Calculation of the Stress intensity factor with CINT command in 2D Workbench 13.0

Aalborg Universitet esbjerg Søren Heide Lambertsen



🖺 New 📴 Open... 🗟 Save 🗟 Save As... | 🏭 Import... | 🍣 Reconnect 🛭 & Refresh Project 🗡 Update Project | 😋 Project 🕢 Compact Mode

File View Tools Units Help

Select Analysis type to 2D and then open the Design Modeler.





Open the model and refine the mesh. Radial/ring patterned mesh is not required.





The mesh.





Select Named Selection.



Ლ /☆ 🌾 🏷 🕞 🕞 💽 🕞 🗲 😳 🕂 🍭 🔍 🔍 🔍 😹 🖂 –

ダ Show Vertices 🍄 Wireframe 🛛 📕 Edge Coloring 🗸 ん 🗸 イ マー スマー スマー メー 🕨 🖿 Thicken Annotations





Select the crack tip and rename the Selection.

File Edit View Units Tools Help] ↓ ↓ Solve → 1 ■ ■	₩ A @ - Worksheet					
<u>] ♥ ヤ `* & ▼ 12 12 12 12 18 04 & ↓</u>	<u> </u>					
F Show Vertices 🛱 Wireframe I I Edge Coloring ▼ 🔏 ▼ 🖊 ▼	✓ Z ▼ Z ▼ X ▼ I*I I*I Thicken Annotat	ions				
Commands 🚵 Export 📾 Import 🖄 Refresh						
Outline 4	Commands					
Project Model (A4) Model (A4) Model (A4) Model (A4) Model (A4) Model (A5) Model Selections Model S	<pre>! Commands inserted into this fi: ! These commands may supersede c: ! Active UNIT system in Workbencl CINT, NEW, 1 ! DI CINT, NEW, 1 ! DI CINT, TYPE, jint CINT, CTNC, tip ! DI CINT, NORMAL, 0, 2 ! DI Graphics commands Messages Taut</pre>	le will be executed just pric ommand settings set by Workbo h when this object was created EFINE CRACK ID EFINE RIGHT CRACK TIP NODE CO UMBER OF COUNTOURS EFINE CRACK PLANE NORMAL	or to the Ansys SOLVE commend. ed: Metric (mm, kg, N, s, MPONENT	nand. , mV, mA)	7	- ×
Details of "Commands (APDL)" 4	Varnii The default defeaturing telerance	was larger than one computed ha	Association Projects Models Geometrys	Surface Rody Roy 12/10/2011 12:50:54 L		
File ▲ File Name File Istatus File Status File not found Definition Suppressed No Target Mechanical APDL Input Arguments ARG1 ARG3 ARG3 ARG4 ARG5 APG6 ▼	Terring the default defeationing totelalice	was larger than one complited ba	- Hojecometry>	Sanace body Bot 12/19/2011 12:30:341		
Press F1 for Help		🟓 1 Message	No Selection		Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius	/

Start a Command window and write the CINT commands.

Start a new calculation and name the calculation.

Cint,new,1

Enter the type of calculation. In this example the valve of the j integral is calculated.

Cint,type,jint

Define the crack tip, in this example the crack tip is named tip

Cint,ctnc,tip

Enter the coordinate system her the x=1 y=2 z=3. In this example the coordinate is 0 with is the default coordinate system and 2 is the y axis with is normal to the crack direction.

Cint,normal,0,2

There are many other parameters there can be changed, in the example is command is the simplest setup possible. A extra command can be the contours number below the number is set to 10.

Cint,ncon,10

Start a new calculation and name the calculation.

Cint,new,1

Enter the type of calculation. In this example the valve of the j integral is calculated.

Cint,type,jint

Define the crack tip, in this example the crack tip is named tip

Cint,ctnc,tip

Enter the coordinate system her the x=1 y=2 z=3. In this example the coordinate is 0 with is the default coordinate system and 2 is the y axis with is normal to the crack direction.

Cint,normal,0,2

There are many other parameters there can be changed, in the example is command is the simplest setup possible. A extra command can be the contours number below the number is set to 10.

Cint,ncon,10



 Start a command window under solution and enter the command for printing the j integral solution.

To print the calculation number 1

Print,1,,JINT

File Edit View Units Tools Help 🛛 🥑 🔰 Solve マ 雛 🐱 🛆 👁 マ 🕼 Worksheet 🊏 🕂 🤻 🗞 🕥 🐚 🐚 🕲 😵 マ 😂 🎨 😌 🔍 🔍 🔍 🗶 🗮 💭 マ

F Show Vertices லWireframe | ■Edge Coloring マ んマ ハマ タマ ムマ トー トー Thicken Annotations

Solution Information 😹 Result Tracker 👻

La Result Hacker		
Putline 4	Worksheet	4
 Project Model (A4) 	<pre>cv NOTE ***</pre>	÷
Details of "Solution Information"	Text Association Timestamp	
Solution Information Solution Output Solver Output Newton-Raphson Residuals 0 Update Interval 2,5 s Display Points All	Warming The default definituring tolerance was larger than one computed bas Project>Model>Geometry>Surface Body Bod 12/19/2011 12:50:54	

the example the values is negatives, to changes this switch the normal plane direction. How to se below.



Changes the direction of y axis.



Like this.

Calculation of the stress intensity factor. It is important that the coordinate system is correct, if the j-integral is negative switch the direction like in the example.

We add a new command. Changes to new,2

Cint, new, 2 Cint, type, sifs Cint, ctnc, tip Cint, ncon, 10 Cint, normal, 0, 2

And also print the result from calculation 2.

Prcint,2,,K1

A : Static Structural - Mechanical [ANSYS Academic Teaching Advanced]					_ B ×
File Edit View Units Tools Help 🛛 🥑 🧚 Solve 🔹 🏥 腿 🚺 🔺	🙆 🕶 🌒 Worksheet 🛛 🛛 🐨 🚧 🦋	🔭 🖻 🖻 💽 🕒 🗳 - 🖸 🕂 🤤 🕀	. @, @, Q, Q, ╦, /?, ਜ਼ □ -		
Commands 🙀 Export 👔 Import 😰 Refresh				」 ダ Show Vertices 🚏 Wireframe	Edge Coloring - 1/0 - 1/2 - 1/3 - 1/2 - 1/3 - H Thicken Annotations
Dutline 🗜	Commands				
Project	! Commands inserted into th	is file will be executed just prior to the	Ansys SOLVE command.		
🖻 🖷 🔞 Model (A4)	! These commands may supers	ede command settings set by Workbench.	-		
⊡, Man Geometry					
Coordinate Systems	Active UNII system in Wor	kbench when this object was created: Metr	ic (mm, kg, N, S, mV, mA)		
🗐 🖓 Nanco Sciections					
Analysis Settings	CINT NEW 1	I DEFINE CRACK TO			
, Fixed Support	CINT, TYPE, jint	: DEFINE CRACK ID			
	CINT, CTNC, tip	! DEFINE RIGHT CRACK TIP NODE COMPONENT			
Commands (APDL)	CINT, NCON, 30	! NUMBER OF COUNTOURS			
🗄 🗸 🔞 Solution (A6)	CINI, NORMAL, 12, 2	! DEFINE CRACK PLANE NORMAL			
Solution Information					
Common de (Appl.)					
	CINT, NEW, 2	! DEFINE CRACK ID			
	CINT CINC tip	DEFINE RIGHT CRACK TIP NODE COMPONENT			
	CINT, NCON, 30	! NUMBER OF COUNTOURS			
	CINT, NORMAL, 12, 2	! DEFINE CRACK PLANE NORMAL			
etails of "Commands (APDL)"					
File	1				
File Name					
File Status File not found					
Definition					
Suppressed No					
Target Mechanical APDL					
Input Arguments					
ARG1					
ARG2					
ARG3					
ARG4					
ARG5					
ARG6					
ARG7					
ARG8	Contribution of the second sec				
ARG9	Graphics Commands				
	Messages				ч ×
	Text		Association	Timestamp	
	Warning The Quad Mesher failed on the f	ollowing faces.	Project>Model>Geometry>Surface Body Bodies	1/5/2012 9:32:23 AM	
	Warning The default defeaturing tolerand	e was larger than one computed based on size controls. The	m Project>Model>Geometry>Surface Body Bodies	1/5/2012 9:32:23 AM	
ection Planes 🛛 🕹 🕂 🗶					
ress F1 for Help		2 Messages	No Selection	Metric	(mm, kg, N, s, mV, mA) Degrees rad/s Celsius
		л у 2		,	
🚺 🚺 📑 😂 堅 🔽 📣 🖳 🛝					DA A P A 09:35

A : Static Structure	al - Mechanical [ANSYS Academic Teaching Advanced]							X
- ile Edit View Unit	s Tools Help	🔞 🗸 💕 Worksheet	🕾 🎶 🔭 🖬 🖬					
mmands Export	millimort @Refresh @Search Parameters					G Show Vertices	ame Edge Coloring y & y & y &	
tino		Commando				l) > pronteraces @function		• • • • • • • • • • • • • • • • • • •
I Project					be been (BOCT) entreed			
🗠 🙀 Model (A4)		Commands Ins	ercea inco chis ille will be	executed immediately after	the Ansys / POSII Command.			
🗉 🏑 🏠 Geomet	'Y	! Active UNIT	system in Workbench when the	s object was created: Metri	z (mm, kg, N, s, mV, mA)			
E Coordin	ate Systems							
Hest Named	Selections	prcint, 1, , JINT						
🗄 🖉 Static	Structural (A5)	prcint.2k1						
∕ <u>Ä</u> Ar	alysis Settings							
Ju FD	ed Support							
Co	mmands (APDL)							
🗄 🗸 👼 So	olution (A6)							
	Solution Information							
	Equivalent Stress							
~	Commanus (APDL)							
ails of "Commands (A	PDL)" 4							
File		1						
File Name		1						
=ile Status	File not found							
Definition								
Suppressed	No							
Output Search Prefix	my_							
Target	Mechanical APDL							
Input Arguments		- 1						
ARGI		- 1						
ARG2		-						
ARG4								
ARG5								
ARG6								
ARG7		Graphics Comma	inds					
ARG8								
ARG9		Messages			A	Timesterre		4 X
Results		Warning The Ouad Me	sher failed on the following faces.		Project >Model >Geometry >Surface Body Bodies	1/5/2012 9:32:23 AM		
		Warning The default d	efeaturing tolerance was larger than on	e computed based on size controls. The m	Project>Model>Geometry>Surface Body Bodies	1/5/2012 9:32:23 AM		
🖄 🗙 🔶 👘								
		Ī						
s F1 for Help				🔁 2 Messages	No Selection	M	etric (mm, kg, N, s, mV, mA) Degrees rad/s Celsiu	s //
								09:36
start 💟	🚍 I 🥌 🔛 🕋 💌 🚺	' 🖤 !						05-01-2012

Like this.

🕅 A : Static Structural - Mechanical [ANSYS Academic Teaching Advanced]						. 8 ×
File Edit View Units Tools Help 🛛 🖉 📝 Solve 🗸 🏥 📷 🔃 🖪	🖻 🕶 🚺 Worksheet 🔄 📽 🛷 🦎 🔓 🕏) 💽 🖻 🚳 - 🖫 💠 🍳 🕀	. @. @. Q. Q. ₩ /?. 🖴 🗖 -			
Solution Information 🛗 Result Tracker 👻				「 」 戸 Show Vertices 🙀 Wireframe	Edge Coloring \cdot $\sqrt{1}$ \cdot $\sqrt{1}$ \cdot $\sqrt{2}$ \cdot $\sqrt{3}$ \cdot $\sqrt{1}$ \cdot \cdot Thicken Anno	tations
Outline 🕂	Worksheet					4
Project P	**** NOTE *** Reading results into the database (SET of displacement and force boundary conditio values from the results file for that lo subsequent solutions will use these value either SAVE the current values or not ov ***** POSTI J-INTEGRAL RESULT LISTING * CrackID = 1 Crack Front Node =13045 Contour Values = 1.7480 1.746 Contour Values = 1.7480 1.746 Contour Values = 1.7481 1.748 Contour Values = 1.7489 1.750 Contour Values = 1.753 1.762 Contour Values = 1.753 1.762 Contour Values = 1.7669 1.766	IOW (F0311) Free CP = 24.180 TIME=09:37 roommand) will update the curren ms in the database with the edd set. Note that any ees unless action is taken to reverite them (/EXIT,NOSAVE). **** 00 1.7482 1.7481 100 1.7480 1.7481 101 1.7490 1.7481 102 1.7451 1.7515 11 1.7551 1.7563 12 1.7561 1.7663 13 1.7679 1.7642	:31 t			
Details of "Solution Information"	***** POSTI K1 RESULT LISTING * Crack ID = 2 Crack Front Node =13045 Contour Values = 637.19 590.4 Contour Values = 591.24 591.2 Contour Values = 591.24 591.2 Contour Values = 591.21 591.2 Contour Values = 591.21 591.2	1 591.56 591.43 16 591.28 591.24 15 591.23 591.22 10 591.17 591.16 1 501.00 501.00				
Solution Information Solution Solution Vulput Solution Vulput Newton-Raphson Residuals 0 Update Interval 2,5 s Display Points	Contour Values = 591.14 591.1 Contour Values = 591.07 591.0 Contour Values = 590.98 590.9 Contour Values = 590.84 601.0 Set Encoding of XML File to:ISO-8859-1	1 591.09 591.00 2 591.00 591.00 5 590.91 590.87 1				
	Set Output of XML File to: FARM, , , , , , , , , , , , , , , , , , ,	· · · · ·	,			•
	Graphics Worksheet					
	Messages Text Warning The Ouad Mesher failed on the following faces. Warning The default defeaturing tolerance was larger than 	n one computed based on size controls. The	Association Project>Model>Geometry>Surface Body Bodies m Project>Model>Geometry>Surface Body Bodies	Timestamp 1/5/2012 9:37:08 AM 1/5/2012 9:37:08 AM		Ψ×
Section Planes 北文						
Press F1 for Help		😟 2 Messages	No Selection	Metric	: (mm, kg, N, s, mV, mA) Degrees rad/s Celsius	
Ar Start 💽 🚞 🤗 💇 🔛 📣 唑 🚺					DA 🔁 🖗 🖒 09:4 05-01-2) 012 💻

 $K1 = 591 MPa \cdot \sqrt{mm}$

Calculated Stress intensity factor

 $K1 = 100 MPa \cdot \sqrt{10 mm \cdot \pi} = 560.5 MPa \cdot \sqrt{mm}$

$$K1 = 100MPa \cdot \sqrt{10mm \cdot \pi} \cdot \frac{1 - \frac{a}{2w} + \frac{0.326a^2}{w^2}}{\sqrt{1 - \frac{a}{w}}} = 572.2 MPa \cdot \sqrt{mm}$$