

Combining Meshes

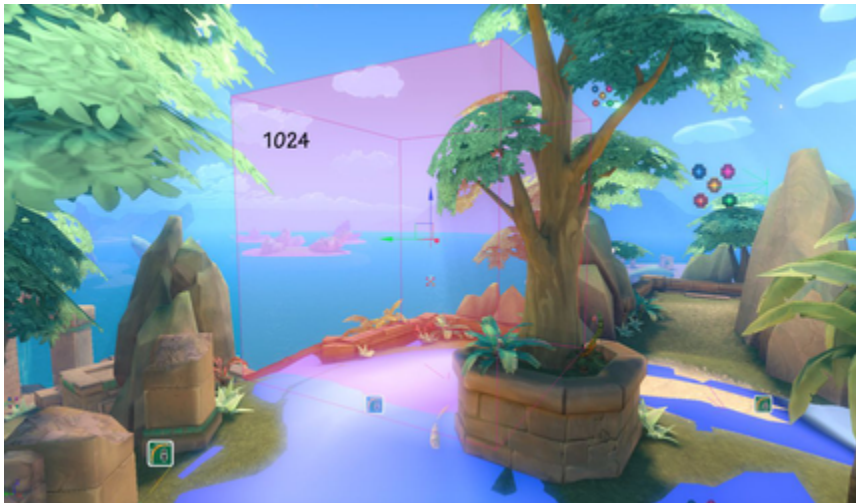
- Basic Guidelines

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Combining for draw calls is good BUT it can be VERY detrimental if it's not done correctly. If a combo mesh is too large or too spaced out it creates cases where those objects will NEVER be occluded or culled (thus making rendering *more* expensive). **It takes 2-4x longer to FIX violations of these guidelines than it does to outright commit the violation on an entire map.**

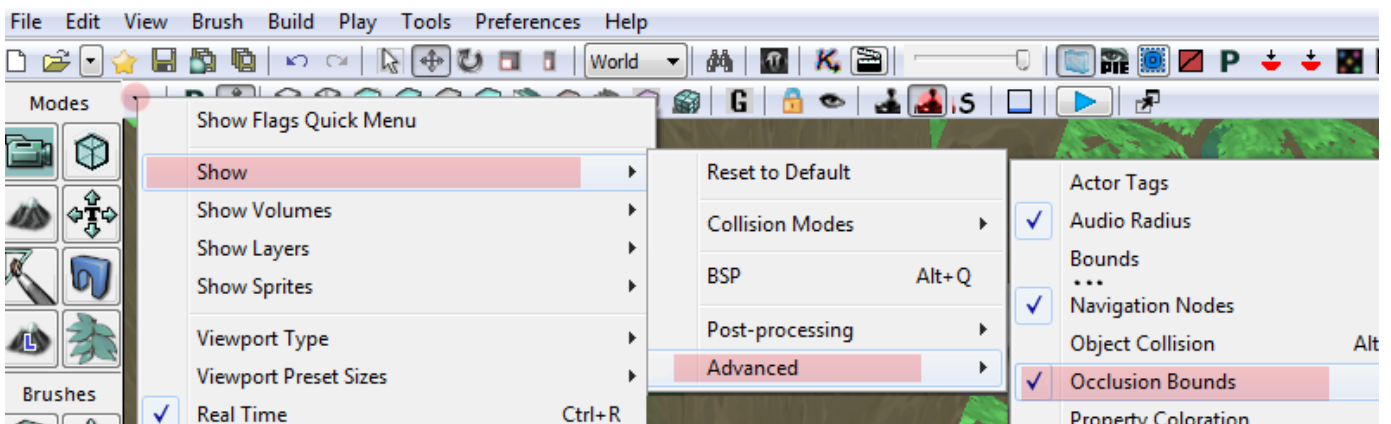
Basic Guidelines

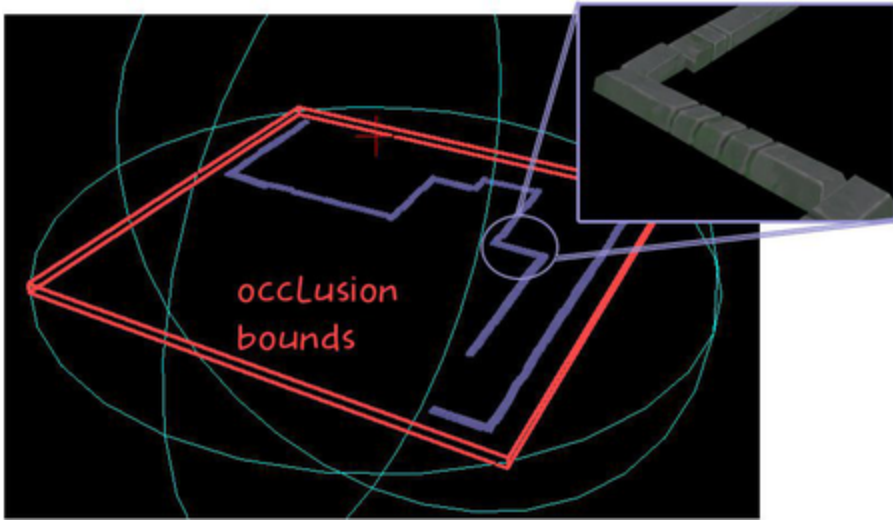
1. Reducing draw calls is just a single COMPONENT of performance. The rendering thread is also greatly effected by whats culled/occluded.
 - a. Example: If you combine 5 columns that are spaced out, it reduces 4 draw calls from *one* viewing angle. However, now you have a large bounding box that can be seen from all areas of the level, therefore it is always drawn even when out of sight (hitting that rendering thread across the rest of the level)
2. **If even a single unit of the bounding box is visible (regardless of if you can see the mesh or not) that combo mesh WILL NOT occlude.**
3. **Large combo meshes are harder to cull.**
 - a. Cull distance is calculated by the closest point of the bounding box to the player camera. So the larger the bounding box, the less likely you'll ever be far enough away for it to cull (without setting absurdly short cull distances).
4. Try your best to keep bounding boxes of assets in gameplay space smaller than 512x512x512 (**DO NOT IGNORE OTHER RULES IF IT STILL FITS IN 512**).
 - a. Consider the verticality/height of an mesh's bounding box. Because of Concept #1, very tall bounding boxes will likely be visible, therefore never occluded.



b.

How to See the Bounding Box



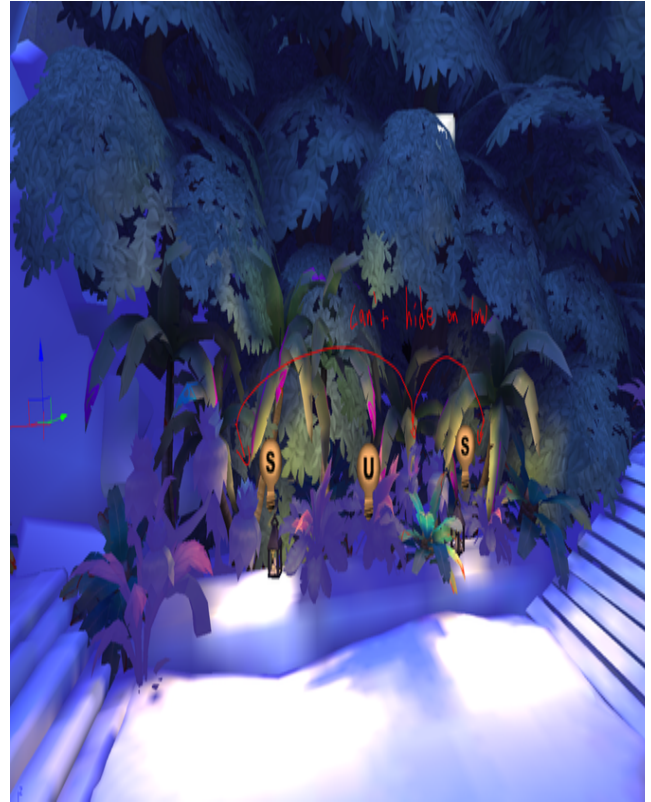


Combining Guidelines

Do	Do Not
	<ul style="list-style-type: none"> Don't combine adjacent meshes that have different materials (unless you consolidate materials with Simplygon) because each material has a draw call and if 2 meshes with 2 materials get combined it does not save anything.
<ul style="list-style-type: none"> Do strongly consider the re-use potential of a combination mesh. <ul style="list-style-type: none"> Creating 50 new unique combinations that are only used once each now increases your memory. If they are large pieces, they also are not being occluded and thus increasing rendering time as well. 50 unique, rendering-heavy meshes are, in most cases, not cheaper than 10 re-used smaller pieces placed 50 times that occlude/cull more easily. 	<ul style="list-style-type: none"> If you're only going to use a combination mesh 1 or 2 times, please just combine smaller units of objects you can re-use multiple times. <ul style="list-style-type: none"> Example: Foliage - Do not combine a row of 10-15 plants (unless you can re-use them) can be made similarly with a multiple instances of 2-3 unit combinations. See the image in the next row for what this violation looks like in practice.

- Do keep poly counts of combo meshes reasonable. They can get very large very quickly.
 - This is a side-effect of violating the above rule about re-use. Very large meshes tend to not be used much and have high poly counts. This can actually perform WORSE than if the mesh stayed separated.

- Do **NOT** combine quantities of meshes that contain meshes commonly turned OFF on low (like small plants/grass/etc.) If you could be shut off on Low, don't combine it with something that always be on.

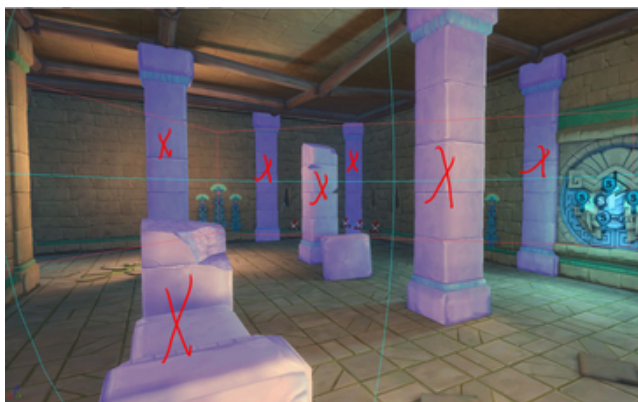
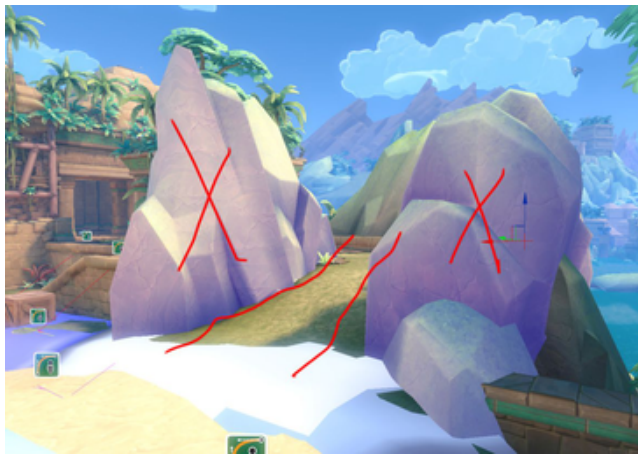


We cannot turn off smaller plants on low if its all combined. Manual re-placement of these assets on low only takes significantly longer than doing it right the first time.

The combo mesh pictured above, violates almost every guideline in this document: giant bounding box, too many meshes, large gaps between meshes, etc.

- Combine smaller, adjacent/touching assets that share the same material. If your bounding box expands outside of 512x512 you start to lose performance benefits. This does not take priority over other guidelines! A combo mesh simply fitting within this measurement doesn't excuse the other guidelines.
 - In many cases, Architecture can be combined in a larger unit if the building itself is larger than 512x512. This rule is more for combining smaller props/trims/foilage.

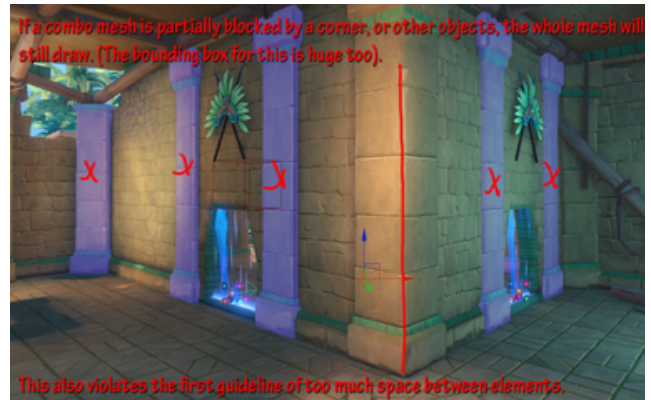
- Don't combine assets that are separated by other objects or otherwise have large spaces in-between each mesh.



- Combine background assets and consolidate materials using SimplyGon and/or MassiveLOD



- Don't combine meshes that are partially blocked by other objects (split up around a corner, or have other meshes between parts). can see half of a combo mesh but not the other you're still paying for the unseen portion.



- Combine large boundary assets that don't need to be occluded or won't be culled. (By design)



- Don't combine large spans of adjacent meshes, creating giant bounding boxes. (As a general rule if the bounding box gets larger than 1024x1024x1024 the odds of it ever being occluded/culled down significantly if not completely).



(This is also a great example of the "Re-Use" General Concept. This easily be 1 combo mesh used 3 times).

- Do consider splitting tall combined meshes at the point where visibility from the bottom portions begins to be obstructed. This is so the bounding box does not span the entire height and you can have the bottom half occlude (Which usually has more detail, therefore more savings).

Consider splitting vertical meshes so you the bottom part can benefit from occlusion even if the top is still visible.

Not splitting creates a super tall bounding box that won't ever benefit from occlusion.

