# Table of Contents

Introduction .............................................................................. 1  
Wireframe & Surfaces ............................................................ 2  
Pull Down Menus ................................................................. 3  
  Edit .................................................................................. 3  
  Insert .............................................................................. 4  
  Tools ............................................................................... 6  
Generative Shape Design Workbench .................................... 7  
Bottom Toolbar ...................................................................... 9  
  Tools ............................................................................... 9  
  Analysis ......................................................................... 9  
Volumes .................................................................................. 10  
Generative Shape Optimizer .................................................. 11  
Developed Shapes .................................................................... 11  
BiW Templates ........................................................................ 11  

Wireframe ................................................................................... 13  
Points ..................................................................................... 13  
  Coordinate ....................................................................... 13  
  On curve ......................................................................... 16  
  On plane ......................................................................... 20  
  On surface ....................................................................... 21  
  Circle / Sphere center ....................................................... 22  
  Tangent on curve ............................................................ 23  
  Between ......................................................................... 26  
  Point Repetition ............................................................. 28  
  Projecting points ............................................................. 32  
  Intersection points .......................................................... 35  
  Extremum ........................................................................ 38  
  Polar Extremum .............................................................. 41  

Lines ......................................................................................... 43  
  Point-Point ................................................................. 43  
  Point-Direction ............................................................ 46  
  Angle/NORMAL to curve .................................................. 47  
  Tangent to curve ............................................................ 52  
  Normal to surface ............................................................ 55  
  Bisecting ................................................................. 57  
  Intersection lines ........................................................... 59  
  Projecting lines .............................................................. 60  
  Axis .............................................................................. 61  
  Polyline ........................................................................ 63
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planes</td>
<td>67</td>
</tr>
<tr>
<td>Offset from plane</td>
<td>67</td>
</tr>
<tr>
<td>Parallel through point</td>
<td>69</td>
</tr>
<tr>
<td>Angle/Normal to plane</td>
<td>70</td>
</tr>
<tr>
<td>Through three points</td>
<td>72</td>
</tr>
<tr>
<td>Through two lines</td>
<td>73</td>
</tr>
<tr>
<td>Through point and line</td>
<td>74</td>
</tr>
<tr>
<td>Through planar curve</td>
<td>75</td>
</tr>
<tr>
<td>Normal to curve</td>
<td>76</td>
</tr>
<tr>
<td>Tangent to surface</td>
<td>77</td>
</tr>
<tr>
<td>Equation</td>
<td>78</td>
</tr>
<tr>
<td>Mean through points</td>
<td>79</td>
</tr>
<tr>
<td>Plane Repetition</td>
<td>80</td>
</tr>
<tr>
<td>Circles</td>
<td>83</td>
</tr>
<tr>
<td>Center and radius</td>
<td>83</td>
</tr>
<tr>
<td>Center and point</td>
<td>85</td>
</tr>
<tr>
<td>Two points and radius</td>
<td>86</td>
</tr>
<tr>
<td>Three points</td>
<td>88</td>
</tr>
<tr>
<td>Bitangent and radius</td>
<td>90</td>
</tr>
<tr>
<td>Bitangent and point</td>
<td>91</td>
</tr>
<tr>
<td>Tritangent</td>
<td>92</td>
</tr>
<tr>
<td>Center and tangent</td>
<td>93</td>
</tr>
<tr>
<td>Corners</td>
<td>94</td>
</tr>
<tr>
<td>Curves</td>
<td>98</td>
</tr>
<tr>
<td>Connect Curves</td>
<td>98</td>
</tr>
<tr>
<td>Conics</td>
<td>103</td>
</tr>
<tr>
<td>Splines</td>
<td>109</td>
</tr>
<tr>
<td>Helixes</td>
<td>115</td>
</tr>
<tr>
<td>Spirals</td>
<td>121</td>
</tr>
<tr>
<td>Project curves</td>
<td>124</td>
</tr>
<tr>
<td>Combine curves</td>
<td>127</td>
</tr>
<tr>
<td>Reflect Line curves</td>
<td>131</td>
</tr>
<tr>
<td>Intersection curves</td>
<td>133</td>
</tr>
<tr>
<td>Parallel Curves</td>
<td>137</td>
</tr>
<tr>
<td>3D Curve Offset</td>
<td>143</td>
</tr>
<tr>
<td>Curve comparison</td>
<td>146</td>
</tr>
<tr>
<td>Supports</td>
<td>149</td>
</tr>
<tr>
<td>Work on Support</td>
<td>149</td>
</tr>
<tr>
<td>Creation on the fly</td>
<td>154</td>
</tr>
<tr>
<td>Modifying</td>
<td>157</td>
</tr>
<tr>
<td>Datums</td>
<td>159</td>
</tr>
<tr>
<td>Object repetition</td>
<td>161</td>
</tr>
</tbody>
</table>
# CATIA Wireframe & Surfaces

## Table of Contents

- **Surfaces** .......................................................... 163
  - Extruded .................................................................... 163
  - Revolution .............................................................. 165
  - Sphere ...................................................................... 167
  - Cylinder ................................................................. 169
  - Offset ....................................................................... 171
  - Variable Offset ...................................................... 174
  - Rough Offset ........................................................ 176
  - Offset with Multiple Sub-elements ............................... 177
  - Sweep ...................................................................... 180
    - Explicit .................................................................. 180
      - With reference surface ........................................ 180
      - With two guide curves ....................................... 188
      - With pulling direction ...................................... 192
    - Linear .................................................................... 194
      - Two limits .......................................................... 194
      - Limit and middle ................................................ 198
      - With reference surface ....................................... 199
      - With reference curve ......................................... 201
      - With tangency surface ....................................... 203
      - With draft direction .......................................... 205
      - With two tangency surfaces ................................. 209
    - Circular ............................................................... 211
      - Three guides ...................................................... 211
      - Two guides and radius ....................................... 213
      - Center and two angles ....................................... 215
      - Center and radius ................................................ 217
      - Two guides and tangency surface ......................... 218
      - One guide and tangency surface ......................... 220
    - Conical .................................................................. 222
      - Two guide curves ................................................. 222
      - Three guide curves ............................................. 224
    - Four guide curves ................................................. 226
    - Five guide curves ................................................ 228
  - Adaptive Sweep .......................................................... 230
  - Fill surfaces ................................................................ 235
  - Multi-section surfaces .............................................. 239
  - Blend surfaces .......................................................... 249
  - Spines ..................................................................... 254
  - Laws ....................................................................... 259
<table>
<thead>
<tr>
<th>Category</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations</td>
<td>271</td>
</tr>
<tr>
<td>Joining Elements</td>
<td>271</td>
</tr>
<tr>
<td>Healing Surfaces</td>
<td>278</td>
</tr>
<tr>
<td>Curve smoothing</td>
<td>281</td>
</tr>
<tr>
<td>Splitting Elements</td>
<td>282</td>
</tr>
<tr>
<td>Trimming Elements</td>
<td>287</td>
</tr>
<tr>
<td>Untrimming Elements</td>
<td>290</td>
</tr>
<tr>
<td>Disassembling Elements</td>
<td>292</td>
</tr>
<tr>
<td>Extracting Boundaries and Faces</td>
<td>294</td>
</tr>
<tr>
<td>Sketch Extract</td>
<td>298</td>
</tr>
<tr>
<td>Creating the Nearest Element</td>
<td>300</td>
</tr>
<tr>
<td>Fillets</td>
<td>302</td>
</tr>
<tr>
<td>Shape Fillet</td>
<td>302</td>
</tr>
<tr>
<td>Edge Fillet</td>
<td>308</td>
</tr>
<tr>
<td>Variable Radius Fillet</td>
<td>310</td>
</tr>
<tr>
<td>Face to Face Fillet</td>
<td>312</td>
</tr>
<tr>
<td>Tritangent Fillet</td>
<td>313</td>
</tr>
<tr>
<td>Transformations</td>
<td>315</td>
</tr>
<tr>
<td>Translate</td>
<td>315</td>
</tr>
<tr>
<td>Rotate</td>
<td>317</td>
</tr>
<tr>
<td>Symmetry</td>
<td>318</td>
</tr>
<tr>
<td>Scale</td>
<td>319</td>
</tr>
<tr>
<td>Affinity</td>
<td>320</td>
</tr>
<tr>
<td>Axis to Axis</td>
<td>323</td>
</tr>
<tr>
<td>Patterns</td>
<td>324</td>
</tr>
<tr>
<td>Rectangular</td>
<td>324</td>
</tr>
<tr>
<td>Circular</td>
<td>327</td>
</tr>
<tr>
<td>Extrapolating Curves and Surfaces</td>
<td>328</td>
</tr>
<tr>
<td>Multi-Selection</td>
<td>333</td>
</tr>
<tr>
<td>Analysis</td>
<td>339</td>
</tr>
<tr>
<td>Curve Connect Checker</td>
<td>339</td>
</tr>
<tr>
<td>Surface Connect Checker</td>
<td>342</td>
</tr>
<tr>
<td>Draft Analysis</td>
<td>347</td>
</tr>
<tr>
<td>Surfacic Curvature Analysis</td>
<td>351</td>
</tr>
<tr>
<td>Porcupine Curvature Analysis</td>
<td>355</td>
</tr>
<tr>
<td>Geometric Information</td>
<td>362</td>
</tr>
<tr>
<td>Dress-Up</td>
<td>364</td>
</tr>
<tr>
<td>Geometrical Set Management</td>
<td>367</td>
</tr>
<tr>
<td>Inserting a Geometrical Set</td>
<td>367</td>
</tr>
<tr>
<td>Changing Sets</td>
<td>368</td>
</tr>
<tr>
<td>Operations on Sets</td>
<td>370</td>
</tr>
<tr>
<td>Groups</td>
<td>372</td>
</tr>
</tbody>
</table>
# Table of Contents

**Ordered Geometrical Set Management** ........................................ 374
  Inserting an Ordered Geometrical Set ..................................... 374
  Modifying Children .......................................................... 376
  Operations on Ordered Sets .................................................. 378
  Scanning Ordered Sets ....................................................... 380
  Inserting in an Ordered Set .................................................. 381
  Switching to a Regular Geometrical Set .................................. 382

**Miscellaneous** ........................................................................ 383
  Parents/Children .............................................................. 383
  Historical Graph ............................................................. 384
  Quick Select ................................................................. 386
  Inserting Elements ............................................................ 388
  Sets of planes ................................................................. 389
  Keep and No Keep Mode ...................................................... 393
    Keep Mode .................................................................. 393
    No Keep Mode ............................................................ 393
  Current Body ................................................................. 397
  Deleting Useless Elements .................................................... 399

**Review** ................................................................................. 401

**Problems** ............................................................................. 423
  Problem 1 - Perfume Bottle ................................................... 423
  Problem 2 - Tubing Cap ......................................................... 424
  Problem 3 - Antenna Holder ................................................... 426
  Problem 4 - Sheetmetal Flange ................................................ 428
  Problem 5 - Hook ............................................................... 429

**Appendix A** .......................................................................... 431
  Shape - Generative Shape Design - General ............................ 431
  Shape - Generative Shape Design - Work On Support ................ 433

**Appendix B** .......................................................................... 435
  Part Design Using Surfaces .................................................... 435
    Split ........................................................................... 435
    Thick Surface ............................................................... 437
    Close .......................................................................... 438
    Sew ............................................................................ 439
    Pad/Pocket ................................................................... 441
  Boolean Operations ............................................................... 442

**Appendix C** .......................................................................... 445
  Generative Shape Optimizer .................................................... 445
    Bump Surfaces ............................................................... 446
    Wrap Curve Surfaces ........................................................ 449
    Wrap Surface Surfaces ........................................................ 451
    Shape Morphing ................................................................ 453
<table>
<thead>
<tr>
<th>Appendix D</th>
<th>457</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed Shapes</td>
<td>457</td>
</tr>
<tr>
<td>Unfold Surfaces</td>
<td>457</td>
</tr>
<tr>
<td>Develop Wires</td>
<td>460</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Appendix E</th>
<th>463</th>
</tr>
</thead>
<tbody>
<tr>
<td>BiW Templates</td>
<td>463</td>
</tr>
<tr>
<td>Junction Surfaces</td>
<td>463</td>
</tr>
<tr>
<td>Diabolo</td>
<td>465</td>
</tr>
<tr>
<td>Hole</td>
<td>467</td>
</tr>
<tr>
<td>Mating Flange</td>
<td>471</td>
</tr>
<tr>
<td>Bead</td>
<td>474</td>
</tr>
<tr>
<td>3D Working Supports</td>
<td>476</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Appendix F</th>
<th>479</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volumes</td>
<td>479</td>
</tr>
</tbody>
</table>
Circular

A circular swept surface forces the cross section to be circular. As with the linear sweep, the profile is defined implicitly based on your options, rather than as a separate profile element.

Open the **Swept Surfaces - Circular** document. You should see some wireframe geometry.

Select the sweep icon. The **Swept Surface Definition** window appears.

**Three guides**

Change the **Profile** type to circle and the **Subtype** to **Three guides**. The options change.

![](image)

**Subtype**

Specifies what type of circle swept surface you are going to create. This determines the **Mandatory elements** and the **Optional elements**. You can choose from **Three guides**, **Two guides and radius**, **Center and two angles**, **Center and radius**, **Two guides and tangency surface** or **One guide and tangency surface**.

**Mandatory elements**

**Guide curve 1,2,3**  Defines the three curves through which the circle will pass
Select the four curves as shown below and select Preview. The surface passes through the three guide curves and uses the other curve as its spine. The cross section remains circular with respect to the normal planes of the spine.
Two guides and radius

Change the **Subtype** to **Two guides and radius**. The options change.

**Mandatory elements**

*Guide curve 1,2* Defines the two curves through which the circle will pass

*Radius* Specifies the radius of the circle cross section

**Optional elements**

*Solution(s)* Allows you to select which solution to generate

Notice that since you had defined three guides and a spine earlier, this option automatically uses the first two guides and the spine.
**Key 1.5 for the Radius and select Preview.** There are four possible solutions. The first one is highlighted.

Select the >> button until you get the second solution, then select *OK*.

Hide this surface.
Center and two angles

Select the sweep icon again. The Swept Surface Definition window appears.

Change the Subtype to Center and two angles. The options change.

Mandatory elements

Center curve Defines the curve that represents the center of the circle
Reference curve Defines the curve used as the base for the angles as well as the radius of the circle
Angle 1,2 Specifies a starting and ending angle for the circle

Optional elements

Use fixed radius Specifies the radius you want the circle to have, thus using the Reference curve only for an angle reference
Select the two curves as shown below, key -45.0 for Angle 1 and 45.0 for Angle 2. Select the reference curve again to define the spine and select Preview. The surface appears centered around the first curve and passing through the second curve. If you were to turn on the Use fixed radius option and specify a value, the reference curve would only be used to determine the angles and the surface would not pass through the curve.

Select OK. The surface is created.
Center and radius

Select the sweep icon again. The Swept Surface Definition window appears.

Change the Subtype to Center and radius. The options change.

Mandatory elements

Center curve Defines the curve that represents the center of the circle

Radius Specifies the radius of the circle

Select the curve as shown below, key 1.5 for the Radius and select Preview. The surface appears. By default the spine is the Center curve. This option is excellent for making quick pipes or tubing.

Select OK. The surface is created.
Two guides and tangency surface

Select the sweep icon again. The Swept Surface Definition window appears.

Change the Subtype to Two guides and tangency surface. The options change.

Mandatory elements

- **Limit curve with tangency** Defines the curve on the Tangency surface that will define one end of the circle
- **Tangency surface** Defines the surface to which the circle will be tangent
- **Limit curve** Defines the other end of the circle
Select the curves and surface as shown below and select Preview. Two solutions appear. Both are tangent to the existing surface and contain the two curves. By default the first curve is the spine.

Keep the first solution and select OK. The surface is created.
One guide and tangency surface

Select the sweep icon again. The Swept Surface Definition window appears.

Change the Subtype to One guide and tangency surface. The options change.

Mandatory elements

- **Guide curve 1**: Defines one limit of the circle
- **Tangency surface**: Defines the surface to which the circle will be tangent
- **Radius**: Specifies the radius of the circle. It needs to be large enough for the circle to exist between the tangent of the surface and the curve.

Optional elements

- **Trim with tangency surface**: Trims the Tangency surface
Select the curve and surface as shown below, key 1.5 for the **Radius** and select **Preview**. Two solutions appear. Both solutions go from the curve to the tangent of the surface using a radius of 1.5 inches. Again, by default, the first curve is the spine.

Keep the first solution and select **OK**. The surface is created.

Save and close your document.
Conical

A conical swept surface forces the cross section to be a conic. You can choose to have two, three, four or five guides to define the surface. However, the number of guides you use will limit the number of tangencies you can define. Regardless of which options you choose, the cross section will always remain conical.

Open the Swept Surfaces - Conical document. You should see some wireframe geometry and some surfaces.

Select the sweep icon. The Swept Surface Definition window appears.

Two guide curves

Change the Profile type to conic and the Subtype to Two guide curves. The options change.

Subtype

Specifies what type of conical swept surface you are going to create. This determines the Mandatory elements and the Optional elements. You can choose from Two guide curves, Three guide curves, Four guide curves or Five guide curves.
Mandatory elements

Guide curve 1, Last: Defines the two curves that will be used as the beginning and the end of the conic.

Tangency: Defines the tangency at that guide curve.

Angle: Modifies the tangency by a specified angle.

Parameter: Specifies the conic parameter to use. The parameter determines the type of conic that will be created.

Select the two curves and the respective surfaces and the line as shown below, key 0.5 for the Parameter, and select Preview. The surface appears; it is tangent to the two existing surfaces and due to the parameter, is parabolic in shape. The parameter determines the type of conical curve that is created, as explained in the conic section. The parameter can vary as it follows the spine, if you use a law.

Note: You were able to define two tangencies but you had to define a parameter.

Select Cancel. The window closes.
Three guide curves

Select the sweep icon again. The Swept Surface Definition window appears.

Change the Subtype to Three guide curves. The options change.

Mandatory elements

Guide curve 1,2, Last

Defines the three curves that will be used to define the conic. The first and last define the beginning and the end of the conic. The second one defines a curve that the conic will pass through, instead of using a parameter value.
Select the three curves, the two surfaces and the line as shown below and select **Preview**. The surface appears, passing through the second guide curve instead of using a parameter.

Select **Cancel**. The window closes.
Four guide curves

Select the sweep icon again. The Swept Surface Definition window appears.

Change the Subtype to Four guide curves. The options change.

Mandatory elements

Guide curve 1,2,3, Last
Defines the four curves that will be used to define the conic. The first and the last one define the beginning and end of the conic. The other two define curves that the conic will pass through. With this option, only one tangency can be defined.
Select the four curves, the surface and the line as shown below and select Preview. The surface appears, passing through all four curves and tangent to the surface.

Select Cancel. The window closes.
Five guide curves

Select the sweep icon again. The Swept Surface Definition window appears.

Change the Subtype to Five guide curves. The options change.

Mandatory elements

**Guide curve 1, 2, 3, 4, Last**

Defines the five curves that will be used to define the conic. The first and the last one define the beginning and end of the conic. The other three define curves that the conic will pass through. With this option, no tangencies can be defined.
Select the five curves and the line as shown below and select Preview. The surface appears, passing through all five curves.

Select OK. The surface is created.

Save and close your document.
Other available courses

CATIA V5 and ENOVIA

- CATIA Basic Concepts
- CATIA Part Design & Sketcher
- CATIA Assembly Design
- CATIA Drafting
- CATIA Wireframe & Surfaces
- CATIA Prismatic Machining
- CATIA Surface Machining
- CATIA Fitting Simulation & Kinematics
- CATIA Functional Tolerancing & Annotation
- CATIA Stress Analysis
- ENOVIA DMU Viewer
- ENOVIA LCA Basic Concepts
- ENOVIA LCA Advanced Concepts
- ENOVIA LCA Product Design

To enroll in any of the above courses, contact us at: (316) 978-3283
toll-free at: 1-800-NIARWSU or email: info@cadcamlab.org