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New input file addendum written to extract data from FLAC for import into EXCEL. FLAC input file FFLAT1RES.TXT is shown below. This file creates an ASCII text file of key data at interface gridpoints.

```
; Flat transgressing joint in a heated infinite rock mass
;
;
res f7ffinal.sav
;
;
his write 1 f7ftemp1.out
his write 2 f7ftemp2.out
his write 3 f7ftemp3.out
his write 4 f7ftemp4.out
his write 5 f7ftemp5.out
his write 6 f7ftemp6.out
;
his write 7 f7fyd1.out
his write 8 f7fyd2.out
his write 9 f7fyd3.out
his write 10 f7fyd4.out
his write 11 f7fyd5.out
his write 12 f7fyd6.out
;
his write 13 f7funbal.out
his write 14 f7fthtime.out

def xxx
  nn=561
end
xxx
def table_fill
  array f71(11,nn)
;
; Bottom of interface
;
thvalr=thvald*pi/180.0
  loop i (1,igp)
    xnot=x(1,26)
    ynot=y(1,26)
    xval=x(i,26)
    yval=y(i,26)
    lval=sqrt(((xval-xnot)*(xval-xnot))+((yval-ynot)*(yval-ynot)))
    dxvalb=xdisp(i,26)
    dyvalb=ydisp(i,26)
    dsvalb=dxvalb*cos(thvalr)-dyvalb*sin(thvalr)
    dnvalb=dxvalb*sin(thvalr)+dyvalb*cos(thvalr)
;
; Top of interface
;
    dxvalt=xdisp(i,27)
    dyvalt=ydisp(i,27)
    dsvalt=dxvalt*cos(thvalr)-dyvalt*sin(thvalr)
    dnvalt=dxvalt*sin(thvalr)+dyvalt*cos(thvalr)
;
; Interface
;
    dclos=dnvalt-dnvalb
    dride=dsvalt-dsvalb
    tempvalb=temp(i,26)
    tempvalt=temp(i,27)
;
; Create table entries
;
    table(1,i)=yval
    table(2,i)=xval
    table(3,i)=lval
    table(4,i)=dsvalb
    table(5,i)=dnvalb
    table(6,i)=dsvalt
    table(7,i)=dnvalt
    table(8,i)=dclos
    table(9,i)=dride
    table(10,i)=tempvalb
    table(11,i)=tempvalt
;
; Array entries
;
    f71(1,i)=string(yval)
    f71(2,i)=string(xval)
    f71(3,i)=string(lval)
    f71(4,i)=string(dsvalb)
    f71(5,i)=string(dnvalb)
    f71(6,i)=string(dsvalt)
    f71(7,i)=string(dnvalt)
    f71(8,i)=string(dclos)
    f71(9,i)=string(dride)
    f71(10,i)=string(tempvalb)
    f71(11,i)=string(tempvalt)
  endLoop
status=open('f71.out',1,1)
status=write(f71,561)
end
;
set thvald=0.0
table_fill
ret
```

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FLAC input file FFLAT1RES.TXT

The ASCII file is named F71.OUT in this case. An EXCEL file F71.XLS was created by importing and rearranging parameters into 26 columns with entries for each interface gridpoint. A printout from F71.XLS is shown on the next page, followed by plots of relevant data along the interface.

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Table 7.1 - Summary of FLAC Output for Case 7.1

I	Y coordinate (m)	X coordinate (m)	Distance along interface (m)	Shear displacement at bottom of interface (m)	Normal displacement at bottom of interface (m)	Shear displacement at top of interface (m)	Normal displacement at top of interface (m)	Relative normal displacement on interface (m)	Relative shear displacement on interface (m)	Temperature at bottom of interface (°C)	Temperature at top of interface (°C)	Total displacement at bottom of interface (m)
1	50.00	0.00	0.00	0.00E+00	3.92E-04	0.00E+00	3.92E-04	1.17E-07	0.00E+00	34.00	3.40E+01	0.00
2	50.00	2.00	2.00	-1.66E-04	3.93E-04	-1.66E-04	3.94E-04	1.20E-07	3.22E-08	34.00	3.40E+01	0.00
3	50.00	4.00	4.00	-3.33E-04	3.98E-04	-3.32E-04	3.98E-04	1.32E-07	6.54E-08	34.00	3.40E+01	0.00
4	50.00	6.00	6.00	-5.02E-04	4.06E-04	-5.02E-04	4.06E-04	1.53E-07	1.01E-07	34.00	3.40E+01	0.00
5	50.00	8.00	8.00	-6.75E-04	4.17E-04	-6.74E-04	4.17E-04	1.82E-07	1.39E-07	34.00	3.40E+01	0.00
6	50.00	10.00	10.00	-8.52E-04	4.31E-04	-8.52E-04	4.32E-04	2.21E-07	1.81E-07	34.00	3.40E+01	0.00
7	50.00	12.00	12.00	-1.04E-03	4.50E-04	-1.04E-03	4.51E-04	2.72E-07	2.31E-07	34.00	3.40E+01	0.00
8	50.00	14.00	14.00	-1.23E-03	4.75E-04	-1.23E-03	4.75E-04	3.35E-07	2.89E-07	34.00	3.40E+01	0.00
9	50.00	16.00	16.00	-1.43E-03	5.05E-04	-1.43E-03	5.06E-04	4.14E-07	3.57E-07	34.00	3.40E+01	0.00
10	50.00	18.00	18.00	-1.65E-03	5.43E-04	-1.65E-03	5.43E-04	5.12E-07	4.41E-07	34.00	3.40E+01	0.00
11	50.00	20.00	20.00	-1.88E-03	5.89E-04	-1.88E-03	5.90E-04	6.29E-07	5.46E-07	34.00	3.40E+01	0.00
12	50.00	22.00	22.00	-2.13E-03	6.48E-04	-2.13E-03	6.48E-04	7.74E-07	6.79E-07	34.00	3.40E+01	0.00
13	50.00	24.00	24.00	-2.40E-03	7.22E-04	-2.40E-03	7.22E-04	9.55E-07	8.53E-07	34.00	3.40E+01	0.00
14	50.00	26.00	26.00	-2.71E-03	8.15E-04	-2.70E-03	8.16E-04	1.18E-06	1.08E-06	34.00	3.40E+01	0.00
15	50.00	28.00	28.00	-3.04E-03	9.34E-04	-3.04E-03	9.36E-04	1.45E-06	1.39E-06	34.00	3.40E+01	0.00
16	50.00	30.00	30.00	-3.43E-03	1.09E-03	-3.43E-03	1.09E-03	1.80E-06	1.82E-06	34.00	3.40E+01	0.00
17	50.00	32.00	32.00	-3.87E-03	1.30E-03	-3.87E-03	1.30E-03	2.22E-06	2.44E-06	34.01	3.40E+01	0.00
18	50.00	34.00	34.00	-4.38E-03	1.58E-03	-4.37E-03	1.58E-03	2.74E-06	3.35E-06	34.05	3.41E+01	0.00
19	50.00	36.00	36.00	-4.97E-03	1.98E-03	-4.97E-03	1.98E-03	3.33E-06	4.71E-06	34.20	3.43E+01	0.01
20	50.00	38.00	38.00	-5.65E-03	2.55E-03	-5.64E-03	2.55E-03	3.85E-06	6.79E-06	34.74	3.49E+01	0.01
21	50.00	40.00	40.00	-6.40E-03	3.37E-03	-6.39E-03	3.38E-03	3.87E-06	9.92E-06	36.47	3.69E+01	0.01
22	50.00	42.00	42.00	-7.09E-03	4.58E-03	-7.07E-03	4.58E-03	2.32E-06	1.44E-05	41.31	4.24E+01	0.01
23	50.00	44.00	44.00	-7.40E-03	6.26E-03	-7.38E-03	6.26E-03	-2.37E-06	1.96E-05	52.80	5.49E+01	0.01
24	50.00	46.00	46.00	-6.70E-03	8.37E-03	-6.67E-03	8.36E-03	-1.05E-05	2.32E-05	74.95	7.84E+01	0.01
25	50.00	47.50	47.50	-4.98E-03	1.00E-02	-4.96E-03	9.98E-03	-2.34E-05	1.80E-05	96.76	1.01E+02	0.01
26	50.00	50.00	50.00	1.01E-07	1.12E-02	9.97E-08	1.12E-02	-2.83E-05	-1.22E-09	119.30	1.24E+02	0.01
27	50.00	52.50	52.50	4.98E-03	1.00E-02	4.96E-03	9.98E-03	-2.34E-05	-1.80E-05	96.76	1.01E+02	0.01
28	50.00	54.00	54.00	6.70E-03	8.37E-03	6.67E-03	8.36E-03	-1.07E-05	-2.32E-05	74.95	7.84E+01	0.01
29	50.00	56.00	56.00	7.40E-03	6.26E-03	7.39E-03	6.26E-03	-2.56E-06	-1.96E-05	52.80	5.49E+01	0.01
30	50.00	58.00	58.00	7.09E-03	4.57E-03	7.07E-03	4.57E-03	2.48E-06	-1.44E-05	41.31	4.24E+01	0.01
31	50.00	60.00	60.00	6.40E-03	3.37E-03	6.39E-03	3.37E-03	3.89E-06	-9.92E-06	36.47	3.69E+01	0.01
32	50.00	62.00	62.00	5.65E-03	2.54E-03	5.65E-03	2.55E-03	3.85E-06	-6.79E-06	34.74	3.49E+01	0.01
33	50.00	64.00	64.00	4.97E-03	1.98E-03	4.97E-03	1.98E-03	3.33E-06	-4.71E-06	34.20	3.43E+01	0.01
34	50.00	66.00	66.00	4.38E-03	1.58E-03	4.37E-03	1.58E-03	2.74E-06	-3.35E-06	34.05	3.41E+01	0.01
35	50.00	68.00	68.00	3.87E-03	1.30E-03	3.87E-03	1.30E-03	2.22E-06	-2.44E-06	34.01	3.40E+01	0.00
36	50.00	70.00	70.00	3.43E-03	1.09E-03	3.43E-03	1.09E-03	1.80E-06	-1.82E-06	34.00	3.40E+01	0.00
37	50.00	72.00	72.00	3.04E-03	9.33E-04	3.04E-03	9.34E-04	1.45E-06	-1.39E-06	34.00	3.40E+01	0.00
38	50.00	74.00	74.00	2.71E-03	8.14E-04	2.70E-03	8.15E-04	1.18E-06	-1.08E-06	34.00	3.40E+01	0.00
39	50.00	76.00	76.00	2.40E-03	7.22E-04	2.40E-03	7.22E-04	9.54E-07	-8.50E-07	34.00	3.40E+01	0.00
40	50.00	78.00	78.00	2.13E-03	6.48E-04	2.13E-03	6.49E-04	7.75E-07	-6.78E-07	34.00	3.40E+01	0.00
41	50.00	80.00	80.00	1.88E-03	5.90E-04	1.88E-03	5.91E-04	6.29E-07	-5.45E-07	34.00	3.40E+01	0.00
42	50.00	82.00	82.00	1.65E-03	5.44E-04	1.65E-03	5.44E-04	5.10E-07	-4.40E-07	34.00	3.40E+01	0.00
43	50.00	84.00	84.00	1.43E-03	5.06E-04	1.43E-03	5.07E-04	4.12E-07	-3.57E-07	34.00	3.40E+01	0.00
44	50.00	86.00	86.00	1.23E-03	4.76E-04	1.23E-03	4.76E-04	3.35E-07	-2.89E-07	34.00	3.40E+01	0.00
45	50.00	88.00	88.00	1.04E-03	4.51E-04	1.04E-03	4.52E-04	2.71E-07	-2.32E-07	34.00	3.40E+01	0.00
46	50.00	90.00	90.00	8.52E-04	4.32E-04	8.52E-04	4.32E-04	2.21E-07	-1.82E-07	34.00	3.40E+01	0.00
47	50.00	92.00	92.00	6.75E-04	4.17E-04	6.74E-04	4.17E-04	1.82E-07	-1.39E-07	34.00	3.40E+01	0.00
48	50.00	94.00	94.00	5.02E-04	4.06E-04	5.02E-04	4.06E-04	1.52E-07	-1.00E-07	34.00	3.40E+01	0.00
49	50.00	96.00	96.00	3.33E-04	3.98E-04	3.33E-04	3.98E-04	1.34E-07	-6.49E-08	34.00	3.40E+01	0.00
50	50.00	98.00	98.00	1.66E-04	3.94E-04	1.66E-04	3.94E-04	1.20E-07	-3.21E-08	34.00	3.40E+01	0.00
51	50.00	100.00	100.00	0.00E+00	3.92E-04	0.00E+00	3.92E-04	1.15E-07	0.00E+00	34.00	3.40E+01	0.00

I	Theta at bottom of interface (°)	Total displacement at top of interface (m)	Theta at top of interface (°)	Normal Stress at Bottom of Interface (Pa)	Shear Stress at Bottom of Interface (Pa)	Slip	Bond	Normal Stress at Top of Interface (Pa)	Shear Stress at Top of Interface (Pa)	Slip	Bond	Sratio at top of interface	Sratio at bottom of interface
1	9.00E+01	0.00	90.00	2.21E+05	0.00E+00	no	yes	2.21E+05	0.00E+00	no	yes	8.00E-05	6.00E-05
2	1.13E+02	0.00	112.83	2.29E+05	4.19E+04	no	yes	2.29E+05	4.19E+04	no	yes	1.90E-04	2.50E-04
3	1.30E+02	0.00	129.87	2.51E+05	8.50E+04	no	yes	2.51E+05	8.50E+04	no	yes	5.20E-04	3.00E-04
4	1.41E+02	0.00	141.04	2.91E+05	1.31E+05	no	yes	2.91E+05	1.31E+05	no	yes	8.00E-05	6.80E-04
5	1.48E+02	0.00	148.28	3.45E+05	1.81E+05	no	yes	3.45E+05	1.81E+05	no	yes	1.20E-04	1.30E-04
6	1.53E+02	0.00	153.14	4.20E+05	2.36E+05	no	yes	4.20E+05	2.36E+05	no	yes	5.30E-04	3.10E-04
7	1.57E+02	0.00	156.50	5.16E+05	3.00E+05	no	yes	5.16E+05	3.00E+05	no	yes	1.46E-03	1.13E-03
8	1.59E+02	0.00	158.87	6.36E+05	3.75E+05	no	yes	6.36E+05	3.75E+05	no	yes	1.63E-03	7.90E-04
9	1.61E+02	0.00	160.55	7.86E+05	4.64E+05	no	yes	7.86E+05	4.64E+05	no	yes	4.40E-04	2.10E-04
10	1.62E+02	0.00	161.75	9.73E+05	5.73E+05	no	yes	9.73E+05	5.73E+05	no	yes	1.80E-04	1.29E-03
11	1.63E+02	0.00	162.57	1.20E+06	7.09E+05	no	yes	1.20E+06	7.09E+05	no	yes	2.10E-03	1.54E-03
12	1.63E+02	0.00	163.06	1.47E+06	8.83E+05	no	yes	1.47E+06	8.83E+05	no	yes	3.20E-03	1.18E-03
13	1.63E+02	0.00	163.26	1.81E+06	1.11E+06	no	yes	1.81E+06	1.11E+06	no	yes	6.90E-04	7.70E-04
14	1.63E+02	0.00	163.21	2.24E+06	1.40E+06	no	yes	2.24E+06	1.40E+06	no	yes	5.60E-04	7.20E-04
15	1.63E+02	0.00	162.91	2.76E+06	1.81E+06	no	yes	2.76E+06	1.81E+06	no	yes	1.33E-03	6.70E-04
16	1.62E+02	0.00	162.32	3.42E+06	2.37E+06	no	yes	3.42E+06	2.37E+06	no	yes	2.40E-04	4.50E-04
17	1.61E+02	0.00	161.41	4.23E+06	3.17E+06	no	yes	4.23E+06	3.17E+06	no	yes	2.15E-03	1.16E-03
18	1.60E+02	0.00	160.09	5.21E+06	4.35E+06	no	yes	5.21E+06	4.35E+06	no	yes	1.23E-03	5.00E-04
19	1.58E+02	0.01	158.24	6.33E+06	6.13E+06	no	yes	6.33E+06	6.13E+06	no	yes	5.40E-04	4.00E-04
20	1.56E+02	0.01	155.69	7.31E+06	8.83E+06	no	yes	7.31E+06	8.83E+06	no	yes	6.10E-04	7.50E-04
21	1.52E+02	0.01	152.13	7.36E+06	1.29E+07	no	yes	7.36E+06	1.29E+07	no	yes	7.00E-05	2.50E-03
22	1.47E+02	0.01	147.07	4.42E+06	1.87E+07	no	yes	4.42E+06	1.87E+07	no	yes	7.96E-03	1.53E-03
23	1.40E+02	0.01	139.71	-4.37E+06	2.55E+07	no	yes	-4.37E+06	2.55E+07	no	yes	1.45E-03	1.43E-02
24	1.29E+02	0.01	128.58	-2.03E+07	3.01E+07	no	yes	-2.03E+07	3.01E+07	no	yes	1.10E-02	6.79E-03
25	1.16E+02	0.01	116.41	-4.46E+07	2.34E+07	no	yes	-4.46E+07	2.34E+07	no	yes	3.09E-03	1.02E-02
26	9.00E+01	0.01	90.00	-5.36E+07	-1.50E+03	no	yes	-5.36E+07	-1.50E+03	no	yes	7.74E-03	2.46E-03
27	6.36E+01	0.01	63.59	-4.47E+07	-2.34E+07	no	yes	-4.47E+07	-2.34E+07	no	yes	6.00E-05	9.18E-03
28	5.14E+01	0.01	51.42	-2.05E+07	-3.01E+07	no	yes	-2.05E+07	-3.01E+07	no	yes	1.83E-02	4.30E-04
29	4.02E+01	0.01	40.29	-4.76E+06	-2.55E+07	no	yes	-4.76E+06	-2.55E+07	no	yes	1.39E-02	5.00E-05
30	3.28E+01	0.01	32.89	4.66E+06	-1.87E+07	no	yes	4.66E+06	-1.87E+07	no	yes	1.53E-03	1.14E-02
31	2.78E+01	0.01	27.84	7.40E+06	-1.29E+07	no	yes	7.40E+06	-1.29E+07	no	yes	1.34E-03	5.55E-03
32	2.42E+01	0.01	24.29	7.31E+06	-8.82E+06	no	yes	7.31E+06	-8.82E+06	no	yes	4.80E-04	6.80E-04
33	2.17E+01	0.01	21.74	6.32E+06	-6.12E+06	no	yes	6.32E+06	-6.12E+06	no	yes	8.80E-04	5.00E-05
34	1.99E+01	0.00	19.90	5.21E+06	-4.35E+06	no	yes	5.21E+06	-4.35E+06	no	yes	1.63E-03	3.10E-04
35	1.85E+01	0.00	18.59	4.23E+06	-3.17E+06	no	yes	4.23E+06	-3.17E+06	no	yes	6.10E-04	3.00E-05
36	1.76E+01	0.00	17.66	3.41E+06	-2.37E+06	no	yes	3.41E+06	-2.37E+06	no	yes	1.37E-03	8.70E-04
37	1.70E+01	0.00	17.06	2.76E+06	-1.81E+06	no	yes	2.76E+06	-1.81E+06	no	yes	2.63E-03	1.68E-03
38	1.67E+01	0.00	16.76	2.24E+06	-1.40E+06	no	yes	2.24E+06	-1.40E+06	no	yes	2.04E-03	1.36E-03
39	1.67E+01	0.00	16.74	1.81E+06	-1.11E+06	no	yes	1.81E+06	-1.11E+06	no	yes	5.40E-04	7.00E-05
40	1.69E+01	0.00	16.96	1.47E+06	-8.82E+05	no	yes	1.47E+06	-8.82E+05	no	yes	8.10E-04	4.60E-04
41	1.74E+01	0.00	17.46	1.19E+06	-7.09E+05	no	yes	1.19E+06	-7.09E+05	no	yes	1.31E-03	8.10E-04
42	1.83E+01	0.00	18.28	9.69E+05	-5.72E+05	no	yes	9.69E+05	-5.72E+05	no	yes	4.60E-04	1.60E-04
43	1.95E+01	0.00	19.49	7.83E+05	-4.64E+05	no	yes	7.83E+05	-4.64E+05	no	yes	3.40E-04	7.70E-04
44	2.12E+01	0.00	21.18	6.36E+05	-3.75E+05	no	yes	6.36E+05	-3.75E+05	no	yes	2.00E-04	1.30E-04
45	2.35E+01	0.00	23.55	5.16E+05	-3.01E+05	no	yes	5.16E+05	-3.01E+05	no	yes	3.10E-04	1.60E-04
46	2.69E+01	0.00	26.87	4.20E+05	-2.37E+05	no	yes	4.20E+05	-2.37E+05	no	yes	1.68E-03	1.23E-03
47	3.17E+01	0.00	31.72	3.45E+05	-1.80E+05	no	yes	3.45E+05	-1.80E+05	no	yes	1.26E-03	1.02E-03
48	3.90E+01	0.00	38.97	2.88E+05	-1.30E+05	no	yes	2.88E+05	-1.30E+05	no	yes	1.51E-03	7.30E-04
49	5.01E+01	0.00	50.15	2.52E+05	-8.44E+04	no	yes	2.52E+05	-8.44E+04	no	yes	5.60E-04	5.60E-04
50	6.72E+01	0.00	67.20	2.28E+05	-4.18E+04	no	yes	2.28E+05	-4.18E+04	no	yes	5.00E-04	3.30E-04
51	9.00E+01	0.00	90.00	2.19E+05	0.00E+00	no	yes	2.19E+05	0.00E+00	no	yes	7.00E-04	1.80E-04

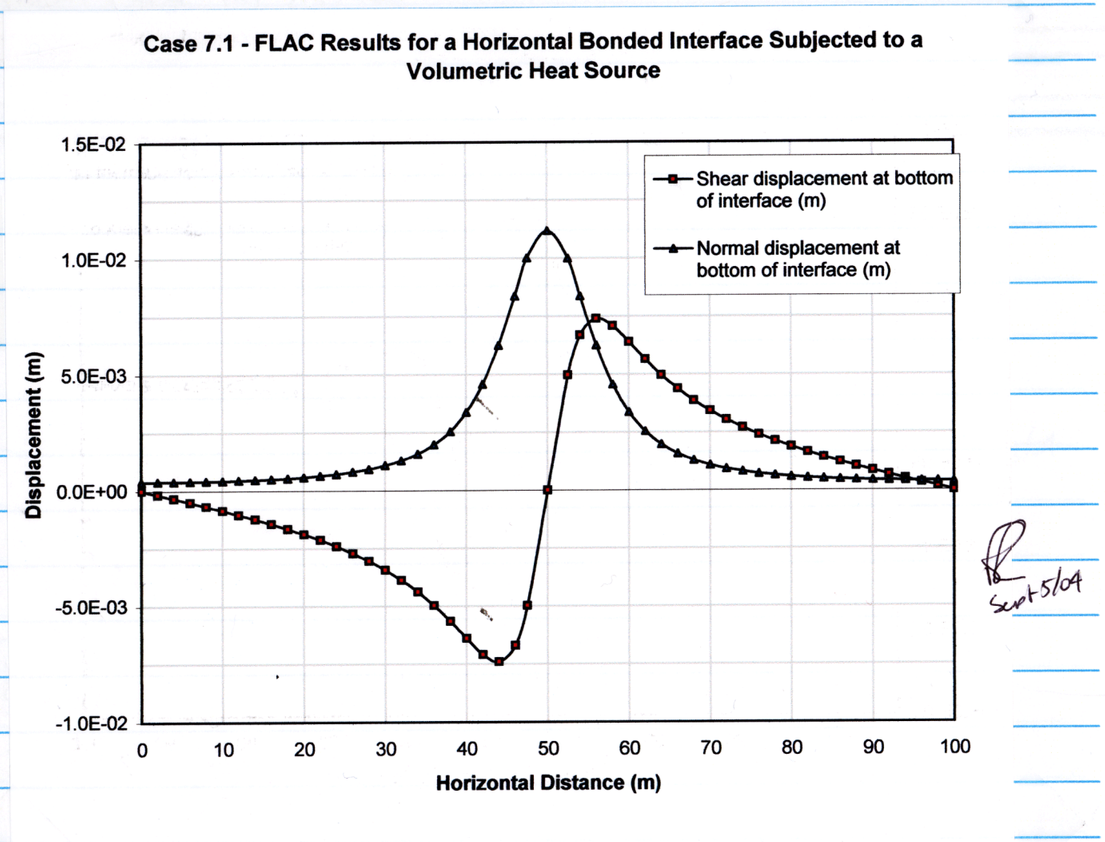
Summary table for FLAC case 7.1 from file F71.XLS. Note that the total displacement and Theta columns are calculated in EXCEL, and the 10 columns to the right are imported from FLAC output files created using the PRINT IF 1 command, and the PRINT SRATIO j=26,27 command.

Note that SRATIO in FLAC is force equilibrium ratio, not strength ratio as in UDEC. Therefore, require explicit calculation of Mohr-Coulomb strength ratio or strength factor (SF)

Define ~~FOS~~ SF (Sept 5/04) as $\frac{\text{s. strength}}{\text{s. stress}} = \frac{-\sigma_n \tan\phi_j + c_j}{|\sigma_s|}$ where σ_n = normal stress, σ_s = shear stress, ϕ_j = joint friction angle, c_j = joint cohesion, T_j = tensile strength of joint.

If σ_n is tensile (ie positive in FLAC) then ~~FOS~~ SF (Sept 5/04) $= \frac{\text{tensile strength}}{\text{tensile stress}} = \frac{\sigma_T}{\sigma_n} = \frac{T_j}{\sigma_n}$ (Sept 5/04)

SN654 Vol 1

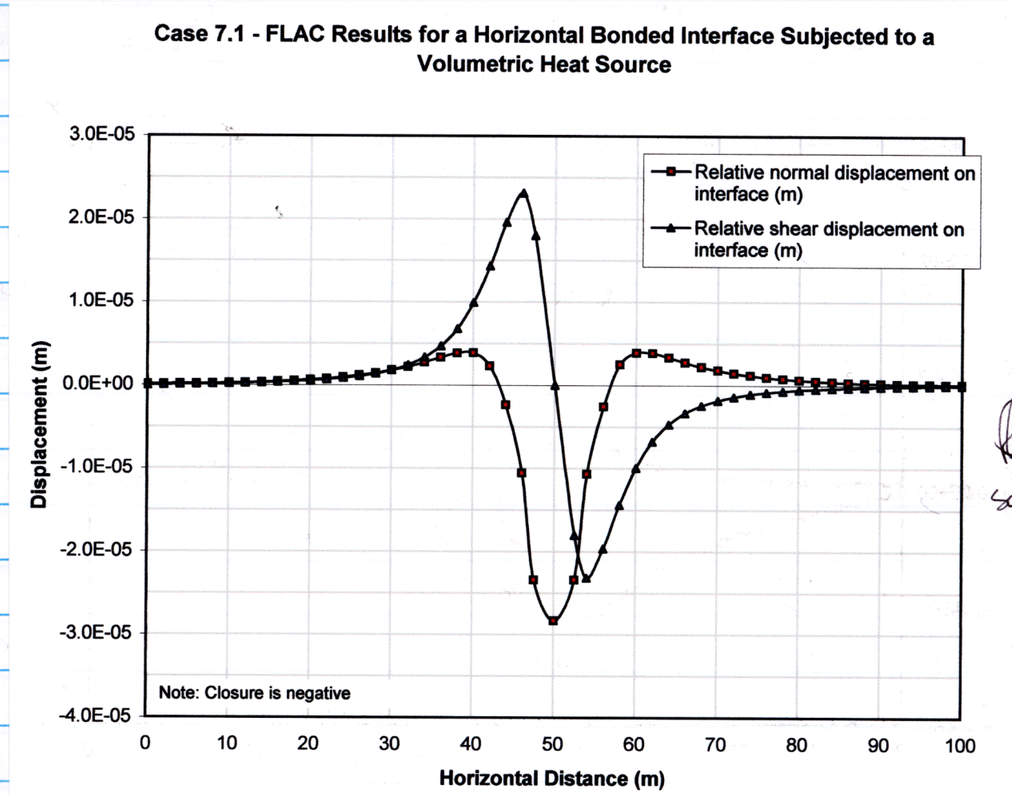


Sept 5/04

From F71.xls

Note that corresponding FLAC plots have mirror image form due to conventions adopted for plotting (positive below interface in this case) See figures on pages 157 and 158.

SN654 Vol 1

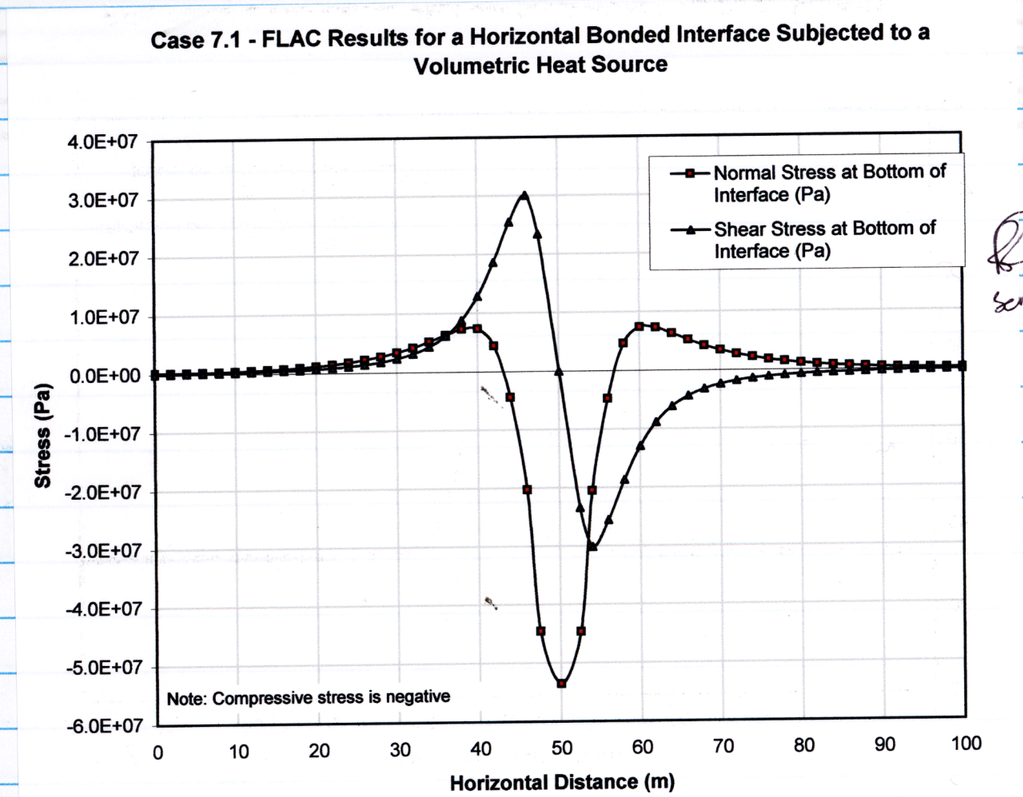


Sept 5/04

From F71.xls

Relative displacement between top and bottom of interface ($\delta_{top} - \delta_{bottom}$)

SNG54 Vol 1

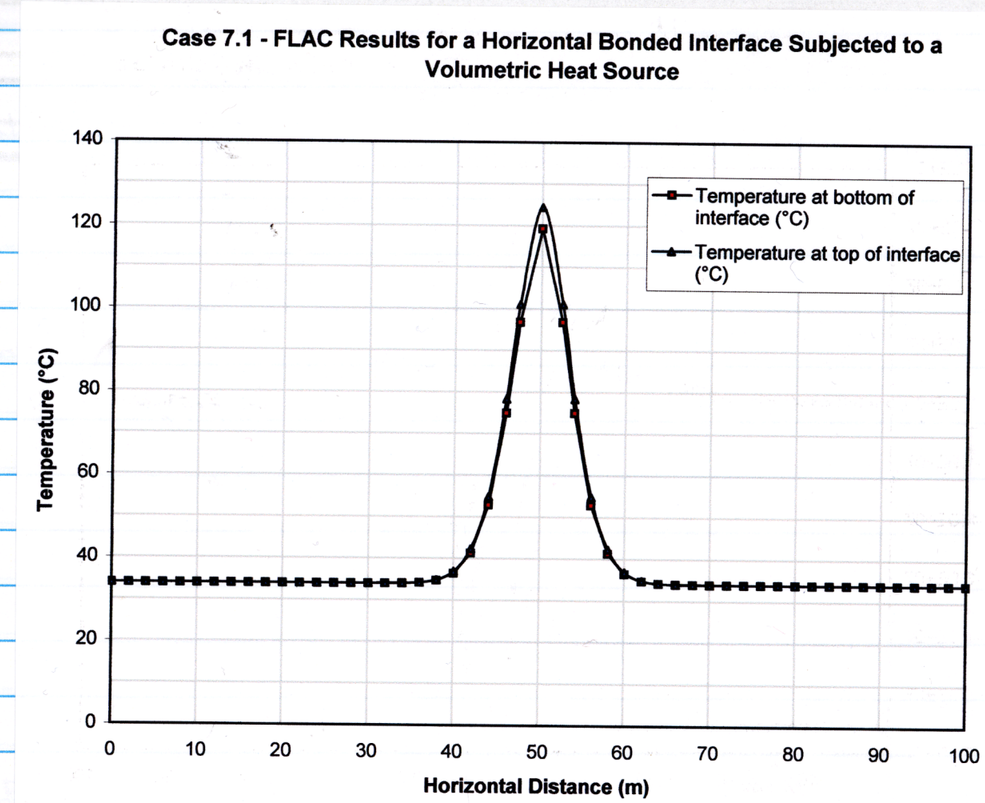


Sent 5/04

From file F71.xls

Note that plots are mirror image of FLAC output on pages 158 and 159 due to FLAC plotting convention (positive values plot below the interface location in this case).

SNG54 Vol 1



Sent 5/04

From file F71.xls

Note slight discrepancy in temperature - top is hotter than bottom.

Table 7.1 - Summary of FLAC Output for Case 7.1

Joint friction angle (°) 0
Joint cohesion (Pa) 1.00E+20
Joint tensile strength (Pa) 1.00E+20

I	Y coordinate (m)	X coordinate (m)	Distance along interface (m)	Shear displacement at bottom of interface (m)	Normal displacement at bottom of interface (m)	Shear displacement at top of interface (m)	Normal displacement at top of interface (m)	Relative normal displacement on interface (m)	Relative shear displacement on interface (m)
1	50.00	0.00	0.00	0.00E+00	3.92E-04	0.00E+00	3.92E-04	1.17E-07	0.00E+00
2	50.00	2.00	2.00	-1.66E-04	3.93E-04	-1.66E-04	3.94E-04	1.20E-07	3.22E-08
3	50.00	4.00	4.00	-3.33E-04	3.98E-04	-3.32E-04	3.98E-04	1.32E-07	6.54E-08
4	50.00	6.00	6.00	-5.02E-04	4.06E-04	-5.02E-04	4.06E-04	1.53E-07	1.01E-07
5	50.00	8.00	8.00	-6.75E-04	4.17E-04	-6.74E-04	4.17E-04	1.82E-07	1.39E-07
6	50.00	10.00	10.00	-8.52E-04	4.31E-04	-8.52E-04	4.32E-04	2.21E-07	1.81E-07
7	50.00	12.00	12.00	-1.04E-03	4.50E-04	-1.04E-03	4.51E-04	2.72E-07	2.31E-07
8	50.00	14.00	14.00	-1.23E-03	4.75E-04	-1.23E-03	4.75E-04	3.35E-07	2.89E-07
9	50.00	16.00	16.00	-1.43E-03	5.05E-04	-1.43E-03	5.06E-04	4.14E-07	3.57E-07
10	50.00	18.00	18.00	-1.65E-03	5.43E-04	-1.65E-03	5.43E-04	5.12E-07	4.41E-07
11	50.00	20.00	20.00	-1.88E-03	5.89E-04	-1.88E-03	5.90E-04	6.29E-07	5.46E-07
12	50.00	22.00	22.00	-2.13E-03	6.48E-04	-2.13E-03	6.48E-04	7.74E-07	6.79E-07
13	50.00	24.00	24.00	-2.40E-03	7.22E-04	-2.40E-03	7.22E-04	9.55E-07	8.53E-07
14	50.00	26.00	26.00	-2.71E-03	8.15E-04	-2.70E-03	8.16E-04	1.18E-06	1.08E-06
15	50.00	28.00	28.00	-3.04E-03	9.34E-04	-3.04E-03	9.35E-04	1.45E-06	1.39E-06
16	50.00	30.00	30.00	-3.43E-03	1.09E-03	-3.43E-03	1.09E-03	1.80E-06	1.82E-06
17	50.00	32.00	32.00	-3.87E-03	1.30E-03	-3.87E-03	1.30E-03	2.22E-06	2.44E-06
18	50.00	34.00	34.00	-4.38E-03	1.58E-03	-4.37E-03	1.58E-03	2.74E-06	3.35E-06
19	50.00	36.00	36.00	-4.97E-03	1.98E-03	-4.97E-03	1.98E-03	3.33E-06	4.71E-06
20	50.00	38.00	38.00	-5.65E-03	2.55E-03	-5.64E-03	2.55E-03	3.85E-06	6.79E-06
21	50.00	40.00	40.00	-6.40E-03	3.37E-03	-6.39E-03	3.38E-03	3.87E-06	9.92E-06
22	50.00	42.00	42.00	-7.09E-03	4.58E-03	-7.07E-03	4.58E-03	2.32E-06	1.44E-05
23	50.00	44.00	44.00	-7.40E-03	6.26E-03	-7.38E-03	6.26E-03	-2.37E-06	1.96E-05
24	50.00	46.00	46.00	-6.70E-03	8.37E-03	-6.67E-03	8.36E-03	-1.05E-05	2.32E-05
25	50.00	47.50	47.50	-4.98E-03	1.00E-02	-4.96E-03	9.98E-03	-2.34E-05	1.80E-05
26	50.00	50.00	50.00	1.01E-07	1.12E-02	9.97E-08	1.12E-02	-2.83E-05	-1.22E-09
27	50.00	52.50	52.50	4.98E-03	1.00E-02	4.96E-03	9.98E-03	-2.34E-05	-1.80E-05
28	50.00	54.00	54.00	6.70E-03	8.37E-03	6.67E-03	8.36E-03	-1.07E-05	-2.32E-05
29	50.00	56.00	56.00	7.40E-03	6.26E-03	7.39E-03	6.26E-03	-2.56E-06	-1.96E-05
30	50.00	58.00	58.00	7.09E-03	4.57E-03	7.07E-03	4.57E-03	2.48E-06	-1.44E-05
31	50.00	60.00	60.00	6.40E-03	3.37E-03	6.39E-03	3.37E-03	3.89E-06	-9.92E-06
32	50.00	62.00	62.00	5.65E-03	2.54E-03	5.65E-03	2.55E-03	3.85E-06	-6.79E-06
33	50.00	64.00	64.00	4.97E-03	1.98E-03	4.97E-03	1.98E-03	3.33E-06	-4.71E-06
34	50.00	66.00	66.00	4.38E-03	1.58E-03	4.37E-03	1.58E-03	2.74E-06	-3.35E-06
35	50.00	68.00	68.00	3.87E-03	1.30E-03	3.87E-03	1.30E-03	2.22E-06	-2.44E-06
36	50.00	70.00	70.00	3.43E-03	1.09E-03	3.43E-03	1.09E-03	1.80E-06	-1.82E-06
37	50.00	72.00	72.00	3.04E-03	9.33E-04	3.04E-03	9.34E-04	1.45E-06	-1.39E-06
38	50.00	74.00	74.00	2.71E-03	8.14E-04	2.70E-03	8.15E-04	1.18E-06	-1.08E-06
39	50.00	76.00	76.00	2.40E-03	7.22E-04	2.40E-03	7.22E-04	9.54E-07	-8.50E-07
40	50.00	78.00	78.00	2.13E-03	6.48E-04	2.13E-03	6.49E-04	7.75E-07	-6.78E-07
41	50.00	80.00	80.00	1.88E-03	5.90E-04	1.88E-03	5.91E-04	6.29E-07	-5.45E-07
42	50.00	82.00	82.00	1.65E-03	5.44E-04	1.65E-03	5.44E-04	5.10E-07	-4.40E-07
43	50.00	84.00	84.00	1.43E-03	5.06E-04	1.43E-03	5.07E-04	4.12E-07	-3.57E-07
44	50.00	86.00	86.00	1.23E-03	4.76E-04	1.23E-03	4.76E-04	3.35E-07	-2.89E-07
45	50.00	88.00	88.00	1.04E-03	4.51E-04	1.04E-03	4.52E-04	2.71E-07	-2.32E-07
46	50.00	90.00	90.00	8.52E-04	4.32E-04	8.52E-04	4.32E-04	2.21E-07	-1.82E-07
47	50.00	92.00	92.00	6.75E-04	4.17E-04	6.74E-04	4.17E-04	1.82E-07	-1.39E-07
48	50.00	94.00	94.00	5.02E-04	4.06E-04	5.02E-04	4.06E-04	1.52E-07	-1.00E-07
49	50.00	96.00	96.00	3.33E-04	3.98E-04	3.33E-04	3.98E-04	1.34E-07	-6.49E-08
50	50.00	98.00	98.00	1.66E-04	3.94E-04	1.66E-04	3.94E-04	1.20E-07	-3.21E-08
51	50.00	100.00	100.00	0.00E+00	3.92E-04	0.00E+00	3.92E-04	1.15E-07	0.00E+00

I	Temperature at bottom of interface (°C)	Temperature at top of interface (°C)	Total displacement at bottom of interface (m)	Theta at bottom of interface (°)	Total displacement at top of interface (m)	Theta at top of interface (°)	Normal Stress at Bottom of Interface (Pa)	Shear Stress at Bottom of Interface (Pa)
1	34.00	34.00	3.92E-04	90.00	3.92E-04	90.00	2.21E+05	0.00E+00
2	34.00	34.00	4.27E-04	112.84	4.27E-04	112.83	2.29E+05	4.19E+04
3	34.00	34.00	5.18E-04	129.89	5.19E-04	129.87	2.51E+05	8.50E+04
4	34.00	34.00	6.45E-04	141.05	6.45E-04	141.04	2.91E+05	1.31E+05
5	34.00	34.00	7.93E-04	148.29	7.93E-04	148.28	3.45E+05	1.81E+05
6	34.00	34.00	9.55E-04	153.15	9.55E-04	153.14	4.20E+05	2.36E+05
7	34.00	34.00	1.13E-03	156.52	1.13E-03	156.50	5.16E+05	3.00E+05
8	34.00	34.00	1.32E-03	158.88	1.32E-03	158.87	6.36E+05	3.75E+05
9	34.00	34.00	1.52E-03	160.57	1.52E-03	160.55	7.86E+05	4.64E+05
10	34.00	34.00	1.73E-03	161.77	1.73E-03	161.75	9.73E+05	5.73E+05
11	34.00	34.00	1.97E-03	162.59	1.97E-03	162.57	1.20E+06	7.09E+05
12	34.00	34.00	2.23E-03	163.08	2.23E-03	163.06	1.47E+06	8.83E+05
13	34.00	34.00	2.51E-03	163.29	2.51E-03	163.26	1.81E+06	1.11E+06
14	34.00	34.00	2.83E-03	163.24	2.83E-03	163.21	2.24E+06	1.40E+06
15	34.00	34.00	3.18E-03	162.94	3.18E-03	162.91	2.76E+06	1.81E+06
16	34.00	34.00	3.60E-03	162.36	3.60E-03	162.32	3.42E+06	2.37E+06
17	34.01	34.02	4.08E-03	161.45	4.08E-03	161.41	4.23E+06	3.17E+06
18	34.05	34.06	4.65E-03	160.13	4.65E-03	160.09	5.21E+06	4.35E+06
19	34.20	34.25	5.35E-03	158.29	5.35E-03	158.24	6.33E+06	6.13E+06
20	34.74	34.91	6.20E-03	155.75	6.19E-03	155.69	7.31E+06	8.83E+06
21	36.47	36.93	7.23E-03	152.19	7.23E-03	152.13	7.36E+06	1.29E+07
22	41.31	42.37	8.44E-03	147.14	8.43E-03	147.07	4.42E+06	1.87E+07
23	52.80	54.89	9.70E-03	139.77	9.68E-03	139.71	-4.37E+06	2.55E+07
24	74.95	78.37	1.07E-02	128.65	1.07E-02	128.58	-2.03E+07	3.01E+07
25	96.76	101.08	1.12E-02	116.44	1.11E-02	116.41	-4.46E+07	2.34E+07
26	119.30	124.44	1.12E-02	90.00	1.12E-02	90.00	-5.36E+07	-1.50E+03
27	96.76	101.08	1.12E-02	63.56	1.11E-02	63.59	-4.47E+07	-2.34E+07
28	74.95	78.37	1.07E-02	51.36	1.07E-02	51.42	-2.05E+07	-3.01E+07
29	52.80	54.89	9.70E-03	40.23	9.68E-03	40.29	-4.76E+06	-2.55E+07
30	41.31	42.37	8.43E-03	32.82	8.42E-03	32.89	4.66E+06	-1.87E+07
31	36.47	36.93	7.23E-03	27.77	7.22E-03	27.84	7.40E+06	-1.29E+07
32	34.74	34.91	6.20E-03	24.24	6.19E-03	24.29	7.31E+06	-8.82E+06
33	34.20	34.25	5.35E-03	21.69	5.35E-03	21.74	6.32E+06	-6.12E+06
34	34.05	34.06	4.65E-03	19.85	4.65E-03	19.90	5.21E+06	-4.35E+06
35	34.01	34.02	4.08E-03	18.55	4.08E-03	18.59	4.23E+06	-3.17E+06
36	34.00	34.00	3.60E-03	17.63	3.60E-03	17.66	3.41E+06	-2.37E+06
37	34.00	34.00	3.18E-03	17.03	3.18E-03	17.06	2.76E+06	-1.81E+06
38	34.00	34.00	2.83E-03	16.74	2.82E-03	16.76	2.24E+06	-1.40E+06
39	34.00	34.00	2.51E-03	16.71	2.51E-03	16.74	1.81E+06	-1.11E+06
40	34.00	34.00	2.23E-03	16.94	2.23E-03	16.96	1.47E+06	-8.82E+05
41	34.00	34.00	1.97E-03	17.44	1.97E-03	17.46	1.19E+06	-7.09E+05
42	34.00	34.00	1.74E-03	18.26	1.73E-03	18.28	9.69E+05	-5.72E+05
43	34.00	34.00	1.52E-03	19.47	1.52E-03	19.49	7.83E+05	-4.64E+05
44	34.00	34.00	1.32E-03	21.16	1.32E-03	21.18	6.36E+05	-3.75E+05
45	34.00	34.00	1.13E-03	23.53	1.13E-03	23.55	5.16E+05	-3.01E+05
46	34.00	34.00	9.55E-04	26.86	9.55E-04	26.87	4.20E+05	-2.37E+05
47	34.00	34.00	7.93E-04	31.70	7.93E-04	31.72	3.45E+05	-1.80E+05
48	34.00	34.00	6.45E-04	38.95	6.45E-04	38.97	2.88E+05	-1.30E+05
49	34.00	34.00	5.19E-04	50.14	5.19E-04	50.15	2.52E+05	-8.44E+04
50	34.00	34.00	4.27E-04	67.19	4.27E-04	67.20	2.28E+05	-4.18E+04
51	34.00	34.00	3.92E-04	90.00	3.92E-04	90.00	2.19E+05	0.00E+00

I	Slip	Bond	Normal Stress at Top of Interface (Pa)	Shear Stress at Top of Interface (Pa)	Slip	Bond	Sratio at top of interface	Sratio at bottom of interface	Strength Factor
1	no	yes	2.21E+05	0.00E+00	no	yes	8.00E-05	6.00E-05	4.53E+14
2	no	yes	2.29E+05	4.19E+04	no	yes	1.90E-04	2.50E-04	4.37E+14
3	no	yes	2.51E+05	8.50E+04	no	yes	5.20E-04	3.00E-04	3.99E+14
4	no	yes	2.91E+05	1.31E+05	no	yes	8.00E-05	6.80E-04	3.44E+14
5	no	yes	3.45E+05	1.81E+05	no	yes	1.20E-04	1.30E-04	2.90E+14
6	no	yes	4.20E+05	2.36E+05	no	yes	5.30E-04	3.10E-04	2.38E+14
7	no	yes	5.16E+05	3.00E+05	no	yes	1.46E-03	1.13E-03	1.94E+14
8	no	yes	6.36E+05	3.75E+05	no	yes	1.63E-03	7.90E-04	1.57E+14
9	no	yes	7.86E+05	4.64E+05	no	yes	4.40E-04	2.10E-04	1.27E+14
10	no	yes	9.73E+05	5.73E+05	no	yes	1.80E-04	1.29E-03	1.03E+14
11	no	yes	1.20E+06	7.09E+05	no	yes	2.10E-03	1.54E-03	8.37E+13
12	no	yes	1.47E+06	8.83E+05	no	yes	3.20E-03	1.18E-03	6.81E+13
13	no	yes	1.81E+06	1.11E+06	no	yes	6.90E-04	7.70E-04	5.51E+13
14	no	yes	2.24E+06	1.40E+06	no	yes	5.60E-04	7.20E-04	4.47E+13
15	no	yes	2.76E+06	1.81E+06	no	yes	1.33E-03	6.70E-04	3.63E+13
16	no	yes	3.42E+06	2.37E+06	no	yes	2.40E-04	4.50E-04	2.93E+13
17	no	yes	4.23E+06	3.17E+06	no	yes	2.15E-03	1.16E-03	2.37E+13
18	no	yes	5.21E+06	4.35E+06	no	yes	1.23E-03	5.00E-04	1.92E+13
19	no	yes	6.33E+06	6.13E+06	no	yes	5.40E-04	4.00E-04	1.58E+13
20	no	yes	7.31E+06	8.83E+06	no	yes	6.10E-04	7.50E-04	1.37E+13
21	no	yes	7.36E+06	1.29E+07	no	yes	7.00E-05	2.50E-03	1.36E+13
22	no	yes	4.42E+06	1.87E+07	no	yes	7.96E-03	1.53E-03	2.26E+13
23	no	yes	-4.37E+06	2.55E+07	no	yes	1.45E-03	1.43E-02	3.92E+12
24	no	yes	-2.03E+07	3.01E+07	no	yes	1.10E-02	6.79E-03	3.32E+12
25	no	yes	-4.46E+07	2.34E+07	no	yes	3.09E-03	1.02E-02	4.27E+12
26	no	yes	-5.36E+07	-1.50E+03	no	yes	7.74E-03	2.46E-03	6.68E+16
27	no	yes	-4.47E+07	-2.34E+07	no	yes	6.00E-05	9.18E-03	4.27E+12
28	no	yes	-2.05E+07	-3.01E+07	no	yes	1.83E-02	4.30E-04	3.32E+12
29	no	yes	-4.76E+06	-2.55E+07	no	yes	1.39E-02	5.00E-05	3.92E+12
30	no	yes	4.66E+06	-1.87E+07	no	yes	1.53E-03	1.14E-02	2.15E+13
31	no	yes	7.40E+06	-1.29E+07	no	yes	1.34E-03	5.55E-03	1.35E+13
32	no	yes	7.31E+06	-8.82E+06	no	yes	4.80E-04	6.80E-04	1.37E+13
33	no	yes	6.32E+06	-6.12E+06	no	yes	8.80E-04	5.00E-05	1.58E+13
34	no	yes	5.21E+06	-4.35E+06	no	yes	1.63E-03	3.10E-04	1.92E+13
35	no	yes	4.23E+06	-3.17E+06	no	yes	6.10E-04	3.00E-05	2.37E+13
36	no	yes	3.41E+06	-2.37E+06	no	yes	1.37E-03	8.70E-04	2.93E+13
37	no	yes	2.76E+06	-1.81E+06	no	yes	2.63E-03	1.68E-03	3.63E+13
38	no	yes	2.24E+06	-1.40E+06	no	yes	2.04E-03	1.36E-03	4.47E+13
39	no	yes	1.81E+06	-1.11E+06	no	yes	5.40E-04	7.00E-05	5.52E+13
40	no	yes	1.47E+06	-8.82E+05	no	yes	8.10E-04	4.60E-04	6.80E+13
41	no	yes	1.19E+06	-7.09E+05	no	yes	1.31E-03	8.10E-04	8.38E+13
42	no	yes	9.69E+05	-5.72E+05	no	yes	4.60E-04	1.60E-04	1.03E+14
43	no	yes	7.83E+05	-4.64E+05	no	yes	3.40E-04	7.70E-04	1.28E+14
44	no	yes	6.36E+05	-3.75E+05	no	yes	2.00E-04	1.30E-04	1.57E+14
45	no	yes	5.16E+05	-3.01E+05	no	yes	3.10E-04	1.60E-04	1.94E+14
46	no	yes	4.20E+05	-2.37E+05	no	yes	1.68E-03	1.23E-03	2.38E+14
47	no	yes	3.45E+05	-1.80E+05	no	yes	1.26E-03	1.02E-03	2.90E+14
48	no	yes	2.88E+05	-1.30E+05	no	yes	1.51E-03	7.30E-04	3.47E+14
49	no	yes	2.52E+05	-8.44E+04	no	yes	5.60E-04	5.60E-04	3.97E+14
50	no	yes	2.28E+05	-4.18E+04	no	yes	5.00E-04	3.30E-04	4.38E+14
51	no	yes	2.19E+05	0.00E+00	no	yes	7.00E-04	1.80E-04	4.56E+14

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Revised table from F71.xls to include Strength Factor

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Modified FFLATIRES.TXT to create temperature history file F7FTEMP.OUT → imported to EXCEL to create plots and saved as F7FTEMP.XLS. Temperature histories taken @ points K, L, M, N, O, P (at respective distances of 0, 2, 5, 15, 30, and ~~100~~ 55 m (RL Sep 6/04) from the center of the heat source).

* Note: History 4 is at the wrong j value → should be j = 32.

Also want to include extra variables and run DISPMAG.FIS to create contour plot of displacements.

→ create modified version of FFLAT1.TXT named F71INPUT.TXT

- include DISPMAG. and 10 extra Fish Variables in case there are additional plots required.
- correct APPLY boundary conditions and incorporate FFLATIRES.TXT commands to create all necessary tables and arrays.
- adjust history points from j = 31 to j = 32.

FLAC 4.0 input file F71INPUT.TXT is attached to pages 174 and 175. Additional data plots generated using this file are attached to the pages following the input file.

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```
; Case 7.1 - FLAC 4.0 input file (Sep 6, 2004; RSR)
;
; Flat transgressing joint in a heated infinite rock mass.
Joint
; properties selected to prevent slippage.  Heat source 5x5 m
centered
; at x=50, y=45. Power is 2000 W/cu.m.
;
config thermal extra 10
call dispmag.fis
;
; Geometry
;
grid 50 51
model elastic th_isotropic
mod null j=26
gen 0,0 0,50 100,50 100,0 i=1,51 j=1,26
gen 0,50 0,100 100,100 100,50 i=1,51 j=27,52
int 1 aside from 1,26 to 51,26 bside from 1,27 to 51,27
ini x=47.5 i=25
ini x=52.5 i=27
ini y=42.5 j=22
ini y=45 j=23
ini y=47 j=24
ini y=47.5 j=25
ini y=75 j=39
gen line 47.5,42.5 47.5,47.5 mark
gen line 47.5,47.5 52.5,47.5 mark
gen line 52.5,47.5 52.5,42.5 mark
gen line 47.5,42.5 52.5,42.5 mark
;
; Material properties
;
prop de=2210.0 b=19.0e9 s=13.0e9
prop thexp=15.0e-6 cond=20.0 spec=1000.0
int 1 kn=19.0e11 ks=13.0e11
int 1 c=1.0e20 f=0.0 t=1.0e20 di=0
;
; Initial conditions
;
ini tem 34.0
;
; Boundary conditions
;
apply yvel 0.0 j=1
apply yvel 0.0 j=52
apply xvel 0.0 i=1 j=1,26
apply xvel 0.0 i=1 j=27,52
apply xvel 0.0 i=51 j=1,26
apply xvel 0.0 i=51 j=27,52
;
; Apply heat source
;
interior source 2000 i=25,26 j=22,24
;
set mech on therm off
step 2000
ini xd 0
ini yd 0
ini xv 0
ini yv 0
;
; Time and force history
;
hist unbalanced ;1
hist thtime ; 2
;
; Thermal histories
;
hist temp i=26 j=23 ;3
hist temp i=26 j=24 ;4
hist temp i=26 j=27 ;5
hist temp i=26 j=32 ;6
hist temp i=26 j=39 ;7
hist temp i=26 j=52 ;8
;
; Mechanical histories
;
hist ydisp i=26 j=23 ;9
hist ydisp i=26 j=24 ;10
hist ydisp i=26 j=27 ;11
hist ydisp i=26 j=32 ;12
hist ydisp i=26 j=39 ;13
hist ydisp i=26 j=52 ;14
;
hist xdisp i=26 j=23 ;15
hist xdisp i=26 j=24 ;16
hist xdisp i=26 j=27 ;17
hist xdisp i=26 j=32 ;18
hist xdisp i=26 j=39 ;19
hist xdisp i=26 j=52 ;20
;
; Thermal mechanical analysis
;
set mech off therm on
set thdt 1e2
solve age 100000
set mech on therm off
step 2000
set mech off therm on
solve age 200000
set mech on therm off
step 2000
set mech off therm on
solve age 300000
set mech on therm off
step 2000
set mech off therm on
solve age 400000
set mech on therm off
step 2000
set mech off therm on
solve age 500000
set mech on therm off
step 2000
set mech off therm on
solve age 600000
set mech on therm off
step 2000
set mech off therm on
solve age 700000
set mech on therm off
step 2000
set mech off therm on
solve age 800000
set mech on therm off
step 2000
set mech off therm on
solve age 900000
set mech on therm off
step 2000
set mech off therm on
solve age 1000000
set mech on therm off
step 2000
disp_mag
save f71final.sav
;
set plot emf color
title
Case 7.1 Horizontal Transgressing Joint (FLAC, No Slip
Allowed)
;
set out f71grid.emf
plot gri bou iw
copy
;
; Joint condition plots
;
set out f71jnd.emf
plot if 1 ndisp
copy
;
set out f71jsd.emf
plot if 1 sdisp
copy
;
set out f71jss.emf
plot if 1 ss
copy
;
set out f71jns.emf
plot if 1 ns
copy
;
set out f71jrnd.emf
plot if 1 closure
copy
;
set out f71jrsd.emf
plot if 1 ride
copy
;
; Contour plots
;
set out f71temp.emf
plot temp fill temp iw bou iw
copy
;
set out f71disp.emf
plot ex_1 fill ex_1 alias 'Displacement' disp bou iw
copy
;
set out f71xd.emf
plot xd fill xd iw bou iw
copy
;
set out f71yd.emf
plot yd fill yd iw bou iw
copy
```

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iw

iw

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FLAC input file F71INPUT.TXT for Case 7.1

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```
;
set out f71sig1.emf
plot sig1 fill sig1 iw bou iw
copy
;
set out f71sig2.emf
plot sig2 fill sig2 iw bou iw
copy
;
set out f71sdif.emf
plot sdiff fill sdiff iw bou iw
copy
;
set out f71thist.emf
plo hist 3 4 5 6 7 8 vs 2
copy
;
set out f71ydhist.emf
plo hist 9 10 11 12 13 14 vs 2
copy
;
set out f71xdhist.emf
plo hist 15 16 17 18 19 20 vs 2
copy
;
set out f71unbal.emf
plo hist 1
copy
;
set hisfile f71temp.his
his write 3 4 5 6 7 8 vs 2 begin 1 skip 10
;
set hisfile f71yd.his
his write 9 10 11 12 13 14 vs 2 begin 1 skip 10
;
set hisfile f71xd.his
his write 15 16 17 18 19 20 vs 2 begin 1 skip 10
;
def xxx
  nn=561
end
xxx
def table_fill
  array f71(11,nn)
;
; Bottom of interface
;
thvalr=thvald*pi/180.0
  loop i (1,igp)
    xnot=x(1,26)
    ynot=y(1,26)
    xval=x(i,26)
    yval=y(i,26)
    lval=sqrt(((xval-xnot)*(xval-xnot))+((yval-ynot)*(yval-
ynot)))
    dxvalb=xdisp(i,26)
    dyvalb=ydisp(i,26)
    dsvalb=dxvalb*cos(thvalr)-dyvalb*sin(thvalr)
    dnvalb=dxvalb*sin(thvalr)+dyvalb*cos(thvalr)
;
; Top of interface
;
    dxvalt=xdisp(i,27)
    dyvalt=ydisp(i,27)
    dsvalt=dxvalt*cos(thvalr)-dyvalt*sin(thvalr)
    dnvalt=dxvalt*sin(thvalr)+dyvalt*cos(thvalr)
;
; Interface
;
    dclos=dnvalt-dnvalb
    dride=dsvalt-dsvalb
    tempvalb=temp(i,26)
    tempvalt=temp(i,27)
;
; Create table entries
;
    table(1,i)=yval
    table(2,i)=xval
    table(3,i)=lval
    table(4,i)=dsvalb
    table(5,i)=dnvalb
    table(6,i)=dsvalt
    table(7,i)=dnvalt
    table(8,i)=dclos
    table(9,i)=dride
    table(10,i)=tempvalb
    table(11,i)=tempvalt
;
; Array entries
;
    f71(1,i)=string(yval)
    f71(2,i)=string(xval)
    f71(3,i)=string(lval)
    f71(4,i)=string(dsvalb)
    f71(5,i)=string(dnvalb)
    f71(6,i)=string(dsvalt)
    f71(7,i)=string(dnvalt)
    f71(8,i)=string(dclos)
    f71(9,i)=string(dride)
    f71(10,i)=string(tempvalb)
    f71(11,i)=string(tempvalt)
  endLoop
  status=open('f71data.out',1,1)
  status=write(f71,561)
end
;
set thvald=0.0
table_fill
ret
```

Added Sept 6/04.

```
set log f71SLIP.OUT
print if 1
set log f71SR.out
print sratio j=26,27
```

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FLAC input file F71INPUT.TXT for Case 7.1

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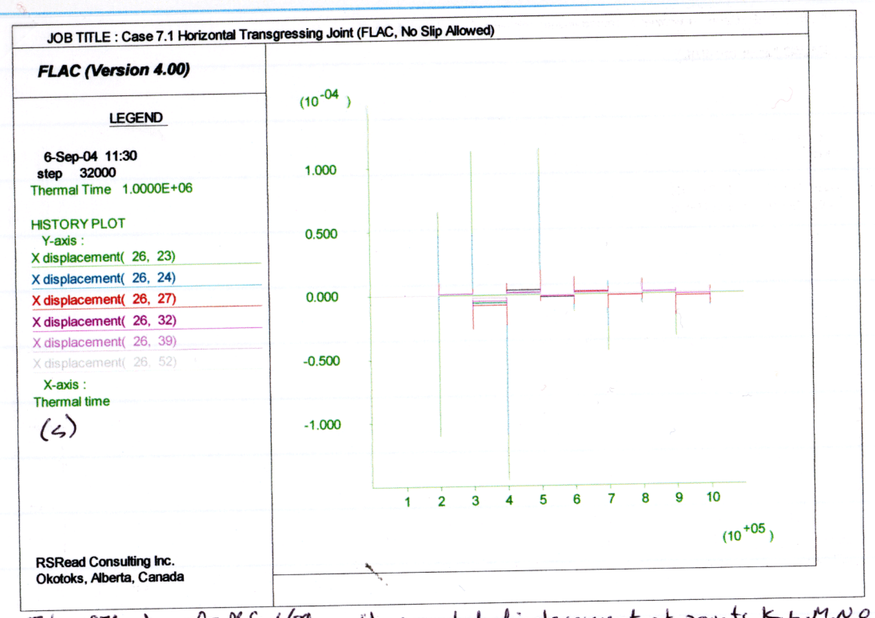

File ~~f71xd.emf~~ ~~PK Sep 6/04~~ f71xdhist.emf Horizontal displacement at points K, L, M, N, O, P versus time (s)

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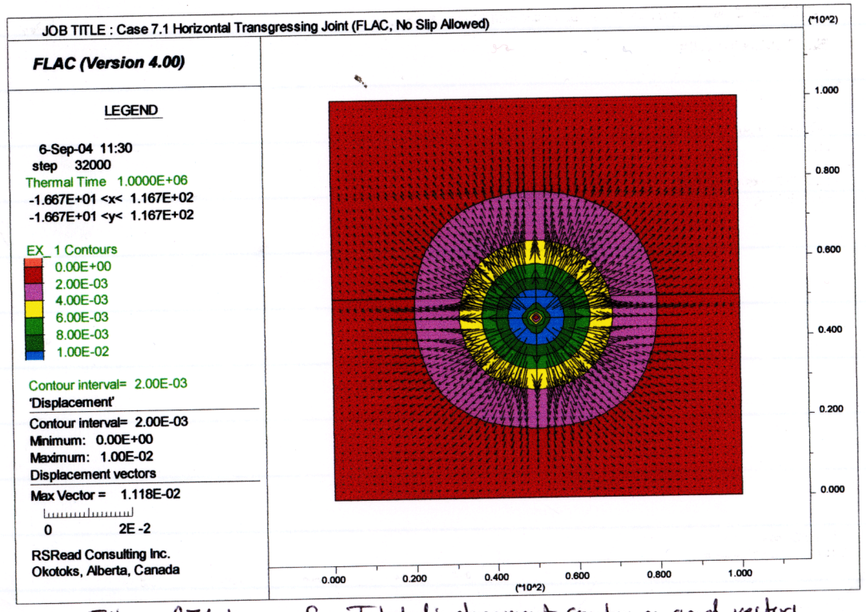

File f71disp.emf Total displacement contours and vectors

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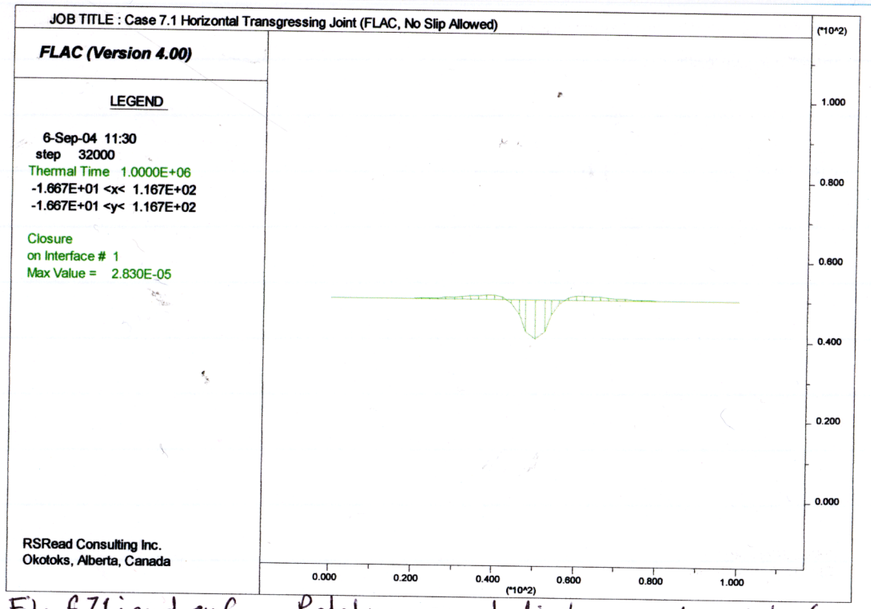

File f71jrnd.emf Relative normal displacement on interface.

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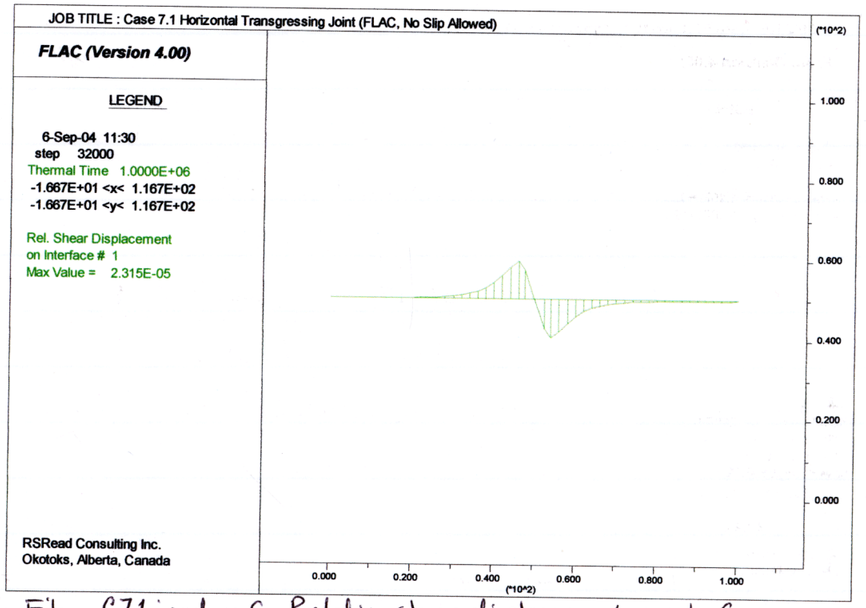
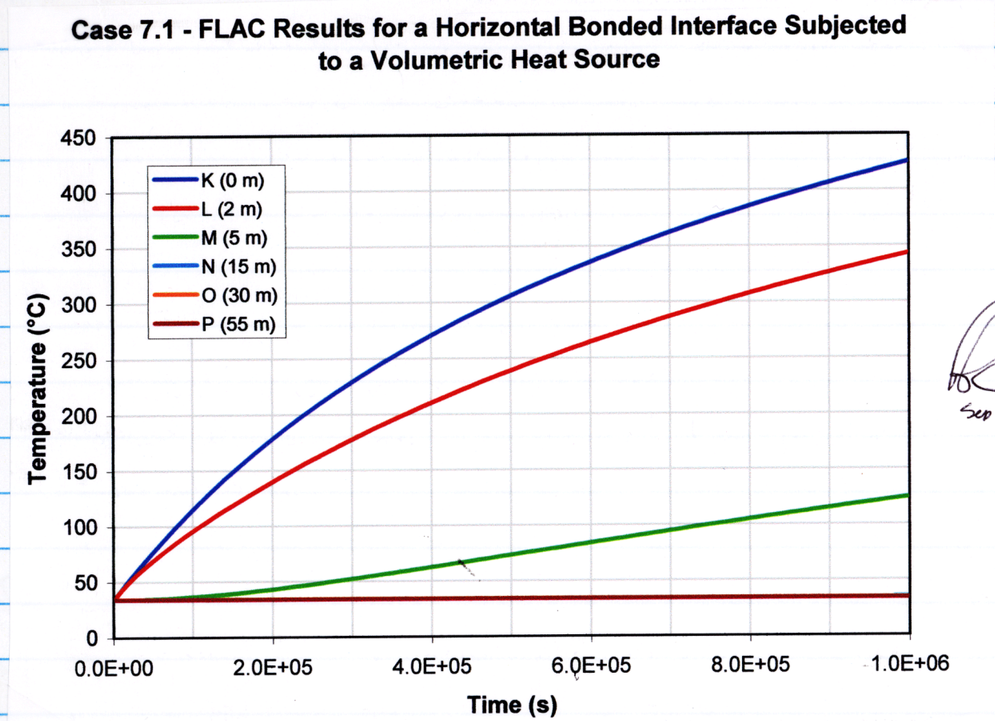


File f71jrsd.emf Relative shear displacement on interface.



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Temperature history from EXCEL file F71 TEMP.xls created by importing data from file f71temp.his

The plots on pages 168, 169, 170, 171 and 178 provide the basis for a quantitative comparison between FLAC 4.0 and UDEC if similar plots can be generated from UDEC data.

Contour plots of temperature, displacement, x-displacement and y-displacement provide qualitative comparison between outputs from the two codes.

Case 7.1 (FLAC) - Summary of Results

This case is representative of any situation where the initial stress is zero in the model (ie, the orientation of the joint is not important in terms of the in situ stress field). This case looks strictly at the thermally-induced stresses and their impact on a bonded joint.

As shown in the table on page 172, the maximum temperature along the joint reaches 124°C from an initial temperature of 34°C. There is no slip along the joint, and no tensile debonding. The maximum temperature at the center of the volumetric heat source is 425°C. The other important results from the analysis are as follows:

- maximum displacement $1.118e^{-2}$ m. → see table.

Parameter	Max	Min
i	51	1
Y coordinate (m)	50	50
X coordinate (m)	100	0
Distance along interface (m)	100	0
Shear displacement at bottom of interface (m)	7.405E-03	-7.405E-03
Normal displacement at bottom of interface (m)	1.118E-02	3.919E-04
Shear displacement at top of interface (m)	7.385E-03	-7.385E-03
Normal displacement at top of interface (m)	1.115E-02	3.920E-04
Relative normal displacement on interface (m)	3.891E-06	-2.831E-05
Relative shear displacement on interface (m)	2.315E-05	-2.315E-05
Temperature at bottom of interface (°C)	119.30	34.00
Temperature at top of interface (°C)	124.44	34.00
Total displacement at bottom of interface (m)	1.118E-02	3.919E-04
Theta at bottom of interface (°)	163.29	16.71
Total displacement at top of interface (m)	1.115E-02	3.920E-04
Theta at top of interface (°)	163.26	16.74
Normal stress at bottom of interface (Pa)	7.396E+06	-5.356E+07
Shear stress at bottom of interface (Pa)	3.010E+07	-3.009E+07
Slip	-	-
Bond	-	-
Normal stress at top of interface (Pa)	7.396E+06	-5.356E+07
Shear stress at top of interface (Pa)	3.010E+07	-3.009E+07
Slip	-	-
Bond	-	-
Sratio at top of interface	1.83E-02	6.00E-05
Sratio at bottom of interface	1.43E-02	3.00E-05
Strength factor	6.68E+16	3.32E+12

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From F71.xls EXCEL file.

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Case 7.2 (FLAC) - Horizontal Transgressing Joint (Slip Allowed)

Modified FLAC input file to create F72 INPUT.TXT. (see pgs 181, 182)

Changed interface properties to the following

- joint cohesion 100 kPa
- joint friction 20°
- joint tensile strength 1 MPa.
- joint normal stiffness 190 GPa
- joint shear stiffness 130 GPa

All other boundary and initial conditions unchanged.

Select plots follow

Summary of Results - Case 7.2 (FLAC)

In this case, slippage occurs as a result of the lowered cohesion of the interface. There is a portion of the interface near the center of the grid that does not slip as a result of high normal stress clamping the interface at this location. Slippage is reflected in all the displacement plots on pages 183, 184, 186 and 187. Similar plots generated in EXCEL using input from FLAC data files show the same trends. The most striking difference between Case 7.2 and Case 7.1 plots is the difference in response between the top and bottom of the interface

The results from Case 7.2 are summarized in the tables on pages 189 and 195. These results provide the basis for a quantitative comparison with results from UDEC.

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```
; Case 7.2 - FLAC 4.0 input file (Sep 6, 2004; RSR)
;
; Flat transgressing joint in a heated infinite rock mass.
Joint
; properties selected to allow slippage.  Heat source 5x5 m
centered
; at x=50, y=45. Power is 2000 W/cu.m.
;
config thermal extra 10
call dispmag.fis
;
; Geometry
;
grid 50 51
model elastic th_isotropic
mod null j=26
gen 0,0 0,50 100,50 100,0 i=1,51 j=1,26
gen 0,50 0,100 100,100 100,50 i=1,51 j=27,52
int 1 aside from 1,26 to 51,26 bside from 1,27 to 51,27
ini x=47.5 i=25
ini x=52.5 i=27
ini y=42.5 j=22
ini y=45 j=23
ini y=47 j=24
ini y=47.5 j=25
ini y=75 j=39
gen line 47.5,42.5 47.5,47.5 mark
gen line 47.5,47.5 52.5,47.5 mark
gen line 52.5,47.5 52.5,42.5 mark
gen line 47.5,42.5 52.5,42.5 mark
;
; Material properties
;
prop de=2210.0 b=19.0e9 s=13.0e9
prop thexp=15.0e-6 cond=20.0 spec=1000.0
int 1 kn=19.0e10 ks=13.0e10
int 1 c=100.0e3 f=20.0 t=1.0e6 di=0
;
; Initial conditions
;
ini tem 34.0
;
; Boundary conditions
;
apply yvel 0.0 j=1
apply yvel 0.0 j=52
apply xvel 0.0 i=1 j=1,26
apply xvel 0.0 i=1 j=27,52
apply xvel 0.0 i=51 j=1,26
apply xvel 0.0 i=51 j=27,52
;
; Apply heat source
;
interior source 2000 i=25,26 j=22,24
;
set mech on therm off
step 2000
ini xd 0
ini yd 0
ini xv 0
ini yv 0
;
; Time and force history
;
hist unbalanced ;1
hist thtime ; 2
;
; Thermal histories
;
hist temp i=26 j=23 ;3
hist temp i=26 j=24 ;4
hist temp i=26 j=27 ;5
hist temp i=26 j=32 ;6
hist temp i=26 j=39 ;7
hist temp i=26 j=52 ;8
;
; Mechanical histories
;
hist ydisp i=26 j=23 ;9
hist ydisp i=26 j=24 ;10
hist ydisp i=26 j=27 ;11
hist ydisp i=26 j=32 ;12
hist ydisp i=26 j=39 ;13
hist ydisp i=26 j=52 ;14
;
hist xdisp i=26 j=23 ;15
hist xdisp i=26 j=24 ;16
hist xdisp i=26 j=27 ;17
hist xdisp i=26 j=32 ;18
hist xdisp i=26 j=39 ;19
hist xdisp i=26 j=52 ;20
;
; Thermal mechanical analysis
;
set mech off therm on
set thdt 1e2
solve age 100000
set mech on therm off
step 2000
set mech off therm on
solve age 200000
set mech on therm off
step 2000
set mech off therm on
solve age 300000
set mech on therm off
step 2000
set mech off therm on
solve age 400000
set mech on therm off
step 2000
set mech off therm on
solve age 500000
set mech on therm off
step 2000
set mech off therm on
solve age 600000
set mech on therm off
step 2000
set mech off therm on
solve age 700000
set mech on therm off
step 2000
set mech off therm on
solve age 800000
set mech on therm off
step 2000
set mech off therm on
solve age 900000
set mech on therm off
step 2000
set mech off therm on
solve age 1000000
set mech on therm off
step 2000
disp_mag
save f72final.sav
;
set plot emf color
title
Case 7.2 Horizontal Transgressing Joint (FLAC, Slip Allowed)
;
set out f72grid.emf
plot gri bou iw
copy
;
; Joint condition plots
;
set out f72jnd.emf
plot if 1 ndisp
copy
;
set out f72jsd.emf
plot if 1 sdisp
copy
;
set out f72jss.emf
plot if 1 ss
copy
;
set out f72jns.emf
plot if 1 ns
copy
;
set out f72jrnd.emf
plot if 1 closure
copy
;
set out f72jrsd.emf
plot if 1 ride
copy
;
; Contour plots
;
set out f72temp.emf
plot temp fill temp iw bou iw
copy
;
set out f72disp.emf
plot ex_1 fill ex_1 iw alias 'Displacement' disp iw bou iw
copy
;
set out f72xd.emf
plot xd fill xd iw bou iw
copy
;
set out f72yd.emf
plot yd fill yd iw bou iw
copy
;
```

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File F72 INPUT.TXT (FLAC input).

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```
set out f72sig1.emf
plot sig1 fill sig1 iw bou iw
copy
;
set out f72sig2.emf
plot sig2 fill sig2 iw bou iw
copy
;
set out f72sdif.emf
plot sdiff fill sdiff iw bou iw
copy
;
set out f72thist.emf
plo hist 3 4 5 6 7 8 vs 2
copy
;
set out f72ydhist.emf
plo hist 9 10 11 12 13 14 vs 2
copy
;
set out f72xdhist.emf
plo hist 15 16 17 18 19 20 vs 2
copy
;
set out f72unbal.emf
plo hist 1
copy
;
set hisfile f72temp.his
his write 3 4 5 6 7 8 vs 2 begin 1 skip 10
;
set hisfile f72yd.his
his write 9 10 11 12 13 14 vs 2 begin 1 skip 10
;
set hisfile f72xd.his
his write 15 16 17 18 19 20 vs 2 begin 1 skip 10
;
def xxx
  nn=561
end
xxx
def table_fill
  array f72(11,nn)
;
; Bottom of interface
;
thvalr=thvald*pi/180.0
  loop i (1,igp)
    xnot=x(1,26)
    ynot=y(1,26)
    xval=x(i,26)
    yval=y(i,26)
    lval=sqrt(((xval-xnot)*(xval-xnot))+((yval-ynot)*(yval-
ynot)))
    dxvalb=xdisp(i,26)
    dyvalb=ydisp(i,26)
    dsvalb=dxvalb*cos(thvalr)-dyvalb*sin(thvalr)
    dnvalb=dxvalb*sin(thvalr)+dyvalb*cos(thvalr)
;
; Top of interface
;
    dxvalt=xdisp(i,27)
    dyvalt=ydisp(i,27)
    dsvalt=dxvalt*cos(thvalr)-dyvalt*sin(thvalr)
    dnvalt=dxvalt*sin(thvalr)+dyvalt*cos(thvalr)
;
; Interface
;
    dclos=dnvalt-dnvalb
    dride=dsvalt-dsvalb
    tempvalb=temp(i,26)
    tempvalt=temp(i,27)
;
; Create table entries
;
    table(1,i)=yval
    table(2,i)=xval
    table(3,i)=lval
    table(4,i)=dsvalb
    table(5,i)=dnvalb
    table(6,i)=dsvalt
    table(7,i)=dnvalt
    table(8,i)=dclos
    table(9,i)=dride
    table(10,i)=tempvalb
    table(11,i)=tempvalt
;
; Array entries
;
    f72(1,i)=string(yval)
    f72(2,i)=string(xval)
    f72(3,i)=string(lval)
    f72(4,i)=string(dsvalb)
    f72(5,i)=string(dnvalb)
    f72(6,i)=string(dsvalt)
    f72(7,i)=string(dnvalt)
    f72(8,i)=string(dclos)
    f72(9,i)=string(dride)
    f72(10,i)=string(tempvalb)
    f72(11,i)=string(tempvalt)
  endLoop
  status=open('f72data.out',1,1)
  status=write(f72,561)
end
;
set thvald=0.0
table_fill
;
set log f72slip.out
pr if 1
set log f72sr.out
pr sratio j=26,27
ret
```

R
Sep 6/04

Pg 2 of 2

File F72INPUT.TXT (FLAC input)

Blank R. Sep 6/04.

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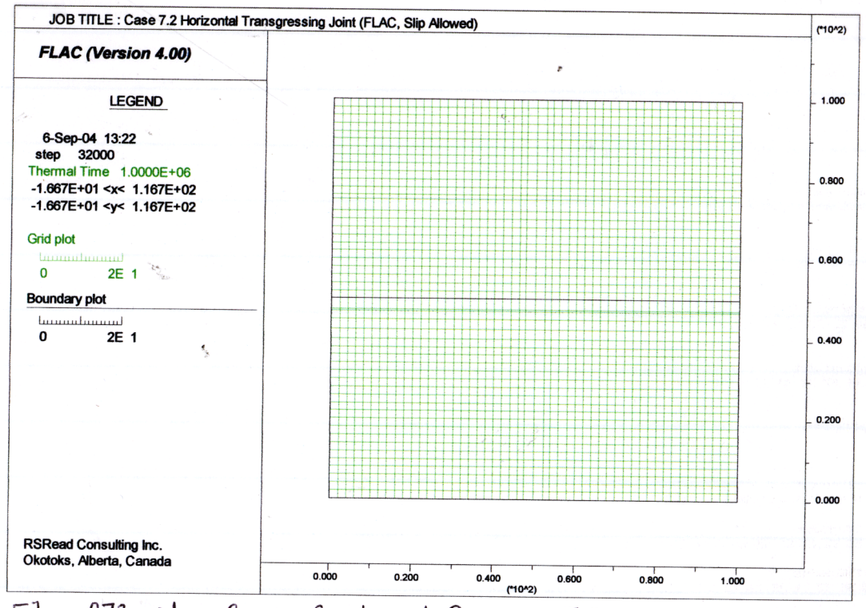
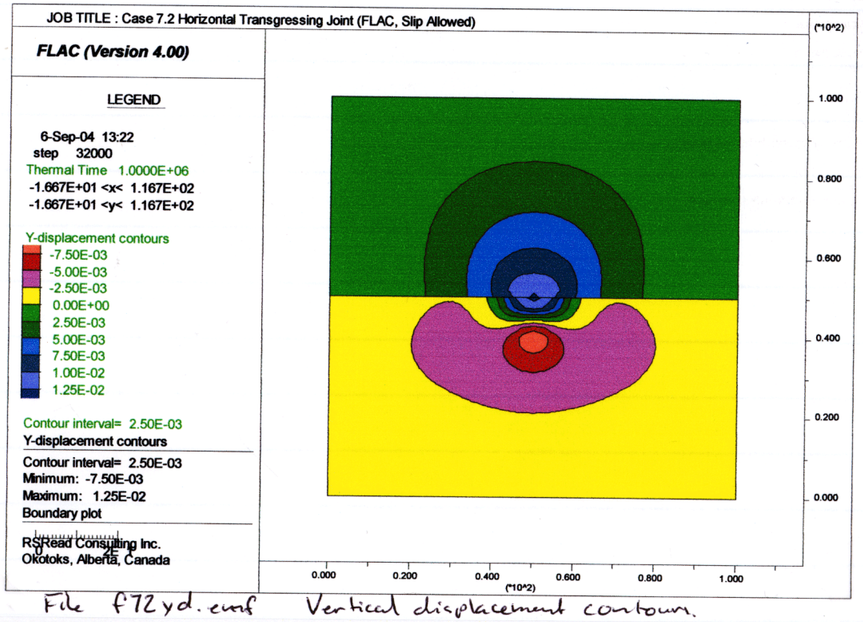


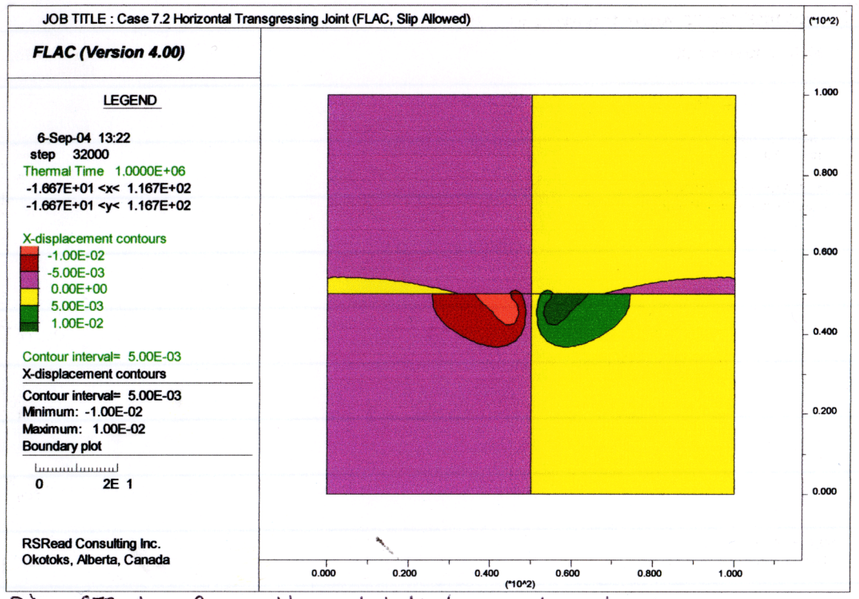
File f72grid.emf Grid used for case 7.2

R
Sep 6/04



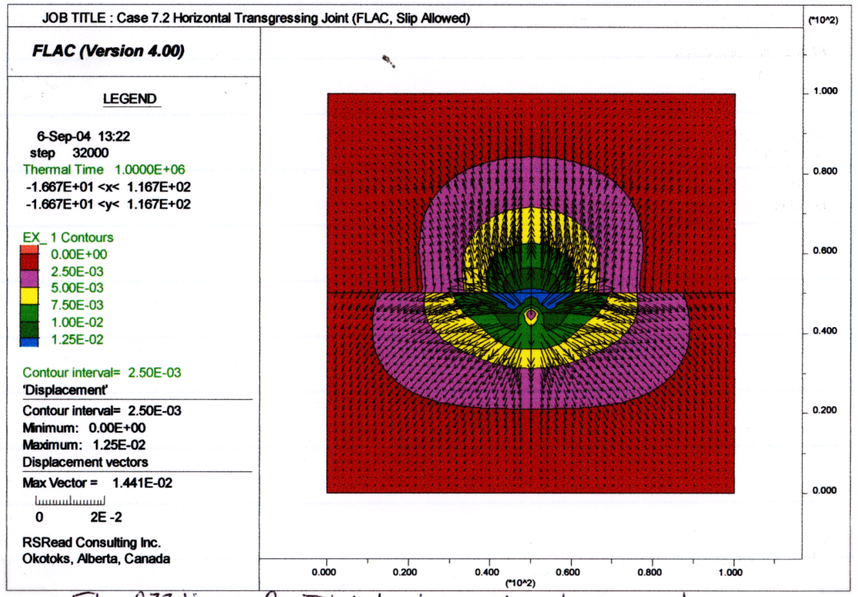
File f72yd.emf Vertical displacement contours.

SN 654 Vol 1



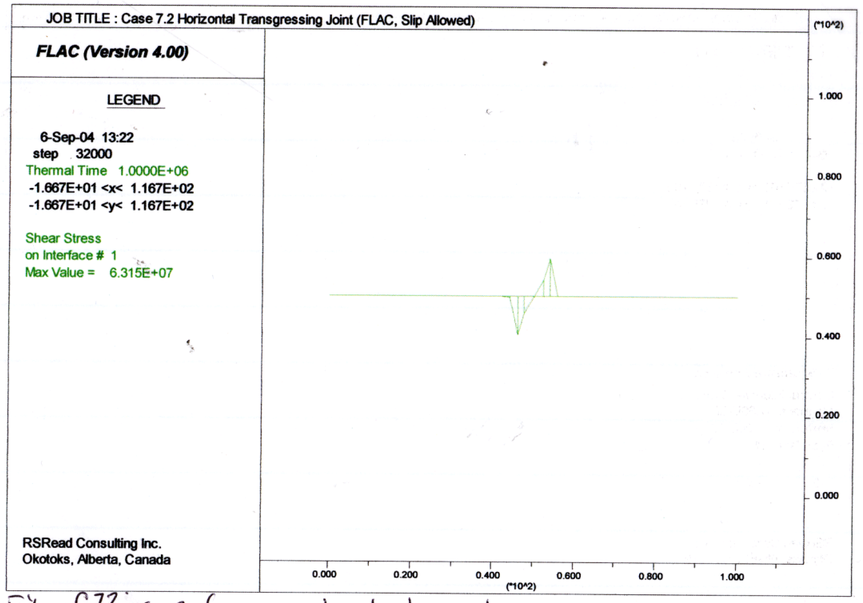
File f72xd.emf Horizontal displacement contours

Sep 6/04



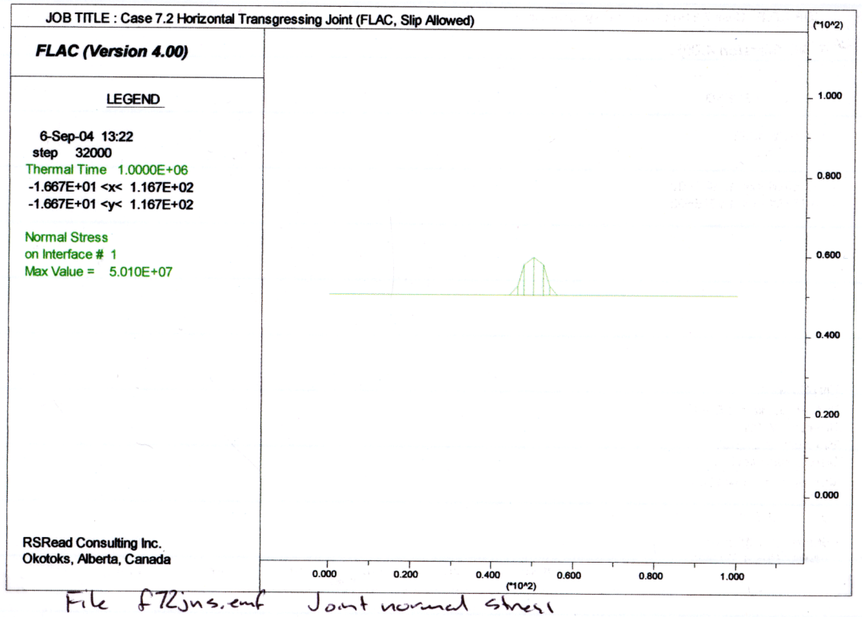
File f72disp.emf Total displacement contours & vectors.

SN654 Vol 1



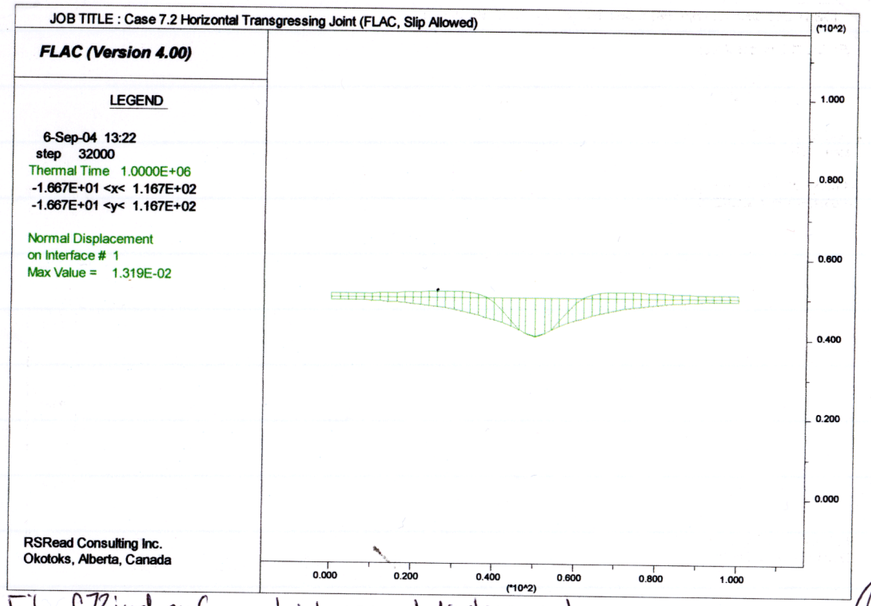
File f72jss.emf Joint shear stress

Sep 6/04



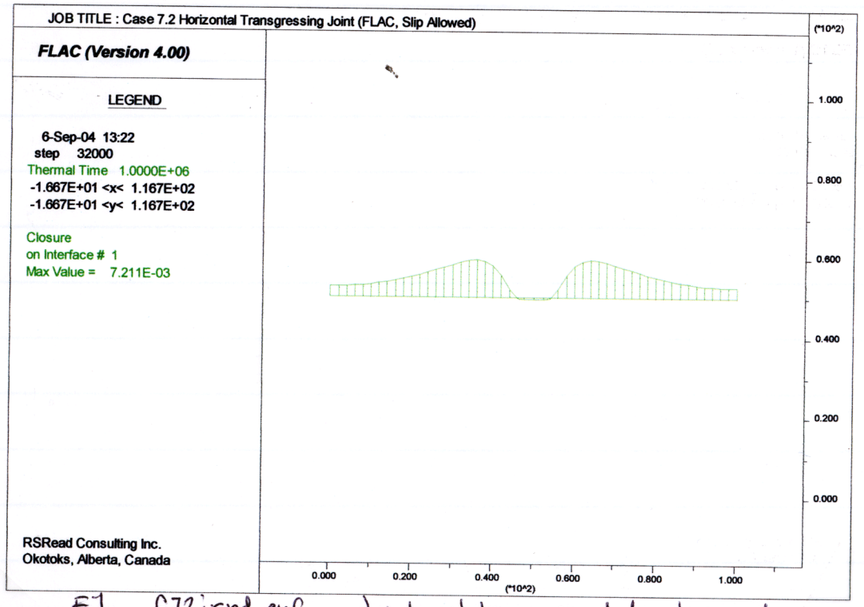
File f72jns.emf Joint normal stress

SN654 Vol 1



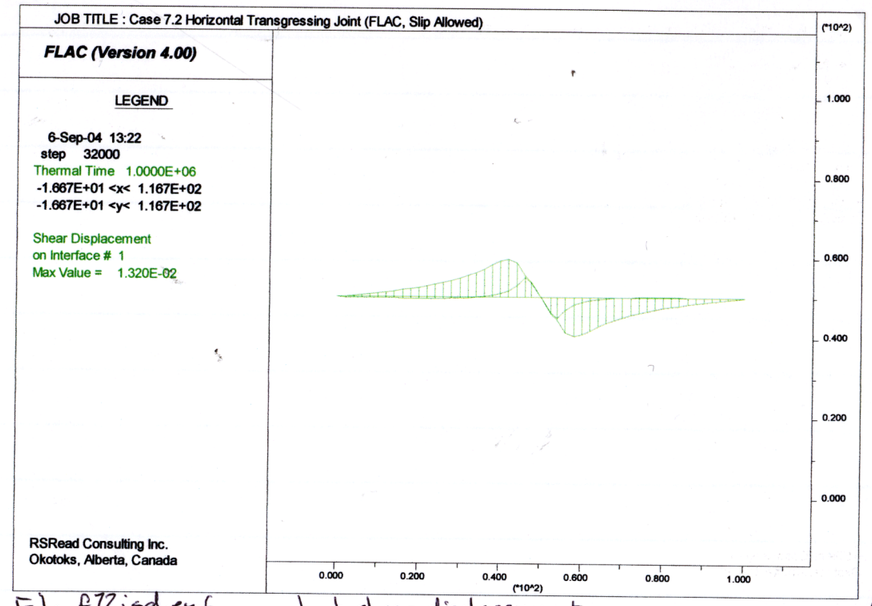
File f72jnd.emf Joint normal displacement

Sep 6/04



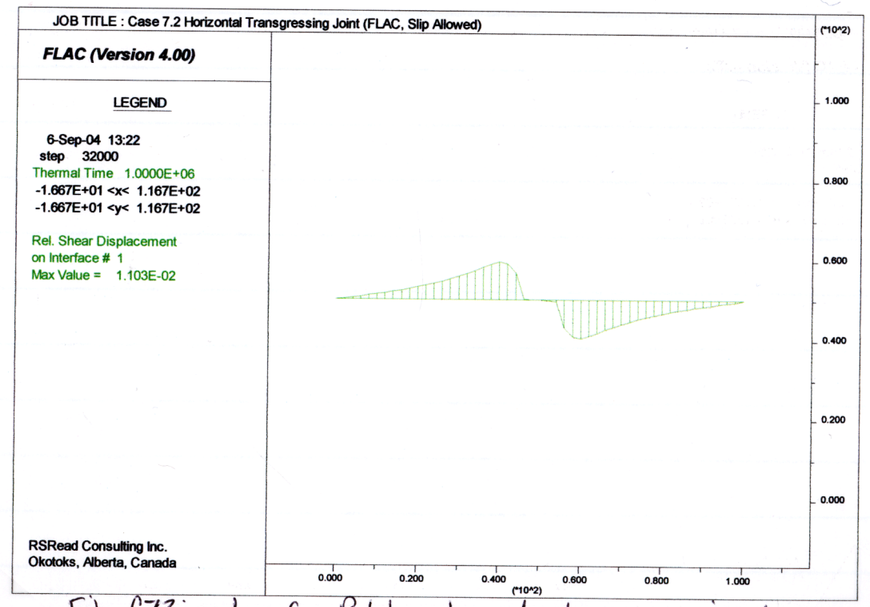
File f72jrnd.emf Joint relative normal displacement

SN654 Vol 1



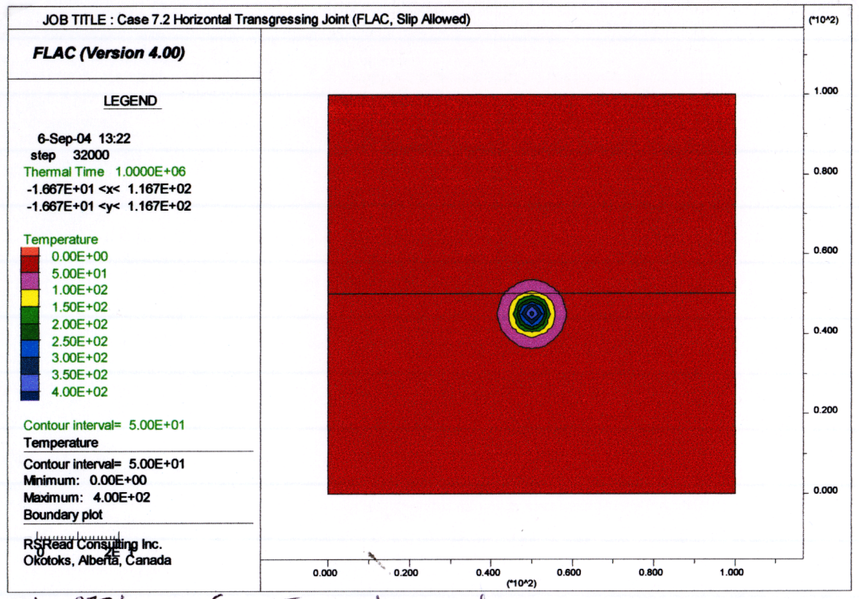
File f72jsd.emf Joint shear displacement

Sep 6/04



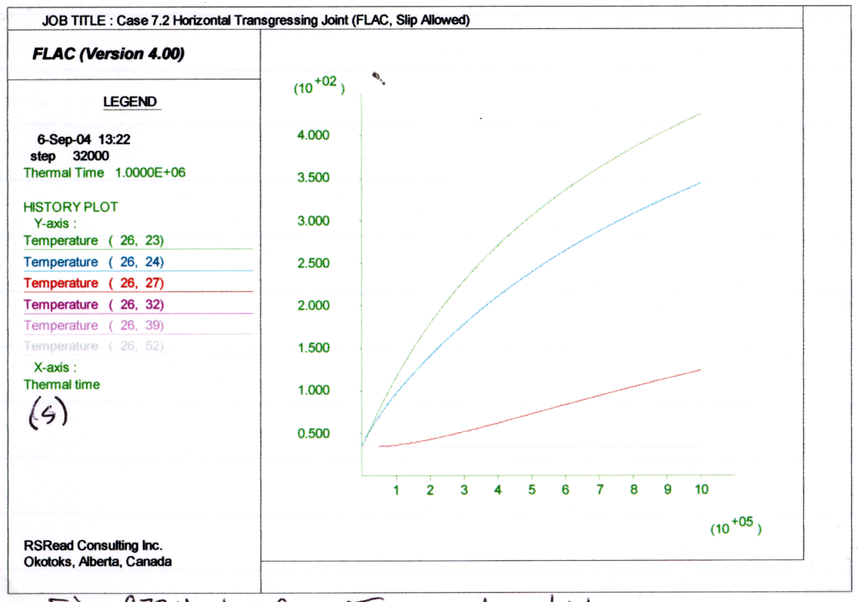
File f72jrsd.emf Relative shear displacement on joint.

SN 654 Vol 1



File f72temp.emf Temperature contours.

Sep 6/04



File f72thist.emf Temperature history.

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Joint friction angle (°) 30
Joint cohesion (Pa) 1.00E+03
Joint tensile strength (Pa) 1.00E+06

Table 7.2 - Summary of FLAC Output for Case 7.2

i	Y coordinate (m)	X coordinate (m)	Distance along interface (m)	Shear displacement at bottom of interface (m)	Normal displacement at bottom of interface (m)	Shear displacement at top of interface (m)	Normal displacement at top of interface (m)	Relative normal displacement at top of interface (m)	Relative shear displacement on interface (m)	Temperature at bottom of interface (°C)	Temperature at top of interface (°C)	Total displacement at bottom of interface (m)	Theta at bottom of interface (°)	Total displacement at top of interface (m)	Theta at top of interface (°)	Normal stress at bottom of interface (Pa)	Shear stress at bottom of interface (Pa)	Slip	Bond	Normal stress at top of interface (Pa)	Shear stress at top of interface (Pa)	Slip	Bond	Sratio at top of interface	Sratio at bottom of interface	Strength factor
1	50.00	0.00	0.00	0.00E+00	-1.33E-03	0.00E+00	7.39E-04	2.07E-03	0.00E+00	34.00	34.00	1.33E-03	-90.00	7.39E-04	90.00	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.41E-04	2.80E-05	0.00E+00
2	50.00	2.00	2.00	1.57E-04	-1.36E-03	1.57E-04	7.41E-04	2.09E-03	3.28E-04	34.00	34.00	1.36E-03	-101.88	7.52E-04	89.44	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.41E-04	2.80E-05	0.00E+00
3	50.00	4.00	4.00	3.15E-04	-1.36E-03	3.15E-04	7.41E-04	2.09E-03	6.56E-04	34.00	34.00	1.36E-03	-112.49	7.61E-04	83.25	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	4.18E-04	1.90E-05	0.00E+00
4	50.00	6.00	6.00	4.72E-04	-1.36E-03	4.72E-04	7.41E-04	2.09E-03	9.84E-04	34.00	34.00	1.36E-03	-120.96	7.70E-04	76.89	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.27E-04	2.00E-05	0.00E+00
5	50.00	8.00	8.00	6.29E-04	-1.36E-03	6.29E-04	7.41E-04	2.09E-03	1.31E-03	34.00	34.00	1.36E-03	-128.57	7.78E-04	70.88	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.12E-04	2.00E-05	0.00E+00
6	50.00	10.00	10.00	7.86E-04	-1.36E-03	7.86E-04	7.41E-04	2.09E-03	1.64E-03	34.00	34.00	1.36E-03	-134.11	7.86E-04	64.58	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.97E-04	2.00E-05	0.00E+00
7	50.00	12.00	12.00	9.44E-04	-1.36E-03	9.44E-04	7.41E-04	2.09E-03	1.97E-03	34.00	34.00	1.36E-03	-138.64	7.94E-04	58.24	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.82E-04	2.00E-05	0.00E+00
8	50.00	14.00	14.00	1.10E-03	-1.36E-03	1.10E-03	7.41E-04	2.09E-03	2.30E-03	34.00	34.00	1.36E-03	-141.89	8.02E-04	51.40	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	4.67E-04	2.00E-05	0.00E+00
9	50.00	16.00	16.00	1.26E-03	-1.36E-03	1.26E-03	7.41E-04	2.09E-03	2.62E-03	34.00	34.00	1.36E-03	-144.73	8.10E-04	45.00	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	5.37E-04	2.00E-05	0.00E+00
10	50.00	18.00	18.00	1.41E-03	-1.36E-03	1.41E-03	7.41E-04	2.09E-03	2.95E-03	34.00	34.00	1.36E-03	-147.44	8.18E-04	39.37	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	6.07E-04	2.00E-05	0.00E+00
11	50.00	20.00	20.00	1.57E-03	-1.36E-03	1.57E-03	7.41E-04	2.09E-03	3.28E-03	34.00	34.00	1.36E-03	-149.30	8.26E-04	33.69	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	6.77E-04	2.00E-05	0.00E+00
12	50.00	22.00	22.00	1.73E-03	-1.36E-03	1.73E-03	7.41E-04	2.09E-03	3.61E-03	34.00	34.00	1.36E-03	-151.32	8.34E-04	28.00	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	7.47E-04	2.00E-05	0.00E+00
13	50.00	24.00	24.00	1.89E-03	-1.36E-03	1.89E-03	7.41E-04	2.09E-03	3.94E-03	34.00	34.00	1.36E-03	-153.33	8.42E-04	22.37	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	8.17E-04	2.00E-05	0.00E+00
14	50.00	26.00	26.00	2.05E-03	-1.36E-03	2.05E-03	7.41E-04	2.09E-03	4.28E-03	34.00	34.00	1.36E-03	-155.43	8.50E-04	16.75	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	8.87E-04	2.00E-05	0.00E+00
15	50.00	28.00	28.00	2.21E-03	-1.36E-03	2.21E-03	7.41E-04	2.09E-03	4.61E-03	34.00	34.00	1.36E-03	-157.72	8.58E-04	11.11	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	9.57E-04	2.00E-05	0.00E+00
16	50.00	30.00	30.00	2.36E-03	-1.36E-03	2.36E-03	7.41E-04	2.09E-03	4.94E-03	34.00	34.00	1.36E-03	-160.34	8.66E-04	5.43	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.03E-05	2.00E-05	0.00E+00
17	50.00	32.00	32.00	2.52E-03	-1.36E-03	2.52E-03	7.41E-04	2.09E-03	5.28E-03	34.00	34.00	1.36E-03	-163.33	8.74E-04	0.00	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.10E-05	2.00E-05	0.00E+00
18	50.00	34.00	34.00	2.68E-03	-1.36E-03	2.68E-03	7.41E-04	2.09E-03	5.61E-03	34.00	34.00	1.36E-03	-166.34	8.82E-04	5.43	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.17E-05	2.00E-05	0.00E+00
19	50.00	36.00	36.00	2.84E-03	-1.36E-03	2.84E-03	7.41E-04	2.09E-03	5.95E-03	34.00	34.00	1.36E-03	-169.43	8.90E-04	11.11	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.24E-05	2.00E-05	0.00E+00
20	50.00	38.00	38.00	3.00E-03	-1.36E-03	3.00E-03	7.41E-04	2.09E-03	6.28E-03	34.00	34.00	1.36E-03	-171.93	8.98E-04	16.75	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.31E-05	2.00E-05	0.00E+00
21	50.00	40.00	40.00	3.15E-03	-1.36E-03	3.15E-03	7.41E-04	2.09E-03	6.62E-03	34.00	34.00	1.36E-03	-174.52	9.06E-04	22.37	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.38E-05	2.00E-05	0.00E+00
22	50.00	42.00	42.00	3.31E-03	-1.36E-03	3.31E-03	7.41E-04	2.09E-03	6.95E-03	34.00	34.00	1.36E-03	-176.05	9.14E-04	28.00	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.45E-05	2.00E-05	0.00E+00
23	50.00	44.00	44.00	3.47E-03	-1.36E-03	3.47E-03	7.41E-04	2.09E-03	7.29E-03	34.00	34.00	1.36E-03	-177.55	9.22E-04	33.69	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.52E-05	2.00E-05	0.00E+00
24	50.00	46.00	46.00	3.63E-03	-1.36E-03	3.63E-03	7.41E-04	2.09E-03	7.62E-03	34.00	34.00	1.36E-03	-179.05	9.30E-04	39.37	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.59E-05	2.00E-05	0.00E+00
25	50.00	47.50	47.50	3.78E-03	-1.36E-03	3.78E-03	7.41E-04	2.09E-03	7.94E-03	34.00	34.00	1.36E-03	-180.54	9.38E-04	44.69	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.66E-05	2.00E-05	0.00E+00
26	50.00	49.00	49.00	3.94E-03	-1.36E-03	3.94E-03	7.41E-04	2.09E-03	8.27E-03	34.00	34.00	1.36E-03	-182.02	9.46E-04	50.00	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.73E-05	2.00E-05	0.00E+00
27	50.00	50.50	50.50	4.09E-03	-1.36E-03	4.09E-03	7.41E-04	2.09E-03	8.59E-03	34.00	34.00	1.36E-03	-183.49	9.54E-04	55.31	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.80E-05	2.00E-05	0.00E+00
28	50.00	52.00	52.00	4.25E-03	-1.36E-03	4.25E-03	7.41E-04	2.09E-03	8.92E-03	34.00	34.00	1.36E-03	-184.95	9.62E-04	60.62	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.87E-05	2.00E-05	0.00E+00
29	50.00	53.50	53.50	4.41E-03	-1.36E-03	4.41E-03	7.41E-04	2.09E-03	9.26E-03	34.00	34.00	1.36E-03	-186.39	9.70E-04	65.93	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	1.94E-05	2.00E-05	0.00E+00
30	50.00	55.00	55.00	4.57E-03	-1.36E-03	4.57E-03	7.41E-04	2.09E-03	9.59E-03	34.00	34.00	1.36E-03	-187.82	9.78E-04	71.11	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.01E-05	2.00E-05	0.00E+00
31	50.00	56.50	56.50	4.73E-03	-1.36E-03	4.73E-03	7.41E-04	2.09E-03	9.93E-03	34.00	34.00	1.36E-03	-189.24	9.86E-04	76.44	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.08E-05	2.00E-05	0.00E+00
32	50.00	58.00	58.00	4.89E-03	-1.36E-03	4.89E-03	7.41E-04	2.09E-03	1.03E-02	34.00	34.00	1.36E-03	-190.65	9.94E-04	81.85	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.15E-05	2.00E-05	0.00E+00
33	50.00	59.50	59.50	5.05E-03	-1.36E-03	5.05E-03	7.41E-04	2.09E-03	1.06E-02	34.00	34.00	1.36E-03	-192.05	1.00E-03	87.26	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.22E-05	2.00E-05	0.00E+00
34	50.00	61.00	61.00	5.21E-03	-1.36E-03	5.21E-03	7.41E-04	2.09E-03	1.09E-02	34.00	34.00	1.36E-03	-193.44	1.01E-03	92.67	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.29E-05	2.00E-05	0.00E+00
35	50.00	62.50	62.50	5.37E-03	-1.36E-03	5.37E-03	7.41E-04	2.09E-03	1.12E-02	34.00	34.00	1.36E-03	-194.82	1.02E-03	98.08	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.36E-05	2.00E-05	0.00E+00
36	50.00	64.00	64.00	5.53E-03	-1.36E-03	5.53E-03	7.41E-04	2.09E-03	1.15E-02	34.00	34.00	1.36E-03	-196.19	1.03E-03	103.49	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.43E-05	2.00E-05	0.00E+00
37	50.00	65.50	65.50	5.69E-03	-1.36E-03	5.69E-03	7.41E-04	2.09E-03	1.18E-02	34.00	34.00	1.36E-03	-197.55	1.04E-03	108.91	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.50E-05	2.00E-05	0.00E+00
38	50.00	67.00	67.00	5.85E-03	-1.36E-03	5.85E-03	7.41E-04	2.09E-03	1.21E-02	34.00	34.00	1.36E-03	-198.91	1.05E-03	114.34	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.57E-05	2.00E-05	0.00E+00
39	50.00	68.50	68.50	6.01E-03	-1.36E-03	6.01E-03	7.41E-04	2.09E-03	1.24E-02	34.00	34.00	1.36E-03	-200.26	1.06E-03	119.78	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.64E-05	2.00E-05	0.00E+00
40	50.00	70.00	70.00	6.17E-03	-1.36E-03	6.17E-03	7.41E-04	2.09E-03	1.27E-02	34.00	34.00	1.36E-03	-201.61	1.07E-03	125.22	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.71E-05	2.00E-05	0.00E+00
41	50.00	71.50	71.50	6.33E-03	-1.36E-03	6.33E-03	7.41E-04	2.09E-03	1.30E-02	34.00	34.00	1.36E-03	-202.95	1.08E-03	130.66	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.78E-05	2.00E-05	0.00E+00
42	50.00	73.00	73.00	6.49E-03	-1.36E-03	6.49E-03	7.41E-04	2.09E-03	1.33E-02	34.00	34.00	1.36E-03	-204.28	1.09E-03	136.11	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.85E-05	2.00E-05	0.00E+00
43	50.00	74.50	74.50	6.65E-03	-1.36E-03	6.65E-03	7.41E-04	2.09E-03	1.36E-02	34.00	34.00	1.36E-03	-205.61	1.10E-03	141.55	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.92E-05	2.00E-05	0.00E+00
44	50.00	76.00	76.00	6.81E-03	-1.36E-03	6.81E-03	7.41E-04	2.09E-03	1.39E-02	34.00	34.00	1.36E-03	-206.94	1.11E-03	146.99	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	2.99E-05	2.00E-05	0.00E+00
45	50.00	77.50	77.50	6.97E-03	-1.36E-03	6.97E-03	7.41E-04	2.09E-03	1.42E-02	34.00	34.00	1.36E-03	-208.26	1.12E-03	152.42	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.06E-05	2.00E-05	0.00E+00
46	50.00	79.00	79.00	7.13E-03	-1.36E-03	7.13E-03	7.41E-04	2.09E-03	1.45E-02	34.00	34.00	1.36E-03	-209.58	1.13E-03	157.86	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.13E-05	2.00E-05	0.00E+00
47	50.00	80.50	80.50	7.29E-03	-1.36E-03	7.29E-03	7.41E-04	2.09E-03	1.48E-02	34.00	34.00	1.36E-03	-210.89	1.14E-03	163.29	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.20E-05	2.00E-05	0.00E+00
48	50.00	82.00	82.00	7.45E-03	-1.36E-03	7.45E-03	7.41E-04	2.09E-03	1.51E-02	34.00	34.00	1.36E-03	-212.19	1.15E-03	168.73	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.27E-05	2.00E-05	0.00E+00
49	50.00	83.50	83.50	7.61E-03	-1.36E-03	7.61E-03	7.41E-04	2.09E-03	1.54E-02	34.00	34.00	1.36E-03	-213.49	1.16E-03	174.16	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.34E-05	2.00E-05	0.00E+00
50	50.00	85.00	85.00	7.77E-03	-1.36E-03	7.77E-03	7.41E-04	2.09E-03	1.57E-02	34.00	34.00	1.36E-03	-214.78	1.17E-03	179.60	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.41E-05	2.00E-05	0.00E+00
51	50.00	86.50	86.50	7.93E-03	-1.36E-03	7.93E-03	7.41E-04	2.09E-03	1.60E-02	34.00	34.00	1.36E-03	-216.06	1.18E-03	185.04	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.48E-05	2.00E-05	0.00E+00
52	50.00	88.00	88.00	8.09E-03	-1.36E-03	8.09E-03	7.41E-04	2.09E-03	1.63E-02	34.00	34.00	1.36E-03	-217.34	1.19E-03	190.47	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.55E-05	2.00E-05	0.00E+00
53	50.00	89.50	89.50	8.25E-03	-1.36E-03	8.25E-03	7.41E-04	2.09E-03	1.66E-02	34.00	34.00	1.36E-03	-218.61	1.20E-03	195.91	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.62E-05	2.00E-05	0.00E+00
54	50.00	91.00	91.00	8.41E-03	-1.36E-03	8.41E-03	7.41E-04	2.09E-03	1.69E-02	34.00	34.00	1.36E-03	-219.88	1.21E-03	201.34	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.69E-05	2.00E-05	0.00E+00
55	50.00	92.50	92.50	8.57E-03	-1.36E-03	8.57E-03	7.41E-04	2.09E-03	1.72E-02	34.00	34.00	1.36E-03	-221.15	1.22E-03	206.78	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.76E-05	2.00E-05	0.00E+00
56	50.00	94.00	94.00	8.73E-03	-1.36E-03	8.73E-03	7.41E-04	2.09E-03	1.75E-02	34.00	34.00	1.36E-03	-222.41	1.23E-03	212.21	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.83E-05	2.00E-05	0.00E+00
57	50.00	95.50	95.50	8.89E-03	-1.36E-03	8.89E-03	7.41E-04	2.09E-03	1.78E-02	34.00	34.00	1.36E-03	-223.67	1.24E-03	217.65	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.90E-05	2.00E-05	0.00E+00
58	50.00	97.00	97.00	9.05E-03	-1.36E-03	9.05E-03	7.41E-04	2.09E-03	1.81E-02	34.00	34.00	1.36E-03	-224.93	1.25E-03	223.08	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	3.97E-05	2.00E-05	0.00E+00
59	50.00	98.50	98.50	9.21E-03	-1.36E-03	9.21E-03	7.41E-04	2.09E-03	1.84E-02	34.00	34.00	1.36E-03	-226.18	1.26E-03	228.52	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	4.04E-05	2.00E-05	0.00E+00
60	50.00	100.00	100.00	9.37E-03	-1.36E-03	9.37E-03	7.41E-04	2.09E-03	1.87E-02	34.00	34.00	1.36E-03	-227.43	1.27E-03	233.95	0.00E+00	0.00E+00	yes	no	0.00E+00	0.00E+00	yes	no	4.11E-05	2.00E-05	0.00E+00

Sratio at top of interface = 2.80E-05 / 3.41E-04 = 0.08E+00

Sratio at bottom of interface = 2.80E-05 / 3.41E-04 = 0.08E+00

Strength factor = 1.00E+06 / 1.00E+03 = 1.00E+03

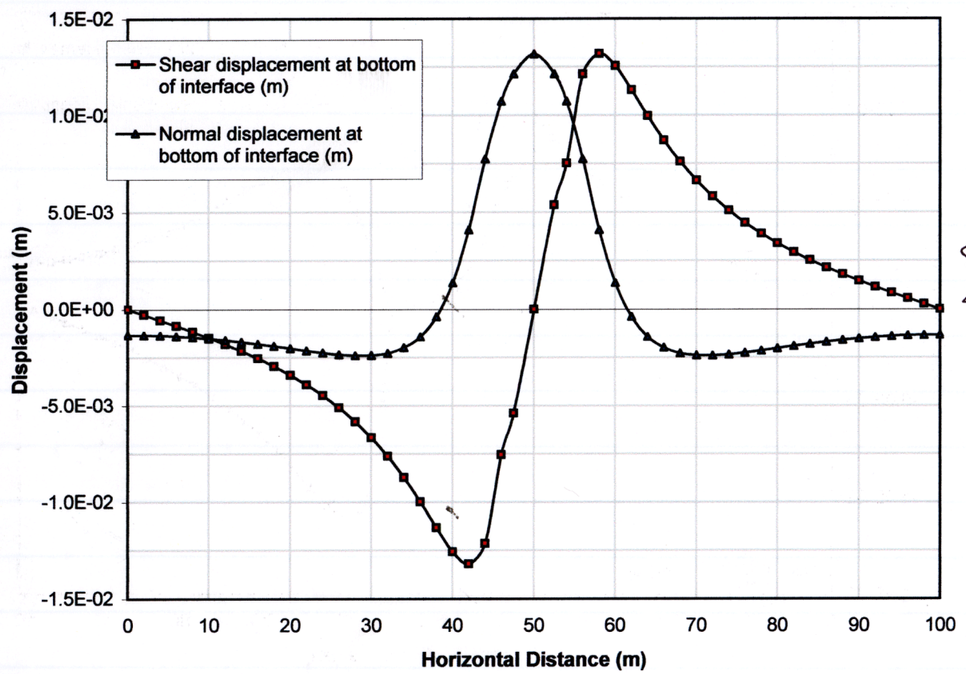
Note that slip occurs on most midpoints, and the bond is broken. (File F72.xls). Important data from F72 data.out and F72s1p.out. Also F72sr.out for equilibrium ratio.

Summary table of FLAC output for Case 7.2

SN 654 Vol 1

Blank Sept 6/04

Case 7.2 - FLAC Results for a Horizontal Weak Interface Subjected to a Volumetric Heat Source



Sep 6/04

From EXCEL file F72.xls

(see page 196 for top and bottom displacements)

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SN 654 Vol 1

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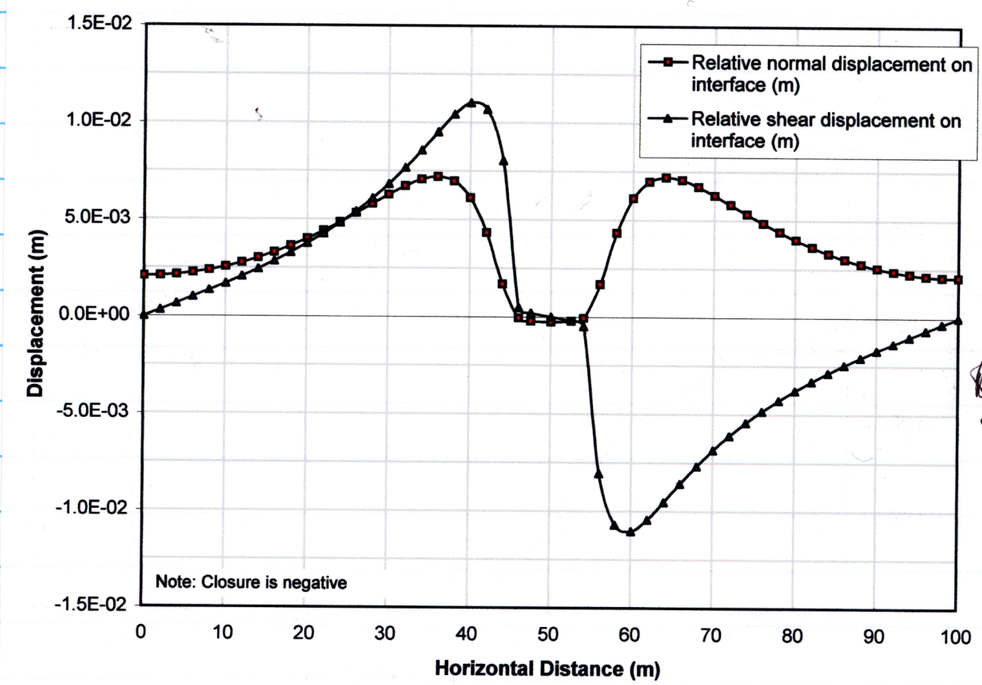
Case 7.2 - FLAC Results for a Horizontal Weak Interface Subjected to a Volumetric Heat Source



Sep 6/04

From EXCEL file F72.xls

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