AR-MA is essentially a hyphenated practice, which from the very beginning, was conceptualised as a way of bridging between architecture and manufacturing, or architectural research and material applications. ROBERT BESON

Which again brings us back to the issue of producing design intent, which operates in isolation. It leads to ambiguity and we want to shift away from design intent to design. Then to really break down the barrier between design and construction, you cannot operate with the means and methods feedback from contractors and subcontractors.

This then leads to sort of building as usual. Problem number three, where because we have this fence in between design and construction, we’re looking at huge amounts of rework. In a commercial building, let’s say you have about 3% of the total cost of construction allocated for a design phase or design engineering. All of that work in any of the design and construct components of that build, as soon as they’re passed over that contractual fence, get thrown into a bin and reworked at a cost of about 8%, which as architects we’re not able to capture.

We need to move to a more linear process, which we control as architects, and move away from drawing and towards a structured process of developing a 3D model for manufacture.

How do we harvest value from digital fabrication? It is also I think interesting to note that what we call digital fabrication and engineers call it digital engineering. There are so many different terms for this and I think it is very much contested at the moment. An option would be to vertically integrate, and offer end-to-end solutions. I think that as architects we don’t employ engineers, in particular, mechanical engineers. I would start getting rid of quantity surveyors. There’s absolutely no need to have a quantity surveyor at all today.

Number two, we need to stand next to the client. I think that when you have quantity surveyors as owner’s agents in between you and the client, it is already over. I would say absolutely do not accept jobs unless you have direct contact with the client. Number three, remove the tender process. The tender mechanism is designed to produce downward cost pressure on the contractors for the benefit of the client. However, it causes many more problems to delivery of buildings than it actually solves. It has become a liability. There are many other models for procuring buildings from early contractor involvement through to partnership models. We really need to push away from a fixed lump sum or a design-bid-build model.

I know that we mostly use Revit, but Revit is only a better way of coordinating 2D drawings. We need to move away from 2D drawings completely. If you are using pdf and looking at drawings, we’re doing the wrong thing. We need to sit down and say “Okay, all of the drawings that we produce on a project, what are they used for?” For everything from approvals through to marketing, to sell the units, etc. and then say “Okay, these are all the things what can we get rid of immediately?” What do we need to lobby government to get rid of such as approvals, for example. And then what’s left? You could probably get rid of about 40% or 70% straight away off the bat without going back, and then looking to improve others.

Lastly, start to develop products. I think we’re all at the mercy of projects and the cycle of projects and everyone feels the fatigue from that. There’s a huge amount of products from architectural systems through to technical apps for construction. There’s a huge opportunity for us to deploy the knowledge that we have in these ways.

Ben Milbourne Thank you Rob. Next I would like to invite Mal Bright from MAKE Architecture to provide the next presentation.

Mal Bright Thanks Rob. I think I might be here as the practice that could be helped by everyone and I’m looking forward to learning a little bit. There’s a lot of things that I really agree with you, and in our very small, humble houses, alts and adds projects ways, we are doing some of those things. We’re not digitally fabricating anything, so I’ll just come clean up front. Maybe we can, I’ll talk you through some of it.

MAKE is a small practice that I set up 10-11 years ago that started with a sort of kitchen and a bathroom. We might not be digitally fabricating anything but we are making things. We’re not making them with our hands but I still see that the work we’re doing is every house is almost treated like a prototype. It’s either got new materials, old materials used in a new way, or some other combination, old methods/new methods, usually something that we haven’t done before.
New materials. We test things and see each project as an opportunity to test a new material. We’re known for doing lots of brick buildings, but we do timber buildings and other things. In many ways I treated the practice like a little experiment about getting good at using different materials, we’ve just been practising for the last 10 years and trying to get a few things right. Using materials that are readily available, and trying to do something with them.

Simple things. We’re not being driven by a computer process that might output something. We’re driven by a design-led response that we want the computer to do something for us. Kind of banal dumb things, like a screen that’s really just our answer to a privacy or overlooking screen. Almost the only way in small alts and add ons that you can get architecture in is to say “Well, we have to have it for town planning”.

Or a brick texture [pg.18] – someone said “Did you use Grasshopper for that Mel?” or something like that when we first did it but it’s not there for that, it’s really our response to context. It’s not to say that – this is just what we do, and this is where I suppose MAKE come from. We work with builders, trades and craftsmen that use their hands and that’s the parameters within which I currently practice, and that we practice.

On messy sites with sticks of timber and two guys trying to get it up on a scaffold. Where the site is never really what you imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we go to, in order to work out a detail and carefully draw it, 3D model it in the computer, it’s never exactly what we imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I don’t know if any of my clients can afford it. No matter how much work we do, it’s not there for that, it’s really our response to context. It’s not to say that – this is just what we do, and this is where I suppose MAKE come from. We work with builders, trades and craftsmen that use their hands and that’s the parameters within which I currently practice, and that we practice.

On messy sites with sticks of timber and two guys trying to get it up on a scaffold. Where the site is never really what you imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we go to, in order to work out a detail and carefully draw it, 3D model it in the computer, it’s never exactly what we imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we do, it’s not there for that, it’s really our response to context. It’s not to say that – this is just what we do, and this is where I suppose MAKE come from. We work with builders, trades and craftsmen that use their hands and that’s the parameters within which I currently practice, and that we practice.

On messy sites with sticks of timber and two guys trying to get it up on a scaffold. Where the site is never really what you imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we go to, in order to work out a detail and carefully draw it, 3D model it in the computer, it’s never exactly what we imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we do, it’s not there for that, it’s really our response to context. It’s not to say that – this is just what we do, and this is where I suppose MAKE come from. We work with builders, trades and craftsmen that use their hands and that’s the parameters within which I currently practice, and that we practice.

On messy sites with sticks of timber and two guys trying to get it up on a scaffold. Where the site is never really what you imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we go to, in order to work out a detail and carefully draw it, 3D model it in the computer, it’s never exactly what we imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we do, it’s not there for that, it’s really our response to context. It’s not to say that – this is just what we do, and this is where I suppose MAKE come from. We work with builders, trades and craftsmen that use their hands and that’s the parameters within which I currently practice, and that we practice.

On messy sites with sticks of timber and two guys trying to get it up on a scaffold. Where the site is never really what you imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we go to, in order to work out a detail and carefully draw it, 3D model it in the computer, it’s never exactly what we imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we do, it’s not there for that, it’s really our response to context. It’s not to say that – this is just what we do, and this is where I suppose MAKE come from. We work with builders, trades and craftsmen that use their hands and that’s the parameters within which I currently practice, and that we practice.

On messy sites with sticks of timber and two guys trying to get it up on a scaffold. Where the site is never really what you imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we go to, in order to work out a detail and carefully draw it, 3D model it in the computer, it’s never exactly what we imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we do, it’s not there for that, it’s really our response to context. It’s not to say that – this is just what we do, and this is where I suppose MAKE come from. We work with builders, trades and craftsmen that use their hands and that’s the parameters within which I currently practice, and that we practice.

On messy sites with sticks of timber and two guys trying to get it up on a scaffold. Where the site is never really what you imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we go to, in order to work out a detail and carefully draw it, 3D model it in the computer, it’s never exactly what we imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we do, it’s not there for that, it’s really our response to context. It’s not to say that – this is just what we do, and this is where I suppose MAKE come from. We work with builders, trades and craftsmen that use their hands and that’s the parameters within which I currently practice, and that we practice.

On messy sites with sticks of timber and two guys trying to get it up on a scaffold. Where the site is never really what you imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we go to, in order to work out a detail and carefully draw it, 3D model it in the computer, it’s never exactly what we imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we do, it’s not there for that, it’s really our response to context. It’s not to say that – this is just what we do, and this is where I suppose MAKE come from. We work with builders, trades and craftsmen that use their hands and that’s the parameters within which I currently practice, and that we practice.

On messy sites with sticks of timber and two guys trying to get it up on a scaffold. Where the site is never really what you imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we go to, in order to work out a detail and carefully draw it, 3D model it in the computer, it’s never exactly what we imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we do, it’s not there for that, it’s really our response to context. It’s not to say that – this is just what we do, and this is where I suppose MAKE come from. We work with builders, trades and craftsmen that use their hands and that’s the parameters within which I currently practice, and that we practice.

On messy sites with sticks of timber and two guys trying to get it up on a scaffold. Where the site is never really what you imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we go to, in order to work out a detail and carefully draw it, 3D model it in the computer, it’s never exactly what we imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we do, it’s not there for that, it’s really our response to context. It’s not to say that – this is just what we do, and this is where I suppose MAKE come from. We work with builders, trades and craftsmen that use their hands and that’s the parameters within which I currently practice, and that we practice.

On messy sites with sticks of timber and two guys trying to get it up on a scaffold. Where the site is never really what you imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we go to, in order to work out a detail and carefully draw it, 3D model it in the computer, it’s never exactly what we imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we do, it’s not there for that, it’s really our response to context. It’s not to say that – this is just what we do, and this is where I suppose MAKE come from. We work with builders, trades and craftsmen that use their hands and that’s the parameters within which I currently practice, and that we practice.

On messy sites with sticks of timber and two guys trying to get it up on a scaffold. Where the site is never really what you imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we go to, in order to work out a detail and carefully draw it, 3D model it in the computer, it’s never exactly what we imagine, and it’s almost always not the right dimension. We might need the 3D Scanner but I didn’t know if any of my clients can afford it. No matter how much work we do, it’s not there for that, it’s really our response to context. It’s not to say that – this is just what we do, and this is where I suppose MAKE come from. We work with builders, trades and craftsmen that use their hands and that’s the parameters within which I currently practice, and that we practice.
material constraints is not the worst thing in the world. We do stand there with builders on site and do mock-ups and test them and decide whether that’s appropriate for the project, and up they go, and that’s the screen.

I think in some of this some of our clients accept risk. Like “Mel, how is this timber screen going to weather?”, and we have to have those conversations, and maybe it would be more straightforward to put aluminium battens on and go “Look, it’ll be fine”. Our builders become responsible in some ways and they do become responsible for the defects and how are we going to manage that. We do try and do some of the things you’re talking about. We don’t tender, we get builders on board early and we can do this because they’re houses. On our bigger projects, we’re like everyone else getting novated and being told what to do by the builder. On our houses we insist on this as a process. Sometimes we only talk to one builder and we start that process earlier on if we can get the client on board. That’s been incredibly useful because we then sit down with that builder’s trades and say “Hey, we want to do this thing, and how are we going to do it?”, and we work it through. It gets more and more expensive, and then we change the material and change the detail.

Similarly on this stair (pg.18), the clients had to accept that we weren’t quite sure if it was going to move and wobble or crack and it isn’t an exact science, and the clients kind of said “Oh, Mel, there’s a few cracks in there”; and I said “Well, you know, we haven’t done a stair like that before”, and the clients accepted it. Maybe not all clients accept that but that’s that stair, worked out largely with the builder on site because the engineer’s scope didn’t stretch to helping us work that out.

This project, Perimeter House, had some sort of fancy brick pattern. It’s not even that fancy when I see what other people are doing with bricks, but on a small alts and adds to a house, it’s just how do you get bricklayers to not add a huge premium and blow the budget on a house that only has a budget of $800,000? Which is not much on the scale of many projects. How do you sort of document these patterns without modelling every single brick in 3D.

The windows, they are sort of odd, are all custom designed by us, which opens us up to a whole lot of risk and we’ve had issues with some of these that we’re going back for again, and the builder sort of said “Oh, Mel, that was a really tricky detail”, and I say “Yeah, I know, but you agreed to do it and you were comfortable with it.” We try and have those conversations early and in many ways try and get the builder on board with the detail. We say “We really want to do this, we want you to be on board, but you have to be comfortable with it.” We are diverting that maybe unfairly risk to some of the guys we work with.

We are often trying to deliver things in 3D to explain construction sequence, or how things might go together. I wonder sometimes if we are opening up too much risk. My dear husband who is incredibly skilled and clever, is almost bordering on an engineer, and I have to stop him doing all of the engineer’s work. In some ways I feel like we have an in-house engineer. I was thinking about your comments, and he will sit there modelling the mechanical ducts and everything, and I have to say “Hang on, can you just detail the bloody architecture?”. We are very fortunate to have an incredibly old school architect that knows how things get built in our practice, with some fantastic graduates and architects. We do 2D details of windows.

This project, Raku House (pg.18), is the one we’re about to start, which is a ceramic screen that we’re working with Bruce Rowe from Anchor Ceramics who is an architect. He used to work at MAKE, and we sort of said “Oh Bruce, come on, let’s do some ceramic façade”. We’ve been talking with Bruce about extruding this façade piece together, and we’re testing that with him and prototyping it, and we’re trying to get the builder at the minute to sign off all the steel that goes together to hold it up. That’s the extruder.

This is our idea of how we think it would be going together, and what we first gave to the contractor. This is the sort of documentation that MAKE are doing that worry me because we’ve modelled all of the engineer’s details, and there’s a lot of overlap with what probably the engineer should do, but that’s what we’ve done for this house with screens set out and everything else. Thanks.

Ben Milbourne

Thanks Mel. I think we’re starting to get a sense of the spectrum of how different people operate in this space. Our next presenter is Roland Snooks, who will further expand that spectrum.
Roland Snooks: Thanks for having me, all who organised this colloquium. I’m going to briefly try and describe the trajectory of my work or how I ended up in the predicament that I am currently in, and then the way my practice straddles an architectural practice called Studio Roland Snooks and a research lab at RMIT University, and the way they tend to work together.

My background is in algorithmic design, generative design and computational tools. I’m sort of native to this type of work. Over a 10 year period my work was dealing with algorithmic design, the types of complex geometries that that generates and I was starting to look at the way these could be protoarchitectural structures, or ornament, or looking at the relationship between various different aspects of architecture in terms of skin structure articulation.

A lot of this was explored through a series of competition entries which were often relatively whimsical. After about 10 years of working this way, I became quite frustrated that there was no way that I could see of building these things. The last five years, and in particular since I’ve been at RMIT, has been looking at the way we can use digital fabrication to start to realise some of this work. What I’m going to try and explain today is through two projects I’m going to try and explain four different ways in which we have set up a relationship between the design we’re doing, and then the way that gets fabricated.

In terms of digital fabrication over the last couple of years we’ve been looking at a series of things, partly through direct metal fabrication of small objects, a lot of composite fibre, looking at fibreglass and carbon fibre and the way they can be used to start to synthesise between structural ornament and form. Flat packed materials, looking at the way material can be cut flat and then can find its own form, so we don’t need moulds.

Looking at a lot of the work I do, one of the hats I wear, is as the director of the Architectural Robotics Lab at RMIT, and a lot of the work has been looking at the way we re-purpose industrial robots to fabricate bits of buildings. In this case, gallery installations. These robots have been used to bend rods of various different scales to make pavilions and installations.

The most recent work that we’re doing is through large scale 3D printing of polymers and this has started to feed back into the design that we’re doing. It started to change what it is that we design through an understanding of new modes of fabrication. In a way we’re going back to some of the highly speculative geometry we’ve been working with for 15 years but we’re coming back to them with an inherent logical construction built into those generative design processes.

The two projects I want to show today, one is a gallery scale installation, and another one is a fit-out at a university. This project is called the Composite Wing (pg 22). It was developed and originally installed for the gallery in this building and subsequently went to Shanghai for the Biennale. It’s a fibre composite installation originally designed as a piece of exhibition design to try and exhibit the work of an exhibition called ‘The Future is Here.’

It’s made up of three large chunks and from those large chunks there’s eight smaller pieces. The algorithmic work that we’ve used developed fairly intense articulation and detail at two scales. One you can see it’s the larger scale of what is a foam inlay and a small scale of silicon inlay. Those inlays are both structural as well as ornamental. The deflection at the tip of the three millimetre composite wing would have been a metre, but it was reduced to less than 10 centimetres through the inlay.

This project was largely produced at RMIT, at least all the particularly tricky bits or untested bits were produced here within the RMIT Architectural Robotics Lab. A part of that were things that were very known, like multi-axis milling for the large foam parts (pg 23) and then parts that were entirely experimental and a little bit haphazard. We built what basically is a glorified caulking gun, and stuck it onto the end of a robot, and started squeezing out silicon to make that fine grain inlay (pg 23). That was printed onto a very fine mesh, which is the same mesh they use in wedding veils, and then that is then inlaid into the fibreglass. We’ve done a fair bit of fibreglass work at university but the bit we didn’t do is the fibreglass because it was quite large. It’s 70 square metres, it’s quite large for things that we do and it went out to a composites company called Composite Constructions whose background is in the boat industry. The other part that we made at RMIT is this mould, the