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## Submitted Portfolio Exemplar

### Level 3 Design and Visual Communication

#### Achievement Standard 91627

Initiate design ideas through exploration

(Product)

Excellence

TOTAL

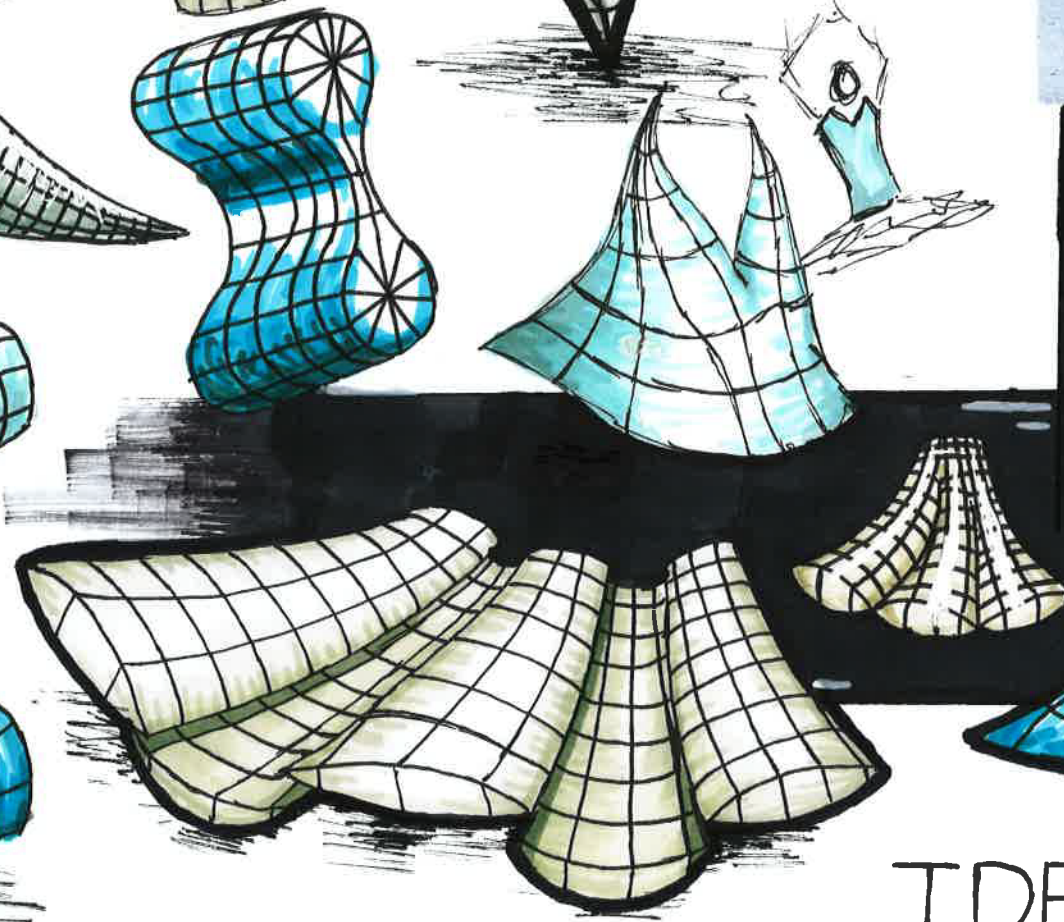
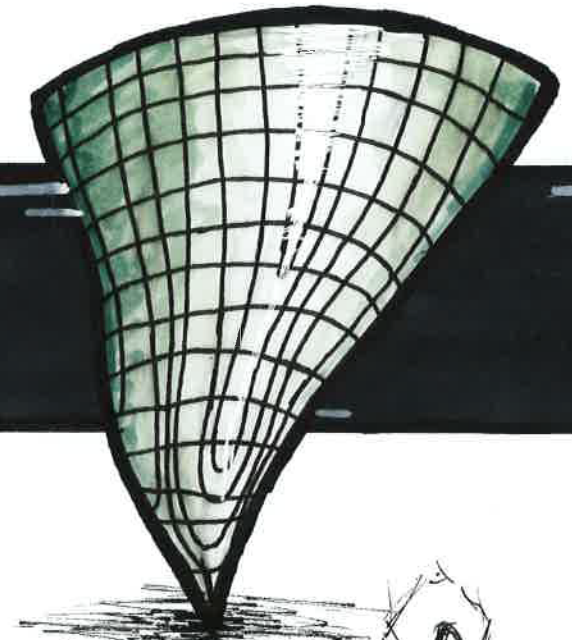
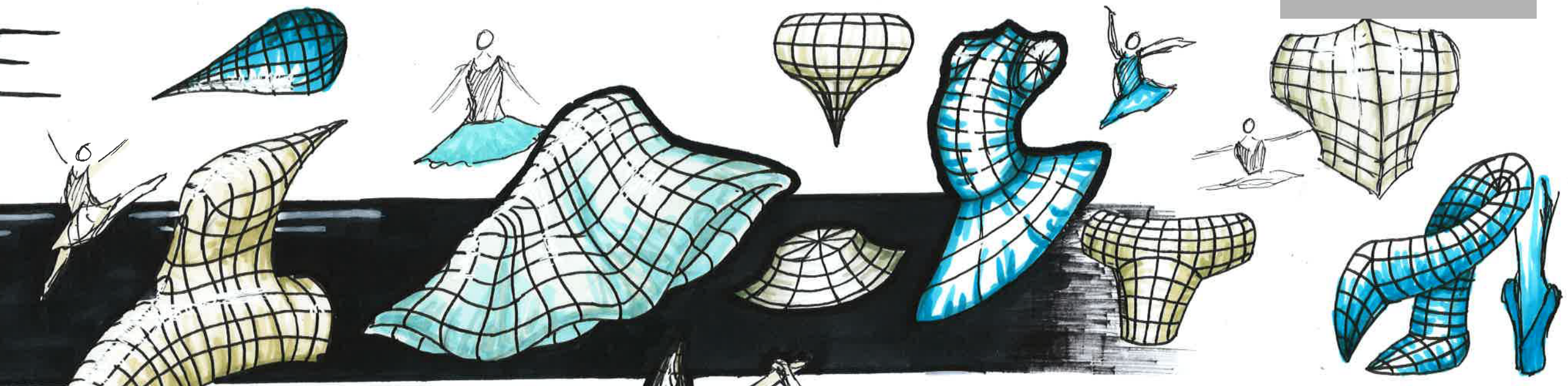
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ASSESSOR'S USE ONLY



# GRACE

BALLET





# GRACE

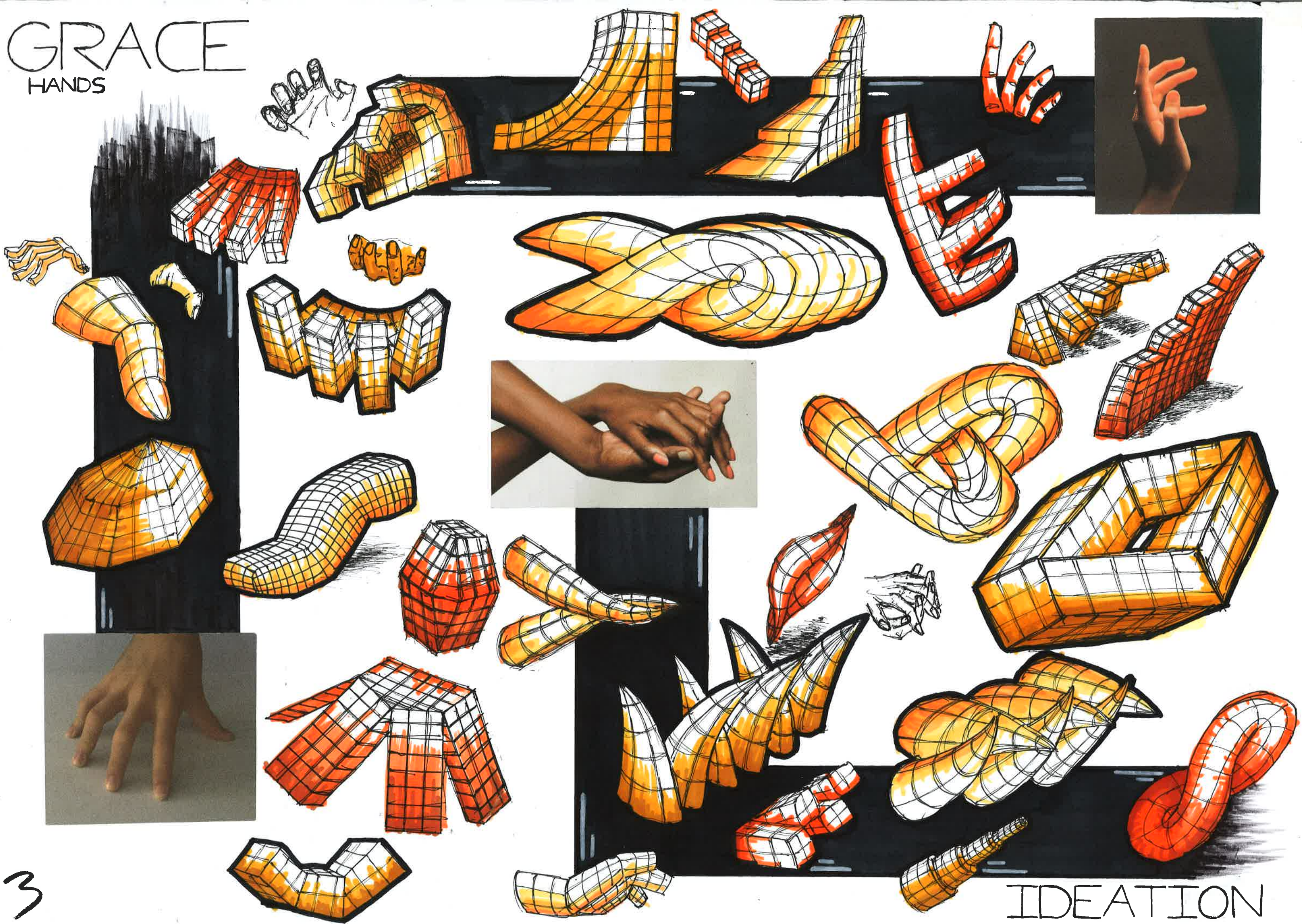
THE SWAN





# GRACE

HANDS

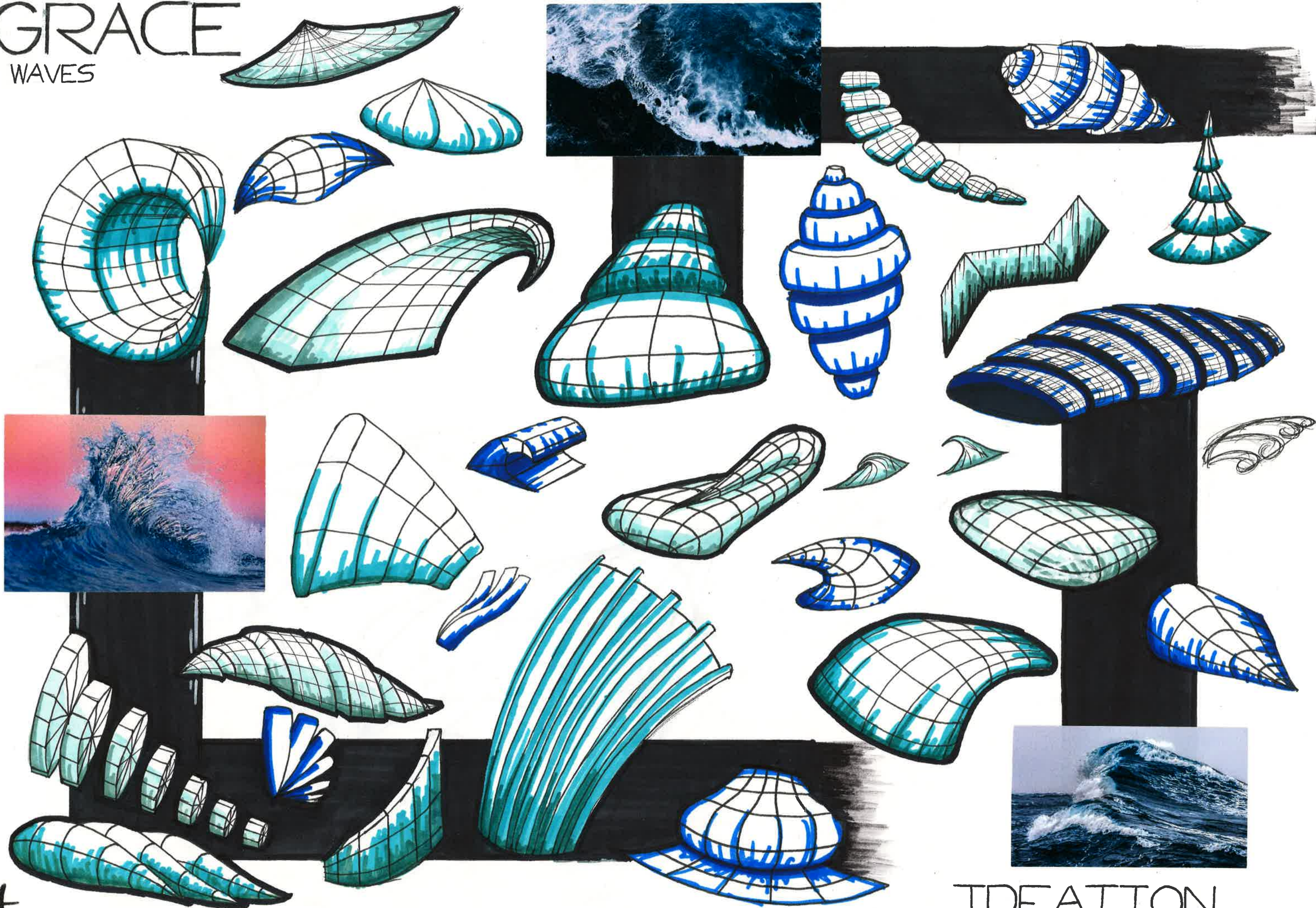


IDEATION



# GRACE

WAVES



IDEATION



# BRIEF

## WORKPLACE INJURIES

### CONTEXT AND PURPOSE

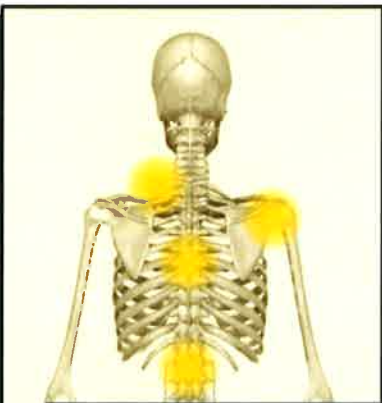
Jobs in physical labour such as construction, the trades and factory jobs are prone to injury. This design seeks to minimise the chances of injuries in jobs which require regular and/or repetitive physical labour.

### TARGET AUDIENCE

This design will be introduced into construction sites, warehouses and wherever else which has workers typically dealing with heavy objects.

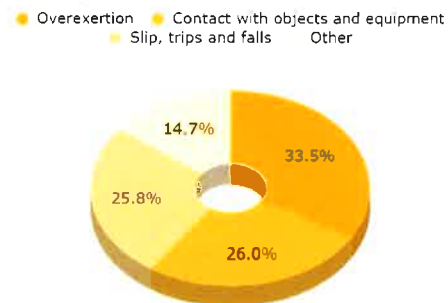
### IDENTIFIED PROBLEM

Manual labour in the work industry today comes with long hours doing repetitive physical exertion, which can result in temporary and chronic injuries. Often from lack of proper training or technique, or simply bad luck. Which in turn can result in Repetitive strain injuries (RSI) which untreated can become chronic



Common RSI locations

Injuries causing lost work days



Labour injuries make up for a third of missed days, a perfect problem to solve

Sitesafe.org.nz states that

## TWO THIRDS

of their accidents were from failure to follow best practice

Therefore a design which enhances a worker's production is more likely to be used often

## PRE-EXISTING SOLUTIONS

### BACK BRACES



According to wonder.cdc.gov, wearing a back brace does reduce abdominal pressure but did reduce motion. And there is no information that suggests pressure on the spine itself is reduced



According to gsmedicalcenter.org, back braces should not be worn for longer than

## TWO HOURS

daily

Unfortunate as the average work week is between 60-70 hours

### VACUUM LIFTERS



- Cheap
- Energy efficient
- Time-effective

Units are large and not portable. And suction cups only work on flat surfaces, not suited for workloads varying in size and shape

### AUTOMATED SYSTEMS



- Excellent at repetition
- Easily mass produced

Robotics offer an already growing solution to RSIs, but are confined to programming and cannot readily adapt to multiple situations as humans can

## SPECIFICATIONS

A design must be:

- Quick to set up regularly
- Easy to operate and maintain
- Not hinder one's abilities

A design without these attributes will simply be avoided by workers if its benefits are outweighed by its disadvantages

## FUNCTION AND

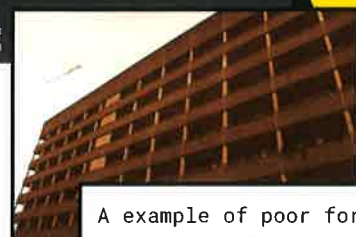
## AESTHETIC

An popular tenet in design and especially architecture is the famous axiom from Louis Sullivan

## FORM FOLLOWS FUNCTION

coined from a theory by Viollet-le-Duc stating

*A rationally designed structure may not necessarily be beautiful but no building can be beautiful that does not have a rationally designed structure*



A example of poor form



A example of poor function

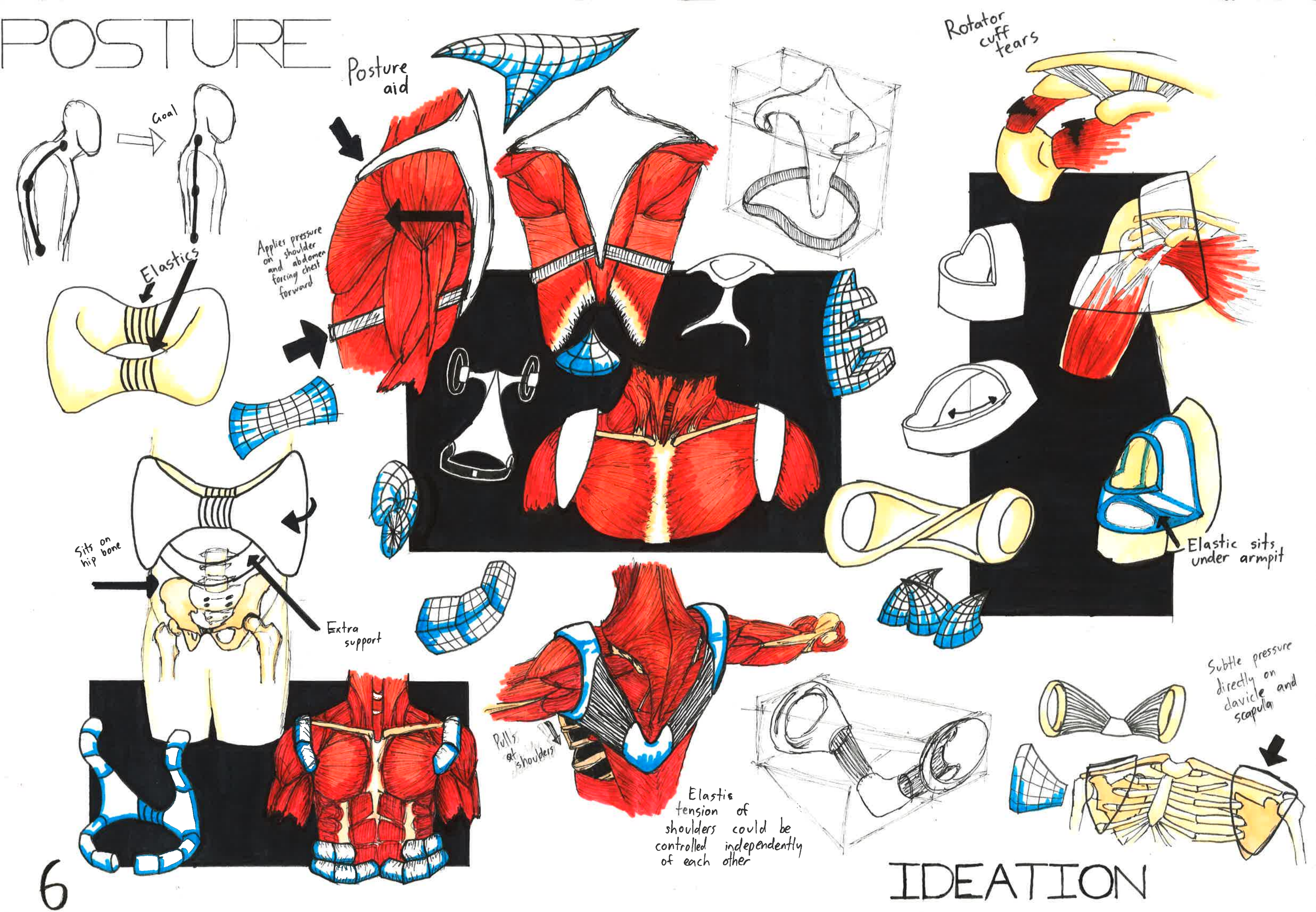


A example of well-executed form from function

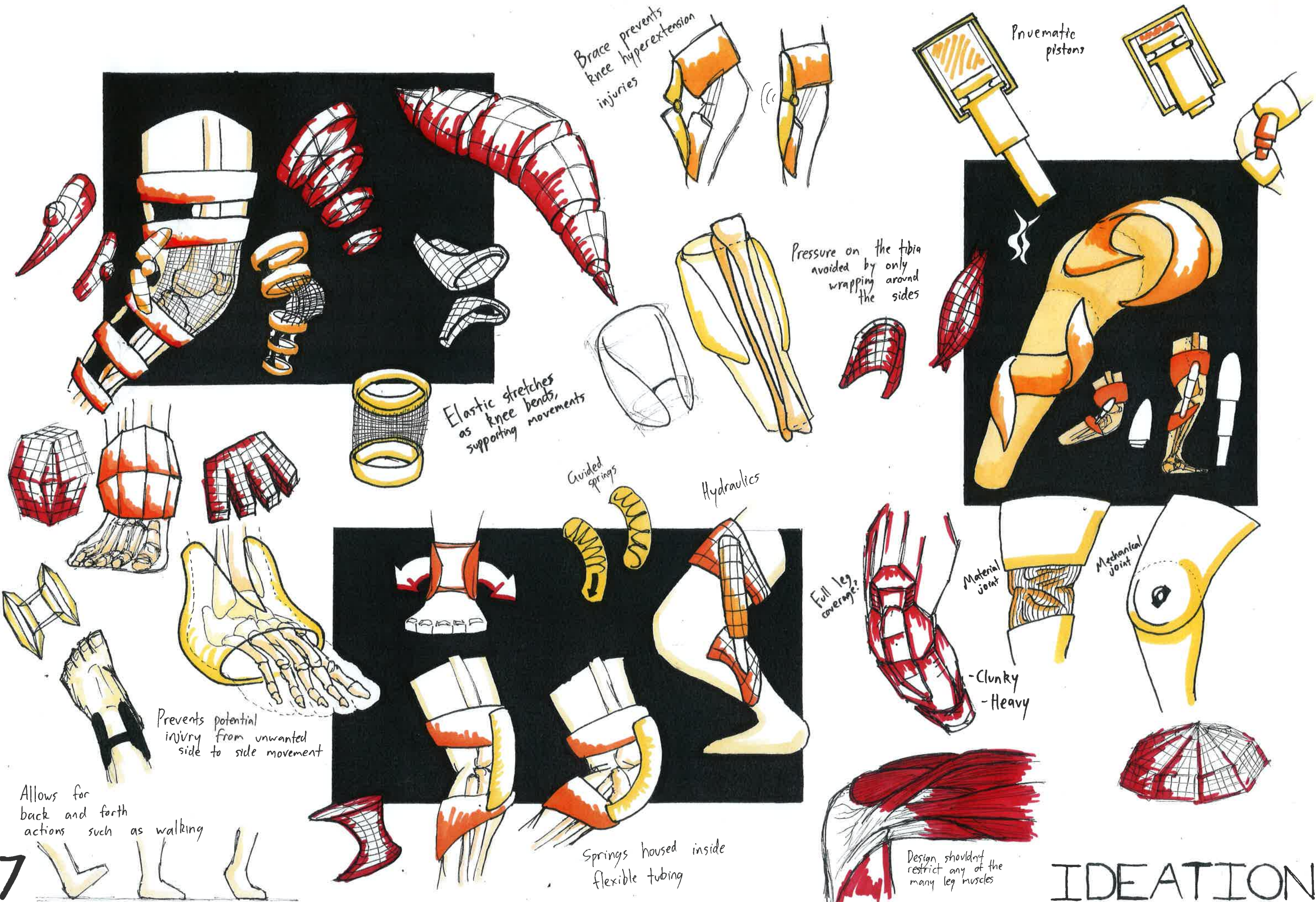
The best designs are those which firstly have full functional use, while then also deriving beautiful aesthetic from it's function.



# POSTURE







Brace prevents knee hyperextension injuries

Pneumatic pistons

Pressure on the tibia avoided by only wrapping the sides

Elastic stretches as knee bends, supporting movements

Guided springs

Hydraulics

Prevents potential injury from unwanted side to side movement

Full leg coverage?

Material joint

Mechanical joint

-Clunky  
-Heavy

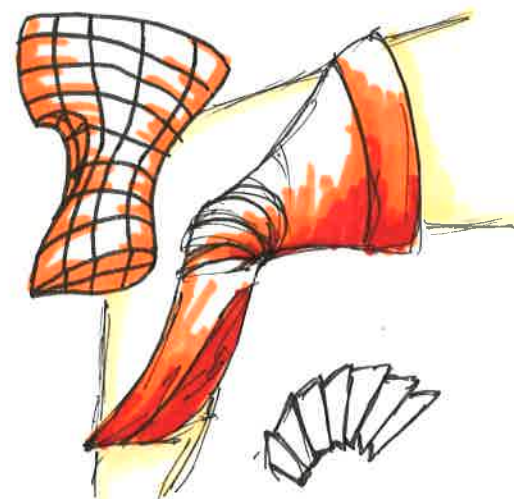
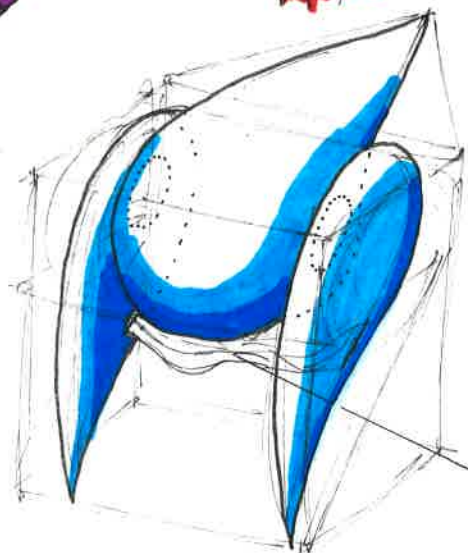
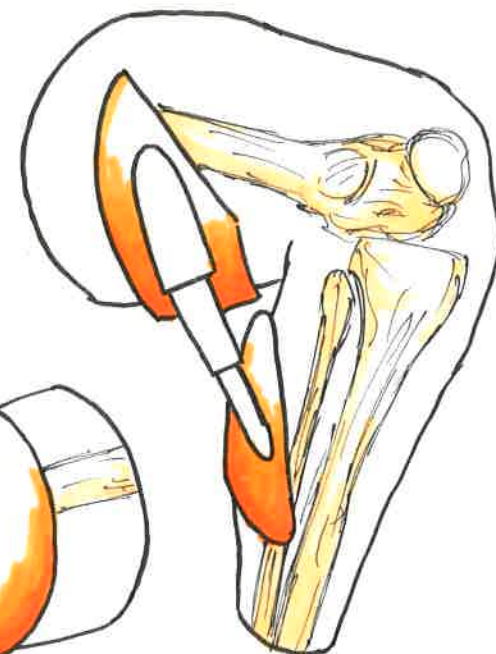
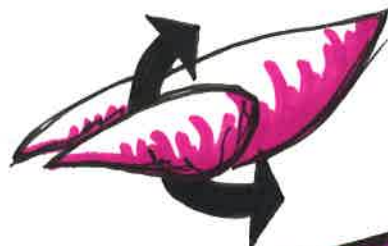
Springs housed inside flexible tubing

Design shouldn't restrict any of the many leg muscles

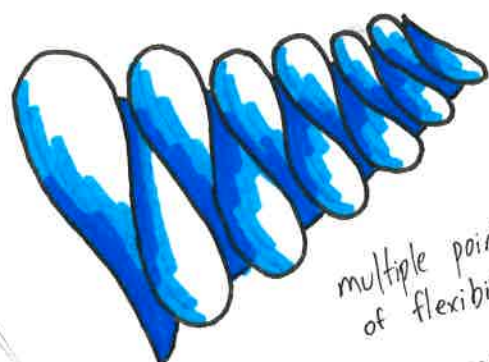
Allows for back and forth actions such as walking

IDEATION

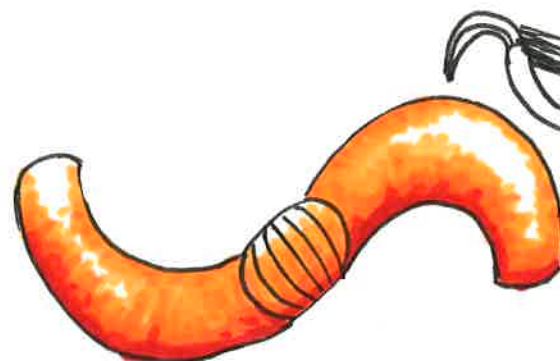
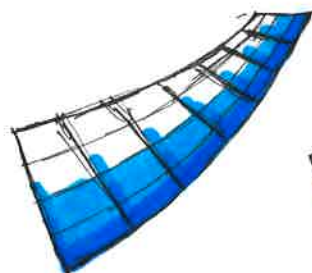
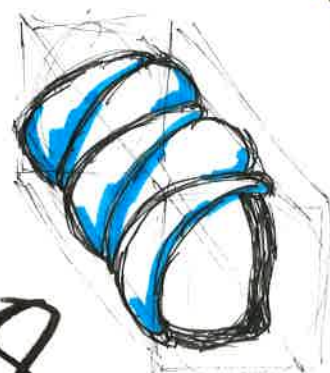
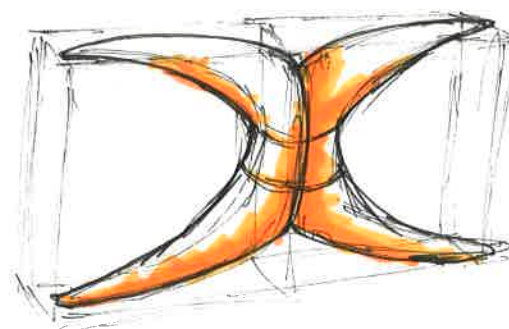
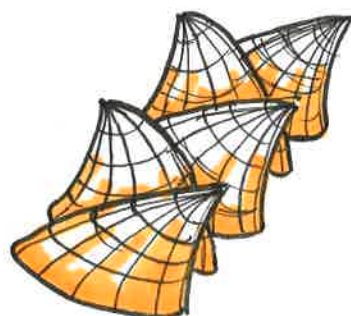




soft elastic  
fits comfortably  
behind knee



multiple points  
of flexibility





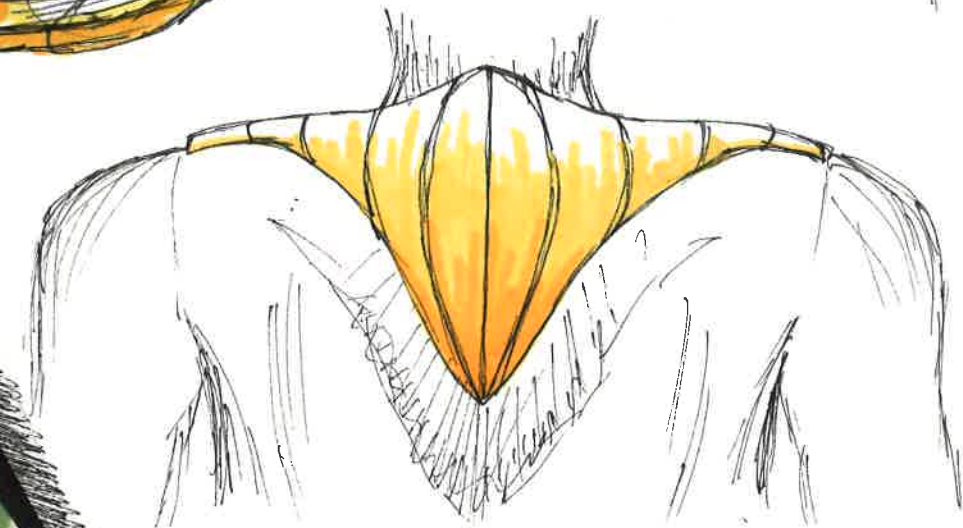
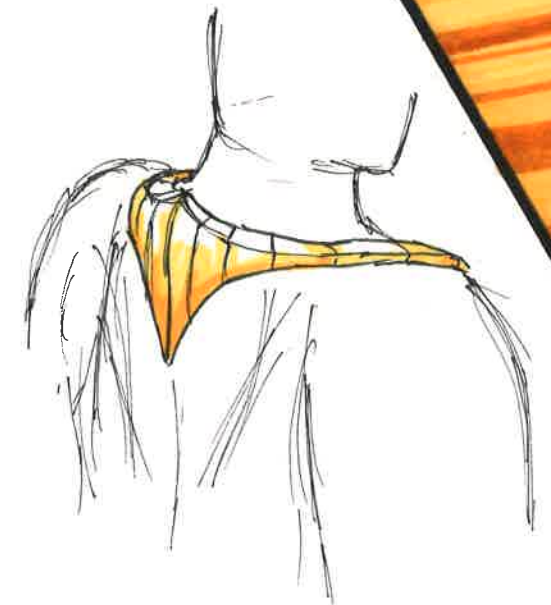
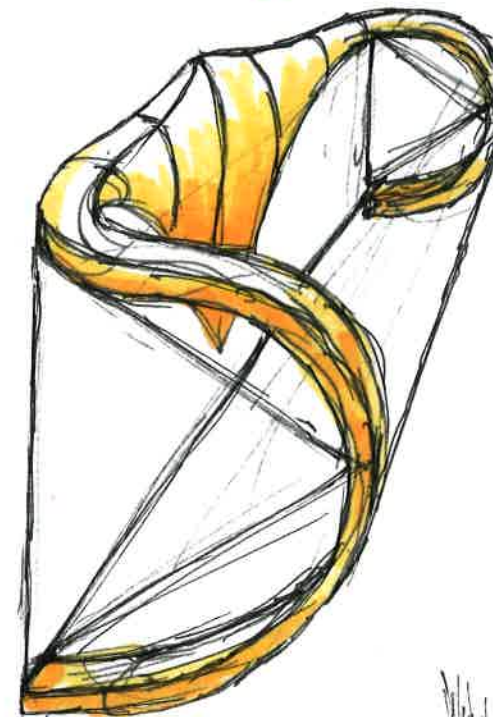
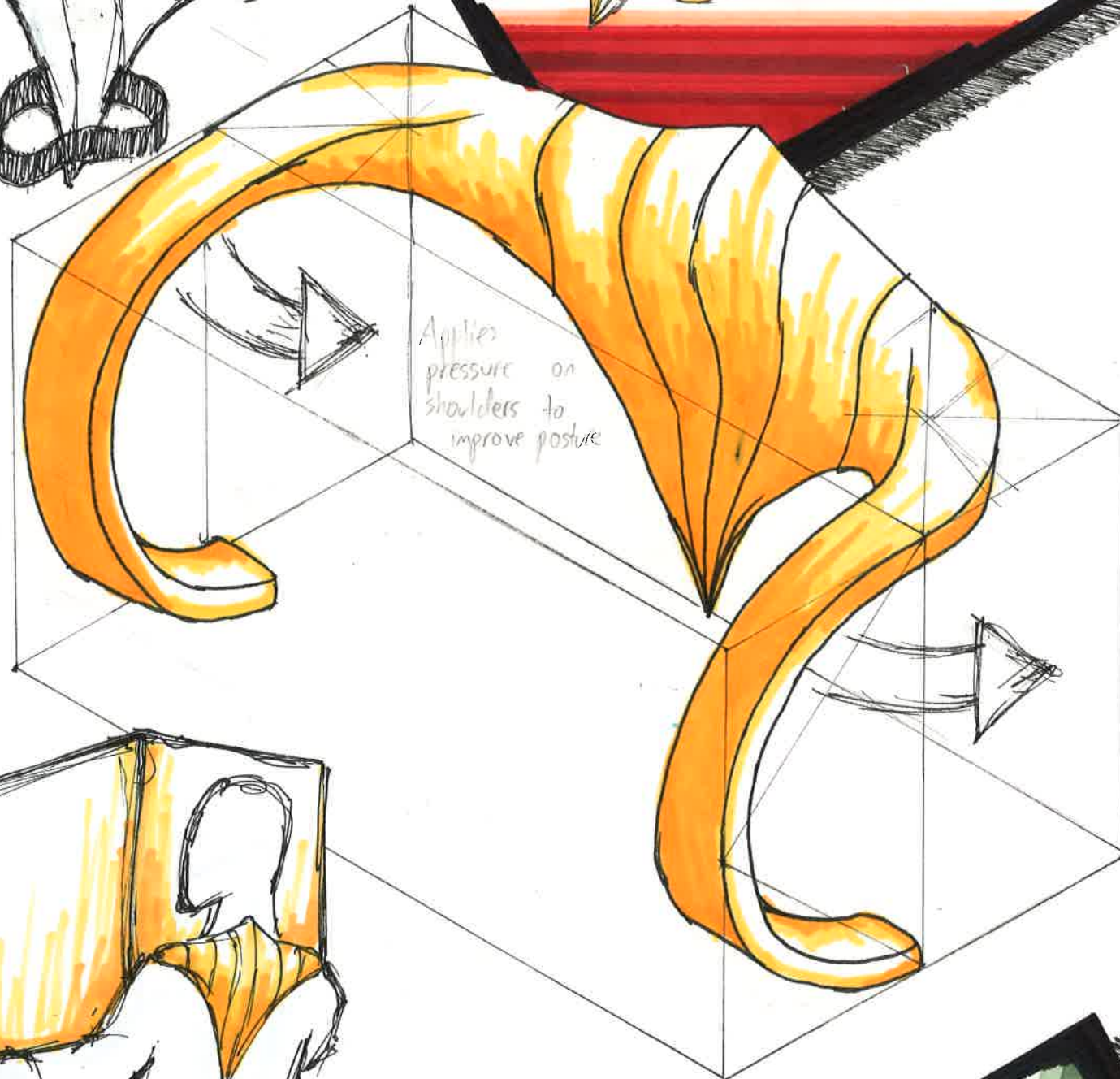
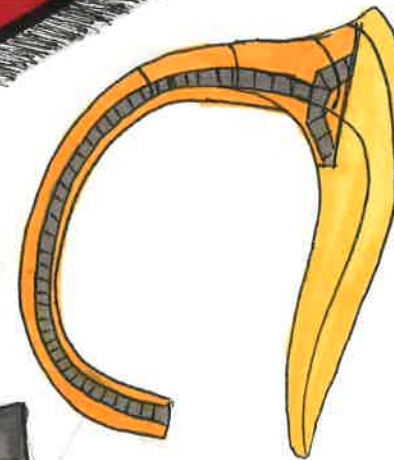
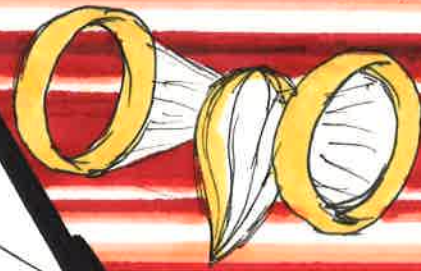
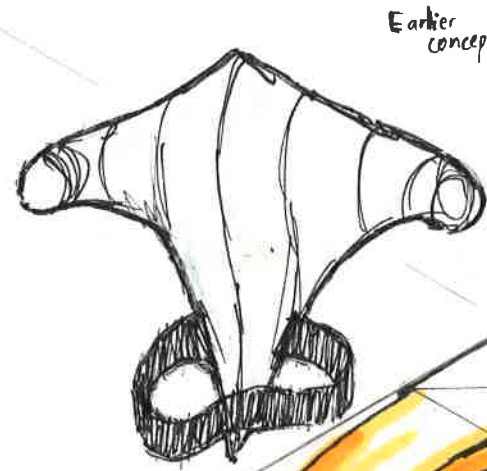


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IDEATION



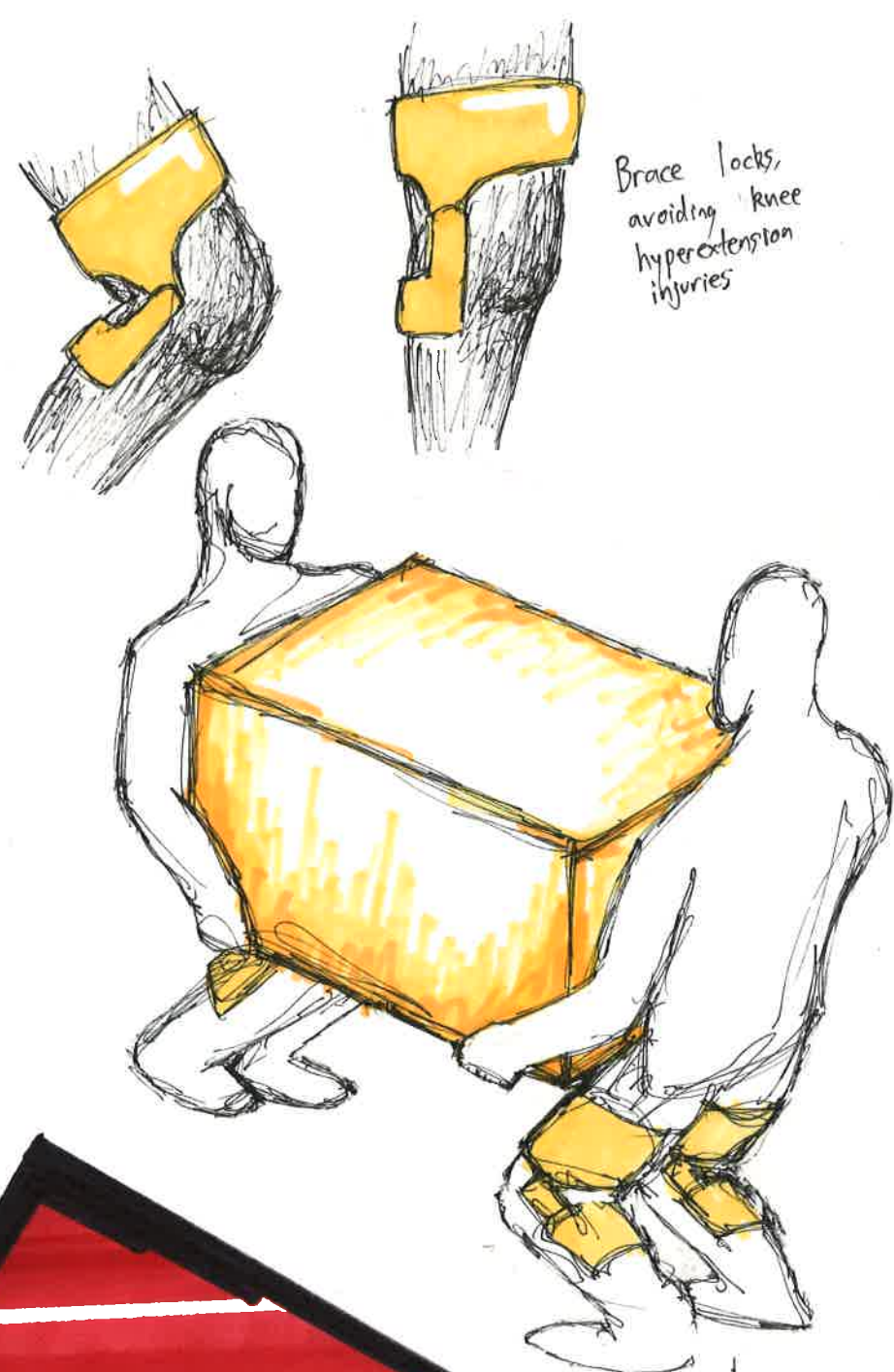
Earlier  
concepts



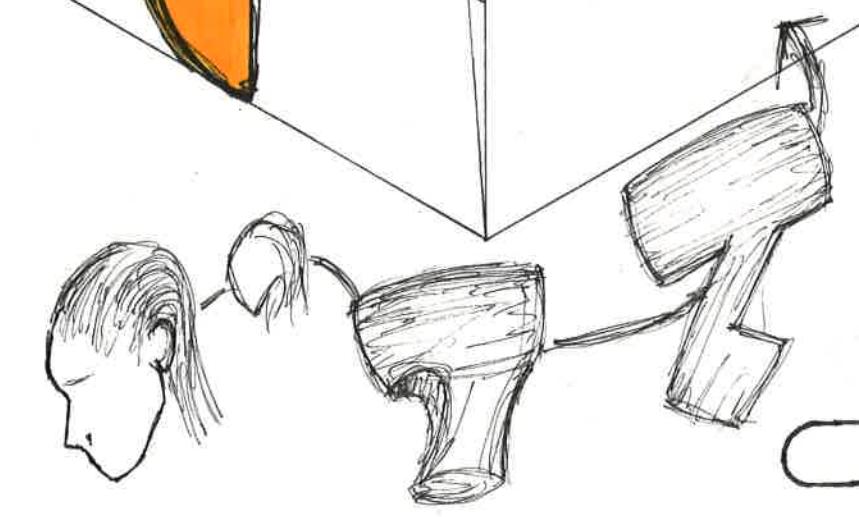
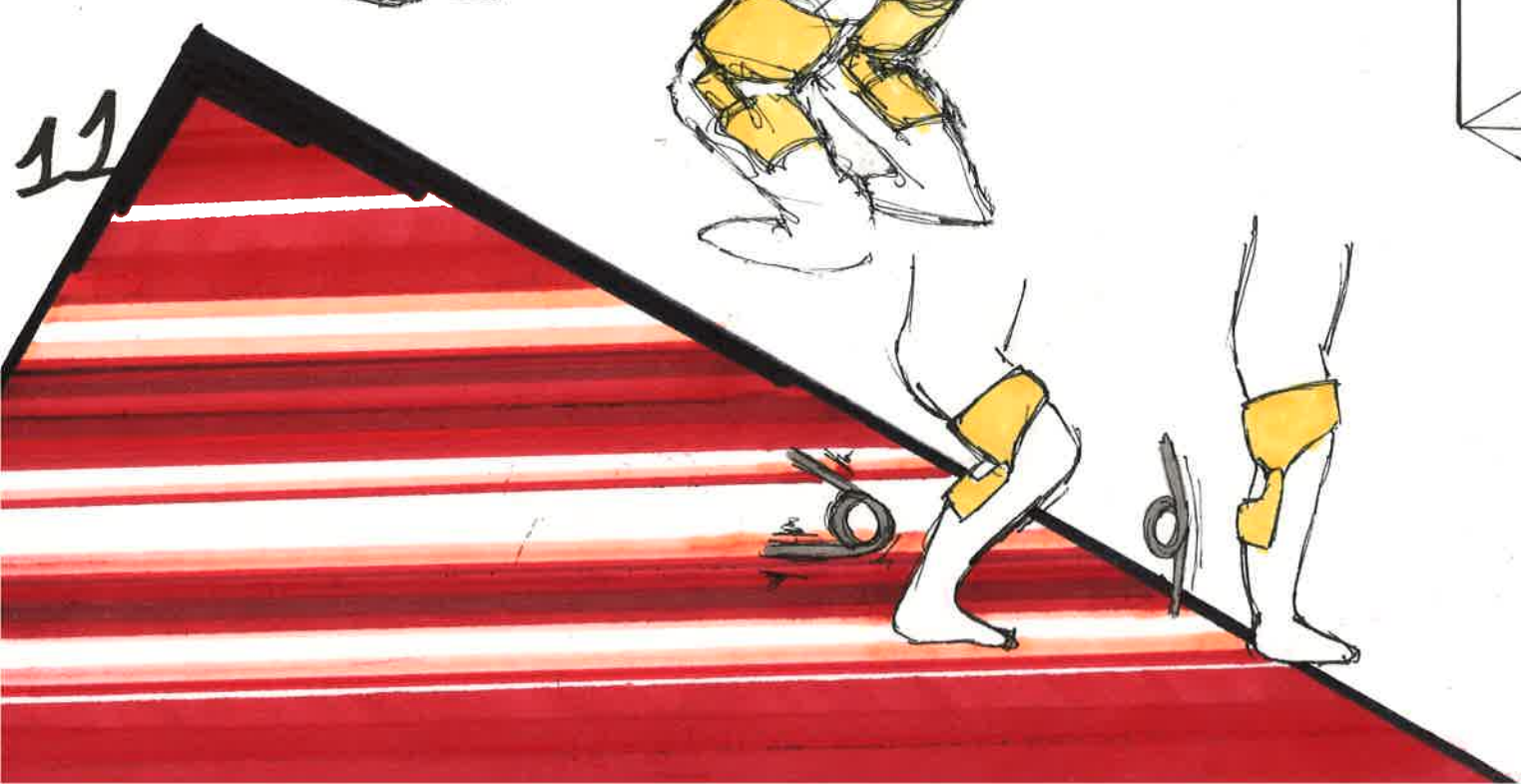
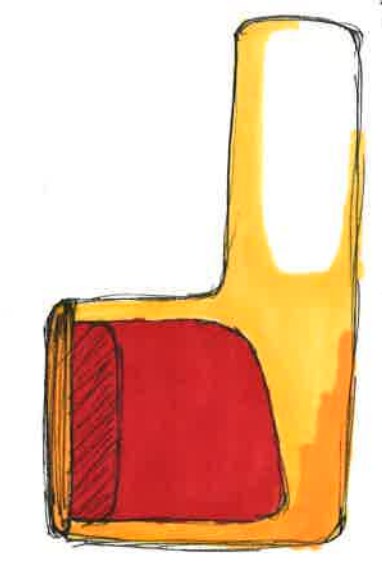
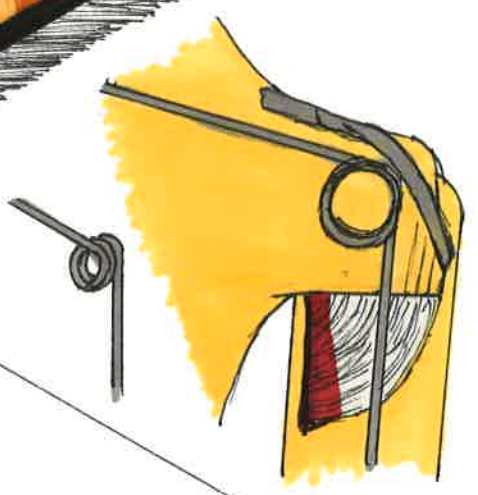
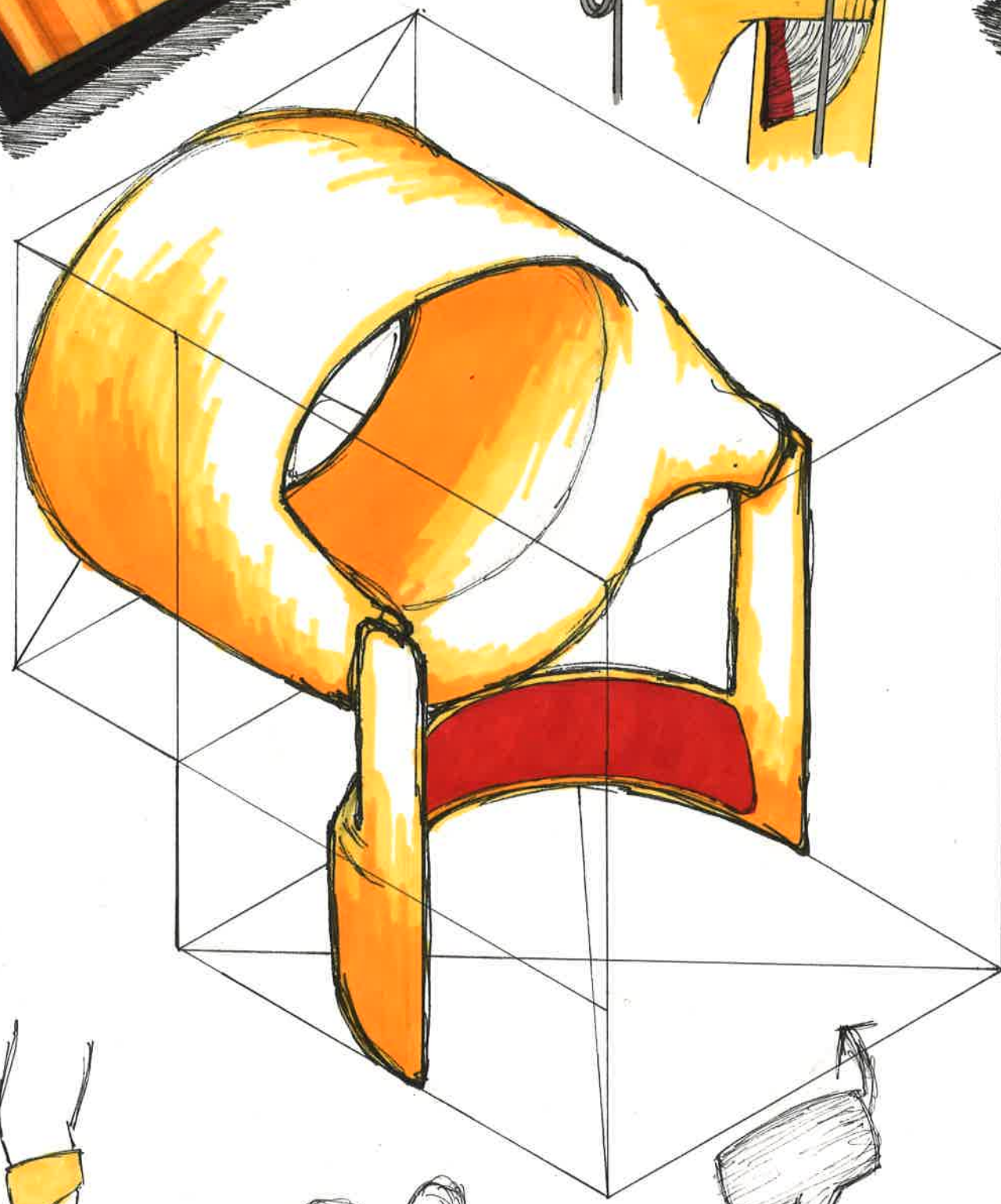
# POSTURE AID



# CONCEPTS



Brace locks,  
avoiding knee  
hyperextension  
injuries



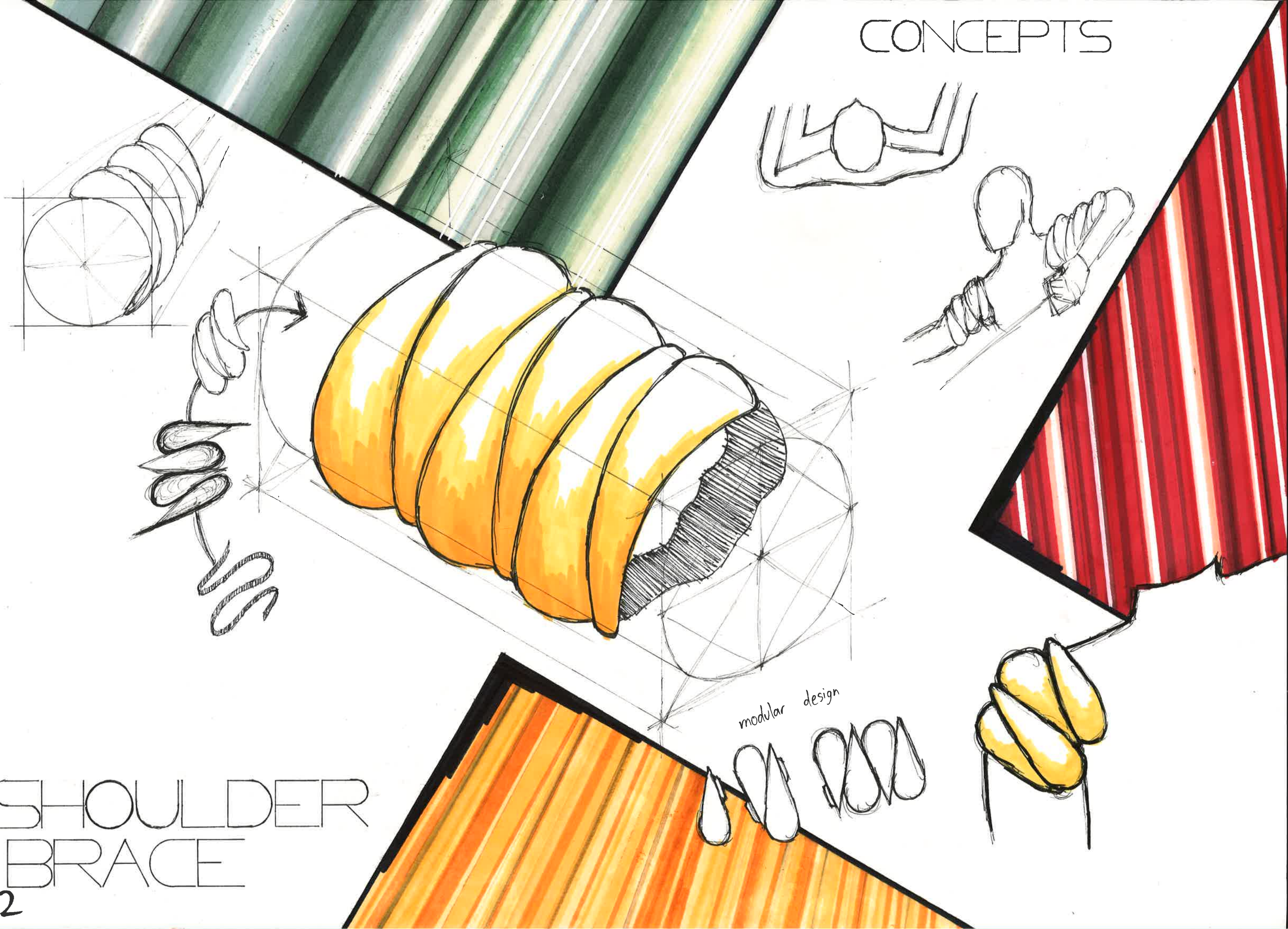
# KNEE SUPPORT



# CONCEPTS

## SHOULDER BRACE

12

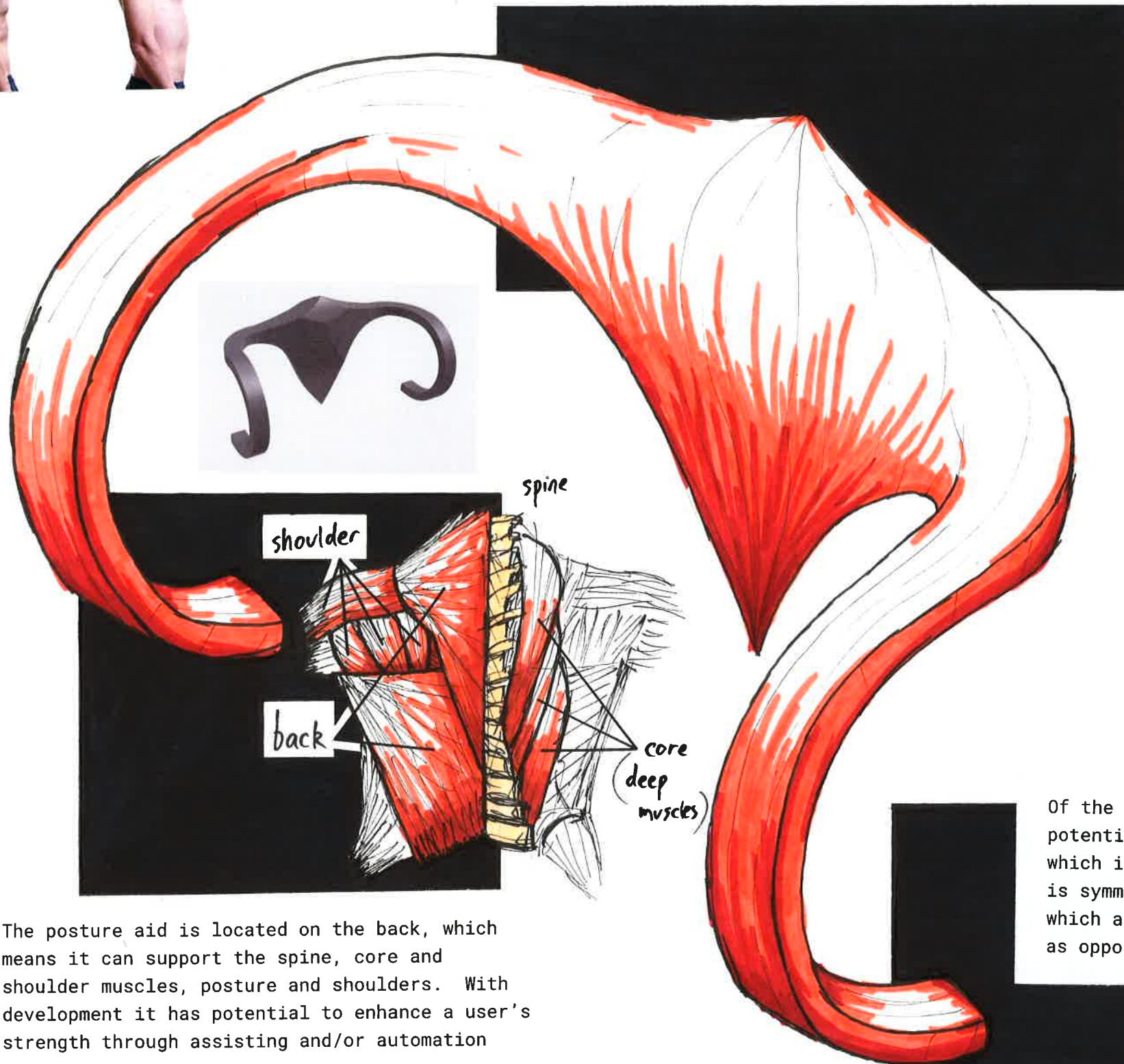






This design has more potential for

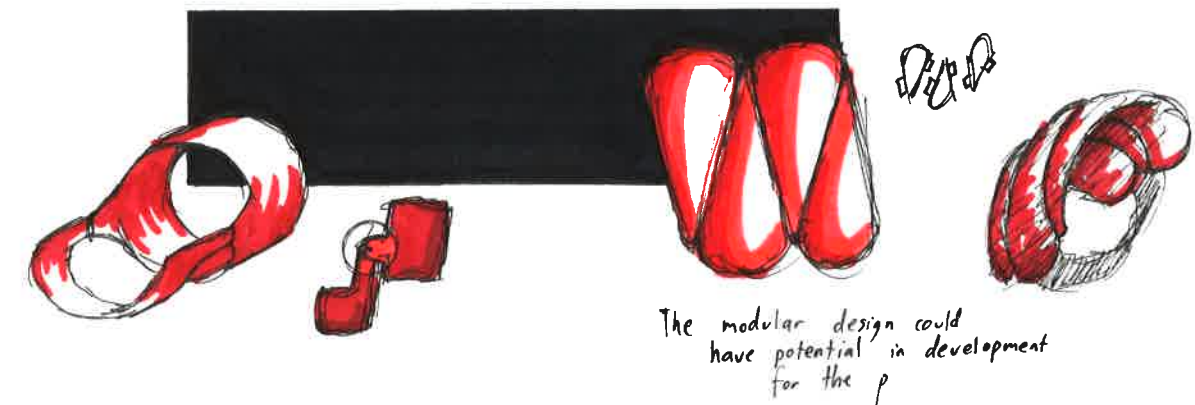
- Development into a more polished product
- Combating workplace injuries in the real world
- High-quality aesthetic considerations based on the function



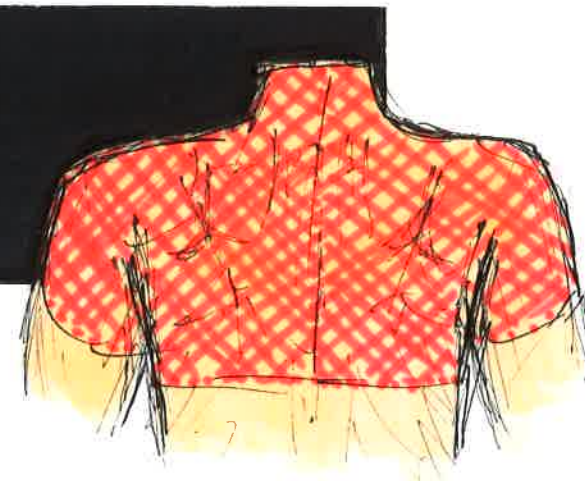
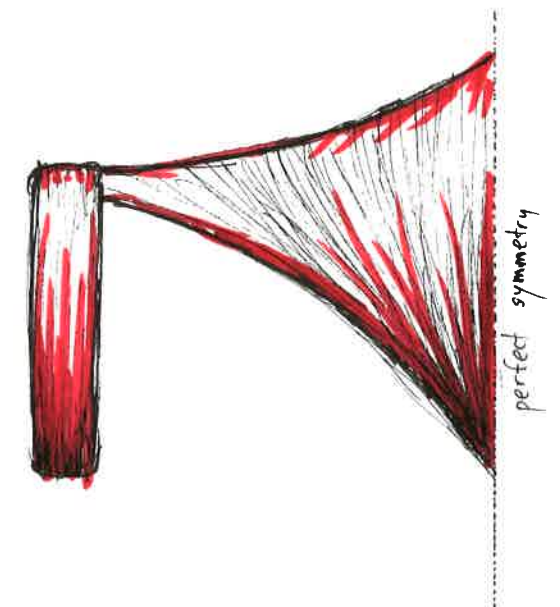
The posture aid is located on the back, which means it can support the spine, core and shoulder muscles, posture and shoulders. With development it has potential to enhance a user's strength through assisting and/or automation



The knee-support brace is very much governed by the shape of the knee and can only effectively fix knee hyperextension and improve squat strength. The single-shoulder brace only guides the shoulder's movement to avoid Repetitive Strain Injuries, without any form of aid or assistance



Of the concepts, the posture-aid has more potential in development for a design which is aesthetically pleasing. As it is symmetrical and sits on the back, which allows for more area to work with as opposed to only the knee or shoulder





# POSTERIOR VIEW

# LATERAL VIEW

Repetitive mechanical movement with poor posture results in muscle fatigue and muscle tightness in the back. This can then impact the neutral shape of the spine resulting in worsening posture issues.

Of the major back muscles, the rhomboid and trapezius are the most affected by posture. Causing muscle fatigue of the rhomboid and lower trapezius, along with tightness in the levator scapulae (not shown) and upper trapezius.

Most of the muscles which contribute to posture are involved in the positioning of the scapula (shoulder blade).

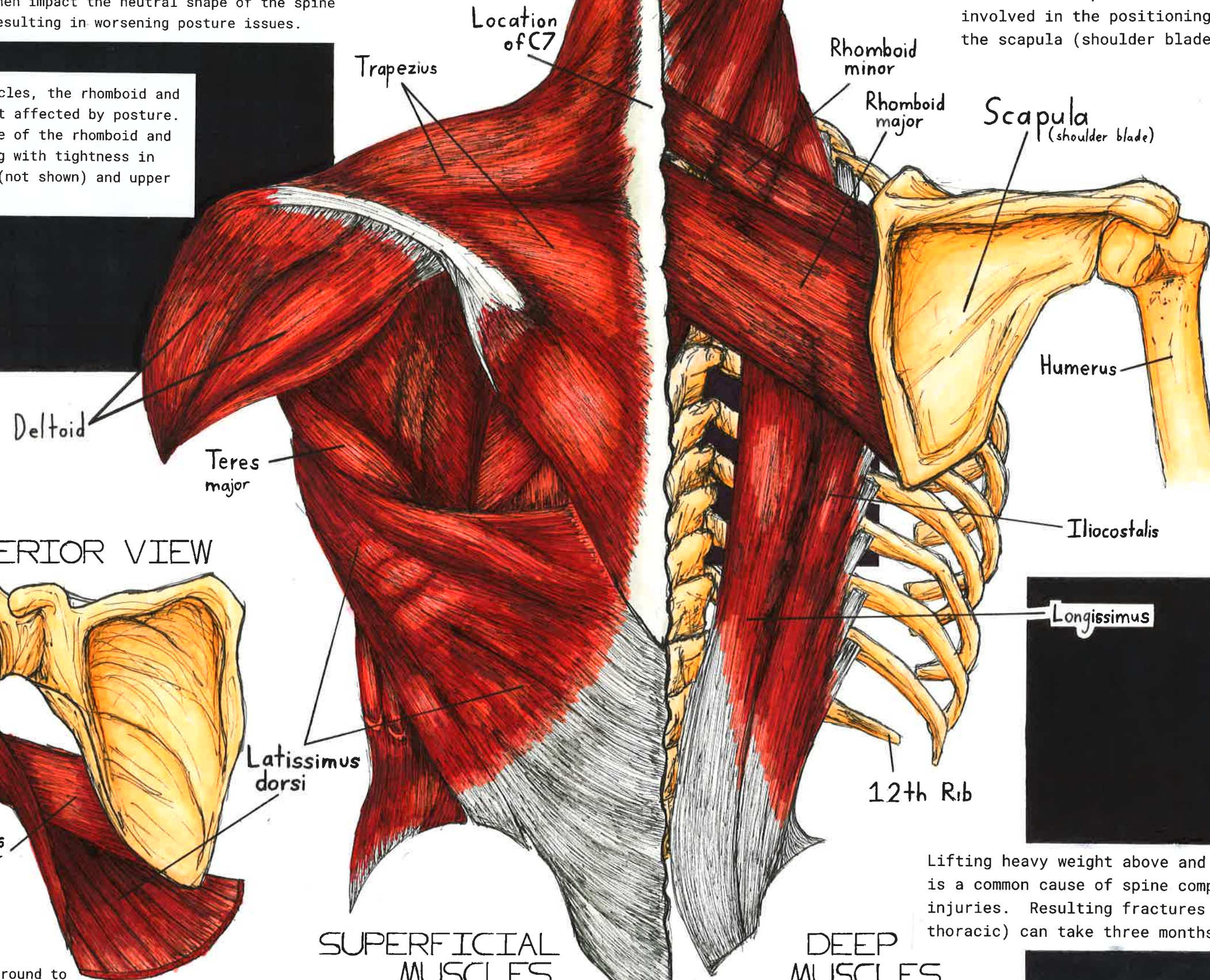
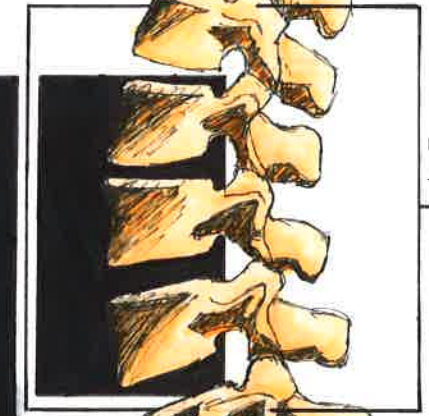
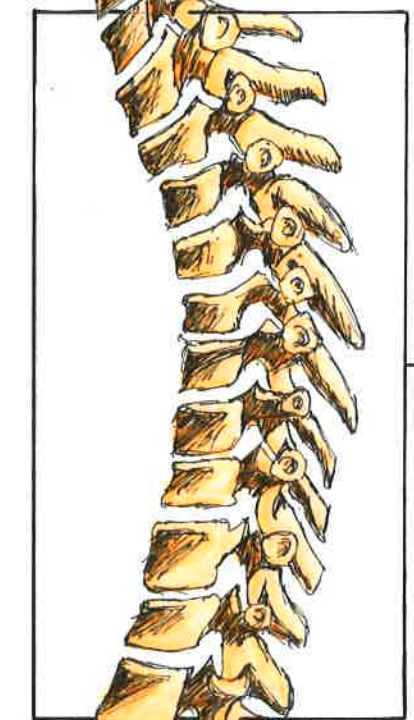
Cervical  
T1-T12

POSTERIOR

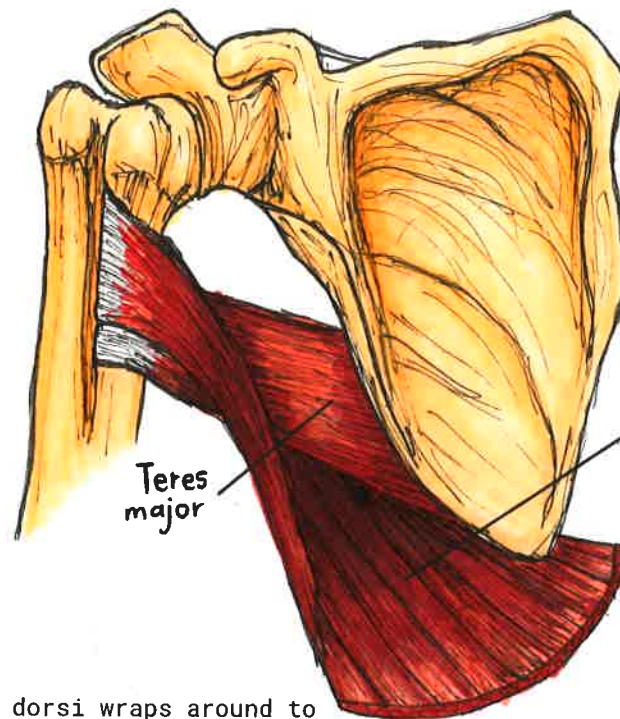
Lumbar  
L1-L5

Sacrum

Coccyx



## ANTERIOR VIEW



## SUPERFICIAL MUSCLES

The superficial muscles of the back lie close to the surface skin, and are primarily responsible for much of the movement of the torso, neck and arms.

## DEEP MUSCLES

Whereas the deep muscles - located underneath - are primarily responsible for support, spinal alignment and reducing the weight load on the spine.

Lifting heavy weight above and behind the head is a common cause of spine compression injuries. Resulting fractures (commonly thoracic) can take three months to heal.

## SPINE

14

Latissimus dorsi wraps around to connect to the front of the humerus, it's tightness can also contribute to poor posture as they can bring your shoulders forward in a hunched position.

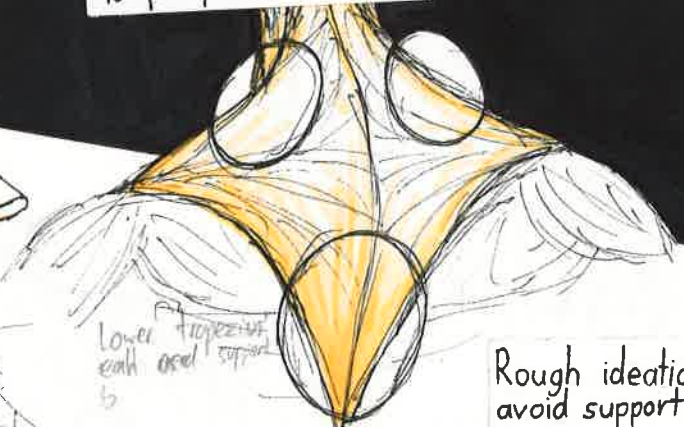
# ANATOMY



15



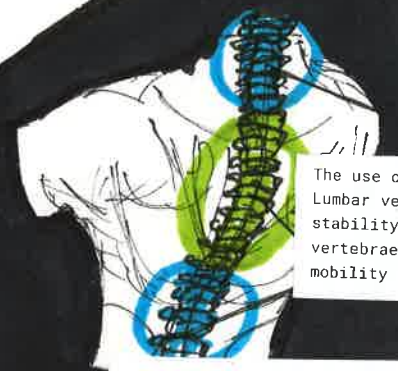
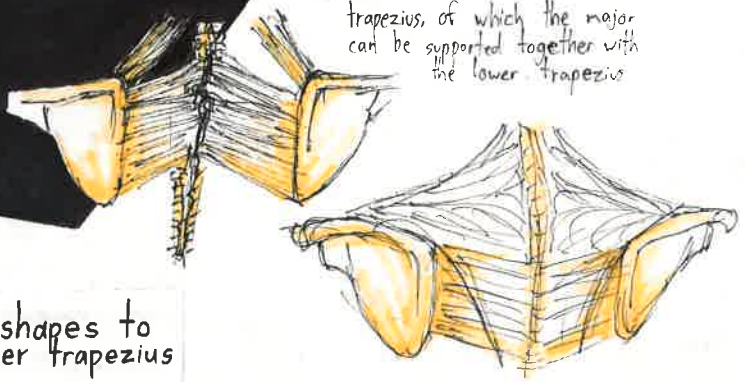
Upper trapezius contributes to poor posture



Lower trapezius each need support

Rough ideation of shapes to avoid supporting upper trapezius

The rhomboids sit under the trapezius, of which the major can be supported together with the lower trapezius



The use of the Cervical and Lumbar vertebrae is stability, whereas Thoracic vertebrae are used for mobility

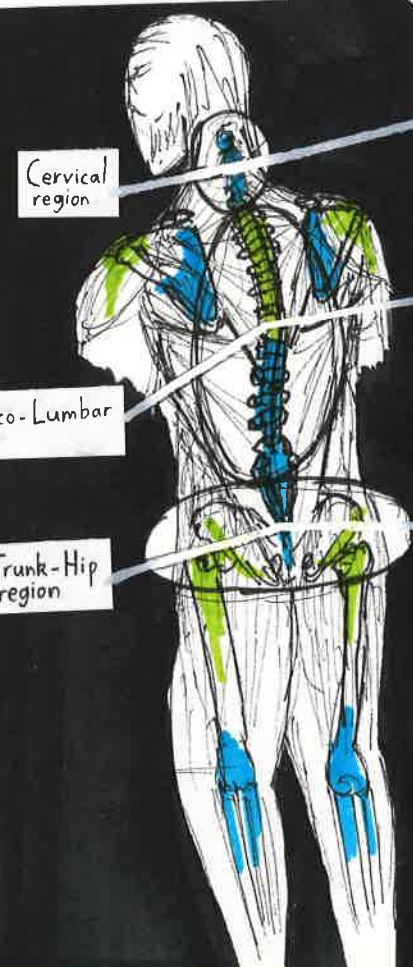
Something to consider when placing support and mobility



Placing a flexible module between rigid points mirrors and supports the spine's own flexibility



# The Kinetic Chain



Cervical region

Thoraco-Lumbar region

Trunk-Hip region

A useful visualisation of the kinetic chain

As the shoulders move, the hips move

Rigid structural support is needed between the shoulders

using previous ideation with intent to create the same shape as above

Follows tendons in

space for spine

clashes with lats

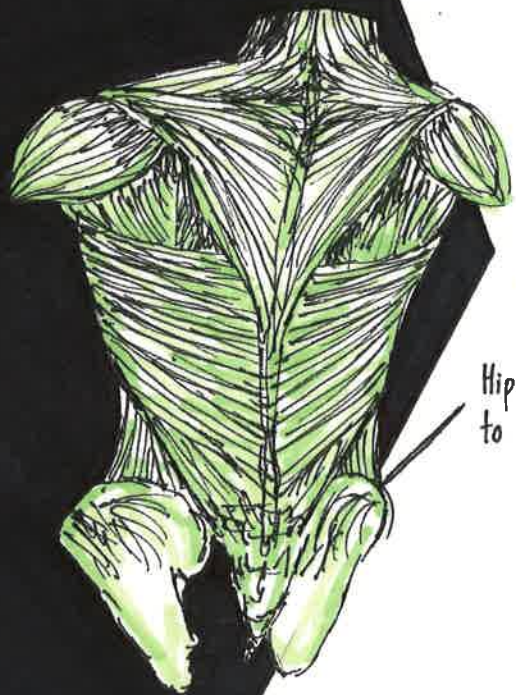
curve travels up trapezius

Point of flexibility

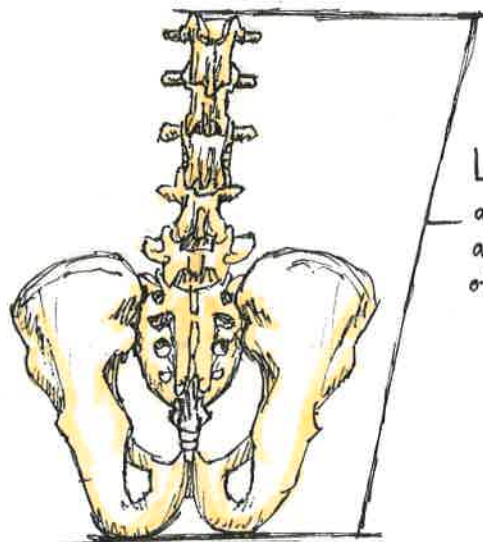
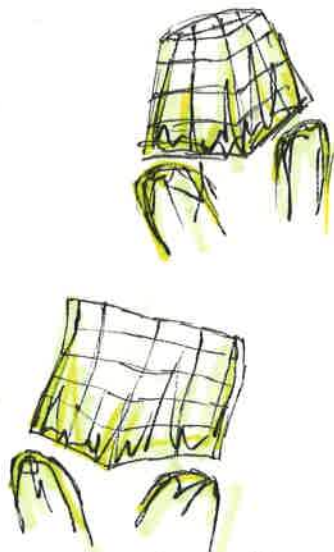


# DEVELOPMENT





Hips are a stable platform to transfer weight

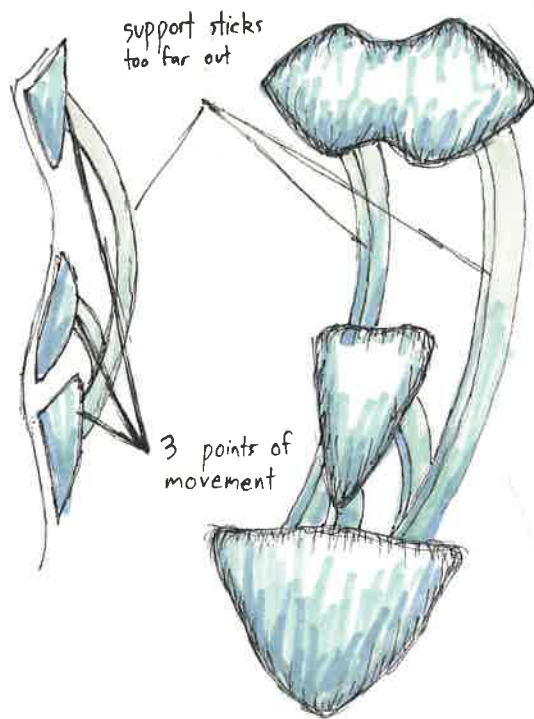


L1 through to the coccyx and Pelvic bones by nature are a stable and supporting region of the kinetic chain.

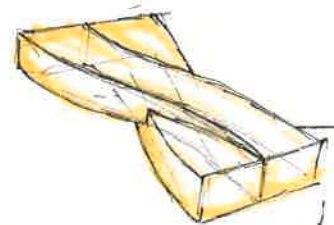
Therefore it's an excellent area to shift weight from the weaker cervical region while also bypassing the thoracic region of the spine



Each section supports each region of the spine



basic shape



No flexibility without using a flexible material

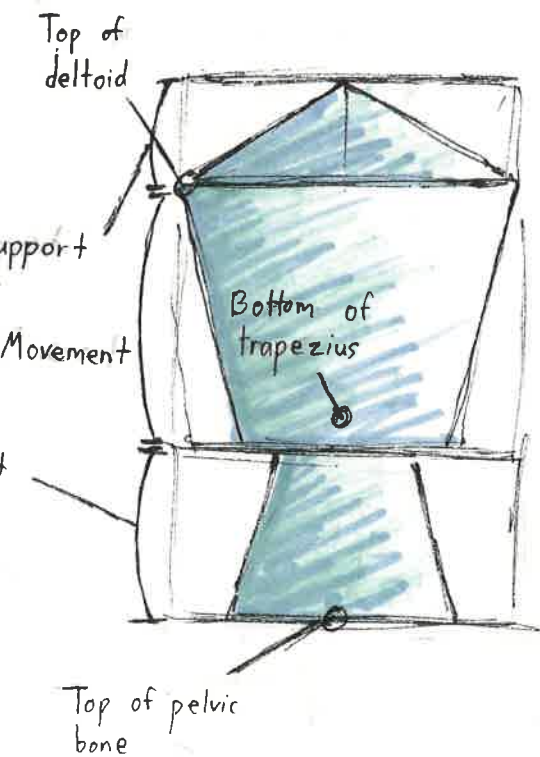
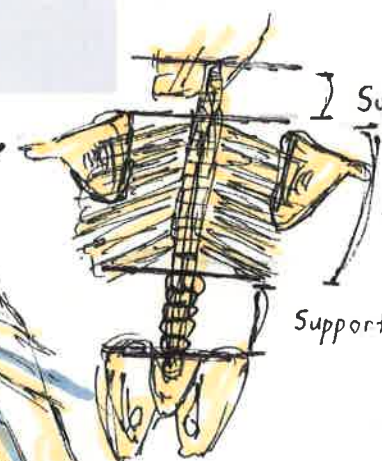


No support of Thoracic region

# MOBILITY

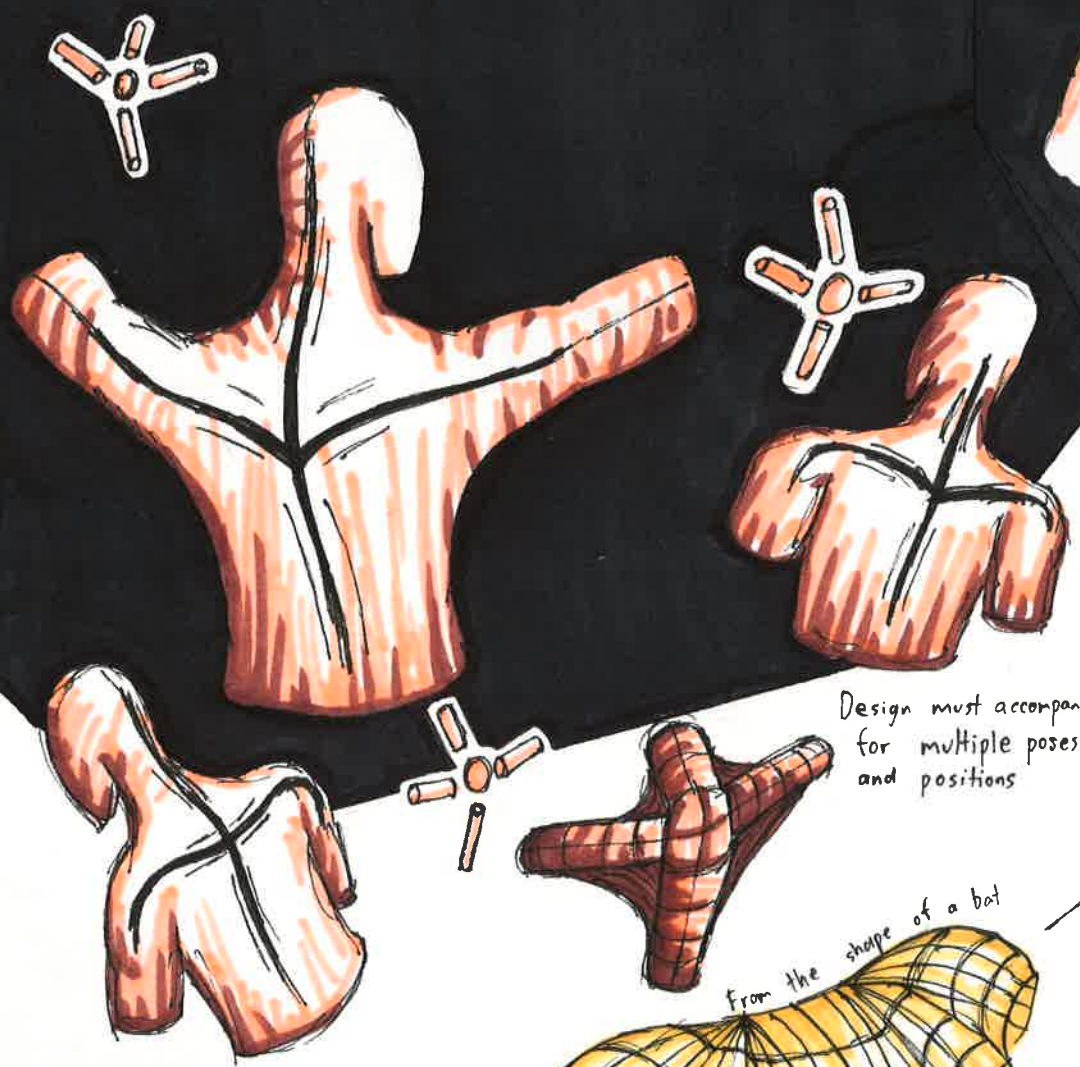
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Further ideation with a single beam instead

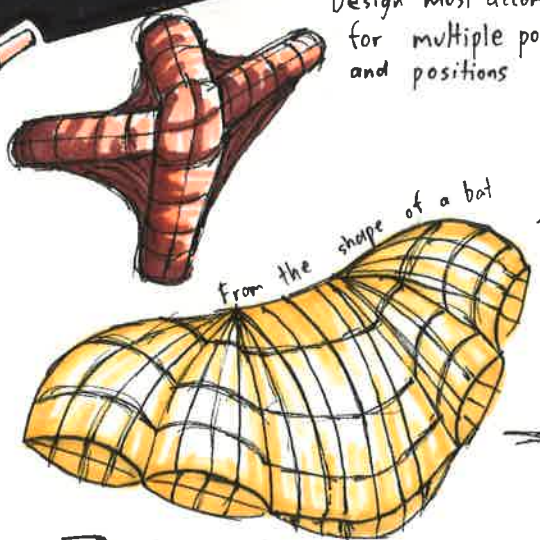




# 17 FORM



Design must accompany for multiple poses and positions

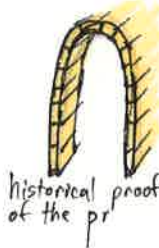


From the shape of a bat

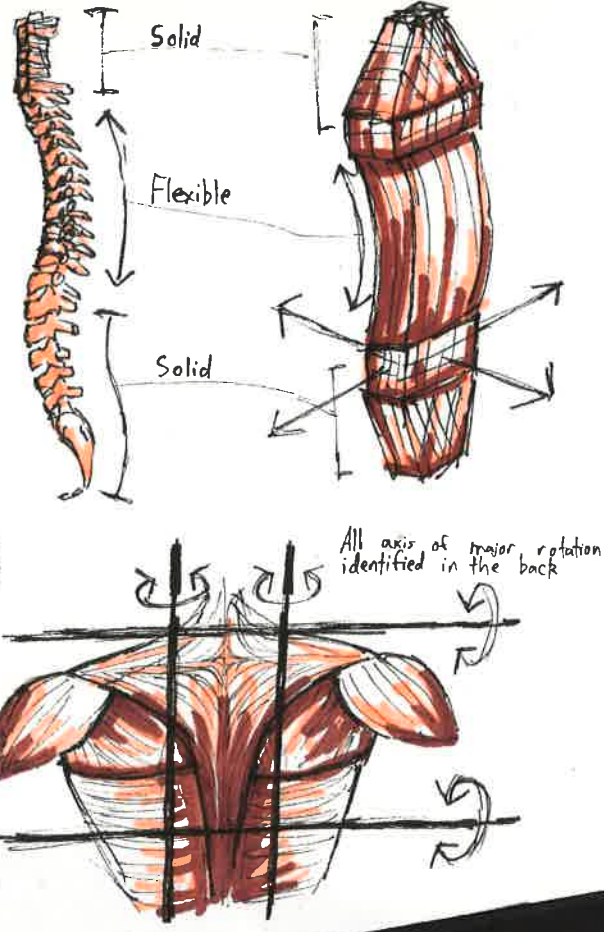
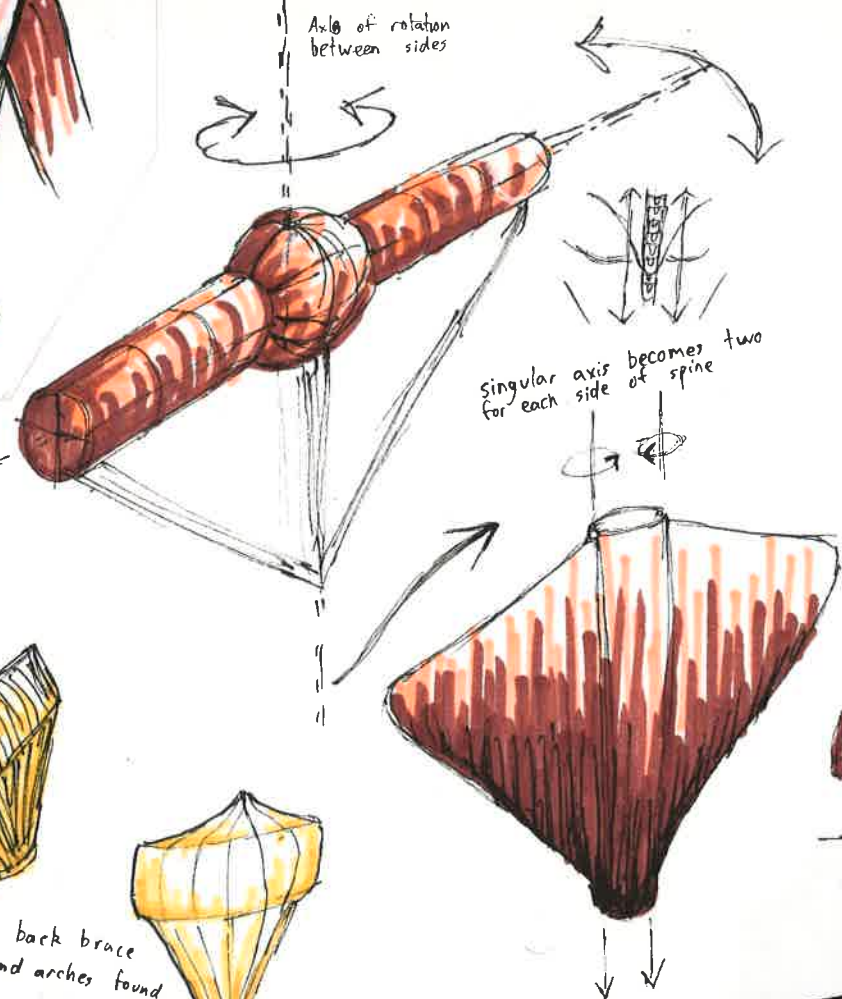
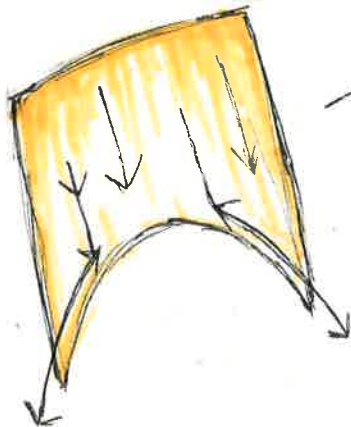
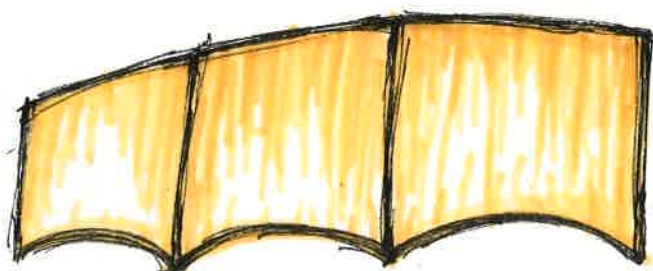
to the shape of a back brace using the curves and arches found on a bat's wings



Ancient Romans used the arch to support thousands of tons of stone and mortar



historical proof of the pr



horizontal connection between shoulders for maximum strength

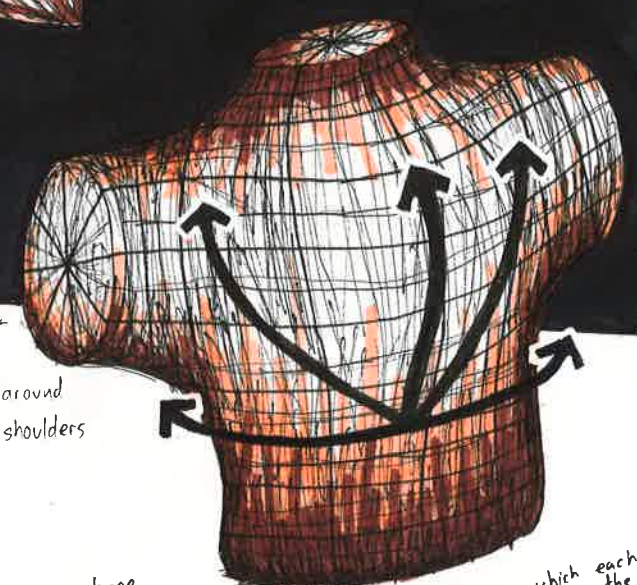
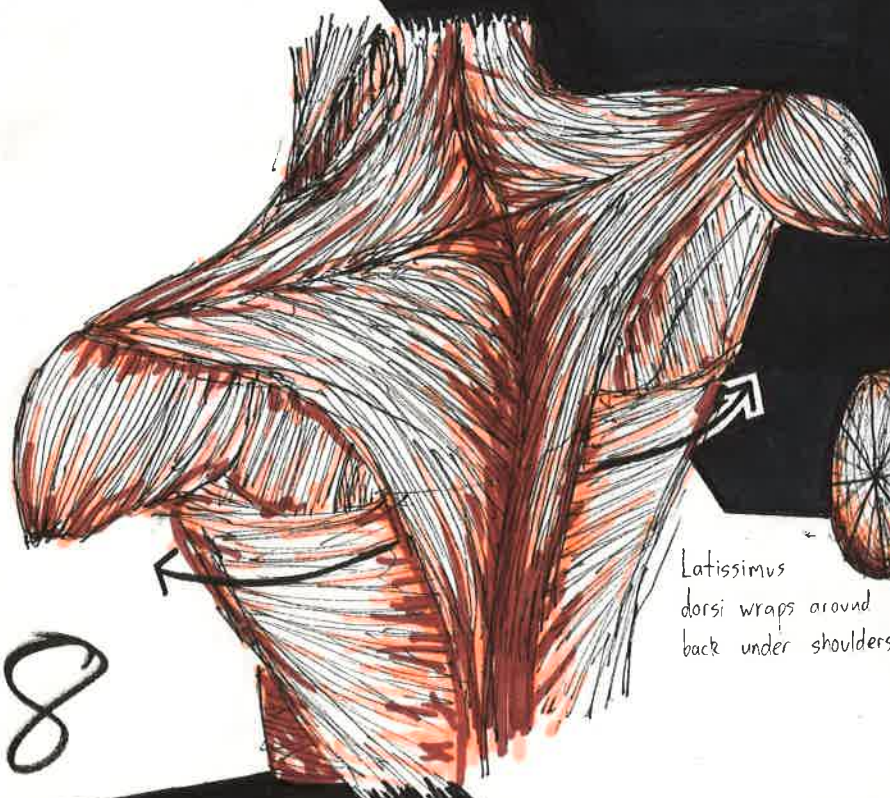
Gravity powered mechanics?

Hydraulics?

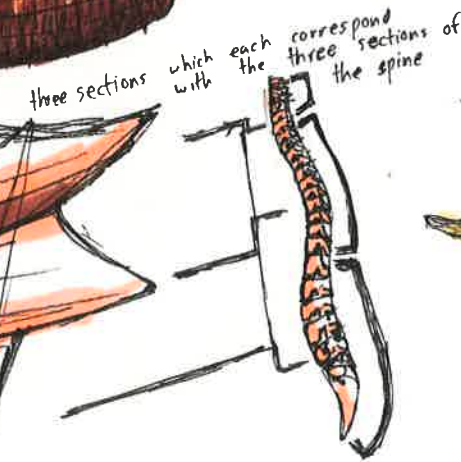
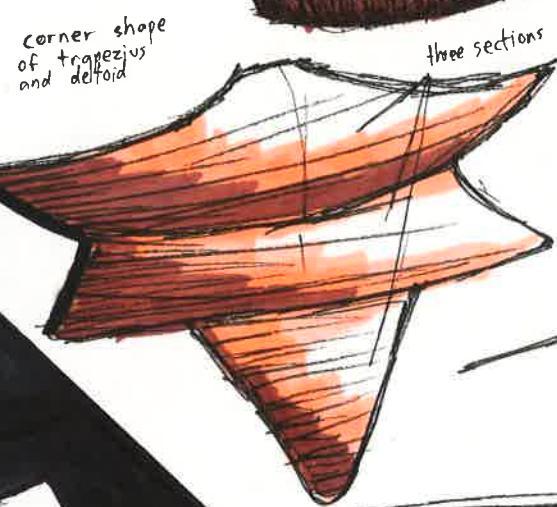
Possibilities for mechanical contraption



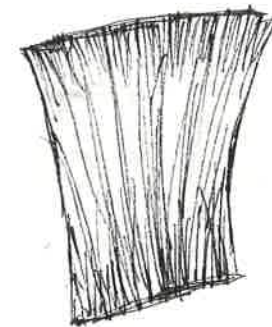
18



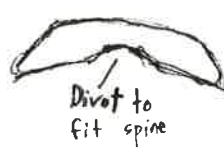
Using the V shape takes into account the trapezius and deltoid



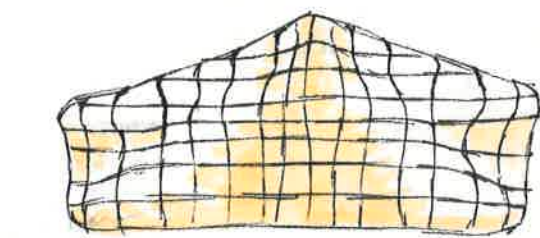
Mid section completely new design



Top view

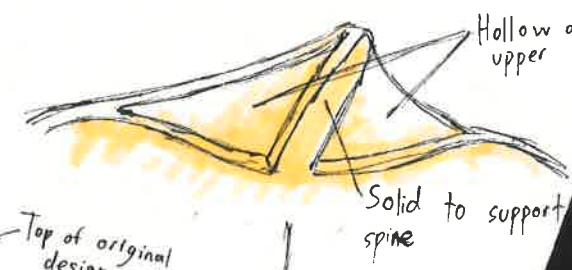
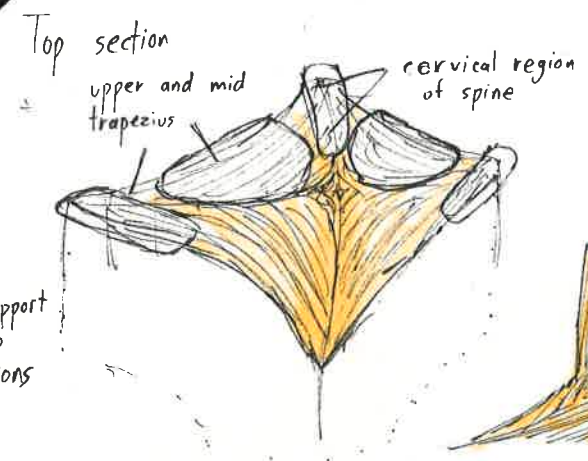
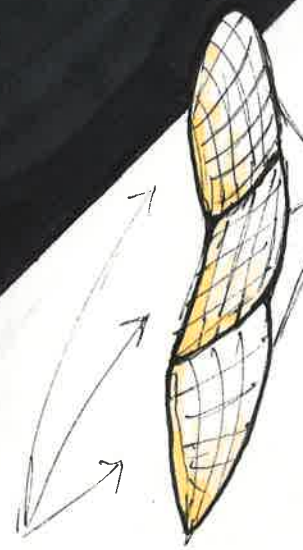


Ideal form

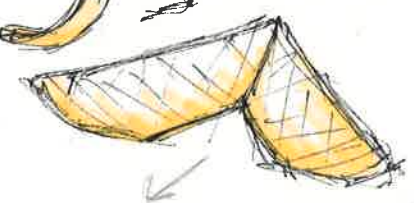


Region to support

Central support divided into three sections



Top of original design works well here



areas to consider for the top section

Bottom section Original concept design does not reach pelvis



Curve of pelvis

Slight curve around back





# APPEALING TO AUDIENCES

Working in physical labour requires accessories. Combining the design will allow for a more practical product



Belt for carrying tools



Vest to ensure visibility

## 19 Colours

Thinking as a manufacturer and marketer



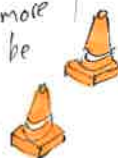
Brightest and most vivid  
- Safety colours usually blends with white and black, black being a much better combination with yellow



Two separate colours, orange for construction and green for roadworks



Most attributed to safety therefore more likely to be purchased



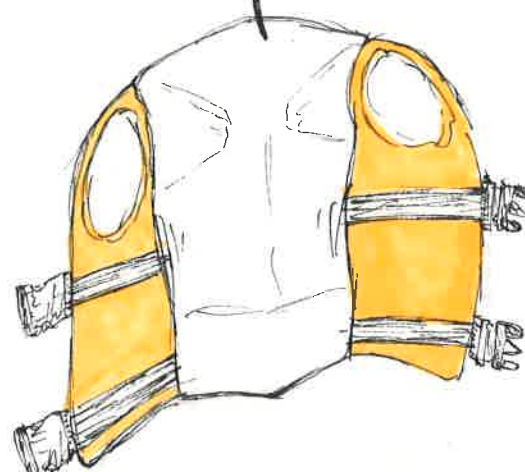
Usually found on road signs  
Portrays a more "Responsible" feeling than safety

Like obeying traffic laws

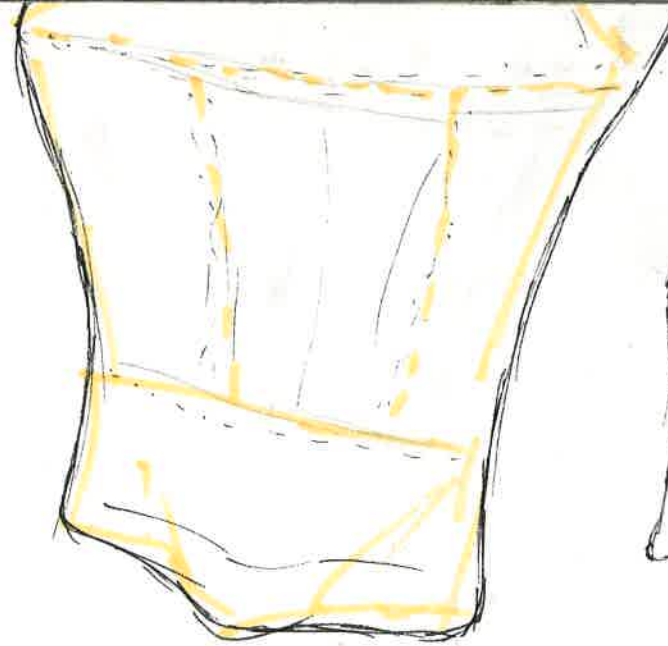
Darkest and least attributed to safety, could be seen as a parody of orange safety gear



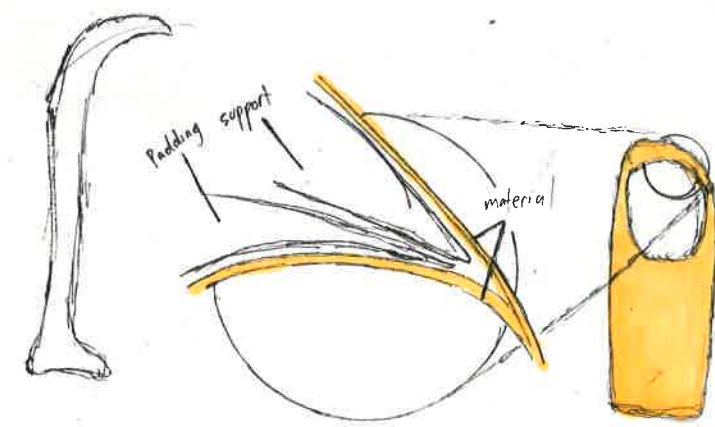
New addition allows for better connection to waist and hips



Rear for will contain mechanics support



Shoulders can come over



Shoulder straps



middle, possibly uncomfortable



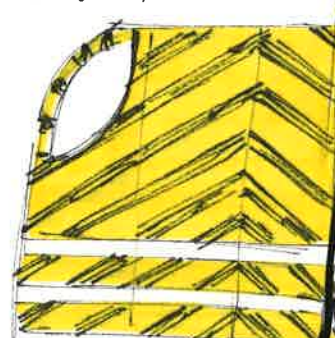
thin, possibly more uncomfortable if design is heavy

Wider, more comfortable, more support



Mechanics will be fully inclosed

Yellow with hazard lines for factory workers



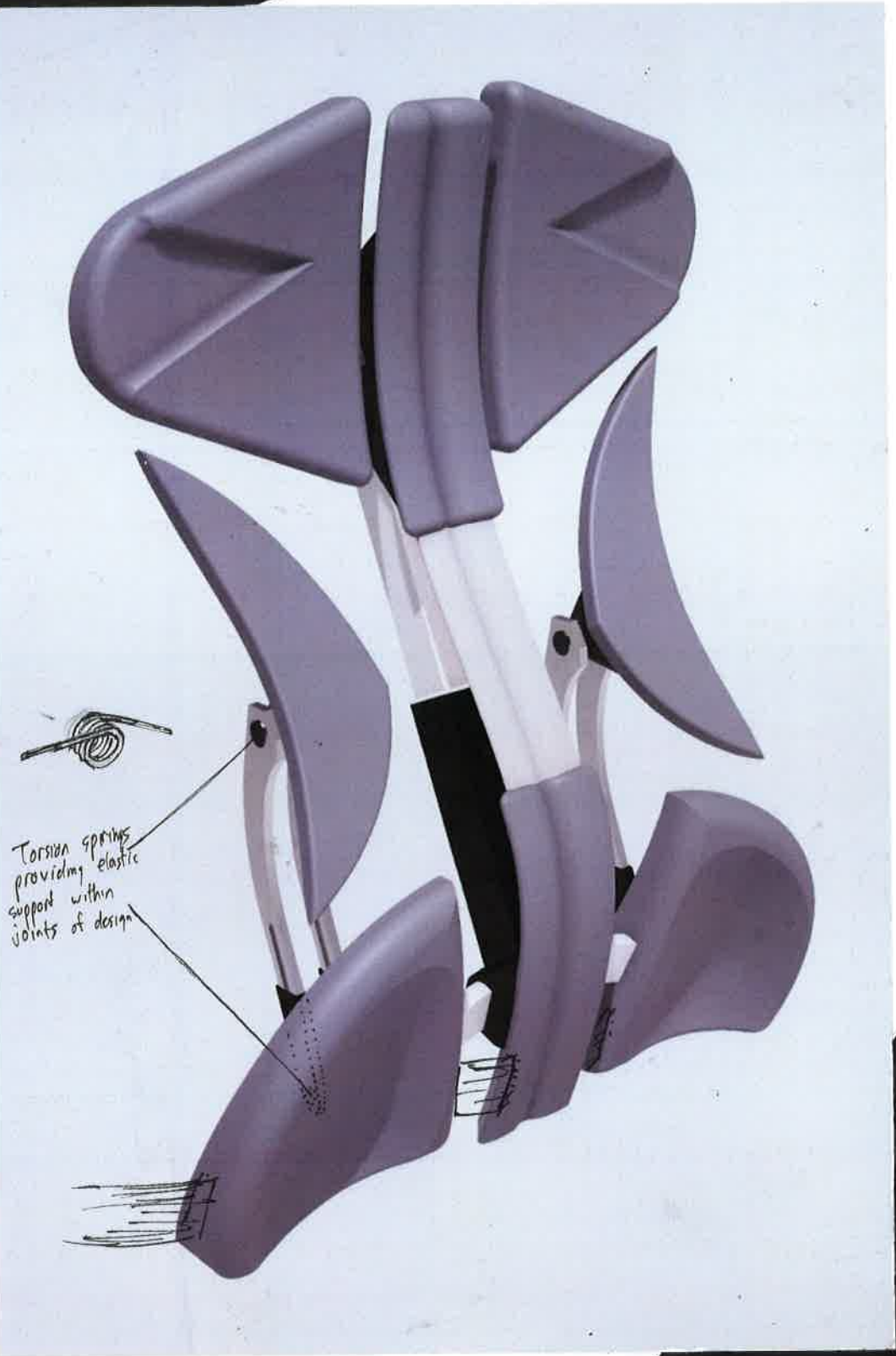
New colour better combats injuries as explored in brief and anatomy



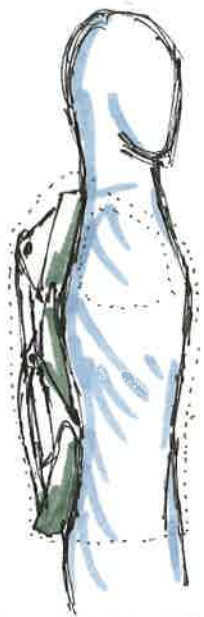


# MECHANICS

spine juts out for most of population, divot in design removes discomfort



Torsion springs providing elastic support within joints of design

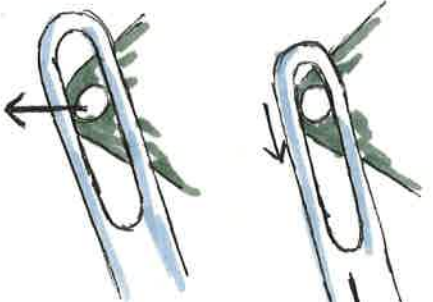


Forces acting on the mid to upper back are transferred to the lower back and hips



Rubber reinforced with iron  
Non-reinforced rubber

slight divot for spine



Simple mechanism to transfer pressure from back down towards hips and hip pads





Interior

Exterior

21



## Excellence (Product) Exemplar 2022

Subject	Design and Visual Communication	Standard	91627	Total score	E
Grade score	Annotation				
E	<p>This submission has multiple starting experiences from ballet, swans, hands, and waves. There are a range of variations and alternatives before a context is introduced. Initial ideas are regenerated and interrogated around the human form and lead into design ideas. Ongoing analysis and re-interpretation of the design ideas is shown with the introduction of new inspirational sources. Immersed throughout these pages are connection to human use factors, design idea functions, and performance all in relation to the context which shows insightful design thinking. The connection to the human form, reinterpretation of the design idea back to the ballerina and introduction of a bat further strengthen the train of thought. The design idea is extended and transformed to an unpredictable design idea by incorporating the posture aid into a high vis vest. The design idea has evolved through extensive exploration. This submission has a clear narrative. The design thinking is concise and effectively communicated (although the final design could have been more effectively shown with more refined detail and multiple views).</p> <p>This submission is an Excellence.</p>				