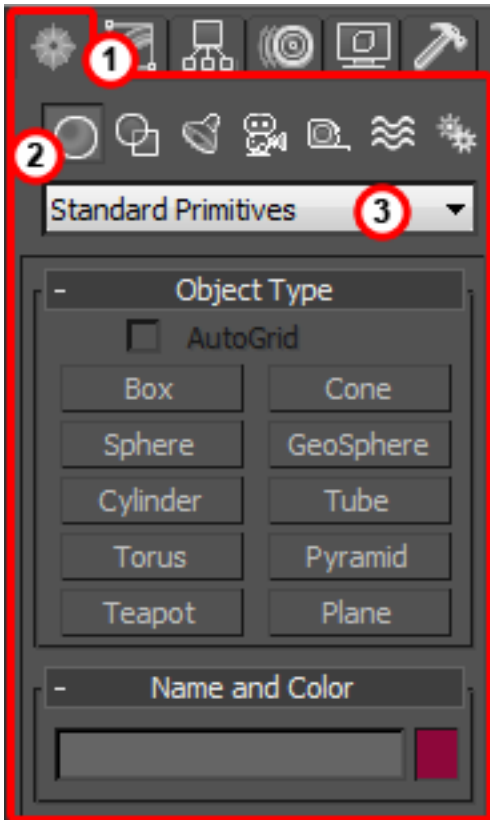# GA2211 – Hard Surfaces Modeling Section A & B – Class Notes – Week 1.5

Standard Primitives:

1) "CREATE" Tab – This section of the interface has options to create scene objects. Almost anything you can create in Max is available from this tab, including: geometry, curves, lights, cameras, helper objects, particles systems, etc. We will be focusing on the GEOMETRY sub-section.

2) "GEOMETRY" Section – The geometry section holds all initial geometry types you can create.

3) Geometry Type Menu – Just below the option buttons for create, you have a drop-down menu with choices organizing the geometry types. Initially, we will use "**Standard Primitives**", as this creates some basic polygonal shapes.

- To create any Standard Primitive, click the button associated with that type.

- This will put the curser into Interactive Creation mode.

- You will begin creating your object when you left click-drag anywhere in the Viewports.

- Most **Standard Primitives** have multiple dimensions to initially set. You will notice as soon as you left-click again, that you switch to dragging out the other dimension. Continue to click-drag out all dimensions.

[Note:] *Interactive Creation usually leaves your geometry somewhere in your scene away from the Origin (X=0, Y =0, Z =0). To take advantage of many tools, it is beneficial to **move your object to absolute origin** (0,0,0) while modeling – then move it to it's desired location when done. Use the Transform/Move Type in to move it to X = 0, Y = 0 , Z = 0.*

[+] Parameters:
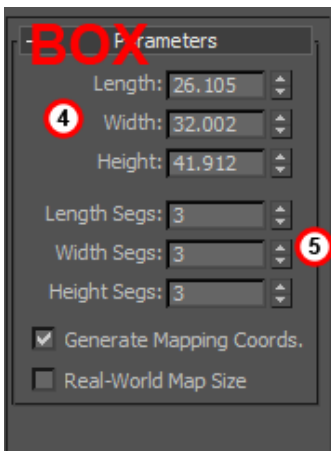
Every Standard Primitive you create has initial parameters. You can change these attributes for every standard primitive.

This Parameters section will initially be available in the **CREATE tab**. After you create the Primitive, it may move to the **MODIFY tab** (the next one over).

4) You will usually have some options for the dimensions of your Primitive – some settings for height, length, width, radius, etc – depending on the type of primitive.

5) You will also have some tessellation options. These options let you set the number of extra faces, edges and vertices that are used to define this object. Use as many as you will need to define the initial shape.

[Note:] *For many objects, we will be further refining, adding to and smoothing the geometry as we model it. You want to start with just enough tessellation to begin modeling, but not too much – as this would mean having to move much more points around initially.*

If the final shape you are after is just the primitive – then go ahead and create it at full resolution.
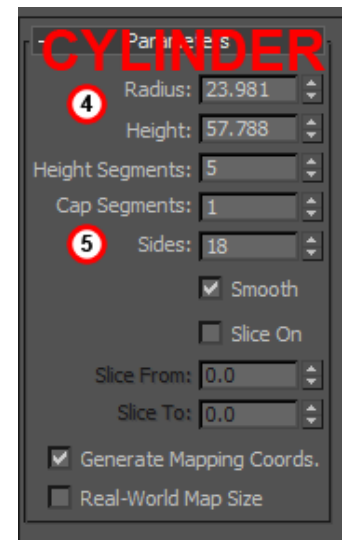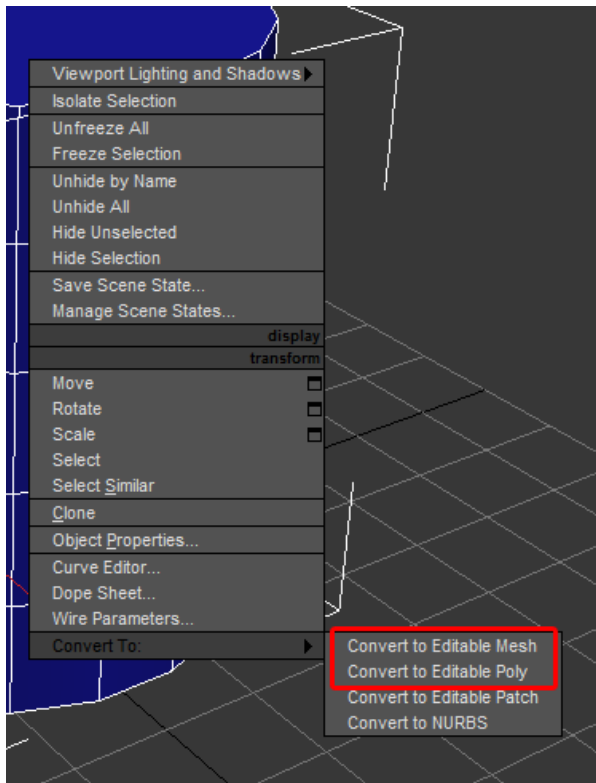
Editable Poly/Editable Mesh:

Once we have a Standard Primitive- that is the starting point for further modeling. To be able to edit the shape on a sub-object level, we need to convert it to one of two types of objects - **Editable Poly** or **Editable Mesh**

Both of these object types have similar functions, although some of the exact details will be slightly different.

To convert a Standard Primitive to an Editable Mesh/Poly - Either:

A) Right- Click (hold) on your mesh and select from the "Convert To:" Menu.

B) In the MODIFY panel, right-click in the stack and choose to Convert to: Editable Mesh or Editable Poly.

Once you have converted the Primitive to an Editable Mesh/Poly, you will see many new features and tools available to you in the MODIFY panel.

The most important is the ability to select sub-object components. You'll be able to select vertices, edges, border edges, polygons and elements.

All of these are tied together, so you can jump around moving and editing any one of them.
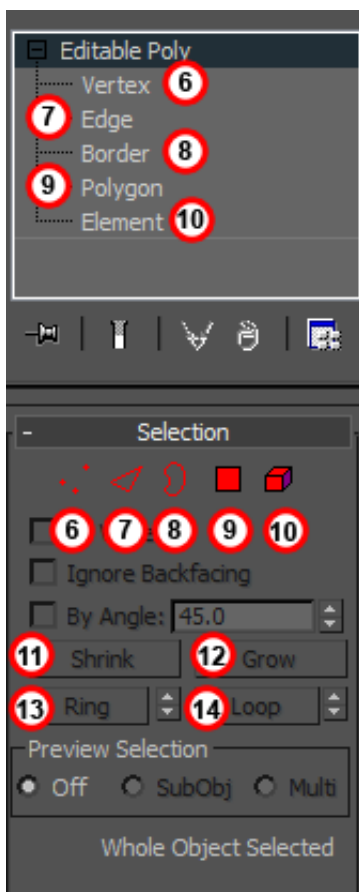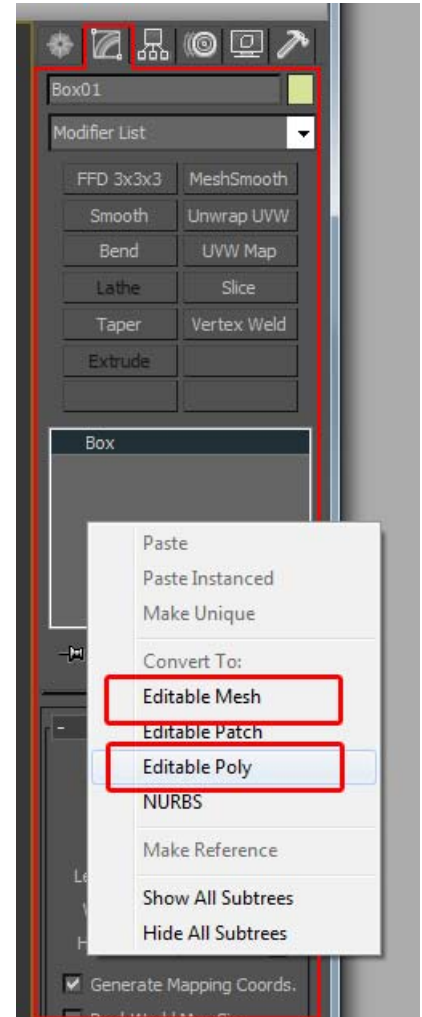
Sub-Object Selections:

Click either in the stack on the component you wish to select, or on the icons below the stack that correspond to the sub-object.

6) Vertex – A vertex is a point. It is the basic building block in 3D, and defines a position in 3D space. Since all other polygonal sub-objects are built from points, allot of your modeling will be pushing points around.

7) Edge – An edge is defined by a line between at least two points. You can therefore select many points at once by simply selecting an edge. It can be beneficial to move lots of point around by working in EDGE sub-object mode.

8) Border – In Max, a Border is a set of edges that define the outline of a hole in your mesh.

9) Polygon – A polygon is simply a face created by a minimum of 3 vertices or edges. A polygon can have more than 3 sides. Generally, it is a good idea to work with 4 sided faces – what is known as a QUAD. In Polygon sub-object mode, your selections are these faces. Note that polygons have a facing direction, called a "Normal". This means there is a "forward" and a "back-facing" direction. Max will show you "back-facing" polygons as BLACK. It is important to note the direction of your faces, as most default rendering modes will only draw forward-facing polygons.

10) Element – Elements are contiguous pieces of your mesh. Any time a piece of your mesh doesn't share at least one vertex/edge/polygon with the rest – it is a new element. Element sub object mode can be useful for selecting separate pieces easily.

Selection Options – These handy tools will help speed up selection of the various sub object components.

11) Shrink – This button will contract, or shirk, your selection.

12) Grow – Conversely, this button will expand or grow your selection outward to include more vertices/edges/polygons.

13) Ring – this tool, especially when your geometry is arranged in good QUADs (all 4-sided polygons only), will allow you to select a ring of similar sub objects along one axis, all the way around your model. This is the opposite axis as the Loop tool.

14) Loop – this tool, especially when your geometry is arranged in good QUADs (all 4-sided polygons only), will allow you to select a loop of similar sub objects along one axis, all the way around your model. This is the opposite axis as the Ring tool.

Tools Covered in Class 1:

CREATE – Create lets you define the boundary of a new polygon. When you click this button, your cursor will change to reflect that you are in create mode.

- You can create a free polygon by clicking anywhere in the viewport, but most of the time you will want to create polygons connected to your existing geometry.
- To do this, hover over one of the vertices of your existing geometry. Notice that the cursor icons changes to reflect that you are over the vertex.
- Click here to begin the creation exactly on that vertex…this will create a polygon that shares that vertex with your existing geometry.
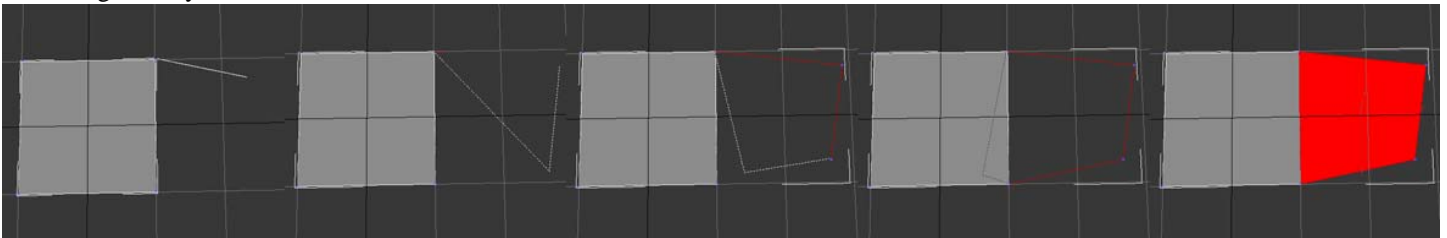
- Continue to click to define the shape of your polygon. Max allows you to create N-sided (unlimited sides) polygons, but we will be working with no more than 4 sides – what is called a QUAD.
- Click back on an existing vertex on your geometry to close the polygon and make it share an edge with your existing geometry.
- Right click to finish the polygon.
- Repeat to create more polygons.

WELD – Weld lets you consolidate vertices and connect gaps in your geometry. Weld operates on selected vertices – so select at least 2 vertices to begin WELD – typically, you will use this tool for your entire mesh, so you can select ALL vertices.
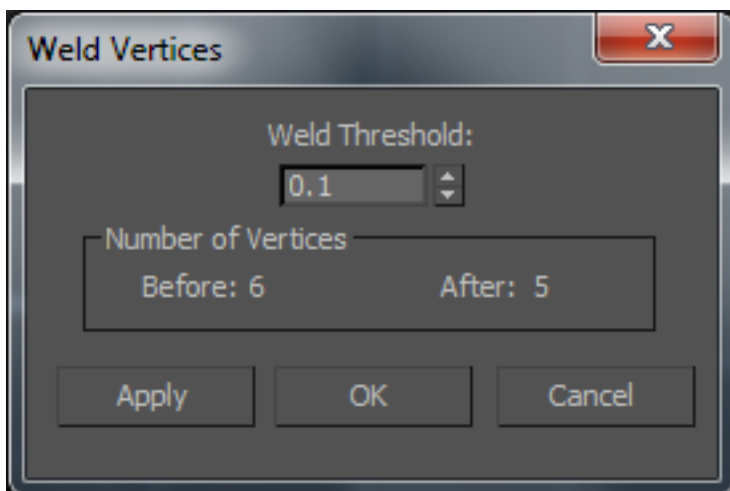
- This tool has an options/settings box – this brings up a window which lets you set some parameters for this tool:

- You will also see a preview in your viewport of the results and some statistics about vertex count before and after.

- Weld will attempt to consolidate and merge vertices close to each other. You can set a threshold for this search area by raising or lowering the threshold. Watch the viewport for sudden, aggressive welding as you raise the threshold.

[Note:] *You want a threshold high enough to remove extra vertices, but not high enough to ruin the shape of your object. If you see your mesh pinching too much, dial the threshold back just enough so that it retains its shape but still consolidates unwanted vertices.*

TARGET WELD - Target weld is more focused and deliberate. It does not have a threshold, but lets the user weld by direct selecting of the vertices. To use TARGET WELD;
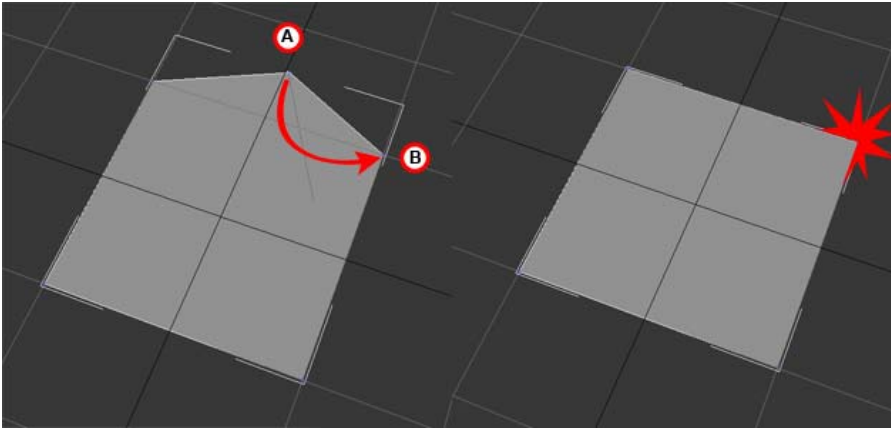
Click the TARGET WELD button.

A) Select the first vertex by left-clicking on it.

B) Select the second vertex by left-clicking on it.

You will notice the first vertex move to the position of the second vertex and was welded.

CHAMFER – Chamfer will take an edge and split it into several edges. You can use it to round out a hard corner, or split an edge into 2 edges.

I use the CHAMFER tool mainly as a modeling aid to:

- Split an edge loop (continuous loop of edges that runs around the entire model) while retaining the position I have set for the previous edge.

- Create a single bevel to catch light on hard corners. This helps make the model look less "CG" (Computer Graphics), and read as higher resolution.

To Chamfer:
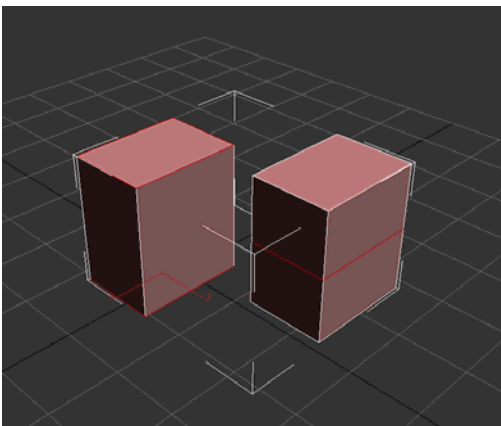
Select one or more edges. To make sure chamfer does not create unwanted N-sided polygons, I usually select an entire loop – terminating my selection at an open hole or taking it all the way around.

Click the chamfer option/setting box. You will see options to chamfer.

You will see a preview of the results.

Chamfer Amount: The size of the offset. Basically, the distance between the new edges this tool will insert.
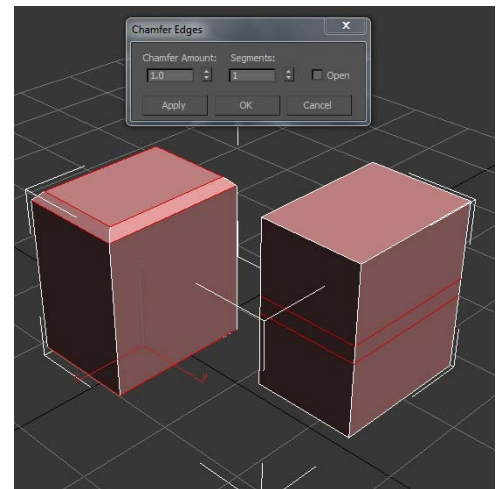
Segments: The number of edges to insert. As more edges are inserted, the corner is rounded more.

[Note:] *I usually leave this tool set to 1 segment, unless I'm trying to completely round a corner. Usually, I just want an extra face at the corner to catch some light. Notice how, already, the corner edge is brighter than the previous hard corner.*

CUT TOOL – The cut tool is a very powerful tool in geometry modification. It lets us create edges (and in turn vertices and polygons) were we want them.

To use the cut tool: Click the **CUT** button. Alternately, you can use the hotkey ALT + C .
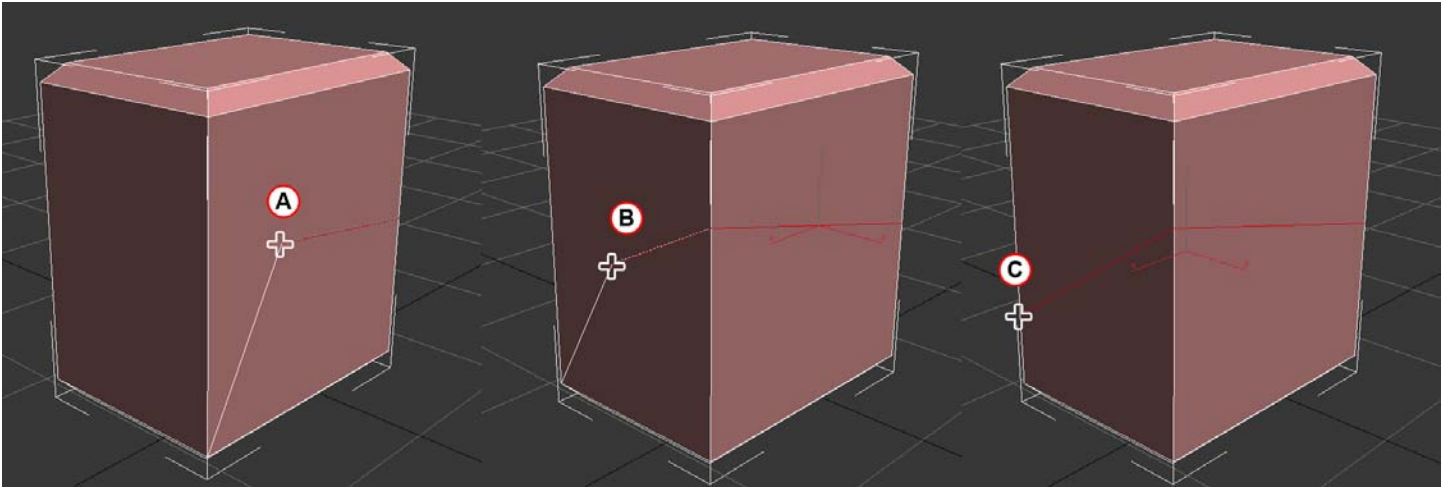
A) Left-Click on an edge to begin the CUT.

B) Left-Click and opposite or adjacent edge to create a cut across the face.

C) Continue cutting edges until you are finished. Right-Click to end the tool.

[Note:] *To avoid making N-sided polygons, you should aim to cut complete edge loops (loops of edges that stretch entirely around the model, or terminate in a hole).*

[Note:] *To end a cut exactly on a vertex, hover over that vertex while in the cut tool – you will notice the cursor change to reflect you are over a vertex. Clicking now will result in a nice welded end of your cut.*

"LOOPS" TOOLS – INSERT LOOP

The "LOOPS" Tool menu has some tools that work nicely with QUADS. One of these tools is the INSERT LOOP tool. This tool will insert a continuous loop of edges completely around your mesh – if your geometry is comprised of 4 sided QUAD polygons.
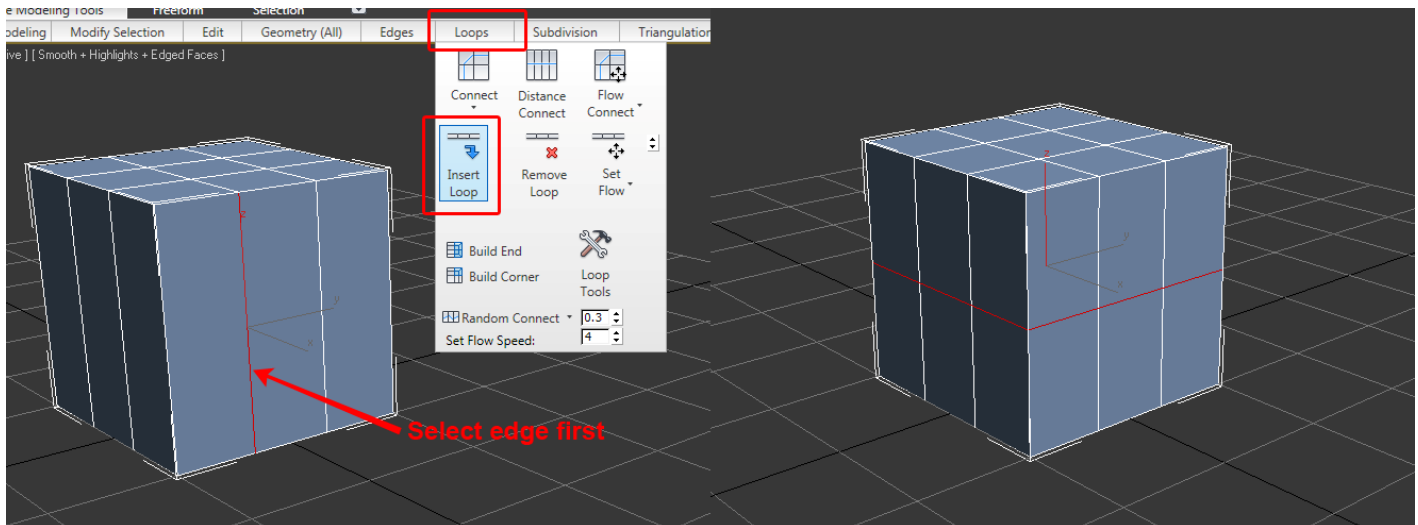
To insert an edge loop:
- Select an edge that is perpendicular to the direction you'd like for your edge loop.
- The ring of polygons must be QUADS, or the edge loop will stop at the first N-gon or Triangle.
- The "LOOPS" menu will only appear when edges are selected.
- From the LOOPS menu, select "INSERT LOOP".

A new edge will have been created. You now can select the new verts/edges/polygons and refine the geometry further.