

Programming in ANSYS APDL To Investigate Stress Concentration Factor On Plate With Circular Hole.

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Abstract

It is Well-known that Automation developing at high notch in our country. It Benefits of using automation gives high production rates, increased productivity, optimized usage of material, high safety, high close tolerance products and reduced lead times. Therefore, this paper introducing automation (programming in ANSYS APDL) in calculation of stress concentration factors for plate with a circular hole at ANY LOCATION, also tested the same specimen with two materials – Structural Steel and Aluminium 6061-T6. In this paper automation using programming code is only introduced but not the finite element method. By using this methodology, a researcher directly get SCF (stress concentration factor) for various materials in a very less time.

Keywords: *Stress Concentration, Automation, ANSYS, APDL, Programming code*

1. INTRODUCTION

In present situation a big challenge for a researcher for analysis on material is the major part in manufacturing of a product and the analysis for Structural integrity plays a crucial part. All industries expecting easy and fast method to complete a specific task using automation. As per codes and standards all the designing and execution works will carry out, for safety and quality. The common structure that comes across in all types of industries is a **plate with hole** appears where ever there is scope of fastening of parts or in assemblies. Evaluating stress concentrations at the location where material has been removed like holes or notches is a standard practice followed before selection of material of construction (MOC).

Hence in this project a Square plate with a circular hole in it is considered with different materials, which is subjected to normal tensile load (bi-axially). Manually if done this project in ANSYS – Pre-processing, Solve and Post processing will take at least 30 to 50 minutes from an expert level to beginner level. Instead of that, this project has contributed its time in developing a program/code to complete this task in milliseconds, with Graphic User Interface and User Customization for geometry changes has also been added in this MACRO, which saves not only time, but also money in research point of view.

2. Methodology

2.1 Writing Programming code for plate with circular hole at any location to find SCF

The Macro code.

```

/NOPR                                %C
KEYW,PR_STRUC,1                      KDELE,ALL
/GO                                   /REP,FAST
/PREP7
ET,1,PLANE183                        *ELSEIF,A,LE,XR,OR,B,LE,XR,THEN
KEYOPT,1,3,3                          *MSG,ERROR,'A & B SHOULD BE
MPTEMP,1,0                             GREATER THAN R+3'
multipro,'start',9                    %C
*cset,1,3,L,'Enter Length of the     KDELE,ALL
Plate',100                             /REP,FAST
*cset,4,6,H,'Enter Height of the
Plate',100
*cset,7,9,A,'Enter Hole Vertical
Distance',50
*cset,10,12,B,'Enter Hole Horizontal
Distance',50
*cset,13,15,R,'Enter Hole Radius',5
*cset,16,18,CURTHICK,'Enter Plate
Thickness',2
*cset,19,21,YM,'Enter Modules of
Elasticity',210E9
*cset,22,24,MU,'Enter Poission
Ratio',0.3
*cset,25,27,F,'Enter Force Applied',500
multipro,'end'
AREA=H*CURTHICK
P=F/AREA
MPDATA,EX,1,,YM
MPDATA,PRXY,1,,MU
R,1,CURTHICK
A1=H-A
B1=L-B
XR=R+3

K,1,B,A1

*IF,H,NE,L,THEN
*MSG,ERROR,'CONSIDER ONLY
SQUARE PLATE'
! *** HOLE AT CENTER ***

*ELSEIF,A,EQ,A1,AND,B,EQ,B1,THEN
K,2,B+R,A1
K,3,B,A1+R
K,4,B,A1+XR
K,5,B+XR,A1+XR
K,6,B+XR,A1
LARC,2,3,1,R
L,3,4
L,4,5
L,5,6
L,6,2
LESIZE,1,,,30
LESIZE,2,,,10
LESIZE,3,,,15
LESIZE,4,,,15
LESIZE,5,,,10
AL,1,2,3,4,5
LCCAT,3,4
MSHKEY,1

```

```

AMESH,ALL
WPSTYLE,,,,,,,,,1
KWPAVE,1
CSYS,4
FLST,3,1,5,ORDE,1
FITEM,3,1
ARSYM,X,ALL, , , ,0,0
FLST,3,1,5,ORDE,1
FITEM,3,1
ARSYM,Y,ALL, , , ,0,0
WPCSYS,-1,0
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** LEFT AREA ***
K,14,0,A1-XR
K,15,0,A1+XR
L,8,13
L,13,14
L,14,15
L,15,8
LESIZE,18,,,30
LESIZE,19,,,30
LESIZE,20,,,30
LESIZE,21,,,30
AL,18,19,20,21
MSHKEY,1
AMESH,5
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** TOP AREA ***
K,16,B-XR,H

K,17,B+XR,H
L,5,8
L,8,16
L,16,17
L,17,5
LESIZE,22,,,30
LESIZE,23,,,30
LESIZE,24,,,30
LESIZE,25,,,30
AL,22,23,24,25
MSHKEY,1
AMESH,6
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** RIGHT AREA ***
K,18,L,A1+XR
K,19,L,A1-XR
L,5,12
L,12,19
L,19,18
L,18,5
LESIZE,26,,,30
LESIZE,27,,,30
LESIZE,28,,,30
LESIZE,29,,,30
AL,26,27,28,29
MSHKEY,1
AMESH,7
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** BOTTOM AREA ***

```

```

K,20,B+XR,0
K,21,B-XR,0
L,13,12
L,12,20
L,20,21
L,21,13
LESIZE,30,,,30
LESIZE,31,,,30
LESIZE,32,,,30
LESIZE,33,,,30
AL,30,31,32,33
MSHKEY,1
AMESH,8
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** R-TOP-LEFT AREA ***
K,22,0,H
L,15,22
L,22,16
LESIZE,34,,,30
LESIZE,35,,,30
AL,34,35,21,23
MSHKEY,1
AMESH,9
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** R-TOP-RIGHT AREA ***
K,23,L,H
L,17,23
L,23,18
LESIZE,36,,,30
LESIZE,37,,,30
AL,36,37,25,29
MSHKEY,1
AMESH,10
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** R-BOTTOM-RIGHT AREA ***
K,24,L,0
L,19,24
L,24,20
LESIZE,38,,,30
LESIZE,39,,,30
AL,38,39,27,31
MSHKEY,1
AMESH,11
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** R-BOTTOM-LEFT AREA ***
K,25,0,0
L,21,25
L,25,14
LESIZE,40,,,30
LESIZE,41,,,30
AL,40,41,19,33
MSHKEY,1
AMESH,12
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP

```

```

NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** HOLE AT 1ST QUADRANT ***

*ELSEIF,A,LT,A1,AND,B,GT,B1,THEN
K,2,B,A1-R
K,3,B-R,A1
K,4,B-XR,A1
K,5,B-XR,A1-XR
K,6,B,A1-XR
LARC,2,3,1,R
L,3,4
L,4,5
L,5,6
L,6,2
LESIZE,1,,,30
LESIZE,2,,,10
LESIZE,3,,,15
LESIZE,4,,,15
LESIZE,5,,,10
AL,1,2,3,4,5
LCCAT,3,4
MSHKEY,1
AMESH,ALL
WPSTYLE,,,,,,,,,1
KWPAVE,1
CSYS,4
FLST,3,1,5,ORDE,1
FITEM,3,1
ARSYM,X,ALL, , , ,0,0
FLST,3,1,5,ORDE,1
FITEM,3,1
ARSYM,Y,ALL, , , ,0,0
WPCSYS,-1,0
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** LEFT AREA ***
K,14,0,A1+XR
K,15,0,A1-XR
L,11,5
L,5,15
L,15,14
L,14,11
LESIZE,18,,,30
LESIZE,19,,,30
LESIZE,20,,,30
LESIZE,21,,,30
AL,18,19,20,21
MSHKEY,1
AMESH,5
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** TOP AREA ***
K,16,B-XR,H
K,17,B+XR,H
L,13,11
L,11,16
L,16,17
L,17,13
LESIZE,22,,,30
LESIZE,23,,,30
LESIZE,24,,,30
LESIZE,25,,,30
AL,22,23,24,25
MSHKEY,1
AMESH,6
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

```

*! *** RIGHT AREA ****

*K,18,L,A1+XR
K,19,L,A1-XR
L,13,9
L,9,19
L,19,18
L,18,13
LESIZE,26,,,30
LESIZE,27,,,30
LESIZE,28,,,30
LESIZE,29,,,30
AL,26,27,28,29
MSHKEY,1
AMESH,7
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA*

*! *** BOTTOM AREA ****

*K,20,B+XR,0
K,21,B-XR,0
L,5,9
L,9,20
L,20,21
L,21,5
LESIZE,30,,,30
LESIZE,31,,,30
LESIZE,32,,,30
LESIZE,33,,,30
AL,30,31,32,33
MSHKEY,1
AMESH,8
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE*

NUMCMP,AREA

*! *** R-TOP-LEFT AREA ****

*K,22,0,H
L,14,22
L,22,16
LESIZE,34,,,30
LESIZE,35,,,30
AL,34,35,21,23
MSHKEY,1
AMESH,9
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA*

*! *** R-TOP-RIGHT AREA ****

*K,23,L,H
L,17,23
L,23,18
LESIZE,36,,,30
LESIZE,37,,,30
AL,36,37,25,29
MSHKEY,1
AMESH,10
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA*

*! *** R-BOTTOM-RIGHT AREA ****

*K,24,L,0
L,19,24
L,24,20
LESIZE,38,,,30
LESIZE,39,,,30
AL,38,39,27,31*

```

MSHKEY,1
AMESH,11
NUMMRG,NODE, , ,LOW
NUMMRG,KP, , ,LOW
NUMMRG,ELEM, , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** R-BOTTOM-LEFT AREA ***
K,25,0,0
L,21,25
L,25,15
LESIZE,40,,,30
LESIZE,41,,,30
AL,40,41,19,33
MSHKEY,1
AMESH,12
NUMMRG,NODE, , ,LOW
NUMMRG,KP, , ,LOW
NUMMRG,ELEM, , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** HOLE AT 2ND QUADRANT ***

*ELSEIF,A,LT,A1,AND,B,LT,B1,THEN
K,2,B,A1-R
K,3,B+R,A1
K,4,B+XR,A1
K,5,B+XR,A1-XR
K,6,B,A1-XR
LARC,2,3,1,R
L,3,4
L,4,5
L,5,6
L,6,2
LESIZE,1,,,30
LESIZE,2,,,10
LESIZE,3,,,15

LESIZE,4,,,15
LESIZE,5,,,10
AL,1,2,3,4,5
LCCAT,3,4
MSHKEY,1
AMESH,ALL
WPSTYLE,,,,,,,,,1
KWPAVE,1
CSYS,4
FLST,3,1,5,ORDE,1
FITEM,3,1
ARSYM,X,ALL, , ,0,0
FLST,3,1,5,ORDE,1
FITEM,3,1
ARSYM,Y,ALL, , ,0,0
WPCSYS,-1,0
NUMMRG,NODE, , ,LOW
NUMMRG,KP, , ,LOW
NUMMRG,ELEM, , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** LEFT AREA ***
K,14,0,A1+XR
K,15,0,A1-XR
L,13,9
L,9,15
L,15,14
L,14,13
LESIZE,18,,,30
LESIZE,19,,,30
LESIZE,20,,,30
LESIZE,21,,,30
AL,18,19,20,21
MSHKEY,1
AMESH,5
NUMMRG,NODE, , ,LOW
NUMMRG,KP, , ,LOW
NUMMRG,ELEM, , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM

```

NUMCMP,LINE
NUMCMP,AREA

! *** TOP AREA ***

K,16,B-XR,H
K,17,B+XR,H
L,11,13
L,13,16
L,16,17
L,17,11
LESIZE,22,,,30
LESIZE,23,,,30
LESIZE,24,,,30
LESIZE,25,,,30
AL,22,23,24,25
MSHKEY,1
AMESH,6
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** RIGHT AREA ***

K,18,L,A1+XR
K,19,L,A1-XR
L,11,5
L,5,19
L,19,18
L,18,11
LESIZE,26,,,30
LESIZE,27,,,30
LESIZE,28,,,30
LESIZE,29,,,30
AL,26,27,28,29
MSHKEY,1
AMESH,7
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP

NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** BOTTOM AREA ***

K,20,B+XR,0
K,21,B-XR,0
L,9,5
L,5,20
L,20,21
L,21,9
LESIZE,30,,,30
LESIZE,31,,,30
LESIZE,32,,,30
LESIZE,33,,,30
AL,30,31,32,33
MSHKEY,1
AMESH,8
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** R-TOP-LEFT AREA ***

K,22,0,H
L,14,22
L,22,16
LESIZE,34,,,30
LESIZE,35,,,30
AL,34,35,21,23
MSHKEY,1
AMESH,9
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** R-TOP-RIGHT AREA ***

K,23,L,H
L,17,23
L,23,18
LESIZE,36,,,30
LESIZE,37,,,30
AL,36,37,25,29
MSHKEY,1
AMESH,10
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** R-BOTTOM-RIGHT AREA ***

K,24,L,0
L,19,24
L,24,20
LESIZE,38,,,30
LESIZE,39,,,30
AL,38,39,27,31
MSHKEY,1
AMESH,11
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** R-BOTTOM-LEFT AREA ***

K,25,0,0
L,21,25
L,25,15
LESIZE,40,,,30
LESIZE,41,,,30
AL,40,41,19,33
MSHKEY,1
AMESH,12

NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** HOLE AT 3RD QUADRANT ***

*ELSEIF,A,GT,A1,AND,B,LT,B1,THEN
K,2,B,A1+R
K,3,B+R,A1
K,4,B+XR,A1
K,5,B+XR,A1+XR
K,6,B,A1+XR
LARC,2,3,1,R
L,3,4
L,4,5
L,5,6
L,6,2
LESIZE,1,,,30
LESIZE,2,,,10
LESIZE,3,,,15
LESIZE,4,,,15
LESIZE,5,,,10
AL,1,2,3,4,5
LCCAT,3,4
MSHKEY,1
AMESH,ALL
WPSTYLE,,,,,,,,,1
KWPAVE,1
CSYS,4
FLST,3,1,5,ORDE,1
FITEM,3,1
ARSYM,X,ALL, , , ,0,0
FLST,3,1,5,ORDE,1
FITEM,3,1
ARSYM,Y,ALL, , , ,0,0
WPCSYS,-1,0
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE

NUMCMP,KP
 NUMCMP,ELEM
 NUMCMP,LINE
 NUMCMP,AREA

! *** LEFT AREA ***

K,14,0,A1-XR
 K,15,0,A1+XR
 L,9,13
 L,13,14
 L,14,15
 L,15,9
 LESIZE,18,,,30
 LESIZE,19,,,30
 LESIZE,20,,,30
 LESIZE,21,,,30
 AL,18,19,20,21
 MSHKEY,1
 AMESH,5
 NUMMRG,NODE, , , ,LOW
 NUMMRG,KP, , , ,LOW
 NUMMRG,ELEM, , , ,LOW
 NUMCMP,NODE
 NUMCMP,KP
 NUMCMP,ELEM
 NUMCMP,LINE
 NUMCMP,AREA

! *** TOP AREA ***

K,16,B-XR,H
 K,17,B+XR,H
 L,5,9
 L,9,16
 L,16,17
 L,17,5
 LESIZE,22,,,30
 LESIZE,23,,,30
 LESIZE,24,,,30
 LESIZE,25,,,30
 AL,22,23,24,25
 MSHKEY,1
 AMESH,6
 NUMMRG,NODE, , , ,LOW
 NUMMRG,KP, , , ,LOW
 NUMMRG,ELEM, , , ,LOW

NUMCMP,NODE
 NUMCMP,KP
 NUMCMP,ELEM
 NUMCMP,LINE
 NUMCMP,AREA

! *** RIGHT AREA ***

K,18,L,A1+XR
 K,19,L,A1-XR
 L,5,11
 L,11,19
 L,19,18
 L,18,5
 LESIZE,26,,,30
 LESIZE,27,,,30
 LESIZE,28,,,30
 LESIZE,29,,,30
 AL,26,27,28,29
 MSHKEY,1
 AMESH,7
 NUMMRG,NODE, , , ,LOW
 NUMMRG,KP, , , ,LOW
 NUMMRG,ELEM, , , ,LOW
 NUMCMP,NODE
 NUMCMP,KP
 NUMCMP,ELEM
 NUMCMP,LINE
 NUMCMP,AREA

! *** BOTTOM AREA ***

K,20,B+XR,0
 K,21,B-XR,0
 L,13,11
 L,11,20
 L,20,21
 L,21,13
 LESIZE,30,,,30
 LESIZE,31,,,30
 LESIZE,32,,,30
 LESIZE,33,,,30
 AL,30,31,32,33
 MSHKEY,1
 AMESH,8
 NUMMRG,NODE, , , ,LOW
 NUMMRG,KP, , , ,LOW

```

NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** R-TOP-LEFT AREA ***
K,22,0,H
L,15,22
L,22,16
LESIZE,34,,,30
LESIZE,35,,,30
AL,34,35,21,23
MSHKEY,1
AMESH,9
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** R-TOP-RIGHT AREA ***
K,23,L,H
L,17,23
L,23,18
LESIZE,36,,,30
LESIZE,37,,,30
AL,36,37,25,29
MSHKEY,1
AMESH,10
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** R-BOTTOM-RIGHT AREA ***
K,24,L,0
L,19,24
L,24,20
LESIZE,38,,,30
LESIZE,39,,,30
AL,38,39,27,31
MSHKEY,1
AMESH,11
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** R-BOTTOM-LEFT AREA ***
K,25,0,0
L,21,25
L,25,14
LESIZE,40,,,30
LESIZE,41,,,30
AL,40,41,19,33
MSHKEY,1
AMESH,12
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** HOLE AT 4TH QUADRANT ***
*ELSE
K,2,B,A1+R
K,3,B-R,A1
K,4,B-XR,A1
K,5,B-XR,A1+XR
K,6,B,A1+XR
LARC,2,3,1,R
L,3,4

```

```

L,4,5
L,5,6
L,6,2
LESIZE,1,,,30
LESIZE,2,,,10
LESIZE,3,,,15
LESIZE,4,,,15
LESIZE,5,,,10
AL,1,2,3,4,5
LCCAT,3,4
MSHKEY,1
AMESH,ALL
WPSTYLE,,,,,,,,,1
KWPAVE,1
CSYS,4
FLST,3,1,5,ORDE,1
FITEM,3,1
ARSYM,X,ALL, , , ,0,0
FLST,3,1,5,ORDE,1
FITEM,3,1
ARSYM,Y,ALL, , , ,0,0
WPCSYS,-1,0
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** LEFT AREA ***
K,14,0,A1-XR
K,15,0,A1+XR
L,5,11
L,11,14
L,14,15
L,15,5
LESIZE,18,,,30
LESIZE,19,,,30
LESIZE,20,,,30
LESIZE,21,,,30
AL,18,19,20,21
MSHKEY,1
AMESH,5

NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** TOP AREA ***
K,16,B-XR,H
K,17,B+XR,H
L,9,5
L,5,16
L,16,17
L,17,9
LESIZE,22,,,30
LESIZE,23,,,30
LESIZE,24,,,30
LESIZE,25,,,30
AL,22,23,24,25
MSHKEY,1
AMESH,6
NUMMRG,NODE, , , ,LOW
NUMMRG,KP, , , ,LOW
NUMMRG,ELEM, , , ,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

! *** RIGHT AREA ***
K,18,L,A1+XR
K,19,L,A1-XR
L,9,13
L,13,19
L,19,18
L,18,9
LESIZE,26,,,30
LESIZE,27,,,30
LESIZE,28,,,30
LESIZE,29,,,30
AL,26,27,28,29
MSHKEY,1

```

AMESH,7
 NUMMRG,NODE, , ,LOW
 NUMMRG,KP, , ,LOW
 NUMMRG,ELEM, , ,LOW
 NUMCMP,NODE
 NUMCMP,KP
 NUMCMP,ELEM
 NUMCMP,LINE
 NUMCMP,AREA

! *** BOTTOM AREA ***

K,20,B+XR,0
 K,21,B-XR,0
 L,11,13
 L,13,20
 L,20,21
 L,21,11
 LESIZE,30,,,30
 LESIZE,31,,,30
 LESIZE,32,,,30
 LESIZE,33,,,30
 AL,30,31,32,33
 MSHKEY,1
 AMESH,8
 NUMMRG,NODE, , ,LOW
 NUMMRG,KP, , ,LOW
 NUMMRG,ELEM, , ,LOW
 NUMCMP,NODE
 NUMCMP,KP
 NUMCMP,ELEM
 NUMCMP,LINE
 NUMCMP,AREA

! *** R-TOP-LEFT AREA ***

K,22,0,H
 L,15,22
 L,22,16
 LESIZE,34,,,30
 LESIZE,35,,,30
 AL,34,35,21,23
 MSHKEY,1
 AMESH,9
 NUMMRG,NODE, , ,LOW
 NUMMRG,KP, , ,LOW
 NUMMRG,ELEM, , ,LOW

NUMCMP,NODE
 NUMCMP,KP
 NUMCMP,ELEM
 NUMCMP,LINE
 NUMCMP,AREA

! *** R-TOP-RIGHT AREA ***

K,23,L,H
 L,17,23
 L,23,18
 LESIZE,36,,,30
 LESIZE,37,,,30
 AL,36,37,25,29
 MSHKEY,1
 AMESH,10
 NUMMRG,NODE, , ,LOW
 NUMMRG,KP, , ,LOW
 NUMMRG,ELEM, , ,LOW
 NUMCMP,NODE
 NUMCMP,KP
 NUMCMP,ELEM
 NUMCMP,LINE
 NUMCMP,AREA

! *** R-BOTTOM-RIGHT AREA ***

K,24,L,0
 L,19,24
 L,24,20
 LESIZE,38,,,30
 LESIZE,39,,,30
 AL,38,39,27,31
 MSHKEY,1
 AMESH,11
 NUMMRG,NODE, , ,LOW
 NUMMRG,KP, , ,LOW
 NUMMRG,ELEM, , ,LOW
 NUMCMP,NODE
 NUMCMP,KP
 NUMCMP,ELEM
 NUMCMP,LINE
 NUMCMP,AREA

! *** R-BOTTOM-LEFT AREA ***

K,25,0,0
 L,21,25

```

L,25,14
LESIZE,40,,,30
LESIZE,41,,,30
AL,40,41,19,33
MSHKEY,1
AMESH,12
NUMMRG,NODE,,,LOW
NUMMRG,KP,,,LOW
NUMMRG,ELEM,,,LOW
NUMCMP,NODE
NUMCMP,KP
NUMCMP,ELEM
NUMCMP,LINE
NUMCMP,AREA

*ENDIF

LSEL,S,LINE,,37
LSEL,A,LINE,,28
LSEL,A,LINE,,38
NSLL,,1
SF,ALL,PRES,-P

!*
/PSF,PRES,NORM,2,0,1
/PBF,DEFA,,1
/PSYMB,CS,0
/PSYMB,NDIR,0
/PSYMB,ESYS,0
/PSYMB,LDIR,0
/PSYMB,ADIR,0
/PSYMB,ECON,0
/PSYMB,XNODE,0

/PSYMB,DOT,1
/PSYMB,PCONV,
/PSYMB,LAYR,0
/PSYMB,FBCS,0
!*
/PBC,ALL,,1
/REP
!*

LSEL,S,LINE,,34
LSEL,A,LINE,,20
LSEL,A,LINE,,41
NSLL,,1
D,ALL,ALL

LSEL,ALL
NSEL,ALL
CSYS,1

FINISH ! Exits normally from
a processor
/SOLU
SOLVE

/POST1
SET,1,1
NSORT,S,X,,,3 ! SORT NODAL
DATA BASED ON SX, RETAIN ONLY
THE HIGHEST 3
PRNSOL,S,COMP ! Prints
nodal solution results
PLESOL,S,EQV
/GOPR
FINISH

```

Open notepad, copy-paste the script and save it as a “.txt” file. Import this text file into ANSYS to run this specific analysis. This TXT file itself is the programming code.

2.2 Run the Programming code

From ANSYS APDL main window access File > Read Input From... > Choose the TXT file which was saved in the previous procedure. A window will appear, prompting the required input to do the analysis.

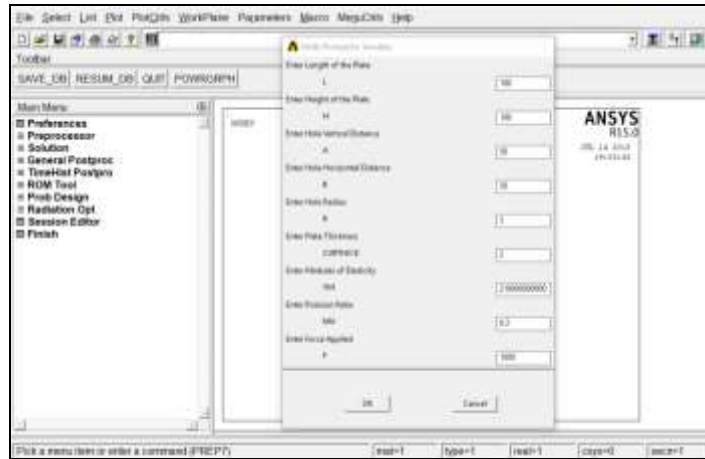


Fig.1 Code Front-end GUI

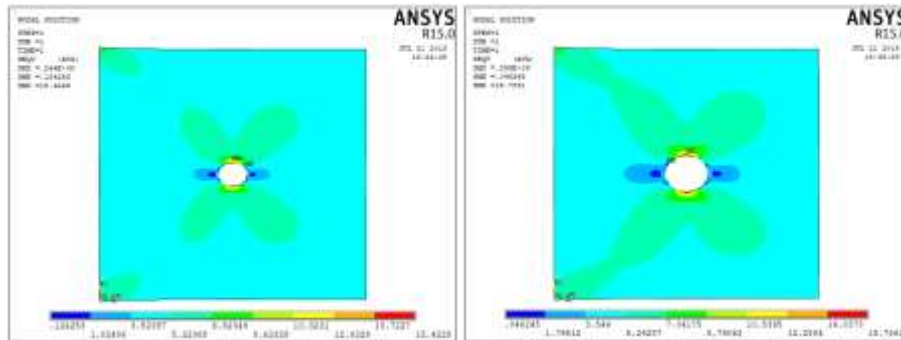
3 RESULTS AND DISCUSSION

3.1 Results

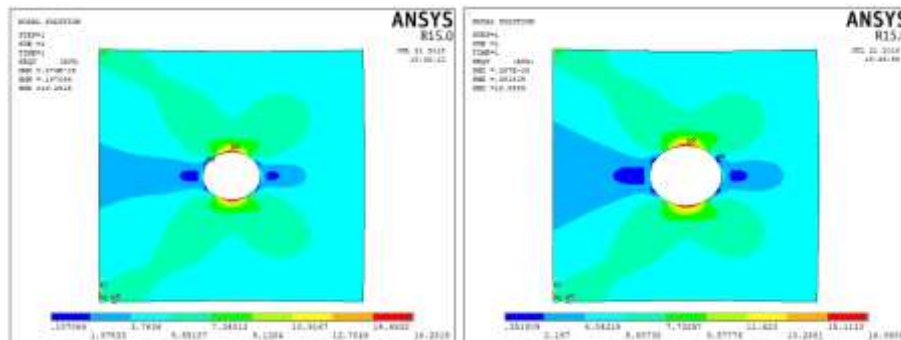
Following are the results obtained:

(Figures from 2 to 9 listed detailed in Figure Table)

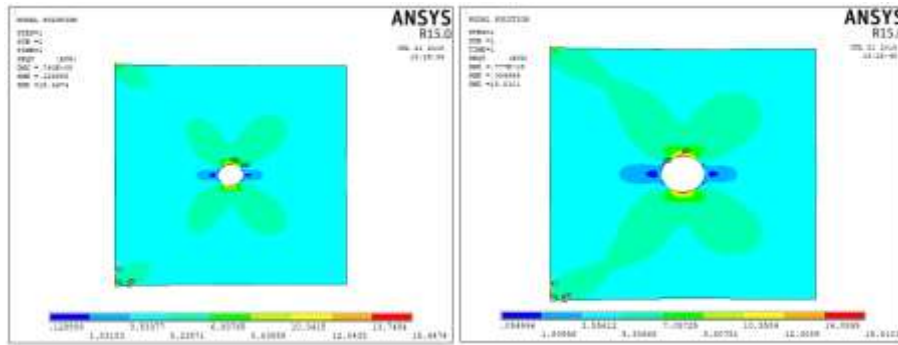
Hole Diameter = 10 mm & 15 mm (Structural Steel) (Done Using MACRO)



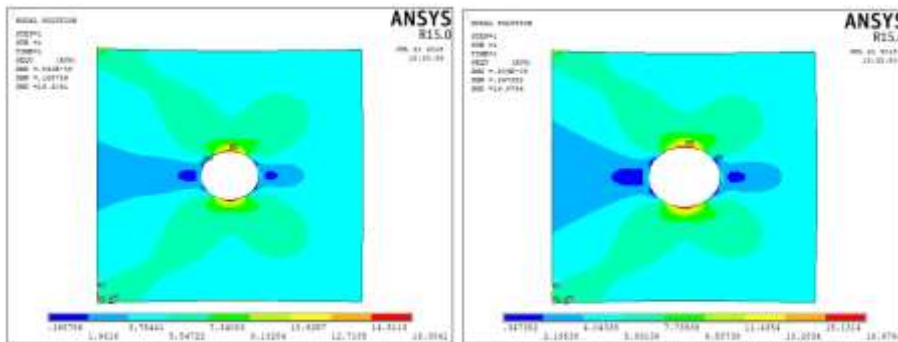
Hole Diameter = 20 mm & 25 mm (Structural Steel) (Done Using MACRO)



Hole Diameter = 10 mm & 15 mm (Al 6061-T6) (Done Using MACRO)



Hole Diameter = 20 mm & 25 mm (Al 6061-T6) (Done Using MACRO)



4. CONCLUSIONS AND FUTURE SCOPE

This paper investigated that, it concluded that the maximum stress developed at corners of holes in both materials.

Ultimate tensile test on a plate with a hole in it is very easy one, but it has enormous technical challenges which have not been relieved yet. If for different materials this same experiment has to run, then the entire pre-processing process has to be changed and re-run the analysis. If in another case the hole which is at center has to be in another location, except center, then the entire modeling work and then the pre & post works has to be carried out newly.

With this programming code, the mentioned challenges can be solved very easily and at rocket speeds.

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