



Above: Residential LA building,
ready for use in virtual production

Below: vrbn solutions skyscrapers
(rendered using Redshift 3D)

APPROACH AT VRBN SOLUTIONS

I'd say our internal approach to content creation is a bit unorthodox, but designed so very deliberately. We're focusing on artistic control and architectural consistency. Therefore, internally, we're not focusing on just one specific procedural workflow but rather multiple, with many supporting processes in the entire pipeline.

We can utilise all the little nuts and bolts to find a suitable solution for working with clients. We will continue to solely focus on the production of 3D architecture (no games or VFX work per se) and refine our toolsets further, so particularly smaller studios don't have to invest in an expensive pipeline.





Procedural Cities series #1 Challenges in procedural architecture

Matthias Buehler, founder of 3D urban environment specialists vrbn solutions, delivers his expert advice on managing procedural modelling projects

This is the first article focusing on ‘procedural cities’, in which we will dive into some of the general challenges of managing the creation of procedural architecture. There are multiple tools for the task out there, such as SideFX Houdini and ArcGIS CityEngine, though the artistic and managerial challenges are the same in every tool.

Creating a gazillion 3D buildings procedurally is quite easy – creating *good* buildings procedurally is difficult. Good in the sense of variety of types, consistent architecture, and optimised data (e.g. ‘levels of detail’ or ‘draw call optimisation’ for real-time use). With everything challenging, good management is key. Which is why, in this month’s article, we’re focusing on the often overlooked strategic aspects of planning procedural systems. Let’s dive in!

1. MANAGEMENT

1.1 Team The most crucial aspect of any project is the team. If you don’t have direct access to experienced specialists like classic architects, technical directors or programmers and you have to assemble a team, make sure you’re combining a team with strong skills in:

- Pattern analysis (geometric and in workflows)
- Communication (between both artists and developers)

- File management (meticulous naming and enforcing conventions)
- Persistence (both in problem-solving and repetitive work)
- Open-mindedness (assimilating novel work methodologies)

1.2 The Project Management Triangle

It’s paramount to define your goals precisely, with everybody in the dialogue (creatives, technical people, clients and so on). Define the precise terminology everybody uses and also which step comes with which (financial) consequences.

It is also quite easy to envision things that we believe are simple to solve which, in reality, will cost millions of euros/dollars to actually realise. But this is just natural and needs to be addressed, then solved.

It’s surprising how little known the Project Management Triangle is, so I include this little gem (see Figure 1). Use it – it’s a great catalyst to get to the point!

1.3 Key factors These five key factors (see Figure 2) are crucial to actively control when planning and implementing a procedural workflow. Furthermore, is there just one project, or are you planning a more long-term investment into procedural modelling? Which aspects of a production can and should be proceduralised? Also, not every project benefits from a procedural system, so carefully evaluate all available techniques for the job regarding their ROI. >

Figure 1

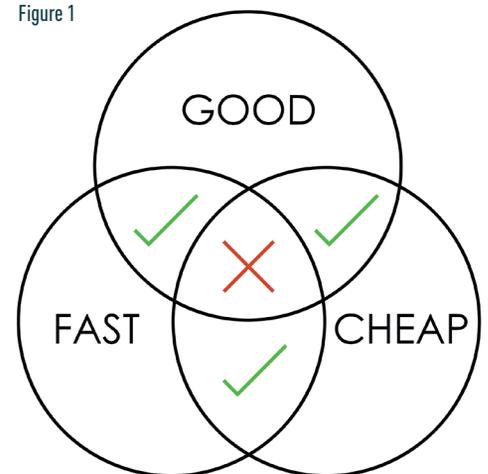
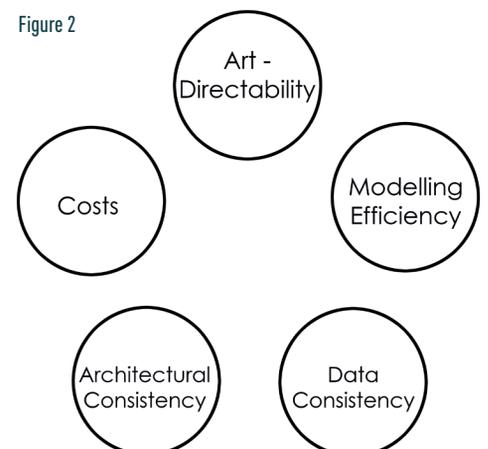


Figure 2



Above: The famous ‘Management Triangle’ and the five challenges when planning a procedural system

Figure 3. Paris in *Fantastic Beasts: The Crimes Of Grindelwald*



© Warner Bros.

2. ARCHETYPES

2.1 A bit of history The classification of architectural archetypes dates back to Ancient Greece. In those times, typically, architects were only tasked to design buildings and structures for the kings and gods, like temples or – dating even further back – the pyramids. Only during Medieval times did architects start to also design profane buildings like residential villas, museums, libraries, courts, hospitals, military structures, or universities. This was the time when architecture and craftsmanship diverged, and architects became more the ‘designers’ and ‘construction managers’.

Since then, many building types that follow certain inner organisational patterns (derived from the building’s usage) have emerged: the building typologies or ‘archetypes’. Let’s start by having a look at two examples – this should make the term quite clear:

1]. Residential buildings in Paris in *Fantastic Beasts And Where To Find Them* [see Figure 3 above]. We observe a clear structure with repeating patterns and constructions – only broken with two landmarks (the Eiffel Tower in the far left background and the Sacré-Coeur basilica in the centre).

2]. Residential buildings in Lake-town in *The Hobbit* [see Figure 4]. Also here, we find just a handful of elements: residential buildings, broken up with a bridge, a few towers, and the Town Hall further back.

You’ll notice that these archetypes are typically chosen to underline the story visually through architecture – using architecture as a ‘silent actor’.

But why even bring this up? Because most procedural systems for architecture follow one particular archetype (and its constructive variations). Though in reality, cities contain many different types of buildings in a complex conglomerate.

But can’t a procedural system be repurposed for use in different archetypes then? See, this is precisely the tricky part... let’s dig deeper!

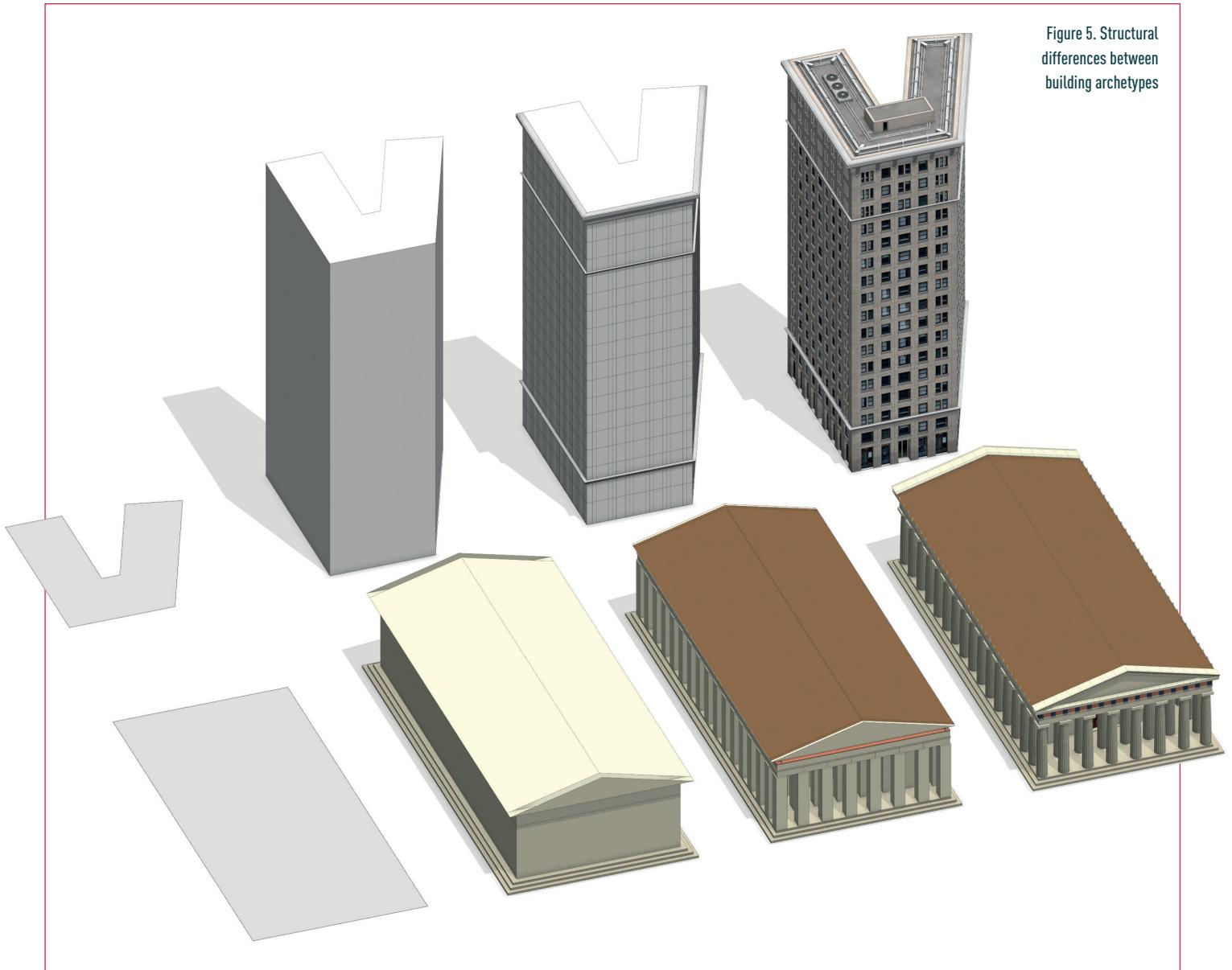
2.2 Examples of procedural structure

As you guessed, transforming one archetype into another isn’t just a simple process. Let’s visualise this using two examples, the Candler Building and the Parthenon (these examples ship with Tutorial 9 in ArcGIS CityEngine).

As you can see from all the different models in Figure 5, in both cases I stopped the procedural system (model generation) at consecutive points in order to demonstrate how the code structure creates the building – from the input footprint (left) to the final model (right).

By studying the images carefully, you will notice that the basic approach to first model the base volumes, cut the repetitive façade patterns, and then detail all elements

Figure 5. Structural differences between building archetypes



is in principle quite similar. However, the approach in the procedural rules of the two examples fundamentally differs in its topological approach. Because of this fundamental difference in the approach (and the subsequent detailing), archetypes cannot be easily transformed into others.

It becomes clear why analysing the target archetypes and structuring the procedural system (or systems!) accordingly is already crucial in the early project stages.

3. BELIEVABILITY & CONSISTENCY

Remember, buildings are not sculptures. Personally, to me, architectural consistency is of the utmost importance. It's about making the details work in the stories you tell. For example:

- A balcony needs a door to access it.
- Building elements should have realistic dimensions.
- Your buildings should not defy gravity... and so on.

“ARCHITECTURAL CONSISTENCY IS OF THE UTMOST IMPORTANCE. IT'S ABOUT MAKING THE DETAILS WORK IN THE STORIES YOU TELL”

Yes, these types of consistency are the hardest things to implement and get right. To research this field, try to find a person with knowledge in architectural construction, design theory, and history. Let them take charge of all aspects from urban planning to archetypes to the individual construction details, so all fits together concisely – like a giant puzzle. We will talk more about this in upcoming articles.

4. PRACTICAL EXERCISE

Let's go for something practical now. Following along with creating procedural

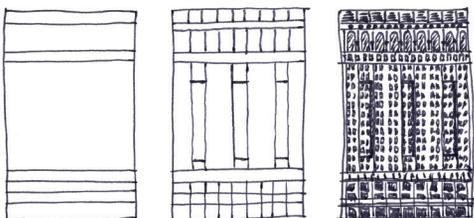
systems is a bit tricky in such a short article, so let's choose my favourite tools: good ol' pen and paper! As we saw, analysing a building's structure and breaking it down into patterns, subpatterns, and elements like windows or ornaments is an excellent exercise on how to proceduralise buildings. For this example, I chose the famous Flatiron Building in Manhattan. The eastern façade is 55m (180ft) wide and 87m (285ft) high.

Step 1: Look at some more reference images on the web.

Step 2: Draw a sequence of patterns >



Figure 6. Derived façade structure example sketch



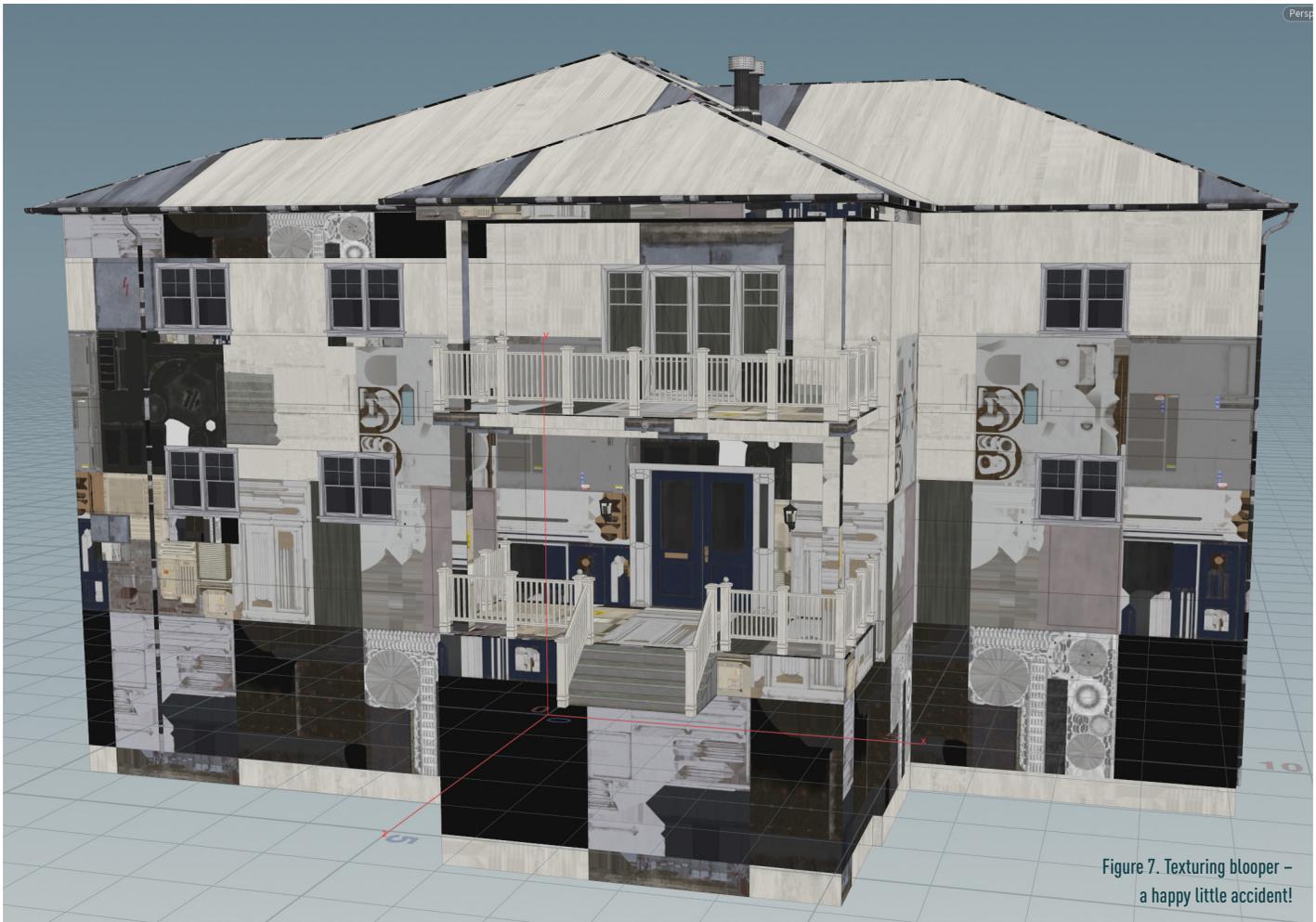


Figure 7. Texturing bloopers – a happy little accident!

“CLOSE COLLABORATION IS CRUCIAL IN SHAPING EFFICIENT PROCEDURAL SYSTEMS”

› that you think represents the building’s structure. (Tip: It’s best to first follow the lines that cut through the entire façade). See the example [Figure 6].

Step 3: Analyse your findings: do you recognise a clear structure among the main façade parts?

Step 4: Using the structural elements you found, draw some alternative façades and then decide which versions you like better – and why.

Step 5: Search more façade types on the web. Training your eye by analysing different patterns is probably the best exercise in general when diving into procedural modelling!

5. CONCLUSION

As we learned, the technicalities of procedural modelling are only one part of the challenge. Solving the technical aspects of the tools or production pipeline is usually a lot of fun (at least to some people). We see

many fantastic tech demos out there – we just have to remind ourselves that these are often not final or production-ready tools.

To summarise, the key points I’d like to make are:

- Procedural systems are not a ‘magic black box’ that have 3D cities ‘solved’.
- Smart planning and close collaboration between the technical and non-technical team members are crucial in shaping efficient procedural systems.
- Procedural systems have pros and cons – be aware of them and choose your strategy accordingly. Remember that each project will be different.

On the architectural side, the more realistic you’d like your architecture to be, the more aspects you will need to control. These controls will be the topic of next issue’s article, as we continue our series.

FYI For any questions, please feel free to contact the author via info@vrbn.io

CONVENTIONS

When producing content for a procedural system, conventions – especially naming conventions – are paramount

When dealing with many assets, textures, intermediate files, post-processed results and the like, there is no way to orchestrate everything without proper order and clean steps. You could say, “Well, this is more of a technical problem”, and I would agree, but still – as we’re mainly talking about managing in this article – it’s an organisational and time-consuming aspect. Automation only works if the computer understands the files (including their precise names). Every artist involved needs to understand every cogwheel precisely in order to work efficiently. Plus, humans are simply prone to making errors (e.g. typos). From time to time, a minor mishap, like in Figure 7 above, can be fun too, though.