Two-Dimensional Steady State Heat Conduction

This sample analysis illustrates the manner in which the *UD_scalar* program can be used to perform steady state heat conduction analyses. The body analyzed, a rectangular plate with a cut-out slot, is shown below.

By the nature of the analysis, this body is assumed to have a unit thickness and to experience zero heat flow into (or out of) the \(x_1\)-\(x_2\) plane. Along a portion of the left edge of the plate, a temperature of 100 degrees is maintained; the entire right edge is maintained at 0 degrees. The remaining portions of the boundary are insulated (i.e., along such portions, the heat flux is zero). A copy of the input data file is provided below.
anal tit "2-d test of 4-node quad. heat conduction elements"
! 
analysis action analyze
analysis temporal static
!
! 
dim max scalar_1  1
dim max nodes 100
dim max qs4  80
!
echo elements off                      ! turn off printing of element data
echo nodes off                         ! turn off printing of nodal data
!
finish settings
!
scalar conductivity constant number 1 &
  desc "sample (constant) scalar conductivity" k11 2.0  k22  1.0
!
nodes  line number   1  x1   0.0  x2  0.0
nodes  line number   5  x1   0.0  x2  4.0  incr  1
nodes  line number   7  x1   0.0  x2  5.0  incr  1
nodes  line number  42  x1   4.0  x2  5.0  incr  7  ratio 0.80
nodes  line number  40  x1   4.0  x2  4.0  incr  -1
nodes  line number  36  x1   4.0  x2  0.0  incr  -1
nodes  line number  -1  x1   0.0  x2  0.0  incr  -7  ratio 1.25
nodes  line number  47  x1   4.5  x2  4.0
nodes  line number  49  x1   4.5  x2  2.0  incr  1
nodes  line number  50  x1   5.0  x2  0.0  incr  -7  ratio 0.80
nodes  line number  98  x1  10.0  x2  5.0  incr  7  ratio 1.25
nodes  line number  96  x1  10.0  x2  4.0  incr  -1
nodes  line number  92  x1  10.0  x2  0.0  incr  -1
nodes  line number  50  x1   5.0  x2  0.0  incr  -7  ratio 0.80
nodes  line number  54  x1   5.0  x2  4.0  incr  1
nodes  line number  50  x1   5.0  x2  0.0  incr  -7  ratio 0.80
nodes  line number  54  x1   5.0  x2  4.0  incr  1
nodes  line number -56  x1   5.0  x2  5.0  incr  1
!

element scalar typ "qs4" nodes  1  8  9  2 scalar  1 &
  1_add 4  1_incr  7  2_add 5  2_incr 1
element scalar typ "qs4" nodes 40 47 48 41 scalar  1 &
  1_add 1  1_incr  7  2_add 1  2_incr 1
element scalar typ "qs4" nodes 50 57 58 51 scalar  1 &
  1_add 5  1_incr  7  2_add 5  2_incr 1
!
generate surfaces
!
specification conc scalar nodes   4:7:1 phi  value 100.0
specification conc scalar nodes  92:98:1 phi  value   0.0
!
finish data
!
solution  time final 1.0 increments 1 output 1:10:1
!
finished loading
This sample analysis illustrates the use of the “missing” node points option, used in order to facilitate the generation of elements. The node and element numbers used in these analyses are shown below.
The results associated with this analysis are graphically summarized below.

Temperature Contours Associated with Analysis

Heat Flux Vectors Associated with Analysis

The associated output file is given below.
2-d test of 4-node quad. heat conduction elements

Largest NODE number which can used in the mesh = 100
Max. no. of CONSTANT scalar conductivity idealizations = 1
Max. no. of 4-node quad. "scalar" (QS4) elements = 80

--> analysis with SCALAR primary dependent variables shall be performed

--> TWO-DIMENSIONAL solution domain assumed (PLANE STRESS idealization)

--> solver type used : SKYLINE
--> storage type : SYMMETRIC
--> "Isoparametric" mesh generation scheme used

--> LINEAR analysis

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--> idealization no.: 1

**Type:** constant scalar conductivity coefficients

**Info.:** sample (constant) scalar conductivity

"Conductivities" (material parameters):

\[
\begin{align*}
\kappa_{11} &= 2.000E+00 & \kappa_{12} &= 0.000E+00 & \kappa_{13} &= 0.000E+00 \\
\kappa_{22} &= 1.000E+00 & \kappa_{23} &= 0.000E+00 \\
\kappa_{33} &= 1.000E+00 \\
\end{align*}
\]

Source term \( S_1 = 0.000E+00 \)

Source term \( S_2 = 0.000E+00 \)

======================================================================

\textbf{NODE POINT SPECIFICATIONS}

======================================================================

<table>
<thead>
<tr>
<th>Node Number</th>
<th>Coordinates</th>
<th>phi (p.d.v.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>((x_1 = 6.018E-36, x_2 = 3.000E+00))</td>
<td>1.000E+02</td>
</tr>
<tr>
<td>5</td>
<td>((x_1 = -6.019E-36, x_2 = 4.000E+00))</td>
<td>1.000E+02</td>
</tr>
<tr>
<td>6</td>
<td>((x_1 = -1.190E-40, x_2 = 4.500E+00))</td>
<td>1.000E+02</td>
</tr>
<tr>
<td>7</td>
<td>((x_1 = -5.510E-29, x_2 = 5.000E+00))</td>
<td>1.000E+02</td>
</tr>
<tr>
<td>92</td>
<td>((x_1 = 1.000E+01, x_2 = 9.404E-37))</td>
<td>0.000E+00</td>
</tr>
<tr>
<td>93</td>
<td>((x_1 = 1.000E+01, x_2 = 1.000E+00))</td>
<td>0.000E+00</td>
</tr>
<tr>
<td>94</td>
<td>((x_1 = 1.000E+01, x_2 = 2.000E+00))</td>
<td>0.000E+00</td>
</tr>
<tr>
<td>95</td>
<td>((x_1 = 1.000E+01, x_2 = 3.000E+00))</td>
<td>0.000E+00</td>
</tr>
<tr>
<td>96</td>
<td>((x_1 = 1.000E+01, x_2 = 4.000E+00))</td>
<td>0.000E+00</td>
</tr>
<tr>
<td>97</td>
<td>((x_1 = 1.000E+01, x_2 = 4.500E+00))</td>
<td>0.000E+00</td>
</tr>
</tbody>
</table>
98 : ( x1 = 1.000E+01, x2 = 5.000E+00 )
phi (p.d.v.) = 0.000E+00

end of mathematical model data

======================================================================
= E L E M E N T      F L U X E S =
======================================================================

--> element 1 ( type = QS4 ) : [
@x1 = 5.950E-01, x2 = 5.000E-01) : flux_1 = 4.307E-01 ; flux_2 = -2.774E-01
--> element 2 ( type = QS4 ) : [
@x1 = 1.666E+00, x2 = 5.000E-01) : flux_1 = 8.299E-01 ; flux_2 = -8.424E-02
--> element 3 ( type = QS4 ) : [
@x1 = 2.523E+00, x2 = 5.000E-01) : flux_1 = 8.569E-01 ; flux_2 = 1.106E-01
--> element 4 ( type = QS4 ) : [
@x1 = 3.208E+00, x2 = 5.000E-01) : flux_1 = 5.608E-01 ; flux_2 = 2.775E-01
--> element 5 ( type = QS4 ) : [
@x1 = 3.756E+00, x2 = 5.000E-01) : flux_1 = 1.330E-01 ; flux_2 = 3.219E-01
--> element 6 ( type = QS4 ) : [
@x1 = 5.950E-01, x2 = 1.500E+00) : flux_1 = 7.590E-01 ; flux_2 = -1.289E+00
--> element 7 ( type = QS4 ) : [
@x1 = 1.666E+00, x2 = 1.500E+00) : flux_1 = 2.599E+00 ; flux_2 = -4.449E-01
--> element 8 ( type = QS4 ) : [
@x1 = 2.523E+00, x2 = 1.500E+00) : flux_1 = 2.100E+00 ; flux_2 = 6.758E-01
--> element 9 ( type = QS4 ) : [
@x1 = 3.208E+00, x2 = 1.500E+00) : flux_1 = 1.227E+00 ; flux_2 = 1.185E+00
--> element 10 ( type = QS4 ) : [
@x1 = 3.756E+00, x2 = 1.500E+00) : flux_1 = 6.842E-01 ; flux_2 = 1.478E+00
--> element 11 ( type = QS4 ) : [

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UD_scalar documentation: program version 1.00

Sample Analyses

@  
@ x1 = 5.950E-01, x2 = 2.500E+00 : flux_1 = 8.039E+00 ; flux_2 = -5.345E+00

--> element 12 ( type = QS4 ) : [


--------------------
@  
@ x1 = 1.666E+00, x2 = 2.500E+00 : flux_1 = 7.001E+00 ; flux_2 = 2.372E-01

--> element 13 ( type = QS4 ) : [


--------------------
@  
@ x1 = 2.523E+00, x2 = 2.500E+00 : flux_1 = 5.492E+00 ; flux_2 = 2.503E+00

--> element 14 ( type = QS4 ) : [


--------------------
@  
@ x1 = 3.208E+00, x2 = 2.500E+00 : flux_1 = 3.081E+00 ; flux_2 = 3.850E+00

--> element 15 ( type = QS4 ) : [


--------------------
@  
@ x1 = 3.756E+00, x2 = 2.500E+00 : flux_1 = -3.768E-01 ; flux_2 = 3.863E+00

--> element 16 ( type = QS4 ) : [


--------------------
@  
@ x1 = 5.950E-01, x2 = 3.500E+00 : flux_1 = 1.520E+01 ; flux_2 = 2.109E-02

--> element 17 ( type = QS4 ) : [


--------------------
@  
@ x1 = 1.666E+00, x2 = 3.500E+00 : flux_1 = 1.281E+01 ; flux_2 = 1.466E+00

--> element 18 ( type = QS4 ) : [


--------------------
@  
@ x1 = 2.523E+00, x2 = 3.500E+00 : flux_1 = 1.235E+01 ; flux_2 = 4.574E+00

--> element 19 ( type = QS4 ) : [


--------------------
@  
@ x1 = 3.208E+00, x2 = 3.500E+00 : flux_1 = 1.186E+01 ; flux_2 = 8.510E+00

--> element 20 ( type = QS4 ) : [


--------------------
@  
@ x1 = 3.756E+00, x2 = 3.500E+00 : flux_1 = 1.057E+01 ; flux_2 = 1.384E+01

--> element 21 ( type = QS4 ) : [


--------------------
@  
@ x1 = 5.950E-01, x2 = 4.250E+00 : flux_1 = 1.561E+01 ; flux_2 = 4.397E-01

--> element 22 ( type = QS4 ) : [


--------------------
@  
@ x1 = 1.666E+00, x2 = 4.250E+00 : flux_1 = 1.654E+01 ; flux_2 = 1.584E+00

--> element 23 ( type = QS4 ) : [


--------------------
@  
@ x1 = 2.523E+00, x2 = 4.250E+00 : flux_1 = 1.840E+01 ; flux_2 = 3.530E+00

--> element 24 ( type = QS4 ) : [


--------------------
@  
@ x1 = 3.208E+00, x2 = 4.250E+00 : flux_1 = 2.189E+01 ; flux_2 = 6.305E+00

--> element 25 ( type = QS4 ) : [


--------------------
@  
@ x1 = 3.756E+00, x2 = 4.250E+00 : flux_1 = 2.770E+01 ; flux_2 = 1.019E+01

--> element 26 ( type = QS4 ) : [


--------------------
@  
@ x1 = 5.950E-01, x2 = 4.750E+00 : flux_1 = 1.612E+01 ; flux_2 = 1.652E-01
--> element    27 ( type = QS4      ) : [                                        
.................................
@(x1 =  1.666E+00, x2 =  4.750E+00 ) : flux_1 =  1.757E+01  ; flux_2 =  6.075E-01
--> element    28 ( type = QS4      ) : [                                        
.................................
@(x1 =  2.523E+00, x2 =  4.750E+00 ) : flux_1 =  2.060E+01  ; flux_2 =  1.315E+00
--> element    29 ( type = QS4      ) : [                                        
.................................
@(x1 =  3.208E+00, x2 =  4.750E+00 ) : flux_1 =  2.525E+01  ; flux_2 =  2.173E+00
--> element    30 ( type = QS4      ) : [                                        
.................................
@(x1 =  3.756E+00, x2 =  4.750E+00 ) : flux_1 =  3.086E+01  ; flux_2 =  1.944E+00
--> element    31 ( type = QS4      ) : [                                        
.................................
@(x1 =  4.250E+00, x2 =  4.750E+00 ) : flux_1 =  4.721E+01  ; flux_2 = -6.479E+00
--> element    32 ( type = QS4      ) : [                                        
.................................
@(x1 =  4.750E+00, x2 =  4.250E+00 ) : flux_1 =  4.736E+01  ; flux_2 =  6.050E+00
--> element    33 ( type = QS4      ) : [                                        
.................................
@(x1 =  4.250E+00, x2 =  4.750E+00 ) : flux_1 =  3.338E+00  ; flux_2 =  6.050E+00
-> element 42 ( type = QS4 ) : |

.................................
@(x1 = 5.722E+00, x2 = 1.500E+00 ) : flux_1 = 1.606E+00 ; flux_2 = -2.696E+00

-> element 43 ( type = QS4 ) : |

.................................
@(x1 = 6.346E+00, x2 = 1.500E+00 ) : flux_1 = 2.883E+00 ; flux_2 = -2.477E+00

-> element 44 ( type = QS4 ) : |

.................................
@(x1 = 7.127E+00, x2 = 1.500E+00 ) : flux_1 = 4.264E+00 ; flux_2 = -2.026E+00

-> element 45 ( type = QS4 ) : |

.................................
@(x1 = 8.103E+00, x2 = 1.500E+00 ) : flux_1 = 5.419E+00 ; flux_2 = -1.333E+00

-> element 46 ( type = QS4 ) : |

.................................
@(x1 = 5.722E+00, x2 = 2.500E+00 ) : flux_1 = -5.668E-01 ; flux_2 = -5.562E+00

-> element 47 ( type = QS4 ) : |

.................................
@(x1 = 6.346E+00, x2 = 2.500E+00 ) : flux_1 = 2.722E+00 ; flux_2 = -5.752E+00

-> element 48 ( type = QS4 ) : |

.................................
@(x1 = 7.127E+00, x2 = 2.500E+00 ) : flux_1 = 5.105E+00 ; flux_2 = -4.889E+00

-> element 49 ( type = QS4 ) : |

.................................
@(x1 = 8.103E+00, x2 = 2.500E+00 ) : flux_1 = 6.629E+00 ; flux_2 = -3.544E+00

-> element 50 ( type = QS4 ) : |

.................................
@(x1 = 5.222E+00, x2 = 3.500E+00 ) : flux_1 = 1.045E+01 ; flux_2 = -1.548E+01

-> element 51 ( type = QS4 ) : |

.................................
@(x1 = 5.722E+00, x2 = 3.500E+00 ) : flux_1 = 1.132E+01 ; flux_2 = -6.766E+00

-> element 52 ( type = QS4 ) : |

.................................
@(x1 = 6.346E+00, x2 = 3.500E+00 ) : flux_1 = 1.135E+01 ; flux_2 = -6.939E+00

-> element 53 ( type = QS4 ) : |

.................................
@(x1 = 7.127E+00, x2 = 3.500E+00 ) : flux_1 = 1.045E+01 ; flux_2 = -1.548E+01
max \mid \text{flux}_1 \mid = 4.736 \times 10^1 \text{ at } x_1 = 4.750 \times 10^0, \ x_2 = 4.250 \times 10^0
max | flux_2 | = 1.548E+01 @ x1 = 5.222E+00, x2 = 3.500E+00

= ================================================
=                NODAL QUANTITIES                  =
= ================================================

node :  1 ( x1 =  5.510E-29,  x2 = -6.019E-36 ), phi =  8.865E+01
node :  2 ( x1 = -4.514E-36,  x2 =  1.000E+00 ), phi =  8.903E+01
node :  3 ( x1 =  6.018E-36,  x2 =  3.000E+00 ), phi =  1.000E+02
node :  4 ( x1 =  6.018E-36,  x2 =  4.000E+00 ), phi =  1.000E+02
node :  5 ( x1 = -1.190E-40,  x2 =  4.500E+00 ), phi =  1.000E+02
node :  6 ( x1 = -5.510E-29,  x2 =  5.000E+00 ), phi =  1.000E+02
node :  7 ( x1 = -4.514E-36,  x2 =  1.000E+00 ), phi =  8.850E+01
node :  8 ( x1 =  1.190E+00,  x2 =  3.009E-36 ), phi =  8.850E+01
node :  9 ( x1 =  1.190E+00,  x2 =  2.000E+00 ), phi =  8.987E+01
node : 10 ( x1 =  1.190E+00,  x2 =  3.000E+00 ), phi =  9.098E+01
node : 11 ( x1 =  1.190E+00,  x2 =  4.000E+00 ), phi =  9.093E+01
node : 12 ( x1 =  1.190E+00,  x2 =  4.500E+00 ), phi =  9.049E+01
node : 13 ( x1 =  1.190E+00,  x2 =  5.000E+00 ), phi =  9.033E+01
node : 14 ( x1 =  2.142E+00,  x2 =  6.019E-36 ), phi =  8.819E+01
node : 15 ( x1 =  2.142E+00,  x2 =  1.000E+00 ), phi =  8.819E+01
node : 16 ( x1 =  2.142E+00,  x2 =  2.000E+00 ), phi =  8.788E+01
node : 17 ( x1 =  2.142E+00,  x2 =  3.000E+00 ), phi =  8.630E+01
node : 18 ( x1 =  2.142E+00,  x2 =  4.000E+00 ), phi =  8.341E+01
node : 19 ( x1 =  2.142E+00,  x2 =  4.500E+00 ), phi =  8.227E+01
node : 20 ( x1 =  2.142E+00,  x2 =  5.000E+00 ), phi =  8.183E+01
node : 21 ( x1 =  2.903E+00,  x2 = -4.514E-36 ), phi =  8.786E+01
node : 22 ( x1 =  2.903E+00,  x2 =  1.000E+00 ), phi =  8.753E+01
node : 23 ( x1 =  2.903E+00,  x2 =  2.000E+00 ), phi =  8.620E+01
node : 24 ( x1 =  2.903E+00,  x2 =  3.000E+00 ), phi =  8.329E+01
node : 25 ( x1 =  2.903E+00,  x2 =  4.000E+00 ), phi =  7.703E+01
node : 26 ( x1 =  2.903E+00,  x2 =  4.500E+00 ), phi =  7.464E+01
node : 27 ( x1 =  2.903E+00,  x2 =  5.000E+00 ), phi =  7.377E+01
node : 28 ( x1 =  3.513E+00,  x2 = -6.019E-36 ), phi =  8.782E+01
node : 29 ( x1 =  3.513E+00,  x2 =  1.000E+00 ), phi =  8.753E+01
node : 30 ( x1 =  3.513E+00,  x2 =  2.000E+00 ), phi =  8.620E+01
node : 31 ( x1 =  3.513E+00,  x2 =  3.000E+00 ), phi =  8.329E+01
node : 32 ( x1 =  3.513E+00,  x2 =  4.000E+00 ), phi =  7.703E+01
node : 33 ( x1 =  3.513E+00,  x2 =  4.500E+00 ), phi =  7.464E+01
node : 34 ( x1 =  3.513E+00,  x2 =  5.000E+00 ), phi =  7.377E+01
node : 35 ( x1 =  4.000E+00,  x2 = -2.633E-36 ), phi =  8.782E+01
node : 36 ( x1 =  4.000E+00,  x2 =  1.000E+00 ), phi =  8.753E+01
node : 37 ( x1 =  4.000E+00,  x2 =  2.000E+00 ), phi =  8.620E+01
node : 38 ( x1 =  4.000E+00,  x2 =  3.000E+00 ), phi =  8.329E+01
node : 39 ( x1 =  4.000E+00,  x2 =  4.000E+00 ), phi =  7.703E+01
node : 40 ( x1 =  4.000E+00,  x2 =  4.500E+00 ), phi =  7.464E+01
node : 41 ( x1 =  4.000E+00,  x2 =  5.000E+00 ), phi =  7.377E+01
node : 42 ( x1 =  4.000E+00,  x2 =  5.000E+00 ), phi =  5.867E+01
node : 43 ( x1 =  4.500E+00,  x2 =  5.000E+00 ), phi =  5.063E+01
node : 44 ( x1 =  4.500E+00,  x2 =  5.000E+00 ), phi =  5.067E+01
node : 45 ( x1 =  5.000E+00,  x2 = -6.019E-36 ), phi =  8.215E+00
node : 46 ( x1 =  5.000E+00,  x2 =  1.000E+00 ), phi =  9.045E+00

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node :  52 ( x1 =  5.000E+00, x2 =  2.000E+00 ), phi =  1.206E+01
node :  53 ( x1 =  5.000E+00, x2 =  3.000E+00 ), phi =  1.719E+01
node :  54 ( x1 =  5.000E+00, x2 =  4.000E+00 ), phi =  3.555E+01
node :  55 ( x1 =  5.000E+00, x2 =  4.500E+00 ), phi =  4.199E+01
node :  56 ( x1 =  5.000E+00, x2 =  5.000E+00 ), phi =  4.270E+01
node :  57 ( x1 =  5.444E+00, x2 =  3.009E-36 ), phi =  8.116E+00
node :  58 ( x1 =  5.444E+00, x2 =  1.000E+00 ), phi =  8.993E+00
node :  59 ( x1 =  5.444E+00, x2 =  2.000E+00 ), phi =  1.175E+01
node :  60 ( x1 =  5.444E+00, x2 =  3.000E+00 ), phi =  1.775E+01
node :  61 ( x1 =  5.444E+00, x2 =  4.000E+00 ), phi =  3.035E+01
node :  62 ( x1 =  5.444E+00, x2 =  4.500E+00 ), phi =  3.483E+01
node :  63 ( x1 =  5.444E+00, x2 =  5.000E+00 ), phi =  3.623E+01
node :  64 ( x1 =  5.999E+00, x2 =  6.019E-36 ), phi =  7.793E+00
node :  65 ( x1 =  5.999E+00, x2 =  1.000E+00 ), phi =  8.610E+00
node :  66 ( x1 =  5.999E+00, x2 =  2.000E+00 ), phi =  1.124E+01
node :  67 ( x1 =  5.999E+00, x2 =  3.000E+00 ), phi =  1.675E+01
node :  68 ( x1 =  5.999E+00, x2 =  4.000E+00 ), phi =  2.507E+01
node :  69 ( x1 =  5.999E+00, x2 =  4.500E+00 ), phi =  2.805E+01
node :  70 ( x1 =  5.999E+00, x2 =  5.000E+00 ), phi =  2.912E+01
node :  71 ( x1 =  6.693E+00, x2 =  6.019E-36 ), phi =  7.048E+00
node :  72 ( x1 =  6.693E+00, x2 =  1.000E+00 ), phi =  7.766E+00
node :  73 ( x1 =  6.693E+00, x2 =  2.000E+00 ), phi =  1.009E+01
node :  74 ( x1 =  6.693E+00, x2 =  3.000E+00 ), phi =  1.436E+01
node :  75 ( x1 =  6.693E+00, x2 =  4.000E+00 ), phi =  1.958E+01
node :  76 ( x1 =  6.693E+00, x2 =  4.500E+00 ), phi =  2.139E+01
node :  77 ( x1 =  6.693E+00, x2 =  5.000E+00 ), phi =  2.204E+01
node :  78 ( x1 =  7.560E+00, x2 =  6.019E-36 ), phi =  5.653E+00
node :  79 ( x1 =  7.560E+00, x2 =  1.000E+00 ), phi =  6.212E+00
node :  80 ( x1 =  7.560E+00, x2 =  2.000E+00 ), phi =  6.943E+00
node :  81 ( x1 =  7.560E+00, x2 =  3.000E+00 ), phi =  1.076E+01
node :  82 ( x1 =  7.560E+00, x2 =  4.000E+00 ), phi =  1.373E+01
node :  83 ( x1 =  7.560E+00, x2 =  4.500E+00 ), phi =  1.471E+01
node :  84 ( x1 =  7.560E+00, x2 =  5.000E+00 ), phi =  1.506E+01
node :  85 ( x1 =  8.645E+00, x2 =  6.019E-36 ), phi =  3.354E+00
node :  86 ( x1 =  8.645E+00, x2 =  1.000E+00 ), phi =  3.672E+00
node :  87 ( x1 =  8.645E+00, x2 =  2.000E+00 ), phi =  4.607E+00
node :  88 ( x1 =  8.645E+00, x2 =  3.000E+00 ), phi =  5.995E+00
node :  89 ( x1 =  8.645E+00, x2 =  4.000E+00 ), phi =  7.334E+00
node :  90 ( x1 =  8.645E+00, x2 =  4.500E+00 ), phi =  7.755E+00
node :  91 ( x1 =  8.645E+00, x2 =  5.000E+00 ), phi =  7.904E+00
node :  92 ( x1 =  1.000E+01, x2 =  9.404E-37 ), phi =  2.781E-20
node :  93 ( x1 =  1.000E+01, x2 =  1.000E+00 ), phi =  6.051E-20
node :  94 ( x1 =  1.000E+01, x2 =  2.000E+00 ), phi =  7.431E-20
node :  95 ( x1 =  1.000E+01, x2 =  3.000E+00 ), phi =  9.351E-20
node :  96 ( x1 =  1.000E+01, x2 =  4.000E+00 ), phi =  8.189E-20
node :  97 ( x1 =  1.000E+01, x2 =  4.500E+00 ), phi =  4.842E-20
node :  98 ( x1 =  1.000E+01, x2 =  5.000E+00 ), phi =  2.462E-20

max | phi | = 1.000E+02 @ node  4 ( 6.018E-36, 3.000E+00)

ud_scalar -> end of analysis . . . . . .