

# REPORT

VELCRO (HOOK & LOOP) + CORK STORAGE SYSTEM  
FOLDING BED + DESK COMBINATION

Ana De Pellegrin:  
+54 9 261 565 4744  
anadepellegrin@gmail.com

Pietro Fareri:  
+44 7 594 974 425  
pietrofareri@protonmail.com

Hafeez Dawood:  
+44 7 901 768 571  
hafeezdawood@gmail.com

# MATERIALS

Materials considered here are all proposed for use by the MoJ in the series of furniture proposals we are putting forward.

While researching these materials we focused on 3 main objectives, making sure the items fit into a circular model as much as possible (there are a few cases in which this was not possible), achieving long lasting products and a focus on achieving a more amicable living environment for all



# CORK AGGLOMERATE



CORK HARVESTING



GRANULATED CORK



BLACK CORK

### Properties

Cork is a thermal insulator, acoustic insulator and it's anti bacterial. Cork is completely hypoallergenic.

There is a conflict between what our research about cork has told us and what an employee of Amorim (the supplier) has told us. According to research cork doesn't absorb water unless fully submerged: **"A cubic inch of solid cork immersed in water for 48 hours will gain less than 3% in weight due to water absorption"**.

According to Lisette Moutinho (from Amorim): "Cork doesn't absorb water, it only adsorbs and becomes wet on the surface. This can affect the properties, depending on the type of cork and the intended use". The difficulty in communicating with the supplier has prevented us from being able to answer this question accurately. **(Additional time and research needed to acquire this data.)**

Black cork is achieved using a different technology for agglomeration with high temperature and pressure. We can have agglomerates with lower density (called expanded cork) or with similar density as white cork. These can't be recycled together, therefore we have decided not to use it.

Cork density doesn't have anything to do with lifespan. It's related to the place on the bark it was removed from: the outer part is denser than the inner part of the cork oak bark.

The great majority of European cork is grown and harvested in Portugal with minor producers in Spain and Italy, it is a common misconception to think that cork only grows in Mediterranean climates. As stated by Paramount plants: "Quercus Suber thrives in the UK climate as it will tolerate winters to -10". This would open up a chance for the MoJ, not only to move towards a circular mode of production, but also to become self-sufficient in terms of cork, **(additional time and research would be necessary to determine how long this would take, however we do know that cork can be harvested from a mature tree every 9 years.)** It is one of the slowest aging materials and does not lose properties in

time. Cork doesn't react with any chemical but a conversation with Alfred Low (a colleague of ours) suggested that it therefore would not be incompatible with charcoal due to its impermeability.

We have made an estimate based on the monthly consumption of whitewood storage cabinets supplied to us by the MoJ to understand how much cork would be needed to substitute them on a monthly basis. To do so would require a 852 Kg delivery of cork per month and would supply 2000 cells each with 20 shelves (10 per inmate). **(A quote for this quantity is pending. Additional time and research needed to be precise.)**

Cork is inherently fire retardant and will not combust, its fire retardancy properties are classified Euro class E, in addition to this it is entirely organic, non-toxic and it does not produce off-gassing.

Exact details regarding the specific type of cork that would be employed for manufacture are pending. **(Additional time and research needed to acquire this data.)**

### Recyclability

Cork presents characters of unprecedented value when it comes to recyclability. It is entirely recyclable with no loss of material. The naturally occurring resin present in the bark allows it to be re-moulded as many times as necessary, without losing material or properties, making it a completely circular material.

The opportunities for the MoJ with cork are crucial, from a business point of view and environmentally. In addition it solves the problem of having a material that is both truly circular and fire resistant without the need for toxic additives.

Cork fabrics exist but we refrained from using them since they are a very thin layer of cork laminated to a fabric backing, this results in a two-layer fabric with the appearance of cork. No cork fabrics can be recycled.

### Supplier

Cork agglomerate would be provided by Amorim in Portugal. We have had great difficulty in getting in touch with them consistently.

### Contact Info

Lisette Moutinho: [Lmoutinho.acc@amorim.com](mailto:Lmoutinho.acc@amorim.com)  
Manuel Miranda: [mmiranda.acc@amorim.com](mailto:mmiranda.acc@amorim.com)  
Amorim UK office: [general.auk@amorim.com](mailto:general.auk@amorim.com)

A potentially viable alternative is a company we found in Germany. They only take part of their cork supplies from Amorim, website and contacts are listed below.

Euro-Cork: <http://www.euro-cork.com/>  
Telephone: +49 (0)4471 / 957 962

### Sources

(<https://amorimcorkcomposites.com/en-us/materials-applications/flooring/acousticcork/why-cork/misconceptions-about-cork/>)

(<https://www.paramountplants.co.uk/blog/index.php/quercus-suber-trees/>)



# HOOK & LOOP



## Properties

Hook & loop is made up of two sides. The loop (or female side) is the softer, velour like side, this is made of polyurethane backed nylon 6, it is treated with fire retardant chemicals and has passed the necessary tests to satisfy the MoJ's requirements. The hook (or male side) side can be either polypropylene or polyethylene, this decision is pending on tests to be done regarding the strength and general qualities of the hook, on samples coming from Velcro LTD (**additional time and research will be needed to accomplish this**), in both cases the hook would be completely recyclable with schemes already present in the MoJ's facilities.

Velcro hook & loop is very solid and tear resistant in order to make sure that it is as hard as possible for the prisoners to abuse it. It isn't listed as fire retardant but won't combust by nature and will only melt at high temperatures without igniting or feeding a fire (precise figures listed below).

For fire retardancy the options explored were:  
NOMEX hook and loop: it's not toxic to handle and highly fire resistant. It releases toxic gasses when exposed to temperatures above 200°C, highly technical product but very expensive.

Fire-retardant treated VELCRO loop (Loop 001, Loop Velour 3165): it's not toxic to handle and highly fire retardant. It does not release toxic gasses; it is not fire resistant but is used in aircrafts and comes with sufficient fire testing results.

## Recyclability

Velcro is the best option we found to provide the feature of personalization while being safe and resistant. Other similar products like Dual Lock from 3M were explored but it's less recyclable than Velcro and has a hook on hook system that involves a different way of attaching elements onto the panels. The loop side of Velcro is not recyclable and we have designed it accordingly to re-

duce the amount we use. It has the potential to be shredded and have a different end of life use, such as bean bags filler. We have identified two different types of hooks that would fit our requirements; samples for these are in the process of being ordered, they are:

## Material Specifications and Composition

Hook 822: Polypropylene (PP)  
Melts at 150° (does not combust as declared by VELCRO LTD UK)  
Peel strength 1,5 N\cm  
Shear strength 12.5 N\cm<sup>2</sup>  
(coupled with Loop 001)  
Life span: Pending (**additional time will be needed to accomplish this**)

Hook 733: Polyethylene (PE)  
Melts at 160°  
Peel strength 2 N\cm  
Shear strength 12 N\cm<sup>2</sup>  
(coupled with Loop Velour 3165)  
Life span: Pending (**additional time will be needed to accomplish this**)  
Plastic recycling processes are already set up in the HMP system for both these materials and they can enter the recycling process seamlessly.

**The loop side is not recyclable!** There is a precedent for recycling loop in Canada but it is a complicated, long and expensive process, nonetheless details are linked below because we believe it may be an opportunity for the MoJ to expand their recycling practice into an area that is not tailored to in the UK or anywhere else from what have found out. (**additional time and extensive research would be necessary to investigate this practice and evaluate its feasibility and viability**)

## Supplier

Hook & loop sheets would be provided by VELCRO LTD UK.

## Contact Info

They can be contacted at this number and email by asking for Rob Salt who is very helpful and who was in direct contact with Pietro for the duration of the assignment:

Telephone: 01270310138  
E-mail: rsalt@velcro.com



# CORK POLYMER COMPOSITE



CPC SHEETS (HARD)



CPC IN A PRODUCT CONTEXT

Cork Polymer Composite, (hereby referred to as CPC) is a young and newly developed material; the patent is held by Amorim (who is our suggested supplier for the organic cork).

It is a material that consists of by proportion 5-95% polymers and 5-95% of cork. The different proportions alter the properties, but for the purposes of this proposal it can be asserted that the proportions used should be such that most of the properties of cork are retained.

CPC is a thermal insulator, acoustic insulator and it’s anti bacterial. It is also fire retardant although those classifications are not yet known and depend on the proportion of polymers and cork as well as any post-production chemical addition. It should be noted that the fire retardancy can be altered after the material has been created.

The patent for the material can be found here \_\_\_\_\_, it outlines specifically what the manufacturing process requires; all machines should be either already present or accessible by the MoJ. It is yet to be determined how the licensing for the production of CPC will be handled.

The benefits of using this material are numerous, specifically in regards to achieving a completely circular, environmentally and economically sustainable process in prison manufacture considering the adoption of standard cork as proposed.

CPC can be extremely flexible or robust akin to the plastics currently in use in the prison.

More information pending phone call from Amorim.

# POLYPROPYLENE



POLYPROPYLENE

## Properties

Polypropylene is a thermoplastic addition polymer already in use in the MoJ's production of furniture; it is currently employed for the chair. It does not need any fire retardant additives because of its non-combustible nature after having added a rubberizing agent that does not affect its recyclability. It does not produce toxic off-gassing.

## Recyclability

To our knowledge the MoJ get at least 4 cycles out of every chair when reusing the polypropylene, this is possible because there are no fire retardant additives in the course of production.

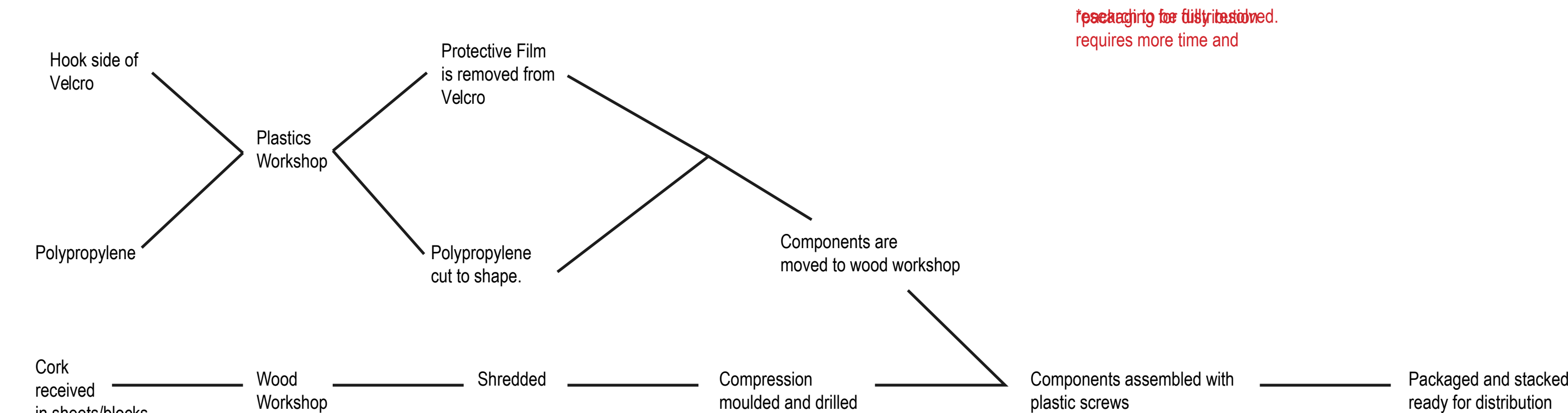
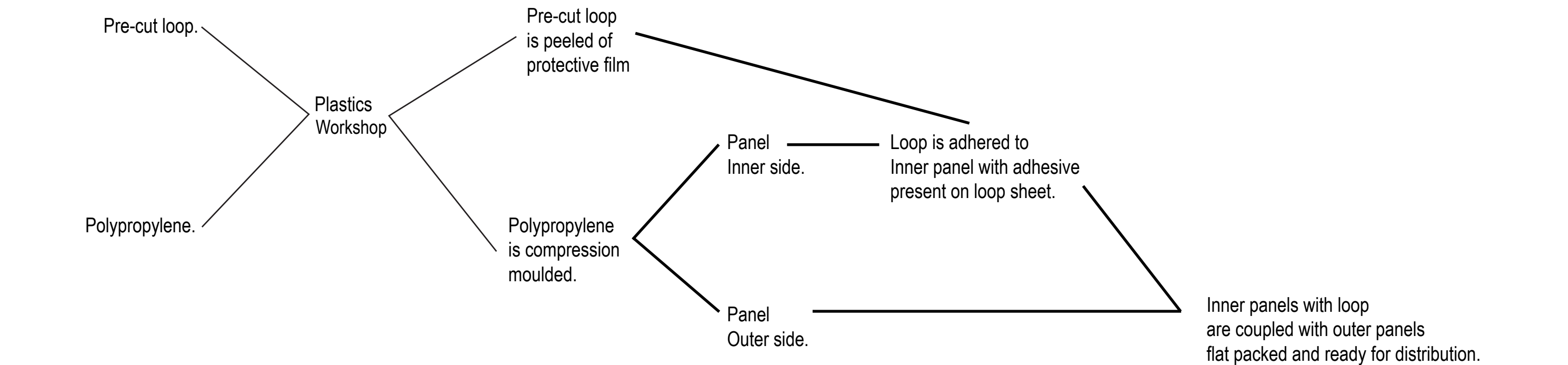
## Supplier

The existing source

# CONCEPTS



MANUFACTURE



MANUFACTURE

Distribution

Cork

Cork would be supplied from Portugal in sheets or blocks (this can be decided based on what works better for the granulator) and goes to distribution to get stored so that it's ready for manufacture (stored in sheets or blocks)

In a second and more advanced phase assimilation of consumer waste cork can be integrated in the cycle, this will require a system that has to be researched and designed specifically and will open up new business possibilities for the MoJ that are currently not present in the UK. (Additional time and research are needed to develop this.)

Hook & loop

Velcro have their European distribution and production facility in Spain from which the product will be sent from. The hook & loop will be pre-cut to the necessary dimensions

Polypropylene

Polypropylene is the material the MoJ uses for the chair they currently produce. The necessary material for the storage system will come from the same supplier and will be stored ready for manufacture in the same way. Part of it will come in pellets to mould the wall panels and part of it in sheets to cut the backing for the cork shelves.

Wall panels

Pre-cut loop and polypropylene are moved to plastics workshop. Here the polypropylene is compression moulded to form both sides of the wall panel. The loop is then adhered to the side of the first panel (loop comes with its own adhesive, this hasn't been tested for strength pending the arrival of the correct samples and adhesives, if tests revealed the standard adhesive to not be strong enough the loop could be heat adhered to the panel, (additional time and research required to determine this) and coupled with the second. In this format the panels are flat-packed with the remaining components necessary for installation to facilitate transportation and storage, ready for distribution.

Cork shelves

Pre-cut hook strips and polypropylene are moved from X to the plastics workshop. Here the polypropylene will be cut to shape, drilled for plastic binding screws (we believe these screws will provide sufficient support but this has to be tested) and the hook will be adhered to it in position. Once this is done they will be sent to the wood workshops. In the wood workshops, the cork will have been shredded in the granulator (reference for the VD 1100 Cork Granulator <https://vecoplan.com/products/shredding/vd-1100/>), compression moulded into shape (we are waiting for an email from Rock because previously he mentioned he knew the name of this machine) and drilled ready to be fit with the poly-

propylene plate. Handling cork is not toxic for workers though using dust mask is suggested. Cork agglomerate is 100% recyclable and can be 3D moulded, CNC machined and compression moulded. We chose compression moulding because the recycling process would need it to be shredded anyway. If it gets broken goes back into the cycle These two will then be assembled with plastic binding screws (OEM parts but we believe that with additional time and research these could be designed for in-house manufacture) and prepared for distribution; they can be stacked for delivery as shown in the technical package.

\*Scitech, an adhesive company based in Wales, has developed and uses a completely biodegradable bio adhesive, using this to adhere the hook to the cork would allow to use less polypropylene and not affect the circular nature of the cork. DACRC are now in possession of a sample of the adhesive ready for testing, testing should be conducted on any hook product that is either polypropylene or polyethylene.

Installation

When the panels and shelves reach HMP's facility they are moved to the cells to be installed, the weight of the panels allows for multiple units to be transported simultaneously with a trolley or by a single person up stairs in absence of lifts. The panels are then mounted with M6 bolts fit into iron rawl plugs (OEM parts but we believe that with additional time and research these could be designed for in-house manufacture). These plugs work equally well for both concrete or brick walls.

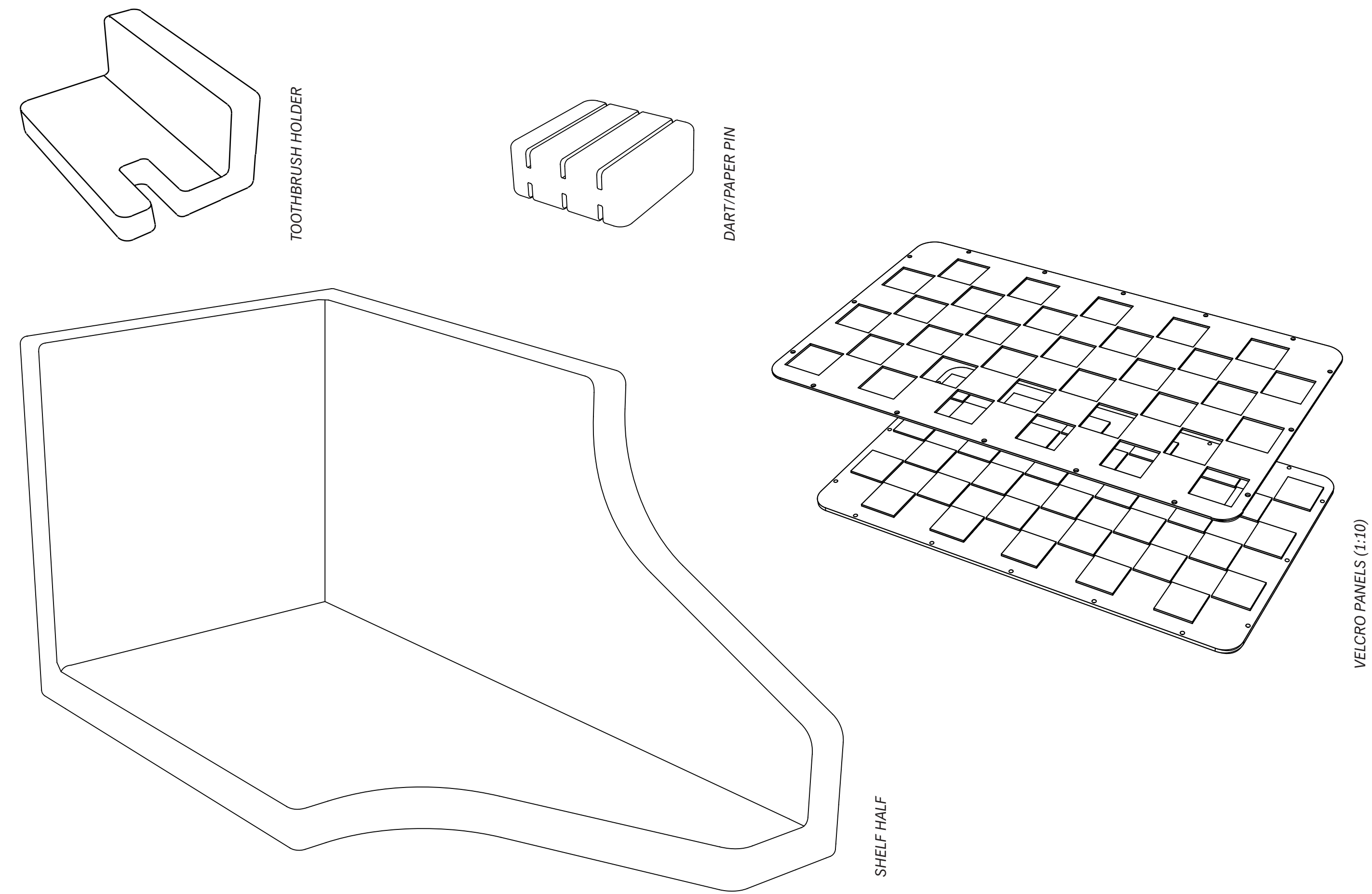
End of use

After use the wall panels are sent to the plastics workshop. Here the loop is detached (no solvent is needed for this) and either employed for alternative end of life use or disposed of. The remainder of the adhesive is cleaned off of the panels and they are melted and re-formed into pellets, ready to be re-used. This is a procedure already in place in the MoJ's facilities.

If damaged or at end of use the cork shelves are sent back to the wood workshops where the polypropylene plates are unscrewed and forwarded to the plastics workshop (ideally this would be done on site before departure, if possible, so as to save an extra trip) to follow the same process as the wall panels with the exception of the hook. Depending on whether the chosen hook is polypropylene or polyethylene it will enter HMP's recycling process regardless, seeing as schemes for both these materials are already present.

The cork is then granulated and stored, ready to be re-used. Storing the new cork in sheets or blocks and the used one granulated will help in telling the difference between the two.

# VELCRO + CORK STORAGE



## THE DESIGN

### Wall panels

The loop wall panels come in three pieces: the part which is fixed to the wall (inner side) which presents a pattern of chequered protrusions to which the loop will be adhered; the loop itself, supplied with its own adhesive (tested for fire retardancy) and the part that encloses the other two and fixes them to the wall (outer panel), this also presents a chequered pattern. Where on the first panel there are protrusions, here there are holes which allow for the loop to be accessible.

The design allows for the loop to be flush with the panel ensuring full functionality, it also avoids the need for stronger adhesives between the loop side and the panel concealing the loop with bolts. The chequered pattern was developed and designed based on the measurements of the shelves and it insures that single panels can't be overloaded and components can't be used for self-harm while maintaining plenty of options for personal-ization.

Loop cannot be supplied in sizes above 300mm x 300mm, this further ruled out the option of having a fully covered loop panel, in the design the sections of loop are 250mm x 250mm in the shape of a cross (refer to technical package), these come pre-cut by Velcro LTD. Dimensions of both hook and loop are calculated in order to insure that the inmates do not attempt to self harm as much as possible and, even if they found a way to connect enough hook or loop strips to make a noose (or other ligature point), both hook and loop wouldn't be strong enough to hold the weight of a person (test have been made to prove this and they are part of the report package).

In addition there are other ways and objects, already present in the cell, to make a noose much more quickly and efficiently. If the panels were to be ripped off of the wall our research has found no way of creating a chance for self-harm or harm to others.

All edges have been filleted or rounded off to minimize the chance for harm or self-harm. The decision of positioning the loop on the wall panel was mainly due to the fact that clothes and other softer objects would get ruined by coming into contact with the hook, in the design there is no way for this to happen, in addition having the hook on the wall may be uncomfortable or, in extreme cases, present the chance for litigation on behalf of the inmates if they were to scratch themselves on it. Hook and loop can be both cleaned by being machine washed without losing any of their functional properties.

With additional time and research Cork Polymer Composite could substitute polypropylene it being widely more recyclable and part of a bigger circular system including prison

generated cork and plastic waste and consumer generated cork and plastic waste, we even believe that the polypropylene could be gradually phased out by becoming part of said circular system.

### Cork shelves

There are three different objects that make the cork shelves range. The first is a bigger shelf used for storage of objects and clothes, it can be used on its side to provide a good amount of storage space without taking away from the space of the cell, on its front to hang clothes or other objects that need more horizontal space, or coupled with another shelf to take the shape of a box. Two shelves together, in the shape of a box, can in turn be used on one side to store bigger objects or upside-down in which case the surface area is measured to be the optimal size for storing folded clothes. The surface is cut out at the extremities of the longer sides to insure that the shelf doesn't get overloaded beyond the weight it can hold. We suggest that every inmate is assigned at least 10 shelves, this is approximately the equivalent of a whitewood cabinet in storage space.

The second is a toiletry shelf, this is designed to store objects like soap, shower gel, deodorants, toilet paper, toothpaste and toothbrush. A recess on the side accommodates the toothbrush without it having to touch any surfaces (this is done for hygiene reasons), the same recess can be used to hang a towel or, by rotating the shelf 90 degrees, multiple heavier towels. Like the first shelf this one too can be used upside-down to hold bigger objects, the same result can also be achieved by aligning more than one shelf in a row. We suggest that each inmate is assigned at least 4 shelves, this should be sufficient for toiletries and toilet paper.

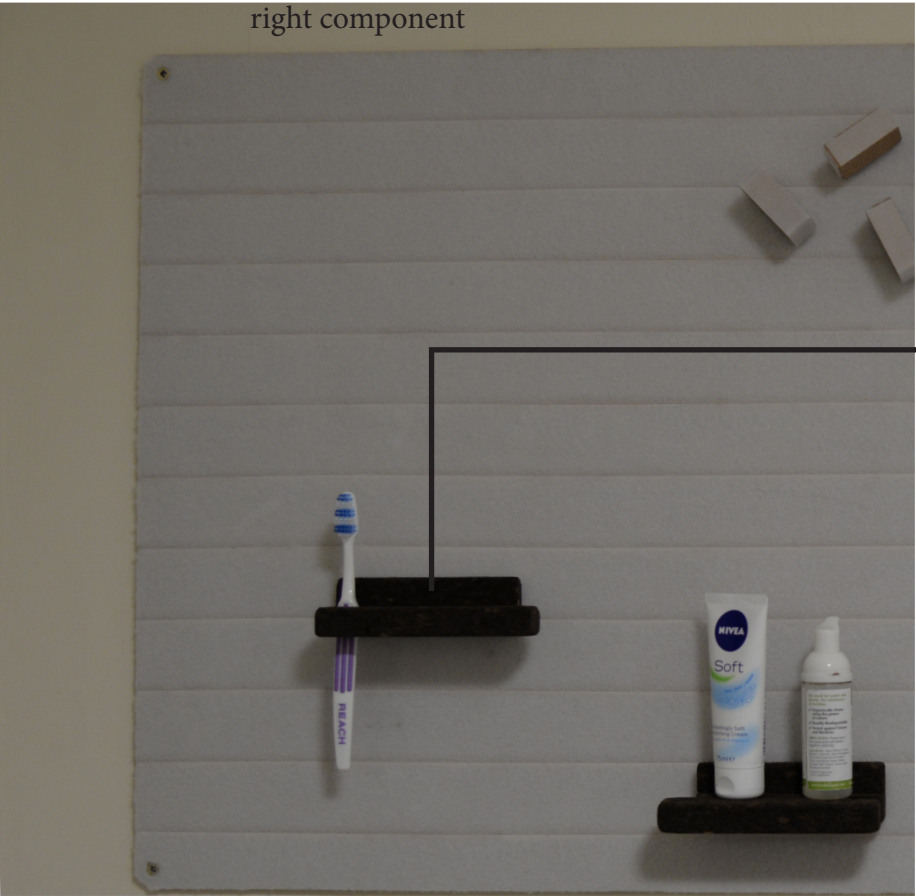
The third is a small rectangular tab, one side of which is wrapped in hook, to hang pictures and small paper like objects. The tab has three different slots cut into the longer side, two tabs hold a picture on the wall without the need for more permanent fixings. These were also designed with the intention of giving the inmates something they could "play" with whilst being in the cell, by throwing them at the hook & loop panels they are reminiscent of the game of darts and function very well. We think that it won't be necessary to communicate this aspect of the design to the inmates for we believe that they will discover it for themselves. It's worth saying that two of these will also successfully hold a light piece of clothing. We suggest that each inmate is assigned at least 9 tabs, 6 to use for holding pictures and small objects, 3 to use to emulate the game of darts. We also suggest that this element be available on request of the inmates if they require it for hanging more pictures. (Additional time and research required to determine the correct amount assigned to each inmate, applicable to all 3 shelves)



# VELCRO + CORK STORAGE



GENERAL SHELF



TOILETRIES

## THE CONCEPT

A set of 10 pieces that comprise an entire storage system for each inmate, allowing for a personalizable and changing cell environment. The system includes storage of toiletries, day to day items and clothing.



- Interactive and personalisable for each prisoner
- Difficult to break and difficult to use maliciously
- Should last for a long amount of time
- Reduces misuse scenarios

## WHY IS IT NEEDED?

- Storage is something the prisoners value highly
- The cell furniture at present does not encourage much emotional attachment to their furniture, this increases wellbeing and generally reduces the chance for furniture to be intentionally destroyed



- Unsure of mechanical fixing strength
- Loop side is completely unrecyclable

## MATERIALS



CORK COMPRESSED

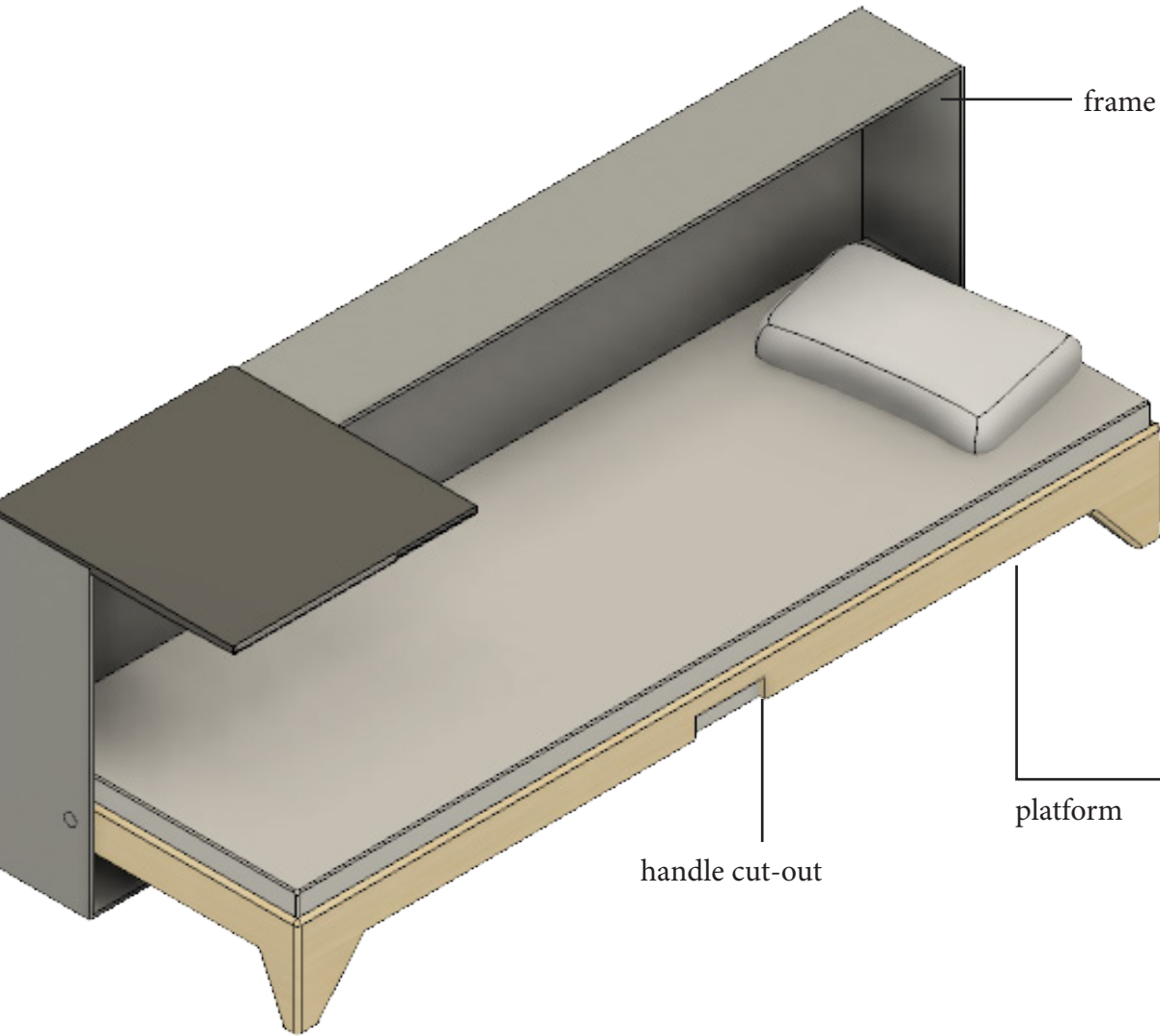
All pieces can be used to make different layouts according to the needs of the prisoner; this gives them a very high degree of personalisability and all shelves can be arranged and rearranged in a matter of minutes when entering the cell for the first time or if (CONT.) moved from one cell to another. We believe that the positive influence of such a high degree of personal involvement with the layout of the cell will keep the inmates from misusing the objects as much as they do now, instigating a much more positive environment and cutting down on expenditures for the MoJ.

The use of cork is an attempt to introduce natural and softer materials into the prison cell environment with the aim of taking away some of the austerity that characterizes it at present but without compromising on safety, affecting the work of the staff, harming the environment or generating unnecessary costs long term. The high concentration of cork agglomerates makes the shelves waterproof and easy to clean as well as antibacterial; this makes it possible for the inmates to keep them clean and tidy.

They don't need any special tools to be removed from the wall, which means that the whole unit is easy to search and all the objects are hard and inconvenient to use as hiding places, the properties of cork also make them useless in the attempt of self-harming or harming someone with them.

Other objects already present in the cell could be adapted to fit this system like the TV or the mirror, the hook could be adhered to these and they could be used and stored on the wall panels, additional time and research are necessary to ensure how this would work.

# FOLDING BED/DESK COMBINATION



## THE CONCEPT

A folding bed and accompanying desk that provides prisoners with the ability to **hide the bed**, drastically increasing the useable space that is available while simultaneously providing activity space and a place to work during the day.



- Clear division of space
- Easy searchability
- Structure and routine in daily life
- Customisable environment
- Optimised use of vertical space and previously used bed space
- Should last very long

## MATERIALS



CORK POLYMER COMPOSITE



STAINLESS STEEL



RECYCLED PLASTIC LUMBER



POLYPROPYLENE

PROPOSED

## WHY IS IT NEEDED?

- Replacing the most spatially cumbersome and problematic item in the cell from the prisoners perspective
- Reducing misuse and abuse scenarios
- Current bed(s) are environmentally problematic



- Difficult to make happen in a short time frame
- Needs extensive safety testing before being distributed properly
- Unsure about the proposed material

ALTERNATIVES

## MANUFACTURE

### FRAME

STEEL IS CUT FROM SHEET

HINGE ALLOWANCE IS DRILLED AT CORRECT HEIGHT

STEEL IS BENT AND WELDED AT THE EDGES

EDGES ARE MACHINED AND FILLETED

### BED PLATFORM

CPC IS COMPRESSION MOULDED

PLATFORM IS ATTACHED TO PIN AND MOUNTED INTO BED