Preface

Who This Document is For

This document is primarily intended for digital artists looking to improve their skill at making armour in Zbrush. It may prove useful for artists working in other mediums/software too. While this document focuses mainly on European plate armour, the concepts discussed can be used to improve any kind of armour, regardless of genre or artstyle.

This is a WIP project that I will maintain over time with updated information or with new tips I may have on the subject. The finished document will include short video tutorials on each subject, particularly on Zbrush techniques. Do let me know if I've written anything false or misleading; I know a fair bit about the construction of armour, but I don't consider myself an expert on the subject.

About the Author

I'm Sheng, a digital artist with a focus on character armour. Before I was pushing vertices, I studied the trade of the armoursmith. I mostly work with Bare Mettle Entertainment on the indie physics combat game Exanima, but have also worked for Grinding Gear Games on the ARPG Path of Exile. Outside of my job, I work as sole developer on an MMORPG of my own design as a challenge for myself and possible magnum opus. You can find more of me over at Artstation and Youtube.

Yes, This is Free

-Armouries across Europe are either entirely free to the public, or are accessible for a negligible fee. I think charging for information that is readily available would be amoral; all I've done here is hopefully make it more convenient for the digital artist to consume.

-Nearly everything I've learned has been from free sources. I've had a lot of help given to me for free from fellow programmers, artists & armoursmiths. We all stand on the shoulders of giants, and now it's time for me to contribute.

-It's not my heritage. Although a decent amount of work has gone into writing and organizing this document, I'd feel odd selling this. However, I do plan on creating and selling useful tools for making 3d armour in the near future at a fair & affordable price. If that sounds interesting, you might want to consider following me on one of my channels.

Helpful Resources

Before we get into this, here are some resources that will be worth looking into.

-Some armour references I took, a Huawei P9 was all I had at the time, so the quality of the refs aren't amazing. If you want better, I recommend buying some of Dr. Tobias Capwell's books. They have stunning professional photographs, text explanations, all that awesome stuff. Nothing can substitute visiting these places in person though, so definitely do that if you're serious about making armour.

-TOMAR - Techniques of Medieval Armour Reproduction by Brian R. Price. You can find it for sale online.

-Myarmoury & the Armour Archive. These are forums where you can pester old masters of armoursmithing who know more than I do. They also have extensive resources. Tell them you want to dual wield zweihanders or make anime armour, they'll love it.

Why Study Armour?

Armour shows up in many games and across multiple genres. It's very prevalent in the video game industry, as well as film. Good looking armour is important in live service games to attract player attention and increase sales of microtransactions. In the film & TV industry, it can help market movies and sell tickets or subscriptions. Conversely, bad looking armour can have the opposite effect.

Like the human body, armour has its own anatomy. It needs to be treated with the same attention to detail that, as digital artists, I know we're all more than capable of. When learning the anatomy of armour, you'll begin to understand the purpose and intent behind certain design elements, and having done so, can then apply these fundamental concepts to your own creations, whatever the genre and artstyle it may be.

Lastly, I just want to say armoursmithing is a very broad subject with a lot of nuance, and this is an understatement. It'll be impossible for me to cover it all satisfactorily in one document, as this document only focuses on the visual and mechanical aspects of armour, and methods of replicating it in digital form. There is an incredible wealth of history that follows plate armour that would simply be far too much to cover. External studies are highly recommended, as well as reaching out to forums & communities where modern armoursmiths gather.

Things to Keep in Mind

Primary vs. Secondary References, and How to Find References

If you've ever written an essay, you were likely taught to know the difference between primary and secondary references for use in citations. You want to focus almost solely on primary references. Can you guess which of the below image is a primary and which is a secondary?

Learning how to find primary references is important. A good method is by searching Google with the family names of armoursmiths, such as 'Negroli' or 'Helmschmied'. These two names will return a lot of good results. There is seemingly a small industry around producing extremely cheap, extremely ugly pieces of armour. Avoid these, unless you're making satirical art.

Context is Key

You'll want to ask yourself these following questions, it's helpful if you already have solid world building established.

-Who/what are you armouring?
-What will they be fighting?
-In what time period will the fighting take place?
-Where will the fight take place? (What environment? Cold, hot, swamp, desert?)
-How will they be fighting? What is their fighting style, and what weapons will they use? Are they on foot, or are they mounted?
-What is their financial status?
-What are the available resources/materials in your world for making armour?

These questions affect many aspects of the armour; how and where the armour is placed, its weight distribution, how it's constructed, what materials the armour is made of, decorations (if any), and so on. Weapons play a key role in determining armour, and especially shields; if you have a shield you may require less armour - likewise if you're using a two handed weapon you'll want more armour. Foot combat vs. mounted combat also plays a large factor in determining how armour is constructed.

Layers

Armour is a multi-layer defense system. Learning how these layers interact with each other and the body underneath, how they affect appearance and angles of motion is important. With plate armour, you'll usually have this setup:

Clothing>Pourpoint>Mail>Plate

In later periods whole mail shirts are reduced to mail goussets; patches of mail laced to the pourpoint that cover gaps in the armour.

Plate is laced to the pourpoint.

Materials

Steel

Plate armour is made of steel, but there are different grades and thicknesses. The real take-away as a digital artist is that plate armour is quite thin, but through several techniques is made stronger. If you require a thick edge to your armour, consider using rolled edges.

Brass

Brass is used in plate armour for rivets, cast fittings and decor, and trim.

Gold

Gold takes the form of gilding and wire.

Leather

Leather is sometimes used as strips to connect lames together, particularly when a very high degree of flexibility is required. It is also used as straps to connect plates.

Linen

Linen is used everywhere, from gambesons to being a substitute for leather straps used for plate articulation. Hemp and jute are good alternatives.

Silk

Silk is used in many articles of armour; lower grades of silk are still prized for their durability and can be used in sewing gambesons, whereas higher grades can be used to make covered plate.

Weight Distribution

Managing weight and how weight is distributed throughout the body is important, and plays a key role in the protective as well as offensive capacity of armour, as well as the overall appearance of the armour. Most suits of armour weighed around 60-80lbs. If you have a fictional race of very strong green people with tusks, you can probably increase that weight limit.

In plate armour, weight is managed with a cuirass that has a snug fit around the natural waist; this frees the weight of the cuirass so it's resting on the waist and not hanging from the shoulders, allowing for less encumbered arms. Similarly, the entire leg rig - cuisses, poleyns and greaves are connected to each other with twist tabs and by harness to the waist, leaving the legs less encumbered and allowing for faster movement. The sabatons are laced to the shoes.

Ankles and wrists also have a snug fit, so the armour doesn't bounce around wasting energy.

Movement and Animation

If the subject of your armour requires air, you need a cavity in the cuirass to allow for expansion of the lungs. This internal cavity will also create a convex surface, the classic shape of a breastplate that serves well to redirect & deflect blows from bladed weapons.

Plate armour is made of smaller plate components riveted together called ‘lames’. In higher end suits, the articulation is immaculate like the metal strap of an expensive wristwatch, and is usually far more flexible than the human body.

A common mistake of 3d artists is not adding detail to show that armour can be removed. You’ll want to indicate this by adding straps, spring rivets, latches, or similar detail. You’ll want to think about how it is removed; a cuirass for example has four connection points that connect the breastplate to the backplate, but one of these four are oftentimes hinges.

Protection Priority

There is an armouring priority when in a scenario such as not having enough materials to make armour, or wanting to forego armour in favour of less weight. Head, neck & torso, then arms, and then legs.

Functional Rivets vs Decorative Rivets & the Intelligent Placement of Rivets

In line with the philosophy of form following function, rivets are an important detail of plate armour that necessitate knowledge of armour anatomy to place correctly.

The Main Components of Armour

Helmet (Head)

The helmet is arguably the most important piece of armour you can have. I usually drag out a sphere, and with the move brush nudge it into shape. I slice it where necessary with the CurveSlice brush, and use Zremesh or manual retopology depending on the need or complexity.

Gorget (Neck)

With the gorget I usually make a duplicate of the base mesh, inflate it by 5, and then it's just a matter of curve slice, move brush, and some zremesh & zmodeler here and there. This is actually a somewhat complex piece of armour, despite appearances. You don't want it to be too tight; leave room for padding and breathing.

Cuirass (Torso)

The cuirass is normally made of two or more parts, primarily the breastplate and backplate; front and back. These pieces are sometimes divided further into lames and plates, like the plackart.


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Faulds & Tassets

Cuirasses sometimes feature faulds and tassets. Faulds are the horizontal plates attached vertically from the bottom edge of the cuirass, sometimes by straps and sometimes by rivets or other means. Tassets are the usually larger plates that hang from the end of the fauld, and serve to protect the gap between the cuirass and the cuisses, while allowing free range of motion.

Pauldrons (Shoulders)

I think most people know what pauldrons are. These are larger pieces of armour made of multiple plates and lames and protect the shoulders. They often appear with besagews and/or haute guards, and are often asymmetrical. Maximilian pauldrons feature quite large haute guards.

Rerebraces (Upper Arms)

Rerebraces are basically tubes cut in half with hinges and spring rivets. They sometimes feature minor articulations in the upper portion to help with shoulder articulation.

Couters (Elbows)

Couters are rounded, sometimes conal plates

Vambraces (Forearms)

Gauntlets (Hands)

Cuisses (Upper Legs)

Poleyns (Knees)

Greaves (Lower Legs)

Sabatons (Feet)

Modular Toe Plates
Modular Spurs

Auxiliary and Alternative Components of Armour

Rondel

A rondel is a round disc of metal. They can basically be placed anywhere where extra defense is needed, or used in place or as support for besagews, couters or poleyns.

Encranche

Modular Jousting Reinforcement Plates

Bevor

A bevor is a less protective neck armour. It protects the front of the neck and usually the bottom half of the face. These are often collapsible, and can be lowered and raised and worn in conjunction with the sallet.

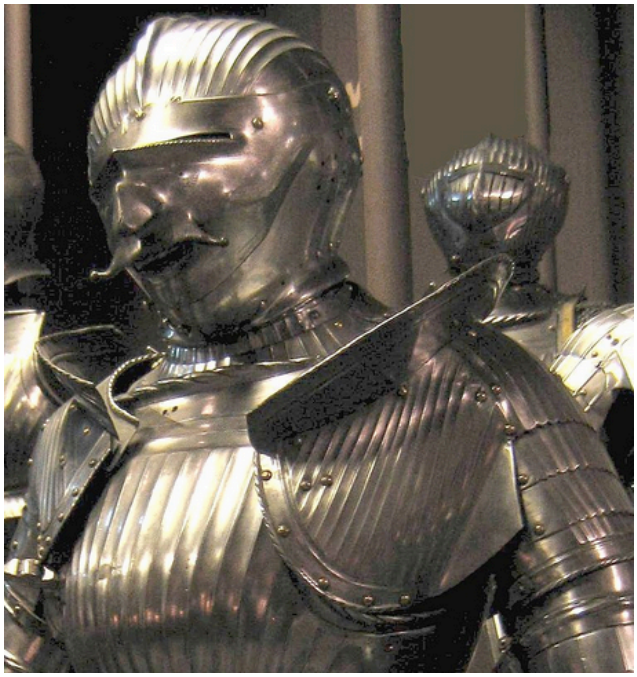
Lance Rest

The lance rest is an expandable/collapsable hook that is bolted to the front and to one side of the breastplate. It serves to nock the lance or spear between the hook itself and the armpit. This frees up both hands for use and prevents arm fatigue.

Besagew (Armpit)

Besagews are round, often fairly decorated pieces of metal that hang from the pauldron by a strap. They protect and hang in front of the armpit, but can be easily moved out of the way if necessary.

Haute Guards

Flanges or wings of metal that rise up from pauldrons to protect the neck from blows from the side and sometimes front. Haute guards usually do not wrap all the way around to the back, contrary to fictional depictions, as this would add unnecessary weight.

Spaulders (Shoulders, but Smaller)

Armour that protects the upper arm and shoulder, but does not cover the chest and back.

Compression Articulations

Compression Articulations are small, thin, overlapping lames that are made flexible enough to protect the insides of joints, such as the inside of the elbow, knee, and sometimes even groin, as is in the case of King Henry’s tournament armour.

The Importance of Mechanisms for Connecting Plates & Lames, and How They Work

Fixed Rivets

Fixed rivets are rivets that have been peened tight enough to connect two plates together.

Pivoting Rivets

Pivoting rivets are rivets that connect two plates together, but have not been peened tight. This gap can be accomplished by threading a waster cardboard or card paper o-ring onto the rivet shank before peening.

Sliding Rivets

Sliding rivets are essentially the same as pivoting rivets in the fact that they have a gap to allow movement. The key difference here is that one or more of the lames threaded by the sliding rivet are cut with slots to allow not only rotation, but compression and extension.

Inset Rivets

Inset rivets are still in use today in the aviation industry. Essentially this is a method of connecting two lames, but having the rivet heads flush to the surface. This is accomplished by drilling the lame with a large diameter drill bit, and then once again in the same location with a smaller diameter drill bit, creating a cone-shaped hole. The rivet can then be peened, and the rivet head filed or ground off.

Spring Rivets

Hinges

Twist Tabs

Hooks & Eyelets

Bolts

Straps & Buckles

Leather or Linen Strips

Preparation of Plates and Lames for the Assembly of Armour

Ground edges

After cutting plates from sheet, edges are beveled 45 degrees on both faces to remove burrs and sharp edges to reduce risk of injury when handling and smithing. As a digital artist you don't need to do this unless you’re doing specialist macro renders or something.

Dishing, Raising, and Planishing

As a digital artist you dont need to know these definitions but they are useful to understand and have in your vocabulary.

There are almost never straight lines or flat surfaces in plate armour. All plates are either dished, raised, or slightly curved due to planishing.

Dishing

Smithing metal over a concavity to give the metal a depression or bowl-shape.

Raising

The inverse of dishing, metal is smithed over a convex surface, oftentimes this convex surface takes the form of a ball stake set within a stake block or in an anvil's hardie hole. This technique is primarily used for helmets, couters, poleyns, finger knuckle plates, shield bosses and similar.

Rolled and Roped Edges

https://youtu.be/GpfKJ4UjeiA

Rolled edges are precisely that; the edge of a plate is hammered over a stake, and carefully rolled into a tube. This serves dual purpose to protect the wearer from the edge of the plates as well as providing a lot of structural stability to armour. Rolled edges can be transformed into roped edges by careful smithing with a dulled chisel. Most importantly, when cutting plates from sheet, extra metal for this exact purpose must be accounted for.

Polishing

Armour can be given a number of different levels of polish.

Rough Polish

Satin Polish

Mirror Polish

Methods of Creating Plates & Lames in Zbrush

Just if you're curious, there's no section for "Real-World Methods of Creating Plates & Lames". IRL, large shears were used (and are still used today), as well as chisels… which are also still in use.

Dynamesh + ZRemesh and/or Manual Retopology

Slice Curve Primatives

Methods of Decorating Armour

Repousse & Chasing

You can think of R&C simply as embossing. Using a hammer, you lift or sink forms into the steel, and using dulled chisels on the other side, you can achieve sharper details. Good examples would be armours made by Filippo Negroli. In Zbrush you can use normal sculpting techniques for this; like normal brush and clay brushes in conjunction with the Damian standard brush. Alphas can also help, as well as IMM brushes.

Fluting

Fluting is a very recognizable decoration method that also serves to structurally reinforce armour, featuring sweeping and fanning graceful ridges that sometimes covers the majority of the plates. It is predominantly featured in Renaissance Maximilian armour, as well as Gothic styled armour. Fluting is achieved through dishing and raising with a dull chisel.

Filing and Punching

Armour is sometimes decorated by drilling and filing patterned holes. Gothic armour makes extensive use of this.

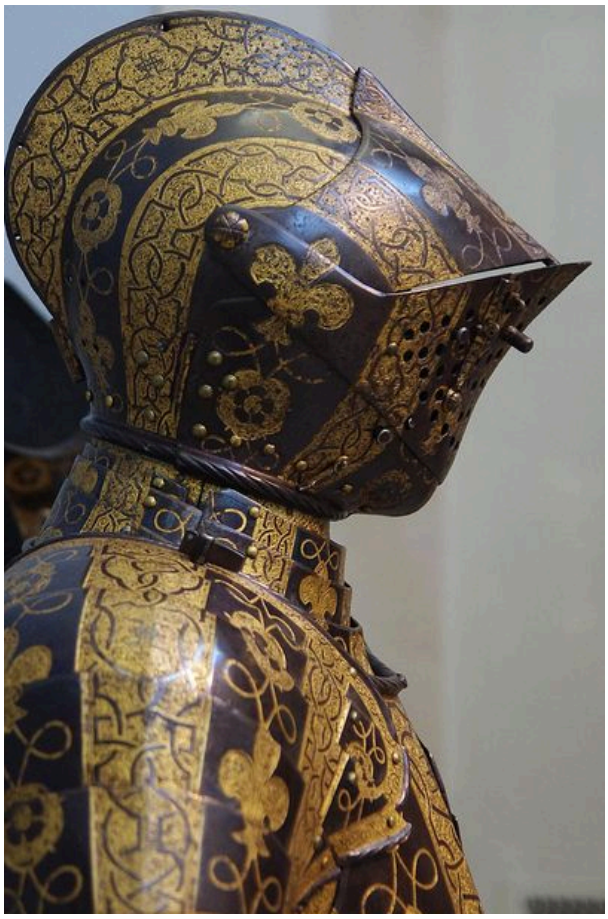
Engraving

Acid Etching


Acid etching is achieved by dipping or painting armour with wax, and carefully scratching away portions to expose metal. The plate is then dipped in a solution of muriatic acid. When sufficient depth is achieved, the plate is removed from the acid, rinsed in water, and removed of wax, leaving whatever was scratched as an impression behind. In Zbrush, you can use alpha maps for this.

https://youtu.be/G6InRJtW5bM

Bluing



Bluing is an iridescent effect achieved through heat treatment. By passing a torch over a plate at the correct temperature or by putting entire pieces of armour in a large oven, different colours

Gilding

Gilding is a dangerous method of decorating armour due to the process of dissolving gold into mercury to make mercury amalgam. This amalgam is painted onto armour, and heated. As mercury has a lower burning point than gold, mercury is vaporized and all that is left is gold bonded to the surface of the armour. Vaporized mercury is extremely toxic.

Gold Leaf

Brasswork

Gold Inlay

Damascening

Painting

Using Zbrush to Replicate Real-World Methods
Nanomesh
Standard Brush
IMM Brushes
Alphas
UVUnwrap
Artificial Intelligence