TUTORIAL VIDEO 09

09 From CAD to crash results: the full chain

The whole chain on one crash case: CAD to mesh, material with failure, properties, rigid ends, boundary conditions, impact velocity, contact, adaptive meshing and outputs, the run, and its results.

Tutorial files	folder `09_CAD_to_crash_results` — open `s-shape_crash.step` first (this video also needs the results zip)
Video	Watch video 09 on YouTube
Download files	Download the tutorial files (97 MB) Download the solver results (225 MB)

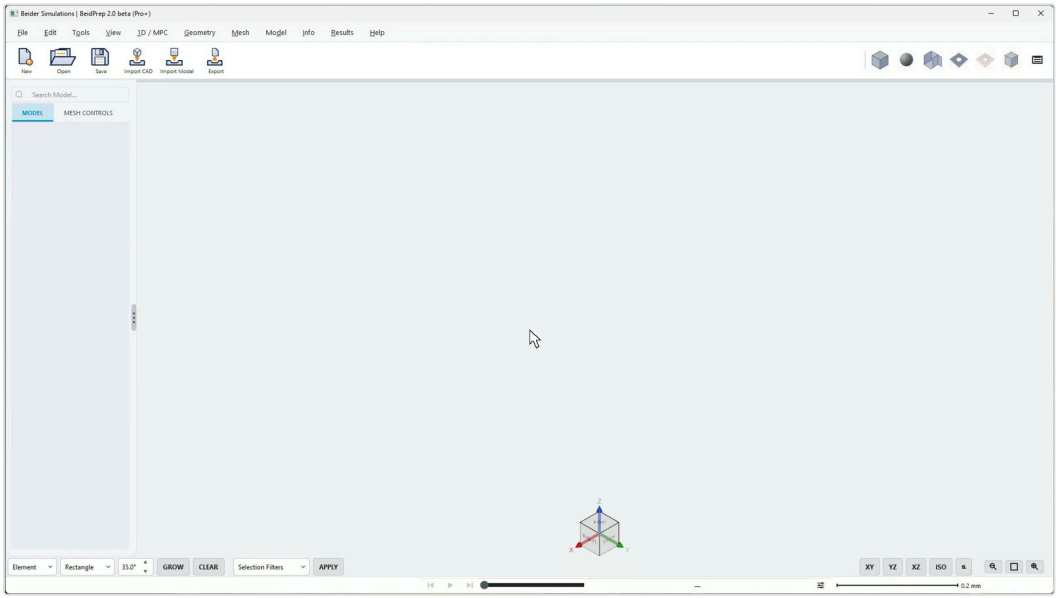
1 Opening

video 0:00

This video builds a crash model from a CAD file inside BeidPrep, runs it with OpenRadioss, and reads the results.

This is a demonstration.

The material values come from published sources, but the model has not been compared with a test.



The screen at 0:14 in the video.

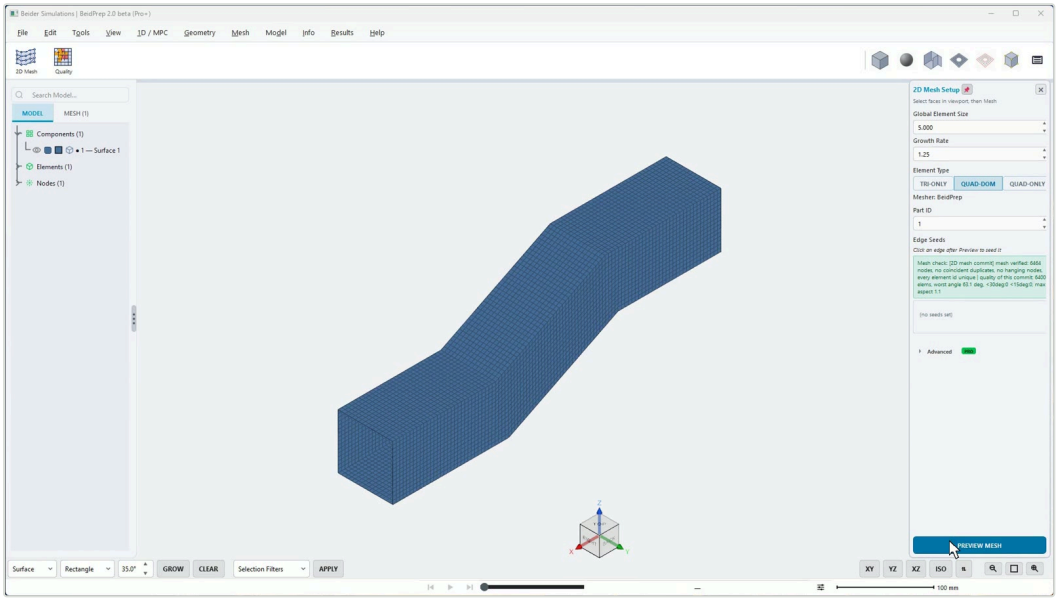
2 The case

video 0:14

The part is an S-shaped steel rail, crushed along its length between a fixed end and a moving end.

The units are kilograms, millimeters and milliseconds, so force is in kilonewtons.

The CAD file is imported, and the rail is meshed at five millimetres with Quad-Dom, as video four shows.



The screen at 0:37 in the video.

3 The mesh, Units: BEGIN

video 0:37

It must be green: connected, and of good quality.

The rail has about six thousand four hundred shells.

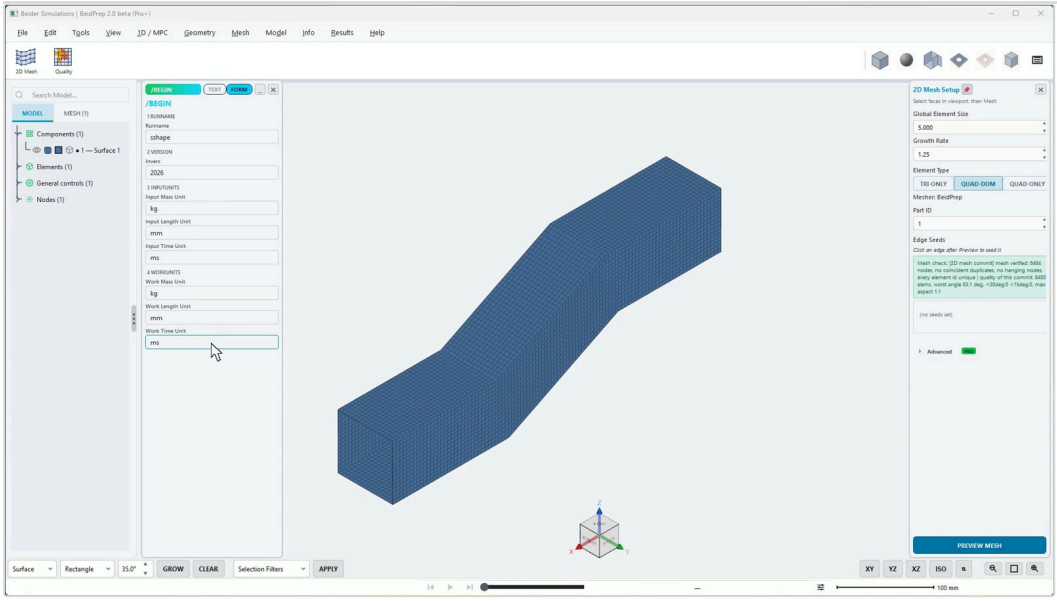
Every deck starts with its units.

1. Right-click an empty place in the model tree, and choose General controls, then BEGIN.
2. Type the run name, sshape.
3. Type the six units: kilograms, millimeters and milliseconds, for both the input and the work units.

BeidPrep fills in the input version, 2026, itself.

In the video: **sshape** in run name field.

In the video: **kg mm ms / kg mm ms** in /BEGIN unit fields.



The screen at 1:09 in the video.

4 The part

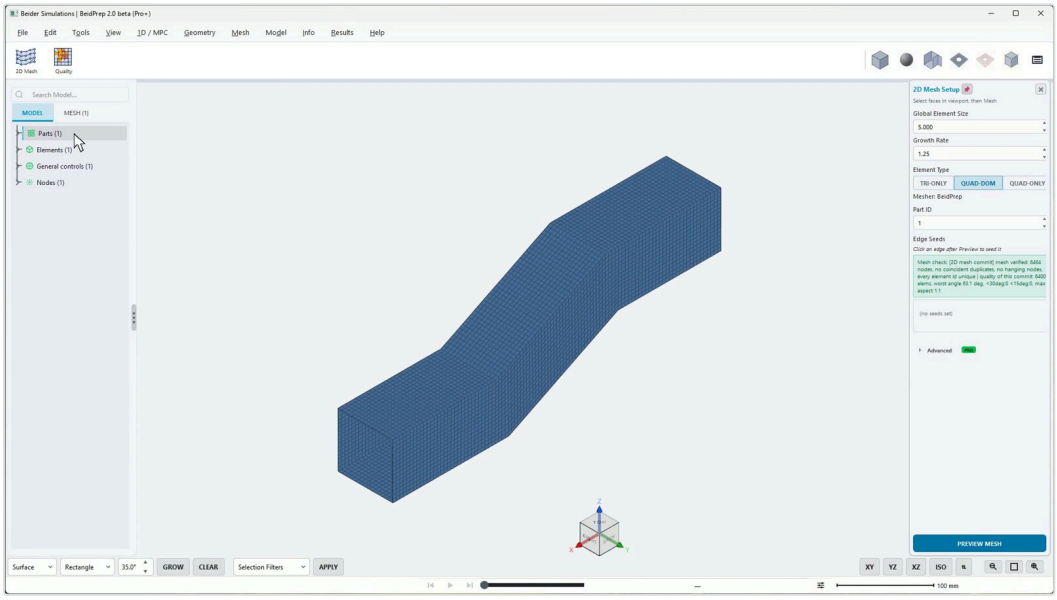
video 1:09

The shells already belong to part 1.

It is listed under Components, with the CAD's name.

1. Click it, and press CHANGE CARD TO PART.

   The tree now lists it under Parts.



The screen at 1:20 in the video.

5 Material

video 1:20

Next, the material: 4340 steel, with the Johnson-Cook material law.

1. Right-click the tree, and choose Materials, Elasto-Plastic, MAT LAW 2.
2. Type a title, then the values on screen: density, Young's modulus in gigapascals, Poisson's ratio, the Johnson-Cook a, b, n and c, and a reference strain rate of one per second, written per millisecond.

   In the video: **steel 4340 Johnson-Cook** in field: /MAT/LAW2 mat_title.

   In the video: **7.83e-6** in field: /MAT/LAW2 rho_i.

   In the video: **208** in field: /MAT/LAW2 E.

   In the video: **0.3** in field: /MAT/LAW2 nu.

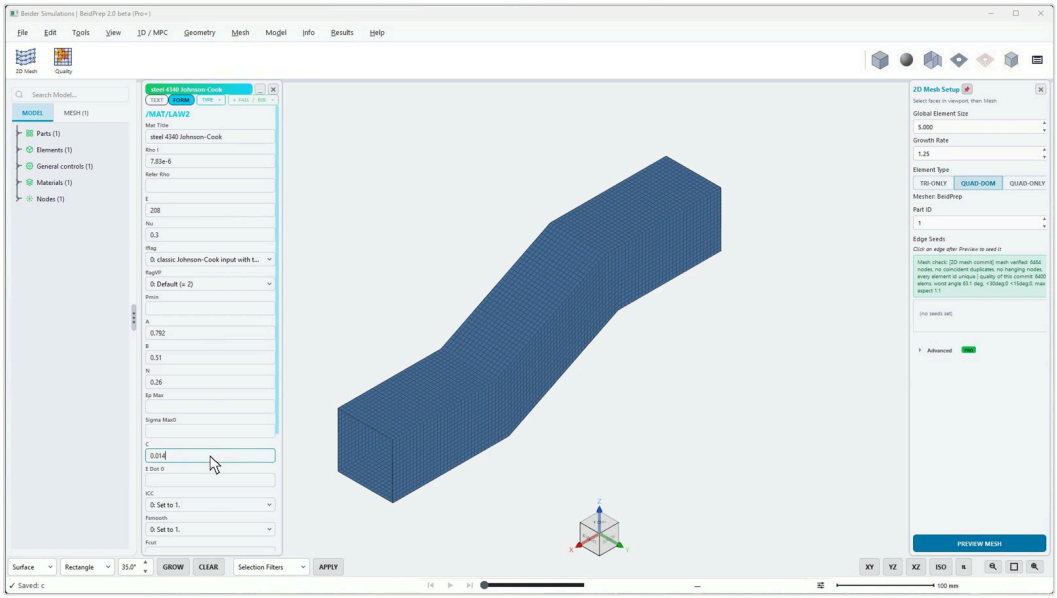
   In the video: **0.792** in field: /MAT/LAW2 a.

   In the video: **0.51** in field: /MAT/LAW2 b.

   In the video: **0.26** in field: /MAT/LAW2 n.

   In the video: **0.014** in field: /MAT/LAW2 c.

   In the video: **0.001** in field: /MAT/LAW2 e_dot_0.



The screen at 1:47 in the video.

6 Failure

video 1:47

1. On the material's form, press plus FAIL, EOS.
2. Choose Add failure model, then FAIL JOHNSON.

   The status line says it was created for material 1.
3. Type D1, 0.05; D2, 3.44; and D3, minus 2.12.
4. Leave D4 and D5 blank.

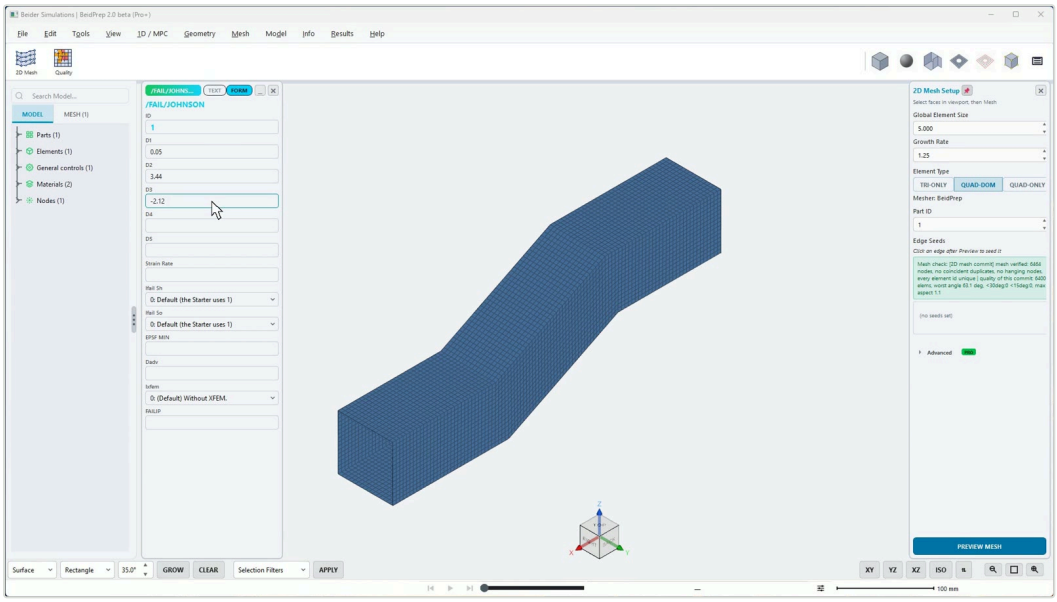
   They are zero: no rate or temperature effect on failure.

   An element is deleted when its accumulated damage reaches one.

In the video: **0.05** in field: /FAIL/JOHNSON D1.

In the video: **3.44** in field: /FAIL/JOHNSON D2.

In the video: **-2.12** in field: /FAIL/JOHNSON D3.



The screen at 2:18 in the video.

7 Shell property

video 2:18

Now the shell property.

1. Right-click the tree, and choose Properties, Shell, PROP TYPE 1.
2. Set Ishell to 24: physical hourglass control, with no artificial stiffness.
3. Set N to 5 points through the thickness, and Thick to 2 millimeters.
4. Set Ithick to 1, so the shells thin as they stretch.
5. Set Iplas to 1.

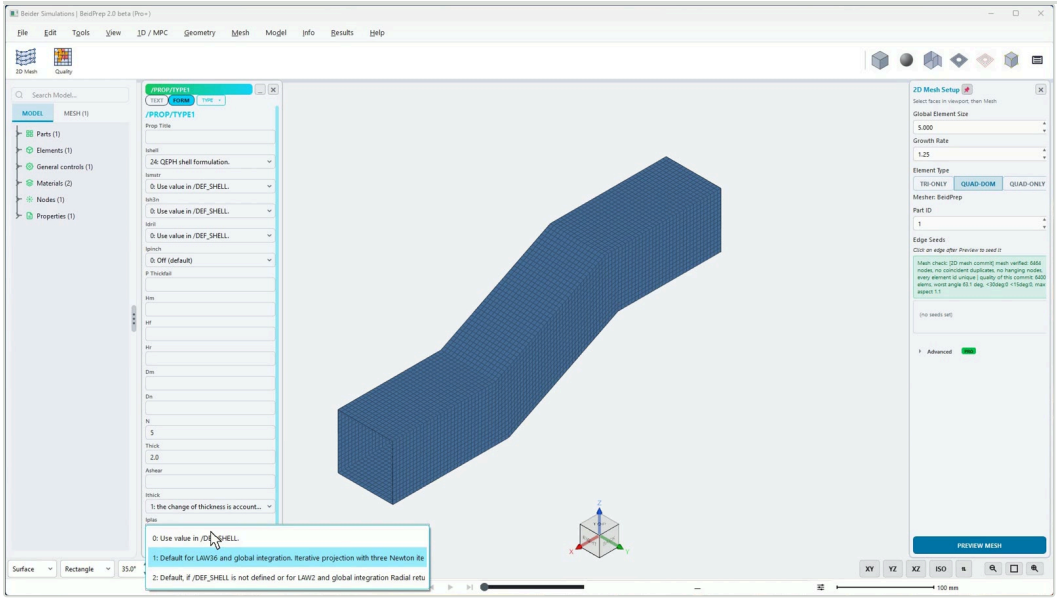
In the video: **24** in flag: /PROP/TYPE1 Ishell.

In the video: **5** in field: /PROP/TYPE1 N.

In the video: **2.0** in field: /PROP/TYPE1 Thick.

In the video: **1** in flag: /PROP/TYPE1 Ithick.

In the video: **1** in flag: /PROP/TYPE1 Iplas.



The screen at 2:42 in the video.

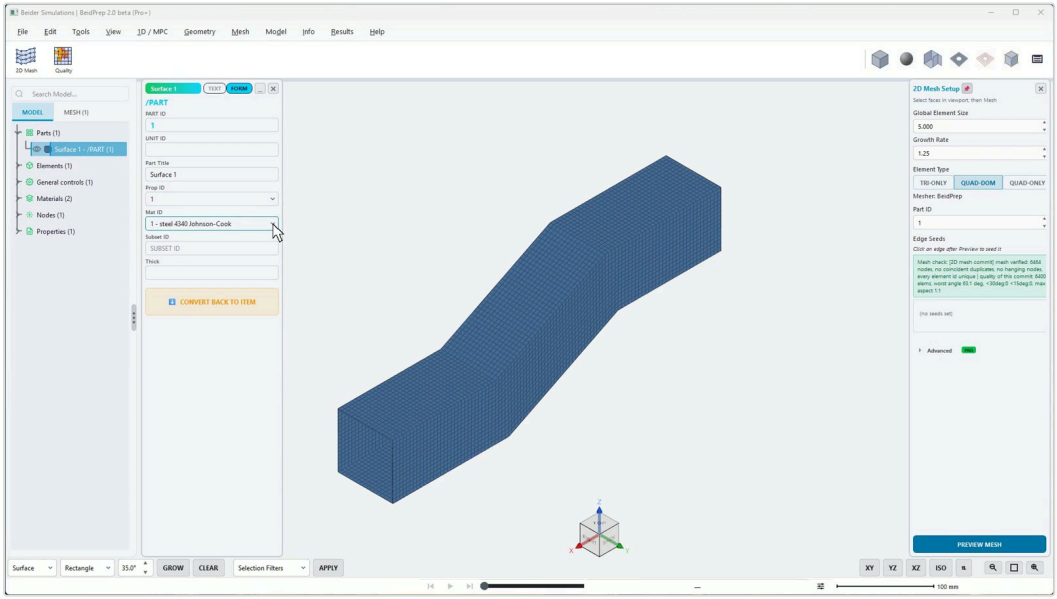
8 Part ids

video 2:43

1. Give the part this property and the material.
2. Click the part under Parts.
3. Choose property 1 in the Prop ID list, and material 1 in the Mat ID list.

   In the video: **1** in list: /PART prop_ID.

   In the video: **1** in list: /PART mat_ID.



The screen at 2:53 in the video.

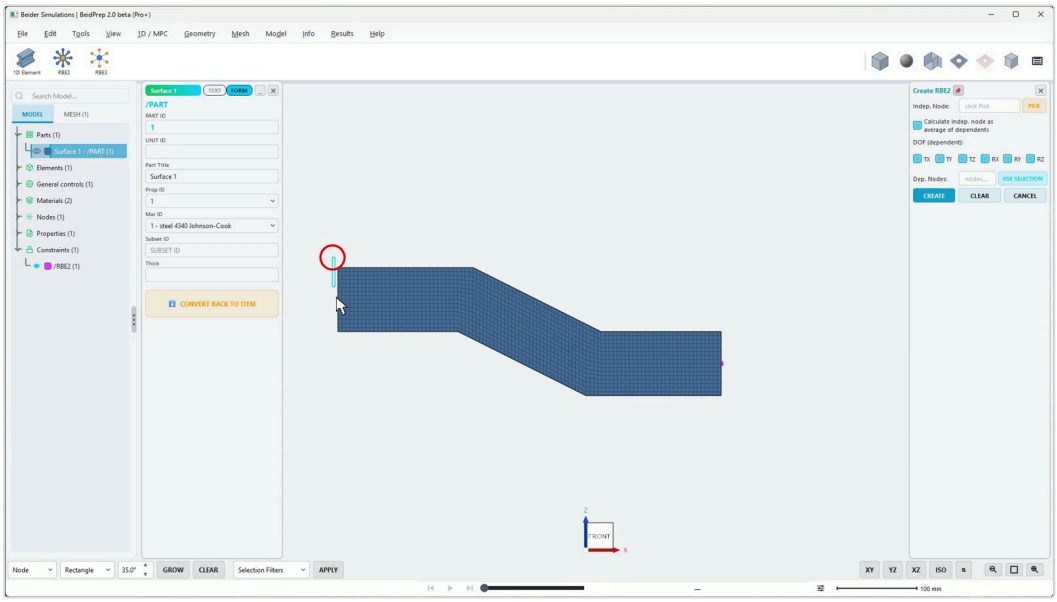
9 RBE2 ends

video 2:53

Now the two ends.

1. Click RBE2 on the 1D MPC tab.
2. Tick Calculate independent node as average of dependents.
3. Drag a rectangle around the end at the largest x.
4. Press USE SELECTION, then CREATE.

   The status line names the main node, made at the middle of the end.
5. Do the same at the smallest x.



The screen at 3:17 in the video.

10 Node groups

video 3:22

The RBE2 group holds the tied nodes, not the main node.

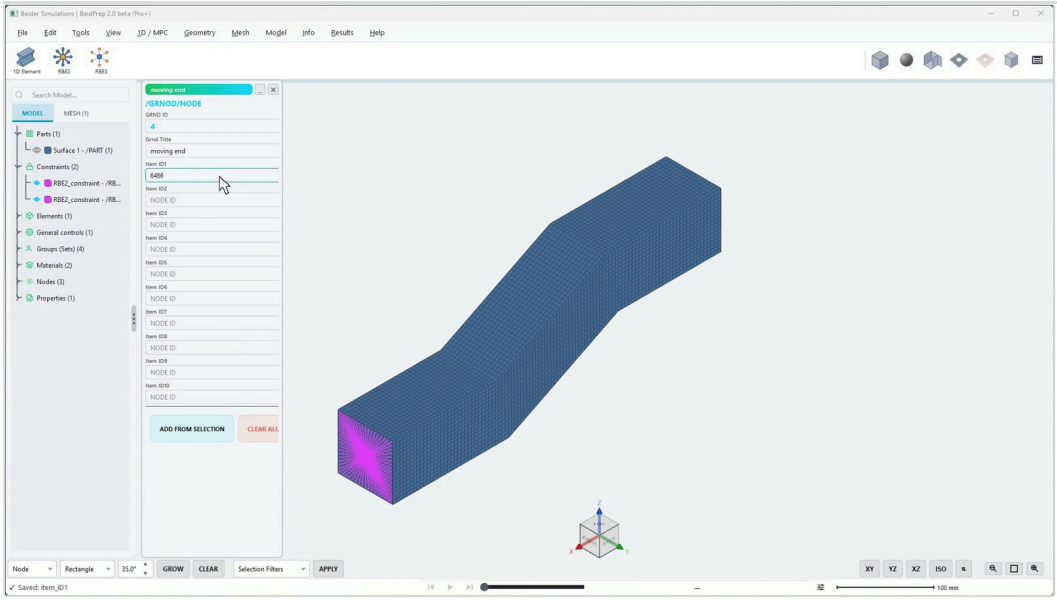
1. So make one node group per end.
2. Press ISO at the bottom right.
3. Right-click the tree, and choose Groups, then GRNOD NODE.
4. Type the title, fixed end, and the end's main node number in Item ID1.

   In the video: **fixed end** in field: /GRNOD/NODE grnd_title.

   In the video: **6465** in field: /GRNOD/NODE item_ID1.

   In the video: **moving end** in field: /GRNOD/NODE grnd_title.

   In the video: **6466** in field: /GRNOD/NODE item_ID1.



The screen at 3:48 in the video.

11 Fixed end

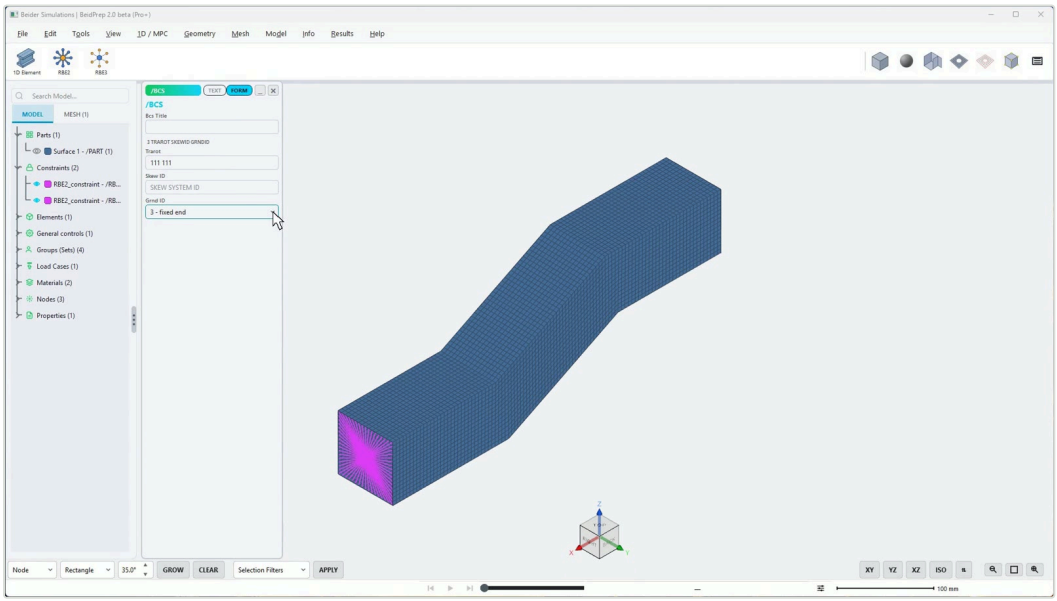
video 3:48

The fixed end.

1. Right-click the tree, and choose Load Cases, Boundary Conditions, BCS.
2. Fix all six directions.
3. Choose the fixed end's main-node group in Grnd ID.

   In the video: **111111** in field: /BCS Trarot.

   In the video: **3** in list: /BCS grnd_ID.



The screen at 4:03 in the video.

12 Moving end

video 4:04

The moving end needs three cards.

First, a BCS on its main-node group that leaves only x free, the other five directions fixed.

Second, a function, FUNCT, under Tools, that is 1 from time 0 to 1000.

Third, an IMPVEL, under Load Cases, Imposed Motion.

1. Choose that group and the function from their lists, the direction X, and a scale of 6 millimeters per millisecond.

In the video: **011111** in field: /BCS Trarot.

In the video: **4** in list: /BCS grnd_ID.

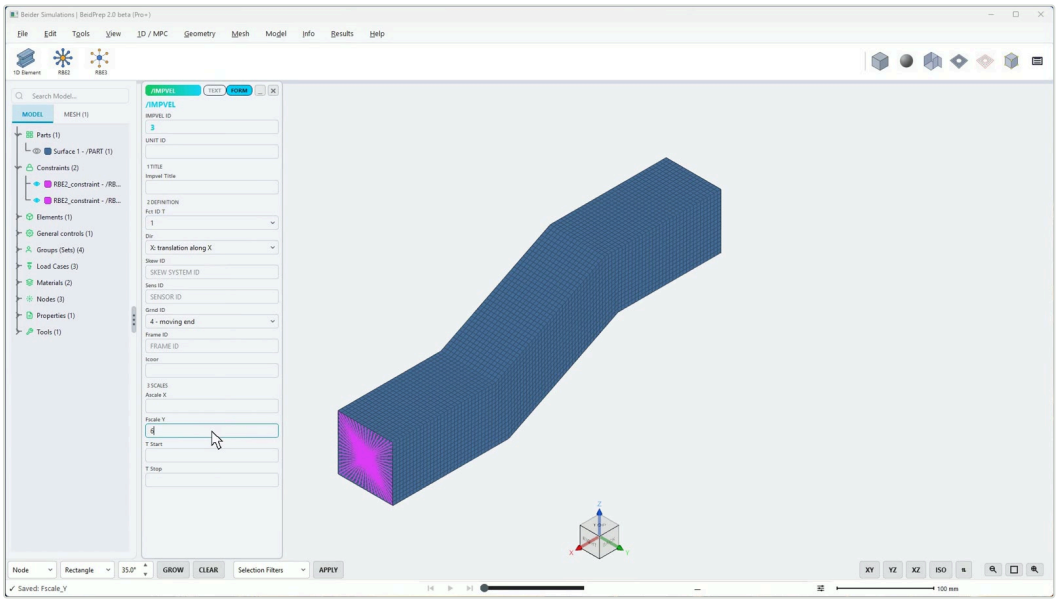
In the video: **0,1 1000,1** in points: /FUNCT.

In the video: **4** in list: /IMPVEL grnd_ID.

In the video: **1** in list: /IMPVEL fct_ID_T.

In the video: **X** in flag: /IMPVEL Dir.

In the video: **6** in field: /IMPVEL Fscale_Y.



The screen at 4:43 in the video.

13 Self-contact

video 4:43

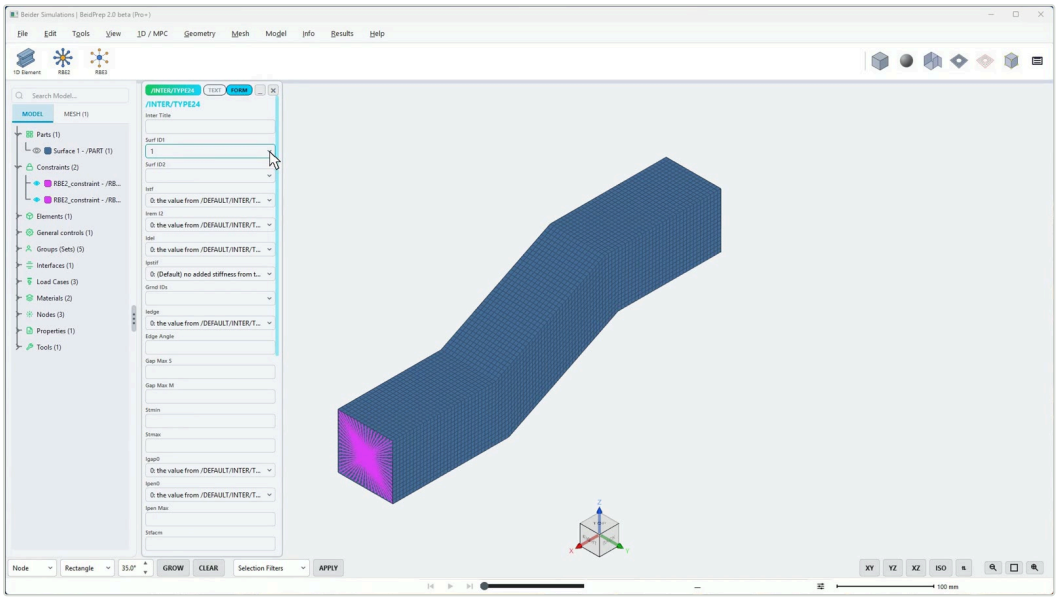
As the rail folds, its walls meet.

The contact needs a surface, so make one first: right-click the tree, create SURF PART, and choose the rail from the list.

1. Then right-click the tree, and choose Interfaces, Penalty Contact, INTER TYPE 24.
2. Choose that surface in the Surf ID1 list, so the walls cannot pass through each other.

In the video: **1** in list: /SURF/PART item_ID1.

In the video: **1** in list: /INTER/TYPE24 surf_ID1.



The screen at 5:07 in the video.

14 Adaptive meshing

video 5:08

Adaptive meshing lets OpenRadioss split a shell into four smaller ones during the run, where the result needs it.

1. Create ADMESH GLOBAL with one level.
2. Create ADMESH SET, choose the rail from the list, and set a thickness error of 0.04 millimeters, and the angle criterion at 179.9 degrees.

   Then only thinning, not bending, splits a shell.

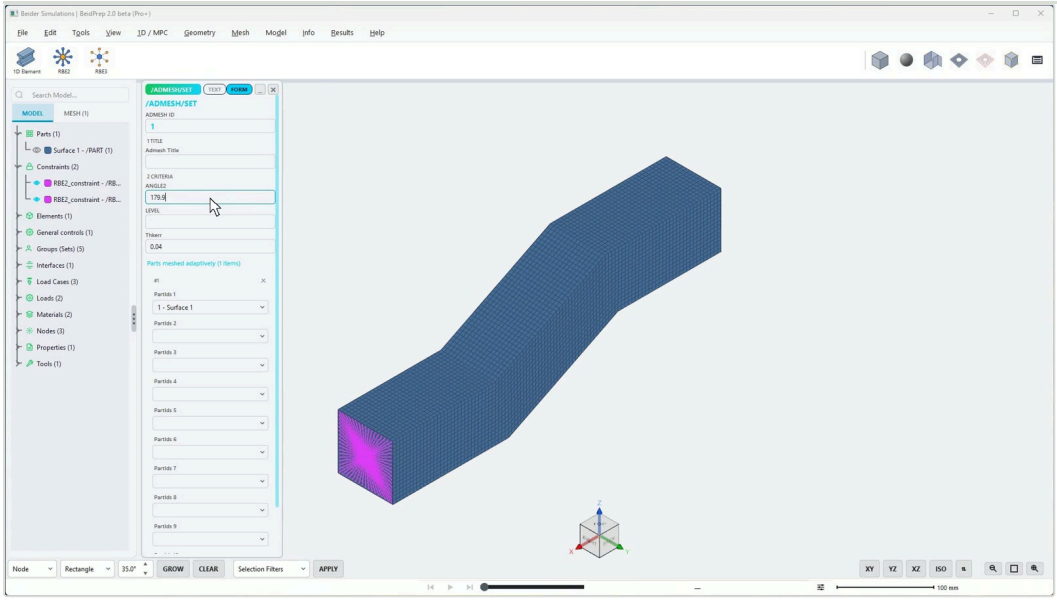
   One level is plenty here: the contact is searched on every refined shell, which slows the run sharply.

   In the video: **1** in field: /ADMESH/GLOBAL LEVEL.

   In the video: **1** in list: /ADMESH/SET PartIds_1.

   In the video: **0.04** in field: /ADMESH/SET Thkerr.

   In the video: **179.9** in field: /ADMESH/SET ANGLE2.



The screen at 5:43 in the video.

15 Run settings

video 5:44

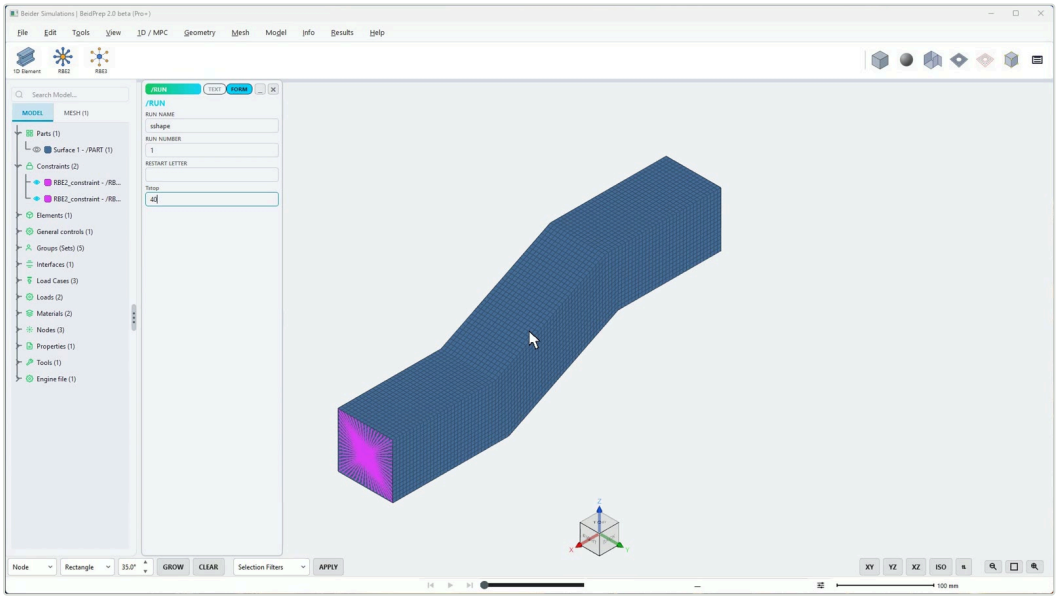
The Engine file holds how the run goes.

1. Create RUN, under General controls, with an end time of 40 milliseconds.

   The brief asks for no mass scaling, so the solver keeps its own stable time step.

   As adaptive meshing refines the shells, that step gets shorter, and the run takes longer.

   In the video: **40** in field: /RUN Tstop.



The screen at 6:02 in the video.

16 Outputs

video 6:02

Now the outputs.

ANIM DT, starting at 0, every 2 milliseconds.

Then the animation results: plastic strain, von Mises stress, the shell stress and strain tensors, thickness, and displacement.

TFILE, every 0.1 milliseconds.

TH NODE on the fixed end's main node, with the reaction force.

And TH PART, with the rail chosen from the list, and its internal, kinetic and hourglass energy.

The run is started from the Tools menu, as video eight shows.

In the video: **0** in field: /ANIM/DT Tstart.

In the video: **2** in field: /ANIM/DT Tfreq.

In the video: **0.1** in field: /TFILE dT.

In the video: **REACX** in field: /TH/NODE var_ID_1.

In the video: **REACY** in field: /TH/NODE var_ID_2.

In the video: **REACZ** in field: /TH/NODE var_ID_3.

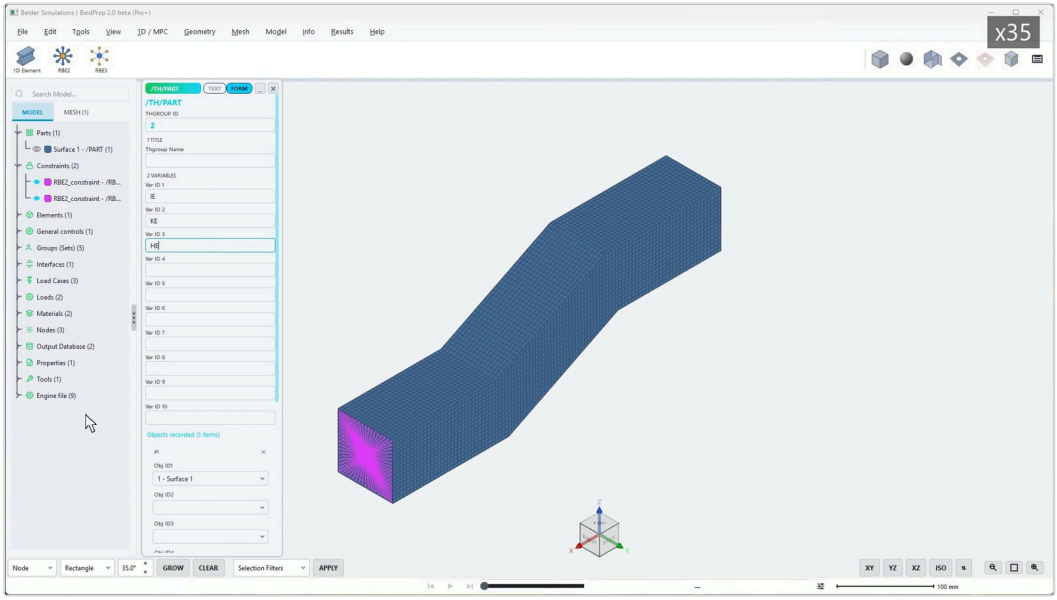
In the video: **6465** in field: /TH/NODE node_ID.

In the video: **1** in list: /TH/PART Obj_ID1.

In the video: **IE** in field: /TH/PART var_ID_1.

In the video: **KE** in field: /TH/PART var_ID_2.

In the video: **HE** in field: /TH/PART var_ID_3.



The screen at 7:29 in the video.

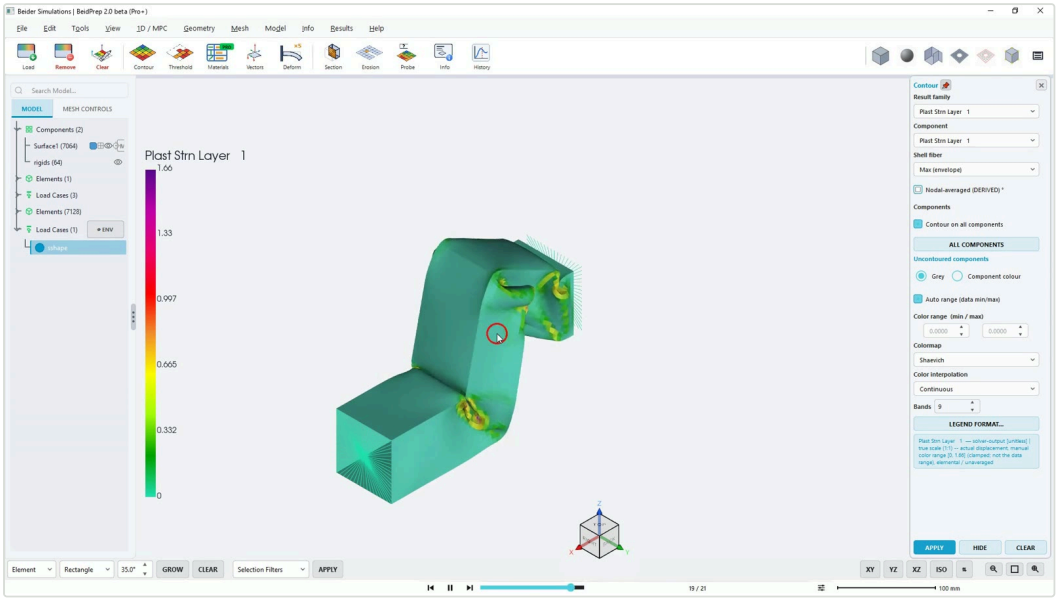
17 The run

video 7:36

With no mass scaling, no mass is added, so the mass error stays at zero.

The run takes a while, so the video skips ahead to its end.

The run's results are opened and coloured by plastic strain, as video ten shows.



The screen at 8:01 in the video.

18 Plastic strain, Refined shells

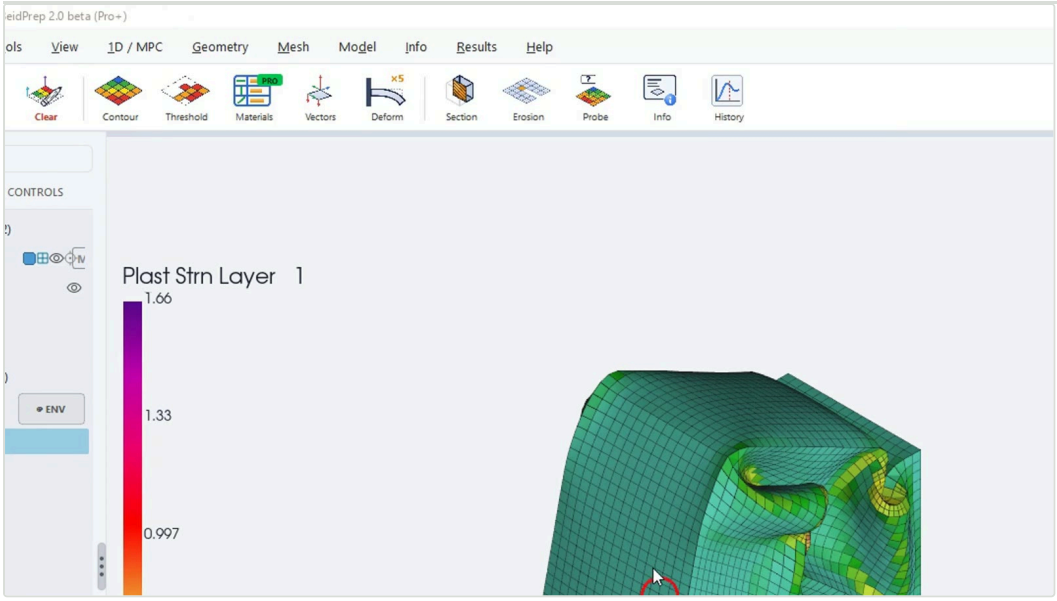
video 8:01

At the end, the folds carry the highest plastic strain, and the straight walls stay almost elastic.

1. Click the grid icon on the rail's row in the tree, to turn its mesh lines on.

The smaller shells in the folds were split during the run.

By the end, the rail has about 670 more shells than it started with.



The screen at 8:19 in the video.

19 Failed shells, Reaction force

video 8:20

1. Click Erosion, and choose Hide.

   Holes are left where shells failed and were removed, in the sharpest folds.

2. Click History on the Results tab.

3. Under Nodes, tick the fixed end's REACX.

   This is the force the fixed end takes as the rail crushes.

   It averages about 85 kilonewtons.

   It is drawn below zero, because it pushes against the x direction.



The screen at 8:42 in the video.

20 Energies

video 8:48

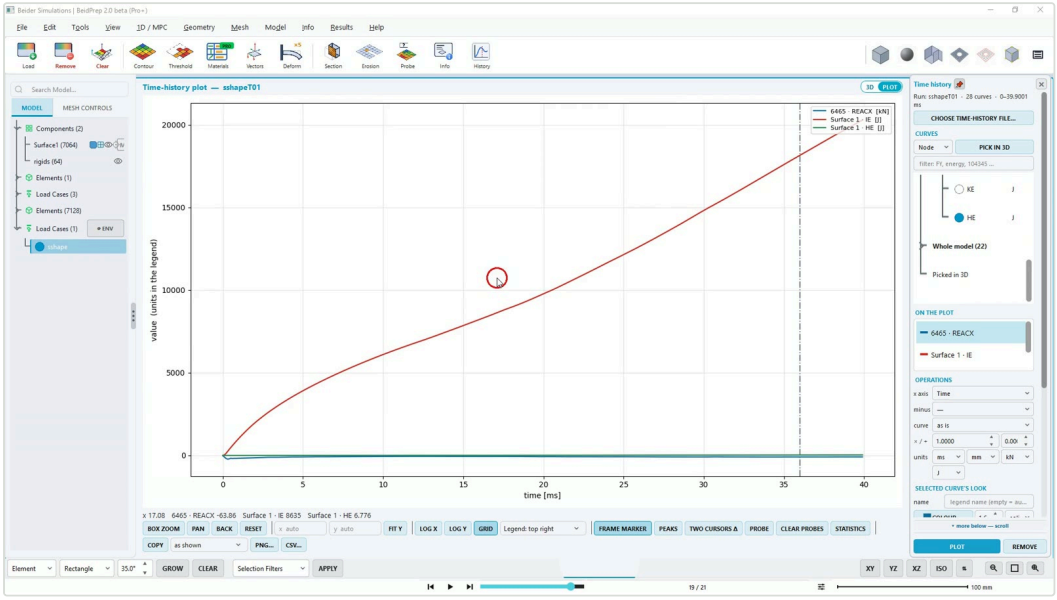
The hourglass energy should stay small against the internal energy.

Here it ends at 0.16 percent.

As a check, about 20,300 joules over 240 millimeters of crush gives the same 85 kilonewtons.

This is a demonstration, not a design result.

Model: Beider Simulations.



The screen at 9:09 in the video.

Steps and pictures are taken from tutorial video 09. Every picture is a frame of the video.