

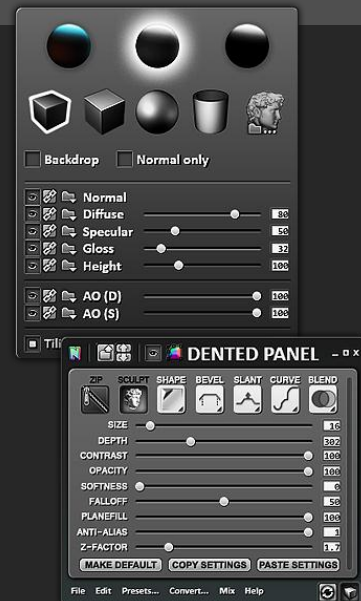
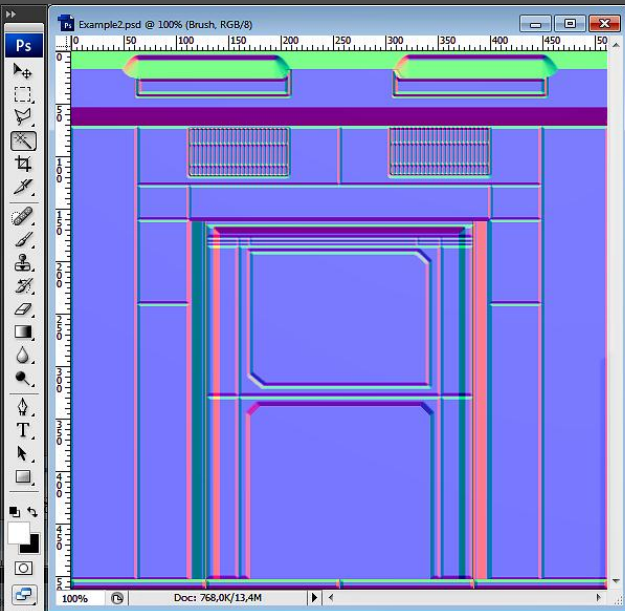


## *What is nDo2?*

nDo2 lets you create normal maps straight in Photoshop. This means you get to create normals with all the tools you already know, while keeping your pipeline clean. nDo2 brings multiple normal mapping disciplines together, and presents a rapid workflow skipping the 3D detour. It can substitute modeling pipelines, or act as a fast and powerful complement to basic high-poly baking. Hard-surface and organic normals become easy.

Luckily, nDo2 does more than just normal maps. Powerful AO, displacement, diffuse, specular and cavity generators are at your disposal, tweakable in real-time and with 16-bit precision. Thanks to what can only be witch craft, rich 3D can be derived from super simple cavity doodles. To top it off, nDo2 extends PS with a 3D previewer, allowing you to preview tweaks without ever leaving Photoshop.

In this tutorial, we'll learn how to create custom normals from photos and hand-painted bases, with results indistinguishable from careful sculpting. We'll also go through how to create hard-surface normals with speeds not enabled by traditional 3D workflows. Lastly, we'll see how nDo2 works as a complement to high-poly modeling, for significantly speeding up detail work. First, let's get to know the UI basics!



## The UI

nDo2 consists of two main components – a small, **flexible UI**, and a floating **3D previewer**. It reacts and transforms according to everything you do inside of Photoshop - it's all about letting you create as much as possible with as few UI interruptions as possible. The previewer is designed to boost turnaround, never forcing you to leave Photoshop when studying your results in 3D. It's as simple as can be -- your mesh, fully interactive, smack on the screen.



nDo2 morphs its UI according to what you do in Photoshop. For instance, when you make a selection, the UI will present you with options to convert it to normal. Select a group of normals, and a quick-tweaking interface will appear instead. No one likes digging through menus, so nDo2 provides you with what you need, when you need it.

It enables simple tweaking of many layers at once, and advanced tweaking of one layer at a time.

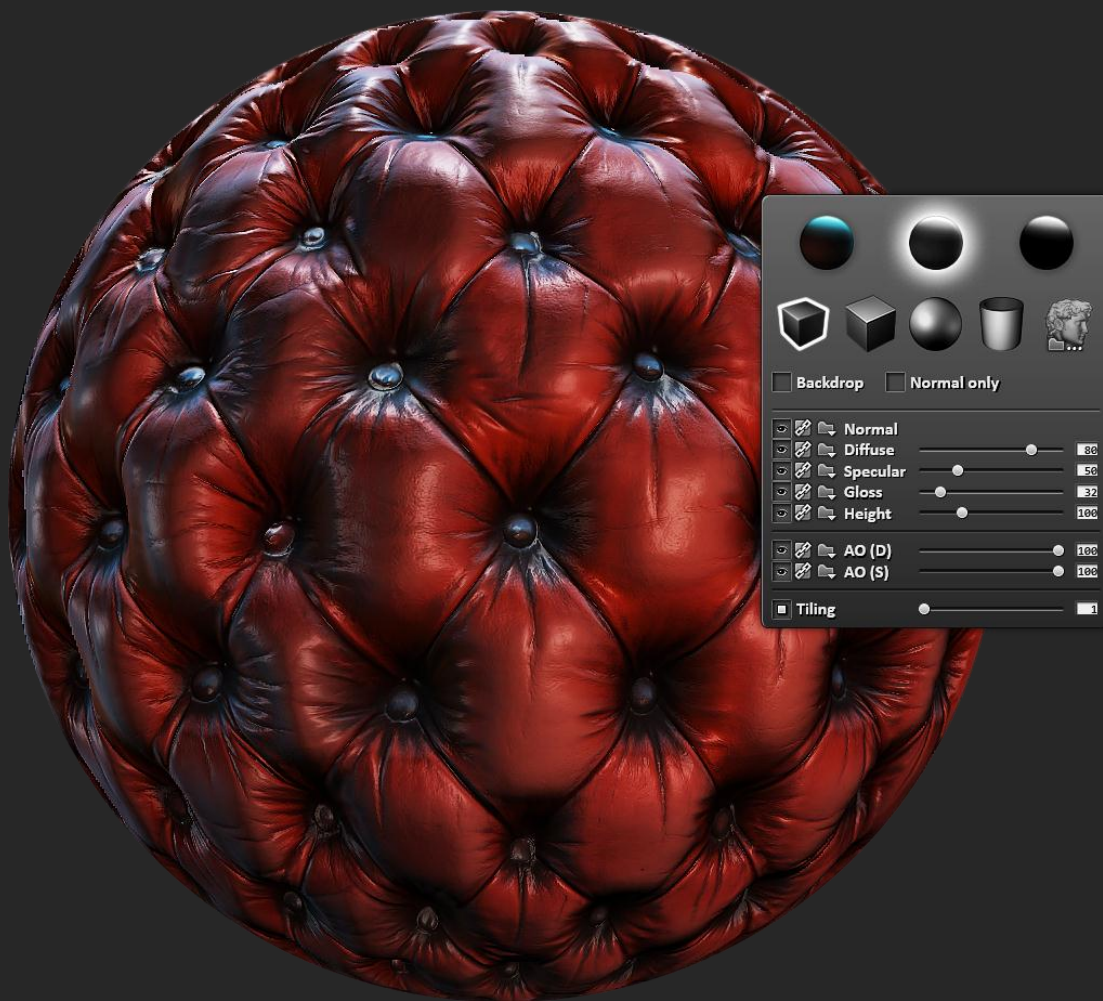
**Tip 1:** All sliders in nDo2 are snappable -- press **Ctrl** for regular snapping and hold **Shift** for double the snap threshold, or **Alt** for half.



**Tip 2:** The nDo2 UI is completely compressible. To compress, double-click the top-left **N** icon, and nDo2 will instantly turn into a small rectangular blob, hiding the previewer in the same instant. The same effect can be achieved by dragging either of the window's corners to size it down. To restore the UI, double click the **N** again.

# The Previewer

The 3D previewer is basically a fully interactive switchable mesh, which hovers in Photoshop. Just like the main UI, it adapts to what you are doing in Photoshop. When you tweak your maps, it instantly updates, and when switching between normal maps it automatically loads the current project. Also, with its relief mapper, you can always preview your normals in full 3D.



The previewer is full of options – simply right click it to open its context menu. The previewer context menu lets you tweak material rendering settings, hook up maps, toggle the backdrop, and select which meshes and light presets to display.

**Tip 1:** Texture maps can be toggled in three ways: hidden, killed, and solo. Hiding the map will temporarily disable the texture, whereas killing it will completely toggle off all reflectivity. The solo mode lets you preview pure, unlit texture information.



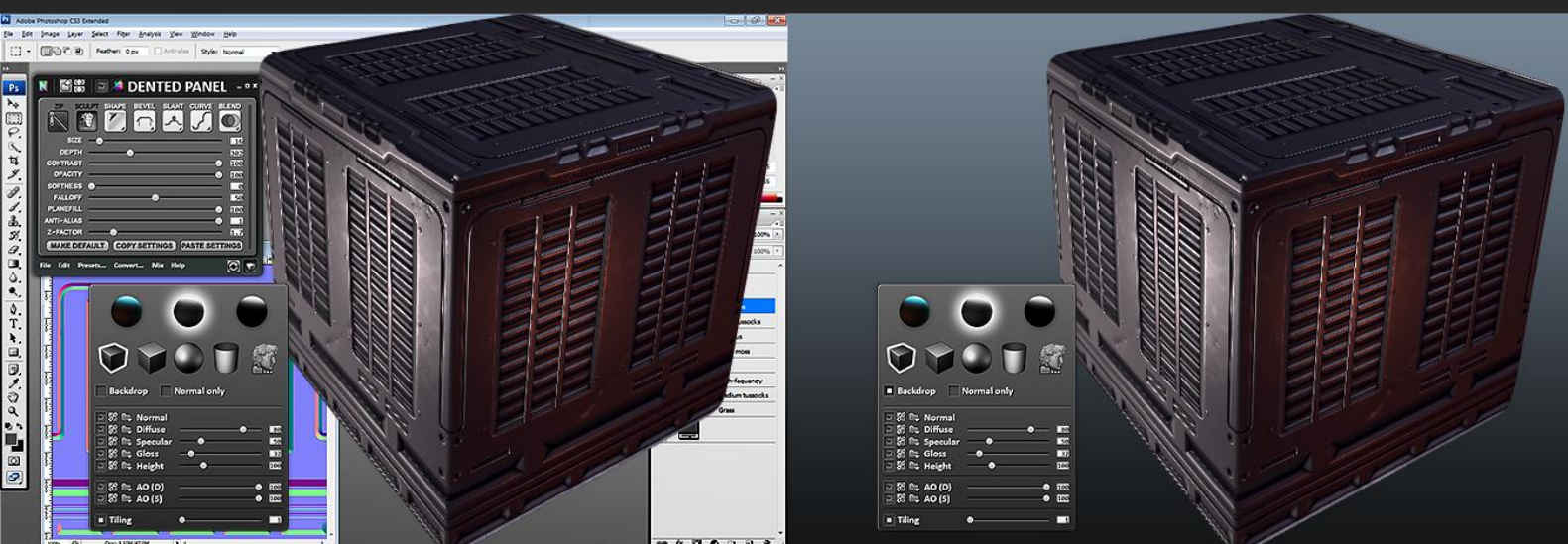
**Tip 2: Map hooking** enables maps to be auto-reloaded in the previewer when saved. To hook up a map, first select the desired Photoshop document, then press the desired **link button**. Now, whenever you save the document, the changes will appear in the previewer. Note that if the document has not yet been saved to disk, it won't auto-reload.

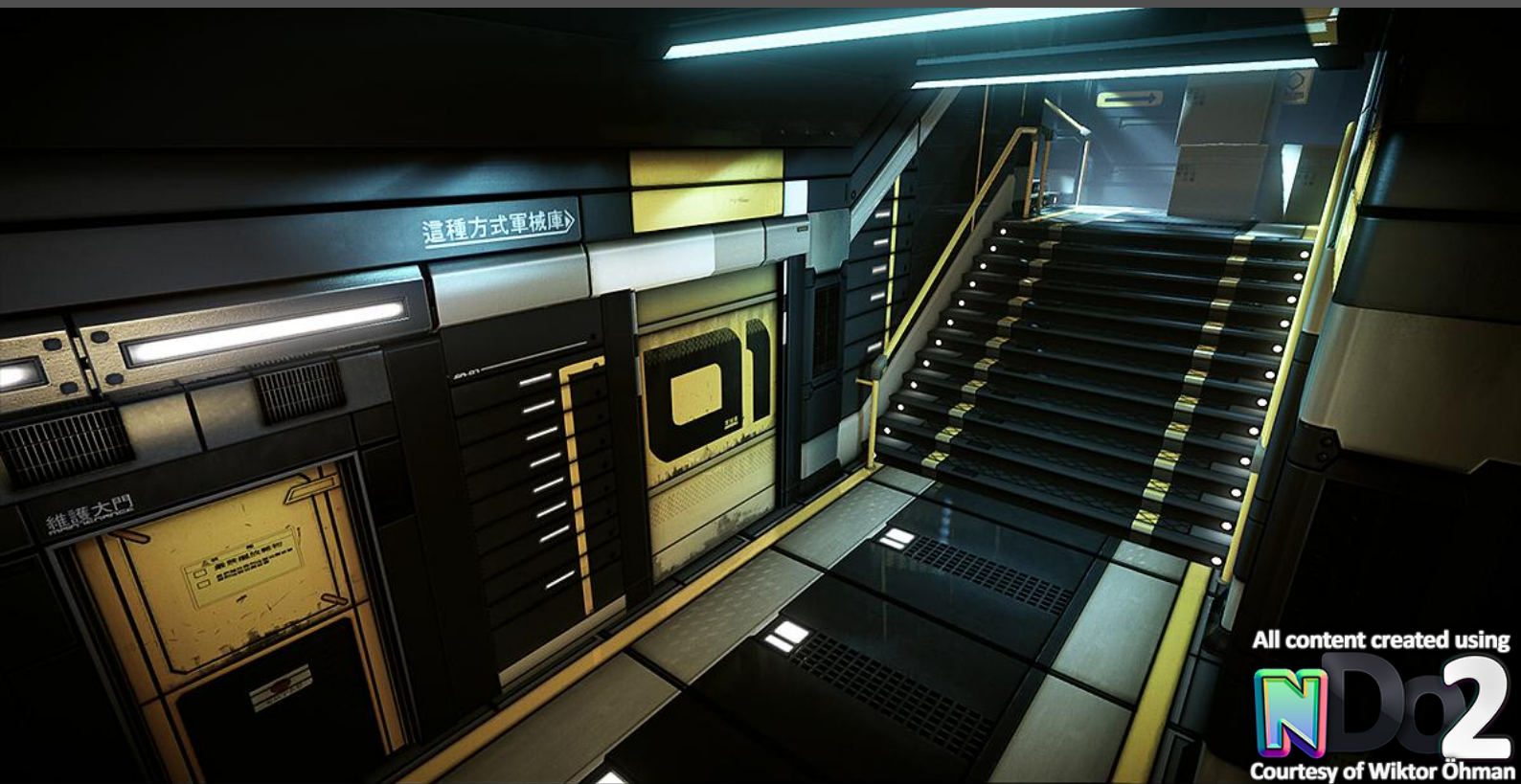
As you tweak any maps that have been generated with nDo2, the previewer will automatically render those updates. As you tweak your height map you will see the previewer reflecting your changes. nDo2 uses a **Relief mapping** shader to render 3D from height, similar to what is found in many real-time technologies, such as CryEngine3. Just like with all other map type values, you can tweak and toggle the height value through the previewer context menu.

**Tip 3:** To switch the preview mesh, click on any of the mesh icons to make it the active one, or press keys 1-4. To load a custom mesh, click the right-most mesh icon. Note that nDo2 will auto-triangulate any non-triangulated meshes.

**Tip 4:** To change the general tiling factor, simply drag the bottom-most tiling slider. Note that all text box values can be overridden, extending the default range.

**Tip 5:** Sometimes it's nice to preview the mesh and nothing else. This is what the **backdrop** is for. Enabling it dims the screen and shows nothing but the mesh.

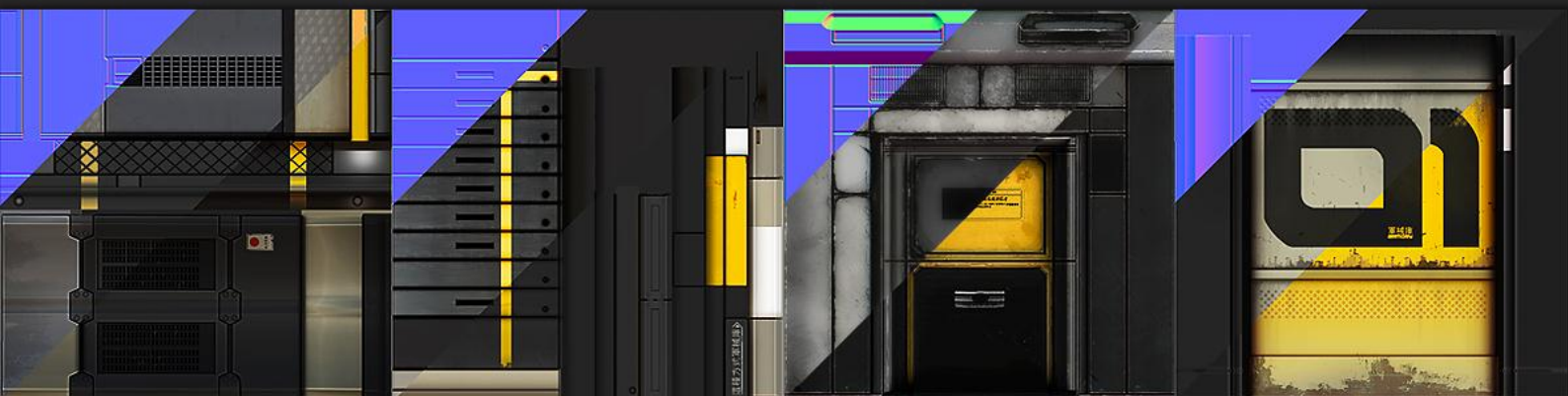


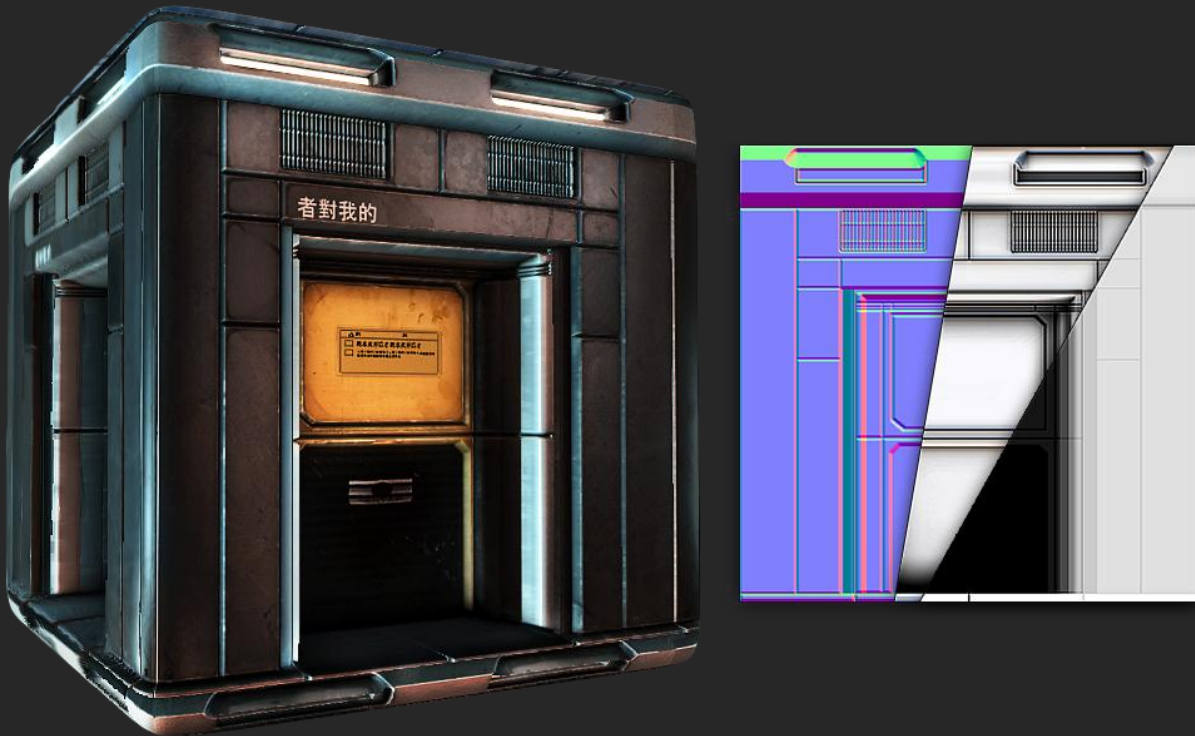


## Hard-surface How-to

All normals in this example scene have been done with nDo2. It contains tiling hard-surface normals, and basic high-poly normals combined with details made using nDo2. In most cases, modeling can be skipped entirely, speeding up the workflow immensely. In this simple example we'll look into how to create normals in the vein of this scene.

So, let's break down how to create a tiling hard-surface normal. We'll use a variety of creation techniques to create a few basic shapes, and then convert those shapes into normal layers. Then, we'll learn a few tweaking tricks for pumping out volume. Lastly, we'll learn about sculpting and zipping, and top it all off with height, AO, diffuse and specular maps.





The above normal may look complex, but it's actually just 6 nDo2 layers. The 3D is calculated automatically from the hard-surface normal. All in all the normal was created in about 5 minutes, and most materials were generated from the normal.



### STEP 1: NEW NORMAL DOCUMENT

Let's begin by creating a new 512x512 normal document. Just press the **NEW NORMAL** button (shows up if no docs are open), and you're good to go. You can also press **File > New normal map** or **Ctrl+N**. Note that a normal document is also automatically created whenever something is converted to normal for the first time.

**Tip 1:** You can customize the normal channel configuration by going to **File > Preferences > Flip normal channels**. For instance, checking **Flip Y** will make your normals compatible with UDK.

### STEP 2: CONVERTING TO NORMAL

nDo2 lets you use virtually any tool in Photoshop to create your normal, from **selections** and **vectors**, to **photographs** and **hand-painted** details. And once a normal has been generated, it's always possible to re-sculpt its original source, whether it be a vector shape, text or art layer.

Whenever a conversion input is detected, nDo2 will display a big **CONVERT** button.

I'll create the first normal using a simple selection -- this is most likely the quickest way you can create a hard-surface normal. Simply design your selection using any of the lasso, polygonal or marquee tools, click the big **CONVERT** button and you've got a normal.

Drag the selection so that it goes all the way down to the bottom of the canvas. Notice how a **NO EDGE BEVEL** option appears -- toggle this, and the normal will not get any bevels near the canvas edges.



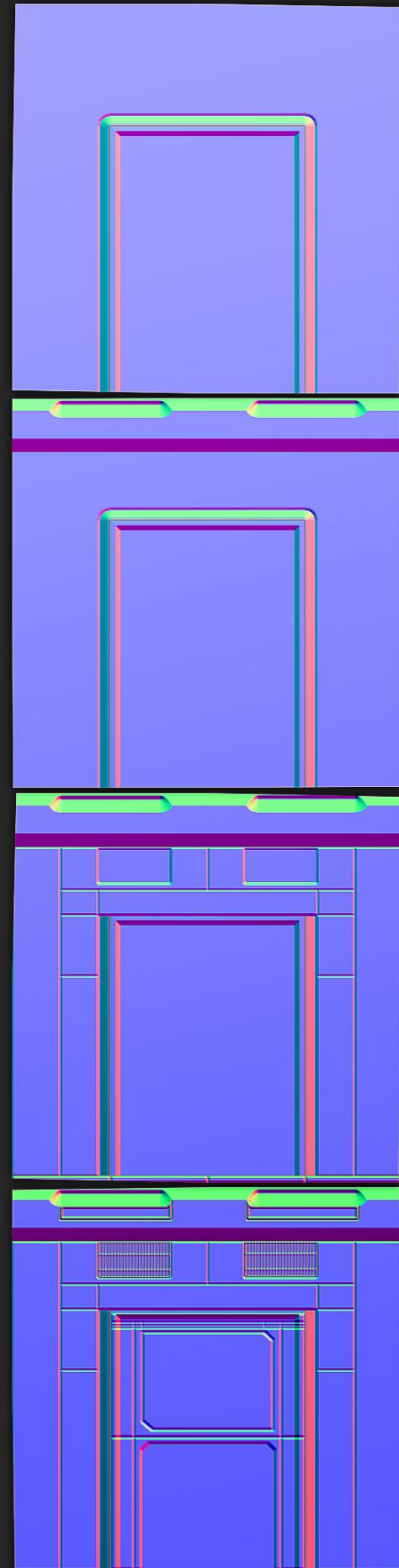
### STEP 3: TWEAKING THE NORMAL

nDo2 comes with more than 50 unique sliders and normal tweaking options, letting you experiment with your normals in endless ways. The moment a new normal has been created a tweaking interface will show up. Let's play around with it!



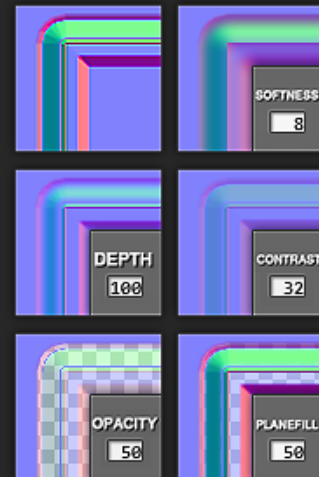
The top row of drop-downs lets you combine and choose between a range of normal **Shapes**, **Bevels** and more. The style I'm going for with this normal is a door frame kind of bevel. I want it to be hard and crisp, so I set its shape to **Chiseled Shallow**. I want a furrowed look, so I set the bevel to **Groove**.

I'll also change the **Slant** to **Down**, making the normal point inwards. To finally get the multi-beveled look of a door frame, I'll go ahead and set the **Curve** to something funky like **Terraced**.

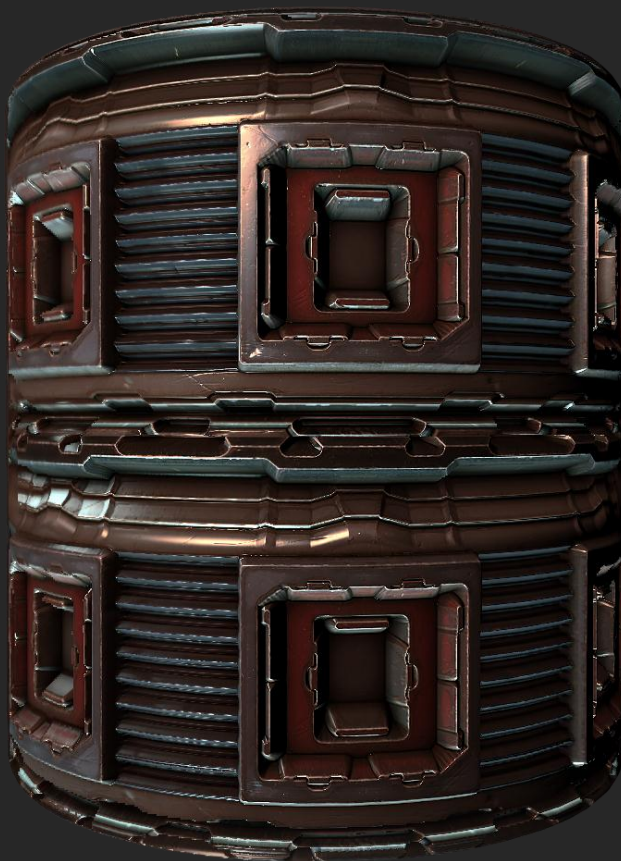


The sliders enable fine-tuning of more general settings, such as **Size**, **Softness** and **Opacity**. For this normal, I've set the size to 32 pixels, and left the rest of the sliders untweaked.

**Depth** and **Contrast** are similar to each other -- low values produce low intensity, but the difference is the depth slider also relaxes the normal bevel at low values. The **Falloff** controls the tightness of the normal bevel -- low values result in a sharper curve, high values yield a smoother, more relaxed curve. **Planefill** controls the opacity of the part of the normal which has zero angle (i.e. anything blue).



**Tip 1: Curves** offer a great simple way to add to the complexity of your normal, by transforming the slope of the bevel. They also reduce the need for combining multiple normals to produce multi-faceted bevels. You can achieve some pretty crazy results with curves, like in this simple but extreme example:

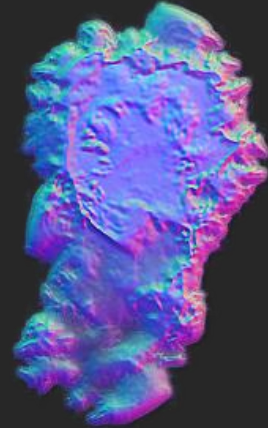


Look past the horrifically nonsensical dev-art – this example simply aims to show that crazy volume can be easily achieved from just 6 very basic layer masks. It is NOT art! :D



## STEP 4: ADDING SCULPTED NORMALS

The sculpt mode lets you use the full capacity of Photoshop paint your normal in real-time using any PS brushes, and lets you edit the source of a normal at any time (such as the vector that was used to create it). Sculpting lets you preview and tweak your normal properties as your normal is being painted. It's just as easy to sculpt organic details as it is sculpting hard-surface stuff. The normal settings of a layer can be tweaked at any time, even after the normal has been painted.



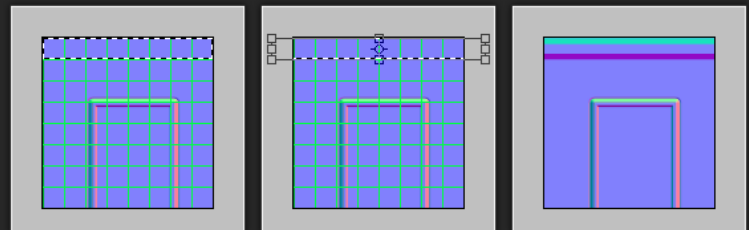
For our next normal, I want to create a new sculpt layer from scratch. It should be a bulky and tileable top trim, with a bit of carved hard-surface detail.



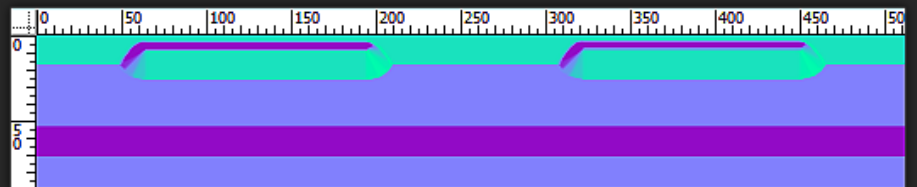
Creating an empty sculpt layer from scratch can be done by either pressing **Ctrl+Shift+N**, or selecting *Edit > New Sculpt Layer*. Regular sculpt layers will produce bevels near document borders – to create a sculpt layer with no border

bevels, instead select *Edit > New Edgeless Sculpt Layer*. This is important when painting tileable details, so let's create one of these!

To create the trim base, I make a selection which I transform to extend the canvas borders. I then fill the selection with a random color, and set the normal **Size** to 16 pixels.



I'll also set the shape to **Chiseled Shallow** and **Anti-Alias** to 1. Next I want to sculpt some big carved details, so I select the eraser tool -- add a layer mask instead if you want the original pixels intact. With the eraser brush radius set to 1px, I erase two straight lines near the top of the normal, to carve the bevel. I use the eraser, and not a black brush – when sculpting, brush color does not matter. To view the latest sculpt layer edits in the previewer, simply click the refresh icon.

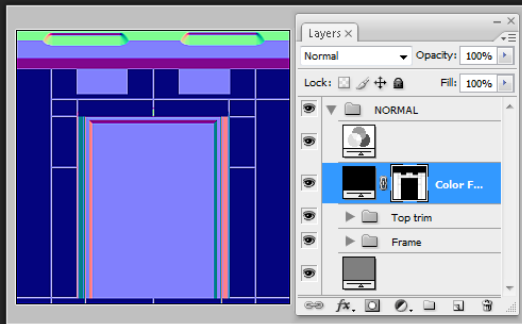


To exit the sculpt mode, click the **SCULPT** button. This is necessary to ensure that the normal gets the correct colors.



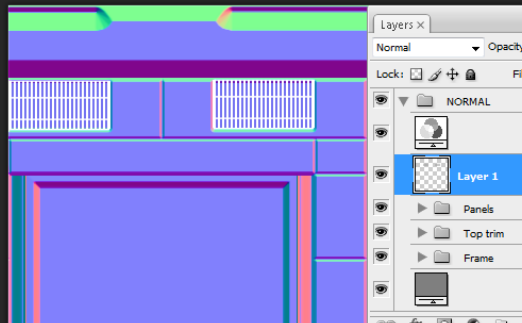
To convert any normal element to a sculpt layer again, simply toggle the **SCULPT** button, and you're ready to start painting. Untoggling turns the sculpt layer back into a normal.

## STEP 5: REPEAT UNTIL DONE



You now know the very basics of creating nDo2 normals – it's all downhill from here!

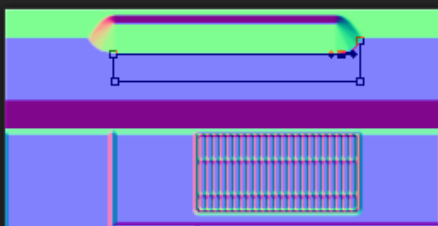
**Panels:** I've created the next normal from a masked solid color layer. I've used a **Chiseled Shallow** shape, an **Emboss** bevel, and set the size to **2 pixels**.



**Gratings:** Now that all basic shapes are in place, it's time for some detail work. Next I'll add some gratings, which I've created using a standard art layer. Simply create a new layer, paint, and generate. Bright colors will produce an opaque, upward-pointing normal, while dark colors and transparency will both point inwards.

Again, I've set the shape to **Chiseled Shallow** (optimal for sharp shapes), the size to **1 pixel**, and the Blend to **Hard light**. With nDo2, you can blend normals together with any blend mode Photoshop has to offer. By setting the blend to Hard light instead of Overlay, the normal will really pop against the underlying normals.

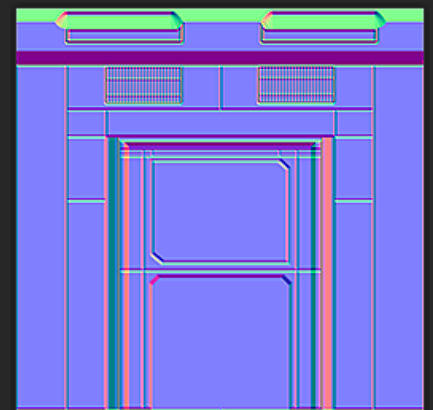
**Lights:** Next I want to add some detail to the top trim, this time using vectors. nDo2 supports any kind of Photoshop vector, including shapes, closed paths, open paths and text vectors. Vectors can always be re-tweaked by entering the sculpt mode, and can be sculpted further using an additional layer mask.

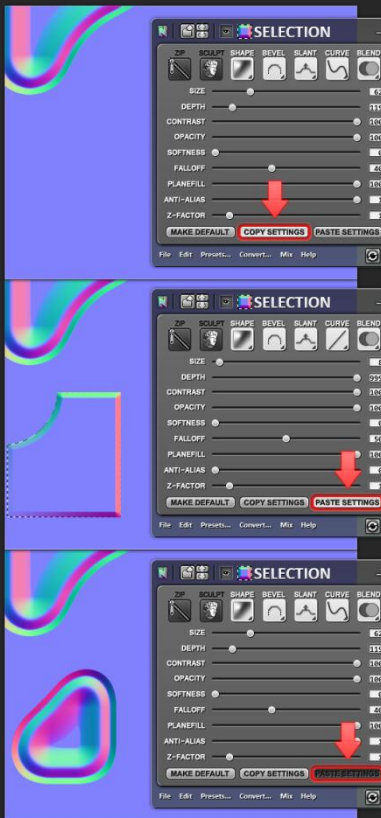


I'll create a simple path vector. I'll make sure to close the path by connecting its first and last anchor points. If I leave the vector open, nDo2 will create a normal along the path using the currently selected brush. This is perfect for creating organic details, such

as cables and welding seams. When I've converted to normal, I set the shape to **Chiseled Shallow**, the bevel to **Emboss**, the slant to **Down**, the curve to **Ring**, the blend to **Overlay**, and finally the size to **4 pixels**.

**Final details:** For the final normal, I'll create a regular sculpt layer. I choose an **Emboss** bevel, set the size to **2 pixels**, and select an **Overlay** blend. I sculpt some simple door details and call it done!





**Tip 1:** Once a normal layer is finished, **zip it!** This is done by toggling the **ZIP** button. It is a completely non-destructive process, and greatly boosts performance. Also, file sizes drop significantly, speeding up both saving & loading. A normal can be unzipped at any time.

**Tip 2:** You can rotate and transform any of your generated normals, and the normal recalculates itself in real-time. Try it out!

**Tip 3:** To transfer one the style of one normal to another, use the **Copy & Paste** buttons. You can also override the default normal style with the **Make Default** button.

**Tip 4:** When sculpting, you have more control over your normal than through standard tweaking. For instance, you can apply Photoshop filters (such as blurs and distortions) or advanced transformations (warp transforms, liquify etc.).

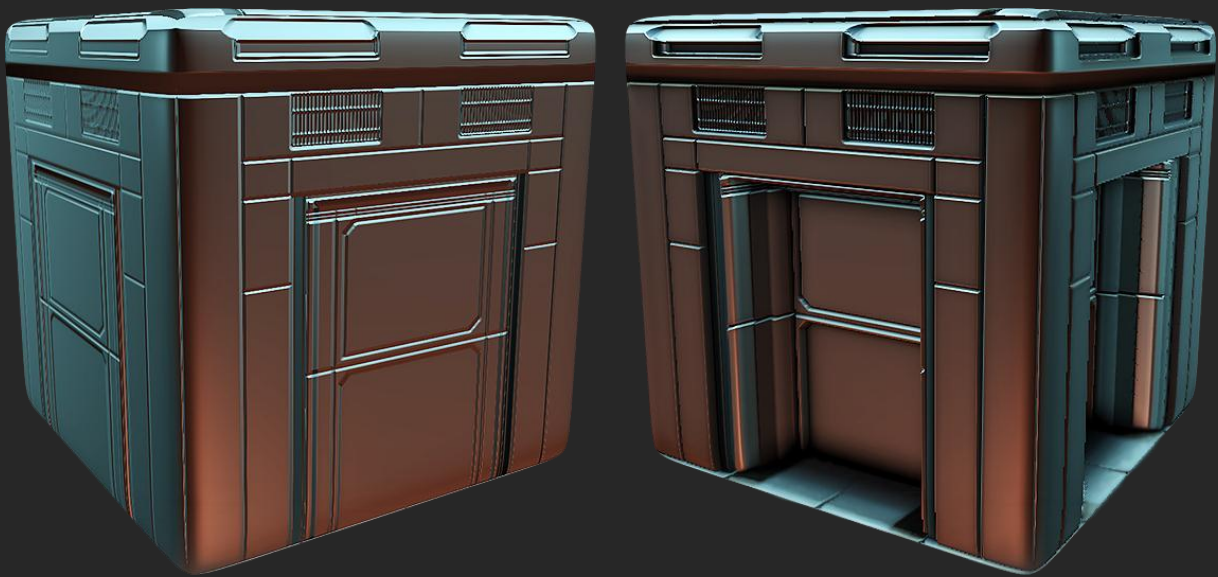
## Creating Materials

Quickly generating high-quality base maps is an important part of efficient material creation. Luckily, nDo2 comes with a set of powerful and flexible map converters. Normal maps can be converted to **Ambient Occlusion**, **Displacement (organic and hard-surface)**, **Diffuse**, **Specular** and **Cavity**. All maps can be generated with 16 bit precision and allow for real-time tweaking, no re-baking required. All converters can be accessed at any time by clicking the **Convert...** menu item.



You'll notice a few more maps than just normals can serve as input. The converter UI lets you choose between three input types, namely **Normal**, **Height** & **Cavity**. This offers a great deal of flexibility (16 conversion options in total), letting you do things like converting height to AO, or better yet, hand-painted cavity maps to normal.

It is possible to generate any combination of maps at once (hold **Ctrl** to select multiple), and batching multiple inputs is supported. Here's the result of converting our new normal to tileable Ambient Occlusion, Displacement, Diffuse and Specular in one go:

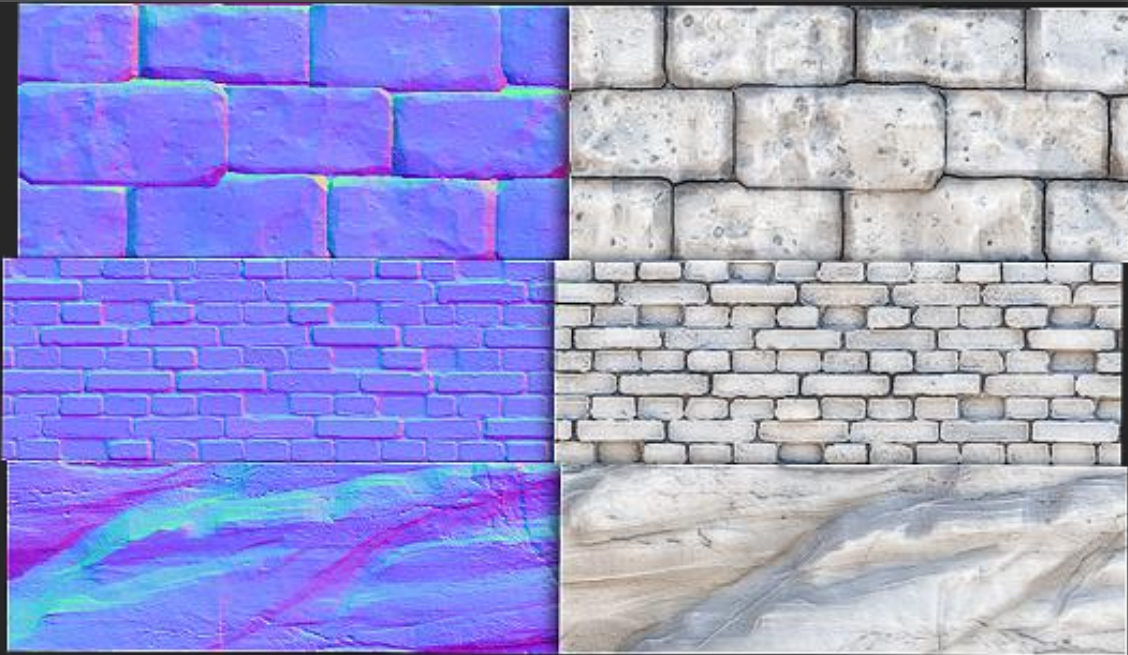


Base materials like these are a necessity, and make texture creation a little less cumbersome. All maps generated by nDo2 can be tweaked in great control. Let's learn more about what can be done with each map type!

## *Ambient Occlusion*

nDo2 offers a powerful Ambient Occlusion generator. It inputs any normal, and rapidly outputs robust AO. The look and feel can be tweaked and previewed in real-time without re-baking, allowing for advanced and efficient customization. Rendering AO from normal is extremely efficient, as all it cares about is pixels, and not hundreds of millions of polygons. Not having to sit through eternal baking times just because of a minor tweak can be quite a joyous experience!

To generate the AO map, click the **Convert...** menu item. As the UI pops up, you'll see that the **AO** option is selected by default, so just press the **Active Doc** button, and your Ambient Occlusion will be ready in a few seconds.



When the conversion is done, you will now see your AO applied in the previewer -- you can tweak its influence on both the diffuse and specular map via the previewer context menu. You'll also see a small tweaking interface – go

ahead and drag the sliders around! The sliders allow you to quickly balance the opacities of three different AO elements, namely the **Fine**, **Medium** and **Large** shadows.

Digging a little deeper, each AO element has a variety of tweaking options. The individually tweakable settings are **Size**, **Softness**, **Opacity**, **Curve** and **Blend**. To access these settings, click one of the AO elements to dive into its advanced tweaking UI. Alternatively, right click the element, and the advanced tweaking UI will appear in the form of a pop-up.



**Tip 1:** The best results are generally achieved by setting the **Softness** to at least 1-2 times larger than the **Size**. A large size and weak softness tend to result in more unnatural-looking shadows.

**Tip 2:** It's possible to extend your AO with additional detail, for instance for adding a layer of larger shadows. To add more layers of detail to the AO map, simply select any AO element ("Fine Shadow", for instance), hover over the nDo2 UI and press **CTRL+D**. You'll now have an extra layer of AO, ready to tweak!

## Displacement

Previewing your normal in full 3D while creating it in 2D is quite a satisfying experience, and gives you a more solid feel of the design you are creating.

nDo2 is equally as much a fully-fledged displacement map creator as it is a normal map creator. Due to the reliability of the nDo2 displacement creators, designing an advanced 3D material simply becomes a matter of designing a normal map. Displacement mapping has many powerful applications both in offline and real-time rendering. One real-time application is hardware tessellation, as demonstrated in this basic UDK example:



Normal maps are significantly easier to read than height maps, thus making them much easier to design. There is no need to think in the third dimension – instead, this is automatically taken care of by the height converter.

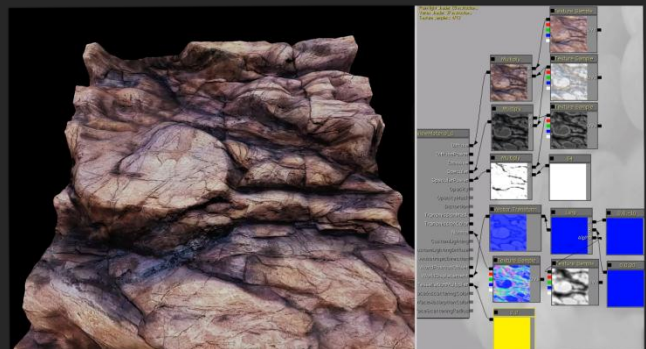
nDo2 includes two displacement converters – **All-round** and **Hard-Surface**. Where the **All-round** displacement generator works for any type of normal map and is biased towards organic normals, the **Hard-Surface** generator yields non-biased, perfectly plane height -- provided that the normal is in nDo2 format. You'll therefore notice the Hard-surface option is only enabled when working with nDo2 normals – i.e. multilayered normal maps created entirely in nDo2.

To generate a **Hard-Surface** height map, we first need to make sure our nDo2 normal map is selected. Then, open up the **Convert...** interface and select the Hard-Surface option. nDo2 will now quickly run through your entire PSD and individually convert each normal element to height. Note that you can manually bias the height of specific layers by modifying the normal elements' **Z-factor** sliders before converting to height.



To generate an **All-round** displacement map, open up the **Convert...** window and select All-round. As the map has been generated, you will be presented with a bunch of sliders for controlling of a range of height frequencies. The topmost slider controls all frequencies at once, and distributes them according to the selected **Distribution curve**. The standard **Slope** curve provides an accurate blend of fine and large details, whereas the **Gaussian** curve lets you pump out more detail.

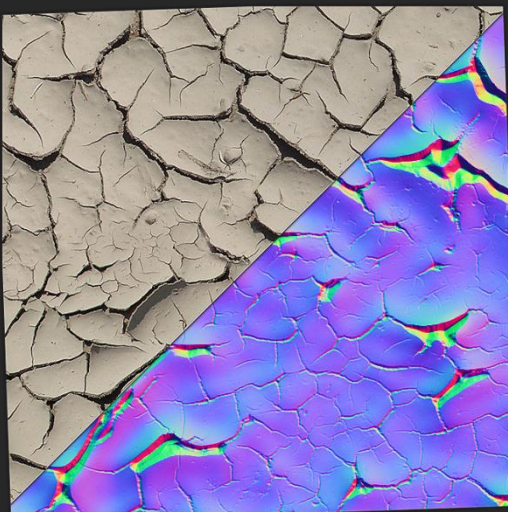
One of the most powerful applications of height maps in real-time rendering is hardware tessellation. nDo2 in combination with tools such as UDK makes tessellation easier than ever before.





All normals and displacement maps in this UDK scene have been created with nDo2. Real-time tessellation is at work, really bringing the streets to life. Next, we'll learn how to create just such normals! You'll find creating organic stuff is easier than a breeze.

## *Diffuse to Normal*

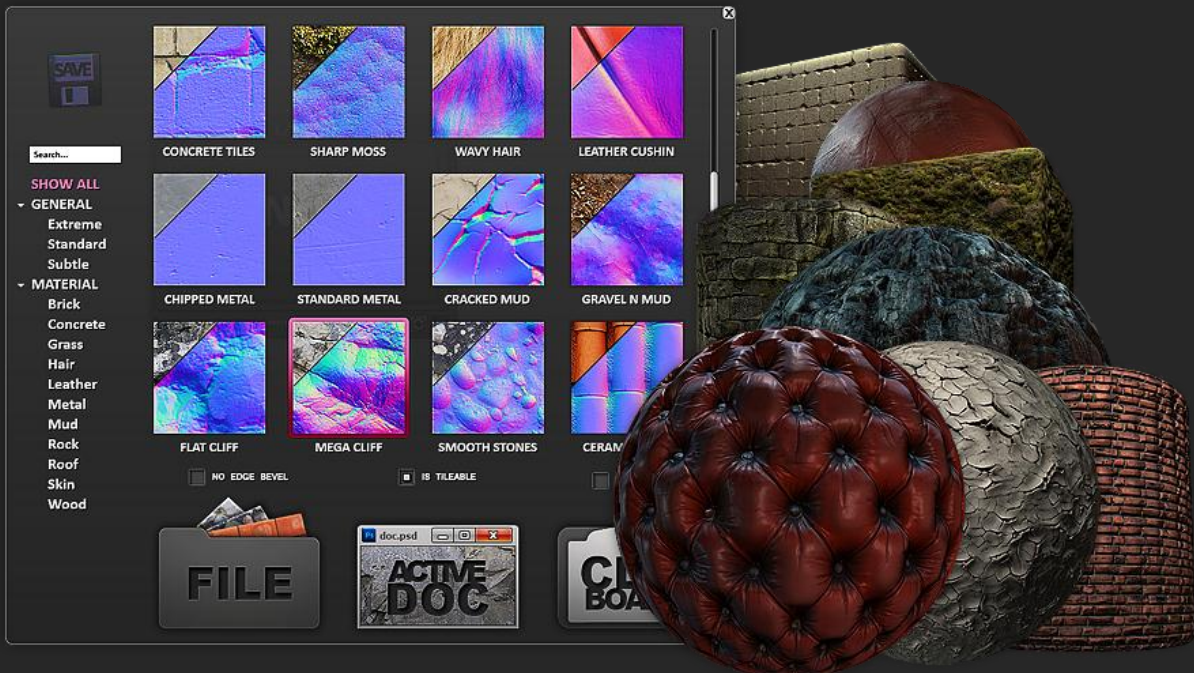


Those familiar with traditional photo-to-normal conversion tools will easily grasp nDo2's photo-normal creation process. When digging a little deeper, you'll soon learn it is fundamentally different in terms of creative control and output.

nDo2 comes with a number of material presets. These presets are designed to reconstruct extremely rich, material specific normals from diffuse maps. The more advanced they are, the longer they will take to process – there is no limit to how much detail a preset can hold.

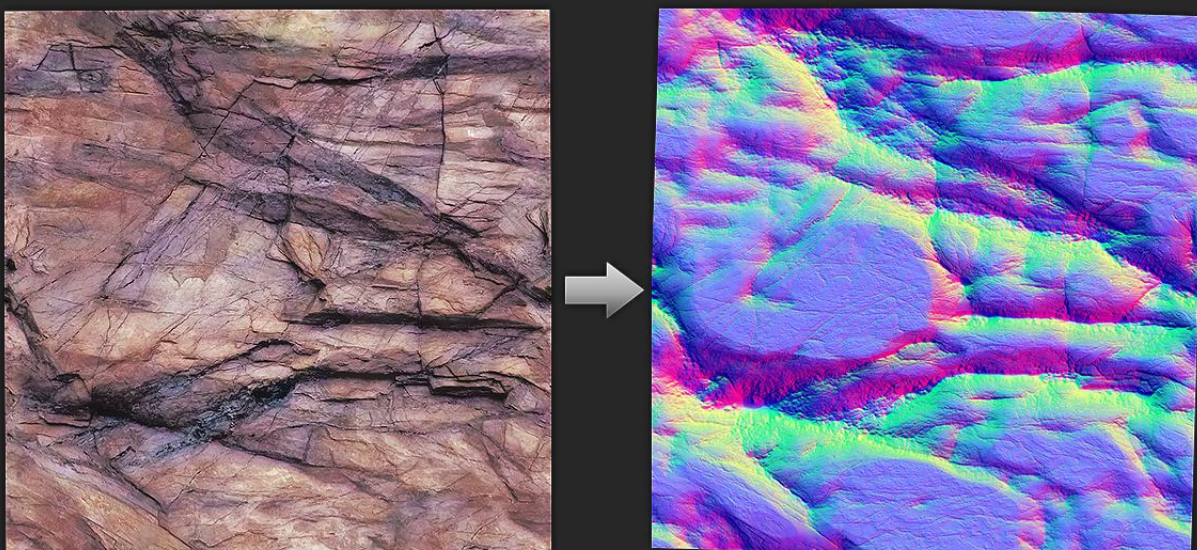


nDo2's normal creation engine makes it easy to achieve clear-cut separation between crisp details and defined volume, enabling results that previously had to be sculpted.



Converting a photo or hand-painted base to normal is super easy. Simply click on **Presets...** and the preset browser will appear. You'll find a tree view of the preset categories available. *General* presets aim to provide a vanilla blend of volume and detail, whereas *Material* presets aim to accurately recreate certain surface types.

As indicated by the three large buttons, you can generate normals from the clipboard, the active document in Photoshop, or from file (selecting multiple files result in batch conversion). If you already have your diffuse base opened and active in Photoshop, press the **Active Doc** button. I've selected the "Flat Cliff" preset for the example below.



When nDo2 has finished, you're presented with a simple tweaking interface for fine-tuning the characteristics of your normal. Play around with the sliders until you are happy with the result – fooling around with these sliders can have a dramatic effect on your normal map.



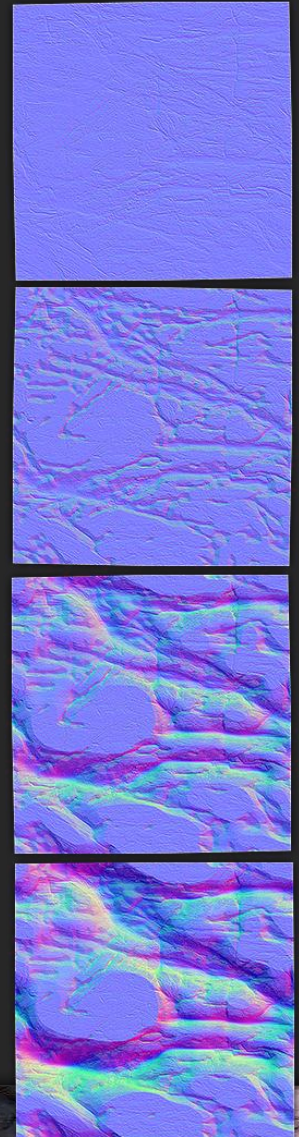
## Custom Presets

It's easy to create your own preset from scratch. Start off by converting your diffuse to a single normal, and tweak its settings to bring out basic details. Then simply duplicate that normal (**Ctrl+D**), set it to overlay and tweak it to bring out new characteristics. Keep duplicating and tweaking until you've reached the perfect blend of details and volumes tailored to your diffuse. There is really no limit to how complex your normal map can be. I usually work my way up from small to large detail, but any order will do. Combining the vast amount of tweaking options lets you recreate pretty much any volume.

When you're done, simply group the normals, name the group, and hit "Save" in the **Presets...** UI – you now have a custom preset to reuse at any time!

**Tip 1:** When creating new presets, I always start off with a 200x200 crop of my diffuse, instead of the full-resolution original. This is because I want tweaking to be as instant as possible when experimenting. I try to pick a part of the diffuse that contains a varied blend of details and volumes, representative of the diffuse in full.

When I'm done building the normal, I save the preset and try it out on my original diffuse. If I spot things to improve, I go back to tweaking the cropped normal and repeat until I'm satisfied.



# Cavity to Normal?!

Here's one of the more crazy bits of nDo2. In nDo2, displacement maps are computed by first converting a normal map to cavity, and then generating displacement from the cavity information. This means it's fully possible to generate height maps straight from cavity. As we can easily convert height to normal, reasonably, we can create normal information straight from a cavity map. This actually means we can just as well paint our own cavity maps, and directly turn them into normal maps. Mother of god...



By looking at a cavity map, we almost instantly visualize how the original normal would look. Unlike normals, it is extremely simple to paint -- learning how to emulate cavity thus opens up powerful new normal creation possibilities.

To paint a custom cavity map, it helps to keep in mind how a real one works. Cavity maps hold convex and concave details, coloring any outward-bulging edges white, and any inward-hollowed edges black. Any constant slopes or flat surfaces turn into plane grey -- thus I start off by creating a new document, filling it with a medium gray.

In the simplest of cases, I create two layers -- one for black cavities, and one for white convexities. For simple stuff, I usually go with a 2-3px soft brush with 10-70% fill opacity, and only use 100% black and white colors. I use low-to-medium intensities as cavity maps generally are not extreme in contrast. Note that painting with a too wide or intense brush will result in an unnatural cavity map, and thus probably a funky normal -- I urge you to experiment though! Start off with a few simple tests to get acquainted with the basic cavity-to-normal logic, and go from there!



All content created using  
**nDo2**  
Courtesy of Wiktor Öhman

As a final example, all normals in this scene are created with nDo2. Here the tool has been used extensively, as the scene holds tiling hard-surface normals, photo-generated normals, and basic high-poly normals combined with details made using nDo2.