



Material Pipeline



So I think we developed a lot of cool tech and pipelines on this project, but I 'd have to say one of our biggest successes was our material pipeline.

We put this concept in motion almost at the very beginning of the project, and it was a very different way of approaching things at the time. The end result helped improved the quality and consistency of visuals of the entire game, all while slashing content creation time to a fraction of more traditional techniques.

Material Pipeline Goals

- Small number of templates drive shading response of entire game
 - Unbroken inheritance chain to a per-pixel level

Cutting Resources across The Sims 4 and Related Products of The Sims 4 Inc. | September 2015

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So just to touch on a few general goals.

[CLICK]

First off, we wanted to a pipeline where the smallest number of artist created templates could drive the shading response of the entire game, down to every pixel in a material.

[CLICK]

Material Pipeline Goals

- Small number of templates drive shading response of entire game
 - Unbroken inheritance chain to a per-pixel level
- Faster, better, and cheaper texturing process
 - Do away with unintuitive texture map authoring
 - Make high quality materials easily reusable
 - Optimized, fixed cost for any shading representation

Cutting Resources across The Sims 3 and The Sims 3: Pets Art and Technical Pipelines of The Sims 3 Team | September 2010

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And we wanted to radically improve the texturing process.

Personally, I feel like creating shading utility maps, such as roughness, fresnel intensity, and specular is not a process that is very suited to a hand authored texture. An artist can make any one asset look great in isolation, but throw a much larger team into the mix, all authoring their own textures from scratch, and you will get a pronounced consistency and quality drift as production scales up.

To me an ideal system is where an artist can indicate:

‘I want metal here, it’s tarnished here, and dust builds up here’

It still is a highly creative process, just a little more intuitive than manipulating pixel intensities in a map

Material Templates

Template Guidelines

- Defines clinical shading response only
- Never used directly in game
- Can be maintained by a single artist



So how did we solve this problem?[CLICK]

First we setup rules for a database of material templates.

So, to us, templates only define clinical shading response of researched materials. We would put some basic color and spec maps on them for a baseline, but there was no artistic variation introduced to these.

[CLICK]

Templates would never go directly into game in any form. You'll notice a cross bevel in the normal map material of all of our templates. This insured that no artist would accidentally use them on a game asset.

[CLICK]

Material Templates

Template Guidelines

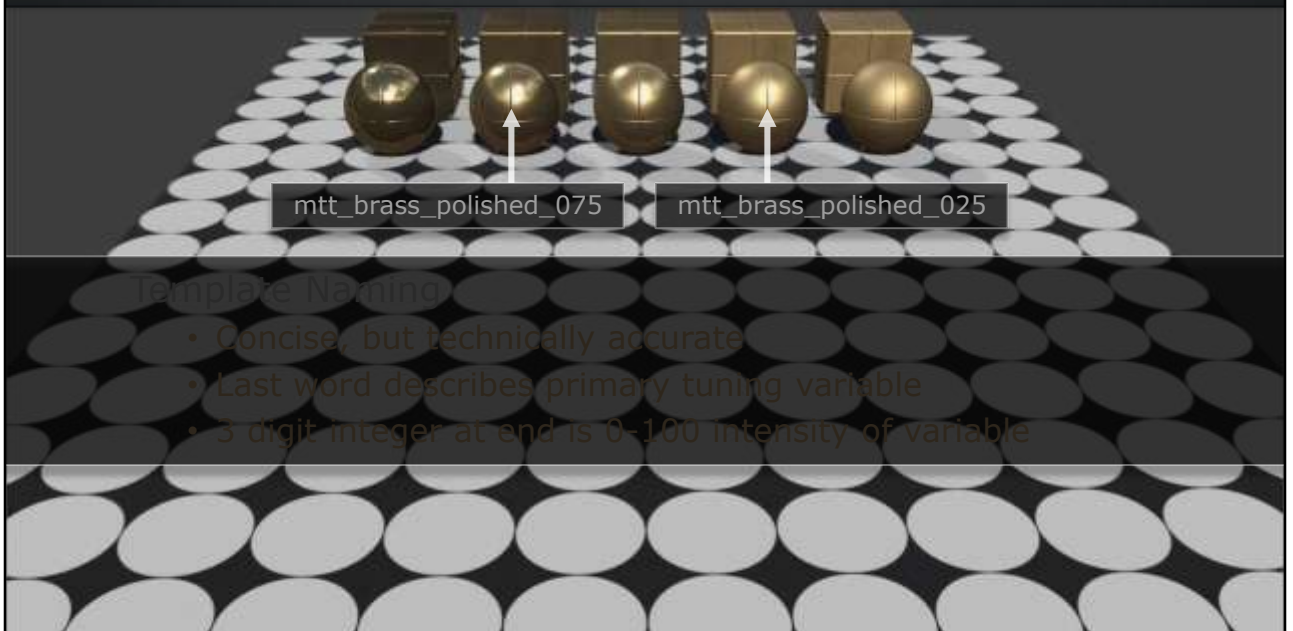
- Defines clinical shading response only
- Never used directly in game
- Can be maintained by a single artist



Lastly, templates were only maintained by one artist for shading consistency. With how our system worked, early on this was even manageable for me as a small part time job, and later, the same for Scot, when he took over as shading and texturing lead. This gave him plenty of time to spare, so we made him solve our character hair pipeline. Just to keep busy.

At any rate, sticking to these rules allowed us to rebalance the shading response of every pixel of every material in the entire game in a few days. It is not something I would recommend doing in the last week of production, but it is conceivably possible. But still stupid.

Material Templates

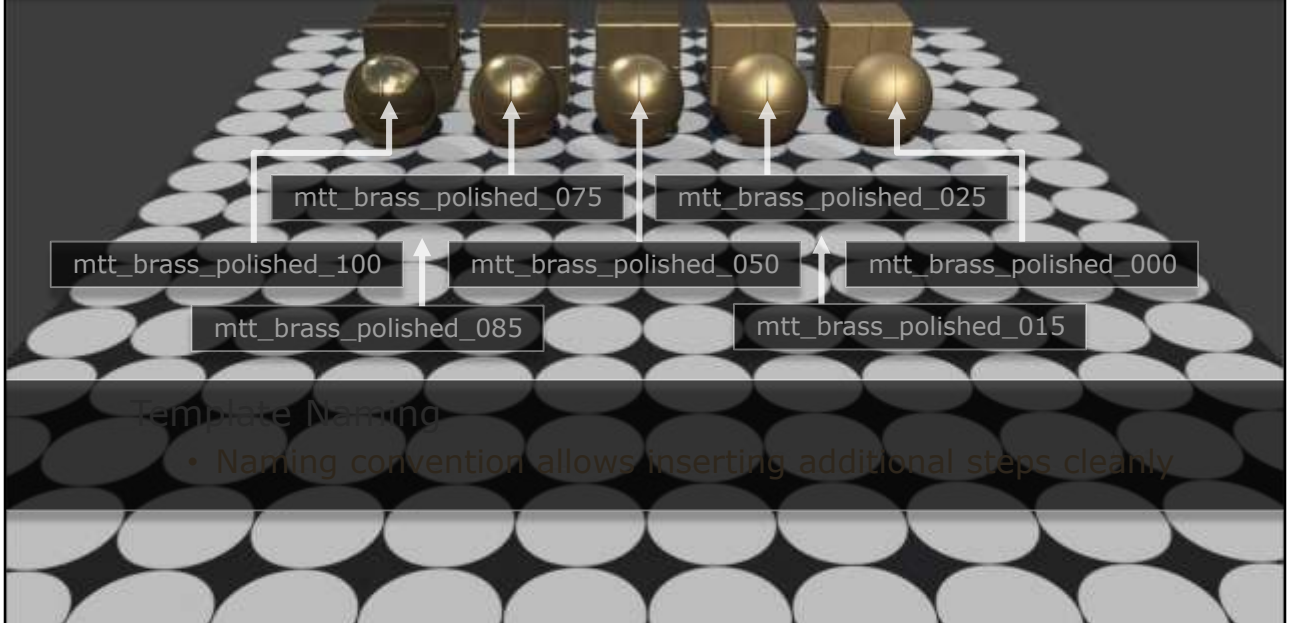


This slide here shows how we standardized naming of materials. We made sure every name was concise, and relatively accurate to the actual material. Any garbage name like 'shiny metal' would instantly be tossed out of the library.

The last word would be the modifier of the base type, generally some form of entropy like degree of polish on metals.

At the very end would be a 3 digit integer to integrate the scale of this modifier.

Material Templates

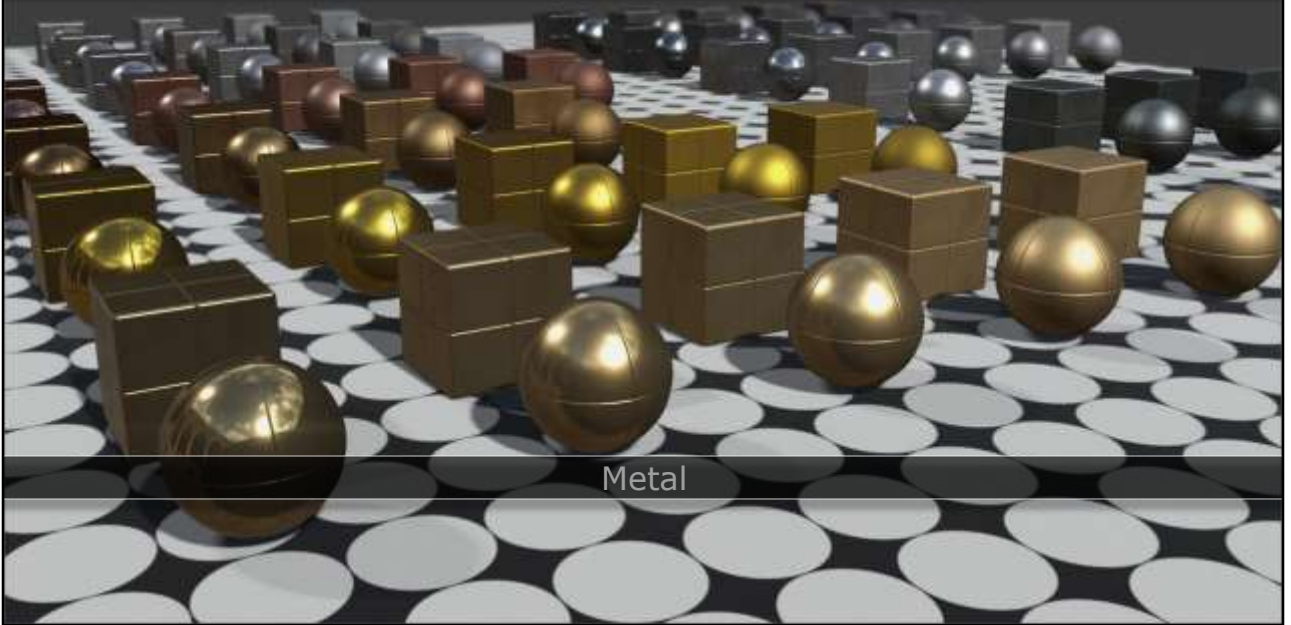


This was actually extremely helpful, as it allowed us to start with a small scale of variants, and insert additional steps as needed, without renaming materials or causing unexpected surprise other artists using the existing templates down the chain.

For this reason we never started with extremes. Generally 075 and 025 would be the baseline. **[CLICK]**

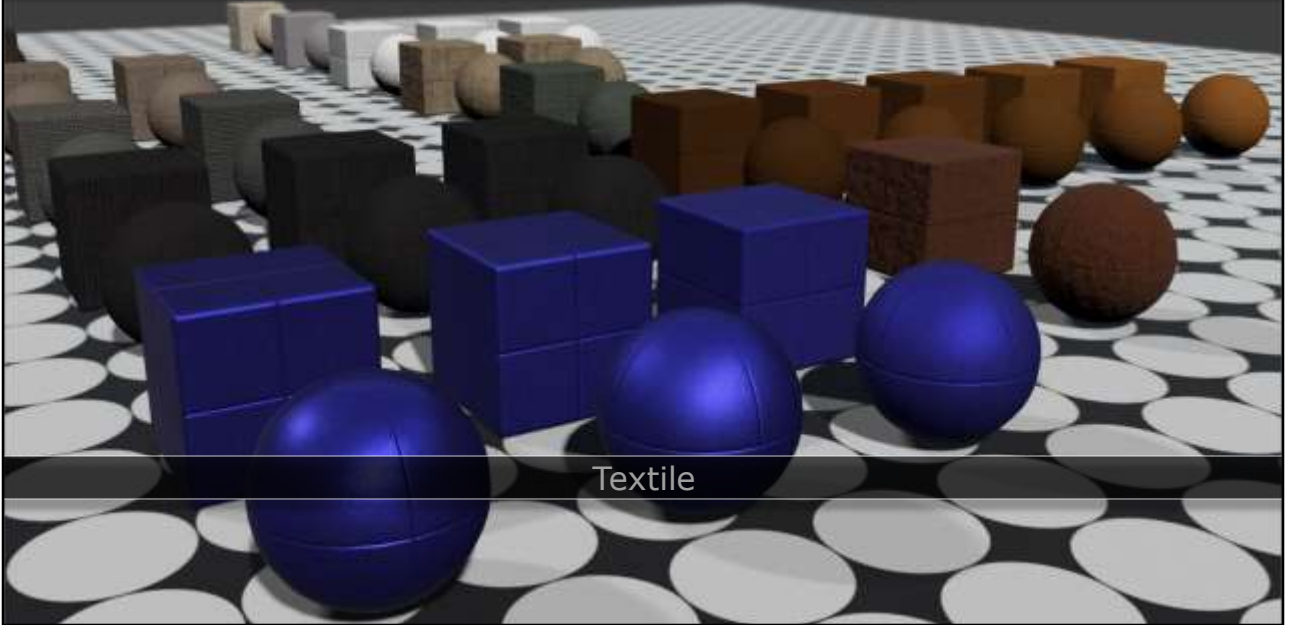
This left room to push above, below, and insert additional steps in between, if needed.

Material Template Samples



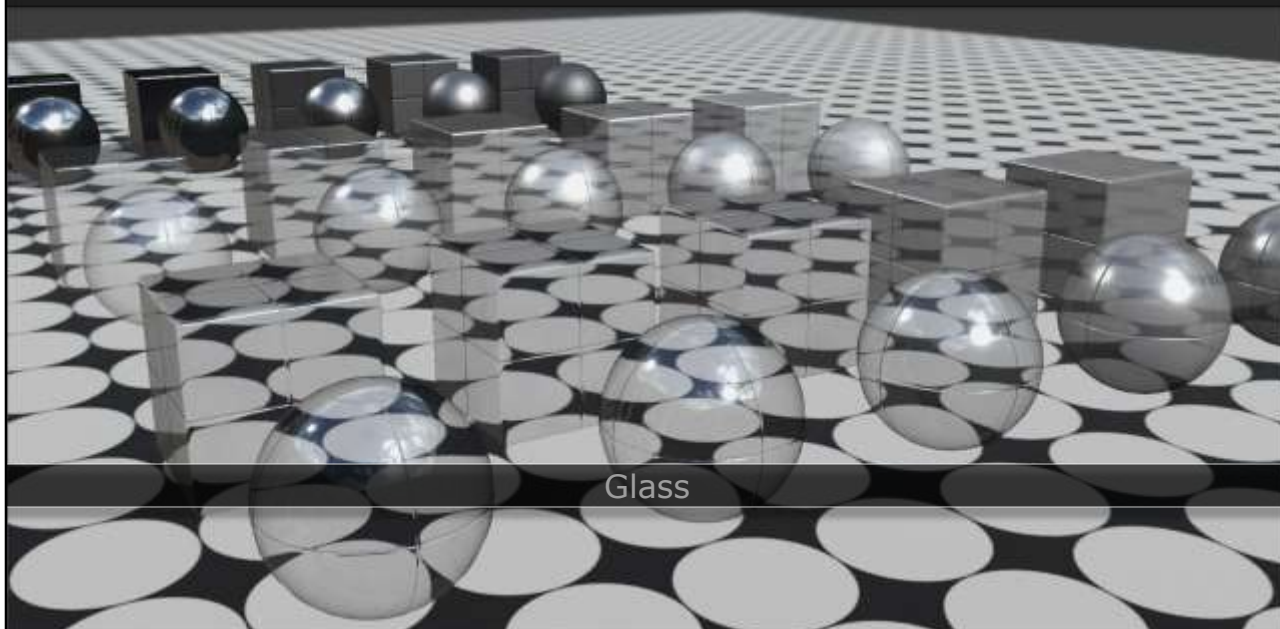
I'll just quickly flip through some template samples here. First up is a subset of our metals.

Material Template Samples



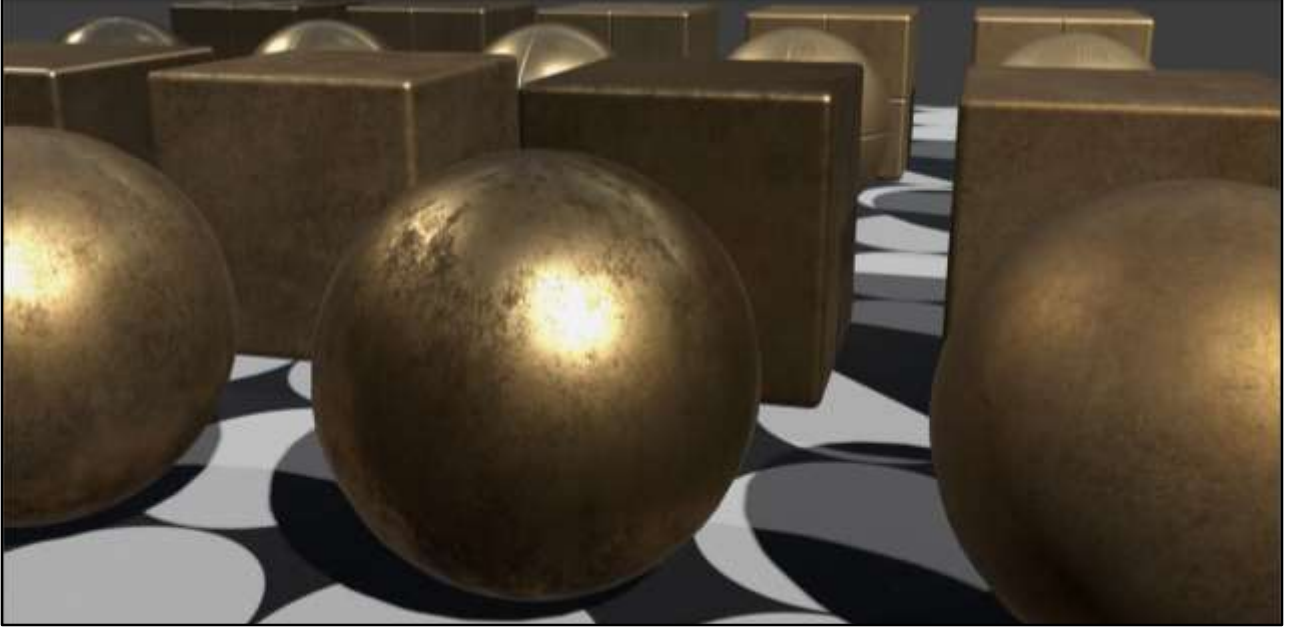
And textiles

Material Template Samples



And glass

Common Materials



So this then leads us to our common material library, which is the first stage where artistic variation is introduced

Common Materials




Brass Templates

Brass Commons

Common Material Guidelines

- Authored by the environment texture team
- All shading response from templates
- Still not used directly in game!



mat_brass_common

mat_brass_templates

These common materials are the responsibility of the environment texture team
[CLICK]

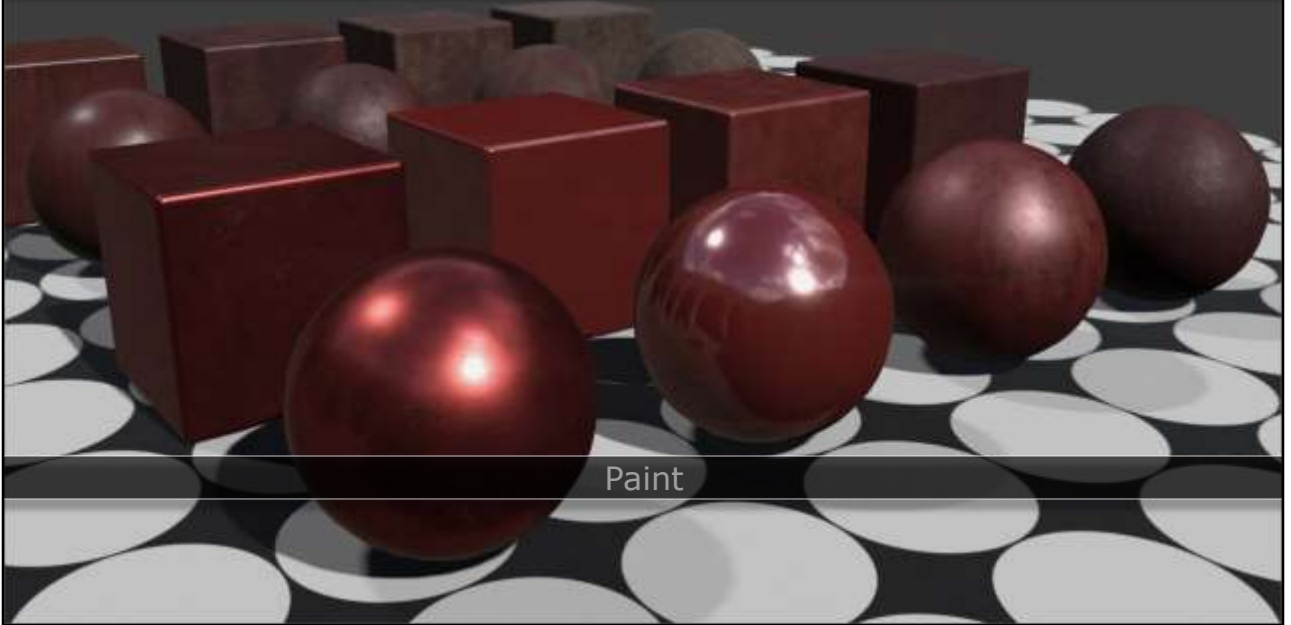
Common materials are still not used directly in game.
Even if a particular environment could use a certain common material, as is, the artist would still inherit to a level version.
This is helped us audit memory and material usage. It also allowed the texture artist to tweak the level version to suit their purposes, without disrupting other people that might be branching off from the same common.

Common Material Samples (Surface Studies)



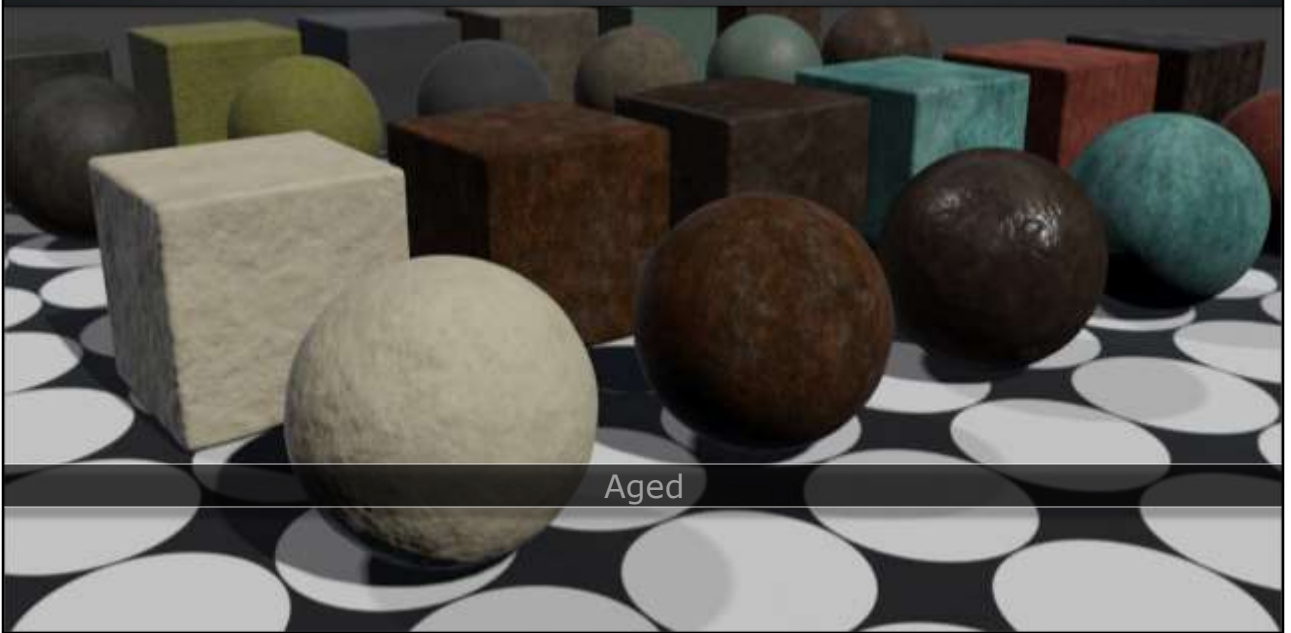
Here are some quick examples of common materials. First a few simpler ones such as metals

Common Material Samples (Surface Studies)



And various paint coatings, from shiny metallic, to lacquers, enamel, oil, etc, including various stages of wear

Common Material Samples (Surface Studies)



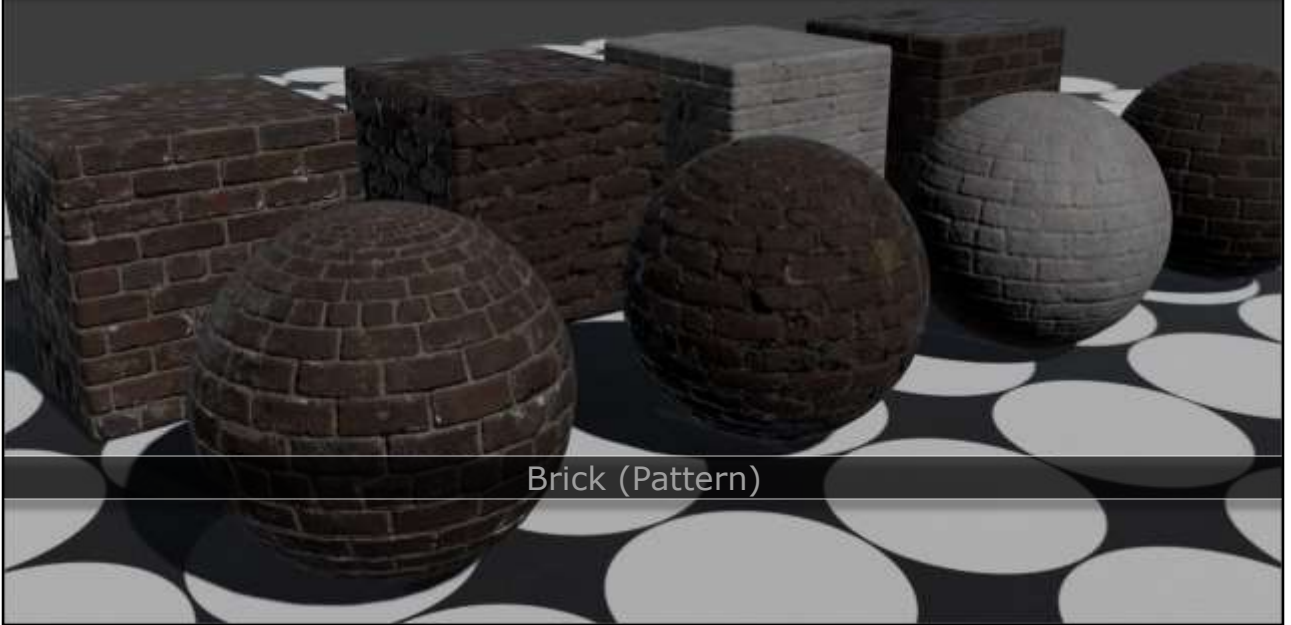
This is a sample of our aged common categories. These include tiles of various weathering ingredients such as dust, dirt, mud, rust, oxidation, and tarnish. They come in many more types and color variants than pictured here.

Common Material Samples (Sculpted Patterns)



The next two examples show sculpted pattern common examples. Such as ceramic tiles pictured here.

Common Material Samples (Sculpted Patterns)



And the bricks here. The bricks are a nice example as well, as they show how we separate components in our material studies.

[CLICK]

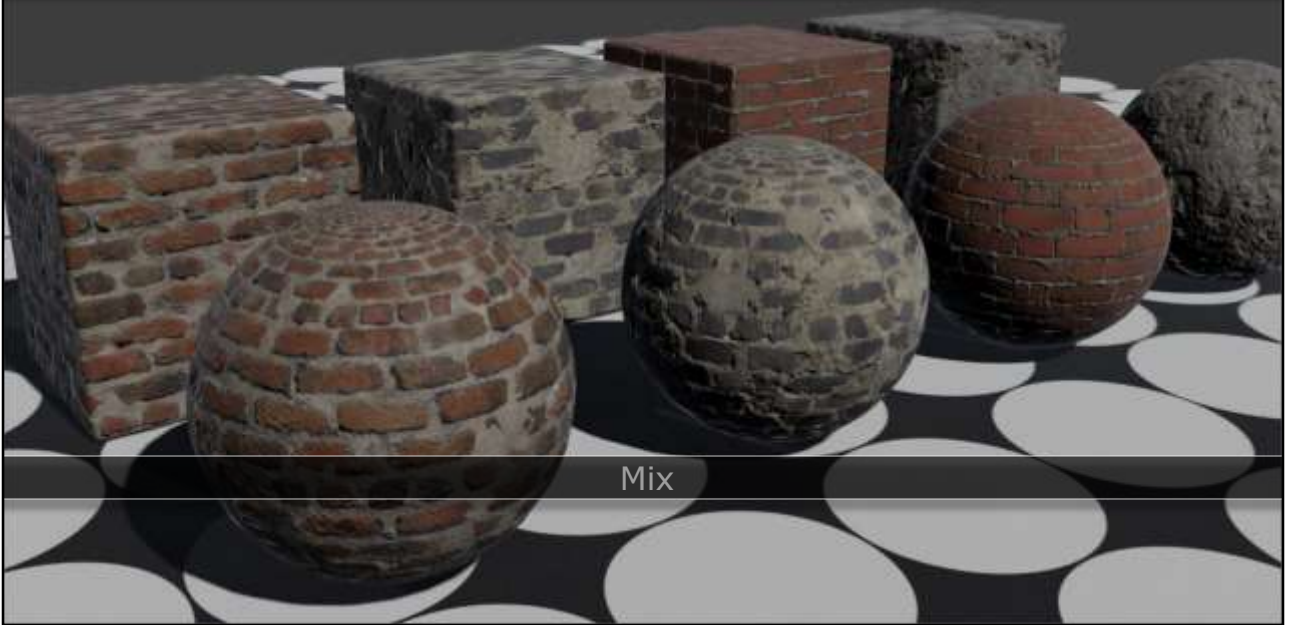
Here are a few more pure brick patterns.

Common Material Samples (Sculpted Patterns)



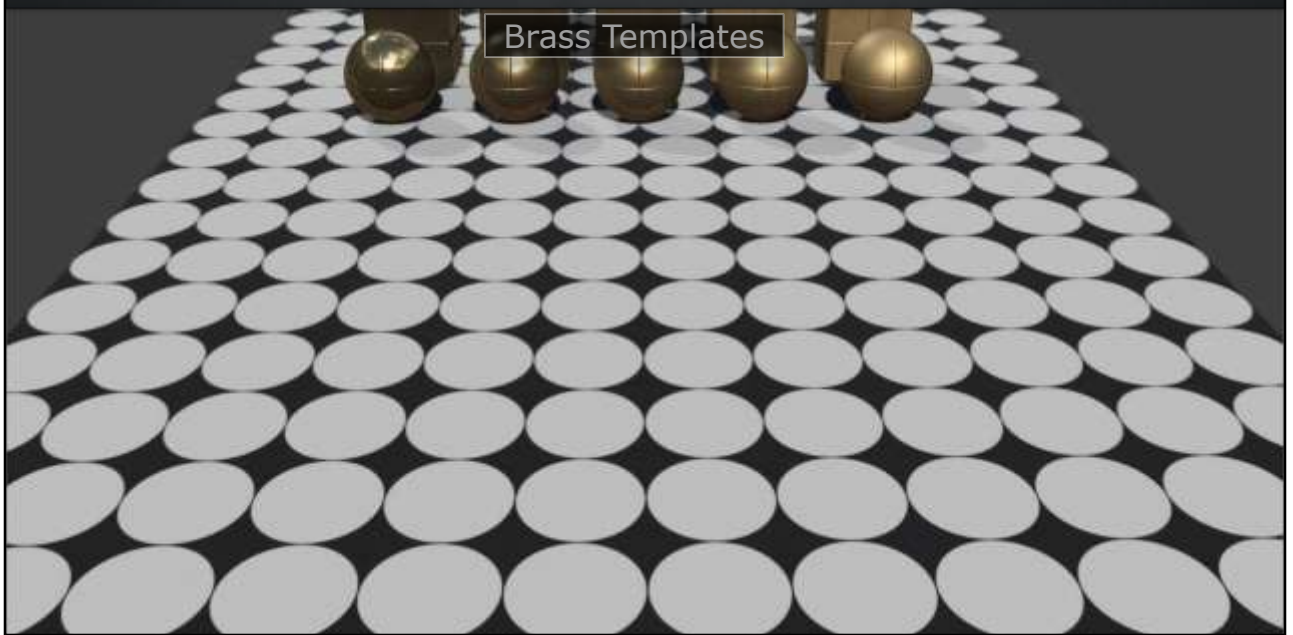
And here are pure studies of mortar

Common Material Samples (Sculpted Patterns)



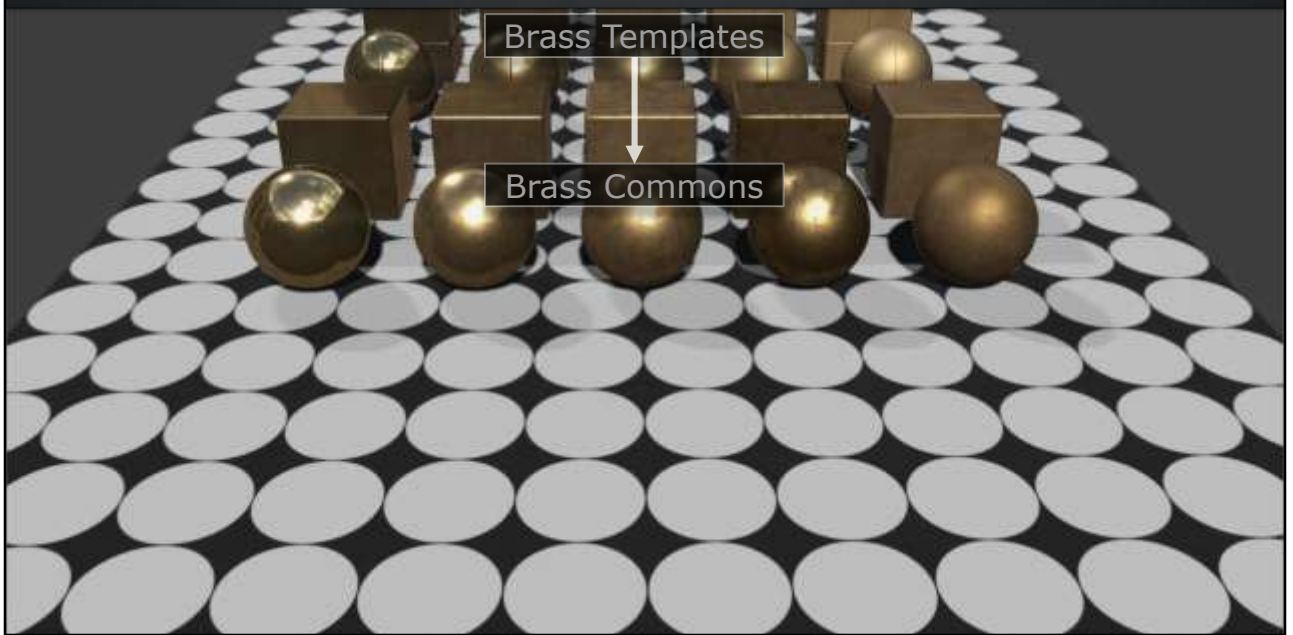
Either ingredient can be used in on it's own, but even better, can then be mixed together without making a unique material from scratch.

Material Pipeline Hierarchy



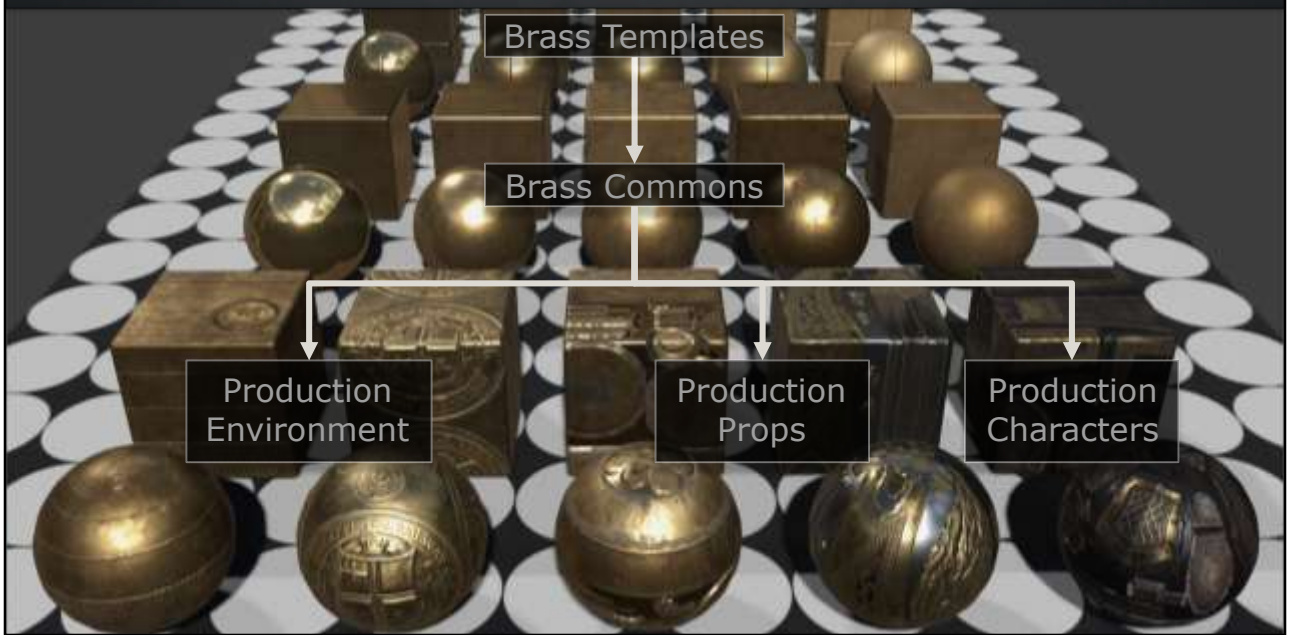
So going back to our material hierarchy overview, you can see how starting with the templates

Material Pipeline Hierarchy



We can author a far larger database of artist commons

Material Pipeline Hierarchy



Which then in turn are used to composite every single, environment tile, prop, and character material in the entire game.

Material Pipeline Hierarchy

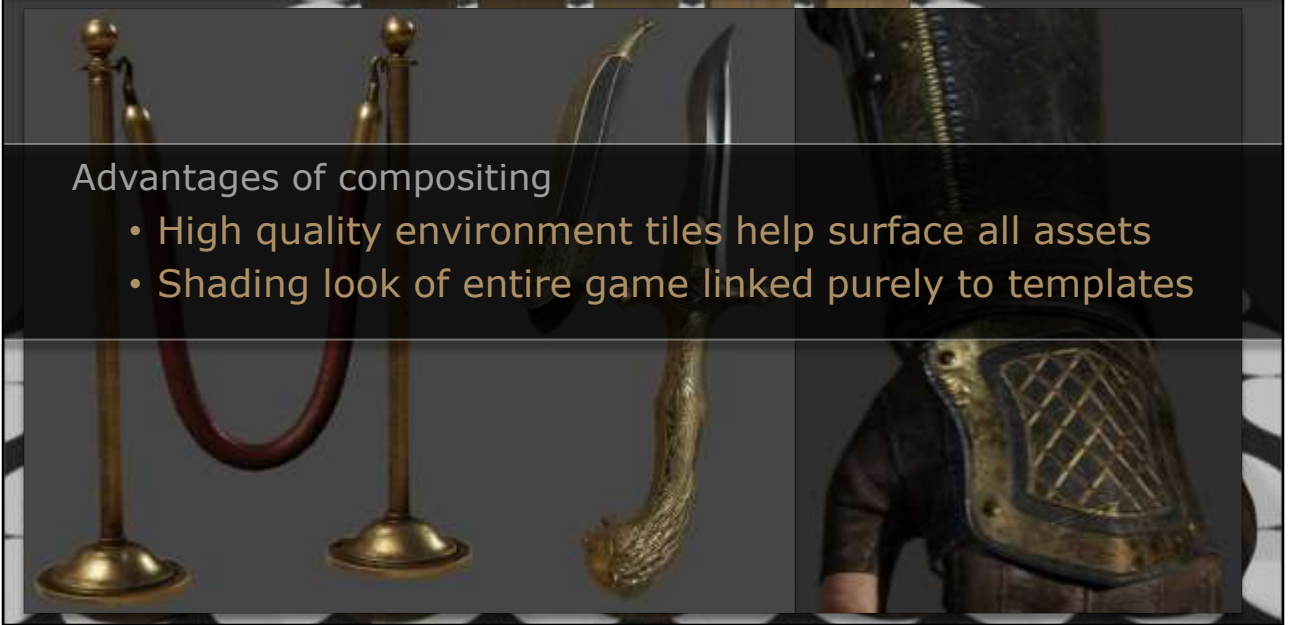


Here are a sample of a few props and character costumes, surfaced by compositing commons, and by way of the commons back through the material templates

Material Pipeline Hierarchy

Advantages of compositing

- High quality environment tiles help surface all assets
- Shading look of entire game linked purely to templates



This is incredibly powerful, as all of our environment texture team's efforts in crafting really refined tiling materials actually helps surface the entire game.

And our inheritance chain all the way back to the small set of templates also remains unbroken. Even down to every material pixel in the game.

Say we found we needed to rebalance the brass templates a little bit, changes to five simple materials would automatically pipe through to each brass derived pixel in this stanchion, blade hilt and bracer material.

Run-time Material Layer Blending



Base layer_Stone floor:

Cutting Room: Inside the Unreal Engine Art and Technical Pipelines of The Stone Isles | September 2019

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As an example, Starting with Base Layer of Stone Floor **[CLICK]**

Run-time Material Layer Blending

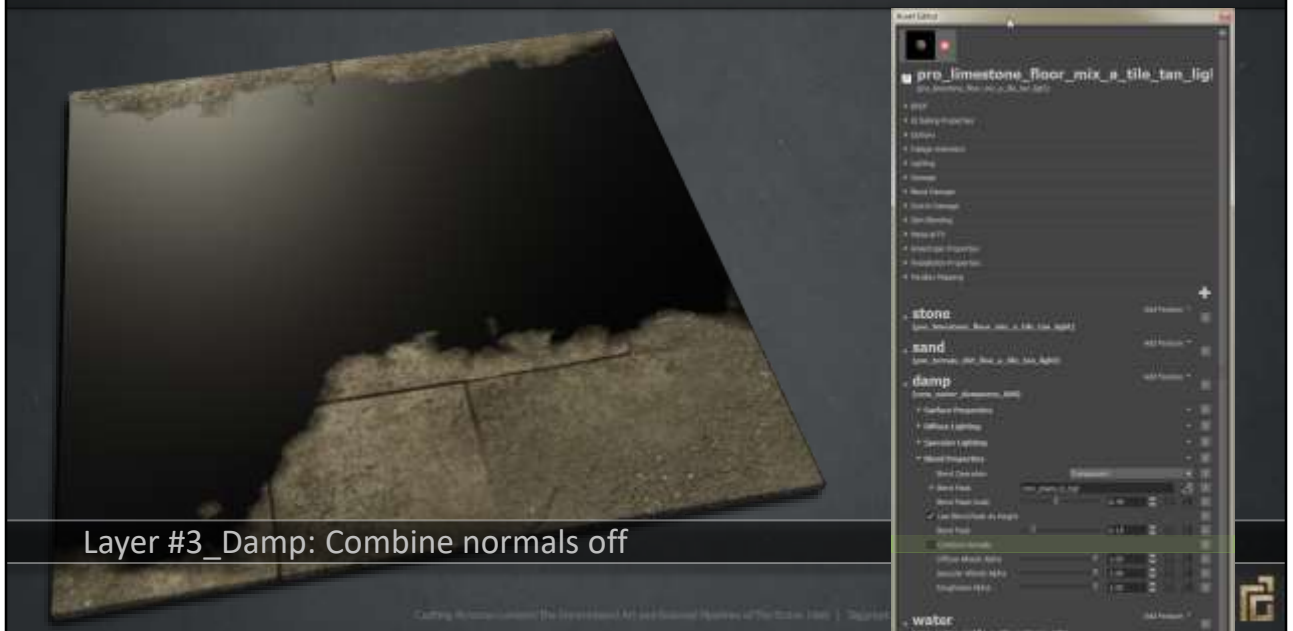


Layer #2_Sand: Basic height blend

Second layer
Sand

Basic height blend. **[CLICK]**

Run-time Material Layer Blending



Third layer
Dampness

But in this case I don't want to overwrite the underlying layer **[CLICK]**

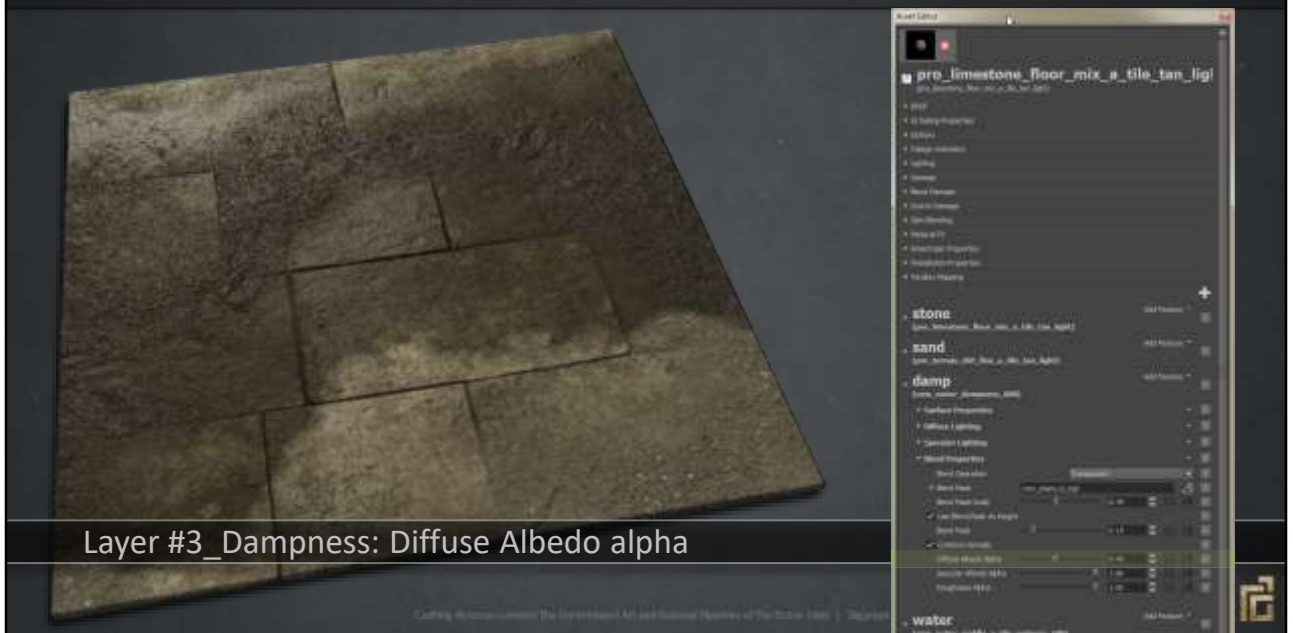
I want to combine with it.

Run-time Material Layer Blending



I want to combine with it. **[CLICK]**

Run-time Material Layer Blending



With our blending controls I tune the Diffuse Albedo contribution of the dampness layer.

This is starting to look better but, the dampness needs to mix with the underlying materials **[CLICK]**

Run-time Material Layer Blending



With our blending controls I tune the Specular Albedo and Roughness contribution of the dampness layer.

Now I have a more realistic mixing of the materials.

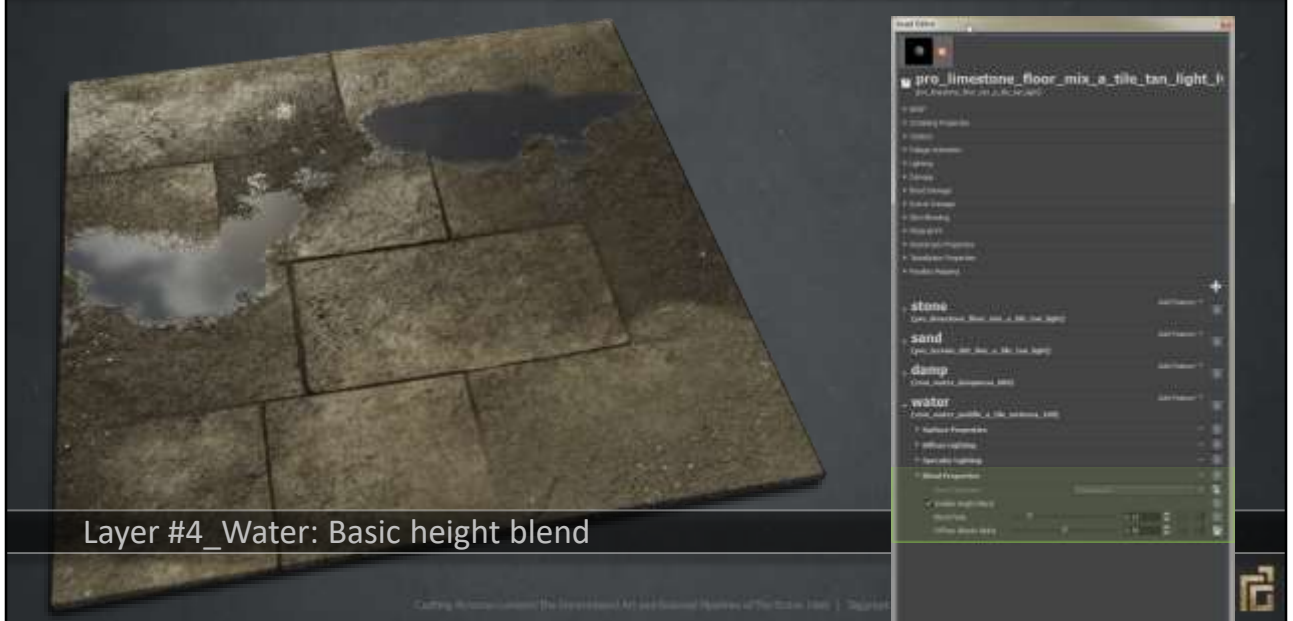
The sand looks like it has absorbed more water than the stone

Our blending controls also have allowed us to save on texture memory.

We can use a single dirt and grunge layer and blend it to look unique for each use.

[CLICK]

Run-time Material Layer Blending



Fourth layer :
Water puddles

Basic height blend. **[CLICK]**

Run-time Material Layer Blending



Add modeled floor stones

Cutting Room: Inside The Unreal Engine Art and Technical Masters of The Stone Isles | September 2019

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To push this floor further I'm adding modeled floor stones. **[CLICK]**

Run-time Material Layer Blending



Add modeled rocks and pebbles

Cutting Roommen created the Unreal Engine Art and Animation Masters of The Stone Isles | Copyright 2015

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Adding modeled rocks and pebbles. **[CLICK]**

Run-time Material Layer Blending



Add skirt mesh for trash

Cutting Roomset: Inside The Unreal Engine Art and Animation Pipelines of The Sims 3 and The Sims 4

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Adding a skirt mesh for trash and debris. **[CLICK]**

Environment Modeling and Materials



In-game model without normal maps

Cutting Room: Inside the Unreal Engine Art and Technical Pipelines of The Sims 3 and The Sims 4

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In-game model without normal maps. [\[CLICK\]](#)

Environment Modeling and Materials



Base layer: Varnished wood light



Layered Material:

Varnished wood base layer. **[CLICK]**

Cutting Room: Inside the Greenhouse Art and Natural History of The Bronx Zoo | The Art of the Zoo

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Environment Modeling and Materials



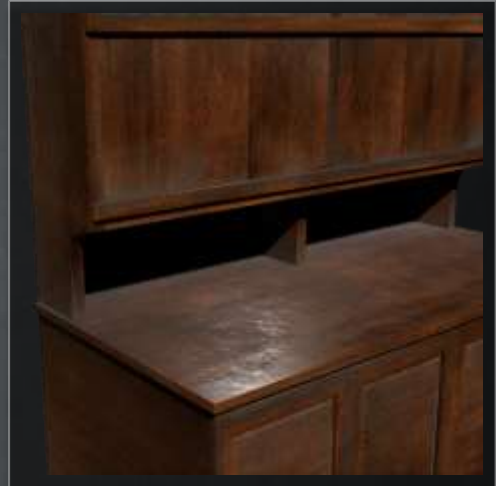
Layer #2: Varnished wood dark

Cutting Room: Inside the Greenhouse Art and Natural History of The British Isles | September 2019

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Second layer
Varnished wood dark
[CLICK]

Environment Modeling and Materials



Layer #3: Dust and grunge

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Third layer
Dust and grunge
[CLICK]

Environment Modeling and Materials



Add skirts and accessory set

Cutting Roomset created the Unreal Engine Art and Technical Resources of The Stone Island | 2018-2019

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Now we add skirts and accessory set. **[CLICK]**

The accessory is the only one-off baked asset. **[CLICK]**

Environment Modeling and Materials



Here is some of the furniture that we made for whitechapel hospital.

5-Tileable materials

2-Skirt materials

1-One-off baked material for the accessories.

These materials were also used on other assets through out the level.
Saved us a lot of memory!

Environment Modeling and Materials



In-game model without normal maps

Cutting Roommen created the Unreal Engine 4 Art and Technical Resources of The Stone Isles | September 2019

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We took the same approach for organics.

In-game model without normal maps. **[CLICK]**

Environment Modeling and Materials



Base layer: Rock rough

Cutting Through the Surface: The Story of the Art and Science of the Stone. 1988. © 2014

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Layered Material:

Base layer
Rock rough
[CLICK]

Environment Modeling and Materials



Layer #2: Rock smooth

Cutting Room: Inside the Unreal Engine Art and Technical Pipelines of The Sims 4

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Second layer
Rock smooth
[CLICK]

Environment Modeling and Materials



Layer #3: Rock crumble

Cutting Room: Inside the Unreal Engine Art and Technical Masters of The Stone Island | The Art of 2019

READY AT DAWN. 

Third layer
Rock crumble
[CLICK]

Environment Modeling and Materials



Layer #4: Water drips

Cutting Room Floor: The Unreal Engine Art and Technical Masters of The Sims 3

READY AT DAWN.



Fourth layer
Water drips
[CLICK]

Environment Modeling and Materials



Rock set.

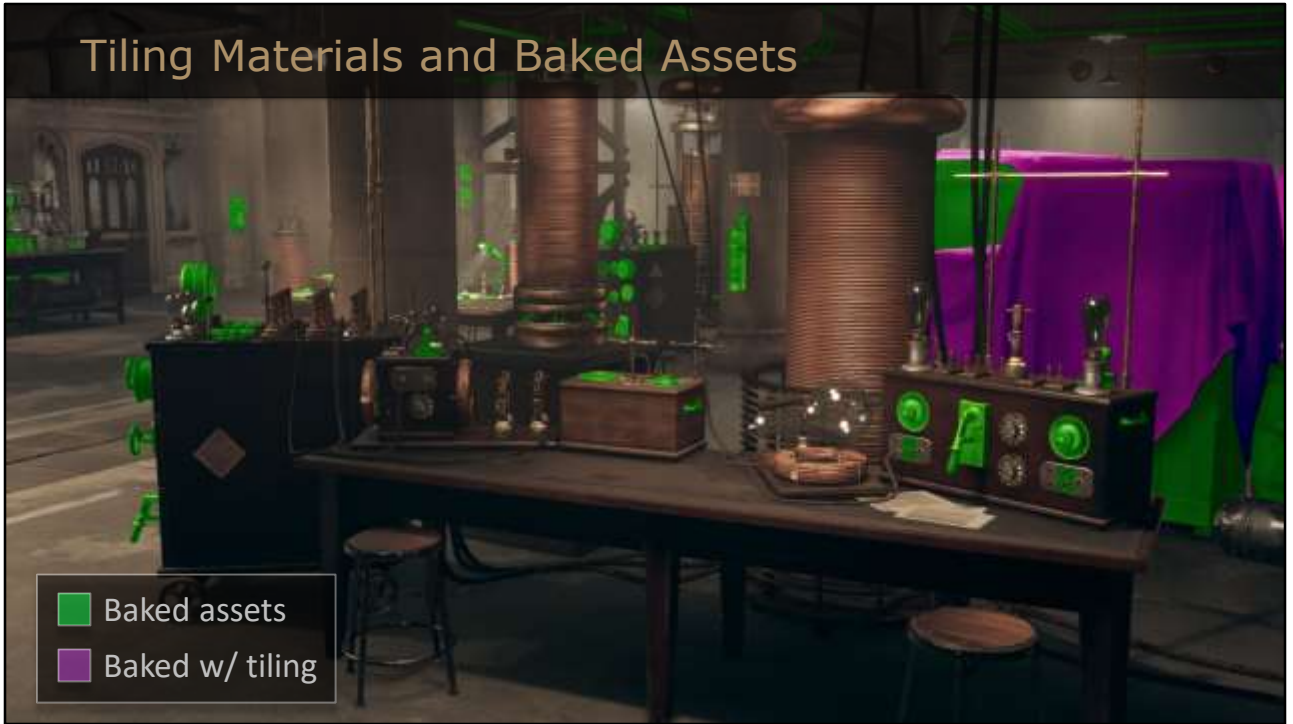
Uses 4-Tileable materials. **[CLICK]**

Tiling Materials and Baked Assets



To finish I have some breakdowns to our show tiling textures to baked assets ratio.
[CLICK]

Tiling Materials and Baked Assets



Tesla's lab is also a great example of our common library. [\[CLICK\]](#)

Only two new materials were made for this level.

All the other materials are from our common library. [\[CLICK\]](#)

Tiling Materials and Baked Assets

