# PAVILION

## SIMPLE SUBDIVISION

| | Mesh to NURBS | Mesh to SubD *default settings | SubD to NURBS *default settings | NURBS to Mesh *lowest meshing parameter | Triangulated Mesh | Triangulated Mesh *from original import | ReduceMesh *80% | | ReduceMesh *80%, from original import | |
|---|---|---|---|---|---|---|---|---|---|---|
| **imported fbx mesh pavilion** | | | | | | | | | | |
| EXPLODABLE? | Yes (66 meshes) | Yes (66 surfaces) | No | Yes (11 surfaces) | Yes (11 meshes) | Yes (66 meshes) | Yes (11 meshes) | | Yes (44 meshes) | |
| POLYGON COUNT | 66 QUADS<br>0 TRIANGLES | 344 QUADS<br>756 TRIANGLES | 16,896 QUADS<br>0 TRIANGLES | 2,894 QUADS<br>1,283 TRIANGLES | 0 QUADS<br>2,408 TRIANGLES | 0 QUADS<br>132 TRIANGLES | 60 QUADS<br>361 TRIANGLES | | 5 QUADS<br>55 TRIANGLES | |
| **imported stl mesh pavilion** | | | | | | | | | | |
| EXPLODABLE? | Yes (66 meshes) | Yes (132 surfaces) | No | Yes (396 surfaces) | Yes (396 meshes) | Yes (10 meshes) | Yes (397 meshes) | | Yes (10 meshes) | |
| POLYGON COUNT | 0 QUADS<br>132 TRIANGLES | 0 QUADS<br>136 TRIANGLES | 25,344 QUADS<br>0 TRIANGLES | 8,256 QUADS<br>16,985 TRIANGLES | 0 QUADS<br>16,623 TRIANGLES | 0 QUADS<br>132 TRIANGLES | 448 QUADS<br>2,432 TRIANGLES | | 4 QUADS<br>58 TRIANGLES | |
| **imported obj mesh pavilion** | | | | | | | | | | |
| EXPLODABLE? | Yes (66 meshes) | Yes (66 surfaces) | No | Yes (11 surfaces) | Yes (11 meshes) | Yes (66 meshes) | Yes (11 meshes) | | Yes (43 meshes) | |
| POLYGON COUNT | 66 QUADS<br>0 TRIANGLES | 344 QUADS<br>756 TRIANGLES | 16,896 QUADS<br>0 TRIANGLES | 2,692 QUADS<br>1,270 TRIANGLES | 0 QUADS<br>2,408 TRIANGLES | 0 QUADS<br>132 TRIANGLES | 60 QUADS<br>361 TRIANGLES | | 4 QUADS<br>58 TRIANGLES | |

## FINDINGS

*1) Converting to NURBS gives objects a more defined surface.*
*2) Converting to SubD gives surfaces a curvature, making it smoother. Flatter surface curvatures are joined after converting to NURBS.*
*3) Converting to Mesh gives objects pointy corners.*
*4) Triangulating Meshes provides depth to objects in the viewport.*
*5) SubDs only operate with quadrilaterals, not triangles.*

# TORUS

## CLOSED VOLUME

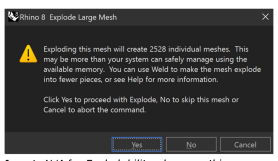
*ReduceMesh is performed on these meshes (under NURBS to Mesh).*

| | Mesh to NURBS | Mesh to SubD *default settings | Welded Mesh | SubD to NURBS *default settings | NURBS to Mesh* *lowest meshing parameter | Triangulated Mesh | Triangulated Mesh *from original import | ReduceMesh* *95% | | ReduceMesh *95%, from original import | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **imported fbx mesh torus** | | | | | | | | | | | |
| EXPLODABLE? | N/A | Yes (2528 surfaces) | No | Yes (220 meshes) | Yes (97 surfaces) | Yes (97 meshes) | N/A | Yes (39 meshes) | | Yes (236 meshes) | |
| POLYGON COUNT | 2,528 QUADS<br>0 TRIANGLES | 10,097 QUADS<br>30,276 TRIANGLES | 16,896 QUADS<br>0 TRIANGLES | 16,896 QUADS<br>0 TRIANGLES | 2,694 QUADS<br>1,283 TRIANGLES | 8,954 QUADS<br>8,628 TRIANGLES | 0 QUADS<br>26,536 TRIANGLES | 0 QUADS<br>5,056 TRIANGLES | 78 QUADS<br>1,176 TRIANGLES | 1 QUAD<br>250 TRIANGLES | |
| **imported stl mesh torus** | | | | | | | | | | | |
| EXPLODABLE? | Yes (21 meshes) | Yes (5056 surfaces) | No | Yes (21 meshes) | Yes (15,168 surfaces) | Yes (396 meshes) | Yes (15168 meshes) | Yes (21 meshes) | N/A | Yes (13 meshes) | |
| POLYGON COUNT | 0 QUADS<br>5,056 TRIANGLES | 0 QUADS<br>5,056 TRIANGLES | 25,344 QUADS<br>0 TRIANGLES | 25,344 QUADS<br>0 TRIANGLES | 9,256 QUADS<br>16,985 TRIANGLES | 182,995 QUADS<br>288,842 TRIANGLES | 0 QUADS<br>614,832 TRIANGLES | 0 QUADS<br>5,056 TRIANGLES | 873 QUADS<br>28,836 TRIANGLES | 5 QUADS<br>242 TRIANGLES | |
| **imported obj mesh torus** | | | | | | | | | | | |
| EXPLODABLE? | N/A | Yes (2528 surfaces) | No | Yes (220 meshes) | Yes (97 surfaces) | Yes (97 meshes) | Yes (97 meshes) | N/A | Yes (34 meshes) | Yes (235 meshes) | |
| POLYGON COUNT | 2,528 QUADS<br>0 TRIANGLES | 344 QUADS<br>756 TRIANGLES | 16,896 QUADS<br>0 TRIANGLES | 16,896 QUADS<br>0 TRIANGLES | 2,692 QUADS<br>1,270 TRIANGLES | 8,958 QUADS<br>8,620 TRIANGLES | 0 QUADS<br>26,536 TRIANGLES | 0 QUADS<br>5,056 TRIANGLES | 84 QUADS<br>1,182 TRIANGLES | 0 QUADS<br>252 TRIANGLES | |

## FINDINGS

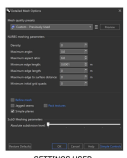
*1) The obj import groups the converted object with the original.*
*2) The torus has a higher subdivision level. Exploding gave this result:*
*3) Looking at the polygon count of the original imports, I noticed that stl files imported the objects with triangular faces. obj and fbx imports have 2,528 quadrilaterals, and double of that is stl's triangle count.*
*4) stl meshes are grouped when exploded. Meanwhile, obj and fbx meshes are not.*
*5) Operations done on objects can be limited by high subdivision levels. I can infer that this is due to the fact that there are more elements that needs to be computed, resulting to Rhino crashing.*
*Blender has modifiers that allow operation on even higher subdivision levels but adding too many modifiers also crashes the software (speaking on personal experience).*

*(This column) welding*




*I wrote N/A for Explodability whenever this window popped up.*

*(This column)*



*SETTINGS USED*

# PONYO

## CHARACTER MODEL

| | Mesh to NURBS | Mesh to SubD *default settings | SubD to NURBS *faces unpacked | SubD to NURBS *faces packed | NURBS to Mesh *lowest meshing parameter | Triangulated Mesh | Triangulated Mesh *from modified import | ReduceMesh *head - 90%, body - 70% |
|---|---|---|---|---|---|---|---|---|
| **imported fbx mesh ponyo** | | | | | | | | |
| EXPLODABLE? | N/A | N/A | Yes (4403 surfaces) | exploding only results in separate SubDs. | Yes (5936 surfaces) | Yes (3759 surfaces) | Yes (3754 meshes) | Yes (3754 meshes) | Yes (3159 meshes) | Yes (39 meshes) |
| POLYGON COUNT | 2,528 QUADS<br>0 TRIANGLES | 3,813 QUADS<br>890 TRIANGLES | 22,447 QUADS<br>51,329 TRIANGLES | 244,864 QUADS<br>0 TRIANGLES | 197,600 QUADS<br>288,231 TRIANGLES | 218,467 QUADS<br>249,878 TRIANGLES | 35,776 QUADS<br>62,752 TRIANGLES | 0 QUADS<br>353,473 TRIANGLES | 0 QUADS<br>7,916 TRIANGLES | 75 QUADS<br>1,176 TRIANGLES |
| **imported stl mesh ponyo** | | | | | | | | |
| EXPLODABLE? | Yes (21 meshes) | Yes (772 meshes) | Yes (7848 surfaces) | exploding only results in separate SubDs. | N/A | N/A | N/A | N/A | Yes (772 meshes) | N/A |
| POLYGON COUNT | 0 QUADS<br>5,056 TRIANGLES | 64 QUADS<br>7,781 TRIANGLES | 268 QUADS<br>8,598 TRIANGLES | 580,512 QUADS<br>0 TRIANGLES | 23,400 NURBS surfaces | 23,400 NURBS surfaces | No output in SubD to NURBS to perform command on. | No output in SubD to NURBS to perform command on. | 0 QUADS<br>7,915 TRIANGLES | 873 QUADS<br>28,836 TRIANGLES |
| **imported obj mesh ponyo** | | | | | | | | |
| EXPLODABLE? | N/A | N/A | Yes (4414 surfaces) | exploding only results in separate SubDs. | Yes (5991 surfaces) | Yes (3814 surfaces) | Yes (3809 meshes) | Yes (3809 meshes) | Yes (3156 meshes) | Yes (34 meshes) |
| POLYGON COUNT | 2,528 QUADS<br>0 TRIANGLES | 3,502 QUADS<br>912 TRIANGLES | 23,298 QUADS<br>52,980 TRIANGLES | 246,272 QUADS<br>0 TRIANGLES | 197,948 QUADS<br>290,753 TRIANGLES | 216,548 QUADS<br>251,924 TRIANGLES | 113,272 QUADS<br>126,266 TRIANGLES | 0 QUADS<br>394,807 TRIANGLES | 0 QUADS<br>7,816 TRIANGLES | 84 QUADS<br>1,192 TRIANGLES |

*ReduceMesh performed on the eyes and mouth to allow as many conversions as possible.*

*Grouped objects will share the same number or percentage in reduction. I ungrouped and performed ReduceMesh separately.*

## FINDINGS

*1) Performing ReduceMesh on stl imported objects causes more division in mesh when exploded.*
*2) In Blender, I used a mirror modifier for geometry. Converting this in Rhino caused a split along the Y-axis. This splitting was avoided in Blender by using the Merge checkbox and adjusting the slide bar under the Mirror modifier.*
*3) NURBS with packed faces have less number of surfaces when exploded because packing merges adjacent surface patches into larger, unified surfaces, reducing the overall count. This approach enhances efficiency and simplifies geometry handling. On the other hand, working with unpacked faces may be tedious but will allow more precision to work with.*
*4) More objects generally increased computational demands, especially during processes like NURBS to Mesh or SubD to NURBS conversions.*
*5) Grouping and organizing objects became essential to prevent errors during operations like ReduceMesh.*

## GENERAL OBSERVATIONS

***FILE IMPORTS***
***- I observed differences in mesh complexity based on the file type I used for import (fbx, stl, obj). stl files tended to have significantly higher polygon counts compared to fbx and obj formats.***
***- The imported objects had their own X and Y Gumball directions, so I had to use the "GumballRelocate" command for efficiency in moving the objects. Another instance happened when converting from NURBS to Mesh and copying meshes individually. The Gumball directions were altered, requiring manual adjustments.***

***CONVERSION LIMITATIONS***
***- When I converted from NURBS to Mesh, the objects lost their precise surface definitions, becoming simplified representations.***
***- Converting from SubD to NURBS gave me more flexibility, allowing proportional editing of surfaces, but it also dramatically increased the surface count.***
***- I noticed significant variations in polygon counts and the ratio of quads to triangles depending on the type of conversion combined with the original import format.***

***DEFAULT SETTINGS***
***- The default settings for SubD and ReduceMesh conversions had a major impact on the final geometry. SubD conversion defaults prioritized smoothness, while ReduceMesh defaults aimed for simplification but sometimes compromised detail.***
***- By adjusting parameters, such as mesh density during ReduceMesh, I was able to optimize results for specific needs like the creation of my low-poly model. For example, an 80% reduction from an original import struck a good balance between retaining form and reducing polygon counts.***

***RHINO-SPECIFIC***
***- I found that tools like "GumballRelocate" were essential for fixing inconsistencies in the object's axis alignment after import.***

***EXPLODABILITY AND TRIANGULATION***
***- Explodability remained consistent across file types, but the number of resulting meshes varied depending on the initial file structure and subsequent operations.***
***- Explodability stayed consistent across different conversion stages. However, the number of meshes generated depended heavily on the input geometry and the operations I performed.***
***- Triangulating meshes during conversion made it easier to separate individual parts.***
***- Triangulated meshes gave me a consistent and uniform structure but increased the polygon count.***

***MESH TOPOLOGY***
***- I noticed that obj and fbx files maintained simpler mesh topology compared to stl files, which made them more efficient for further processing.***

***POLYGON COUNTS***
***- I observed significant differences in quad and triangle counts across various formats and operations. For instance, stl imports generated a high number of triangles, which impacted efficiency.***
***- SubD to NURBS conversions resulted in high quad counts, creating smoother curvatures that retained surface continuity.***

***EFFICIENCY***
***- High-polygon meshes, such as those from stl imports, affected viewport performance, especially after complex conversions.***
***- Using ReduceMesh improved viewport efficiency by lowering polygon counts while preserving the overall form. For example, an 80% reduction produced quads and triangles optimized for performance.***

***Other(s)***
***- Converting from NURBS to Mesh greatly reduced the geometry's complexity by merging surfaces.***

# INTEROPERABILITY

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