock
*Elastic
20000., 0.20
*Expansion
  7.14e-06,  0.
  7.14e-06, 50.
  7.47e-06, 75.
  7.46e-06,100.
  9.07e-06,125.
  9.07e-06,225.
*User Output Variables
      1,
```

GW 2/26/07

Recorded by: Date Verified by Date

RVK 2/26/07

REMOVE B002 (101-102)

690 ·[B002]
256 ·

ddtherm.inp

1) Change nodes in Nset from 643, 256 → 256, 690 {layer B002}
2) added step 6, and last step changed to 7,

---

tMatAssignment.def

1) Remove b002 from Rocklayers
2) Remove a002 from airlayers
3) Expand comments
4) Add new layers to properties

---

tmaterials.def

1) Add properties for b002 mat (became air)
2) Add properties for a002 mat (became rubble)

---

abaqus job = ddtherm global = tgm01.fil

---

ddmech.inp

1) Add to list Elements
 b004: 3926, 3929, '
 b003: 3917, 3920, '
2) add step 7 (a copy of 6)
3) add comment
4) Remove b002 layer
5) change bstep=5→6, estep=5→6
6) edit step 8 (last step)

abaqus job=ddmech user= MeanHighGrade.f global=mym01.f

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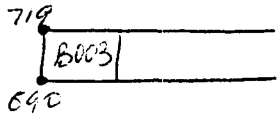
PVK
2/28/07

REMOVE B003 (102-103)

ddtherm.inp

1) 

changed to 245, 690, 719

2) added step 7, last changed to 8

+Mat Assignment.dif

1) remove b003
2) remove a003
3) expand comment
4) add new layers

+materials.def

1) Add b003 mat to air
2) Add a003 mat to rubble

ddmech.inp

1) Add to list Elements
   b005: 3935, 3938, 1
   b004: 3926, 3929, 1
2) Add step 8 (a copy of 7)
3) add comment, rock layer b003 overstressed.
4) remove b003
5) changed bstep=6 → 7, estep=6 → 7
6) edit step 9 (last step)

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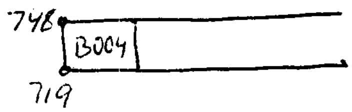
RVV 2/28/07

REMOVE B004 (103-104)

ddterm.inp

1)



changed to 345, 719, 748

2) added step 8, changed last to 9

tMat Assignment.def

1) Remove b004 from Rocklayers
2) Remove a004 from Air layers
3) Expand comments
4) Add new layers to prop.

tmaterials.def

1) Add b004mat to air
2) Add a004mat to Rubble

---

oldmech.inp

1) Add to hist Elements
   b006: 3944, 3947, 1
   b005: 3935, 3938, 1
2) Add step 9 (a copy of 8)
3) Add comment: „Rock layer b004 overst... 108
4) Remove b004
5) change bstep = 7 → 8, estep = 7 → 8
6) edit step 10 (last step)
   ... bstep = 8 → 9, estep = 8 → 9

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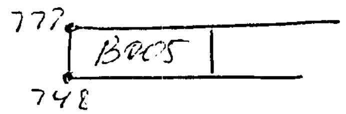
RVK 2/28/07

REMOVE B005 (104-105)

doltherm.inp

1) 

change to 245,748,777

2) Add step 9, change last to 10

tMat Assignment.def

1) Remove b005 from Rock layers
2) Remove a005 from Air layers
3) Expand comments
4) Add new layers to prop.

tMaterials.def

1) Add b005 mat to air
2) Add a005 mat to rubble

dolmech.inp

1) Add to list. Elements
   b007: 3953, 3956, 1
   b006: 3944, 3947, 1
2) Add step 10 (a copy of 9)
3) Add comment: "Rock layer b005 over... 104.4"
4) Remove b005
5) change bstep=8 → 9, Rstep=8 → 9
6) edit step 11 (last step)

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RWL 2/28/07

REMOVE BOC6 (105-106)

ddtherm.inp

1) 806 / 777 — B006 — change to: 245, 777, 806

2) Add step 10, change last to 11

tMatAssignment.def

1) Remove b006 from rock layers
2) Remove a006 from BIR layers
3) Expand comments
4) Add new layers to prep.

tMaterials.def

1) Add b006mat to ark
2) Add a006 mat to rubble

ddmech.inp

1) Add to list elements
   b008: 3962, 3965, 1
   b007: 3953, 3956, 1
2) Add step 11 (a copy of 10)
3) Add comment: "Rock layers 006 ... 105..."
4) Remove b006
5) change bstep = 9 → 10, estep = 9 → 10
6) Edit step 12 (last step)

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RWR 2/28/07

REMOVE B007 (106-107)

ddTherm. ~~tet~~ RWR inp

1) 835 [B007] 806 change to 245, 806, 835

2) Add step 11, change last one to 12

tMat Assignment. def

1) Remove b007 from Rock layers
2) Remove a007 from Air layers
3) Expand comments
4) Add new layers to prop.

+materials. def

1) Add b007mat to air
2) Add a007mat to rubble

ddmech. inp

1) Add to list Elements
b009: 3971, 3974, 1
b008: 3962, 3965, 1
2) Add step 12 (a copy of 11)
3) Add Comment: „Rock layer 007... 106.."
4) Remove b007
5) Change bstep = 10 → 11, estep = 10 → 11
6) Edit last step (step 13)

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Project No. ____________

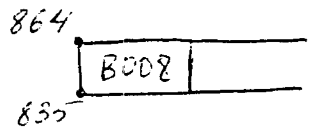
Book No. ____________ TITLE ______________________

RWR 3/1/07

REMOVE B008 (107-108)

ddTherm.inp

1)



change to 245, 835, 864

2) Add step 12, change last one to 13

iMatAssignment.def

1) Remove b008 from Rock layers
2) Remove a008 from air layers
3) Expand comments
4) Add new layers to prop

tMaterials.def

1) Add b008mat to air
2) Add B008mat to rubble

ddmech.inp

1) Add to list Elements
b010: 3980, 3983, 1
b009: 3971, 3974, 1
2) Add step 13 (a copy of 12)
3) Add comment: "Rock layer b008 ... 107.."
4) Remove b008
5) Change bstep = 11→12, estep = 11→12
6) Edit last step (step 14)

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RNK 3/1/07

REMOVE B009 (108-109)

ddtherm.inp

1) 245, 643, 777
↑ DS, ↑ original drift wall, ↑ top of B005

2) Add step 13, change last one to 14

tMat Assignment.def

1) Remove b009 from rock layers
2) Remove a009 from BSC layers
3) Expand comments
4) Add new layers to prop.

tmaterials.def

1) Add b009 mat to air
2) Add a009 mat to rubble

ddmech.inp

1) Add to list Elements
b011: 3989, 3992, 1
b010: 3980, 3983, 1
2) Add step 14 (a copy of 13)
3) Add comment: "rock layer b009... 108..."
4) Remove b009
5) Change bstep=12→13, estep=12→13
6) Edit last step (step 15)

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NP
3/1/07

REMOVE B010 (109 - 110)

ddchem.INP

1) 245, 643, 777 - no change
2) Add step 14, change last one to 15

&Mat Assignment.def

1) Remove b010 from Rock layer
2) Remove a010 from Air layers
3) Expand comments
4) Add new layers to prop

&materials.def

1) Add b010mat to air
2) Add a010 mat to rubble

ddmech.INP

1) Add to list Elements:
   b012: 3998, 4001, 1
   b011: 3989, 3992, 1
2) Add step 15 (a copy of 14)
3) Add comment: "Rock layer b010,,, 109,,"
4) Remove b010
5) Change bstep = 13→14, estep = 13→14
6) Edit last step (step 16)

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TITLE ______________________ Book No. ____________

RNK 3/5/07

REMOVE BC11 (110-111)

ddtherm.inp

1) 245, 643, 777 - no change
2) Add step 15, change last one to 16

tMatAssignment.def.

1) Remove b011 from Rock layers
2) Remove a011 from Ore layers
3) Expand Comments
4) Add new layers to prop.

tMaterials.def

1) Add b011mat to air
2) Add a011mat to rubble

ddmech.inp

1) Add to list Elements:
b013: 4007, 4010, 1
b012: 3998, 4001, 1
2) Add step 16 (a copy of 15)
3) Add comment: "Rock layer b011 ... 110 ..."
4) Remove b011
5) Change bstep = 14→15, estep = 14→15
6) Edit last step (step 17)

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RVK 3/5/07

REMOVE B012 (111-112)

ddtherm.inp

1) 245, 643, 777 - no change
2) Add step 16, change last one to 17

tmatAssignment.def

1) Remove b012 from Rock layers
2) Remove a012 from air layers
3) Expand comments
4) Add new layers to prop.

tmaterials.def

1) Add b012 mat to air
2) Add b012 mat to rubble

ddmech.inp

1) Add to hist Elements:
b014: 4018, 4019, 1
b013: 4007, 4010, 1
2) Add step 17 (a copy of 16)
3) Add comment; "Rock layer b012 ... 111..."
4) Remove b012
5) Change bstep = 15 → 16, estep = 15 → 16
6) Edit last step (step 18)

Recorded by:	Date	Verified by:	Date

PWK 3/5/07

REMOVE B013 (112-113)

ddtheem.inp

1) 245, 643, 777 — no change
2) Add step 17, change last one to 18

tMat Assignment.def

1) Remove b013 from Rock layers
2) Remove a013 from air layers
3) Expand comments
4) Add new layers to prop.

tmaterials.def

1) Add b013mat to air
2) Add B013 mat to rubble

ddmech.inp

1) Add to his Elements
 b015: 4025, 4028, 1
 b014: 4016, 4019, 1
2) Add step 18 (a copy of 17)
3) Add comment: "Rock layer b013... 112..."
4) Remove b013
5) Change bstep = 16 → 17, estep = 16 → 17
6) Edit last step (step 19)

RVL 3/5/07

REMOVE B014 (113-114)

dolthexm.inp

1) 245, 643, 777 - no change
2) Add step 18, change last one to 19

t-Mat Assignment.def

1) Remove b014 from Rock layers
2) Remove a014 from Air layers
3) Expand comment
4) Add new layers to excp.

t-Materials.def

1) Add b014 mat to air
2) Add a014 mat to rocktable

dolmech.inp

1) Add to list elements
b016. 4034, 4037, 1
b015. 4025, 4028, 1
2) Add step 19 (a copy of 18)
3) Add comment: "Rock layer b014... 113..4"
4) Remove b014
5) Change bstep = 17→18, estep = 17→18
6) Edit last step (step 20)

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RNK 3/5/07

REMOVE B015 (114-115)

ddTherm.inp

1) 245, 643, 777 - no change
2) Add step 19, change last one to 20.

tMatAssignment.def

1) Remove b015 from Rock layers
2) Remove a015 from Air layers
3) Expand comments
4) Add new layers to prop.

tMaterials.def

1) Add b015mat to air
2) Add B015mat to rubble

ddmech.inp

1) Add to list Elements
b017: 4043, 4046, 1
b016: 4034, 4037, 1
2) Add step 20 (a copy of 19)
3) Add comment: "Rock layer b015... 114"
4) Remove b014
5) Change bstep = 18→19, estep = 18→19
6) Edit last step (step 21)

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RVK 3/5/07

REMOVE B016 (115-116)

ddTherm.inp

1) 245, 643, 777 – no change
2) Add step 20, change last one to 21.

ThmAssignments.def

1) Remove b016 from rock layers
2) Remove a016 from air layers
3) Expand comments
4) Add new layers to prop.

ThMaterials.def

1) Add b016 mat. to air
2) Add a017 mat to rubble

ddmech.inp

1) Add to list elements
   b018: 4052, 4055, 1
   b017: 4043, 4046, 1
2) Add step 21 (a copy of 20)
3) Add comment: "Rock layer b016 ... 115."
4) Remove b015
5) Change bstep = 19 → 20, estep = ~~[illegible]~~ → 20
6) Edit last step (step 22)

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RJK 3/6/07

REMOVE B017 (116 – 117)

ddTherm.inp

1) 245, 643, 777 – no change
2) Add step 21, change last one to 22.

tMat Assignment.def

1) Remove b017 from Rock layers
2) Remove a017 from Air layers
3) Expand comments
4) Add new layers to prop

tmaterials.def

1) Add b017 mat to air
2) Add a017 mat to rubble – last air layer

ddmech.inp

1) Add to List Elements
b019: 4061, 4064, 1
b018: 4052, 4055, 1
2) Add step 22 (a copy of 21)
3) Add comment: "Rock layer b017 ... 116 ..."
4) Remove b016
5) Change bstep = 20 → 21, estep = 20 → 21.
6) Edit last step (step 23)

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new changes

REMOVE B018 (117-118)

RVK 3/6/07

ddtherm.inp

1) 245, 643, 777 ← no change
2) Add step 22, change last one to 23

tMatAssignment.def

1) Remove b018
2) Expand comments
3) Add b018mat to prep

tMaterials.def

1) change b001 mat prop
2) add b018 mat prop.

abaqus job = ddtherm global = tgmØ1.fil

ddmech.inp

1) Add to listElements,
 b020: 4070, 4073, 1
 b019: 4061, 4064, 1
2) Add step 23 (a copy of 22)
3) Add comment: "Rock layer b018 ... 117..."
4) Remove b018
5) Change bstep = 21 → 22, estep = 21 → 22
6) Edit last step 24

abaqus job = ddmech user = MeanHighGrade.f global = mgmØ1.fil

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RNF 3/6/07

REMOVE b019 (118-119)

ddtherm.inp

1) 245, 643, 777 ← no change
2) Add step 23, change last one to 24

tmatAssignment.def

1) Remove b019
2) Expand comments
3) Add b019mat to prop.

tmaterials.def

1) Change b002 mat prop.
2) add b019mat prop.

ddmech.inp

1) Add to list Elements
b021: 4079, 4082, 1
b020: 4070, 4073, 1
2) Add step 24 (a copy of 23)
3) ~~Add~~ comment: "lock layer b019,,, 118,,,"
4) Remove b019
5) Change bstep=22→23, estep=22→23
6) Edit last step

 Project No. ______

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RVK
3/6/07

REMOVE B020 (119-120)

ddTherm.inp

1) 245, 643, 777 ← no change
2) Add step 24, change last one to 25

tMatAssignment.def

1) Remove b020
2) Expand comments
3) Add b020mat to prop.

tmaterials.def

1) Change b003mat prop.
2) Add b020 mat prop.

ddmech.inp

1) Add to lisElements
b022: 4088, 4091, 1
b021: 4079, 4082, 1
2) Add step 25 (a copy of 24)
3) Add comment: "look layer b020... 119..."
4) Remove b020
5) Change bstep=23→24, estep=23→24
6) Edit last step

Recorded by:	Date	Verified by:	Date

TITLE ____ Book No. ____

RMC
3/7/07

REMOVE B021 (120-121)

ddTherm.inp

1) 245, 643, 777 ← no change
2) Add step 25, change last one to 26

---

tMatAssignment.def

1) Remove b021
2) Expand comments
3) Add b021 mat to prop.

tMaterials.def

1) Change b004 mat prop.
2) Add b021 mat prop.

---

ddMech.inp

1) Add to listElements
b023 : 4097, 4100, 1
b022 : 4088, 4091, 1
2) Add step 26 (a copy of 25)
3) Add comment: "Rock layer b021... 120..."
4) Remove b021
5) Change bstep = 24 → 25, estep = 24 → 25
6) Edit last step

Recorded by: | Date | Verified by: | Date

PK
3/7/07

REMOVE b022 (121-122)

<u>oldtherm.inp</u>

1) 245, 643, 777 ← no change
2) Add step 26, change last one to 27.

<u>tmatAssignment.def</u>

1) Remove b022
2) Expand comments
3) Add b022 mat to prop.

<u>tmaterials.def</u>

1) Change b005 mat prop
2) Add b022 mat prop

<u>oldmech.inp</u>

1) Add to listElements
   b024: 4106, 4109, 1
   b023. 4097, 4100, 1
2) Add step 27 (a copy of 21)
3) Add comment: „Rock layer b022„, 121..."
4) Remove b022
5) Change bstep = ~~25~~ → 26, estep = 25 → 26
6) Edit last step 28

Recorded by: | Date | Verified by: | Date

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RVK 3/17/07

REMOVE B023 (122-123)

ddTherm. inp

1) 245, 643, 777 — no change
2) Add step 27, change last one to 28.

tMatAssignment. def

1) Remove b023
2) Expand comments
3) Add b023 mat to prop.

tmaterials. def

1) Change b006 mat prop
2) Add b023 mat prop.

ddmech. inp

1) Add to ListElements
b025: 4115, 4118, 1
b024: 4106, 4109, 1
2) Add step 28 (a copy of 27)
3) Add comment: „Rock layer b023... 122..."
4) Remove b023
5) Change bstep=26→27, estep=26→27
6) Edit last step 29

Recorded by:	Date	Verified by:	Date

 Project No. ______

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RWK 3/7/07

REMOVE B024 (123-124)

ddTherm.inp

1) 245, 643, 777 ← no change
2) Add step 28, change last one to 29

tMatAssignment.def

1) Remove b024
2) Expand comments
3) Add b024 mat to prop

tMaterials.def

1) Change b007 mat prop
2) Add b024 mat prop

ddmech.inp

1) Add to list Elements
   b026 : 4124, 4127, 1
   b025 : 4115, 4118, 1
2) Add step 29 (a copy of 28)
3) Add comment: "Rock layer b024...123..."
4) Remove b024
5) Change bstep = 27→28, estep = 27 → 28
6) Edit last step 30

Recorded by:	Date	Verified by:	Date

TITLE ______ Book No. ______

RNK 3/8/07

REMOVE B025 (124-125)

ddTherm.inp

1) 245, 643, 777 ← no change
2) Add step 29, change last one to 30

tmatAssignment.def

1) Remove b025
2) Expand comments
3) Add b025mat to prop

tmaterials.def

1) Change b008mat prop
2) Add b025mat prop.

ddmech.inp

1) Add to listElements
   b027: 4133, 4136, 1
   b026: 4124, 4127, 1
2) Add step 30 (a copy of 29).
3) Add comment: "Rock layer b025,,, 124,,,"
4) Remove b025
5) Change bstep = 28→29, estep = 28→29
6) Edit last step 31

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RKR 3/8/07

REMOVE 6026 (125-126)

ddTherm.inp

1) 245, 643, 777 ← no change

2) Add step 30, change last one to 31

tMatAssignment.def

1) Remove 6026

2) Expand comments

3) Add 6026 mat to prop.

tmaterials.def

1) Change 6009 mat prop

2) Add 6026 mat prop

ddmech.inp

1) Add to listElements

6028: 4142, 4145, 1

6027: 4133, 4136, 1

2) Add step 31 (a copy of 30)

3) Add comment: "Rock layer 6026,,, 125..."

4) Remove 6026

5) Change bstep = 29 → 30, estep = 29 → 30

6) Edit last step 32

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KVR
3/8/07

REMOVE B027 (126-127)

ddTherm.inp

1) 245, 643, 777, 922, 1067, 1212, 1357
DS, Orig. DRIFT, TOP B005, TOP B010, TOP B015, TOP B020, TOP B025
1502, 1647, 1792, 1937, 2082
TOP B030, TOP B035, TOP B040, TOP B045, TOP B050

2) Add step 31, change last one to 52

i Mat Assignment.def

1) Remove b027
2) Expand comments
3) Add b027mat to prop

materials.def

1) Change b010 mat prop.
2) Add b027mat prop.

ddmech.inp

1) Add to list Elements
b029: 4151, 4154, 1
b028: 4142, 4145, 1
2) Add step 32 (a copy of 31)
3) Add comment: „Rock layer b027,,,126,,,"
4) Remove b027
5) Change bstep = 30→31, estep = 30→31
6) Edit last step 53

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RW
3/8/07

REMOVE B028 (127-128)

ddtherm.inp

1) 245, 643, 777, 922, 1067, 1212, 1357, 1502, 1647, 1792, 1937, 2082 ← no change
2) Add step 32, change last one to 33

tMat Assignment.dat

1) Remove b028
2) Expand comments
3) Add b028mat to prop.

tmaterials.dat

1) Change b011 mat prop.
2) Add b028 mat to prop.

ddmech.inp

1) Add to list Elements
   b030: 4160, 4163, 1
   b029: 4151, 4154, 1
2) Add step 33 (a copy of 32)
3) Add comment: "Rock layer b028.., 127..."
4) Remove b028
5) Change bstep = 31→32, estep = 31→32
6) Edit last step 34

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3/8/07

REMOVE B029 (128-129)

ddtherm.inp

1) 245 ÷ 2082 ← no change
2) Add step 33, change last one to 34.

tmatAssignment.det

1) Remove b029
2) Expand comments
3) Add b029mat to prop.

tmaterials.det

1) change b012 mat prop
2) Add b029mat to prop.

ddmech.inp

1) Add to listElements
b031 ! 4169, 4172, 1
b030: 4160, 4163, 1
2) Add step 34 (a copy of 33)
3) Add comment: „lock layer b029... 128..."
4) Remove b029
5) Change bstep = 32 → 33, estep = 32 → 33
6) Edit last step 35

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RNR
3/8/07

REMOVE B030 (129-130)

ddTherm.inp

1) 245 + 2082 ← no change
2) Add step 34, change last one to 35.

tMatAssignment.def

1) Remove b030
2) Expand comments
3) Add b030mat to prop.

tmaterials.def

1) Change b013.mat prop.
2) Add b030mat to prop.

ddmech.inp

1) Add to listElements
b032: 4178, 4181, 1
b031: 4169, 4172, 1
2) Add step 35 (a copy of 34)
3) Add comment: "Rock layer b030... 129..."
4) Remove b030
5) Change bstep = 33→34, estep = 33→34
6) Edit last step 36.

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PVK 3/9/07

REMOVE B031 (130-131)

ddtherm.inp

1) 245 + 2082 ← no change
2) Add step 35, change last one to 36.

tmatAssignment.def

1) Remove b031
2) Expand comments
3) Add b031mat to prep

tmaterials.def

1) Change b014 mat prep.
2) Add b031mat to prep.

ddmech.inp

1) Add to listElements
b033: 4187, 4190, 1
b032: 4178, 4181, 1
2) Add step 36 (a copy of 35)
3) Add comment: „Rock layer b031... 180..."
4) Remove b031
5) Change bstep = 34 → 35, estep = 34 → 35
6) Edit last step 37.

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DNK 3/9/07

REMOVE B032 (131-132)

ddTherm.inp

1) 245 ÷ 2882 ← no change
2) Add step 36, change last one to 37.

tPartAssignment.def

1) Remove b032
2) Expand comments
3) Add b032mat to prop

tMaterials.def

1) Change b015 mat prop
2) Add b032 mat to prop.

ddmech.inp

1) Add to listElements
   b034: 4196, 4199, 1
   b033: 4187, 4190, 1
2) Add step 37 (a copy of 36)
3) Add comment: "Rock layer b032... 131..."
4) Remove b032
5) Change bstep = 35 → 36, estep = 35 → 36
6) Edit last step 38.

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RWK 3/12/07

REMOVE B033 (132-133)

ddTherm.inp

1) ~~RWK~~ 19158 , 16696 , 245÷2082
 20m below DS   10m below DS

2) Add step 37, change last one to 38.

tMatAssignment.def

1) Remove b033
2) Expand comments
3) Add b033mat to prep.

tMaterials.def

1) Change b016 mat prop
2) Add b033mat to prop

ddmech.inp

1) Add to listElements
 b033: 4205, 4208, 1
 b034: 4196, 4199, 1
2) Add step 38 (a copy of 37)
3) Add comment: "Rock layer b033... 132..."
4) Remove b033
5) Change bstep=36→37, estep=36→37
6) Edit last step 39

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BVR
3/12/07

REMOVE B034 (133-134)

ddTherm.inp

1) 19158, 16696, 245+2082 → no change
2) Add step 38, change last one to 39.

tMat Assignment def

1) Remove b034
2) Expand comments
3) Add b034mat to prop

tmaterials def

1) Change b017mat prop.
2) Add b034mat prop.

ddmech.inp

1) Add to list Elements
b036: 4214, 4217, 1
b035: 4205, 4208, 1
2) Add step 39 (a copy of 38)
3) Add comment "Rock layer b034... 133..."
4) Remove b034
5) Change bstep = 37→38, estep = 37→38
6) Edit last step 40

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RVR 9/13/07

REMOVE B035 (134-135)

ddtherm.inp

1) 19152, 16696, 245+2082 ← no change
2) Add step 39, change last one to 40

tmatassignment.def

1) Remove b035
2) Expand comment
3) Add b035mat to prop

tmaterials.def

1) Change b0Rmat prop.
2) Add b035mat prop

[illegible]

ddmech.inp

1) Add to list Element
   b037: 4223, 4226, 1
   b036: 4214, 4217, 1
2) Add step 40 (a copy of 38)
3) Add comment: „Rock layer b035... 134..."
4) Remove b035
5) Change bstep = 38→39, estep = 38→39
6) Edit last step 41

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RVR
3/13/07

REMOVE B036 (135–136)

ddtherm.inp

1) 1918, 16696, 245 ÷ 2082 ← no change
2) Add step 40, change last one to 41

tMatAssignment.def

1) Remove b036
2) Expand comments
3) Add b036mat to prop

tMaterials.def

1) Change b619mat prop
2) Add b036 mat prop

ddmech.inp

1) Add to listElements
 b038: 4232, 4235, 1
 b037: 4223, 4226, 1
2) Add step 41 (a copy of 40)
3) Add comment: „Rock layer b036,,, 135,,,"
4) Remove b036
5) Change bstep = 39→40 estep = 39→40
6) Edit last step 42

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RNR 3/13/07

REMOVE B037 (136–137)

ddTherm.inp

1) 19158, 16696, 245÷2082 – no change
2) Add step 41, change last one to 42

tMatAssignment.def

1) Remove b037
2) Expand comments
3) ~~Add~~ b037mat to prop

tMaterials.def

1) Change b020mat prop
2) ~~Add~~ b037mat prop

ddmech.inp

1) Add to list Elements:
   b039: 4241, 4244, 1
   b038: 4232, 4235, 1
2) Add step 42 (a copy of 41)
3) Add comment: „Rock layer b037... 136..."
4) Remove b037
5) Change bstep = 40→41, estep = 40→41
6) Edit last step 43

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KWK 3/13/07

REMOVE B038 (137-138)

delTherm.inp

1) 19158, 16696, 245 + 2082 – no change
2) Add step 42, change last one to 43

tMatAssignment.dat

1) Remove b038
2) Expand comments
3) Add b038 mat to prop

tMaterials.dat

1) Change b021 mat prop.
2) Add b038 mat prop.

addmech.inp

1) Add to list Element:
   b040: 4250, 4253, 1
   b039: 4241, 4244, 1
2) Add step 43 (a copy of 42)
3) Add comment: "Rock layer b038... 137.."
4) Remove b038
5) Change bstep = 41 → 42, estep = 41 → 42
6) Edit last step 44

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RVK 3/13/07

REMOVE B039 (138-139)

ddtherm.inp

1) 19158, 16696, 245 + 2082 - no change
2) Add step 43, change last one to 44

tMatAssignment.dat

1) Remove 6039
2) Expand comments
3) Add 6039mat to prop.

tmaterials.dat

1) Change 6022mat prop.
2) Add 6039 mat prop

ddmech.inp

1) Add to listElement:
   6041: 4259, 4262, 1
   6040: 4250, 4253, 1
2) Add step 44 (a copy of 48)
3) Add comment: „Rock layer 6039,,, 138..."
4) Remove 6039
5) Change bstep = 42 → 43, estep = 42 → 43
6) Edit last step 45

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EVK
3/14/07

REMOVE B040 (139-140)

ddTherm.inp

1) 19158, 16696, 245 ÷ 2032 → no change
2) Add step 44, change last one to 45

dMatAssignment.def

1) Remove b040
2) Expand comment
3) Add b040mat to prop

tMaterials.def

1) Change b023 mat prop
2) Add b040 mat prop

ddmesh.inp

1) Add to list Element
b042: 4268, 4271, 1
b041: 4259, 4262, 1
2) Add step 45 (a copy of 44)
3) Add comment: "lock layer b040,, 139,, "
4) Remove B040
5) Change bstep = 43 → 44, estep = 43 → 44
6) Edit last step 46

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RVK 3/14/07

REMOVE B041 (140-141)

<u>deltherm.inp</u>

1) 19158, 16696, 245 + 2082 - no change
2) Add step 45, change last one to 46

<u>tMatAssignment.dat</u>

1) Remove b041
2) Expand comments
3) Add b041mat to prop.

<u>tmaterials.dat</u>

1) Change b024mat prop.
2) Add b041mat prop

<u>ddmech.inp</u>

1) Add to ListElement
b043: 4277, 4280, 1
b042: 4268, 4271, 1
2) Add step 46 (a copy of 45)
3) Add comment: "Rock layer b041,,, 140,,,"
4) Remove b041
5) Change bstep = 44→45, estep = 44→45
6) Edit last step 47

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PVK 3/14/07

REMOVE B042 (141-142)

ddlTherm.inp

1) 19158, 16696, 245÷2082 – no change
2) Add step 46, change last one to 47

tMatAssignment.def

1) Remove b042
2) Expand comments
3) Add b042mat to prop

tmaterials.def

1) change b025 mat prop
2) Add b042 mat prop

ddlmesh.inp

1) Add to listElements
   b044: 4286, 4229, 1
   b043: 4277, 4280, 1
2) Add step 47 (a copy of 46)
3) Add comment: "Rock layer b042... 141..."
4) Remove b042
5) Change bstep = 45 → 46, estep = 45 → 46
6) Edit last step 48.

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KNK 3/15/07

REMOVE B043 (142-143)

dd therm. inp

1) 19152, 16696, 245 ÷ 2082 — no change
2) Add step 47, change last one to 48

tMatAssignment.def

1) Remove b043
2) Expand comments
3) Add b043 mat to prop.

tMaterials.def

1) Change b026 mat prop
2) Add b043 mat prop.

ddmech. inp

1) Add to listElements
B045: 4295, 4298, 1
b044: 4286, 4289, 1
2) Add step 48 (a copy of 47)
3) Add comment: "Rock layer b043.. 142..."
4) Remove b043
5) Change bstep = 46 → 47, estep = 46 → 47
6) Edit last step 49

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RVK 3/15/07

REMOVE 6044 (148-144)

ddTherm. inp

1) 19158, 16696, 245÷2082 – no change
2) Add step 48, change last one to 49

tMatAssignment. def

1) Remove 6044
2) Expand comments
3) Add 6044 mat to prop.

tMaterials. def

1) Change 6027 mat prop.
2) Add 6044 mat to prop.

ddmech. inp

1) Add to listElements
   6046: 4304, 4307, 1
   6045: 4295, 4298, 1
2) Add step 49 (a copy of 48)
3) Add comment: „Rock layer 6044,,, 143,,,"
4) Remove 6044
5) Change bstep = 47→48, estep = 47→48
6) Edit last step 50

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RVK 3/16/07

REMOVE B045 (144-145)

ddTherm.inp

1) 19152, 16696, 245 + 2082 — no change
2) Add step 49, change last one to 50

tMatAssignment.dat

1) Remove b045
2) Expand comments
3) Add b045 mat to prop

tMaterials.dat

1) change b028 mat prop.
2) Add b045 mat prop

ddmech.inp

1) Add to List Elements
   b047: 4313, 4316, 1
   b046: 4304, 4307, 1
2) Add step 50 (a copy of 49)
3) Add comment: "Roof layer b045,,, 144,,,"
4) Remove b045
5) Change bstep = 48 → 49, estep = 48 → 49
6) Edit last step 51

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RVK 3/16/07

REMOVE B046 (145-148)

ddTherm.inp

1) 19158, 16696, 245÷2082 — no change
2) Add step 50, change last one to 51.

tMatAssignment.def

1) Remove 6046
2) Expand comments
3) Add 6046mat to prop

tMaterials.dat

1) Change 6029mat prop.
2) Add 6046mat prop.

ddmech.inp

1) Add to listElements
6048: 4322, 4325, 1
6047: 4313, 4316, 1
2) Add step 51 (a copy of 50)
3) Add comment: "Rock layer 6046 ... 145 ..."
4) Remove 6046
5) Change bstep = 49→50, estep = 49→50
6) Edit last step 52

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RVK
3/16/07

REMOVE B047 (146-147)

oldTherm.inp

1) 19153, 16696, 245 ÷ 2082 – no change
4) Add step 51, change last one to 52.

tMatAssignment.def

1) Remove b047
2) Expand comments
3) Add b047mat to prop

tMaterials.def

1) Change b030mat prop
2) Add b047mat prop

oldmech.inp

1) Add to list Elements
   b049 : 4331, 4334, 1
   b048 : 4322, 4325, 1
2) Add step 52 (a copy of 51)
3) Add comment: "Rock layer b047... 146..."
4) Remove b047
5) Change sstep = 50 → 51, estep = 50 → 51
6) Edit last step 53

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RVK
3/16/07

REMOVE B048 (147-148)

ddTherm.inp

1) 19159, 16696, 245 + 2082 = no change
2) Add step 52, change last one to 53

tHeatAssignment.dat

1) Remove b048
2) Expand comments
3) Add b048mat to props

tmaterials.def

1) Change b031mat prop
2) Add b048mat prop

ddmech.inp

1) Add to listElements
   b050: 4340, 4343, 1
   b049: 4331, 4334, 1
2) Add step 53 (a copy of 52)
3) Add comment: "Rock layer b048..., 147..."
4) Remove b048
5) Change bstep = 51→52, estp = 51→52
6) Edit last step 54.

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RNK 3/16/07

REMOVE 6049 (148-149)

ddtherm.inp

1) 19158, 16696, 245 + 2082 — no change
2) Add step 53, change last one to 54

tMatAssignment.def

1) Remove 6049
2) Expand comments
3) Add 6049mat to prop

tMaterials.def

1) Change 6032 mat prop
2) Add 6049 mat prop

ddmech.inp

1) Add to listElements
   6051: 4349, 4352, 1
   6050: 4340, 4343, 1
2) Add step 54 (a copy of 53)
3) Add comment: "Rock layers 6049... 148..."
4) Remove 6049
5) Change bstep = 52→53, estep = 52→53
6) Edit last step 55.

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RVK 3/16/07

REMOVE 6050 (149-150)

ddTherm.inp

1) 19158, 16696, 245+2082 — no change
2) Add step 54, change last one to 55.

~~t~~MatAssignment.def

1) Remove 6050
2) Expand comments
3) Add 6050mat to props

t materials.def

1) Change 6033 mat prop
2) Add 6050 mat to prop

ddmech.inp

1) Add to listElements
   6052: 4358, 4361, 1
   6051: 4349, 4352, 1
2) Add step 55 (a copy of 54)
3) Add Comment "Rock layer 6050... 149..."
4) Remove 6050
5) Change bstep=53→54, estep=53→54
6) Edit last step 56.

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BVK 3/19/07

REMOVE 6051 (150-151)

ddtherm.inp

1) 19158, 16696, 245 ÷ 2082 — no change
2) Add step 55, change last one to 56.

tMatAssignment.dat

1) Remove 6051
2) Expand Comments
3) Add 6051mat to prop

tMaterials.dat

1) Change 6034mat prop
2) Add 6051mat prop

---

ddmech.inp

1) Add to List Elements
6053: 4367, 4370, 1
6052: 4358, 4361, 1
2) Add step 56 (a copy of 55)
3) Add comment: "Rock layer 6051... 150..."
4) Remove 6051
5) Change bstep = 54 → 55, estep = 54 → 55
6) Edit last step 57.

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RVK 3/19/07

REMOVE B052 (151-152)

ddTherm.inp

1) 19158, 16696, 245 + 2082 – no change
2) Add step 56, change last one to 57.

imatAssignment.dat

1) Remove b052
2) Expand Comments
3) Add b052mat to prep-

tmaterials.dat

1) Change b035mat prep
2) Add b052mat prep

ddmech.inp

1) Add to listElements
   b054: 4376, 4379, 1
   b053: 4367, 4370, 1
2) Add step 57 (a copy of 56)
3) Add comment: "Rock layer b052... 151..."
4) Remove b052
5) Change bstep = 55→56, estep = 55→56
6) Edit last step 58.

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RVK 3/19/07

REMOVE B053 (152-158) RVK

[redacted]

ddTherm.inp

1) 19158, 16696, 245 + 2082 - no change
2) Add step 57, change last one to 58.

tMatAssignment.def

1) Remove b053
2) Expand comments
3) Add b053mat to prop.

tMaterials.def

1) Change b036mat prop.
2) Add b053mat prop.

ddmech.inp

1) Add to listElements
b055: 4385, 4388, 1
b054: 4376, 4379, 1
2) Add step 58 (a copy of 57)
3) Add comment: "Rock layer b053... 152..."
4) Remove b053
5) Change bstep = 56→57, estep = 56→57
6) Edit last step 59.

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RVK 3/19/07

REMOVE B054 (153-154)

ddTherm.inp

1) 19158, 16696, 245 + 2082 – no change
2) Add step 58, change last one to 59

tMat Assignment.det

1) Remove b054
2) Expand comments
3) Add b054mat to prop.

tmaterials.det

1) change b037mat prop
2) Add b054mat prop

ddmech.inp

1) Add to listElements
   b056: 4394, 4397, 1
   b055: 4385, 4388, 1
2) Add step 59 (a copy of 58)
3) Add comment: "Rock layer b054... 153..."
4) Remove b054
5) Change bstep=57→58, estep=57→58
6) Edit last step co.

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PWK
3/20/07

REMOVE BOSS (154-156)

ddTherm.inp

1) 19158, 16696, 245 + 2082 — no change
2) Add step 59, change last one to 60

tMatAssignment.def

1) Remove 6055
2) Expand comments
3) Add 6055 mat to prop

tMaterials.def

1) Change 6038 mat prop
2) Add 6055 mat prop

ddmech.inp

1) Add to listElements
   6057: 4403, 4406, 1
   6056: 4394, 4397, 1
2) Add step 60 (a copy of 59)
3) Add Comment: "Rock layer 6055,,, 154,,,"
4) Remove 6055
5) Change bstep = 58 → 59, estep = 58 → 59
6) Edit last step 61.

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RVK 3/21/07

REMOVE 6056 (155-156)

ddtherm.inp

1) 19158, 16696, 245 ÷ 2082 ← no change
2) Add step 60, change last one to 61

tmatAssignment.def

1) Remove 6056
2) Expand comments
3) Add 6056 mat to prop

tmaterials.def

1) change 6039 mat prop
2) Add 6056 mat prop

ddmech.inp

1) Add to listElement
 6058: 4412, 4415, 1
 6057: 4403, 4406, 1
2) Add step 61 (a copy of 60)
3) Add Comment: "Rock layer 6056... 155..."
4) Remove 6056
5) Change bstep=59→60 estep=59→60
6) Edit last step 62.

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PVR
3/21/07

REMOVE 6057 (156-157)

dotherm.inp

1) 19158, 16696, 245 ÷ 2082 — no change
2) Add step 61, change last one to 62.

tmatAssignment.dat

1) Remove 6057
2) Expand comments
3) Add 6057mat to prop

tmaterials.dat

1) Change 6040mat prop
2) Add 6057mat prop

dolmech.inp

1) Add to listElements
 6059: 4421, 4424, 1
 6058: 4412, 4415, 1
2) Add step 62 (a copy of 61)
3) Add comment: „Rock layer 6057... 156..."
4) Remove 6057
5) Change bstep = 60→61, estep = 60→61
6) Edit last step 63

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JWK 3/21/07

REMOVE B058 (157-158)

dd Therm inp

1) 19158, 16696, 245÷2082, 2227 (↑ TOP B055), 2372 (↑ TOP B060)
2517 (↑ TOP B065), 2662 (↑ TOP B070), 2807 (↑ TOP B075).

2) Add step 62, change last one to 63

tMatAssignment.dat

1) Remove b058
2) Expand comments
3) Add b058mat to prop

tmaterials.dat

1) Change b041mat prop
2) Add b058mat prop

ddmech inp

1) Add to listElements
   b060: 4430, 4433, 1
   b059: 4421, 4424, 1
2) Add step 63 (a copy of 62)
3) Add comment: "Rock layer b058,,, 157,,,"
4) Remove b058
5) Change bstep = 61→62, estep=61→62
6) Edit last step 64.

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RVL 3/22/07

REMOVE B059 (158–159)

ddTherm.inp

1) 19158, 16696, 245 + 2207 ← no change
2) Add step 63, change last one to 64.

~~tMatAssignment.def~~

1) Remove b059
2) Expand comments
3) Add b059mat to prop

tmaterials.def

1) change b042mat prop
2) Add b059 mat prop

ddmech.inp

1) Add to list Elements
b061: 4439, 4442, 1
b060: 4430, 4433, 1
2) Add step 64 (a copy of 63)
3) Add comment: "Rock layer b059 ... 158 ..."
4) Remove b059
5) Change bstep=62→63, estep=62→63
6) Edit last step 65.

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RK 3/22/07

REMOVE B060 (159-160)

ddTherm.inp

1) 19158, 16696, 245 + 2207 — no change
2) Add step 64, change last one to 65

Eddat Assignment.dat

1) Remove b060
2) Expend comments
3) Add b060mat to prop

+ materials-dat

1) Change b043mat prop
2) Add b060mat prop

ddmech.inp

1) Add to list Elements
b062: 4448, 4457, 1
b061: 4439, 4442, 1
2) Add step 65 (a copy of 64)
3) Add comment: "Rock layer b060 ... 159 ..."
4) Remove b060
5) Change bstep = 63→64, estep = 63→64.
6) Edit last step 66.

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RVK 3/22/07

REMOVE B061 (160-161)

dolTherm.inp

1) 19158, 16696, 245÷2807 — no change
2) Add step 65, change last one to 66

tMatAssignment

1) Remove b061
2) Expand comments
3) Add b061mat to prop

tMaterials.dat

1) Change b044mat prop
2) Add b061mat prop.

dolmech.inp

1) Add to List Elements
   b063: 4457, 4460, 1
   b062: 4448, 4451, 1
2) Add step 66 (a copy of 65)
3) Add comment: „Rock layer b061... 160..."
4) Remove b061
5) Change bstep = 64→65, estep = 64→65
6) Edit last step 67.

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RVK 3/23/07

REMOVE B062 (161-162)

ddtherm. inp

1) 19158, 16696, 245÷2207 → no change

2) Add step 66, change last one to 67.

tMatAssignment.dat

1) Remove b062

2) Expand comments

3) Add b062mat to prop

tMaterials.dat

1) Change b045mat prop.

2) Add b062mat to prop.

ddmech. inp

1) Add to ListElements

b064: 4466, 4469, 1

b063: 4457, 4460, 1

2) Add step 67

3) Add comment: „Rock layer b062,,, 161,,,"

4) Remove b062

5) Change bstep=65→66, estep=65→66

6) Edit last step 68.

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RVR 3/23/07

REMOVE B063 (162-163)

ddTherm.inp

1) 19158, 16696, 245+2807 → no change
2) Add step 67, change last one to 68.

tmatAssignment.dat

1) Remove b063
2) Expand comments
3) Add b063mat to prop

tMaterials.dat

1) change b046mat prop.
2) Add b063mat prop.

---

ddmech.inp

1) Add to listElements
b065: 4475, 4478, 1
b064: 4466, 4469, 1
2) Add step 68
3) Add comment: "Rock layer b063... 162..."
4) Remove b063
5) Change bstep=66→67, estep=66→67
6) Edit last step 69.

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RJK 3/23/07

REMOVE B064 (163-164)

ddTherm.inp
1) 19158, 16696, 245 + 2807 – no change
2) Add step 68, change last one to 69.

tMatAssignment.dat
1) Remove b064
2) Expand comments
3) Add b064mat to prop.

tMaterials.dat
1) Change b047mat prop
2) Add b064mat prop

---

ddmech.inp
1) Add to listElements
b066: 4484, 4487, 1
b065: 4475, 4478, 1
2) Add step 69
3) Add comment: "Rock layer b064,,, 163,,,"
4) Remove b064
5) Change bstep = 67→68, estep = 67→68
6) Edit last step 70.

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RVK 3/26/03

REMOVE B065 (164-165)

ddtherm.inp

1) 19158, 16696, 245÷2807 — no change
2) Add step 69, change last one to 70.

tMatAssignment.def

1) Remove 6065
2) Expand comments
3) Add 6065mat to prop

tMaterials.def

1) Change 6048mat prop
2) Add 6065mat prop

---

ddmech.inp

1) Add to listElements
6067 4493, 4496, 1
6066: 4484, 4487, 1
2) Add step 70
3) Add comment "Rock layer 6065... 164..."
4) Remove 6065
5) Change bstep=68→69, estep=68→69
6) Edit last step 71.

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EVK 3/26/07

REMOVE B066 (165-166)

ddTherm.inp

1) 19158, 16696, 245÷2807 – no change
2) Add step 70, change last one to 71.

tMatAssignment.def

1) Remove b066
2) Expand comments
3) Add b066mat to prop

tmaterials.def

1) Change b049mat prop
2) Add b066mat prop.

ddmech.inp

1) Add to list Elements
b068: 4502, 4505, 1
b067: 4493, 4496, 1
2) Add step 71
3) Add comment: „Rock layer b066... 165m"
4) Remove b066
5) Change bstep=69→70, estep=69→70
6) Edit last step 72

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RNP 3/28/07

REMOVE B067 (166 - 167)

ddtherm.inp

1) 19158, 16696, 245 ÷ 280? - no change
2) Add step 71, change last one to 72.

tMatAssignment.def

1) Remove b067
2) Expand comments
3) Add b067mat to prop

tmaterials.def

1) Change b050mat prop
2) Add b067mat prop

ddmech.inp

1) Add to listElements
b069: 4511, 4514, 1
b068: 4502, 4505, 1
2) Add step 72
3) Add comment: „Rock layer b067... 166..."
4) Remove b067
5) Change bstep = 70→71, estep = 70→71
6) Edit last step 73

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RVK
3/26/07

REMOVE B068 (167-168)

ddTherm.inp

1) 19158, 16696, 245÷2807 – no change
2) Add step 72, change last one to 73.

tMatAssignment.dat

1) Remove b068
2) Expand comments
3) Add b068mat to prop.

tMaterials.dat

1) Change b057mat prop.
2) Add b068mat prop

---

ddmech.inp

1) Add to listElements
   b070: 4520, 4523, 1
   b069: 4511, 4514, 1
2) Add step 72
3) Add comment: „Rock layer b068,,, 167,,,"
4) Remove b068
5) Change bstep = 71 → 72, estep = 71 → 72
6) Edit last step 74.

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3/26/07

REMOVE B069 (168-169)

ddTherm.inf
1) 19158, 16696, 245+2807 – no change
2) Add step 73, change last one to 74.

tMatAssignment.def
1) Remove 6069
2) Expand comments
3) Add 6069mat to prop

tMaterials.def
1) Change 6052mat prop.
2) Add 6069mat prop

---

ddmech.inf
1) Add to listElements
6071: 4529, 4532, 1
6070: 4520, 4523, 1
2) Add step 74
3) Add comment: "Rock layer 6069... 168..."
4) Remove 6069
5) Change bstep = 72→73, estep = 72→73
6) Edit last step 75.

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RVK
3/26/07

REMOVE BO70 (169-170)

ddtherm.inp

1) 19158, 16696, 245÷2807 — no change
2) Add step 74, change last one to 75.

tMatAssignment.dat

1) Remove b070
2) Expand comments
3) Add b070mat to prop

tmaterials.dat

1) Change b053mat prop.
2) Add b070mat prop

ddmeshinp

1) Add to listElements
b072: 4538, 4541, 1
b071: 4529, 4532, 1
2) Add step 75
3) Add comment: "Rock layer b070,,, 169,,,"
4) Remove b070
5) Change bstep = 73 → 74, estep = 73 → 74
6) Edit last step 76

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RVK
3/27/07

REMOVE B071 (170-171)

ddTherm.inp

1) 19158, 16696, 245 + 2807 - no change
2) Add step 75, change last one to 76.

tMatAssignment.def

1) Remove b071
2) Expand comments
3) Add b071mat to prop

tMaterials.def

1) Change b054mat prop
2) Add b071mat prop

---

ddmech.inp

1) Add to listElements
   b073: 4547, 4550, 1
   b072: 4538, 4541, 1
2) Add step 76
3) Add comment: „Rock layer b071..., 170..."
4) Remove b071
5) Change bstep = 74→75, estep = 74→75
6) Edit last step 77.

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RJK 3/28/07

REMOVE B072 (171-172)

ddtherm.inp

1) 19158, 16696, 245 ÷ 2807 — no change
2) Add step 76, change last one to 77.

tMatAssignment.def

1) Remove 6072
2) Expand comments
3) Add 6072mat to prop.

tMaterials.def

1) change 6055mat prop.
2) Add 6072 mat prop.

---

ddmech.inp

1) Add to listElements
 6074: 4556, 4559, 1
 6073: 4547, 4550, 1
2) Add step 77
3) Add comment: „Rock layer 6072... 171..."
4) Remove 6072
5) Change bstep = 75 → 76, estep = 75 → 76.
6) Edit last step 78.

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RMC 3/28/07

REMOVE B073 (172-173)

ddTherm.inp
1) 19158, 16696, 245 ÷ 2807 – no change
2) Add step 77, change last one to 78.

~~tMatAssignment.old~~
1) Remove b073
2) Expand comments
3) Add b073mat prop.

~~tMaterials.old~~
1) Change b056mat prop.
2) Add b073mat prop.

---

ddmech.inp
1) Add to initElements
b075: 4565, 4568, 1
b074: 4556, 4559, 1
2) Add step 78
3) Add comment: „Rock layer b073,,, 172..."
4) Remove b073
5) Change bstep = 76→77, estep = 76→77
6) Edit last step 79.

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RK
3/28/07

REMOVE B074 (173-174)

ddTherm.inf

1) 19158, 16696, 245÷280? – no change
2) Add step 78, change last one to 79.

tMatAssignment.def

1) Remove b074
2) Expand comments
3) Add b074mat prep

tMaterials.def

1) Change b057mat prep.
2) Add b074mat prep

---

ddmech.inp

1) Add to listElements
b076: 4574, 4577, 1
b075: 4565, 4568, 1
2) Add step 79
3) Add comment: „Rock layer b074... 173..."
4) Remove b074
5) Change bstep = 77→78, estep = 77→78
6) Edit last step 80.

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RNK 3/28/07

REMOVE B075 (174-185)

ddTherm.inp

1) 19158, 16696, 245 ÷ 2807 – no change
2) Add step 79, change last one to 80.

tMatAssignment.def

1) Remove b075
2) Expand comments
3) Add b075mat prop.

tMaterials.def

1) Change b058mat prop
2) Add b075mat prop

---

ddmech.inp

1) Add to ListElement
   b077: 4583, 4586, 1
   b076: 4574, 4577, 1
2) Add step 80
3) Add comment: "Rock layer b075... 174..."
4) Remove b075
5) Change bstep = 78 → 79, estep = 78 → 79
6) Edit last step 81.

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RJK 3/30/07

REMOVE B076 (175-176)

ddTherm.inp

1) 19158, 16696, 245÷2807 – no change
2) Add step 80, change last one to 81.

tMatAssignment.dat

1) Remove b076
2) Expand comments
3) Add b076 mat prop.

tmaterials.dat

1) Change b059 mat prop.
2) Add b076 mat prop.

---

ddmech.inp

1) Add to listElement
   b077: 4592, 4595, 1
   b077: 4583, 4586, 1
2) Add step 81
3) Add comment: „Rock layer b076... 175..."
4) Remove b076
5) Change bstep = 79→80, estep = 79→80
6) Edit last step 82.

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RVR 3/30/07

REMOVE 6077 (176-177)

ddtherm.inp

1) 19158, 16696, 245÷2807 — no change
2) Add step 21, change last one to 82.

tMatAssignment.def

1) Remove 6077
2) Expand comments
3) Add 6077 mat prop

tMaterials.def

1) Change 6060 mat prop.
2) Add 6077 mat prop

---

ddmech.inp

1) Add to listElement
6079: 4601, 4604, 1
6078: 4592, 4595, 1
2) Add step 82
3) Add comment: „Rock layer 6077... 176..."
4) Remove 6077
5) Change bstep = 80→81, estep = 80→81
6) Edit last step 83.

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RVK 3/30/07

REMOVE 6078 (177-178)

delthERm.inp

1) 19158, 16696, 245 + 2807 - no change
2) Add step 82, change last one to 83.

tMatAssignment.def

1) Remove 6078
2) Expand comments
3) Add 6078mat to prop.

tMaterials.def

1) Change 6061mat prop.
2) Add 6078mat prop.

---

delmech.inp

1) Add to listElement
 6080: 4610, 4613, 1
 6079: 4601, 4604, 1
2) Add step 83
3) Add comment: "Rock layer 6078... 177..."
4) Remove 6078
5) Change bstep = 81 → 82, estep = 81 → 82
6) Edit last step 84.

See Scientific Notebook No 872 for the continuation of the study. 4/24/07 RVK

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