Replication of results

This section describes the step-by-step procedure to do topology optimization of C-clip as shown in figure 1 using Altair OptiStruct 14.0. The C-clip is fixed at left end and loads are applied in ‘z’ direction at inner side of right end. The magnitude of load is 100 N and applied at last five nodes of both top side and bottom side (refer figure 2). The optimization problem is to minimize the compliance along with a volume constraint of 50% of the total volume. The design domain and non-design domain are differentiated with orange and grey colors respectively as shown in figure 2.

- Importing the geometry file:
  Go to File → Import → Geometry → choose the geometry file (ROR-Geometry.stp) → Import. Rename it as ‘Design’. Figure 1 shows the geometry after the import.

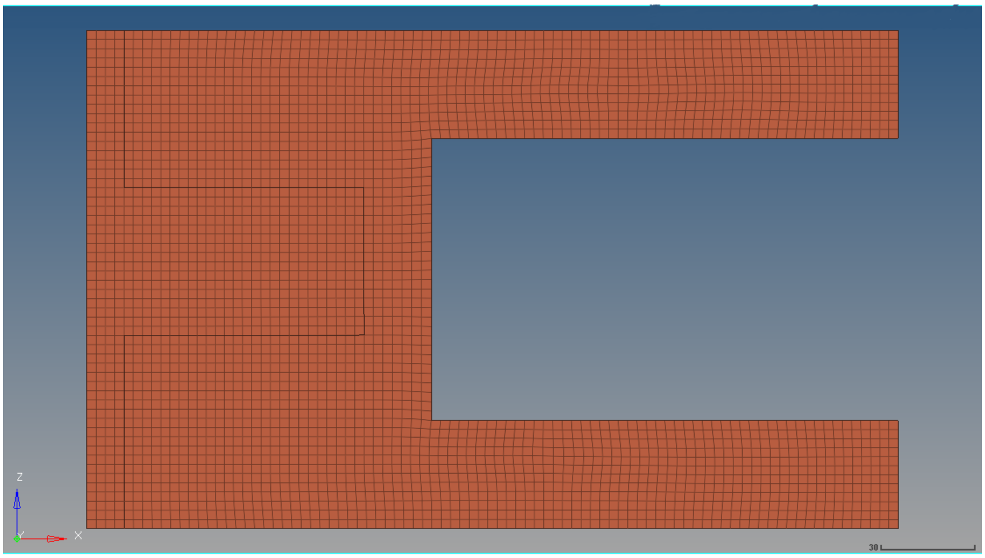

Figure 1: Geometry without nondesign domain and no loads.

- Meshing the geometry:
  Click on 3D → tetramesh → choose the component → click on mesh → return.

- Creating component, material and property and assigning it to the geometry:
  Creating a material: Materials → give mat name = ‘steel’ → choose type = ‘isotropic’ → card image = ‘MAT1’ → then click on create → return.
  Creating property: Property → give prop name = ‘Design’ → type = ‘3D’ → card image = ‘ PSOLID’ → material = ‘steel’ → click on create → return. Repeat this procedure for creating ‘Non-Design’ property by giving prop name as Non-Design.
  Creating a component : Component → comp name = ‘Non-design’ → property → ‘Non-Design’ → create → return.

Assigning elements to Non-design component: Mesh → Organize → Elements → To Component → choose elements from the components → dest component =‘Non-design’ → move → return.
Assigning properties to Design component: Components → click Property → choose Design → OK; click Material → choose steel → OK.

- Creating and applying the loads:
  Creating the displacement BC’s : Load Collecters → loadcolname = ‘Fixed’ → create → return. Repeat the same procedure with loadcolname = ‘Loads’ to create load.
  Applying the displacement BC’s : Make sure that current select load is ‘Fixed’, other wise right click on it and choose ‘Make Current’. To apply displacement constraints click on Analysis → constraints → nodes → select the nodes → tick on dof1 to dof6 → create → return.
  Applying the force BC’s : Make the ‘Loads’ as the current collecter. Analysis → forces → select nodes → choose = ‘constant components’ → give X, Y, Z components of force → create → return. Figure 2 shows the geometry includes the non-design domain after applying the boundary conditions.

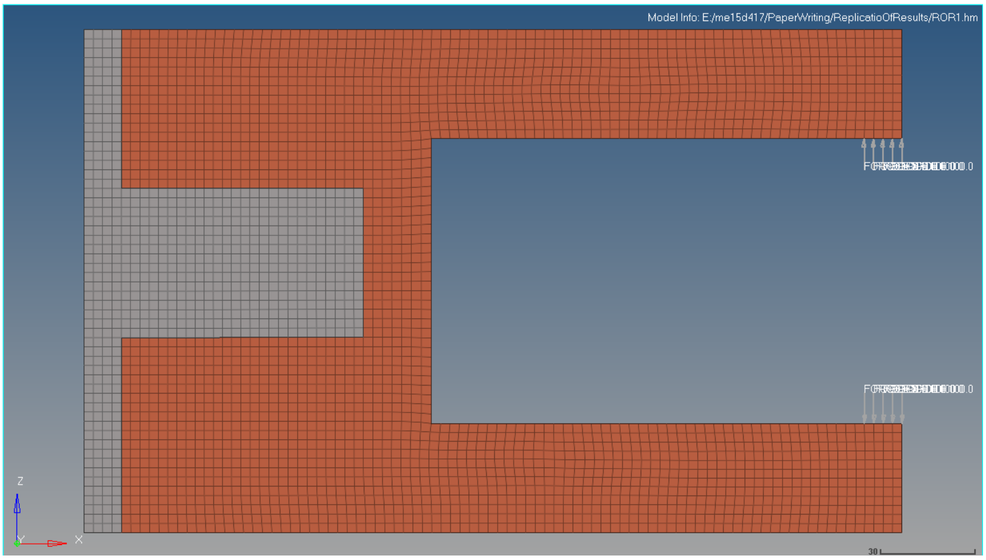

Figure 2: Geometry with nondesign domain (grey color) and loads.

- Creating loadsteps:
  Analysis → loadsteps → name = ‘LS’ → choose SPC = ‘Fixed’ and LOAD = ‘Loads’ → type = ‘linear static’ → create → return.

- Setting optimization paramets:
  Analysis → optimization → topology → create → desvar = ‘TopOpt’ → type = ‘PSOLID’ → props → Design → select → create → return.
  responses → response name = ‘volfrac’ → response type → choose volfrac → create → return. Repeat this to create another response, i.e, compliance.
  dconstraints → constraint = ‘volcon’ → tick on upper bound → give the

volume fraction value as 0.5 → response = ‘volfrac’ → create → return. objective → choose min → response = ‘compliance’ → loadsteps → LS → create → return → return.

- Optimization with OptiStruct:
  Analysis → Optistruct → run options = ‘optimization’ → click on OptiStruct.

- Viewing results:
  Analysis → OptiStruct → HyperView. This opens HyperView software. To view results, click Iteration to last number using the drag and drop bar, then go to Iso → current value = ‘0.6’ → Apply. The nastran version of FE deck file of this example is available in this folder as ‘ROR.nas’. Figure 3 shows the optimal design obtained for the boundary conditions. The displacement contours are shown in figure 4. The maximum displacement region is identified by red color and value is equal to 0.5432 mm. The stress contours are shown in figure 5. The maximum value of stress is 303 MPa. The compliance value of the optimal design is 2189.48 N-mm.

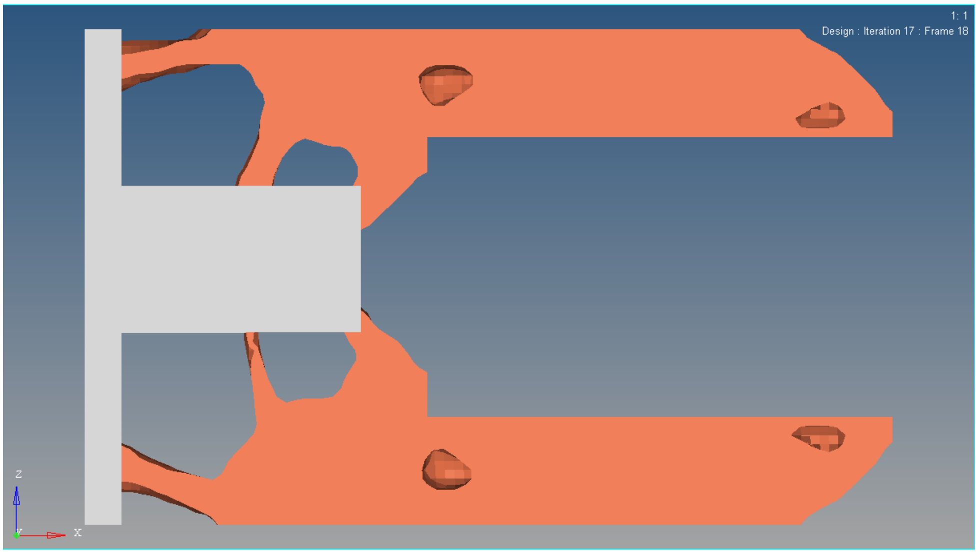

Figure 3: Optimal design obtained for density threshold value of 0.6.

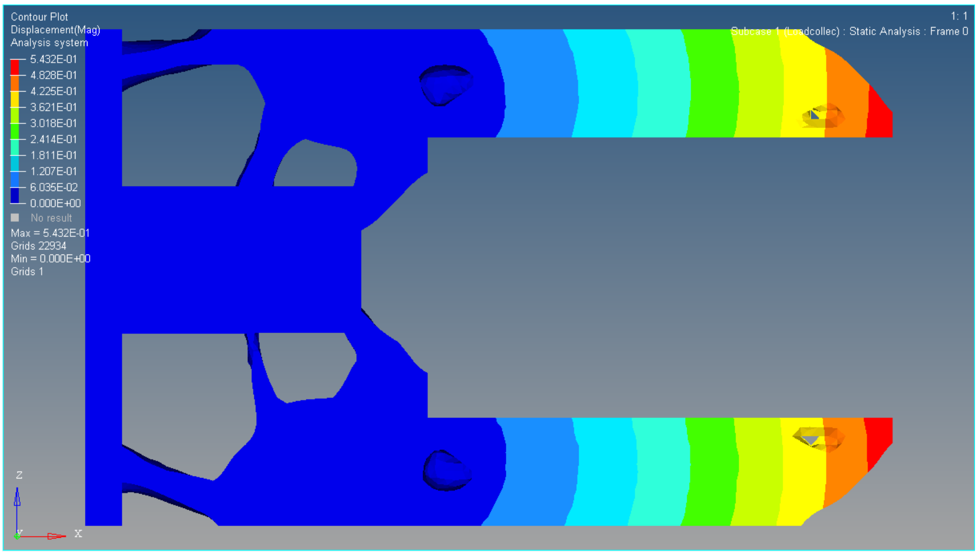

Figure 4: Displacement contours of the optimal design.

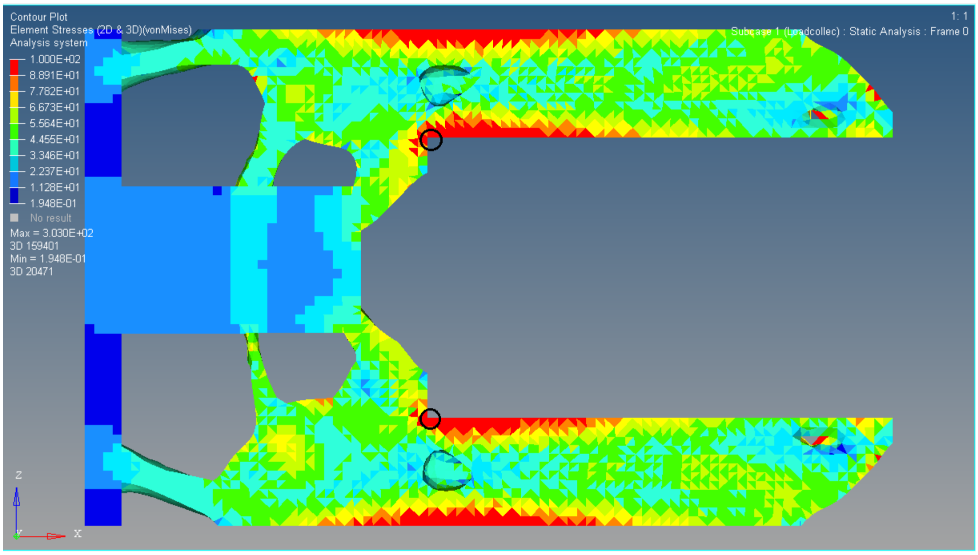

Figure 5: Stress contours of the optimal design. Maximum stress region is highlighted with black circle.