Sertifikat Penghargaan

Diberikan kepada:

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Atas kontribusinya dalam menyusun dokumen

Tata cara membuat model balok baja canai dingin berlubang pada program Abaqus



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1 Februari 2024



TATA CARA MEMBUAT MODEL BALOK BAJA CANAI DINGIN BERLUBANG PADA PROGRAM ABAQUS

DISUSUN OLEH: ANDY PRABOWO DAN KELSEN ANDRIAN PRIESTLEY



PROGRAM STUDI SARJANA TEKNIK SIPIL

FAKULTAS TEKNIK

UNIVERSITAS TARUMANAGARA

Februari 2024

STUDI KASUS



Bentuk Profil Rectangular Hollow Section (RHS)



Pengujian Four-Point Bending (Chen et al., 2022)



Gambar Tampak Memanjang Dan Melintang Balok RHS

Model yang digunakan adalah RHS Lean Duplex Stainless Steel dengan ukuran sebagai berikut:

H (mm)	B (mm)	t (mm)	L1 (mm)	L2 (mm)	L3 (mm)	r _o (mm)	r _i (mm)
120	80	3	410	390	90	6	6

Properti material yang digunakan adalah pada temperatur 900°C yang didapatkan dari rumus empiris Huang & Young (2014) yaitu sebagai berikut:

Elastic:

 $E_{T} = 40259.2308 \text{ MPa}$

$$f_{y,T} = 54.2724 \text{ MPa}$$

 $f_{u,T} = 66.8872 \text{ MPa}$

$$\epsilon_{u,T} = 2.19\%$$

Poisson's Ratio = 0.3

Plastic:

σ_{true} (MPa)	€ _{true}
35.0308	0
45.0598	2.0880E-04
50.0995	7.4324E-04
54.4541	1.9899E-03
56.3705	5.1948E-03
58.6279	9.3111E-03
60.9135	1.3597E-02
63.2244	1.7986E-02
64.3890	2.0209E-02
65.5596	2.2448E-02
66.7360	2.4700E-02
67.9183	2.6964E-02
68.9720	2.8981E-02

1. Membuka Abaqus.

Klik Windows – Ketik Abaqus CAE – Klik Abaqus CAE.



Pada saat Klik Abaqus CAE akan muncul window Abaqus CAE seperti dibawah ini.



Diamkan beberapa saat, lalu akan muncul window Abaqus/CAE [Viewport 1].

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2. Membuat Model, pada Module: Part – Klik Create Part.

Setelah itu, akan muncul *window Create Part*. Untuk studi kasus ini, digunakan Modeling Space – 3D, Type – Deformable, Base Feature – Shape – Shell, Type Extrusion dan Approximate Size 200. Klik Continue...

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Setelah itu, akan muncul window seperti ini.



Gunakan Create Lines: Connected (1) untuk membuat garis. Gunakanlah tinggi dan



lebar bersih serta radius yang diperoleh dari $\frac{(r_o + r_i)}{2}$.

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Setelah bentuk kotak sudah seperti gambar, gunakan *Add Dimension* (4) untuk merubah ukuran kotak sesuai tinggi dan lebar bersih. Klik *Add Dimension* (4) – Klik ujung kiri dan ujung kanan salah satu garis lebar yang telah dibuat.



Pada kotak *New Dimension*, ketik lebar bersih profil, yaitu B - t (80 - 3) lalu tekan *Enter*.



Lakukan hal yang sama dengan garis tinggi sehingga diperoleh bentuk kotak sebagai berikut.

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Setelah itu pindahkan bentuk kotak ke titik tengah *grid* dengan menambahkan garis bantu terlebih dahulu. Lalu pindahkan bentuk kotak dengan menggunakan *Translate* (3). Klik *Translate – Move – Select* bentuk kotak – *Done –* Klik titik tengah garis bantu – Klik titik tengah *grid*. Bentuk kotak akan berada ditengah-tengah *grid*.





Setelah itu, hapus garis bantu dengan menggunakan Delete (5) - Select garis bantu -

Done.



Klik Create Fillet: Between 2 Curves (2) – Masukan Fillet Radius 6 dari perhitungan

 $\frac{(r_o + r_i)}{2} - Enter - Klik$ garis tinggi dan lebar sehingga terbentuk *fillet*.



Klik X pada tulisan "Select the first entity near the end to be filleted" – Klik Done pada tulisan "Sketch the section for the shell extrusion".

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Pada *Edit Base Extrusion – Depth* di isi dengan total panjang bentang model tersebut dimana pada studi kasus ini adalah 1300 – Klik Ok. Maka akan terbentuk model penampang profil RHS dengan panjang total 1300 mm.



Membuat Partisi, Klik *Create Datum Plane: Offset From Principal Plane* – Klik *XY Plane* – Masukan *Offset* sesuai dengan partisi yang diinginkan – Enter. Pada studi kasus ini, jarak partisi yang diinginkan adalah sebagai berikut: 90-410-500-800-890-1210.



Setelah itu, Klik *Create Partition – Type Face – Use Datum Plane – Select* semua bagian model – Klik *Done* – Klik *Datum Plane* (Garis kuning putus-putus) yang sudah dibuat – Klik *Create Partition*. Lakukan secara berulang sampai semua *Datum Plane* sudah terpartisi.









3. Membuat Properti Material, pada Module: Pilih Property.

Klik Create Material – Pada Edit Material – Klik Mechanical – Elasticity – Elastic.



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Input nilai Young's Modulus yaitu 40259.2308 MPa dan Poisson's Ratio yaitu 0.3.

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Membuat Section Properties, Klik Create Section – Category Shell – Type Homogeneous – Klik Continue...





Pada *Edit Section – Shell Thickness: Value* diisi sesuai tebal profil yaitu 3 – Klik Ok. Lalu ulangi untuk *section* 2 dengan *Shell Thickness: Value* diisi 12 untuk penebalan pada bagian tumpuan dan *load*.



Setelah dibuat 2 *section*, Klik *Assign Section – Select* bagian-bagian yang tidak mengalami penebalan – Klik Done. Cara *select* bagian-bagian yang tidak mengalami penebalan dengan cara *select* semua bagian model lalu tahan tombol Ctrl dan klik bagian-bagian yang mengalami penebalan. Untuk memutar model, dapat menekan tombol Ctrl, Alt dan bagian kiri *mouse*.





Pada Edit Section Assignment, gunakan Section-1 dengan Shell Offset – Definition: Middle Surface – Klik Ok.

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Lakukan juga untuk bagian-bagian yang mengalami penebalan dengan *Assign Section*. Cara *select* dengan menahan tombol *Shift* dan bagian kiri *mouse*.



Pada *Edit Section Assignment*, gunakan Section-2 dengan *Shell Offset – Definition: Bottom Surface –* Klik Ok.



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4. Memasukan Part, pada Module: Pilih Assembly.

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Klik Create Instance – Create Instance From: Parts – Klik Part-1 – Instance Type Dependent (mesh on part) – Klik Ok.





5. Membuat Step, pada Module: Pilih Step.

Create Step – Static, Riks – Continue... – Pada Edit Step, NLGEOM ON – Klik Ok.







6. Membuat Interaction, pada Module: Pilih Interaction.

Klik *Create Reference Point* – Input Titik Tengah dari *section* yang mengalami penebalan seperti pada tabel.

	Х	Y	Ζ
RP1	0	105	455
RP2	0	105	845
RP3	0	-105	45
RP4	0	-105	1255





Setelah semua *reference point* (RP) sudah diinput, klik X pada "*Select point to act as reference point – or enter* X,Y,Z:".

Klik Create Constraint – Type Coupling – Continue... – Klik RP-1 – Klik Done – Klik Surface – Klik Bidang di bawah RP-1 – Klik Done – Klik Brown – Pada Edit Constraint, Coupling Type: Kinematic – Klik Ok.







Lakukan hal yang sama untuk ketiga RP lainnya.

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7. Membuat Load, pada Module: Pilih Load.

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Klik Create Boundary Condition – Pada Create Boundary Condition, Step: Initial, Types for Selected Step – Displacement/Rotation – Klik Continue... – Klik RP-1 – Klik Done – Pada Edit Boundary Condition, Centang U1, UR2 dan UR3 – Klik Ok.





Lakukan hal yang sama untuk ketiga RP lainnya sesuai tabel di bawah ini.

	U1	U2	U3	UR1	UR2	UR3
RP-1	\checkmark				\checkmark	\checkmark
RP-2	\checkmark				\checkmark	\checkmark
RP-3	\checkmark	\checkmark			\checkmark	\checkmark
RP-4	\checkmark	\checkmark	\checkmark		\checkmark	\checkmark



Klik Create Boundary Condition – Pada Create Boundary Condition, Step: Step-1, Types for Selected Step – Displacement/Rotation – Klik Continue... – Klik RP-1 – Klik Done – Pada Edit Boundary Condition, Centang U2, Input -5 – Klik Ok.





Lakukan hal yang sama untuk RP-2.





8. Membuat Mesh, pada Module: Pilih Mesh.









Klik Assign Mesh Controls – Select semua – Klik Done – Pada Mesh Controls, Element Shape Quad-dominated, Technique Sweep – Klik Ok.





Klik Seed Part – Pada Global Seeds, Sizing Controls, Approximate Global Size: Input 7.5 – Klik Ok.





Klik Seed Edges – Klik Apply Front View – Klik Semua Corner dengan menahan tombol Shift saat mengklik corner – Klik Done – Pada Local Seeds, Method By Number, Sizing Controls, Number of elements input 5 – Klik Ok





Klik Mesh Part – Klik Yes.





9. Membuat Job, pada Module: Pilih Job.

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Klik Create Job – Pada Create Job, Klik Continue... – Pada Edit Job, Klik Ok.







Klik Job Manager – Pada Job Manager, Klik Submit – Tunggu hingga selesai run.





Setelah Status Completed, Pada Job Manager, Klik Results – Klik Plot Countours on

Deformed Shape.





Jika ingin melihat hasil dalam grafik Force Vs Displacement:

- Klik Create XY Data Klik ODB Field Output Klik Continue... Pada XY Data from ODB Field Output, Variables – Output Variables pilih Unique Nodal – Klik RF: Reaction Force – Centang RF2 – Klik U: Spatial Displacement – Centang U2 – Klik Element/Nodes – Klik SET-5 – Klik Plot.
- Klik Create XY Data Klik Operate on XY Data Klik Continue... Pada Operate on XY Data, ketik seperti digambar – Klik Plot Expression.







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DAFTAR PUSTAKA

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