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Did you ever find yourself spending a lot of time creating the same type of assets? Working with modular building sets, but your scene still feels repetitive? Creating an environment, but missing that bit of sophistication?

This article takes you through the process of designing an environment using modular assets to bring your environment/prototype to life as quickly as possible without showing repetitiveness.

About me

My name is Stan van den Heuvel. I'm a Game Artist specialized in stylized realtime VFX and props. For my graduation project I took a deep dive into the process of creating an environment using modular assets.

You can download my article here:

<https://github.com/MindlessStan/UPD-Article-Stan-van-den-Heuvel>

Sections

1. Introduction [P.3]

A short introduction to the tutorial.

2. What is modularity? [P.4 / P.6]

Before we dive into the environment we will take a look at what exactly modularity is.

3. Environment design [P.7 / P.10]

In the first chapter you determine the setting and style of your environment. You will spend some time gathering references with the focus on which elements you want to highlight in your scene.

4. Targeted research [P.11 / P.14]

With the theme set you will be conducting research on how other games approach similar settings and analyze their work.

5. Avoiding repetitiveness in your assets [P.15 / P.24]

With the picture complete you are going to put together a list of the assets you will need to quickly assemble your scene. This section will explain how to prevent your assets from feeling repetitive.

6. Modular ARM master material [P.25 / P.40]

With all our assets done I will show you how to create a modular ARM master material. This material will allow us to create instances and tweak our textures in UE4. This will greatly improve our workflow.

7. The power of modular assets [P.41]

A short summary of the things we went over in this article and some links that helped me along the way.

1 | Introduction

When it comes to prototyping, modularity is one of the most powerful tools there is. Especially when trying to determine if your environment succeeds at triggering the desired emotions in your players outside of the blockout phase. Modular assets help you reach the stage where you can get a clear view on how your environment would resonate really fast. In this tutorial I will take you through the process of my graduation project, where I wanted to get to this stage as fast as possible. So if you want to learn how to design your own environment and improve your workflow with modularity this is for you!

What this article will teach you

In this article I will share my experiences and tips on how modularity can be brought to use. I will share the in-depth design process I followed for the design of my graduation environment. Along the way I will give you assignments which are on par with what I have done for my own environment. I will also share how you can set up a modular ARM master material in UE4, which allows you to create instances of materials which are highly tweakable.

This tutorial is for you if:

- You are planning on creating your own environment
- Want to learn about modularity in game assets
- Interested in knowing how to utilize modular assets
- Want to learn how to set up an ARM master material for your UE4 project

Prerequisites

- An art pipeline (for those who want to create their own assets)
- Access to a software for creating reference boards
- The basics of UE4 and the material editor

For my graduation I created the art myself, using my Blender, Zbrush & Substance Painter workflow. However you can use any workflow, or if you don't want to create your own assets you can follow along with an asset pack.

2 | What is modularity?

The last two pages I have used “modularity” quite a few times already, but what exactly does modularity mean?

Modularity is a technique which you can use when creating assets for a game. It greatly improves the workflow by minimizing the amount of assets you need, and maximizing the flexibility in what you can build with your assets. In a nutshell, it adds scalability to your project.

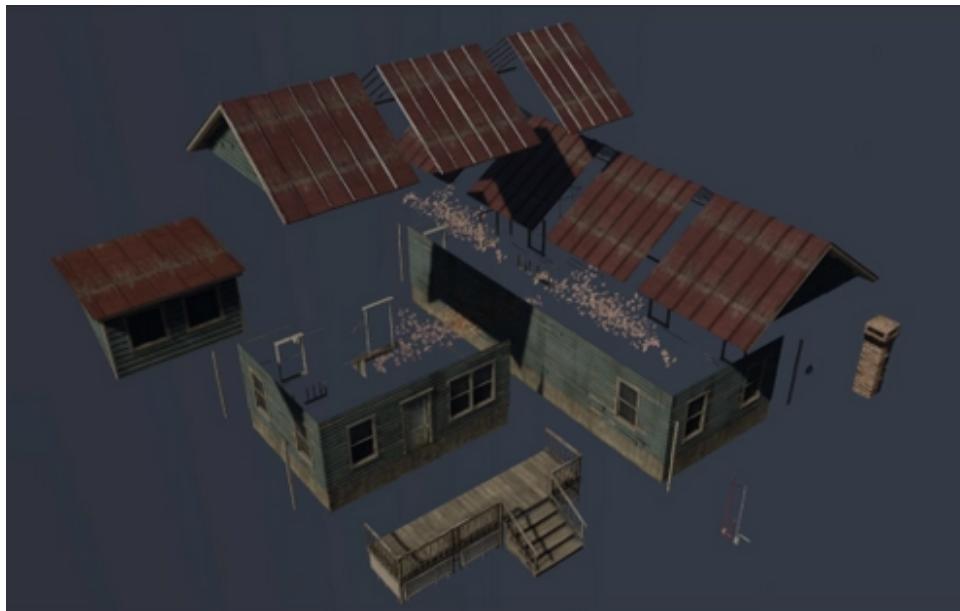
For example, when creating a city you need a lot of buildings. You could spend 6 months creating every single building for your city, however this is highly inefficient. If we take a look at a building, each building consists of walls, a roof, has doors and most likely some windows as well.

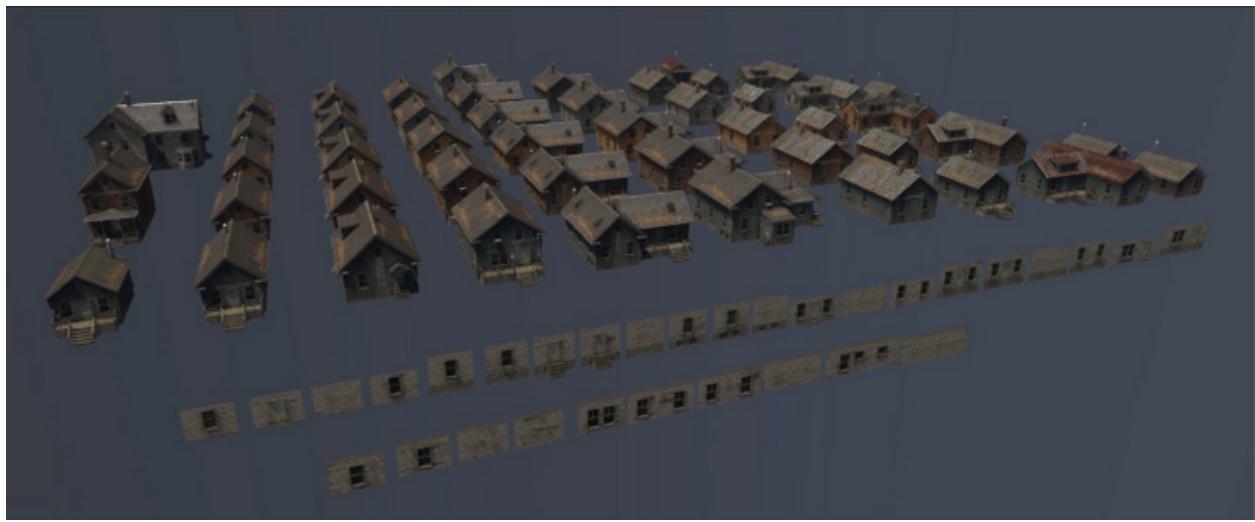
If you take these essential parts, create each of them separately and keep the same dynamics and style, you have a modular building set. With this set you will be able to create an infinite amount of buildings and put them together very quickly.

A good example of modularity is the buildings from Watch Dogs.



Here you can clearly see which modular parts the artist used to create the house above. They have different shapes and sizes for example for the roof, which gives a lot of flexibility.





The same set was used to create all the buildings in the picture above. Note that in the case of Watch Dogs the creators have textured their objects, but kept things like the walls white. This allows them to adjust the colors in UE4 by adding a color overlay in their material instances. This is also something I will be doing in this article.

3 | Environment design

The setting

The setting is the time and period your environment will be taking place in. It could be a real time period and a location on earth, or a fictional world in a parallel universe taking place at an undetermined time. The setting also includes the landscape, weather and climate. What kind of societal and cultural surroundings will there be? All these things will help to create a background for your environment.

As with every environment, choosing your setting is the first step. For my graduation I wanted to create a stylized underworld environment called Tartarus. As the name suggests, it is based on Tartarus from Roman mythology.

Your environment can be anything you want. Personally I would say pick a setting you have genuine interest in. This will give you the extra drive when doing research and creating the background for your environment.

Assignment 1 / Create your setting:

Create a document and answer the following questions:

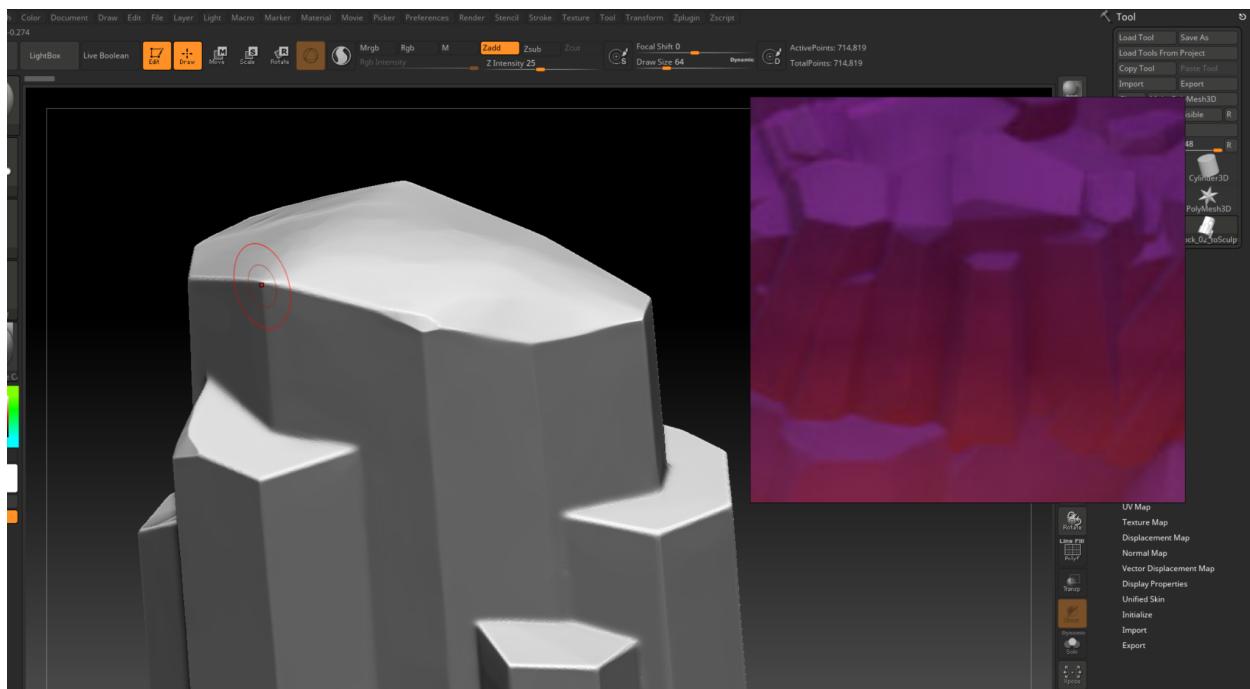
1. *What is the physical location (e.g. a temple, city etc.) of my scene?*
2. *During which time period does my scene take place?*
3. *What kind of landscape is my scene set in?*
4. *What kind of climate is my scene set in?*

Reference boards

Now that you have determined the setting for your environment it's time to start looking for references. We will be working on two reference boards. One with the focus on your setting, the other on the style you want to work with. Reference boards can be made in many different programs, you can use anything from word to photoshop.

Tip

Personally I use [PureRef](#) for making my reference boards. This is a free software which allows you to display it over different programs you are using. This means that for example when sculpting, you can keep the reference next to what you are working on. If you don't have a second monitor (like me) I highly recommend it.



The key to finding good references is using the right terms and looking at the right place. In my case the first term I started working with is “Tartarus” as it’s shown quite a bit in Roman mythology. I can also work with hellish landscapes and similar things. These depict very similar emotions to what I want to communicate to the players.

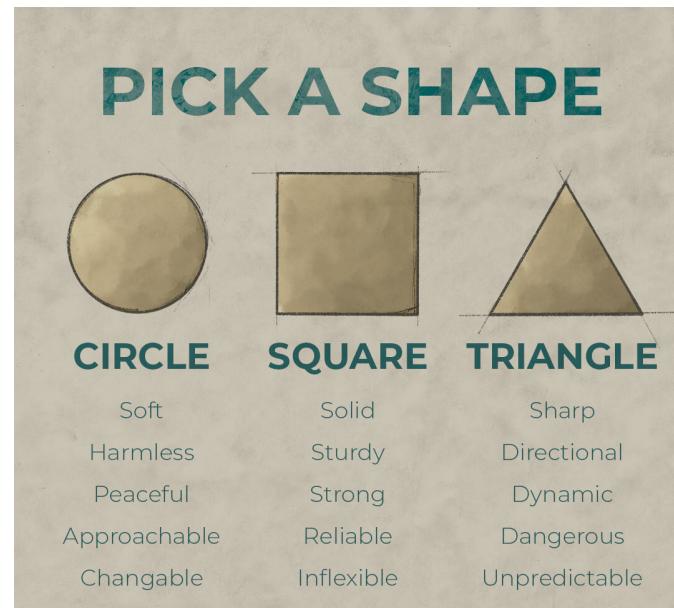
Why gather reference images for your setting?

Simply put, the main reason is inspiration. It might give you ideas for your environment. Maybe you really like that one particular building from the Star Wars Tatooine scenes for your desert environment? In this stage we want to go deeper into just “liking the building”. We will look at why we like the building, what colors and shapes they use etc.



Example

So let's continue with Tatooine as an example. We gather images of the buildings and look at what they have in common. You can see that the main body consists of a box or cylinder shape. Other shapes were added to these, to break the big surfaces and make them more interesting to look at. Almost all the roofs have some form of a dome on them. Colorwise they are just a bit brighter than the sand, but the pipes, windows and doors are darker, more saturated colors to create contrast. Gather these kinds of elements and analyze the shape language.



Reference board for the setting

The first reference board we will be working on is aimed at the environment. You need to gather pictures of what you imagine your environment to look like. Some of the places I recommend checking are:

- Pinterest
- Artstation
- Google

Assignment 2 / Setting reference:

Create a document in your chosen software. Gather references based on the setting for your environment. Start by using the physical location from the previous assignment.

Reference board for the style

The style reference board is meant for those who plan to create their own assets for their environment. First pick your style, for my graduation I decided to go with stylized. For style reference I recommend looking on Artstation. Many great artists and students post their work there and it can really be a goldmine when trying to find inspiration.

When looking at art references you generally want to create a consistent style. Pick your style and put together a document consisting of art pieces which represent the style you are going for. Analyze the visual elements of the art you have gathered. What types of shapes are used? What types of colors and textures are used? How much noise is present?

Assignment 3 (for the artists) / Style reference:

Create a document in your chosen software. Gather art references based on the style for your environment.

4 | Targeted research

Diving deeper

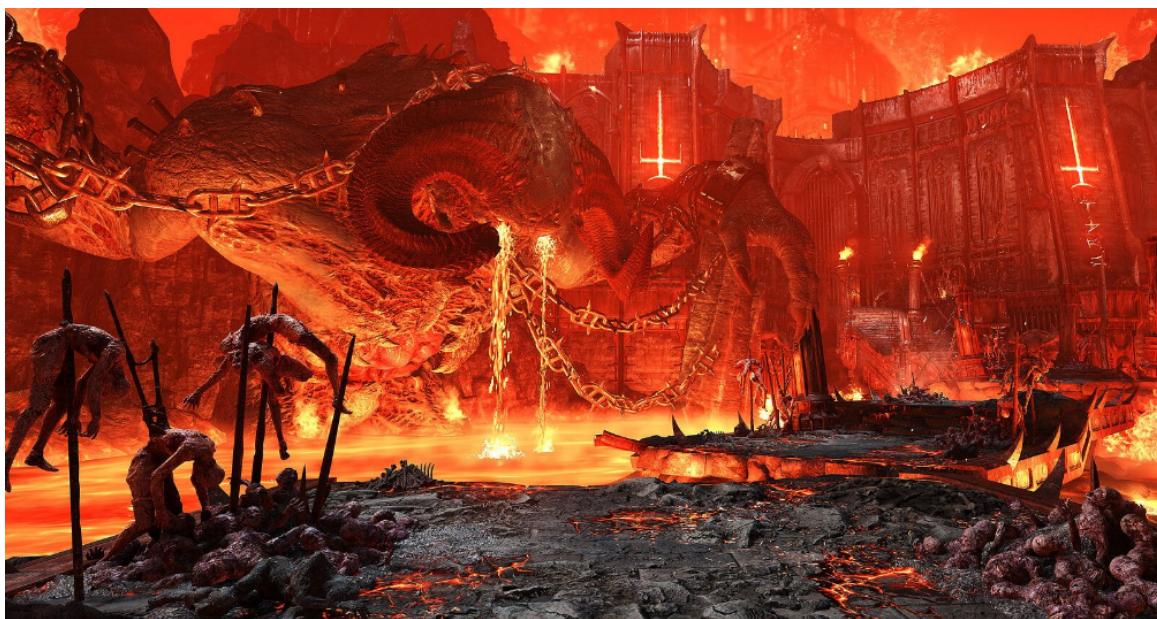
You would think that by now we have done a lot of research already, but we are not done yet. Personally, until my graduation, I had never spent that much time on gathering references and researching. However, during my graduation I discovered it's really useful. When asked about certain design choices in your project, you should be able to justify your choices and back them up with research.

In this chapter you will be diving even deeper and be doing more research. We have a clear picture of what we want to create by now, the question now is, for whom?

Target audience

For my graduation my goal was to communicate the uneasiness of a place like Tartarus in a playful way to a player base of ESRB rating 10+. Deciding your target audience might limit you in some way.

Taking this image as an example from my reference board, we can clearly see that in Doom they add a lot of dead things everywhere. However, for my target audience I couldn't do that.



ESRB Rating

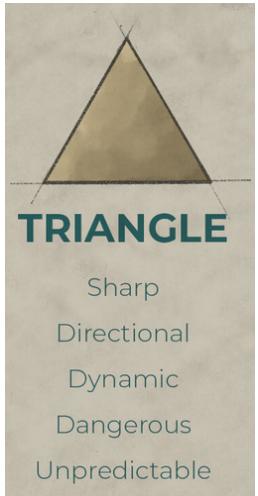
ESRB has good guidelines on what you can and can't do when aiming for a certain target audience. In my case, going for the 10+ rating meant the following for my project:

- It may contain fantasy, cartoon or mild forms of violence
- It may contain mild forms of mild language
- It may contain minimal suggestive themes



So it is clear that I couldn't go full Doom style and sprinkle dead bodies everywhere. But how can I achieve the uneasiness they give in a less violent way? If we look at the image again what else do we notice? Spikes! If we look back at the shape language image from earlier, spikes definitely fall in the triangle category. They feel sharp, dangerous and perhaps even unpredictable. Whilst not immediately showing to the 10 year olds that there is death everywhere, these traits will communicate that it is a dangerous environment.

When working with an ESRB rating, you want to try to analyze what exactly triggers certain emotions. And in my case how you can transfer the same emotions to your players whilst staying within the boundaries of your rating category.



Assignment 4 | Target audience:

Create a new page in the document you made for the first assignment. Write down who your target audience is. Head over to [the ESRB rating guide](#) and find out what this means for your project

How do they do it?

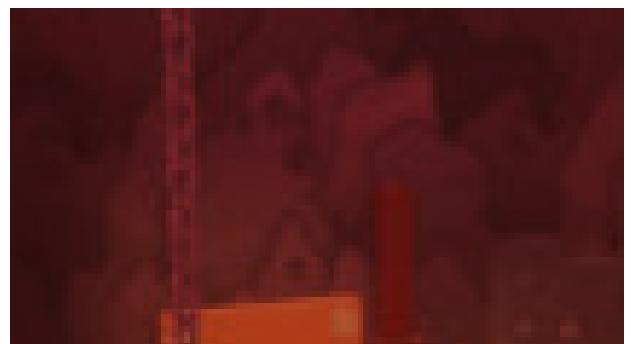
At this stage you want to check how other games build up similar environments and analyze some of their design choices. I will take you through one of my reference board images and some things I noticed in it.



This art is from Mario + Rabbids Kingdom battle, this fits right into my ESRB rating making it perfect to analyze in my case. Though this level is not in a hellish landscape as Tartarus, there is still a lot that we can learn.

The first thing I notice is how much red is present in this image. There is a lot of lava present, which makes it a dangerous environment. It's clearly an area we don't want to be in.

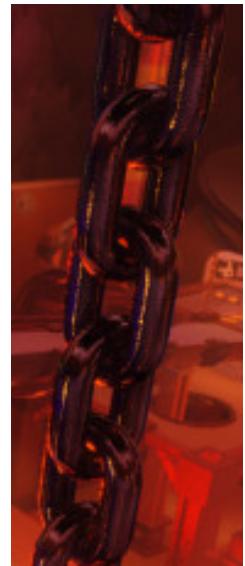
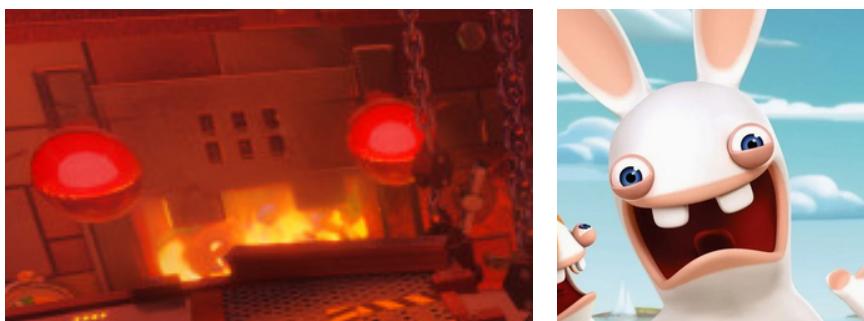
When we zoom in to the background, we can see that the rock walls consist of very sharp rocks. This ties in with the shape language mentioned with the spikes from earlier.



Also we have these chains hanging everywhere. These big chains are strong so they are used for anything hanging. But they can also communicate being trapped, as they are often linked to prisons in our minds.

If you think of a hellish landscape what is the first color that comes to mind? I bet you thought of red, but why? It is often associated with danger and anger. The environment is seemingly red, which gives it a dangerous impression.

Also, did you notice the furnace in this image is a rabbid?



When analyzing your own reference you really want to be diving deep into the images. Pick elements that stand out to you. Find out why they stand out to you, because the artist most likely wanted them to stand out. How did they make them stand out to you, and what do they communicate to the players/target audience?

Assignment 5 | Analyzing your reference:

Head over to the setting reference board you created and start analyzing the reference. What do the images have in common? What do they communicate to the target audience? Can we spot returning elements in the different images?

5 | Avoiding repetitiveness

What is repetitiveness?

In environments the repetitiveness can be seen as using the same assets over and over to the point where it becomes noticeable for the players. As I mentioned before modularity is a very powerful tool, however there are certain things you need to keep in mind when working with modular assets. If not used properly it can really break the immersion.

How not to use modular assets

Imagine walking through a forest in a game, but the forest consists only of one single tree which is copy pasted over the entire forest. Needless to say that most of the players will start to notice this.

Let's take The Isle as an example:

We only need one model for the walls right? It's easy to recognise because of the scratch in the middle. Also note how the building behind is mirrored from left to right.



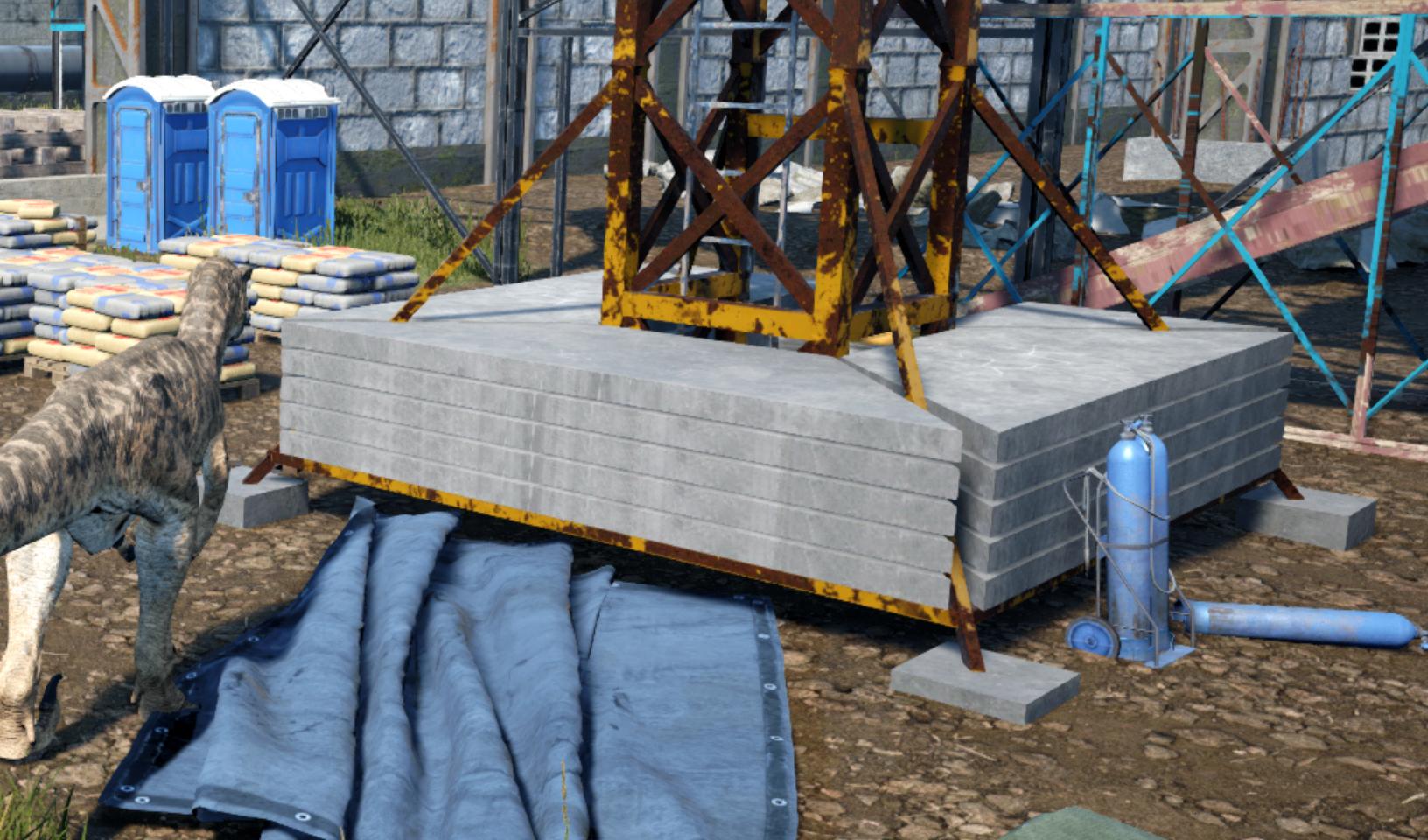


But what if we need a shorter wall on the edges of the docks? Just take the same wall and scale it down in the Z axis, nobody will notice, right? We can tell because the same scratch in the middle is present, just squished.

Also note how the pillars underneath the walls have the 2 dots towards the top, now follow along the dockline. How many dots do you count?



We can see this wall also consists of the same wall piece and the same pillar, copy pasted over and over and over. Same for the pipes on the right, we can tell by looking at the rusty line in the center of each pipe.

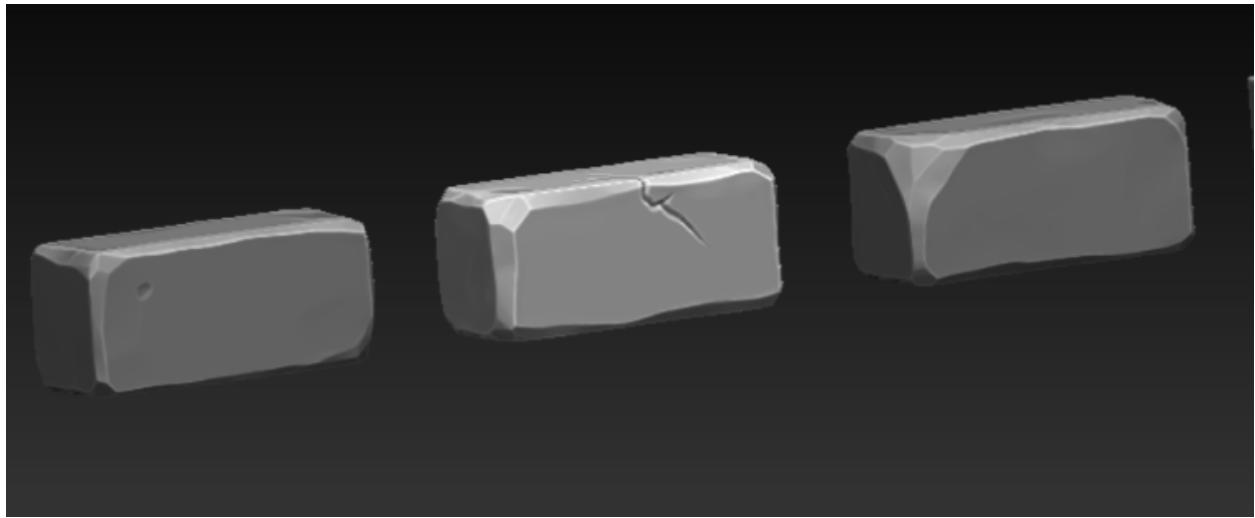


Need stone slates for your crane? Just make one and copy paste it 5 times, rotate the whole stack around the crane and we are done. Note how also the two port-a-potties in the top left are the exact same, as well as the concrete bags in front of them.

Now obviously I have been a little sarcastic, but these kinds of things become really noticeable once you start paying attention to them.

Alright I think you get what repetitiveness is by now, so the question now is how to prevent repetitiveness in your environment. There are two places where the repetitiveness can be created; in the art pipeline, and set dressing.

If you are creating the assets for your environment yourself, like me, you need to be cautious of details. Details make your assets look cool, but it also makes them easily recognisable. I will show you an example from my own graduation project. I created a set of bricks to create ruins and structures. One of the bricks has a corner which has been worn down. (Right brick)



This bigger surface which is missing makes it easily recognisable when I use it too often in my project.



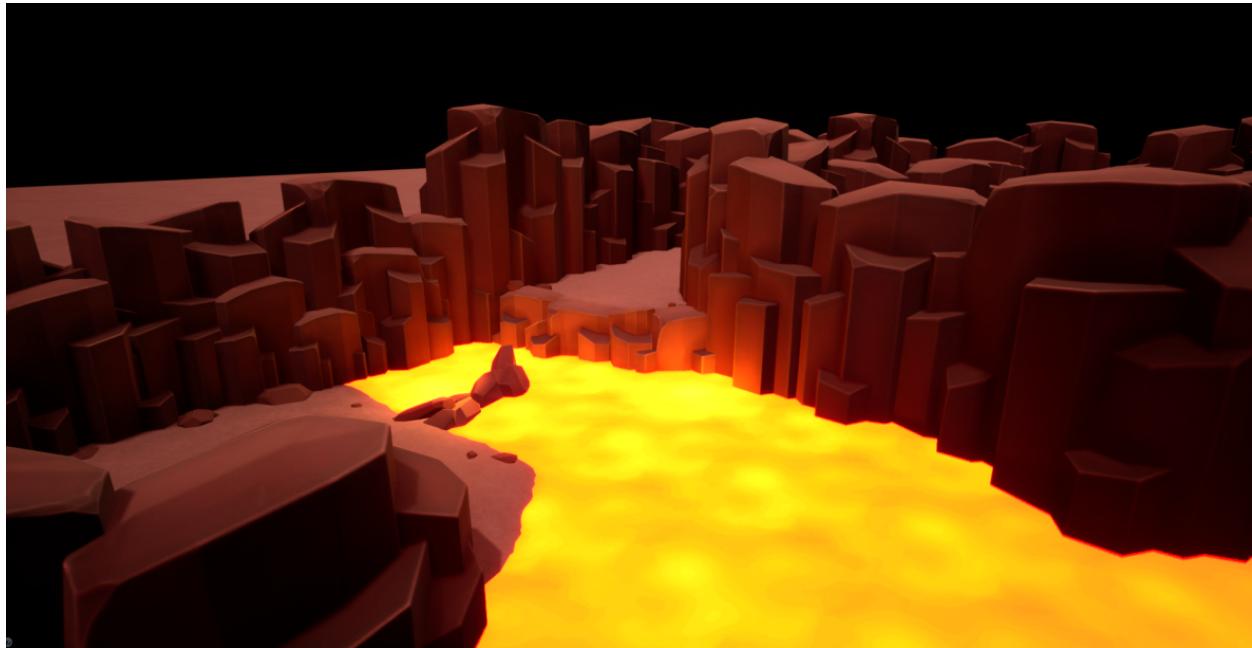
Now I'm not saying you should not add any details to your modular assets, because the world would be pretty bland without any details. If you have bigger more noticeable details like my brick, there are a few things we can do to minimize the repetitiveness with set dressing.



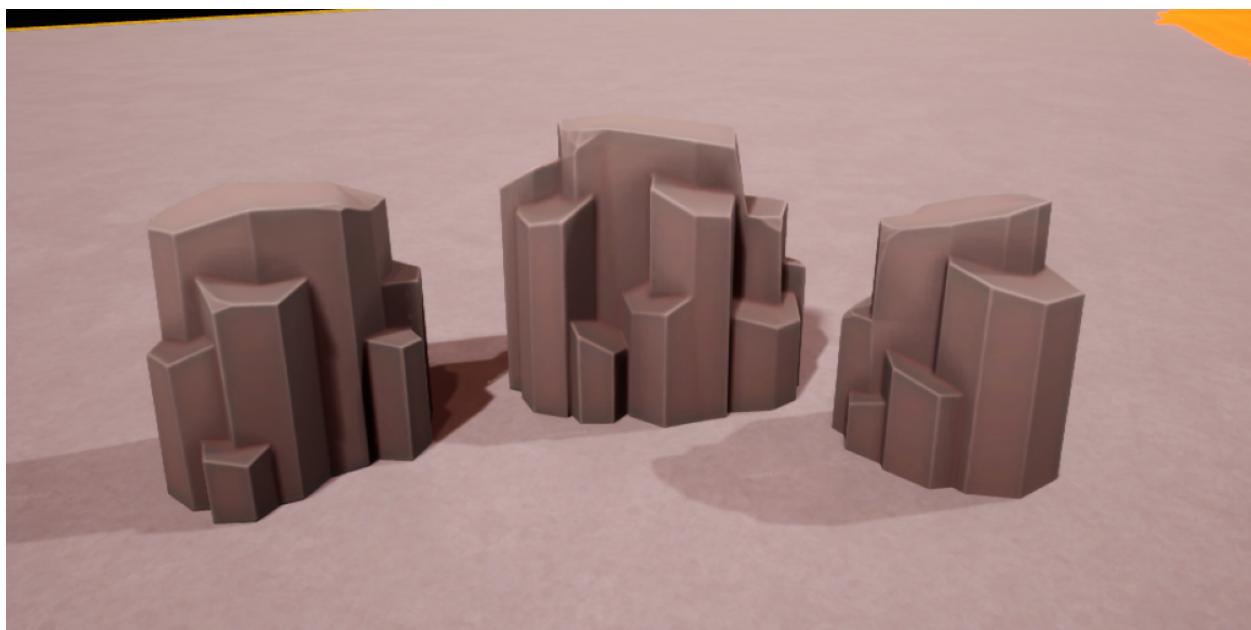
Looking back at the example of The Isle walls, they added a scratch detail to the middle of the wall. This detail is what makes it so easily recognisable. If the artists had not put that on there it would have been harder to see it was the same model being copy-pasted.

As an example on how to prevent repetitiveness when set dressing, I want to show my own graduation project.

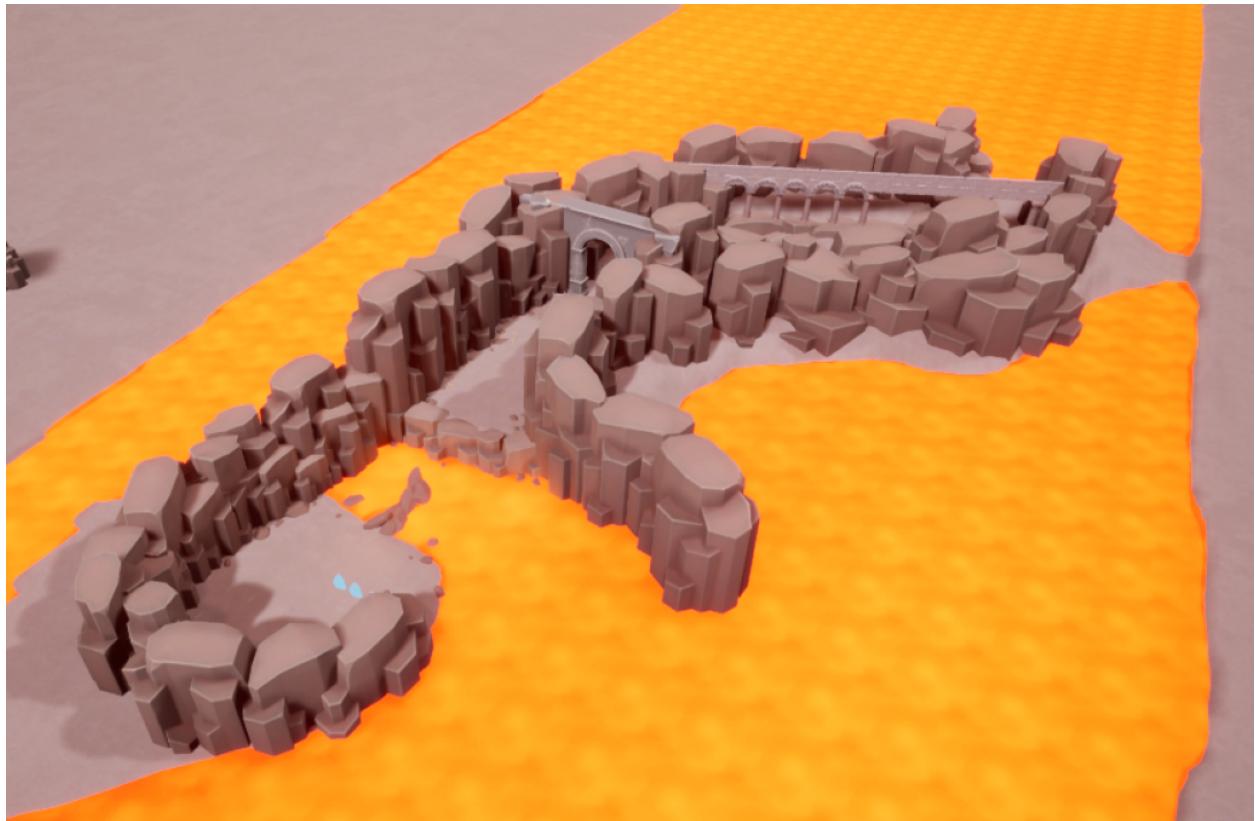
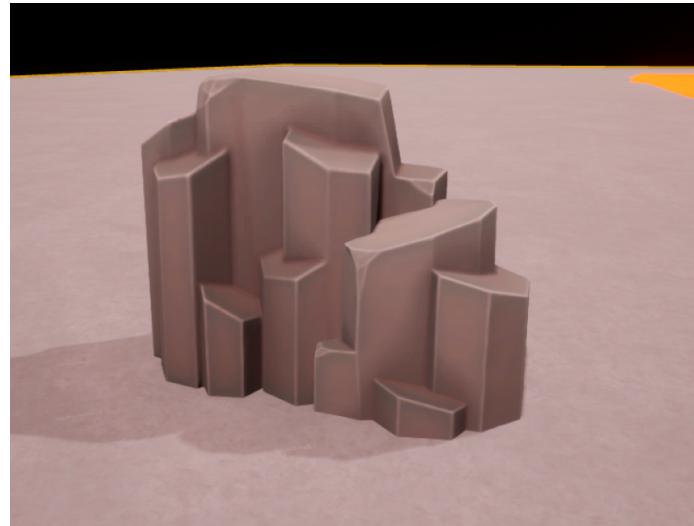
The image below is a (WIP) image of my scene. There are a lot of rocks in my scene which create the path for my players to follow.



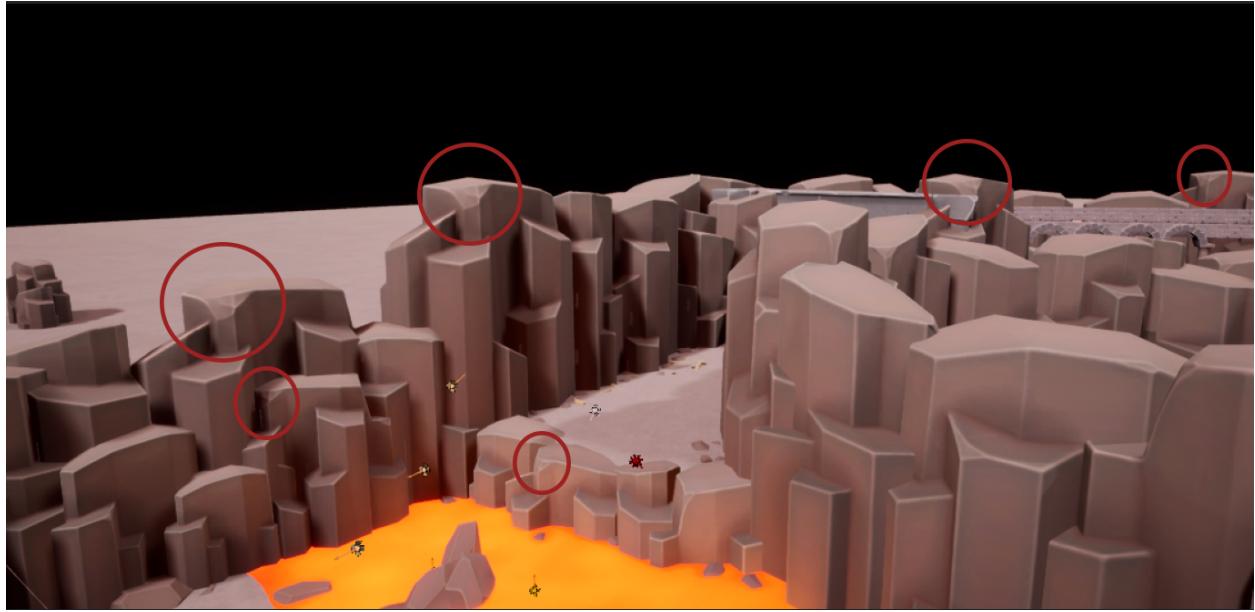
When looking at the image you can not immediately tell the same assets are being used over and over again. But in fact it is very present in the image, as the entire scene only consists of 3 different shapes of rocks.



The big shapes in my rock walls allow me to overlap them and by doing so create new shapes. Combined with a consistent art style this enabled me to create a large environment without it feeling too repetitive.



Returning to details making repetitiveness noticeable in my graduation project, from a project overview angle it is evident that I'm also reusing my assets.



However from the players perspective this will never be noticeable.



While set dressing for my graduation, I tried using the rocks in such a way that the player would not see the same angle of each rock twice in the same scene. This makes it less evident that the same walls are used over and over.

To summarize:

- Big details can make modular assets recognisable.
- Using the same style and shapes allow you to mix your assets together.
- Using assets with bigger details sparingly decreases the repetitiveness in your scene.
- Check your scene from your players perspective to see if your scene is repetitive.
- When working with modular assets, make sure you make a few different types of the same assets (different walls, bricks etc.).

6 | ARM master material

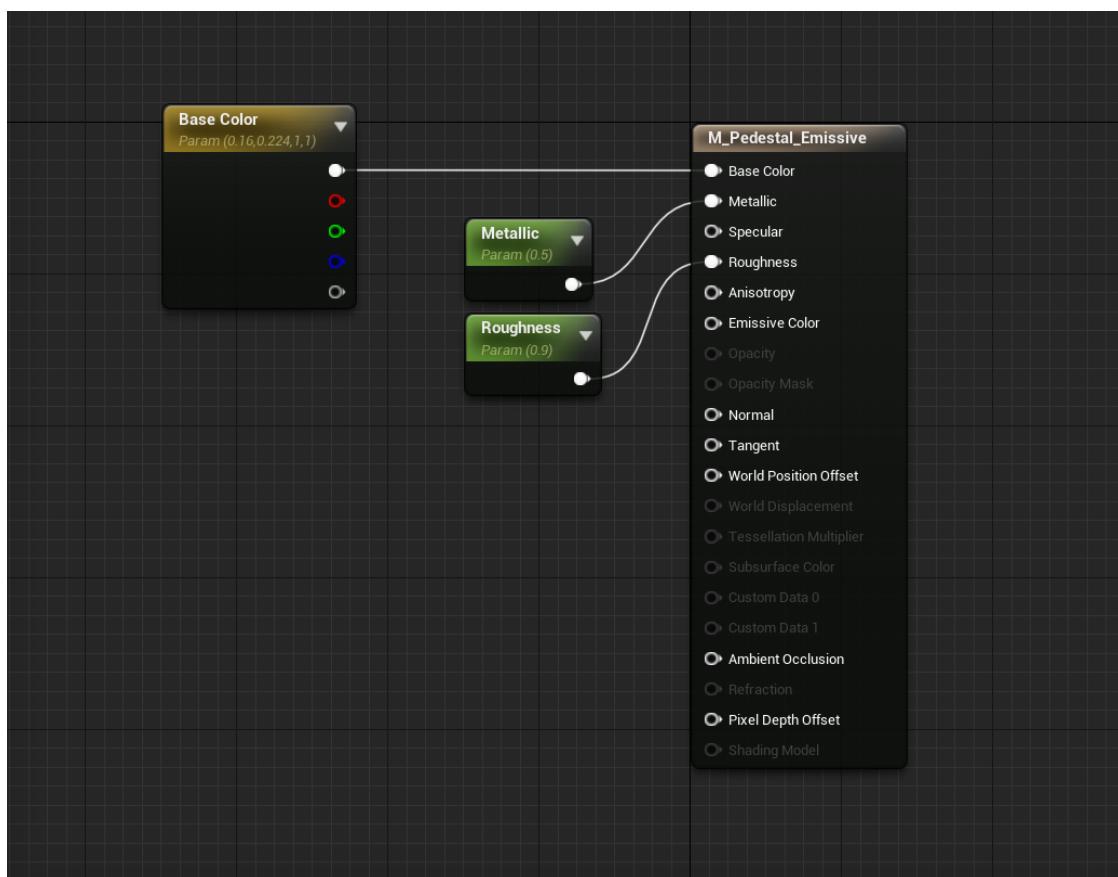
What is a master material?

An article from Techarthub (linked at the last page of the article) explains the principle of a master material really well:

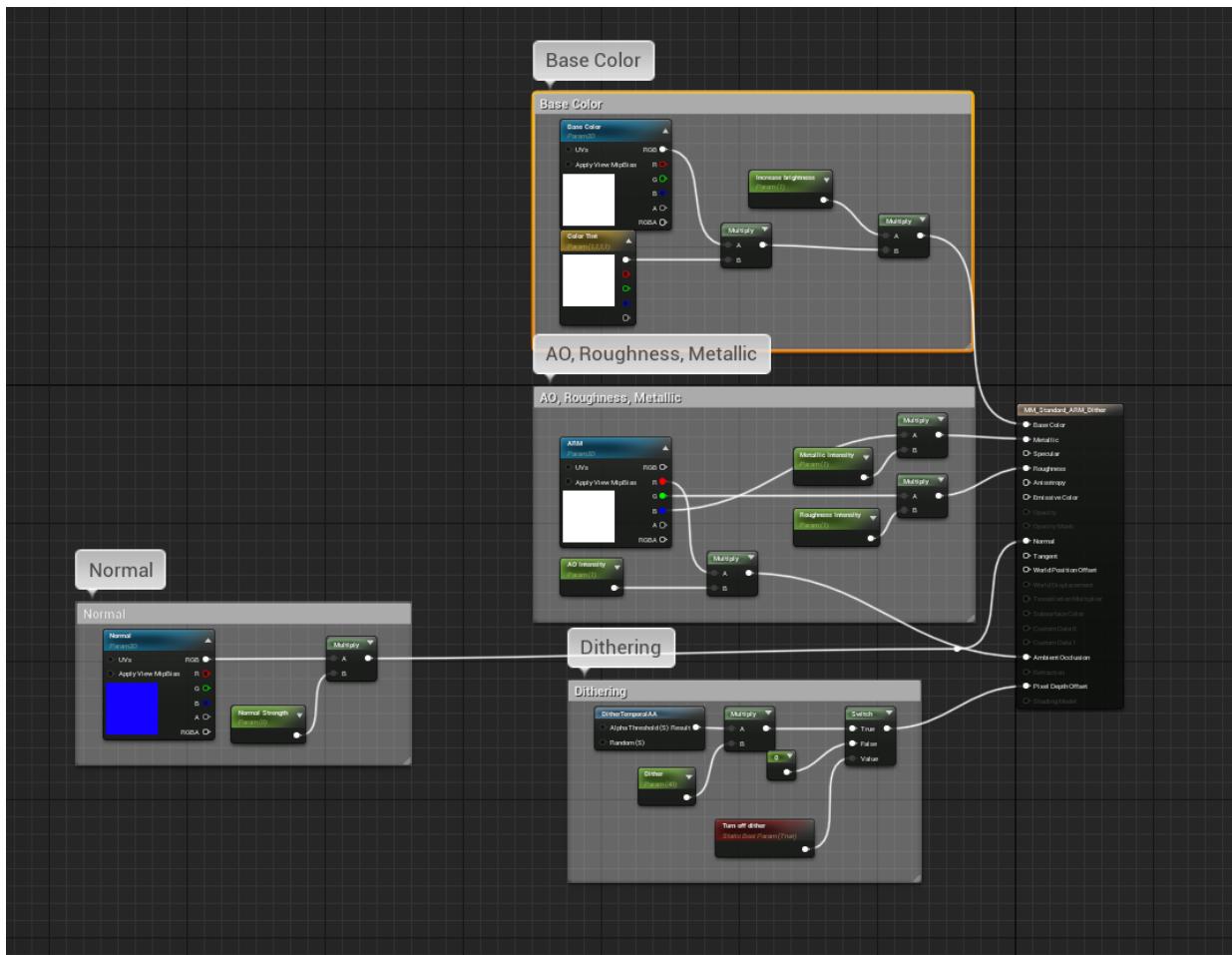
“A Master Material is a versatile Material template that utilizes customizable parameters to provide a higher level of utility than a standard Material setup. Through these parameters, an instanced Master Material can be both easier to maintain and support a much larger range of different use cases.”

What does a master material look like?

Master materials can be as complex as need be. If your project only needs a flat color and a parameter to control metallic and roughness values for your assets, your master material could be as simple as this:



However if your assets have custom maps for normals, AO and roughness or use emission, you can add additional maps. Very quickly your master material will start looking somewhat like this:



In short: a master material can be as simple or complex as your project requires.

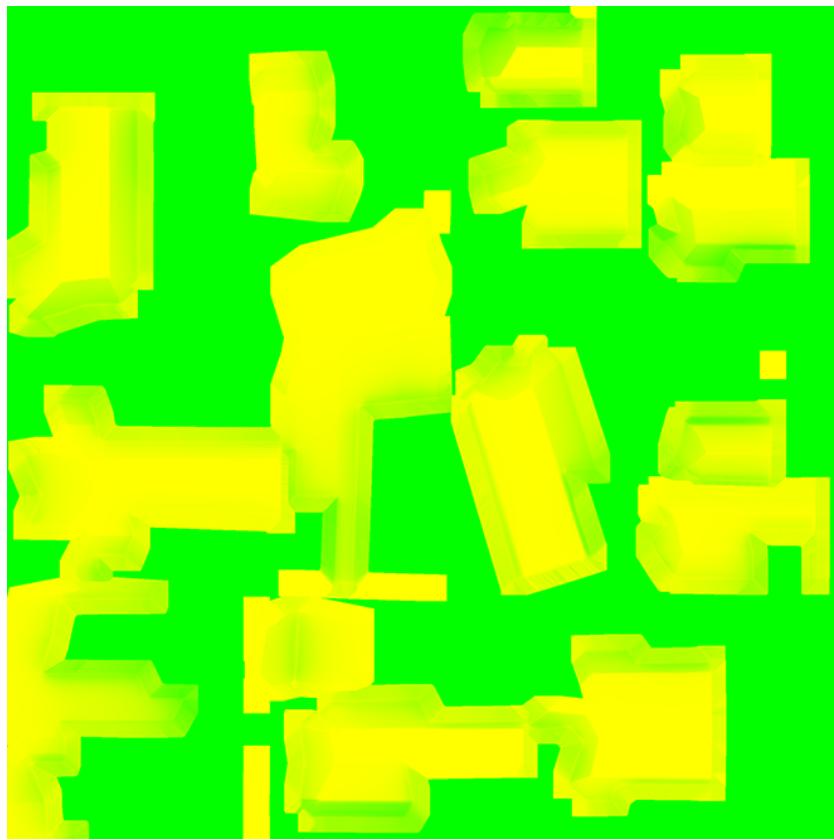
What is ARM?

I think we get what a master material is by now, but what exactly does the ARM stand for?

ARM maps are an optimisation for your assets, They consist of one texture map containing the following data:

- Ambient occlusion
- Roughness
- Metallic

These 3 maps are baked into the 3 color channels of 1 image, effectively putting 3 textures in 1. This data can then be separated in the engine and put in the respective nodes. Here is an example of an ARM map:



Why ARM?

The process of mapping textures in channels is not new and exists in many forms. MRA, RMA, MAR are all forms that are being used. But the ARM is from my experience the best one of them.

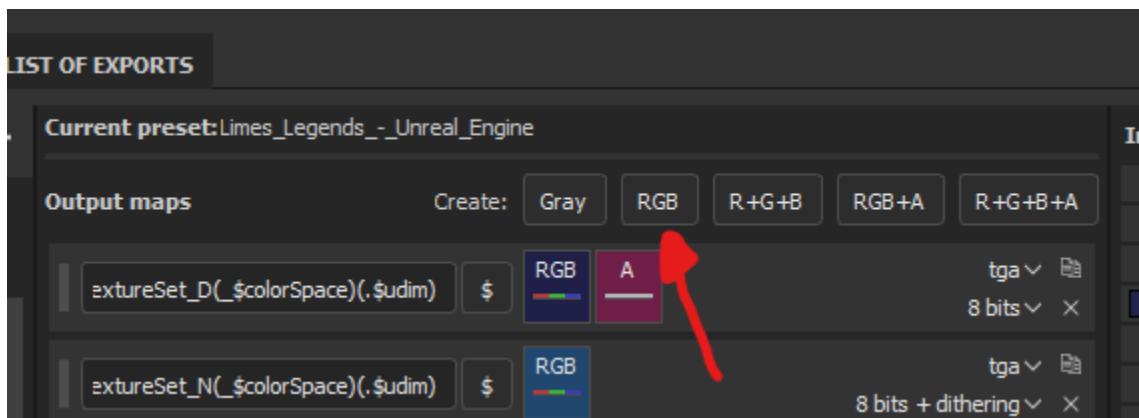
Because we are not using an alpha channel, UE4 will apply DXT1 compression to our ARM texture. Images compressed with DXT1 have a higher bitrate in the green channel (6 bits in the green channel, 5 bits in the red and blue). This is why you should put the roughness in the green channel as it contains the most detail out of the three textures.

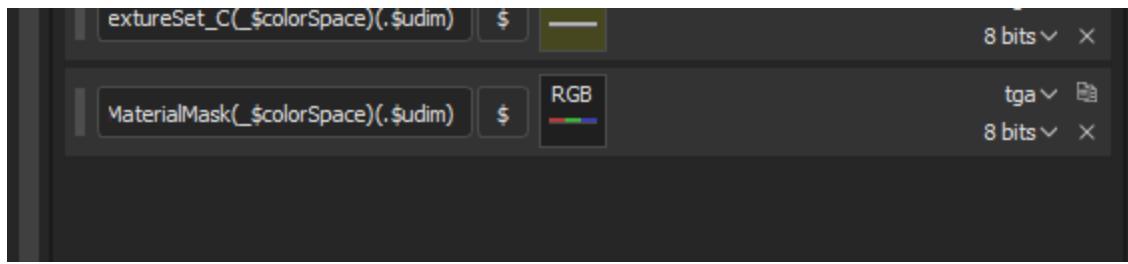
How do you make an ARM map?

In this subchapter I will show you how to set up ARM map exports from Substance Painter.

Once done with the texturing of your assets, head over to the export textures window.

Step 1: Create a new RGB output map

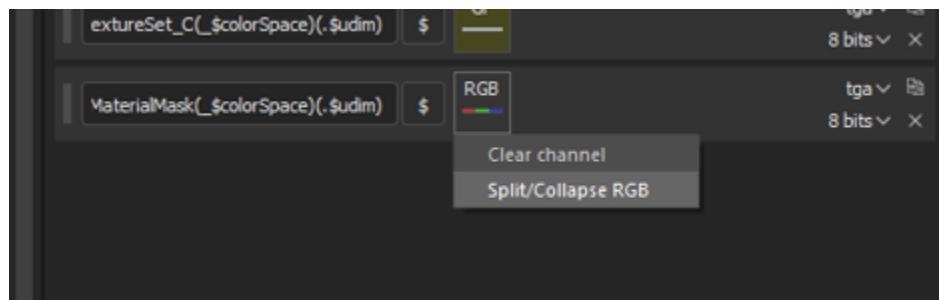




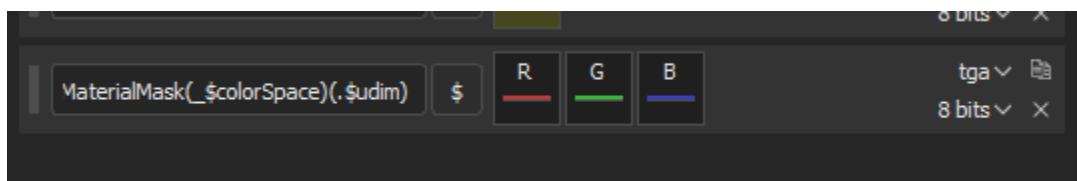
Doing so gives us a new RGB output map. Next we want to separate the RGB channels so we can put the respective maps into them.

Step 2: Separate RGB maps

Click on RGB, and then split the RGB maps.



Now that we have our RGB accessible separately we will assign the maps we want exported to them.



Step 3: Allocating input maps

Lastly it's a drag & drop process of the input maps.

Drag the Mixed AO into the red channel, the Roughness in the green and Metallic in the blue channel.

With these steps done our ARM export is ready to go! Hit export when you are done and head over to your export folder. You will now find an ARM texture there.

Input maps	Mesh maps
Base color	Normal
Blending mask	World space normal
Coat color	ID
Coat normal	Ambient occlusion
Coat opacity	Curvature
Coat roughness	Position
Coat specular level	Thickness
Diffuse	
Displacement	
Emissive	
Glossiness	
Height	
Ior	
Metallic	
Normal	
Opacity	
Reflection	
Roughness	
Scattering	
Scattering color	
Sheen color	
Sheen opacity	
Sheen roughness	
Specular	
Specular edge color	
Specular level	
Translucency	
Transmissive	
User0	
User1	
User10	
Converted maps	
1/ior	
Mixed AO	
Diffuse	
f0	
Glossiness	
Glossiness ²	
Normal DirectX	
Normal OpenGL	
Reflection	
Specular	
Unity4 Diffuse	
Unity4 Gloss	
2D View	

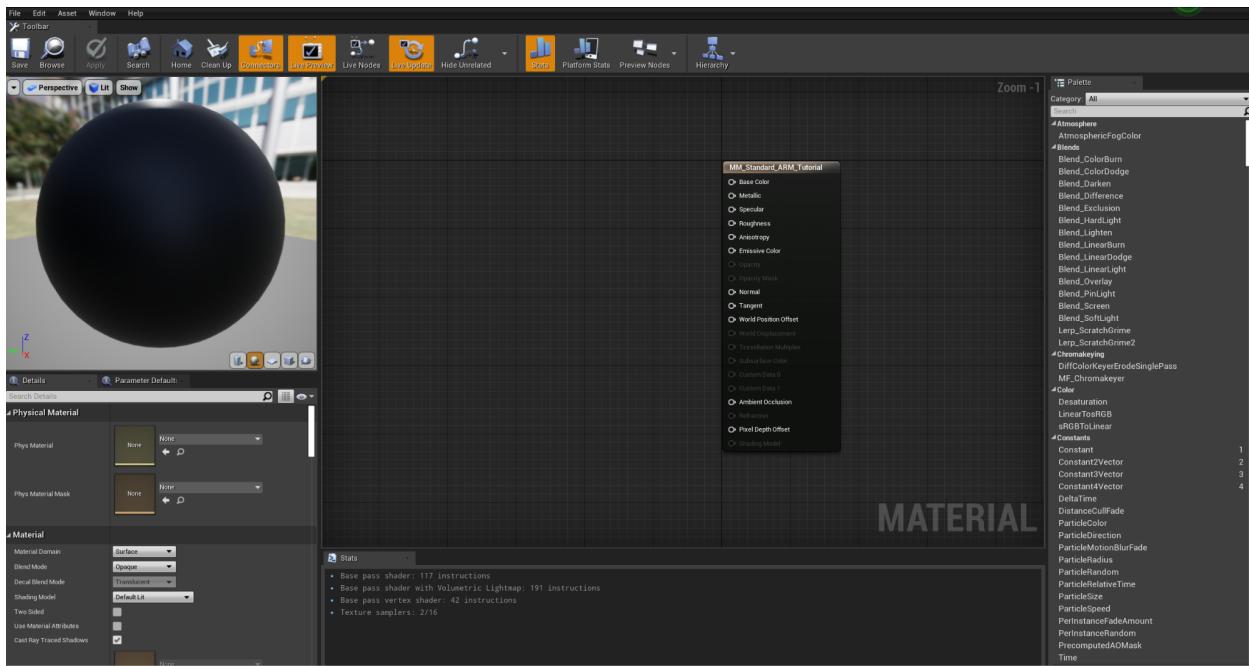
Setting up the ARM master material

Now that we have an understanding of what a master material is for and how to create ARM maps, it is time for us to set up the ARM master material.

Base Color

Step 1: Create a new material

Create a new material in your UE project, name it MM_Standard_ARM. You should be left with a screen like this:



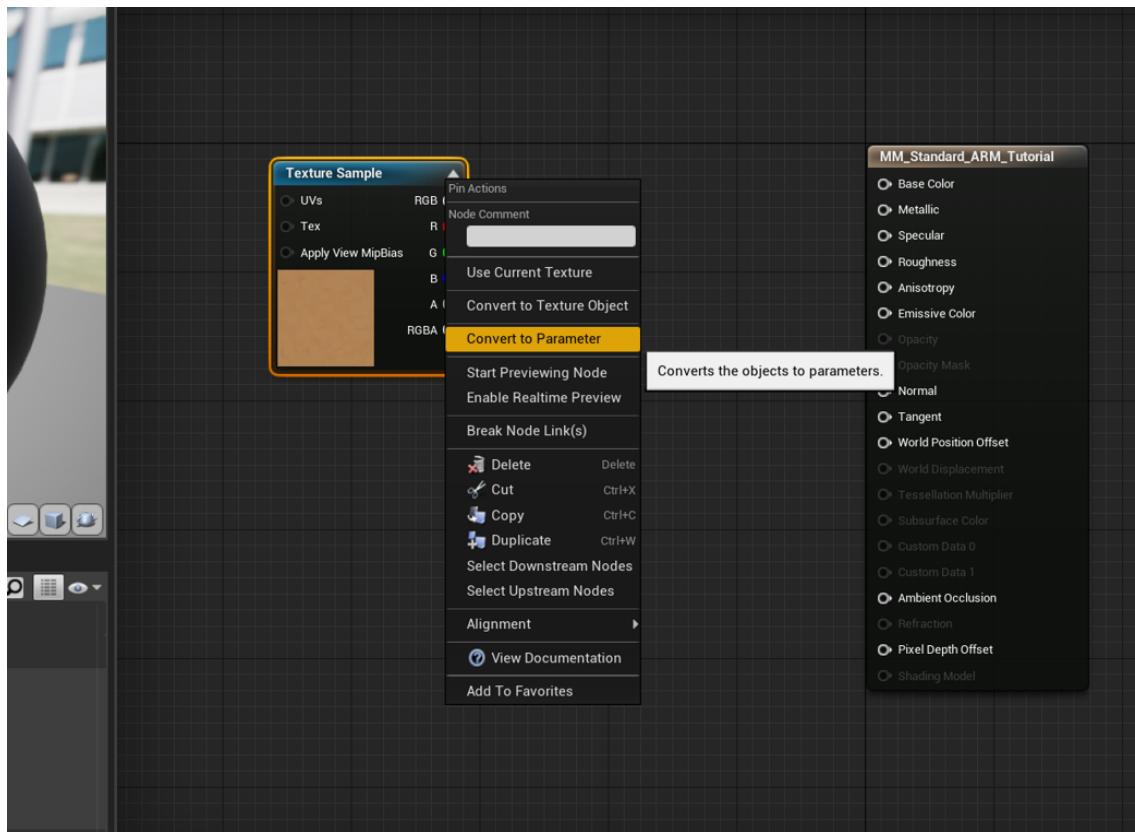
Parameters

Every asset needs a basecolor. To make our master material modular we will be turning all the things we want to be able to change into “Parameters”. Parameters allow us to change the values once we start creating instances of our master material.

Step 2: Setting up the base color

Add a “Texture Sample” to your material. The Texture Sample allows us to use a texture as an input. Next, right click on your Texture Sample, and click on “Convert to Parameter”. This, as the name suggests, turns a node into a parameter. Throughout the rest of the tutorial, if I mention converting something into a parameter, this is how it’s done.

Now that we have our Texture Sample Parameter, we want to name it accordingly so we can keep our material organized. I will go for “Base color”.

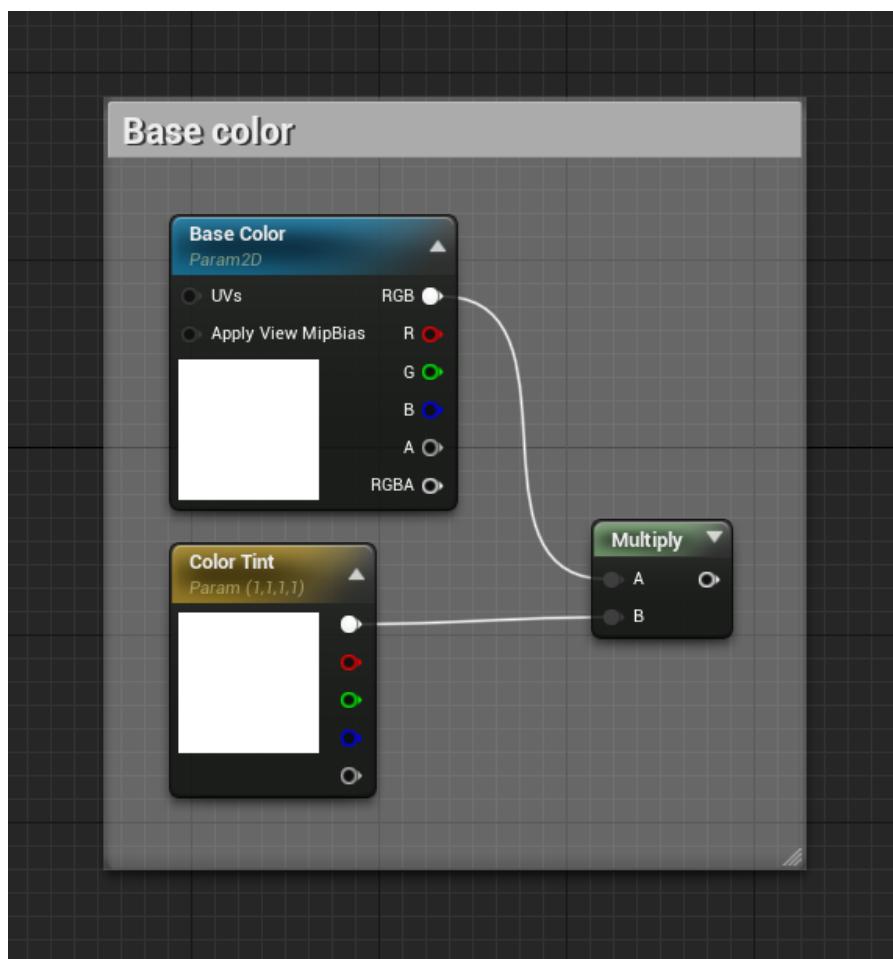


Color tint

To have a little more control over my assets I add a color tint. To give an example as to why it is nice to have this option: Let's say you have created a wall. Once you put this asset into your scene, you recognize that the color of the wall is a bit too warm. Having a color tint parameter allows you to retroactively account for that issue by using colors on the opposite side of the color spectrum.

Step 3: Adding color tint

Hold “4” on your keyboard and left click in your material window, this will create a Vector 4. Next up, convert this Vector 4 to a parameter and name it “Color tint”. Add a “Multiply”-node to bring them together with the base color going to A and color tint to B. We should be left with something like this:

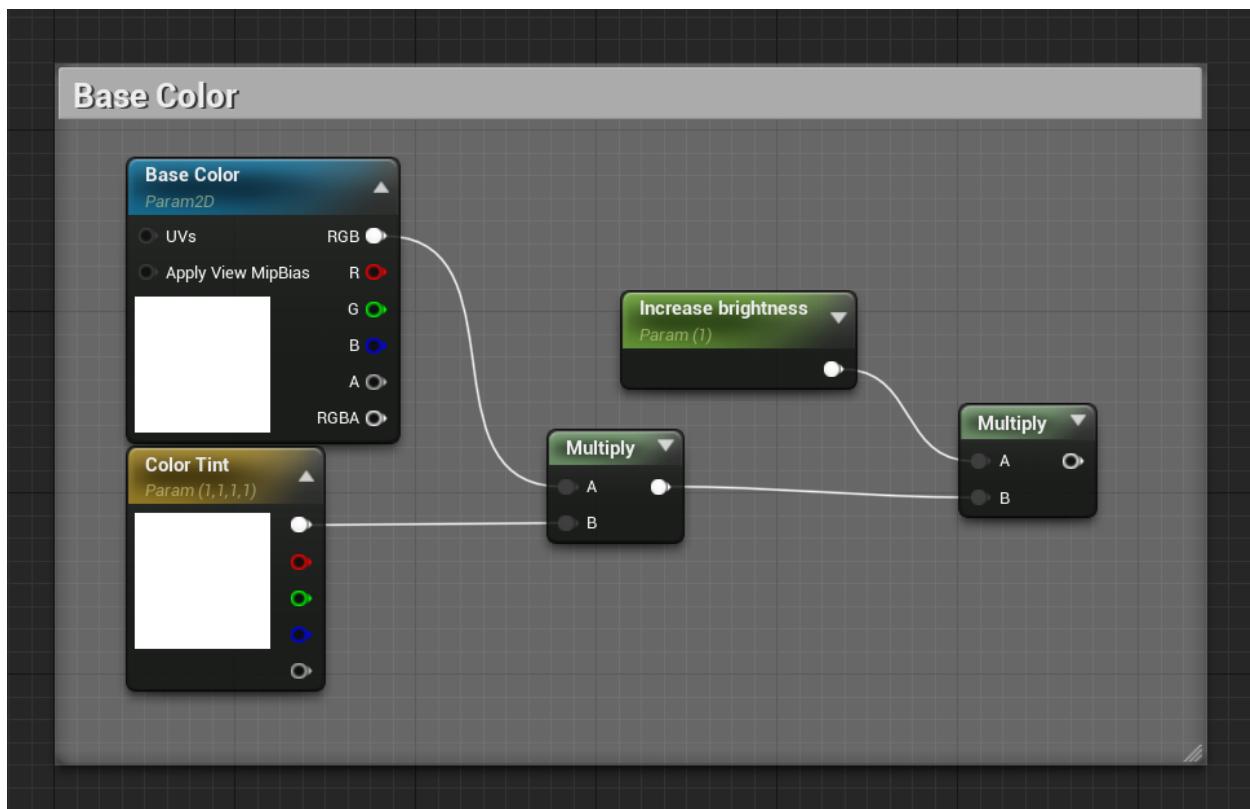


Control over brightness

What if we discover we don't want to change the color, but the brightness of our material? We can do just that by adding 2 more nodes.

Step 4: Adding brightness control

Create another Multiply and Constant node. Convert the Constant to a parameter and name it "Increase brightness". Next up plug the Constant into the A of your new Multiply and the Base Color Multiply into the B. This allows us to make the Base Color brighter or darker by multiplying it with a value. If you lower the value below 1 the material will become darker, values above 1 will make it brighter. You should be left with this:



Connect the Multiply node to the "Base Color" of the material, the first step to the ARM material is now done!

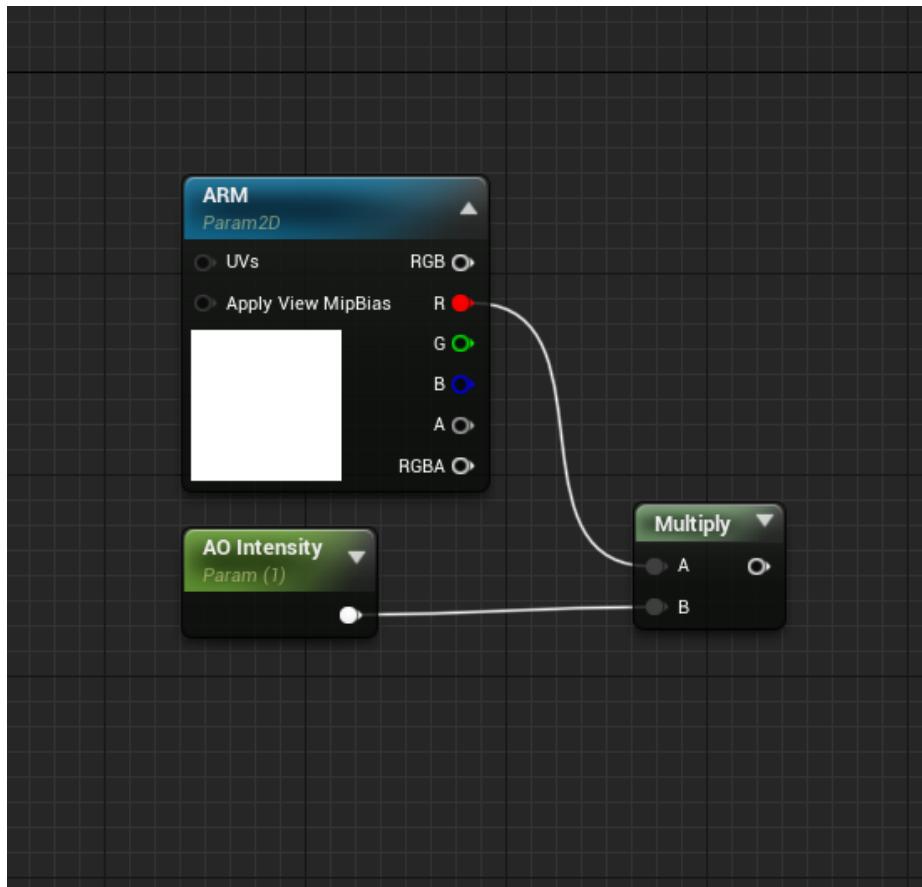
Tip

Select all the nodes you added so far and hit "C". This creates a comment box around the nodes. Doing this for all our separate functions keeps our material organized and allows us to find certain functions quickly.

ARM Input

Step 1: Ambient occlusion

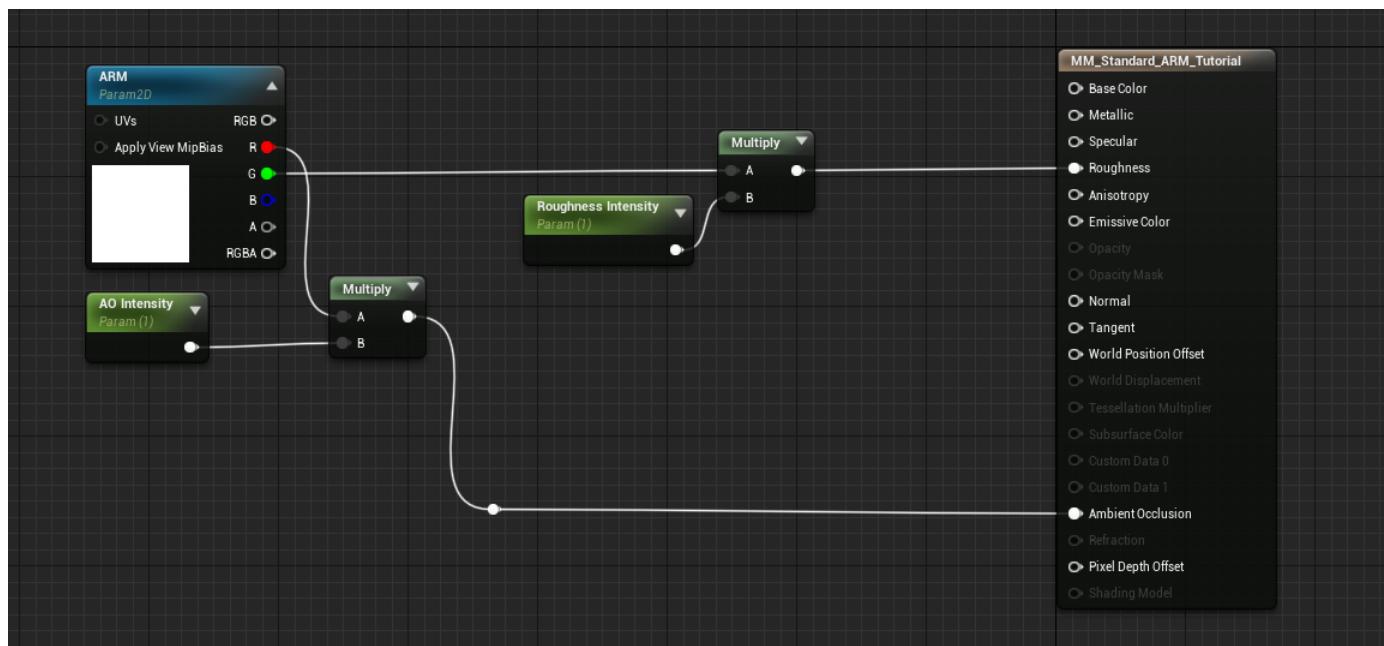
Create a copy of the Base Color Parameter you created before and rename it to “ARM”. Add another Multiply-node and Constant. Convert the Constant to a parameter and name it “AO intensity”. Connect the Red channel of the Texture Sample to A of the new Multiply and the AO Intensity Constant to the B. You should be left with this:



With the AO intensity parameter we will be able to increase or decrease the AO strength of our textures. Connect the Multiply-node to the “Ambient Occlusion” material.

Step 2: Roughness

To set up the Roughness for the master material we will start by dragging outwards from the green output of our ARM Texture Sample. Create a Multiply and another Constant which we convert to a Parameter, name it “Roughness Intensity”. Make sure the Roughness Intensity is connected to input B of the Multiply-node and the Green channel of the ARM Texture Sample to input A. Now connect the Multiply-node to the Roughness input of the Material and you are all set! You should be left with this:

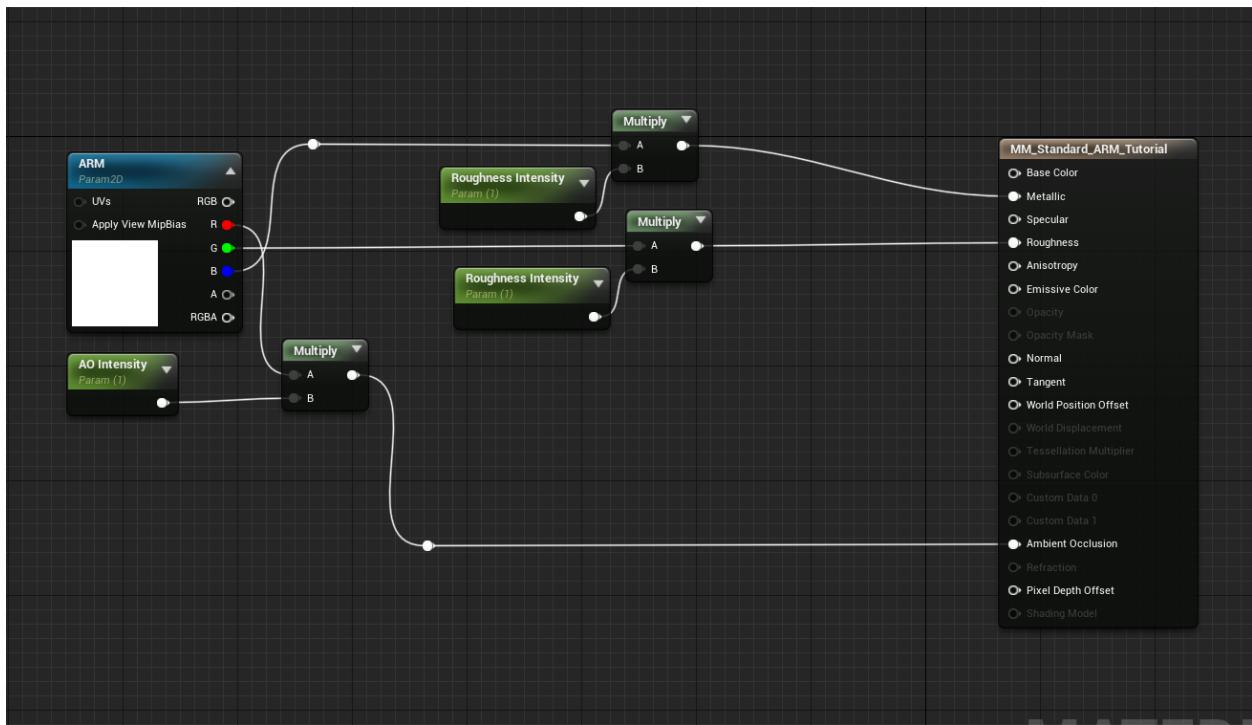


Tip

You can see how I used a small ball to change the flow of the line towards the Ambient Occlusion. Personally I prefer having the lines as straight as possible because this prevents our material from becoming, quite literally, spaghetti. To do this, hover over any line you want a point on. Then double click with your left mouse button. This will create a point which you can drag around. You can also start new node connections from there.

Step 3: Metallic

Select both the Roughness Intensity Constant, and the Multiply it is connected to. Copy and paste these two nodes and rename the Roughness Intensity copy to “Metallic Intensity”. Next, drag the Blue channel from the ARM Texture Sample and connect it to the A-input of our copied Multiply-node. Then connect the new Multiply-node to the Metallic of the material. This completes our ARM input for the material and you should have something looking like this:



The parameters we added are used to give us a lot of control over our Ambient Occlusion, Roughness and Metallic maps. To finish the ARM setup, select all the nodes except the material and hit “C” again. Change the comment name to ARM.

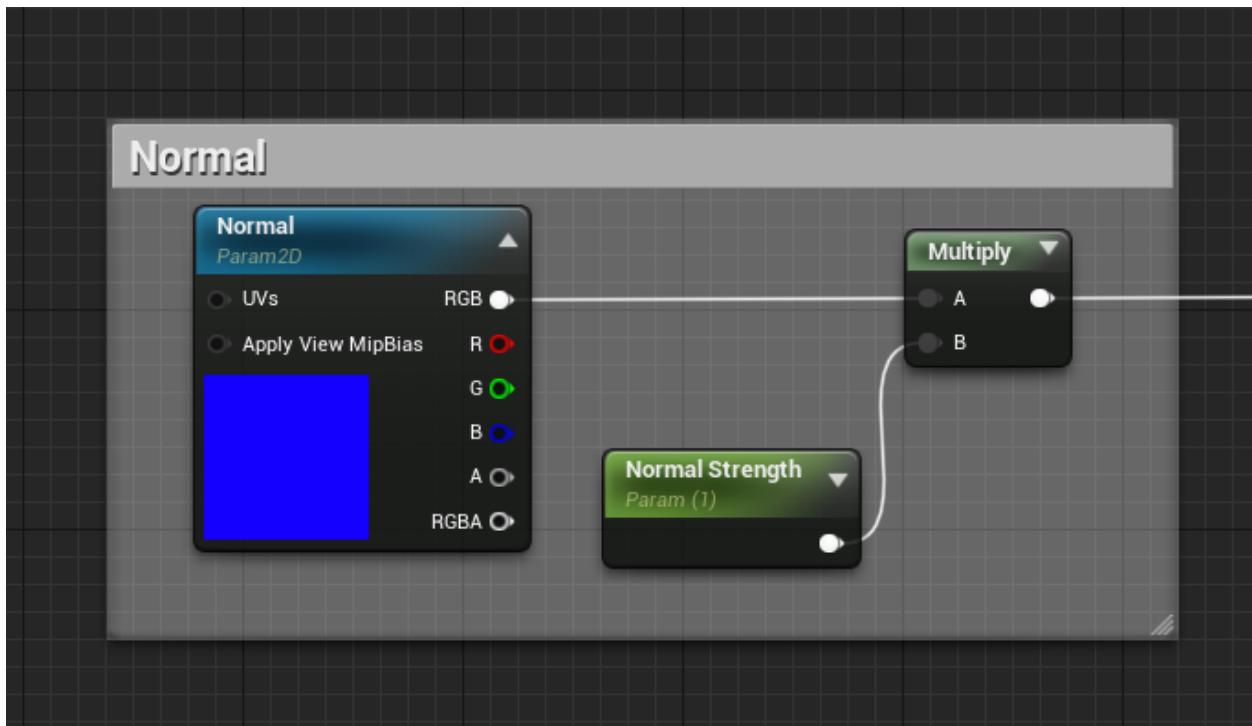
Normal map input

Step 1: Normal map

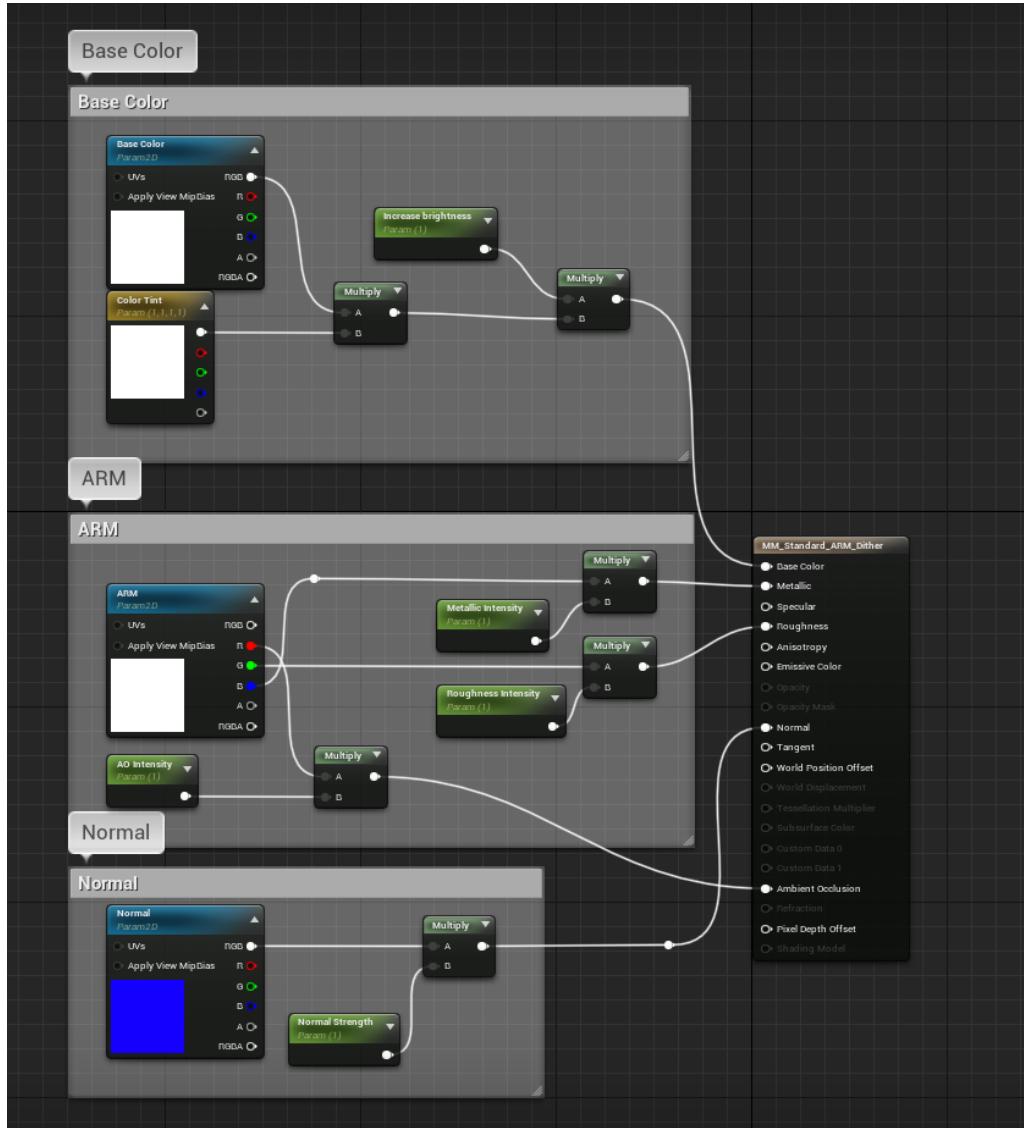
The last step for the setup of the master material is easiest, mainly because we already have set up everything we need for this.

Select the ARM Texture Sample, AO Intensity and its Multiply node.

Rename the copied Texture Sample to “Normal” and the AO Intensity copy to “Normal Strength”. Plug in the Multiply to the Normal input of the material. Select the three nodes and create another Comment, name this “Normal”.



And with that your ARM Master Material is good to go! You now have created a modular material with all the basics and lots of control. You should have something similar to the following:



Bonus

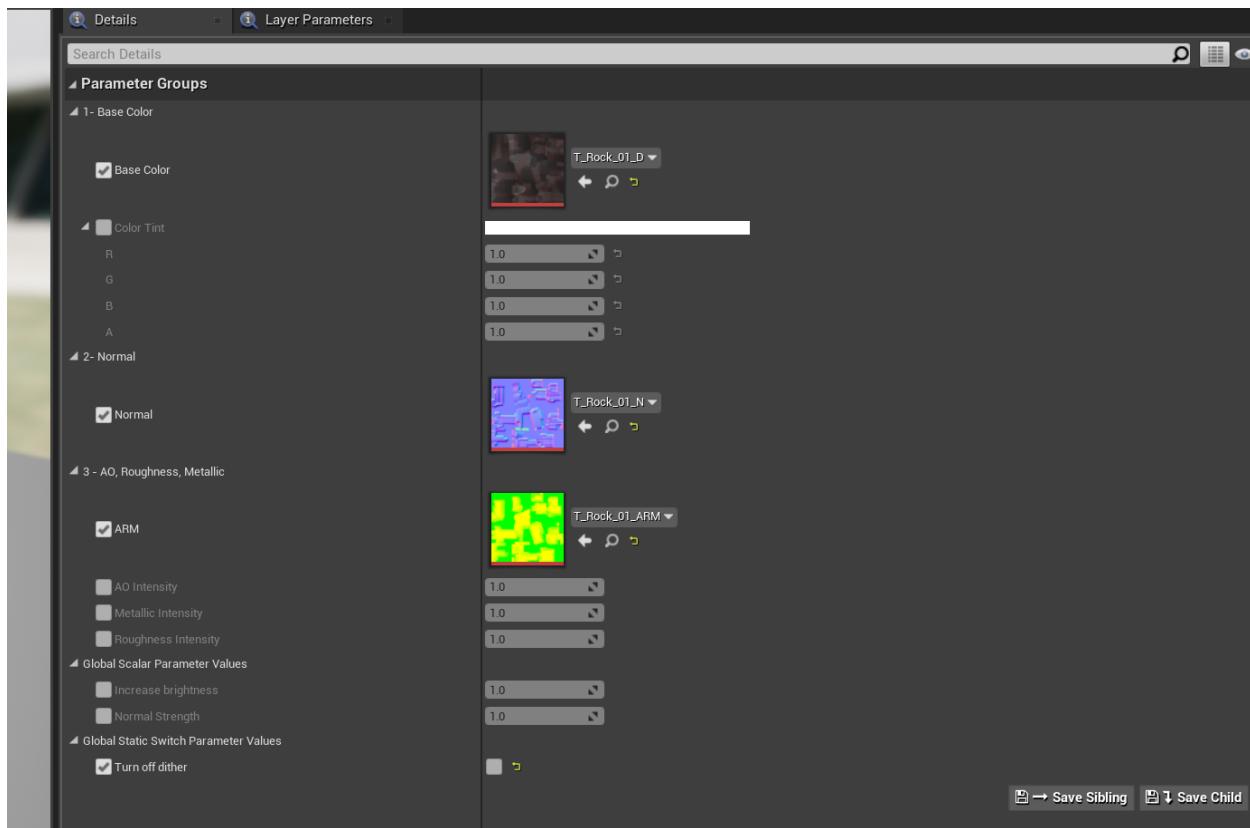
If you want to review my ARM Master Material, I have put my source files over on my drive:

<https://drive.google.com/drive/folders/1pjzWNEJJbcnivV5o60TG6dB5YBZN7LaO?usp=sharing>

If you have any additional questions, feel free to reach out to me in discord:
Stan#8364

Material Instances

Now that your ARM Master Material is set up, it is time to put it to use. If you right click on the MM in the content browser, you will be able to create a Material Instance.



If we open up the instance we will see all our Parameters return. Check the things you need, apply your textures accordingly and then apply the instance to your Static Mesh. Now if needed, you can play around with the intensity values or color tint. I would say have a go at it and see what these values do to your textures.

7 | The power of modular assets

To conclude

Modular assets can help you set up an environment exceptionally fast. To prevent the environment from feeling repetitive we need to pay attention to details. By making sure assets with bigger details are spread out and not next to each other, we can minimize the repetitiveness in our scene. Make sure you have enough assets to build with, one wall just won't cut it. Pay attention to the players' perspective when Set Dressing and block out any noticeable details if they become repetitive.

That's it for this article! I hope this article has brought you some new knowledge or gave you some useful insights.

A few links to articles and videos that helped me during my process:

[Anatomy of an UE master material](#)

[Understanding story setting](#)

[Modularity in Game environment](#)

[What is shape language?](#)