



Scenic Construction

Jevon Jones

1902309

Contents

3	Introduction
4	Introduction continued
5	Health and Safety Pt I
6	Health and Safety Pt II
7	Tools - Introduction
8	Tools - Part I - Measuring and Marking
9	Tools - Part II - Organic Materials
10	Tools - Part III - Synthetic Materials
11	Tools - Part IV - Metal instead of Timber
12	Tools - Part V - Drills
13	Drills Illustrated
14	Tools - Part VI - Saws
15	Saws Illustrated
16	Saws Illustrated Continued
17	Tools - Part VII - Fasteners and Adhesives
18	Theatre Flats
19	Theatre Treads
20	Flats, benches and the new workspace
21	Curved stair treads task
22	Curved stair treads task continued
23	Cave facade task
24	Existing sets: The Unreturning
25	Existing sets: 1979 Broadway set for Sweeney Todd
26	Orthographic Drawings
27	AutoCAD (In context to construction)
28	Exercises in AutoCAD
29	References

Introduction

Like many things in the entertainment industry, it is not enough to have a powerful imagination when it comes to visuals. One must be able to not just imagine and design a scene, but ‘justify’ its shapes and forms with coherent and straightforward plans that can be easily explained in a format that everybody understands. And on top of that, unless you have the means to hire somebody else to do it, you’re additionally going to have to be able to actually build your design in an efficient and structurally sound manner.

In this module, I hope to cover some of the basic principles of construction within the theatrical and cinematic industries. This includes the tools, the methods of designing and appropriate programs, some examples of sets that I really like, and some projects that me and my fellow students built together during the module.

As the upcoming set designers of tomorrow, we have an unusual task ahead of us. Due to the nature of the single use that most sets and props serve, we must somehow reuse and upcycle as much as we possibly can so that we can cut down on the infamous amounts of waste that these industries leave in their wake. Hopefully we can adopt positive new methods and perspectives towards used materials as opposed to brand new ones.

Introduction continued (My background & biases)

As a trained and qualified Joiner, I'm very familiar with a wide contrast of construction techniques. However, I suffer from the ailment known as perfectionism. This is one of my character flaws, and it is only made worse by my training in accurate joinery. I must try to keep a handle on that, as it often leads to me becoming a bit of a control freak when other less experienced builders try something for the first time. I am aware of this and I do try to incorporate others when I know they have never done something before.

Before I was trained in the above, I worked with various tradespeople in shopfitting, to timber framing, to theatre construction. Because of this I do feel comfortable with most woodworking tools, and I have undertaken various health and safety courses to aid me in my career.

I must try to slow down and explain what I'm doing to others when I fly off at 100mph, and not let my old habits of losing faith in people's ability to learn get the best of me. I hopefully will have some good opportunities to practice this during this module.

Health and Safety - Pt I

Aside from the obvious individual risks that each tool and powertool can pose, in general health and safety can not be taken too lightly, ever. As somebody who has worked in the construction industry, often times this macho workplace culture causes people to not wear the proper PPE, or forsake it entirely. Life is wasted on the living it seems; and though many in youth feel indestructible despite the warnings, later life will remind them of the risks they needlessly took.

Make no mistake, it is the responsibility of not only the individual undertaking the work, but also those around them to always be ready to flag any misconduct of health and safety. The school playground culture of 'snitching' is an incredibly bad influence here, as many workers are hesitant to report their friends and co-workers to the higher authority as a result of peer pressure not to.

If a worker takes risks, either for the sake of saving time or possibly out of sheer ignorance, they are putting not just themselves but all of their immediate colleagues in danger. We must strive to remember that.

Health and Safety - Pt II

In general, all fine dust is not meant to be breathed in. This only gets worse with the species of wood/type of man-made substances you are inhaling - the long-term outcomes ranging from asthma to a significantly shorter lifespan. The risks are not worth the short term convenience of not equipping a respirator. Always fit test. The same goes for goggles and eyes, and headphones and hearing.

In the film and theatre industries, working at height is commonplace. What many do not know is how small a fall can permanently change/end your life. I know a fellow theatre worker who's back was broken from a five foot drop. She was working on a production, and nobody told her the stage trap door was open when the lights were down. Her life was changed forever and she was only **20**. She was in the final year of her degree. Always make sure you and your co-workers know correct procedure with ladders and other rigging equipment.

Four by Eight foot sheets of 20mm plywood are very heavy, and full of ragged edges. Most sheet goods, as well as timber slabs are a major risk when not handled properly due to their weight and difficulty to grasp - this is a good time to touch on the importance of correct hand protection when moving said materials. An infected splinter can lead to an amputated finger.

And of course, there is the mechanical danger of the equipment and materials. It goes without saying that a steel/tungsten blade designed for cutting solid wood will have no trouble cutting through flesh and bones.

Tools - introduction

Our hands have evolved over countless millennia to hold the things we work with every day. And so, some credit is due to the humble hammer handle for changing *us* as much as we have changed *it*. Speaking of hammers, some basic line up of versatile tools can take you a long way. Electronic industrial machines, however, can turn jobs that historically would take days into minutes.

Every benefit comes with a cost, however. The machines that make our lives easier are often loud, dusty, and outright dangerous without constant observation. And though it is true that hand tools are dangerous - i.e. a sharp chisel or the teeth of a hand saw, the danger factor pales in comparison to an unguarded planer-thicknesser blade at full RPM.

With this progression and convenience, however, I feel it necessary to say that we must not forget the journey we took to this position in modern technology. And with respect to our ancestors, we should try to incorporate the older methods into our work - not just because they are sometimes faster (chopping a door hinge recess by hand versus setting up a router bit and all of the associated safety precautions), but because we live in an age where we ought to be saving energy in order to help curb the climate crisis.

We have to ask ourselves in regard to the latter, what is more important; the preservation of the environment we live in, or the time it takes to complete a job?

Tools - Part I - Measuring and marking

The most significant skill in any professional construction occupation is the ability to consistently measure to an accurate degree. It cannot be understated that much like a game of chess, making things is about seeing several steps ahead - in preparation for snags and errors. And just like a defeat snatched from the jaws of victory, every discrepancy in **your** ability to measure and mark will stack against **you** when it comes to the accuracy of the final product.

There is nothing to fear, however. Much of the difficulty of times past has been effectively eliminated with more modern technology. Modern measuring tapes feature a loosely riveted metal hook - this will account for the distance needed to measure the outside and inside of objects. But the ghost of human error will never stop haunting you; that metal hook will 'sag' with misuse. Eventually, unless you and your co-workers use that **one tape** for the whole job, yours and other people's measurements will slightly differ from each other because of that slop. You can bypass this slop by starting all counts from the 100mm or 2" mark, respectively. But be vigilant of factoring that extra length into your measurements.

An essential tool in marking and measuring is the humble square. An ability to accurately check 90/45 degree angles will definitely improve your work. There are many different kinds, from the classic wood/steel 'try square', to the adjustable engineer's square. Whatever you have, the key point is this, don't trust a square you have not checked yourself, and don't drop it. This goes for for your co-worker's squares too.

Last, but not least, is the humble pencil. A basic pencil is fine, but it will blunt after a few lines and then leave a thick, inaccurate line. So unless you are constantly sharpening it, that ghost of inaccuracy will be visiting soon. The alternative is to use a mechanical pencil. But they are fragile and expensive. Don't let your friends use it.

Tools - Part II - Organic materials

Timber is a fantastic resource. However, it is unpredictable at times, and easy to misuse in accordance with its strengths and weaknesses. Grain direction, knots, and moisture content will play heavy factors in the way it reacts to your attempts to build things with it.

For example, if a curved tree is cut down into straight timbers, those pieces of timber will, over time, bend to one side as the moisture leaves them. Timber is extremely sensitive to its environment, and in most cases moving a length of wood from one space to another (shop to a building interior) will cause it to acclimatize slightly - very likely curving or 'corkscrewing'.

And so, timber merchants grade their timber. It goes without saying that the higher the grade, the more likely it was cut from a more stable part of the tree with less knots and 'reaction wood'. Always check timber in person before you buy it if you can.



Pictured above are four species of hardwood I had on hand: Ash, Oak, Beech, and Utile. It is important to stress here that the terms 'hardwood' and 'softwood' mean very little in regard to timber density or quality. It is a marketing term used to sell furniture to people.

The softest wood species in the world, Balsa, is a hardwood. Meanwhile the sacred Yew's timber is harder than most hardwoods, yet it is a softwood. The two terms are referring to if the species is a broadleaf, or an evergreen.

Tools - Part III - Synthetic materials

Though technological breakthroughs, we have access to materials that would be impossible to obtain before 70 years ago. These man-made materials bypass the problems that wood grain presents in most cases. But they each have their own drawbacks.

Plywood - This composite material is made from several sheets of veneer (thin sheet shaving of a tree), with the grain direction alternated with each layer. They generally come in 8'x4' sheets, and come in a wide range of thicknesses. Each type of ply has a use, i.e. marine ply is made for boat construction and won't delaminate when moisture penetrates it. However, most plywood will delaminate once wet.

Chipboard - The mulleted child of the sheet goods, this material is made from recycled chips of timber that have been glued and squashed together to create a rigid board. Once again susceptible to moisture, and very unsightly compared to real wood. Mostly used when a solid sheet is needed to add structure to something.

MDF - This sheet based resource comes in 8'x4' sheets just like the above two, and the easiest way to explain it is to imagine chipboard, but with wood dust used instead of chips. It cuts smoothly compared to the above two, and its uniform texture is less offensive than the above mentioned chipboard. Unless you buy the chemically treated stuff for exterior use, this will also gently come apart once moisture gets involved.

Polystyrene - Though unrelated to the previous entries here, it does one thing better than all of them - depth and texture. It achieves this by being low-density, making easy to work with. Additionally, its not used as a building material, but more of a cladding material that is glued onto the internal structure. Because of its low density and workability, it will need to be sealed and painted in order to minimise damage after it has been sculpted.

Tools - Part IV - Metal instead of Timber

In live performance art, sometimes a set must be moved multiple times between each use (i.e. when a musical goes on tour). This means the set itself must be strong enough to withstand being taken apart and constructed without becoming weak and problematic in the joints.

This would not be an issue for a set built with traditional wooden joinery, but that takes time and is expensive. And simple butt joints held together with screws lose their integrity quickly - due to how end grain has very little holding capacity.

So for some sets that will have a long lifetime planned, or alternatively multi functional sets that will see years of use, the realistic option is metal scaffolding. By using the scaff bars and clamps as the 'skeleton' of the large props, the crew can reliably construct and deconstruct a safe set that can be used time and time again with minimal wear.

Metal is a good resource for construction, but it is heavy, difficult to cut without the right tools, and expensive compared to timber.

Tools - Part V - drills

Used to bore holes, drills are indispensable to any construction project. Though there are many types and jigs, generally they can be seen as two broad categories:

Hand drills - These portable, lightweight tools allow for quick boring in softer materials such as plastic and wood. Unless they are of the SDS percussion variety, however, they will be tedious when drilling through concrete - and very tedious when drilling through metals. These come in both corded and cordless versions. Corded is more powerful.

The danger of hand drills is pretty obvious, but the danger is more present when people are working carelessly around each other. Most frequently somebody will use one hand to give extra force to the drill, only to go straight through into their flesh.

Pillar drills - Are everything the hand drill wishes it could be, accurate, consistent, and heavy duty. Featuring a 'table' for one's work and a feed handle for very precise depth control, the pillar drill is fantastic for drilling perfectly straight holes (especially through steel). Additionally it excels in jig based work, and works well with clamps and funny angles.

Like any powerful machine, pillar drills can be seen as a 'vertical lathe'. Their sheer torque and unstoppable speeds do not go well with loose clothing and hair. Most modern pillar drills come with a guard, this is to be used at all times.

Speed selector

Torque/impact
selector

Forward
/reverse
selector

Trigger

Battery

Battery release clip

Hand Drill

Pillar Drill

Head

Chuck

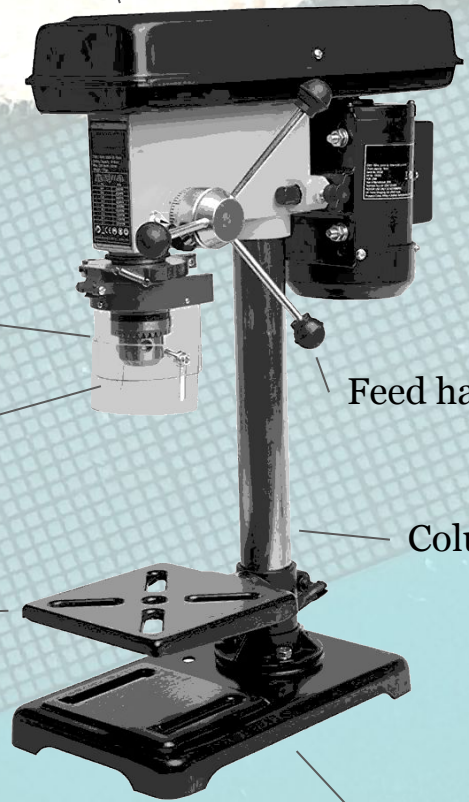
Guard

Table

Feed handle

Column

Base



Tools - Part VI - saws

Sheet materials are serious business when it comes to accurate cutting. Relying on a handsaw becomes impractical once you're dealing with eight feet of 3/4" plywood. These electrified saws handle straight lines and curves very well:

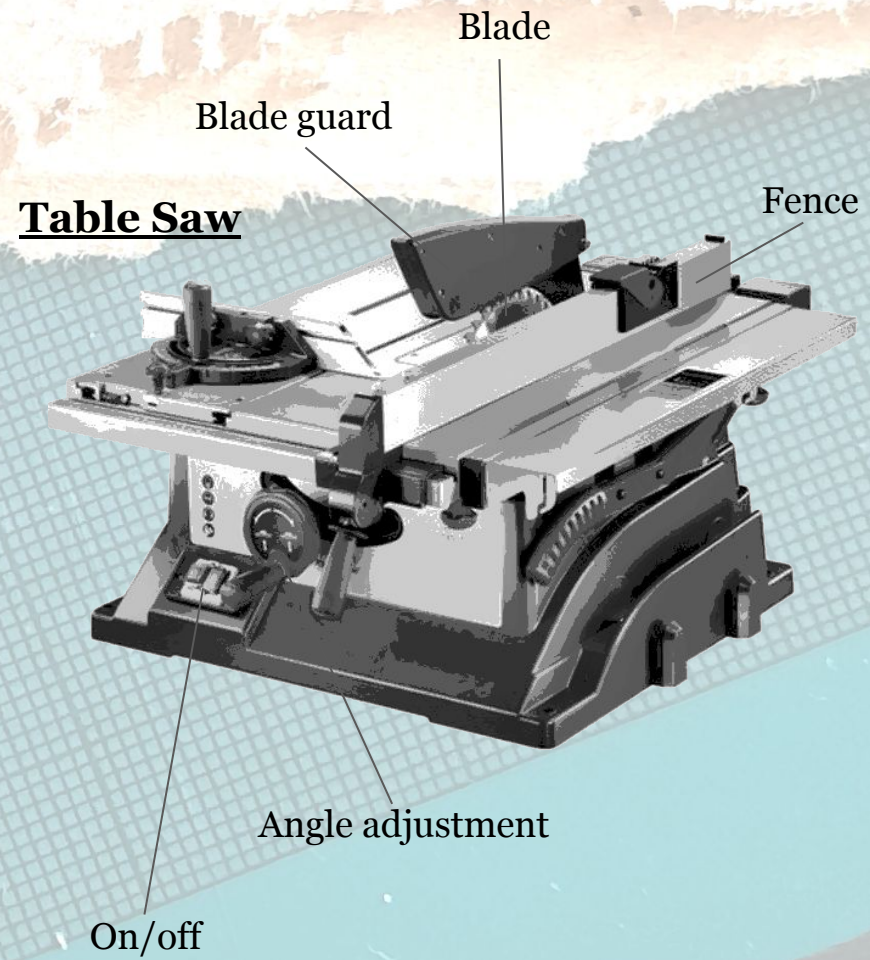
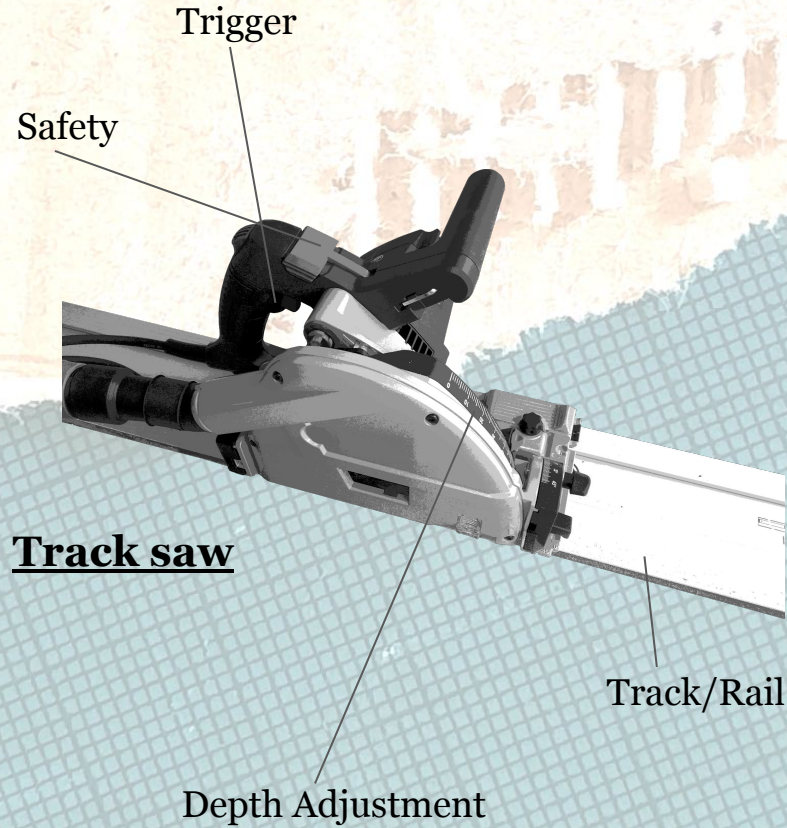
Track/Circular saw - This tool is operated by 'plunging' and pushing the tool across your work. By using a straight track, the saw will always cut a perfectly straight line. This saw is a must for working with sheet goods, if you don't have a table saw.

Table saw - Essentially, a circular saw, flipped upside down, and attached to a solid surface. You push the work across the saw against a moveable fence to achieve the desired cut. One of the more dangerous machines, table saws are credited with a majority of accidents in workplaces that use them. Between unsupported work flying back at the user, and people not using push sticks, they are dangerous because of the way that long, stationary tasks cause people to daydream while using them for long hours, thus they must be used with caution - and frequent breaks.

Jigsaw - One of the reciprocating saw family, this inaccurate tool is held in the hand and pushed along the work. Fast and flashy, the jigsaw cuts curves very well, but is useless at straight lines. Unless the foot is properly supported, this tool will wiggle about and cause trouble.

Mitre Saw - The most common and useful saw, this tool allows you to accurately cut to many different degrees, thus the name Mitre. Mounted on legs or a table, one places their work on its bed and brings down the saw into the cut. One must remember with most of these machines, that they should not be used to cut excessively short materials, as it means your hand is very close to the blade, as well as the un-supported work possibly being 'sucked in' - along with your hand.

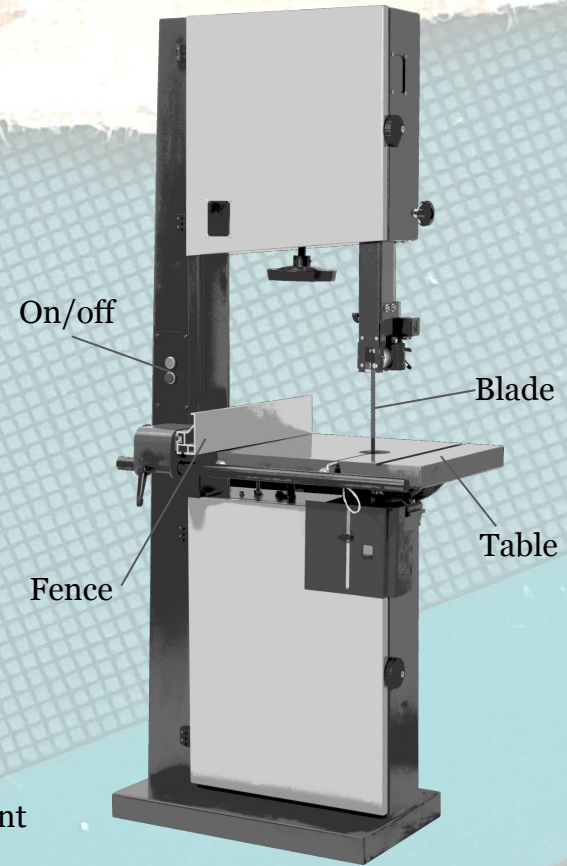
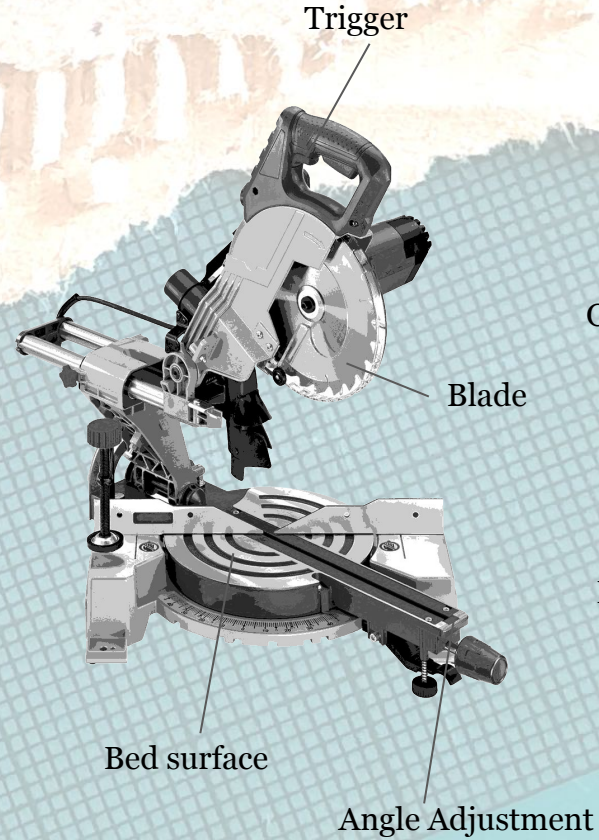
Band Saw - Another large machine, this machine fills a niche between the table saw and the jigsaw. Because of its thin blade, it cuts curves very well. However, because of its table and fence, it also rough cuts straight lines to a great degree of accuracy. Never cut round objects that are unsupported on the bandsaw.



Mitre Saw

Band Saw

Jigsaw



Tools - Part VII - Fasteners and Adhesives

Fasteners are what makes the construction world go around. Without fasteners and adhesives everything we make would have to employ mechanical joining methods. Which I would not mind...

Screws and nails - The go to fastener, screws are a simple evolution of the humble nail. Though wire nails are pretty useless for holding power, they are great for a temporary hold while you fasten in a different way. Screws offer superb holding power, but one must remember that in end-grain they will lose their hold as soon as any stress is applied to the joint.

Bolts - Bolts bypass the problems that screws and nails suffer, as they hold themselves in from both sides. Nuts and bolts are an incredibly versatile fastener, but are more expensive, more time consuming and fiddly. Perfect for a project that must be disassembled.

Pins and wiggle pins - With staples, pins, and wiggle pins, they should not be used alone. Ideally they should be holding together a joint with additional glue or other fasteners, as they are very akin to little nails otherwise.

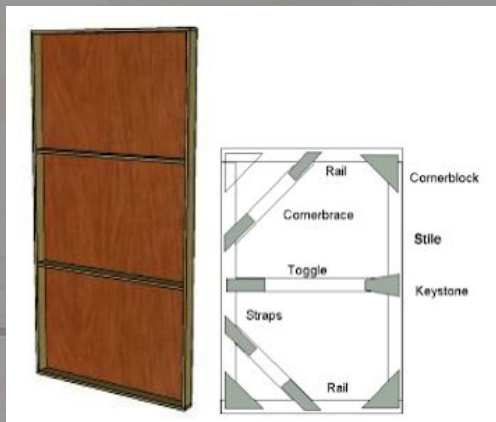
PVA vs expanding foam - The most common adhesives in the construction industry are Pva wood glue, and the resin-based expanding foam glue. Both are perfectly strong, the only real difference to the user is the set up time. PVA can take up to 24 hours to fully dry, whereas the appeal with the latter is that it can come in variants that take only 30 minutes to completely cure. This however, is offset by how messy it can be to clean up, compared to PVA, which is usually water based by comparison.

Theatre Flats

Flats are, in the most simplistic sense, used to emulate walls. Film, television, and theatre use flats - so flats can be generally divided into two categories: Hollywood and Broadway.

In theatre, flats can sometimes be hung via a fly system. Therefore, they are built to be low profile - this is done by placing the timbers flat against the plywood surface when they are constructed.

Hollywood style flats, are built with the timbers standing up, and usually slightly thicker plywood is also used. This allows this flat to be more sturdy, and suitable for doors and windows. They are not as easy to store, however.



(Watts, 2015)

Pictured to the left is an illustration of the components of stage flats, the 3d image representing how a Hollywood flat's timbers are placed 'standing up'.

Though old joinery can be used to make a flat stronger and longer lasting, typically a series of flat pieces of plywood are used to reinforce the butt joints.

These include the corner blocks, keystones, and straps.

On the right is a frame I built for my projection task in the production technology module.

I feel it is a good example of the principles of flat construction, with both half lap joints and corner blocks to keep it sturdy.



Theatre treads

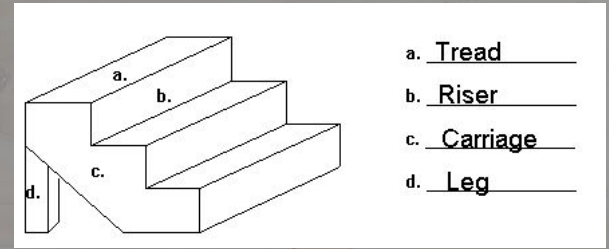
In theatre treads are the way actors enter and exit elevated stages. This puts a few requirements upon their design, such as a need for no noise, a safe sturdy structure, and a step ratio that conforms to muscle memory. The first two are pretty straight forward, in theory. The last point about ratios however, deserves further explanation.

As bipedal mammals, we have an average step length and height. Not known to many, is that stairs built across the world conform to these rules of that average step. Otherwise they risk being dangerous. This is because if a step misleads people's muscle memory of how high and long a stair step should take, they will trip and possibly fall. Therefore, it is no surprise to learn that theatre treads follow this same principle.

Think of a time that you've had to walk up or down stairs in the dark and how the last or first step can surprise you. Your foot expects a certain length until the next contact, and it's always a surprise when that contact comes sooner or later than expected.

Often, stairs will squeak with use. This is caused by two pieces, most commonly a tread and a riser, rubbing together. In a theatre environment, this would be most unwelcome, as the control of sound is crucial for atmospheric purposes. Thankfully, as Ullman and Vila (2021) mention in their blog, this can be remedied with strategic use of wooden blocks:

“Apply wood glue to the two shorter sides of each glue block, and then firmly press the blocks into the right angle created by the meeting of the riser and the tread. Position one block in the center of the step and the other two at the opposite edges of the step.”



(Alderson, 2010)

In his document titled ‘platforms, parallels and stairways’, Alderson (2010) summarises the different kinds of stairs in theatre as open and closed carriage, this refers to the way in which the side panel is cut to accommodate the treads and risers. A stronger carriage panel will not need so much ‘meat’ to do the job, and therefore can be made from a thick timber, but will need a leg to support it. Closed carriage, however, is when a sheet of plywood is used to cover the entire side, and is strong enough because of its thickness. This does not need a leg, but is not as structurally sound as the former.

Flats, benches and the new workspace

When we first had our days in the Carmarthen workshop, we set about doing multiple projects at once. We resurfaced the tables with fresh sheets of plywood, but we also made flats (both kinds) in groups.

For me the difficult part was not learning how the tools worked, but rather how to slow down and explain what I was doing to other people instead of completely hijacking the whole exercise from them.



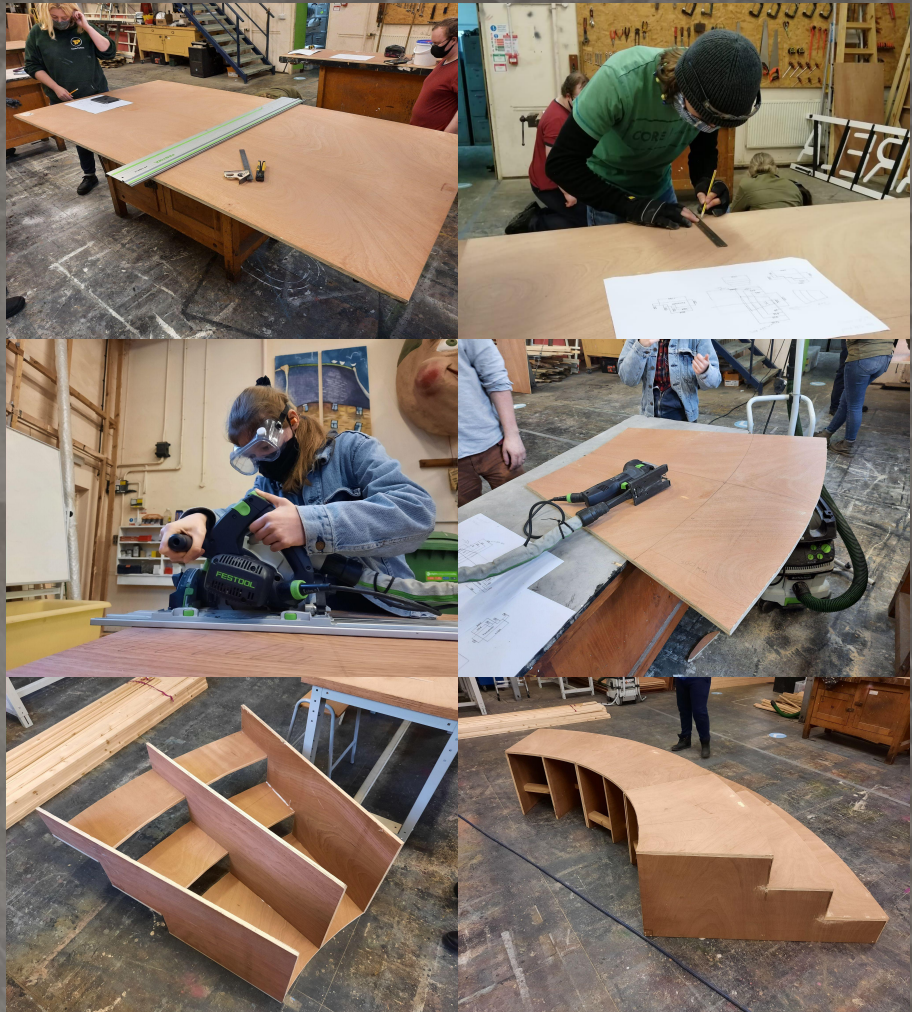
Curved stair treads task

As soon as we were established in the workshop, we started working on something that was to be used in a real production - a set of stair treads.

This would be much more serious than the previous tasks as we could fail if we didn't take care during layout.

Because we were short on people, I kept being moved around to the different groups. All in all I took part in the construction of three stair treads. This seemed frustrating at the time, but in retrospect it was probably for the best, as the tools are not the difficult part for me, rather the *teamwork* component.

I had the opportunity to try to help with several different people's challenges with their stair treads, and the compassion is the real task for me sometimes. I had fun overall and I'm proud that our treads seemed very stable.



Curved stair treads task



Here you can see three of the treads lined up next to each other, and they look pretty good in my opinion.

Stacey took the photo from the balcony, and we were told to make funny faces. I'm not purposefully trying to look like everybody is driving me insane (Though in this photo it certainly looks like it!)

Because of Covid, there would be a big space between this task and the next one.

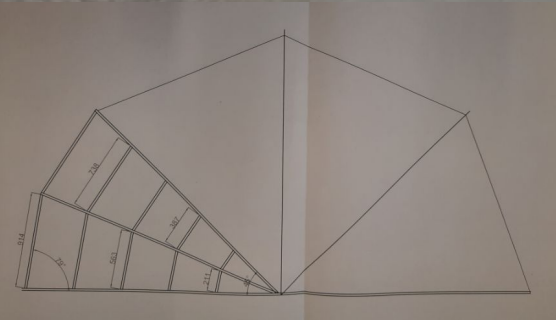
Cave facade task

Even more intricate than the previous tasks, the cave facade had us using tools I had never seen before.

Initially we built curved 'struts', that we then joined together in tangents to create skeletons that could be clad with plywood to control how light moves through them.

After that we got to carve polystyrene with a hot wire tool, it was incredibly messy but very satisfying.

Once again I feel the challenge for me was delegation, as most of the work was not new to me. I think I had a better hang on it this time, as we would circulate the tasks around between our group. Once everybody understood the tool or procedure, that's when I would go full speed and just tie up loose ends.



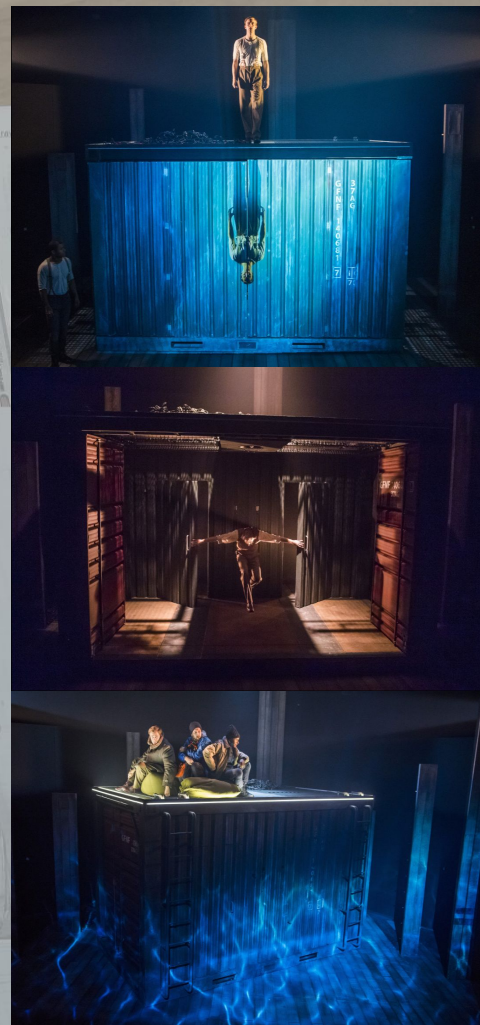
Existing Sets: The Unreturning

Frantic Assembly's production *The Unreturning* features a set like no other. By using a revolving shipping container with multiple doors, a state of the art projection system, and a cast of fantastic talent, they achieve so much with so little.

Using the containers multiple doors and positions, they portray three separate times in history, from the 1910's to 20 years into the future.

What amazes me about this set is that they can have one man pushing the entire shipping container with no trouble, and then suddenly there can be three people jumping and climbing around on top of it, without it budging an inch. The core concepts of the play, with its ever changing set, are the ways in which conflict displace people's lives.

“What happens when you go home? Do you feel the same? Do you see things differently? How does home see you?” (Graham, 2018)



(Graham, 2018)

Existing Sets: 1979 Broadway set for Sweeney Todd

Though there are many incarnations of this story, the 1979 Broadway rendition has some unique character to its set.

Legendary designer Eugene Lee was tasked with this production's set design, and he opted for a visual that made it look like all of the inhabitants of London were eternally living inside a dark filthy factory, where they never get any sunlight. The masterful use of shadow and run down paint on wood achieves this effect to a terrific degree.

On the construction of the set itself, Lee had this to say:

"During the load (when the set gets installed in the theatre), the work stopped for a bit as the steelworkers union said it was their work - not stagehands'. It was a very heavy set with a lot of steel" (Fierberg, 2018)

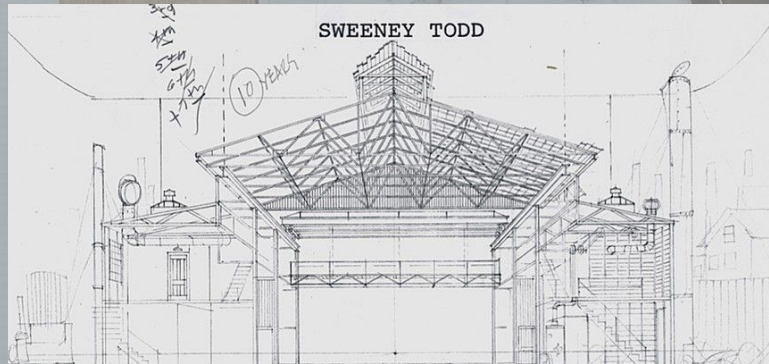
As the nature of Broadway is often a long and drawn out one, this use of steel is a perfect example of a set being designed to be long-lasting, as opposed to a fixed set with a limited life-span.



(Skethway, 2020)



(Fierberg, 2018)



Orthographic drawings

Though I have already covered perspective drawing and architectural drawing in my previous module 'Modelling a Set', there is a component I did not touch on, that is the difference between **first angle** and **third angle** orthographic drawings.

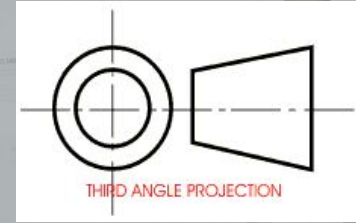
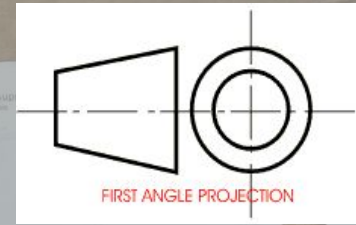
Though the components of what makes an orthographic drawing (Plan view, front view, and side views) are the same in both types, it is the positioning and orientation that sets them apart.

In **3rd angle** layout, the object can be seen as an 'unfolded' version of itself. So to remember easily, think of it being called 3rd angle, because you view the object from the third person. Thus, the face to the left of the front is seen labelled the left side view, and so on.

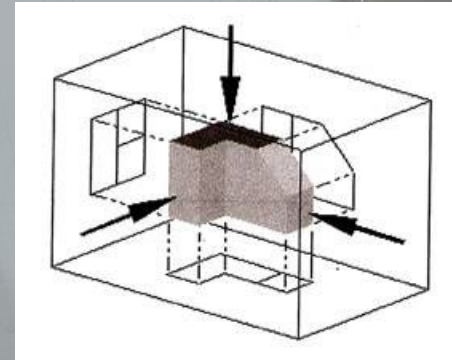
In **1st angle** layout, the object is seen from inside it, and one has to imagine that the sides are then projected onto the flat drawing from those locations. Therefore, the side to the left of the front face is the right side view, and vice-versa.

This system of first and third angle has no language barrier, but instead uses a symbol to illustrate which system is in use. Both use a 'cone' and a 'target' (Pictured above), their positioning indicates which style of orthographic drawing is to be undertaken.

"In first angle projection, each view of the object is projected in the direction (sense) of sight of the object, onto the interior walls of the box. A two dimensional representation of the object is then created by "unfolding" the box, to view all the interior walls." (Kelly, 2014)



(Ryan, 2010)



(Kelly, 2014)

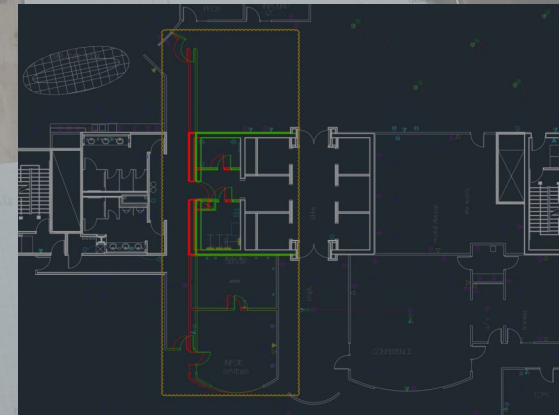
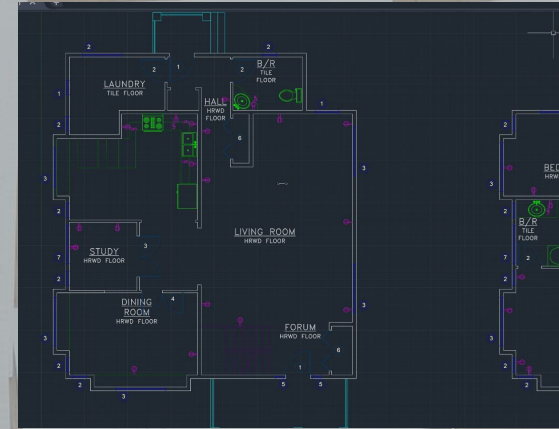
Autocad (in context to construction)

Developed and marketed by Autodesk, Autocad is a software tool that allows architects and amateurs alike to precisely layout and design three dimensional objects in an efficient, accurate manner. This means that for architects of theatre sets, the impacts of this program are monumental to how they plan and shape their designs.

The program can be used to draw accurate lines, curves, zigzags, or any other preset pattern to illustrate what components go where. With a default feature of inputs based around whichever measurement system the user chooses, a drawing can be very quickly created - and then imported directly to other hardware systems, such as a CNC machine. Therefore, it can be somewhat indispensable to somebody who works with this kind of machine, as it is so quick and convenient to program it to cut the exact measurements you need.

As well as the ability to draw, you can also use all the common functions of a illustrative program to further speed up your process, i.e. copy intricate parts of a room to skip drawing it numerous times. It is especially useful for architects, as they are always conveying their ideas to a third party. With the click of a button, you can turn every line into a wall of your desired thickness, and so forth.

“Recognizing the potencial offered by computation, AutoCAD was originally developed as digitization of hand drafting tools. However, over the course of almost 40 years and the release of 35 versions, Autodesk AutoCAD has transformed the way that designs are conceptualized, developed, and ultimately documented in 2D drawings and 3D drawings.” (Freund, 2021)

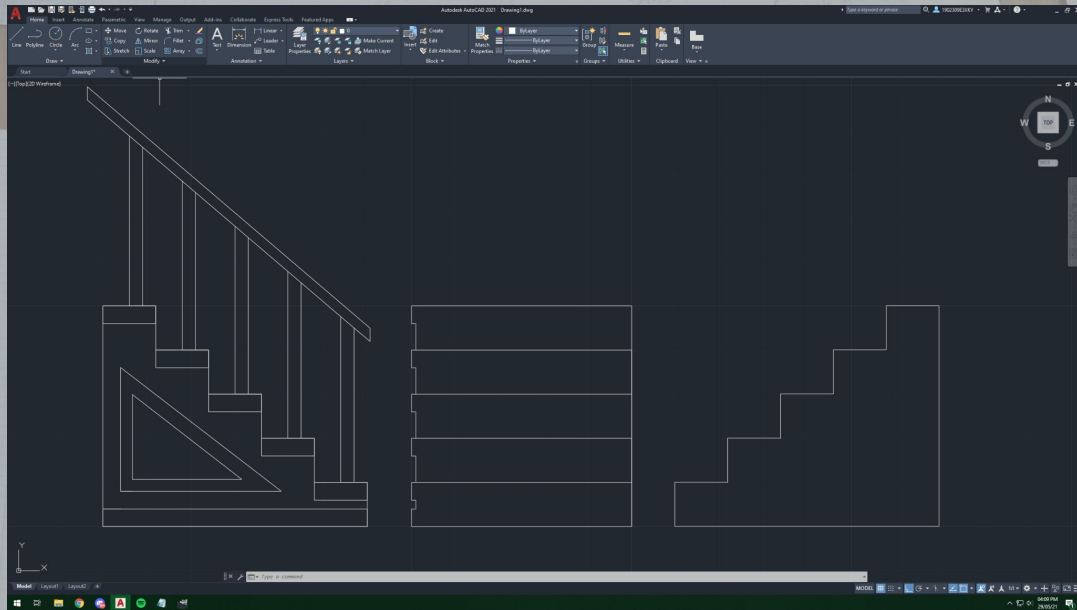
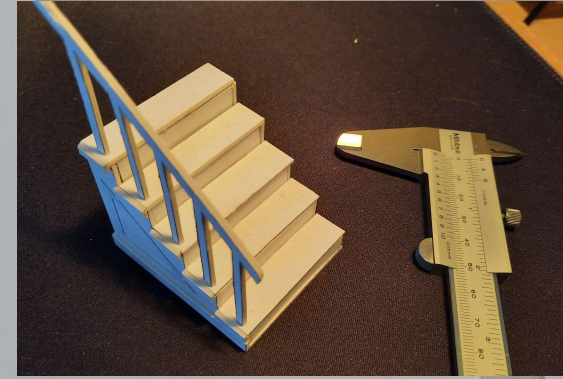
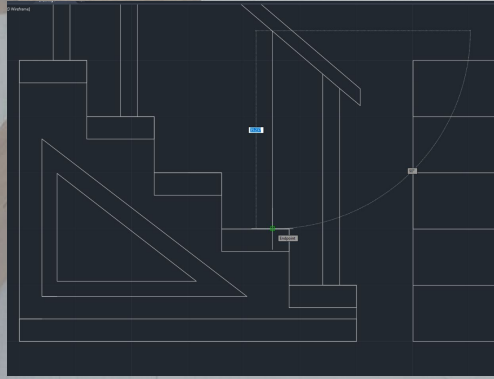


(Anonymous, 2021)

Exercises in AutoCAD

Though learning a completely new software was intimidating, I eventually 'got in the groove' while using AutoCAD for myself. Using a temporary student license, I replicated a real life prop - the model stairway I made during my first module of the course. I did this in the 3rd angle orthographic variant.

We had dabbled in the software before, earlier in the academic year. But I did run into some difficulties at first, however once I had learned a few shortcuts my struggles were mostly overcome. I'm sure as more challenges present themselves, this will encourage further learning of the software's many functionalities.



References

- Ullman, M & Vila, B (2021) 5 Solutions for stairs that squeak [bobvila.com] Available at: <https://www.bobvila.com/articles/how-to-fix-squeaky-stairs/> (Accessed 28th of May 2021)
- Alderman, M (2010) Platforms, Parallels and stairways [ia470.com] Available at: <https://www.ia470.com/primer/platform.htm> (Accessed 28th of May 2021)
- Watts, M (2015) Hollywood and Broadway flats [sites.google.com] Available at: <https://sites.google.com/site/olympushighstagecrew/home/certifications/hollywood-and-broadway-flats> (Accessed 29th of May 2021)
- Graham, S (2018) The Unreturning [franticassembly.co.uk] Available at: <https://www.franticassembly.co.uk/productions/the-unreturning> (Accessed 29th of May 2021)
- Skethway, N (2020) Looking back at the original broadway production of Sweeney Todd [playbill.com] Available at: <https://www.playbill.com/article/looking-back-at-the-original-broadway-production-of-sweeney-todd> (Accessed 29th of May 2021)
- Fierberg, R (2018) 20 secrets behind the scenic designs for Wicked, Sweeney Todd and more [playbill.com] Available at: <https://www.playbill.com/article/20-secrets-behind-the-scenic-designs-for-wicked-sweeney-todd-and-more> (Accessed 29th of May 2021)
- Ryan, V (2010) First angle - orthographic projection [technologystudent.com] Available at: <https://technologystudent.com/designpro/ortho1.htm> (Accessed 29th of May 2021)
- Kelly, M (2014) First and third angle orthographic projection [summaryplanet.com] Available at: <https://www.summaryplanet.com/engineering/First-Third-Angle-Orthographic-Projection.html> (Accessed 29th of May 2021)
- Freund, J (2021) What are the benefits of AutoCAD? [microsolresources.com] Available at: <https://microsolresources.com/tech-resources/article/what-are-the-benefits-of-autocad/> (Accessed 29th of May 2021)
- Anonymous (2021) AutoCAD 2021 is here: see what's inside [blogs.autodesk.com] Available at: <https://blogs.autodesk.com/autocad/autocad-2021/> (Accessed 29th of May 2021)