

*Professional Practice*  
*Berghaus Live Project*  
*Project Log*



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## *initial design brief*

Design an infant carrier that might be added to the existing range of equipment produced by Berghaus. It's purpose should mainly be for outdoor use, with the intention of carrying an infant aged approximately between 6 months to 3 years.

The carrier should be aimed at the low intensity trail user, but an allowance for a crossover between the high intensity user and everyday should be made. The design language should follow that of Berghaus to theoretically fit their range of existing products.



*initial research*

## about berghaus

**1966 - 1970** Peter Lockey and Gordon Davison open LD Mountain Centre, selling high-performance outdoor products. they soon started to sell their own designs, under the name Berghaus.

**1976 - 1980** the introduction of the new waterproof and breathable GORE-TEX® fabric, and the development of the unique Yeti® Gaiter.

1986 - 1990 recieved Queen's Award for Export in 1988 and the Northern Business Award for Exporter of the Year.

**1971 - 1975** start manufacturing backpacks, including Cyclops, famed for it's internal frame and padding.

**1981 - 1985** introduction of layering in clothing, and development of more rucksacks.

**1996 - 2000** introduction of the lightest, most packable outerwear available – GORE-TEX® Paclite®.

**1991 - 1995** Pentland Group PLC, already home to leading sports brands Speedo and Ellesse, acquired Berghaus.

**2006 - 2010** received royal recognition – the Queen's Award for innovation in the design and technical development of outdoor products. Three flagship stores were launched.

**2001 - 2005** innovation of more materials and systems, including Bioflex®, the world's most innovative back system to date.

**2011 - Present** continuous improvement.



## the brand

**“creating world class outdoor performance products, driven by innovation, built for adventure”**

*MtnHaus, Jan 2015*



Performance: Colour and form convey performance. Does what it's meant to do. Bold. Not over-emphasised.



Innovation: Pseudo-technology impression. Draw attention to innovation via colours, textures etc.



Adventure: Form accurately conveys adventurous nature of product. Not utilitarian, nor exaggerated. Durable and robust.

## their consumer profiles

Berghaus design their products for a broad range of consumers, all being authentic and of high quality at every level:

**Extrem**

**Mountain**

**Trail (high intensity)**

**Trail (lower intensity)**

**Everyday**

## the ideal consumer?

Assumed age range: late 20's - late 30's.

May be a single parent or a family, with one or more children.

It is possible that the design may overlap into the above and below categories, depending on the user's lifestyle.

## *carrying a child*

There are many ways that children can be carried from one place to another; these can include:



pushchairs



car seat (carriers)



slings



(front-facing)  
infant carriers

...as well as child carriers. Their use depends on the age/size of the child, the time and place of use and the kind of activities the adult is most likely to use it in.

Child carriers can vary in style and functionality too. Some have more of a compact rucksack aesthetic, whilst others appear to be more practical and more suited to trail use.



## *the low-intensity trail user*

Taking a look at the intended market in greater detail.

### *Who they are*

They could be parents, or a single parent with one or more children, in their late twenties to late thirties.

### *What they do*

This kind of user would like to maintain their pasttime of walking outdoors in the countryside for a few hours once or twice a month or so at least, and be able to share their experiences with their child. However, they are aware that the child may not be able to handle a long day out as an adult, and pushing a pushchair would be impractical on rough ground.

They could also want to go on a quick trip into town or the shops; a carrier that can allow for this kind of outing as well as a trail walk would be ideal, instead of having several child carrying systems (e.g. and pushchair) for different purposes.

### *What happens/what they would need*

The adult(s) would have to plan eating and resting times around the child, especially at a younger age when they still require bottle feeding. This would mean that their carrier would ideally be easily adaptable to either a growing childs' needs, or straightforward to adjust between parents to take turns, or have easy access to the day's supplements.

Ample storage would also be ideal in order to store the day's gear for both the adult and child, but without the bulky size or form - this would make it difficult to use the carrier in short term, or urban situations.



# features and components of a carrier

An analysis and simplification of the parts/components found in an existing child carrier, by colour.

**Blue** shades = features most relevant to the adult.

**Yellow** shades = features most relevant to the child.

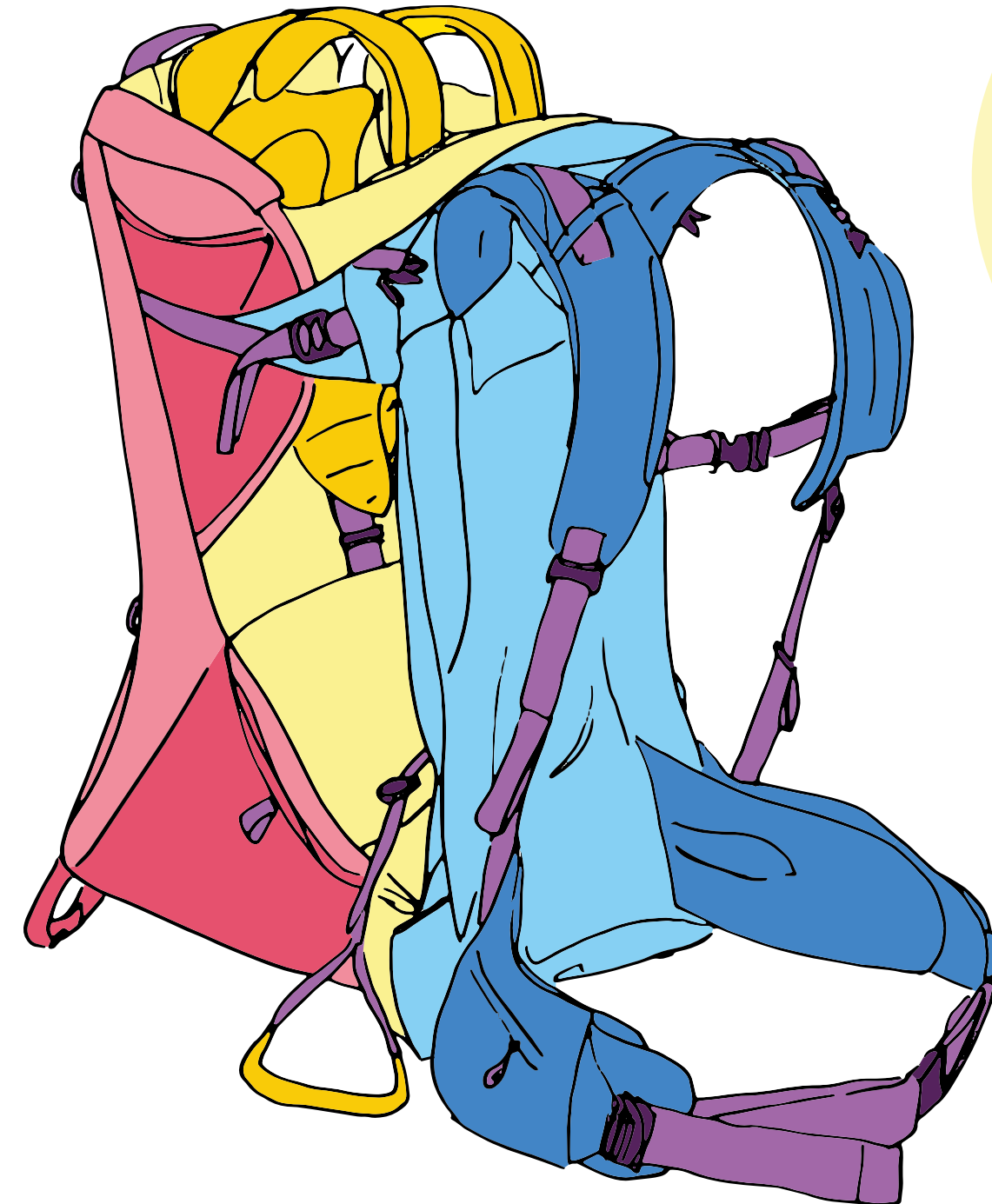
**Pink** shades = features of equal importance to both/overall structure or framework.

**Purple** shades = Straps, belts, clips etc.

Darker shades of each colour represent key features found in those sections.

back storage  
sun shade (built in or in base)  
kickstand (aluminium alloy)  
side pockets  
raincover (in base)  
padding  
internal frame (aluminium alloy)  
skin freindly fabrics  
toy loops  
detachable chin pad

grab handles  
hip belt straps  
shoulder straps  
side panel straps  
sternum strap  
associated plastic buckles



padded seat  
seat adjustments  
adjustable 5-point harness  
stirrups  
teddy bear  
head rest

padded shoulder straps  
padded hip belt  
back adjustment system  
shoulder strap pockets  
hip belt pockets  
mirror  
foldability  
handles  
removable day pack  
side pockets

Deuter



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## Kid Comfort III

Features: teddy bear // detachable chin pad // footrests // pivoting hip belt // foldability // rearview mirror // soft padding // integrated sun roof // hydration system compartment

Price: £230

The Deuter Kid Comfort III is one of three carriers in Deuter's child carrier range. It aims to provide maximum comfort for both the parent and child, by using soft, aerated padding throughout, and a pivoting hip belt system. The design is very user-centered - more so than others - for example, features such as the kickstand and handles are emphasised by shape, size and colour. The overall body of the carrier is concave, creating a 'cabin' for the child, whilst evenly distributing the weight on the wearer's hips.

This specific carrier does not come in a range of colours, but the combination of greys and blacks makes it suitable for a larger audience as the palette is neutral.

The form of the carrier, when packed, appears to be quite rounded, bulky and large, due to optimising the storage and padding - they are what characterise the carrier. The emphasis of storage implies the carrier is intended for more adventurous users, who spend longer days out and would therefore need to take more food and equipment with them. However, increasing the storage space and therefore size means that the carrier could be difficult to carry/manoeuvre in smaller, urban areas.

## Pathfinder 3.0

Features: auto-deploy kickstand // detachable chin pad // included changing pad // included sun hood // toy loops // hydration system compartment // zip on/off day pack

Price: \$299.95

The Kelty Pathfinder 3.0 is the top of their range of six carriers, prioritising comfort and safety for the child. It comes in only one colourway, with minimum highlighting. Its overall appearance is quite bulging and curved. There is little flowing form throughout the design; it appears as though each part has been designed separately with little effort to make it fit together - for example, the daypack has a very rounded form, but the sunshade is quite sharp in comparison, as it has only been designed for its flat-folding functionality.

It appears that the shape has been designed around the user, resulting in a product that appears less stylish - this could be an issue for some low-intensity users as they would most likely want to use their carrier for purposes other than just long walks (e.g. going out to town).

When deployed, it appears that the kickstand creates a larger, more stable footprint than some carriers, showing that it would be most suitable for a user that takes the carrier on more adventurous walks, where there is likely to be more rougher terrain.



2

Kelty



3

## All Terrain S2

Features: anchor point // removable daysack // large base pocket// pivoting hip belt // soft face pad // soft padding

Price: £199.99

Although the highest priced carrier in the range, the All Terrain S2 offers fewer features compared to other brands of similar prices. The lack of kickstand could be an issue for more adventurous users as it would not be stable to stand on rough ground, although this allows for a more compact design. This, combined with fewer features, would lower the weight of the carrier too, making it suitable for longer walks for higher-intensity trail users, but also everyday users who are more likely to wear the carrier in urban environments.

The form of the carrier is relatively cubic in comparison to other carriers, but overall gives it a less bulbous form. The pivoting hip belt makes up for the less human focussed shape and curvature.

Overall, the carrier has a friendly appearance, with the panelling softening the shape as well as adding some dynamic styling.

## Vamoose

Features: hinged alloy frame // 10L removable daysack // extra large base storage//hipbelt pocket// mirror // soft padded grab handle

Price: £221

Macpac's best selling carrier boasts a clean design with straightforward storage options - one daypack, large base storage and a hipbelt pocket. The internal hinged frame is what sets it's aesthetics apart from other carriers, although does not appear to provide stable support on rough ground; it also appears that the base would get dirty very quickly when set down.

There are no other colour choices, but the combination of red and shades of grey give quite a serious appearance, as though the carrier is capable for long, adventurous days out. The red nylon in the child seating area shows that the emphasis of the product is for the child.

The grey straps are quite inconspicuous, suggesting that it could be quite difficult for the adult to adjust, although on the other hand suggests that the carrier need not be adjusted so often, therefore they don't need drawing attention to.



4



Osprey



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## Poco Premium

Features: fold away design//emergency whistle // redirected adjustable hip belt//pivoting hip belt // integrated nappy mat // internal hydration sleeve

Price: £200

Osprey's top of the range child carrier includes many features, of which a lot are integrated into the carrier. It's air mesh adjustable back system is quite different to other carriers back systems, and the redirected hip belt allows for easy adjustment whilst still wearing the carrier.

It has a soft, bulbous form too, but with more purpose due to the prominent base storage/internal kickstand. The internal kickstand gives the carrier a cleaner aesthetic, but also means that when folded away, the base storage is eliminated too. This would force the user to leave the stand open if they want to use some of the storage, meaning that the design is not as compact as it could be and therefore using it in urban spaces would be difficult.

The carrier uses a variety of materials each with their own purpose. The most different to other carriers would be the soft polyester fleece used to line the child area.

## Shuttle Premium

Features: fold away design//kickstand// redirected adjustable hip belt//pivoting hip belt // detachable dribble pad// integrated sunshade//included changing mat

Price: £225

Vaude's top child carrier is also one the most expensive carriers available in the market. It comprises of a smart black RipStop nylon outer shell, with coordinating coloured straps and pronounced kickstand. It also features a fun shaped dribble pad, which is a contrast to the rest of the design.

Each panel appears to be double lined or padded, giving the carrier a more refined shape, although this could add to weight and manufacturing costs.

The satin finish of the nylon makes the carrier appear suitable for cleaner, urban use, whilst the exposed aluminium alloy kickstand suggests outdoors use more so.

It is quite an angular formed body, softened by padding throughout. The contrasting geometric crossing of the straps against the smooth body give it a serious, complex, with concealed, yet not hidden extra features.

Vaude



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- to a local outdoor equipment shop, appropriately named 'outdoors' in Hathersage. Key and ideal features of baby carriers were discussed with a sales advisor, as well as improvements that could be made, from user experience.

What must be kept in mind is that these statements are biased - design considerations that the sales advisor would be unaware of are discussed on the following page.

*Kickstands are much better than anchor points - they provide a greater amount of stability.*

*The option of being to adjust hip height/width and seat height/width is more popular as child and adult comfort is increased.*

*The automatic locking of moving parts provides user assurance and ease.*

*A design that allows for replaceable parts is advisable - they are not damaged easily, but the availabilty provides reassurance and means that the user doesn't have to buy a whole new carrier.*

*Parts that can get dirty (at least quickly) should be washable.*

*More often than not, the sunshade is kept up even when it is not a very sunny day - to protect the child.*

*Colour coding features makes it easier to see which parts the user should be handling.*

*Stirrups are ideal - they support the child's legs.*

*Reflective features and pockets are also ideal.*

*Removable sun shields are not as stable as the built ones; they can be liable to fly away in stronger winds.*

Although they provide users with more stability, it is another mechanism to consider which potentially add weight or cost more to manufacture.

Research into the current market also shows that the more adjustable the carrier, the more positive the reviews. However this does pose a risk of over complication or over engineering.

This feature could make the carrier appear over-engineered, or more daunting, depending on the user's preferences.

A straightforward option to include, although maybe not as a USP; it could give users the wrog impression that the carrier is not durable.

An already available option on some higher-priced carriers, but not all - an opportunity to fill a gap in the market.

This could be a safety issue that has been overlooked - is it a large risk to consider? It could just be built into a design.

A definite factor that should be included in all designs - it allows the users to better understand and locate key adjustments etc.

Another feature that could be included, but is not very important. They could also be desgined to be removable for smaller children.

These could be worked into the details of the deisgn - large parts would be overpowering.

A considerable feature, although not necessary if the removable shade and it's fittings are designed such a way that they wouldn't fly away.





urban vs. trail



Exposed, almost external aluminium frame  
Minimal padding  
No storage  
Compact size



Internal aluminium alloy and plastic frame  
No kickstand  
Padding on straps, hip belt, child seat  
No storage  
Slim form



Internal aluminium alloy frame  
Kickstand  
Padding over whole frame as well as straps etc.  
Several storage spaces, including hip belt pouches  
Dribble pad  
Rounded form



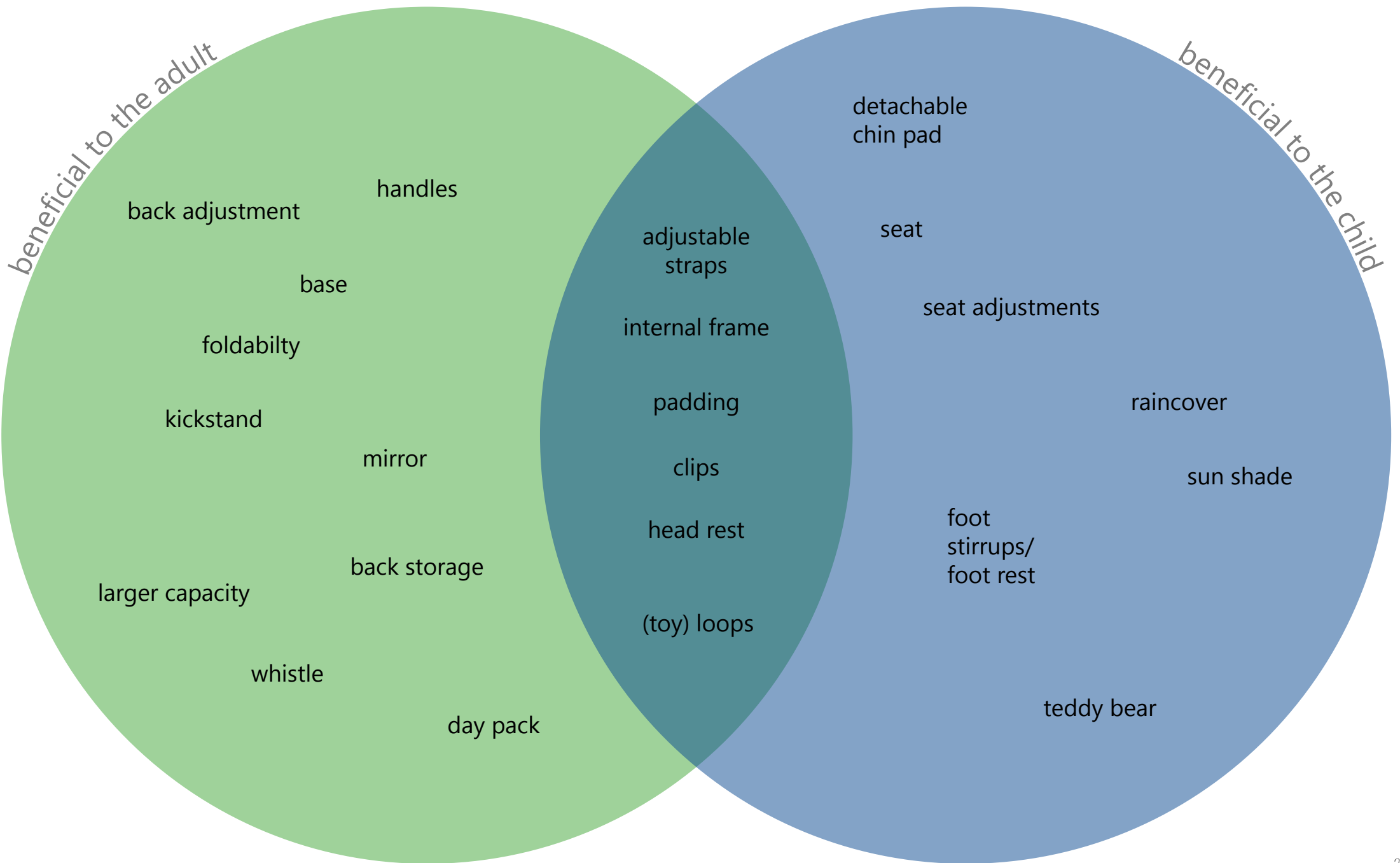
Internal aluminium alloy frame  
Kickstand  
Padding over whole frame as well as straps etc.  
Several storage spaces, including hip belt pouches  
Removable dribble pad  
Removable daypack  
Taller structure



Internal aluminium alloy frame  
Kickstand  
Padding over whole frame as well as straps etc.  
Several storage spaces, including hip belt pouches  
Removable dribble pad  
Removable daypack  
Waterproof zips  
Extra side storage  
Full child seat adjustability

A difference of where and when a carrier was best used was spotted throughout the range of available carriers. Key aspects of the carriers are compared between the variants to highlight this.

adult vs. child



## customer reviews

//



deuter kid comfort iii

The carrier is a delight with a thorough, easy-to-use safety system for the infant payload, and a highly configurable carrying interface for the adult. Light and masterfully constructed, I would highly recommend this product.

This pack is very uncomfortable around the shoulders and torso. You also feel very unbalanced due to the pack sitting higher. I would never recommend this product.



junction 2.0

It might be alright for a smaller child, but heaven forbid you get close to the max weight. On the plus side there is a lot of room for storage and it has a removable daypack incorporated into it.

This pack is too small [for her] and digs into my shoulder blades. It hurt my neck when we used it last summer.



osprey poco premium

The kickstand is very sturdy. A lot of storage, especially on the premium model. Plenty of useful features like the sunshade, diaper changing pad, hip-belt pockets on both sides, sturdy and well-padded child restraints. The child cockpit offers many adjustments such as ride-height, shoulder strap length and stirrup length.

The only downside was the storage compartment in the rear. There's lots of space, but not if you collapse the metal stand. Seems like it's sort of an either or - collapse the stand to reduce the profile a bit, or leave it open to carry more stuff. We just left it open most of the time to carry some snacks and our big camera.

//

Reviews sourced from  
rei.com 2015

## Berghaus design language



Curved, sharp lines, offset by colour and/or material texture.

The bulging form caused by when items are placed in the bag are pre-determined in the panelling and stitching.

The upwards, sharp, sweeping lines are highlighted by contrasting colours.

It also means that there is no need to make the lid obviously different for easier accessibility, due to the contrasting lines and stitching.

7



No more than four colours used in their colourways.

Rounded, bulging form.

The pannelling provides strength and structure and double up as a design feature.

Overall, the subtle highlighting of key features through colours and textures, which have been chosen with a purpose, and genuine aesthetic design (which don't interrupt the functionality) is what defines Berghaus style, especially throughout their backpacks.

# *a Berghaus backpack*

A closer look at the anatomy of a Berghaus backpack to help define manufacturing and detailing techniques that can be applied to the carrier design.

The shoulder straps are stitched into an angled tab, which is stitched into the back of backpack, to spread the load onto the back.

01.

The adjustable back system is almost entirely made of nylon and padding. The strength required for the weight appears to rely on fabric strength and clever stitching, rather than anything rigid.

02.

The straps are fed through loops stitched into the padding, to help guide the straps and stop them flying around in strong weather conditions.

03.

A detailed view of reinforcement stitching, where the hip belt meets the back panel.

04.

Drawstring closing under the lid - an idea that allows easy user access to personal belongings, whilst providing sufficient waterproofing/weatherproofing.

05.

A close up of a clip. The Berghaus logo is moulded into the plastic, reminding the user of the brand in a subtle way. The unique 'x' shape is amplified through the use of colour, too.

06.

Redirecting the straps through more than one plastic loop is a common feature in many backpacks - they allow easier adjustability. At least four types of loops are used throughout Berghaus designs.

07.

The strap and carabiner loops are used as a feature on the shoulder padding - this simplifies the design giving a cleaner look , and lowers manufacturing costs and materials.

08.

Clipping the hip belt together. The user feels the shape and texture of the clips to guide them into place, as well as using sight.

09.



01.



02.



03.



04.



05.



06.



07.



08.



09.



# manufacturing a rucksack

The number of similar features found between rucksacks and carriers understandably meant that materials and manufcatruing techinques would be similar, too. There was also a lack of sources infroming the manufacturing details of a carrier, leading to researching ruckasack manufacture instead - this information can easily be applied back to carriers. Information sourced from White Mountain, 2015.

## *fabrics*

popular materials

950 Denier Kodra - Polyurethane Coated.

420 Denier RipStop Nylon - Polyurethane Coated.

420 Denier Nylon - Polyurethane Coated.

600 Denier Polyester - Polyurethane Coated.

The main outer shell of the carrier could ideally be made using RipStop Nylon - it is relatively lighter int weight compared to Polyester, and is more durable, protecting it from scuffs and catches.

Pack Cloth Polyester has a higher resistance to ultra-violet (UV) degradation, but overall, Nylon or RipStop Nylon are still a stronger material.

The heavier threads prevent further ripping if the pack is punctured or torn . The RipStop design can provide extra protection to help ensure that the pack doesn't continue to break all the way through.

The main advantages of rip-stop nylon is also it's lightweight and waterproof quality.

## *threads, stitching*

Nylon thread provides durability, strength and rot resistance

Most backpacks are sewn at 6 to 10 stitches per inch. Another factor is the twin stitching method, where all stitching is doubled stitched for added strength, including the zip attachment to backpacks.

## *zips*

backpacks commonly use high quality YBS zippers and are twin stitched at 8 stitches per inch.

A coil zip is a continuous piece of plastic that's been formed into a coil shape and sewn onto a piece of fabric webbing. The main advantage of the coil zip is that if fabric gets caught in the teeth, the fabric can be gently pulled out without tearing. This is certainly a consideration since the pack will sometimes be crammed with clothing, a sleeping bag, etc.

Some backpacks may have regular solid tooth zippers, which are reasonable to use, too. These zip don't let go of fabric that easily, but they're stronger than coil zippers.

## *padding*

Different types of foam include open cell foam, closed cell foam, dual density foam and compression moulded foam, all of which are suitable for backpacks of different purposes and durabilty requirements.

## *Buckles, D-rings and clips*

- are commonly known as being made of injection moulded Duraflex, which is essentially acetal polyoxymethylene (acetal POM). This material is is mainly for it's creep resistance, strength, hardness, stiffness, fatigue resistance and toughness; all properties which are required, especially for heavy loads.



## using a carrier

The torso length is adjusted. The shoulder straps and hip belt are roughly adjusted.



The user appears to be struggling to locate the grab handle - is this because of where it's placed, the size, or that there are not enough of them?

The child is placed and secured via a five-point harness.



The adult holds onto the straps and grab handles as they lift the carrier up.



The curvature in the hip belt appears to help the user swing the carrier around them. They also appear hold the bottom of the carrier for support, which could be unwanted if it gets dirty.

Using a leg for support, the adult balances the carrier and slowly swings it around their hip. Assistance from another person may be required.



The adult put their arm through on strap and hoists the carrier onto one shoulder. Assistance may be useful at this point if another adult is nearby.



Here shows how essential it is that the child is well fitted and secured into their harness - the adult may be required to tip the carrier at angles to securely fit the pack to themselves.

The adult puts their arm through the second strap.



The hip belt and sternum strap are clipped into place, and adjusted accordingly, by pulling/releasing the straps provided. The shoulder straps are tightened.



The carrier is loaded with food/equipment by another user, if it was not already loaded prior to putting the carrier on.







**restricted**  
no small parts

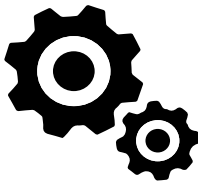
*Safety requirements for child back carriers with framed support, intended for children who can sit unaided (~6 months) and are designed to be attached to a carer's torso allowing hands free operation when stnading/walking.*

*key aspects to be considered in this project*

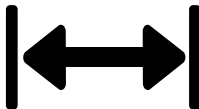
*carer's attachment system  
child restraint system  
freestanding carriers*



**flamability**  
textiles (coated), supports, plastic coverings  
the rate of spread of flame shall not exceed 30mm/s



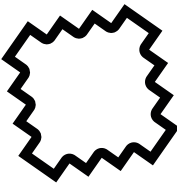
**mechanisms**  
folding/locking mechanisms shall continue to meet the following requirements after being opened/closed 300x.  
must be inoperable by child. considered inopereable if at least one of the following apply:  
-folding/locking only possible when 2 independent locking mechanisms are operated simultaneously  
-release of folding/locking mechanism requires specifiied minimum force of 50N, or use of tool  
-release of folding/locking mechanism requires 2 consecutive actions



**minimum/ maximum sizes**  
cords/straps/belts mas fre length of 220mm when stretched with force of 25N  
  
no gaps/openings >5 <12mm, excluding buckles, fastenings, sliders



**testing**  
all forces should have an accuracy of +/- 5%  
  
all dimensions/ angle/masses/times should have an accuracy of +/- 1%

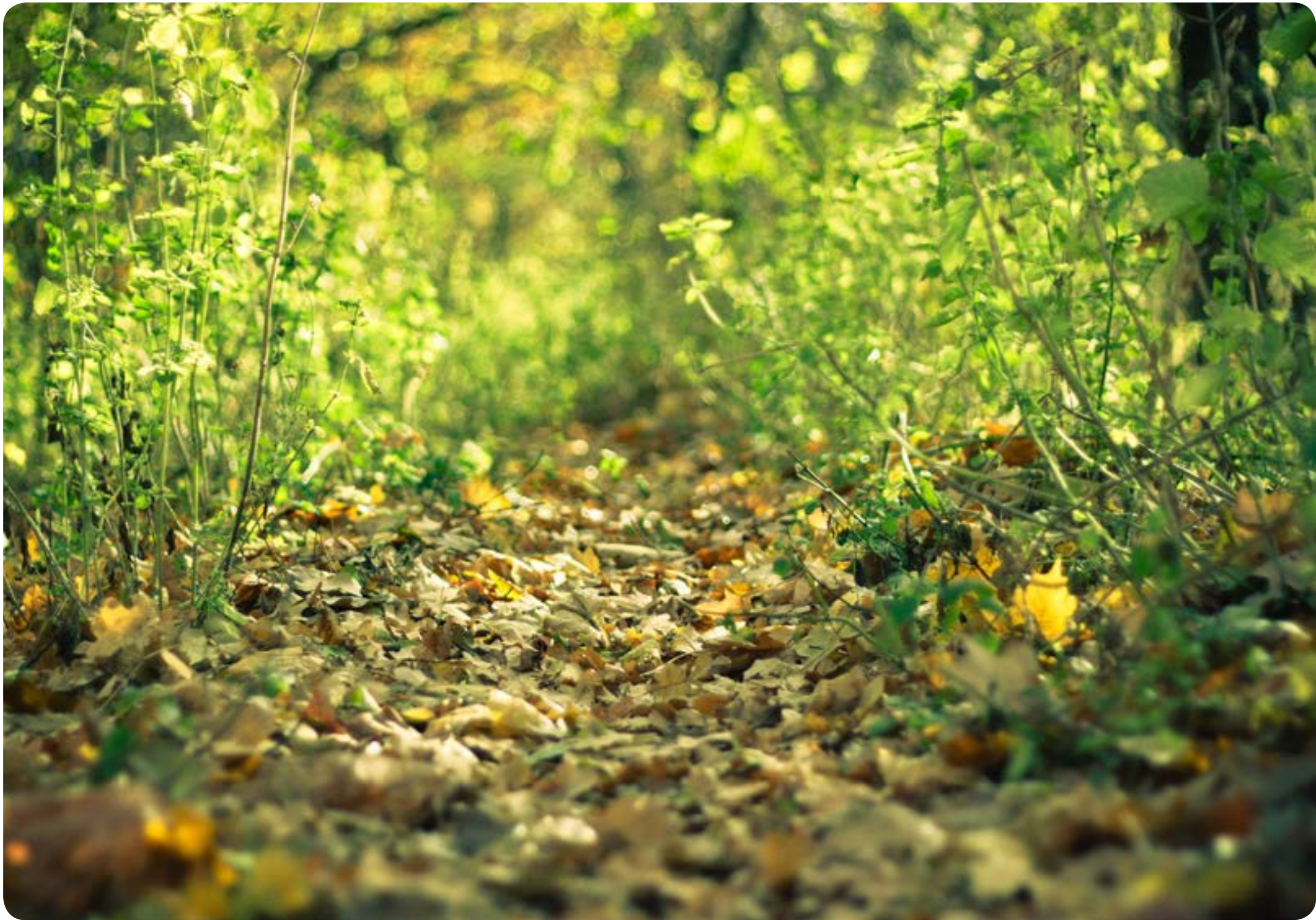


**material**  
don't use monofilament threads



**other key points**  
edges should be smooth, free from spointers, burrs  
should be rounded, folded, rolled, spiralled, proective covering  
  
no open-ended tubes, projections, holes, loose washer, speed fixings, nuts, crevices, where the child's finger or flesh could become trapped







## design direction

From research, it was apparent that the key aspects of a popular carrier are adjustability, durability, and modularity (of inclusive and exclusive features).

Adjustability is the most common factor - from customer reviews, the ease of being able to adjust the carriers for different sized adults - and remain comfortable - was important; having a carrier that only fits one of two adults would be an inconvenience.

Durability is a given factor, as it is associated with any outdoors product - they need to be able to withstand

Modularity is the defining factor between good carriers and better carriers - the optional inclusive/exclusive features allow the parents to choose what is best for their needs, making the experience more personal and efficient.

Research into the existing carrier market also showed a difference in the types of carriers available - some were more suited to urban use, and others more so to trail use. Designs that tried to bridge the gap between the two often had negative customer reviews as trying to cater for both types lead to crucial properties such as strength and comfort being overlooked, accompanied with an abundance of inessential features.

Commonly, urban carriers were smaller and/or had fewer features, whereas long-term outdoor use carriers had more features, but also a larger footprint, making them difficult for some users to navigate in urban areas and thus impractical for all-round use.

Therefore, it seems appropriate that the following ideas should consider and focus on methods of adjusting different - or new - parts of the carrier for comfort and ease, and combining durable materials and structures for a design that can cater for varying levels of trail use, all the way to urban, everyday use. Modularity could be explored more, although trying to branch between more than one kind of user through this aspect may over-complicate the design.

## capturing the language

After analysing the design language of Berghaus rucksacks, it was thought that it would be helpful to put the style into practice at the beginning by applying it to daypacks, which may or may not be used in the final design.

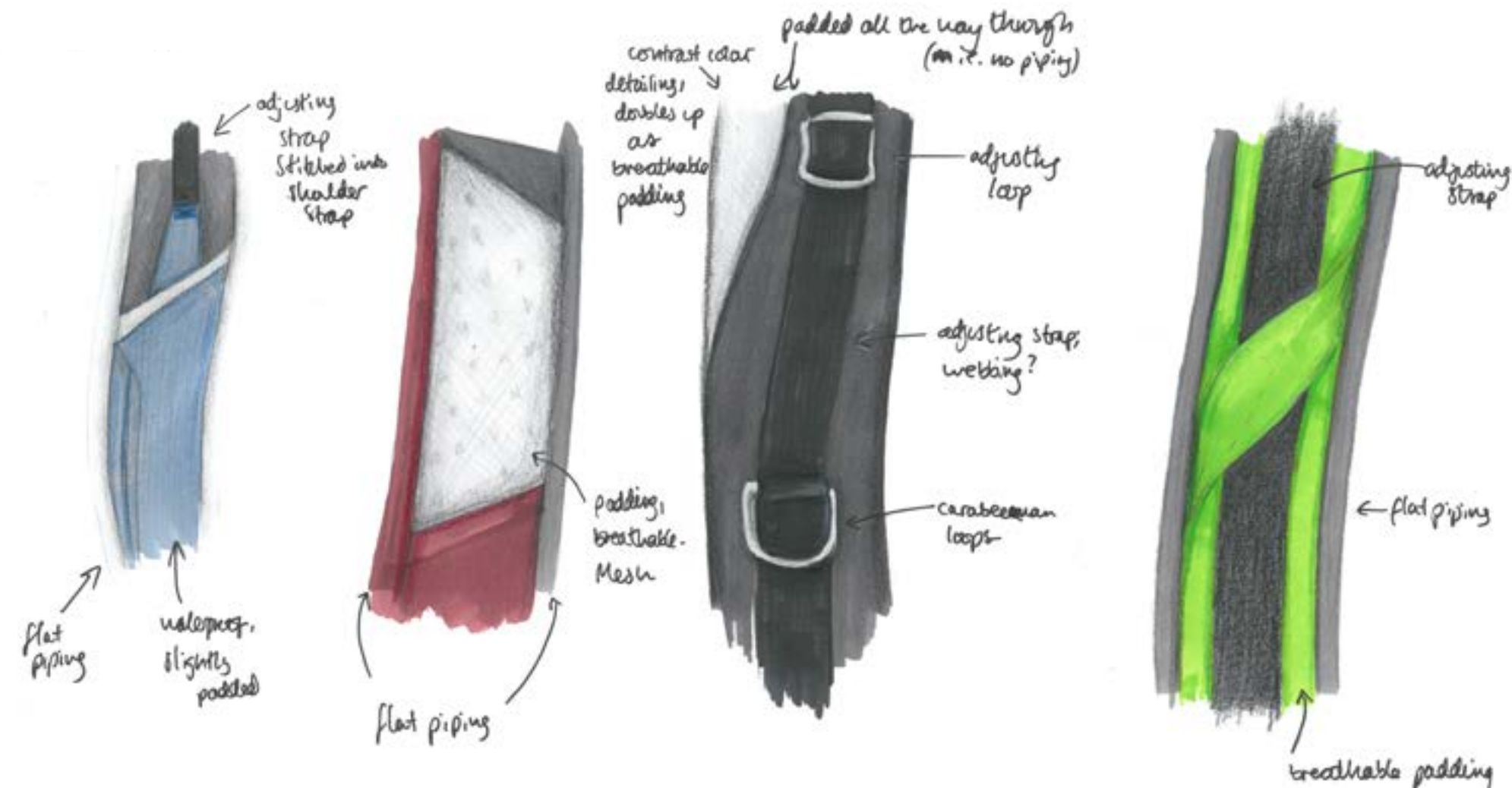
Current Berghaus colours



Trending colours 2015/2016



# internal vs. external frame



Shoulder straps were also another opportunity to apply Berghaus language to. The way (different) materials were stitched together for different outcomes was explored, as well as their structure and layout.

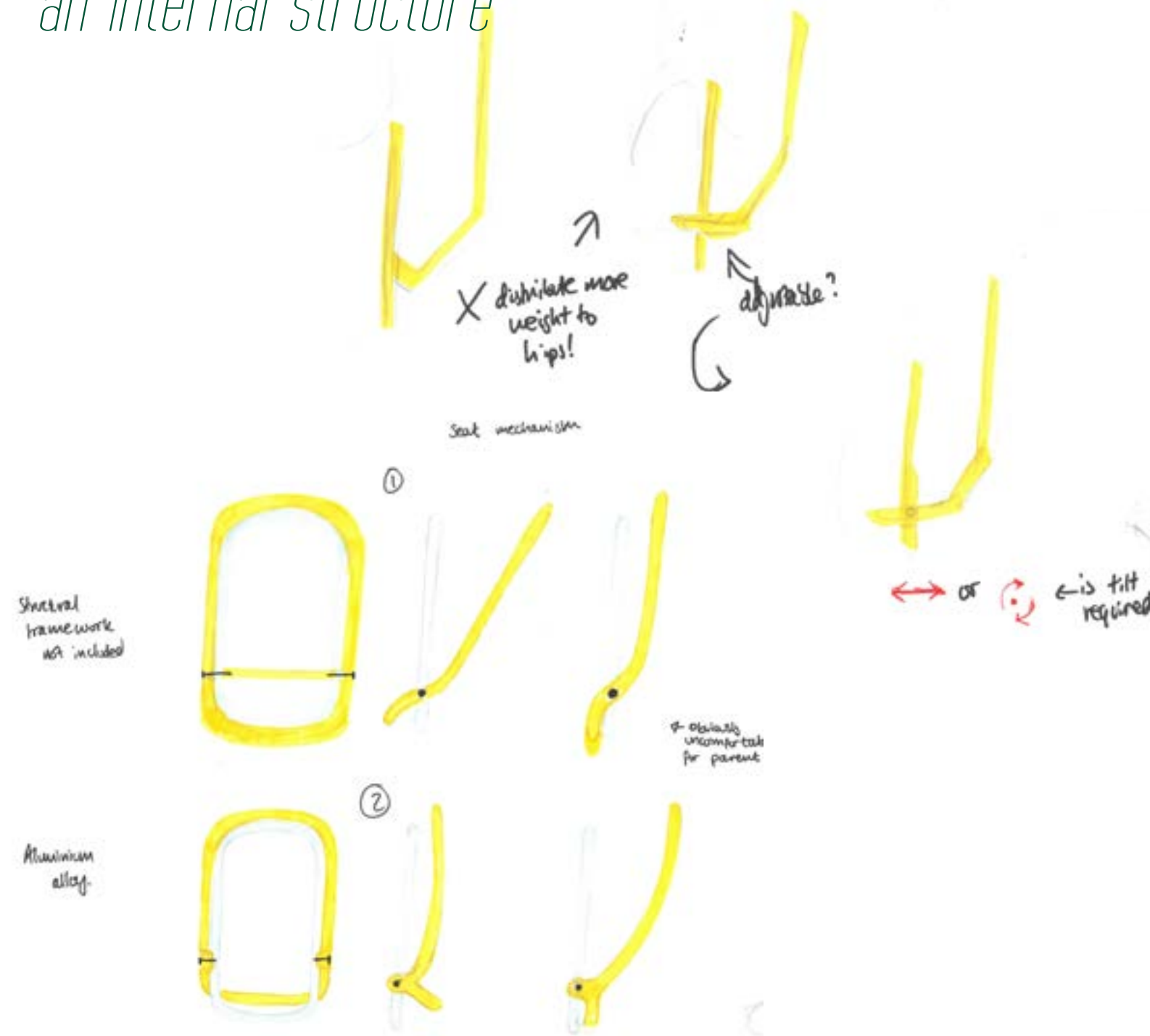
Internal	Features	External
✓	Hidden framework	
✓	Form fitting	
✓	Lots of compartments	✓
✓	Good mobility	
✓	Even load transfer	✓
	Low cost	✓
✓	Good balance	✓
	Ventilation on back	✓
	Carry heavy weight	✓
✓	Easily attach external gear	✓
✓	Wide selection/range	
✓	Compact	

Which is better for a child carrier?

It appears that the best kind of frame for a child carrier is an internal one.

Some features are subject to design direction, overall frame structure and material, but existing carriers in the market and also (Berghaus) backpacks aimed at low intensity trail users tend to use more intelligent internal structures that allow users to wear them in a range of environments - an external framed carrier would be very bulky and heavy to wear in an urban area.

## an internal structure



There is an opportunity here to build a stand into the pivoting mechanism.

Initial ideas for an internal frame - making the frame adjustable in terms of seat height or foldability.

Here shows an opportunity to make the child seat/height more adjustable, as current ones are only adjusted with a strap/loop system.

The seat could be adjusted from the sides when the adult is wearing the carrier, although this could require an extra safety system, which could add extra weight and/or manufacturing. It would also be difficult for the wearer to know what height the child is at, unless there is another adult present.

## spreading the load



In terms of rucksacks, the best way to distribute a heavy load on the back for an elongated period of time, is having the heaviest items towards the middle, closest to the back, for both men and women. The lightest items are placed at the top or bottom, and items in between surround the two. This theory can be applied to child carrier,s, due to the similar format and structure. Where there is a heavy item in this diagram would ideally be where the child is placed.



## meeting 1

### Group thoughts:

Take a look at structures found in other products and technologies.

Tent poles could be an alternative to aluminium alloy frames.

What is the function of the back system?

It provides adjustability, contact in order to spread the load correctly.

Correct shaping and/or padding can provide ventilation, which in turn increasing user comfort

### Own thoughts:

It was concluded that the visual and technical aspects of the carrier need to be balanced throughout the development.

## other systems

Tent poles for the internal frame could be used instead of a solid metal frame - this could allow for a lighter carrier and a greater variation in shape and size compared to standard carrier.



8

The hinged locking mechanism used in high chairs could be very similar to one used in the carrier design. It is a standard feature in many and therefore can be relied upon more as a system.



10



9

5-point car seat safety harnesses are heavily tested for high impact forces, - these are less likely to occur in a child carrying situations, but something similar would give parents reassurance for their child's safety.

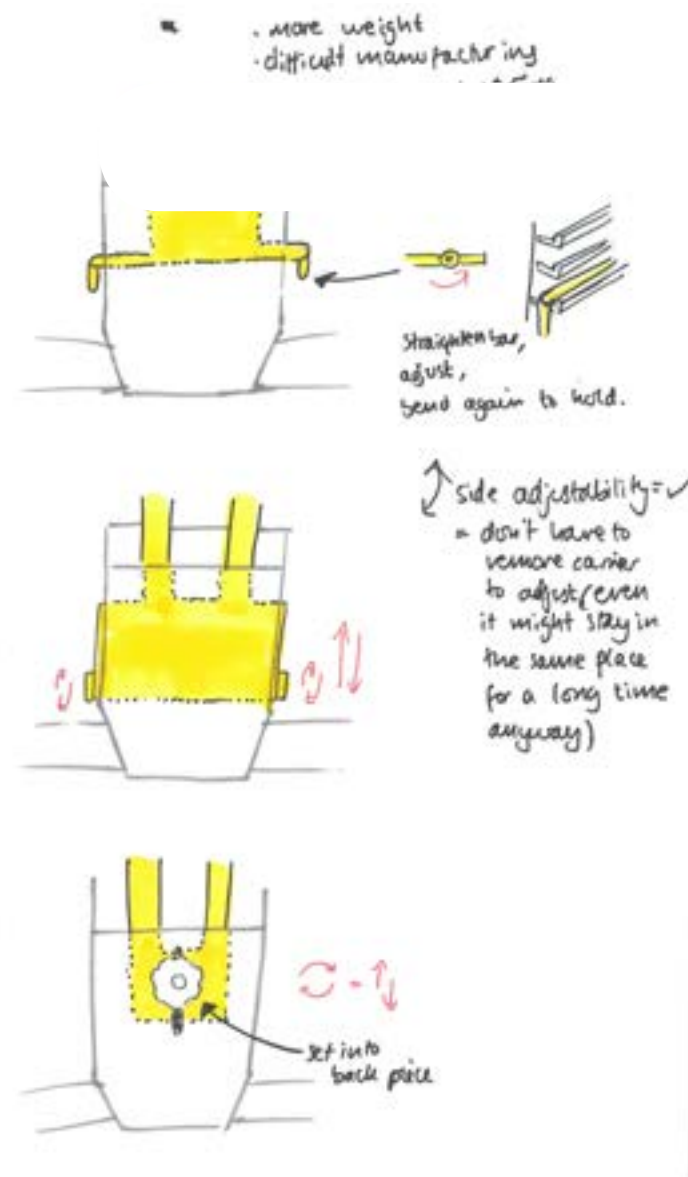


11

Another hinge mechanism, this time found in tent/gazebo structures. The locking mechanism here is also very reliable as it is resistant to very strong winds, which would be a health and safety bonus for carrier.

# back systems

A typical back system consists of:  
a hip belt  
back length adjustment  
shoulder straps  
relevant padding



In keeping with adjustability, generally the more adjustable a system, the more comfortable it is.

However, increased adjustability can lead to more complicated systems and/or more weight, lowering user experience. Furthermore, it would be more difficult to manufacture, thus making it more expensive.



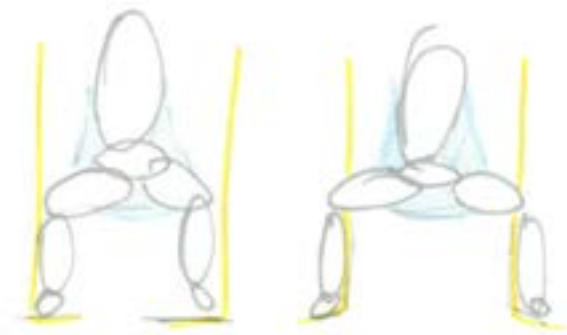
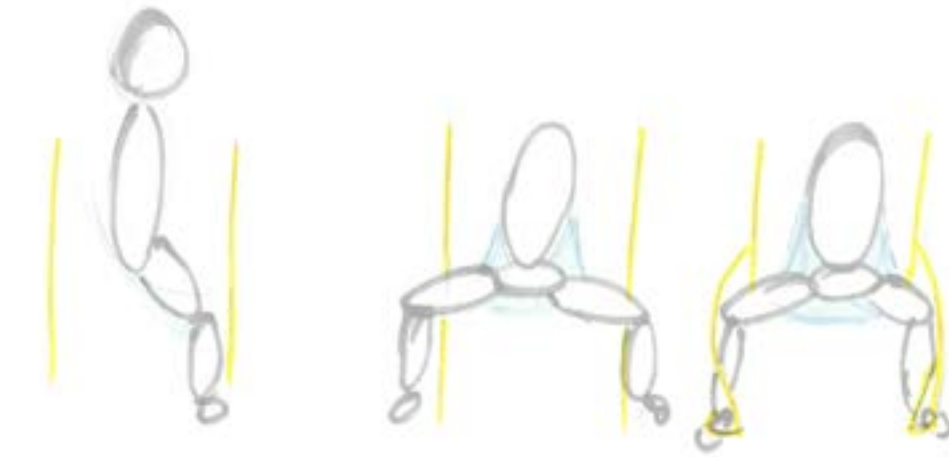
# Testing 1

A simple card model of the back system was made to order to understand ideal anthropometrics. It was learnt that the back panel needn't be as big as it was made here; it should be narrower and possibly slightly shorter, too. Also, the shoulder straps started further down the back panel than expected, so it could fit the user better - a feature found in backpacks. Whilst making model, an idea for the back adjustment system was spotted - somehow having the system adjustable from the sides instead of behind the back could be an improvement on existing systems, where, as spotted in earlier research, the user had to try the carrier on multiple times to check if it was the right size.





## child seat/hip dysplasia



*Having the legs out supported by optional stirrups appears to be the best solution.*

*How should the child sit?*

There are two main types:

rigid framed seat:

+stronger

+provides posture support for smaller children

-would require more padding for comfort and air flow

-if the carrier is to be foldable, then it would need to be hinged

-using hinges increases manufacturing costs and more importantly safety issues - what if the child's fingers get trapped?

soft, padded seat:

+ padding forms to shape of child - more comfortable

+ fewer complex safety issues

+ warmer

- less support for the child

- easily compatible with folding systems

Are there any related health issues?

Hip dysplasia - general instability, or looseness, of the hip joint - if diagnosed after birth, it is usually caused by improper positioning for long periods of time, disforming the soft bone joint tissue.

According the International Hip Dysplasia Institute (2015), the best position for a child to sit is when the hips fall or spread (naturally) apart to the side, with the thighs supported and the hips and knees bent. Although they are most at risk of joint damage before they are six months old, there is still a chance of damage if kept in the same position for a long time.

## meeting 2

### *Group thoughts*

Decide on the back system - could a ratchet system be used? Finalise the internal structure and focus more on working from the outside in.

Minor changes to the internals can be made when the final design is being resolved.

Clarify the USP

### *Own thoughts*

Check adult and child anthropometrics

Child harnesses - is there an opportunity to develop there? Such as a pre-fit harness that clips in - would this make it easier for the adult? Or less comfortable for the child?

## meeting 3 - client drop in

### Group thoughts

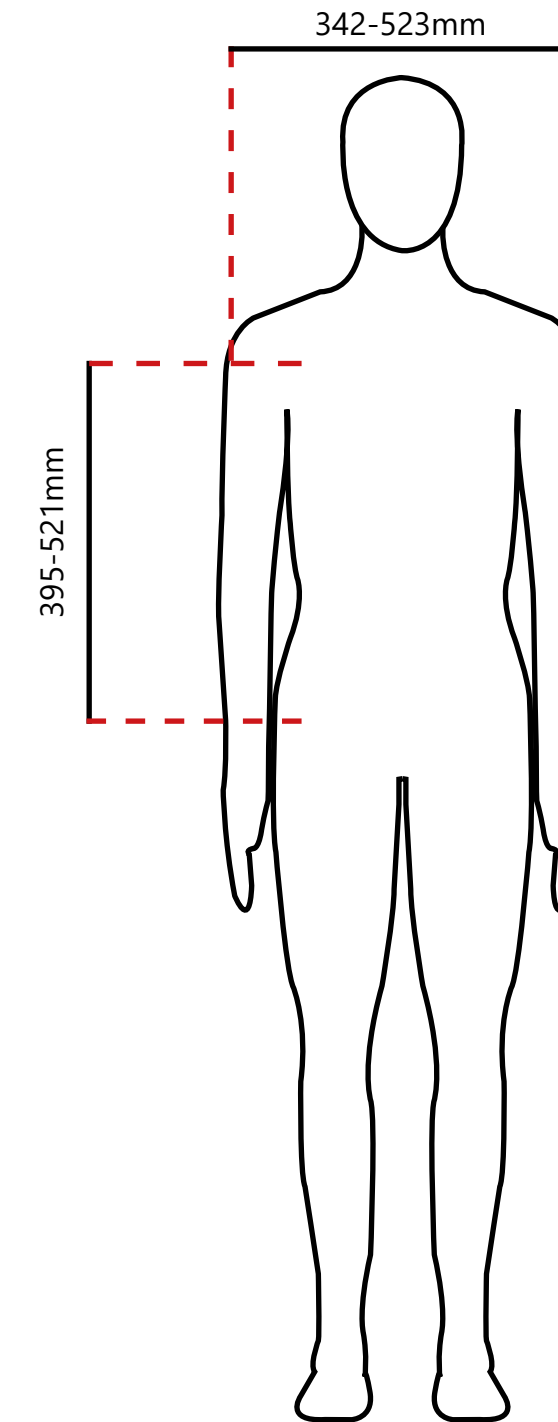
The idea of colour coding is definitely ideal - there are many aspects to the carrier which would otherwise be confusing to a user.

In order to cater for an audience that is less familiar with outdoor equipment, make sure that the back system is designed more subtly/is easy to use - it makes for a less daunting user experience.

Take a look at pushchair brands - especially their folding systems

### Own thoughts

A realisation of another way of applying adaptability - switching between parents whilst out on a walk



## anthropometrics- adult

The main data to consider for the adult was the hip-shoulder range, and shoulder-shoulder range.

The ranges are between the 1st percentile of women up to the 99th percentile of men.

This anthropometric data provided insight into how big the torso/back frame should be, and what the range for the torso adjustment should be (a difference of approx. 120mm).

This data has been sourced from *The Measure of Man and Woman*, by Alvin R. Tilley.





Testing the best height for the stand - in order to minimise the size of it's footprint and to be able to stand itself up at the same time, the highest setting was the most appropriate. It also turned out to be the most compact when folded flat at the same setting.



Trying the carrier on different sized people.

This, combined with anthropometric data, helped to confirm the range of the torso length adjustment, and the width and length of the hip belt and shoulder pads and straps - being careful that they don't reach a length greater than 220mm when pulled to their maximum, as mentioned according to British standards.



6'



5'10"



5'4"

*testing - 2*

## proportions - child

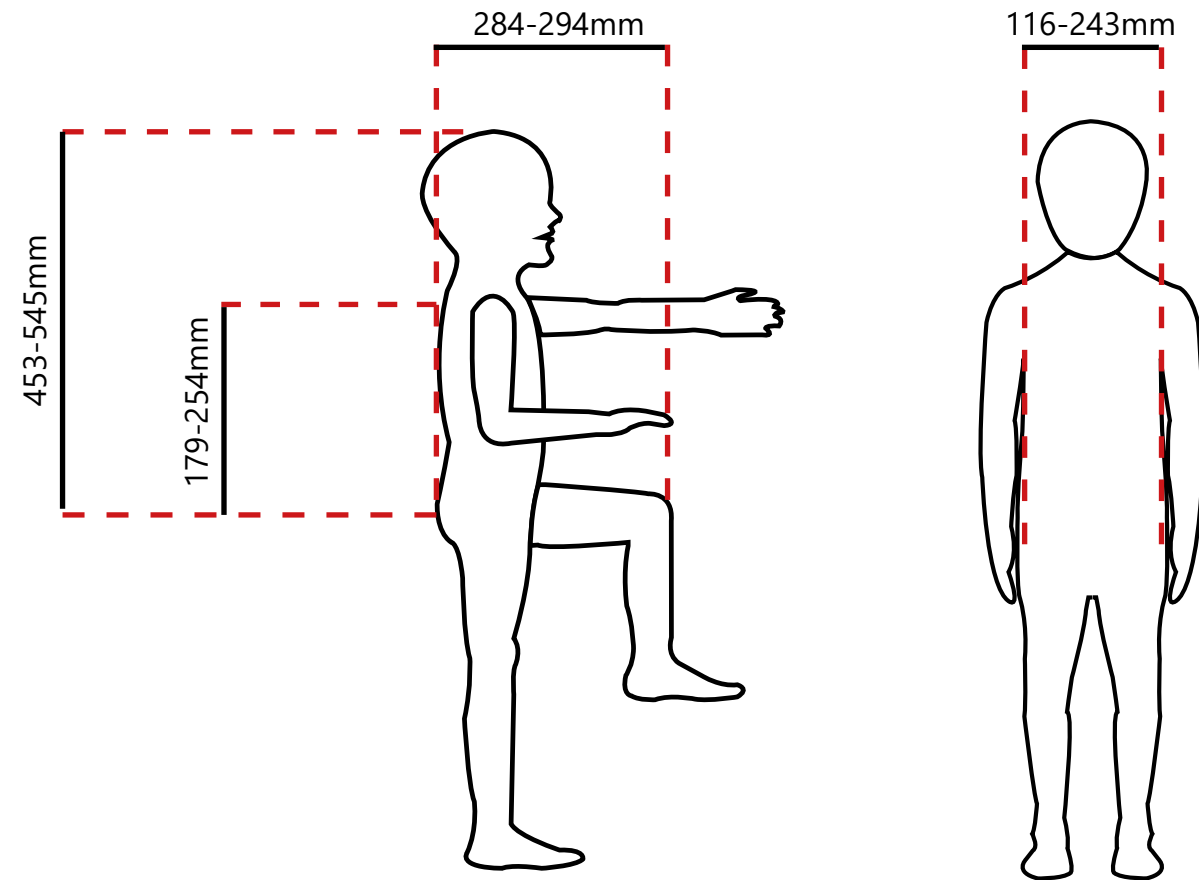
The main data to consider for the child was the sitting height, the hip-bent knee distance and leg length in seated position.

The measurements range between the 1st percentile of a six-month old child, to the 99th percentile of a three-year old.

This data provided insight into how much the seat height can be adjusted, how wide the seat should be, the general size of the 'cockpit' and the opening/closing distance of the folding frame.

The weight difference was also found: 8-14kg.

This data has been sourced from *The Measure of Man and Woman*, by Alvin R. Tilley.



## testing- 3

Here shows different sized users trying the carrier with representative models of children aged between approximately 6 months to 3 years.

The importance of an adjustable seat (the strap system being taken from existing carriers) is highlighted here - not only does the seat height depend on the size of the child, but also the user. Shorter users must adjust the seat to be slightly higher, or the child (especially if older) has a restricted view.

The kickstand length is also important too - it must be easy to access - again especially for 1st-99th percentile users - so that it can be opened with ease and reached with ease when it is to be closed again. Here it was found that roughly the best angle at which the kickstand should stop at is 50 degrees, with the bottom surface area increasing to approximately 300mm<sup>2</sup>. This still allows for a compact, uniform footprint. It was also noted that having the kickstand protrude beneath the torso panel made it easy for the user to identify where the kickstand is without having to turn uncomfortably to find it.

## Finalising the frame

A CAD model of the internal frame. It would be made of aluminium alloy tubing, bent into shape and held together with rivets through plastic connectors.

It is purposefully quite slim to minimise on bulkiness, and to allow the child to fit their legs around. The kickstand, also designed reduce space, has a distinctive bend at the bottom, so the carrier can balance on rough ground.

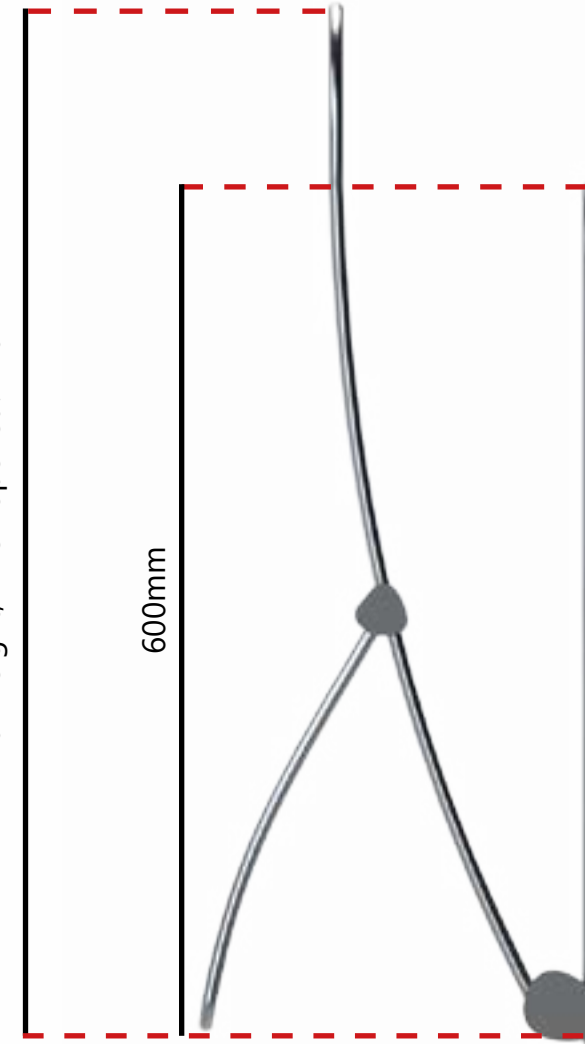
The kickstand is connected to the curved back frame (a curved frame allows for more space for the child) with a plastic anti-twist locking mechanism, thus only locking in two places - in the open or closed position.

It protrudes out slightly at the bottom (see third image) so the adult can easily identify where it is by sense of touch - it is quite difficult to see.



Max height, when opened: 720mm

600mm



280mm



Material decision:  
An aluminium alloy was chosen over a plastic or composite frame, due to its availability, ease of manufacture and durability.

It is also still light in weight whilst providing strength and structure - this allows for the carrier to be used from urban to outdoors environments.

Furthermore, having the hinged mechanism meant that a material that doesn't warp or flex would be ideal, with better, even load transfer capabilities.

The curved structure also allows for the load to be spread evenly to the hips, essential for comfortable wear.



## leaf and pebble aesthetic

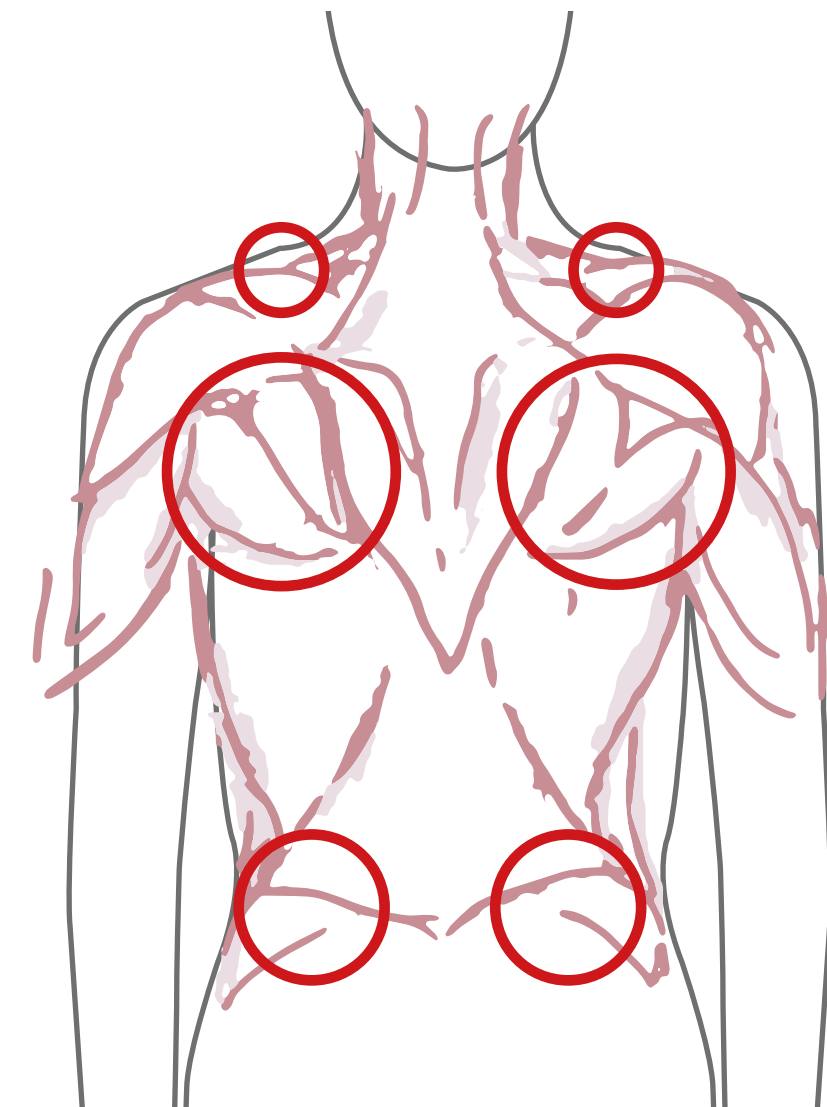
To give the carrier some character, inspiration was taken from nature - primarily in the form of leaves and pebbles. These could be used in the styling of the carrier in terms of the overall form, or in the detailing.



From observation of user interaction with existing carriers, the test rig and some research into the human anatomy, the best places for padding were identified. Padding is just as important as structure of the frame - it forces the load to be spread over a greater surface area (specifically the hips) and can replace parts of the carrier that would otherwise be made of a more solid material, thus reducing it's overall weight. It also plays an important role in supporting and protecting the child.

Back muscles that protrude more than others and therefore make the most contact with the back systems of carriers/ backpacks; these will be the areas in the design that will have the most padding.

To accomodate for different people, and differences in gender too, the pieces of padding stitched/bonded into the carrier will have quite a large surface area.



## padding

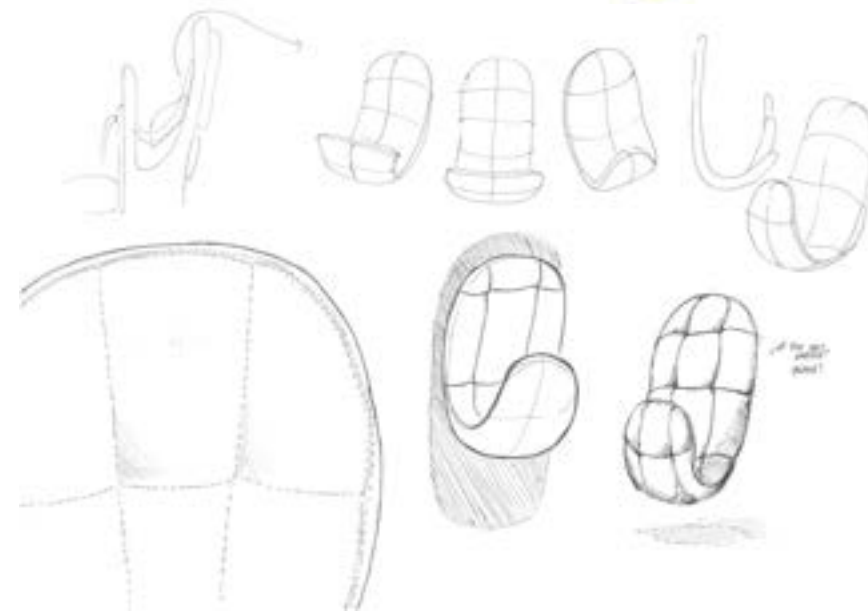
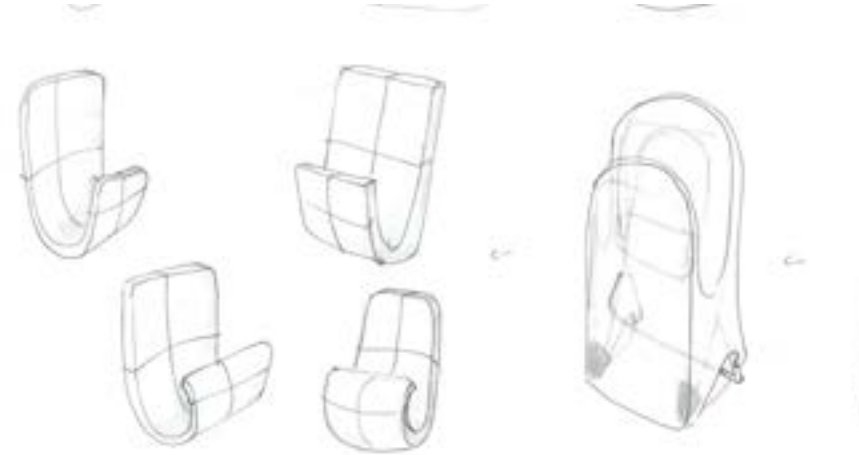
What kind of padding is available?

According to White Mountain (2015) the main types are:

- open cell foam
- closed cell foam
- dual density foam
- compression moulded foam

The most appropriate foam for a higher-ended, durable product appears to be closed cell foam - it combines the soft compression of open cell foam against the user, with the firm protection of the closed cell foam from the load. It could preferably be compression moulded to reduce waste, but it is a more expensive method of manufacture. Regular cutting, shaping and stitching could be employed instead.

## *padding (cont.)*



## design direction - 2

It was recognised that the focus of adjustability, durability and modularity did not help to aim the design towards the low-intensity trail user - they are aspects that can be applied to all types of users. It was also recognised that trying to manipulate existing adjustability features would over-complicate manufacturing and increase costing. It would be better to include the adjustment features alike to those found in existing carriers or (Berghaus\_backpacks). Durability would come along mostly with the types of materials used and manufacturing process chosen.

Revisiting an initial research outcome - that some carriers are best suited for different outings, with fewer carriers efficiently bridging the gap - made the decision that the focus of the design should be more towards modularity.

The term *modularity* lends itself to mean that the carrier consists of different *modules* that allow the user to *modify* the carrier to the user's needs. This allows room for them to adapt the carrier to their requirements- i.e. being able to use their carrier for more than just long walks in the countryside.

Therefore, it can be said that the revised design direction is to design a carrier suited for urban *and* trail use, by using *modularity* as a way to reinforce this.

## exploring modularity

There are two main ways that modularity can be used to sell this product to a broader range of users - having a number of different features that can be added or removed to or from the carrier, or focussing on one feature.

Having a lot of different features could:  
over-complicate the product, confusing the user  
increase the overall cost of the carrier, with users potentially buying inclusive parts that they may not ever use  
put off users that are less familiar with outdoor equipment but also attract users that have past experience.  
A decision would have to be made as to which features are to be sold with the carrier, or separately.

Having one feature (*not* one part) could:  
give the product a USP  
clarify what is and is not required for the carrier  
increase user experience - having only one or two things to make a decision is better than many decisions.

The principle of modularity is what and how components can be combined or separated to form a product that looks or functions differently according to the user's preferences. Some carriers follow an idea similar to this already, where the user can add or remove a single daypack - these offer multiple benefits - more things can be taken on a trip if required, and the load can be spread between more than one user simply by removing the daypack and wearing it.

Naturally it was thought that this would be a good starting point - there is certainly room for improvement, and there is plenty of scope for unique features and design aesthetics to increase Berghaus' brand value.

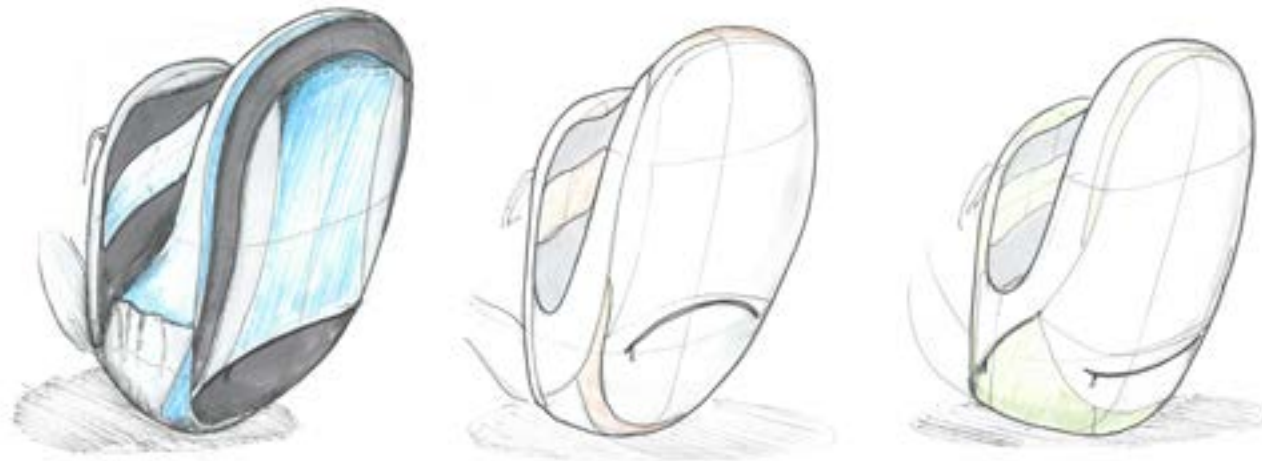




## revisiting the overall form



The form of the carrier was revisited, this time considering how the future daypack(s) could fit, now that some of padding was considered.



## meeting no. 4

### Group thoughts

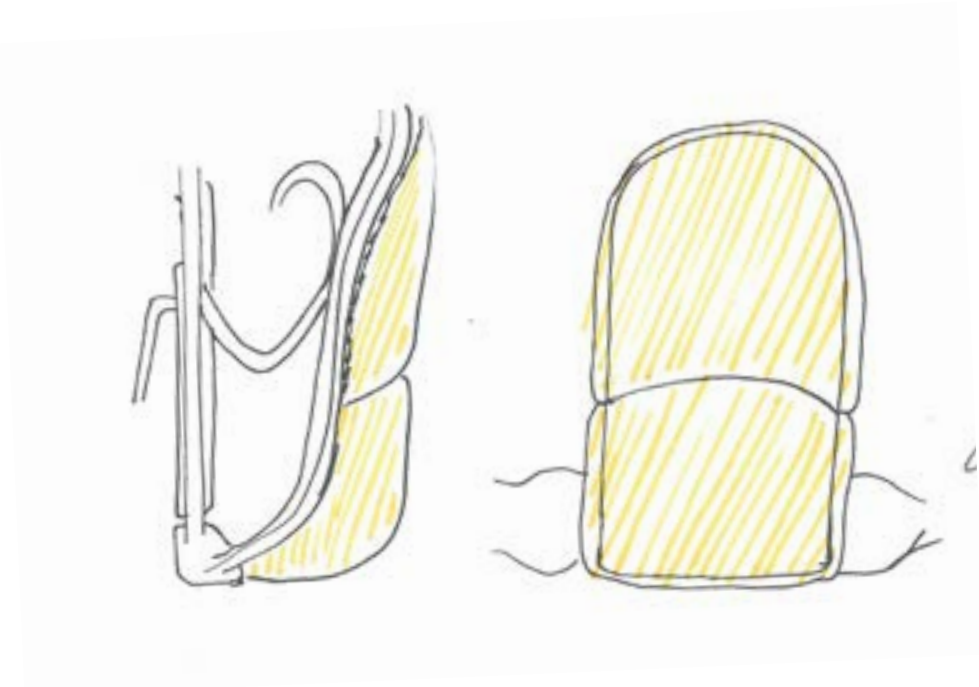
Would making the carrier hands free in a certain way be an option?  
Look further into fabrics, how they are stitched, what properties are best for the carrier etc.

### Own thoughts

Gather up ideas and produce a final design.

# using the base

Making use of the available back space to prioritise daypacks. Here, one daypack is shown above what could be permanent base storage. This base storage area could be ideal to store a raincover, which is essential for unexpected weather on a day out.





The main purpose of a removable daypack is to be able to carry more, and being able to transfer it to another person with ease. However, their size restricts what the adult can store. What would really need to be packed for a day out?

These all vary on the intention of the day out - a long day or a long walk would naturally mean that more supplies are required for both the adult and child, and a short trip would only require essentials, such as phone, money, keys. The age of the child will affect this, too. An older child would be more capable of eating solid foods and require less frequent (or no) nappy changing, whereas a younger child (around 6-9) months would need jarred foods and baby formula.

This lead to the idea that maybe more than one daypack or area of storage would be helpful - the parent can organise their items in a more efficient way, and the carrier can be adapted to for their needs - e.g. maybe only one small pack would be necessary for a quick trip to the shops, or one or two larger ones for a longer day out.

# What do you need on a day out?

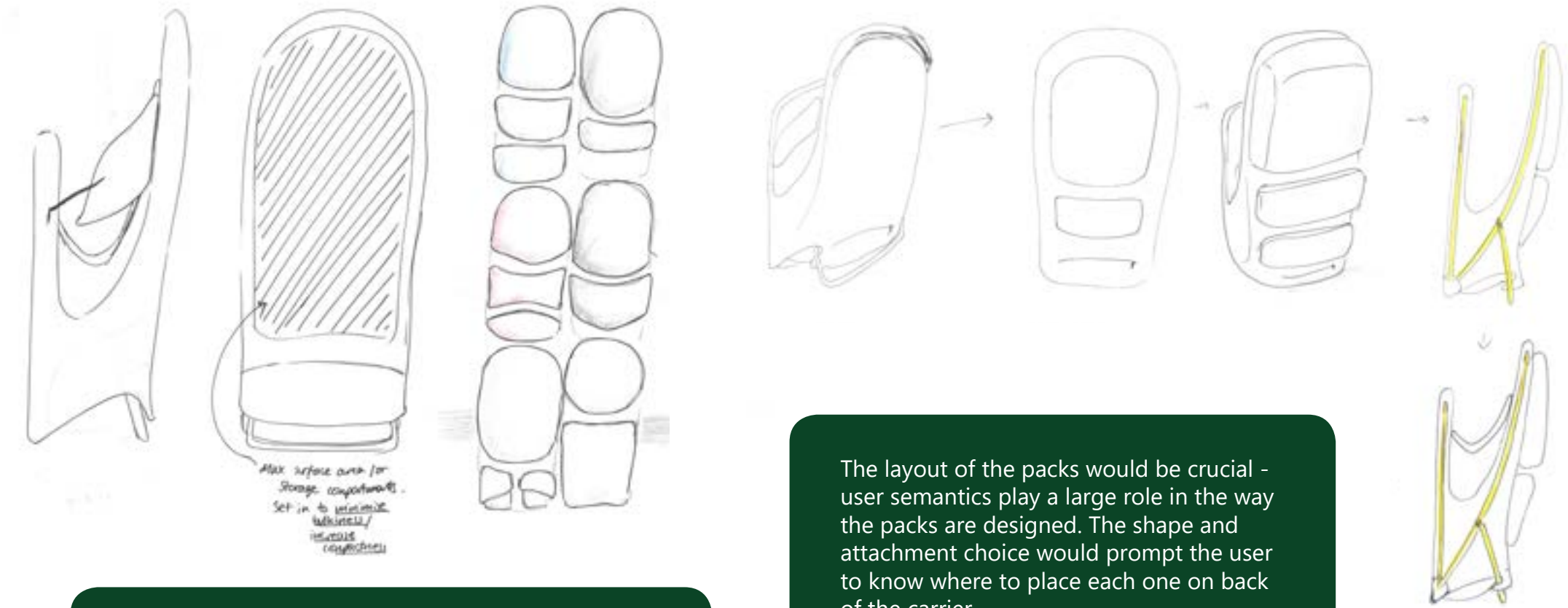
- formula/milk, 2-3x milk bottles 
- 2-3x nappies, nappy cream, wipes, changing mat 
- change of clothes for baby 2x, change of clothes for adult 
- food e.g. sandwiches 3x, packaged food 
- keys, money, phone 
- outdoor gear e.g. compass, map, walking poles 
- first aid kit 

## more than one daypack?

Having more than one daypack allows the user to adapt the carrier according to where they're going - what should the shape and format of the packs look like? How many should there be? What layout is best for straightforward user interaction?



## how many and how should they be placed?



Designing packs that fit the shape of the back of the carrier - to minimise its foot print so it doesn't feel like a bulky outdoors carrier when being used around town.

Research into what was needed on a day out showed that three packs attached to the carrier could become a bit complicated - having two instead still gives the user four options in total.

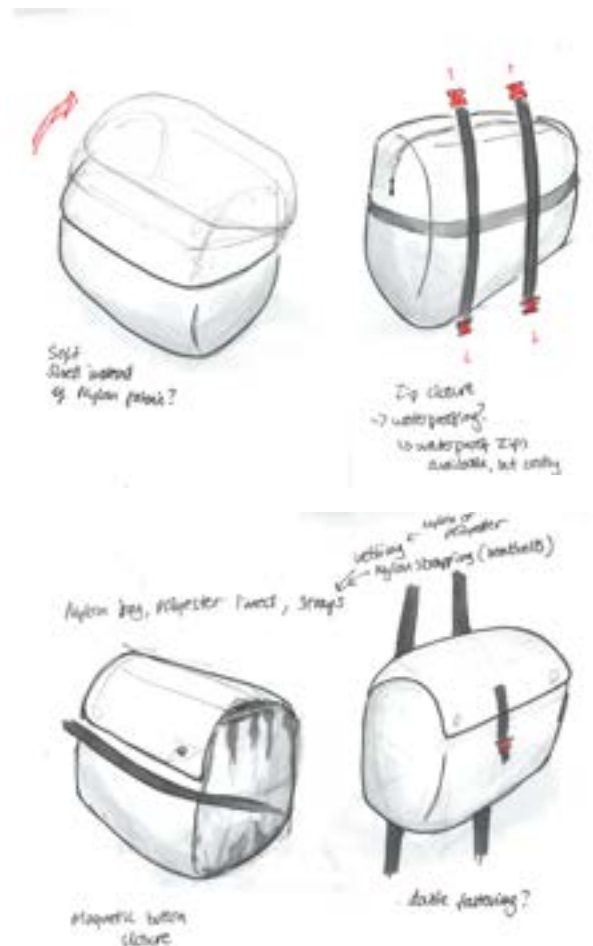
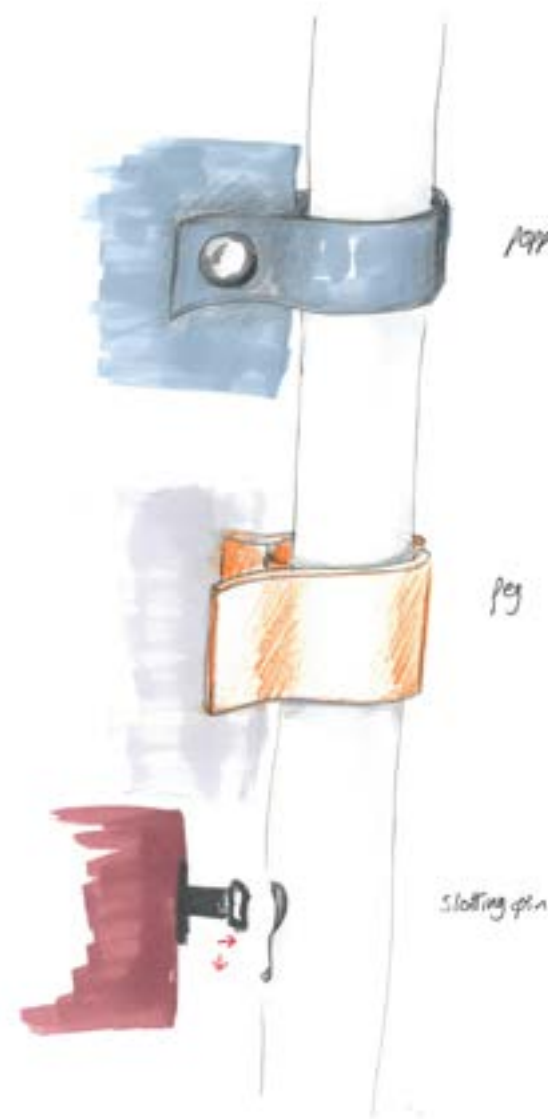
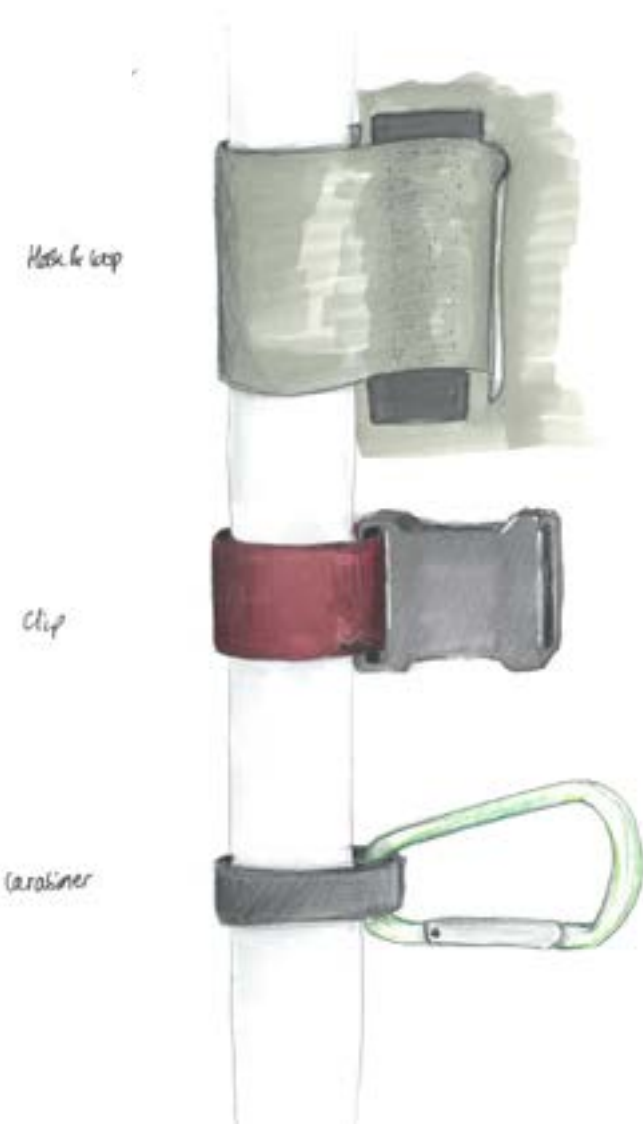
The layout of the packs would be crucial - user semantics play a large role in the way the packs are designed. The shape and attachment choice would prompt the user to know where to place each one on back of the carrier.

In order to distribute the weight evenly across the pack, it was decided that the best layout would be one pack underneath the other. Attaching one pack on top of the other could offset the load, causing the adult discomfort.

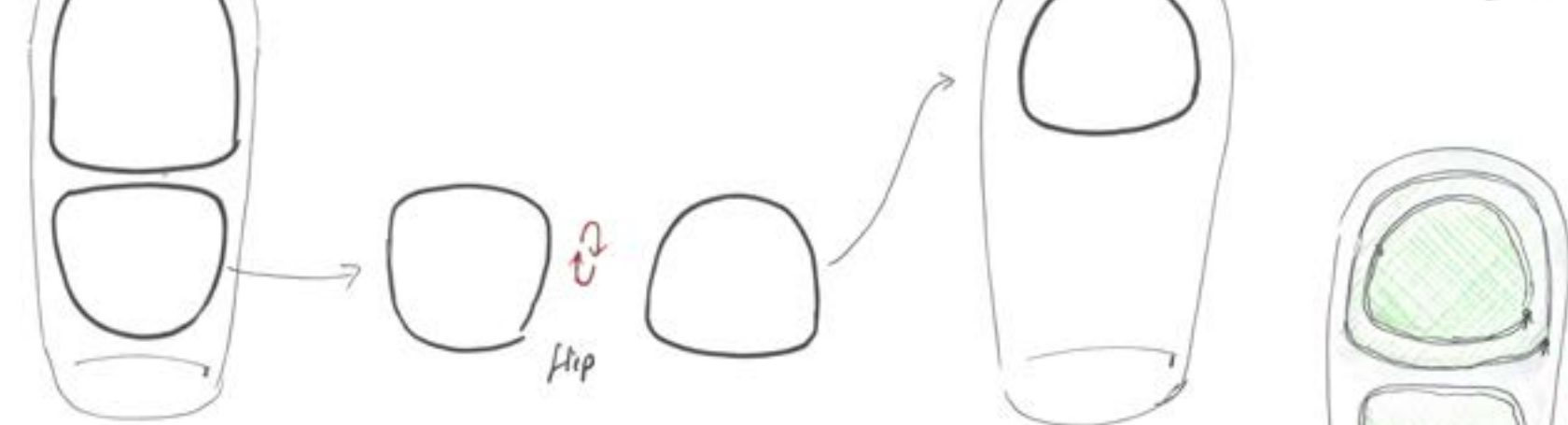


# attaching daypacks

Looking at ways of attaching packs to the carrier - these could influence the design of the daypack. What other ways can daypacks be attached?



2 separate bags that fit well to the carrier design, but also fit together when both are attached..

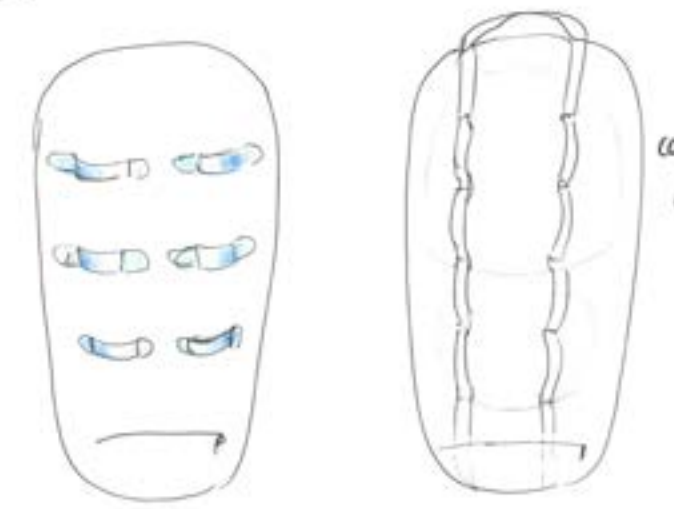


Modular design also makes Zip attachment/design a bit difficult/complicated. - for manufacturer and user

- using zips =
- restricted modularity
- a bit ugly where the pack isn't zipped on
- + stops user from placing bag in wrong place (weight distribution)
- + less options could be less hassle for users

Clips would be good, but work on external frames better. Don't have an external frame.

Making the storage packs fit well together as well as on their own when attached to the carrier. The attachment system could inform the user which way is best to attach the packs, to ensure even weight distribution and therefore greater comfort.



## storage pack sizes

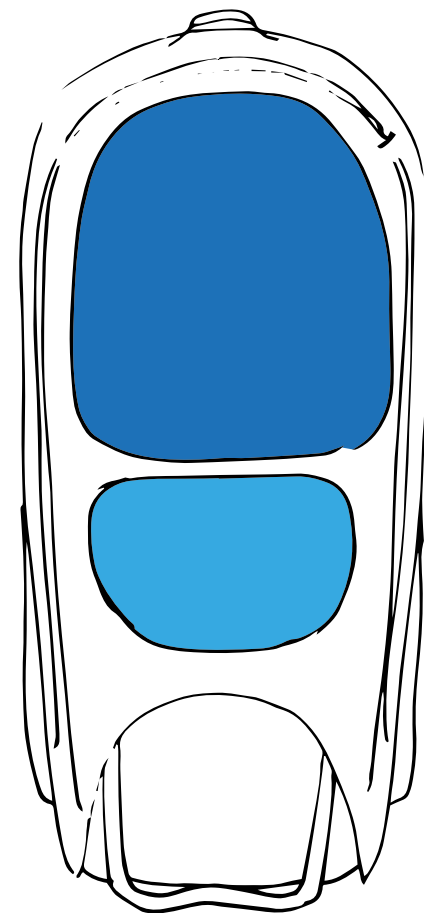
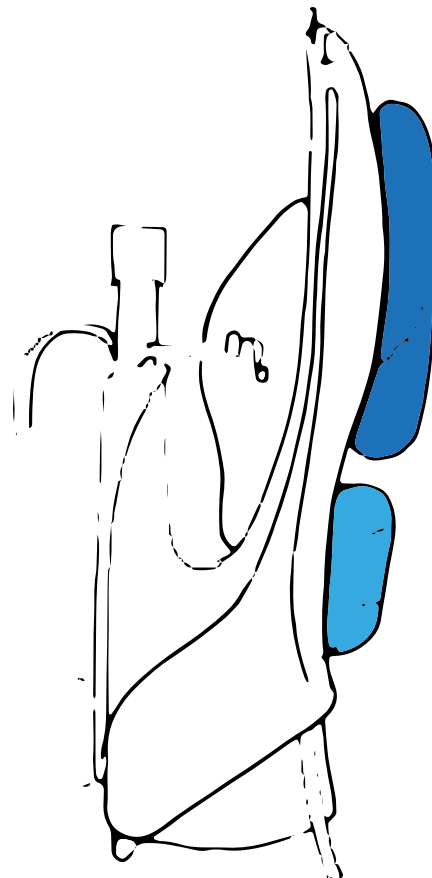


310x330x120mm

12

This leaves enough storage space in the base of the carrier - making use of the area underneath the curved frame. This would be an ideal area to store the raincover, as it is in keeping with weight distribution guidelines (it's lightweight).

The maximum length and width of each pack can easily be determined by offsetting inwards from the 'edge' of the back of the carrier. However, the measurement for the maximum depth was unknown. Other existing methods of storage were looked at, including other daypacks and nappy bags.

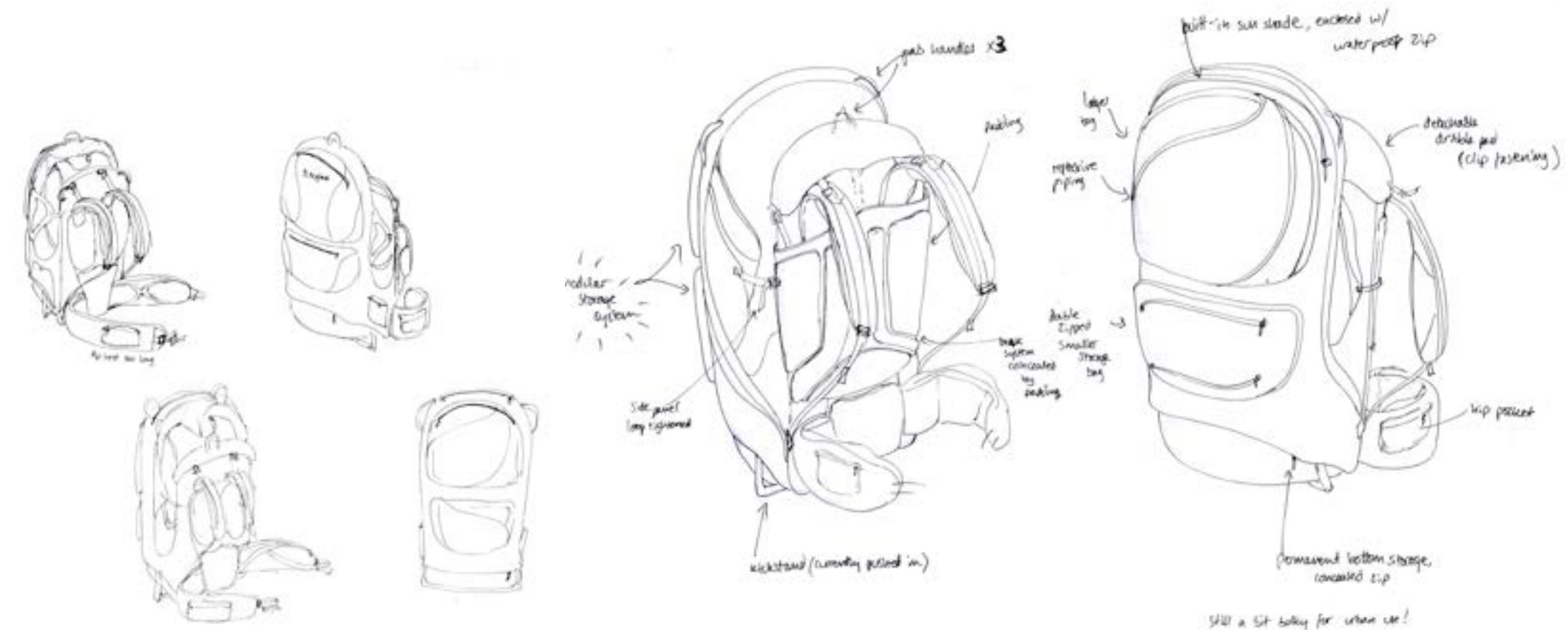


270x230x90mm

260x190x85mm

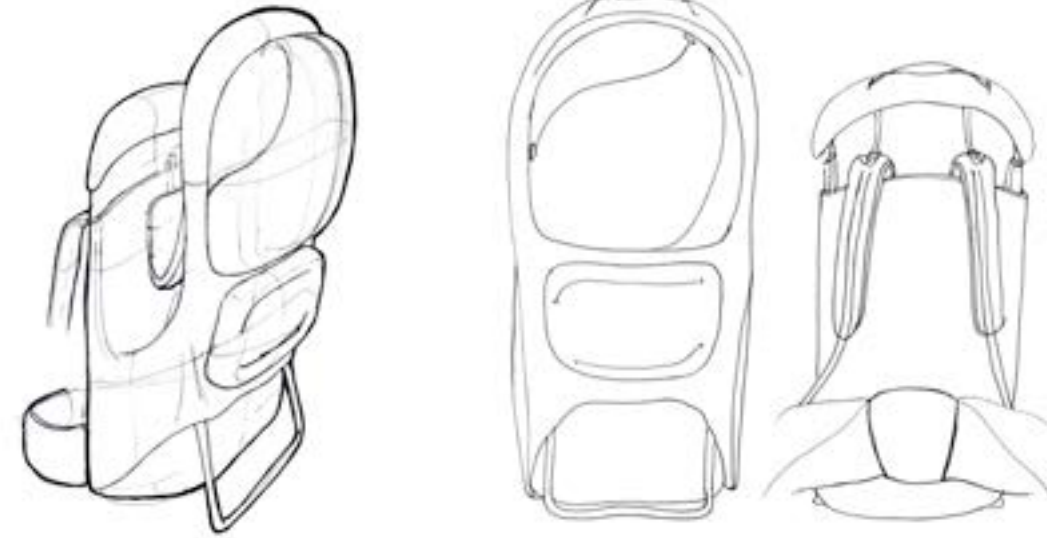
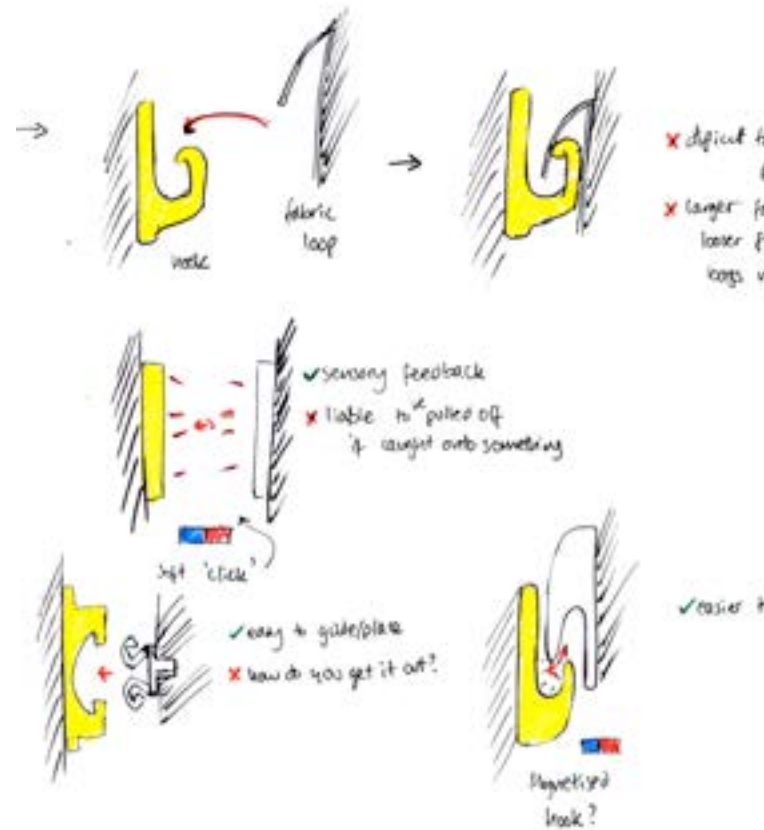
## unique selling point

Once the layout of the packs was achieved, the USP was obtained - modular storage. Final design concepts were then produced, with focus on the storage system.





## revisiting attachments

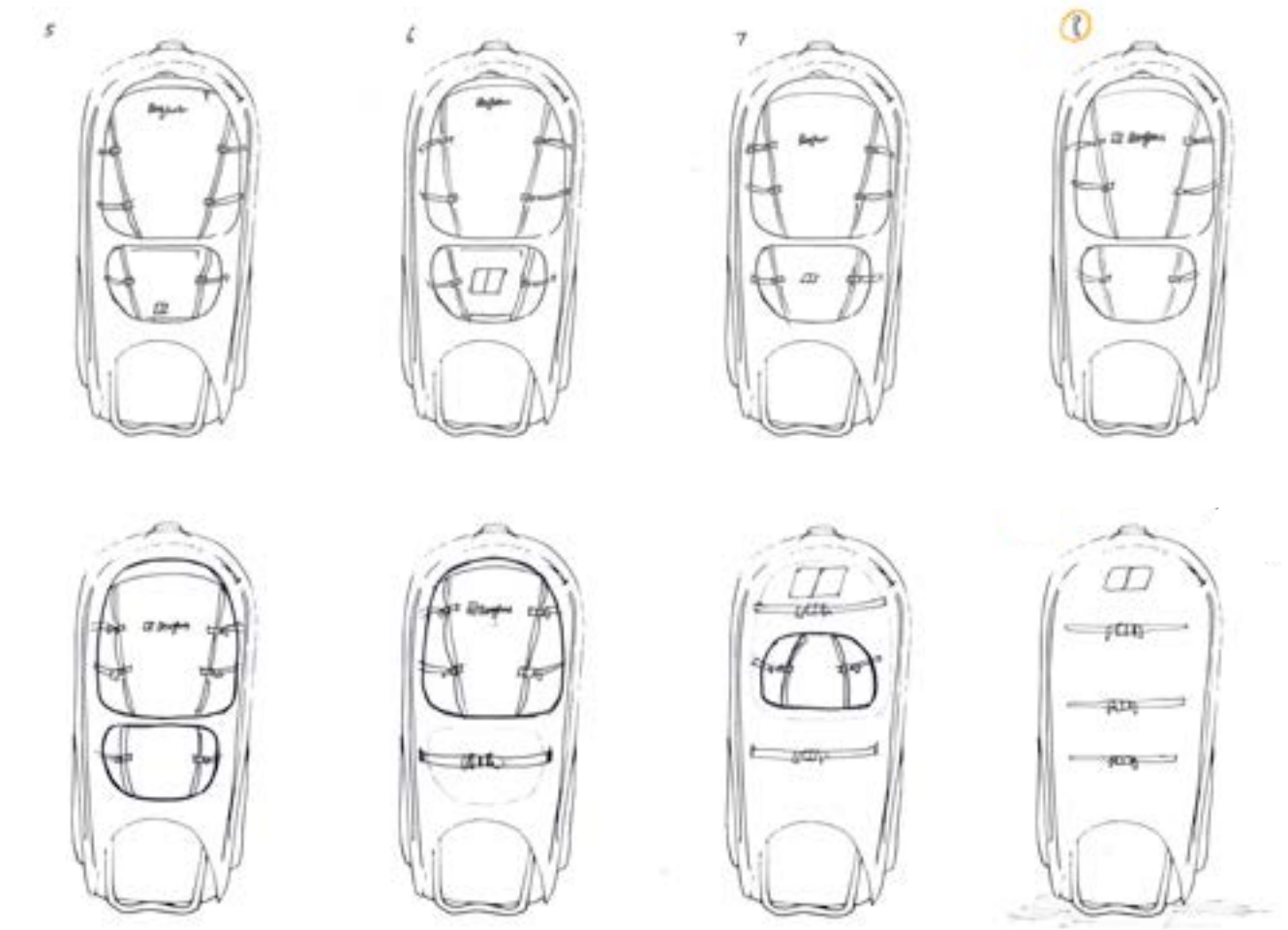


The placement of the clips was resolved.

The placement of the logo was resolved too - an obviously important decision - so that it still showed in a sensible way whichever way the user places the storage packs.

In an ideal world, custom-made magnetic attachments such as these would work well with the aesthetic of the product and really highlight the USP - the packs would be easy to add and remove and they don't upset their styling either. However, using Berghaus' own clips could lower manufacturing costs, increase brand identity, mimic their design language more strongly and also increase brand value. This would mean a change in pack styling again.

## pack design revised



Both packs

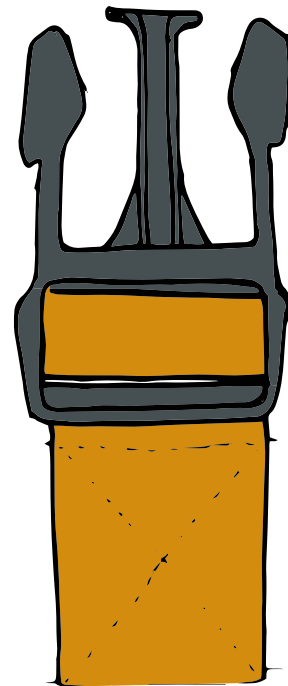
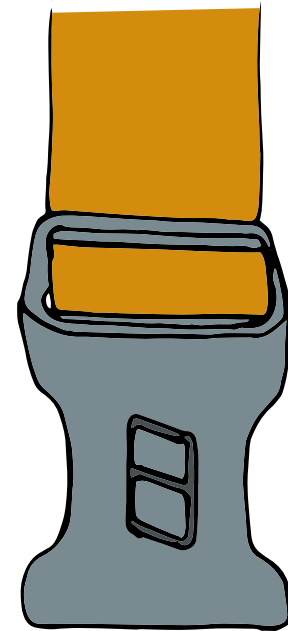
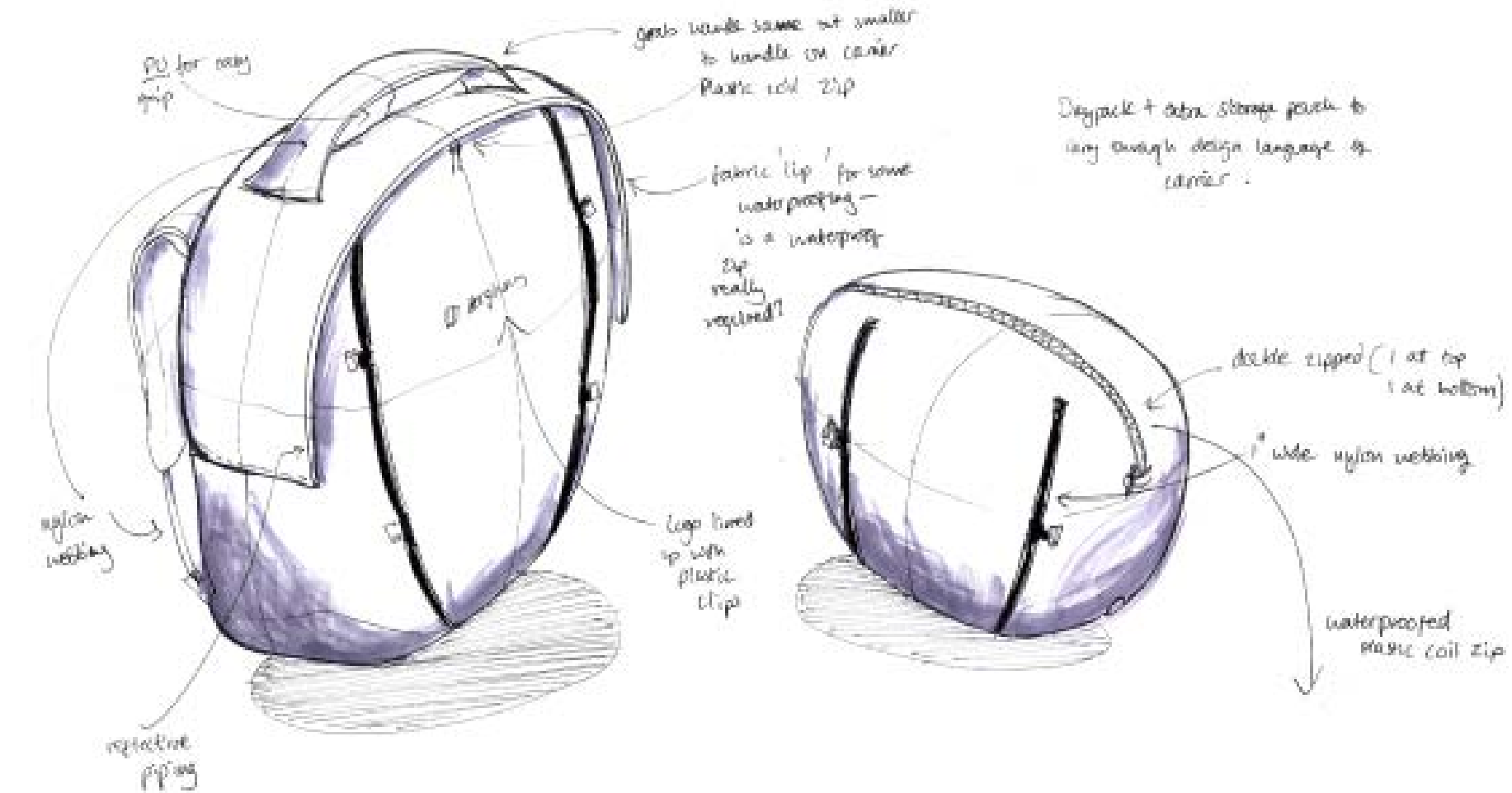
Daypack only

Small pack only

No packs



## pack design revised (cont.)

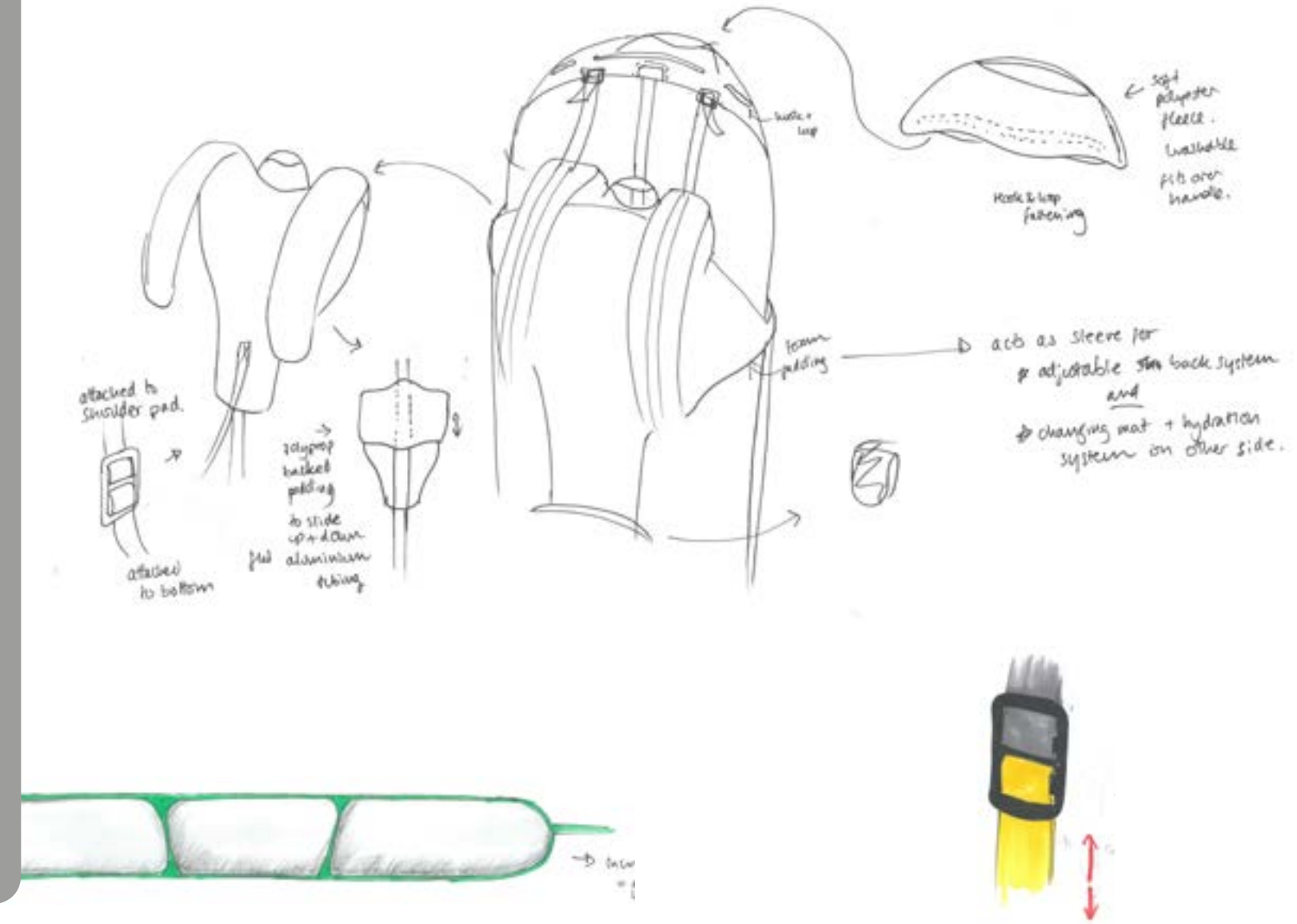


Time limits and design development meant that the back adjustment system was left to reconcile for a later time. It was finally decided that as modular storage had become the USP, and that adjustability was no longer part of the design direction, it would be suitable for the carrier to have a system similar to existing ones.

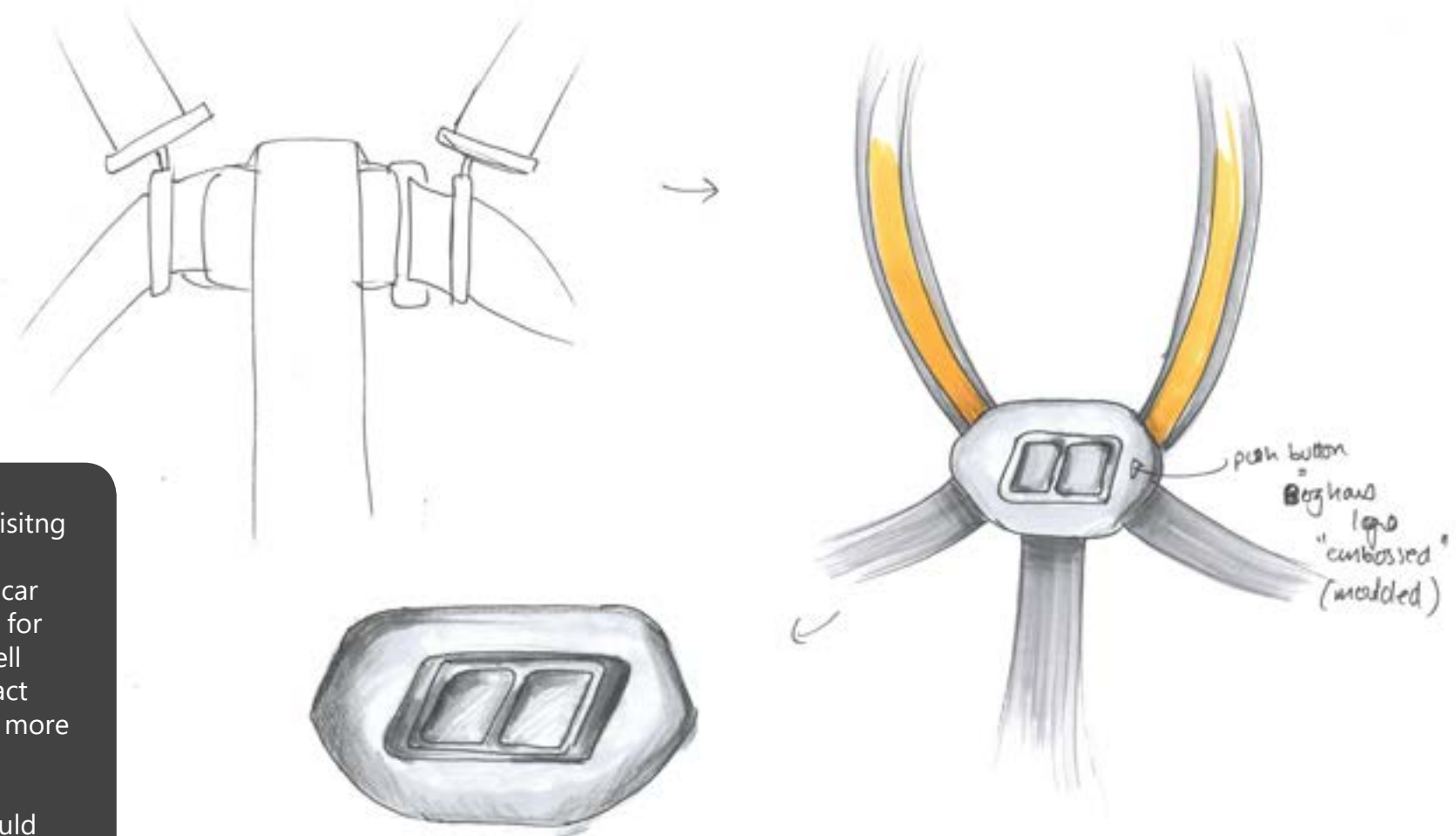
In order for the carrier to be lightweight and durable for trail and urban use, the best option was to have plastic backed (polypropylene) shoulder pads running up and down flat aluminium tubing.

The decision to have an adjustable belt for the locking system over a plastic hinged clip was made, as the belt system would be easier to conceal when not in use (it is a coarse adjustment that isn't changed often) and therefore reduce some bulk and allow the focus of the carrier to be on the storage system.

## revisiting the back system



## the child harness



It was decided that an existing 5-point child harness - similar to those found in car seats - would be suitable for the carrier, as they are well tested under higher impact conditions and therefore more reliable.

Naturally the harness would be stitched into the padding, preventing the child from touching the adjustments.

## materials - fabrics

Before looking the fabric swatches, it was decided that nylon - over polyester - fabrics would be ideal for the carrier - it is lighter in weight and stronger than polyester - even though it feels tougher - and comes in RipStop, waterproof variants.



Duraford 160D Diamond nylon

A light material with diamond patterning for strength. However, the texture does not fit the friendly aesthetic of the design.



RipStop 420D nylon

A tougher material due to its RipStop properties, ideal for catches and scuffs from the child's shoes etc. Ideal for the outer shell of the carrier.



Duraford 160D Taslan nylon

A very lightweight but strong material with wipe-clean properties. Ideal for lining the inside of the storage packs.

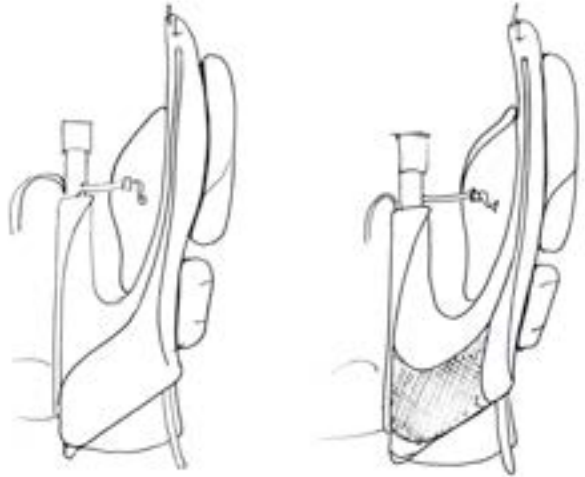


RipStop 160D nylon

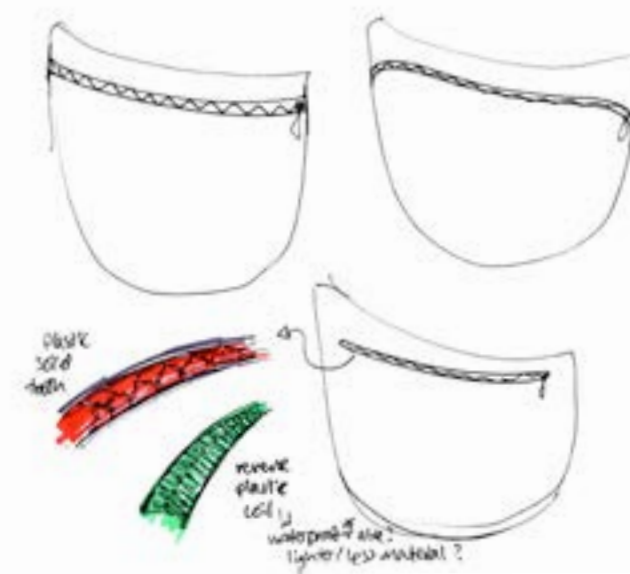
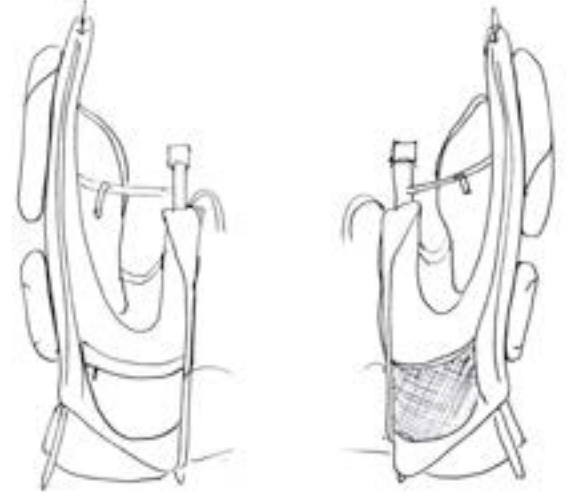
A lighter RipStop variant. This could be used for the outer shell of the storage packs - it's not necessary but could reduce the overall weight of the carrier slightly.



## detail - small storage



To make use of the available side space, it was decided to include extra pockets. The left side is to have an elasticated nylon mesh pocket, and the right is to have a waterproofed zip pocket - having a pocket of each type on either side accommodates for users of either hand, and also general user preferences to pocket types.



A common minor feature found across best-selling carriers was small storage pouches on the hip belt - these will be included in the design of the carrier. A small flap of material will be stitched to cover the zip, in order to minimise costs of using a waterproof zip instead.

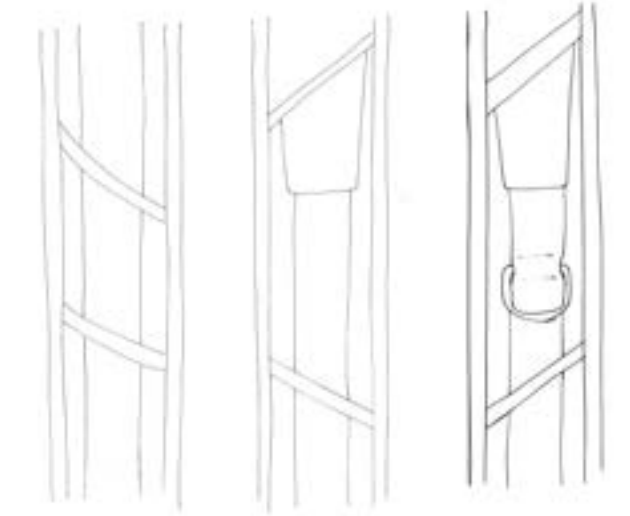
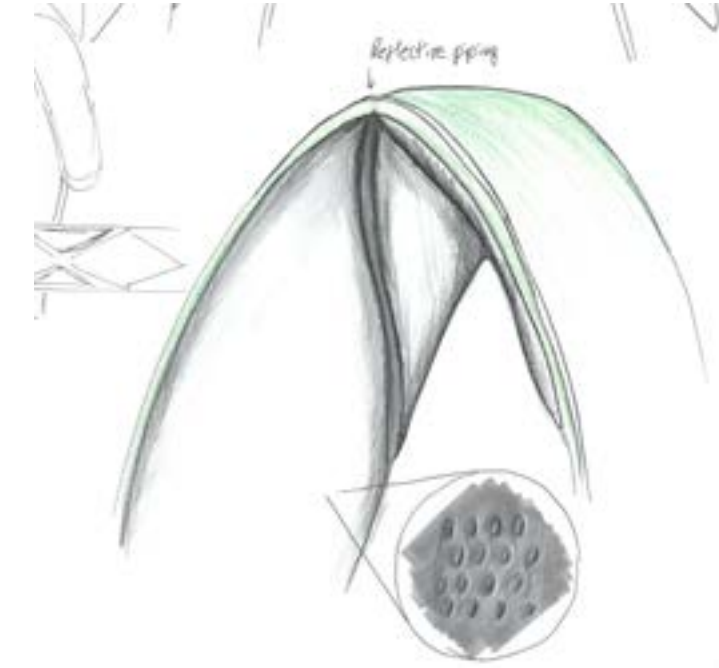
Existing carriers and bags tended to have handles made just of nylon webbing (as used for the straps) or EVA foam bonded in between layers of fabric and webbing. For this carrier, the second option was chosen, to give a slightly increased appearance of durability, instead of having an overall bulky pack, and also increased user comfort.

Nylon webbing is used throughout the carrier, with a larger width for the hip belt.

Flat piping is also to be used on the edges of the straps to close off the edges, with some parts selected with reflective piping instead.



## detail - handles, straps





current shades



future shades, for 2016



An insight into current colours that Berghaus use throughout their equipment and apparel, mainly being a range of greys with bright or bold highlights, or a combination of one or two bold colours with complimenting shades of grey.

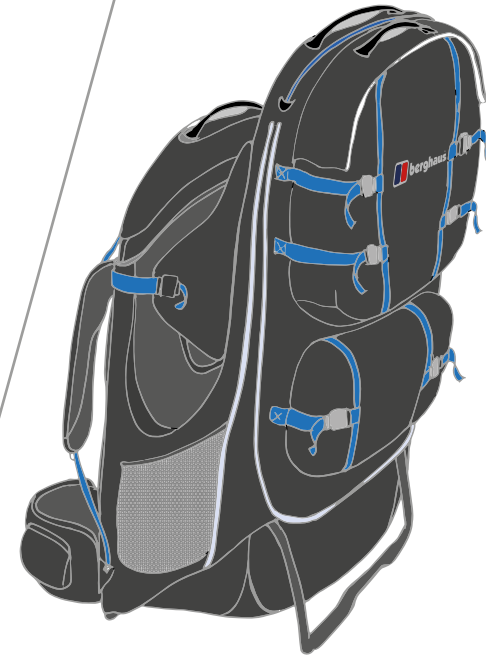
A look into the Outdoor Show (2015) gave insight into future trending colours - to use even bolder, even explosive colours.

Preliminary combinations of colours were matched, in keeping with Berghaus design style.

# colourways - applied



Brights



Greys



Blues



Bright highlights



*final design*



## the final design



The **outcome** is a child carrier intended for low-intensity trail users, but also with a natural crossover to high-intensity trail users to everyday users through the use of modular storage.

### *Structure*

It consists of a simple aluminium alloy folding frame, with locking hinge concepts similar to those found in pushchairs and highchairs.

### *Colour*

A fresh and original colour scheme has been chosen - navy blue with grey undertones and splashes of burnt orange. They have been chosen in accordance with the current Berghaus colour palette, standard outdoors equipment greys and trending colours.

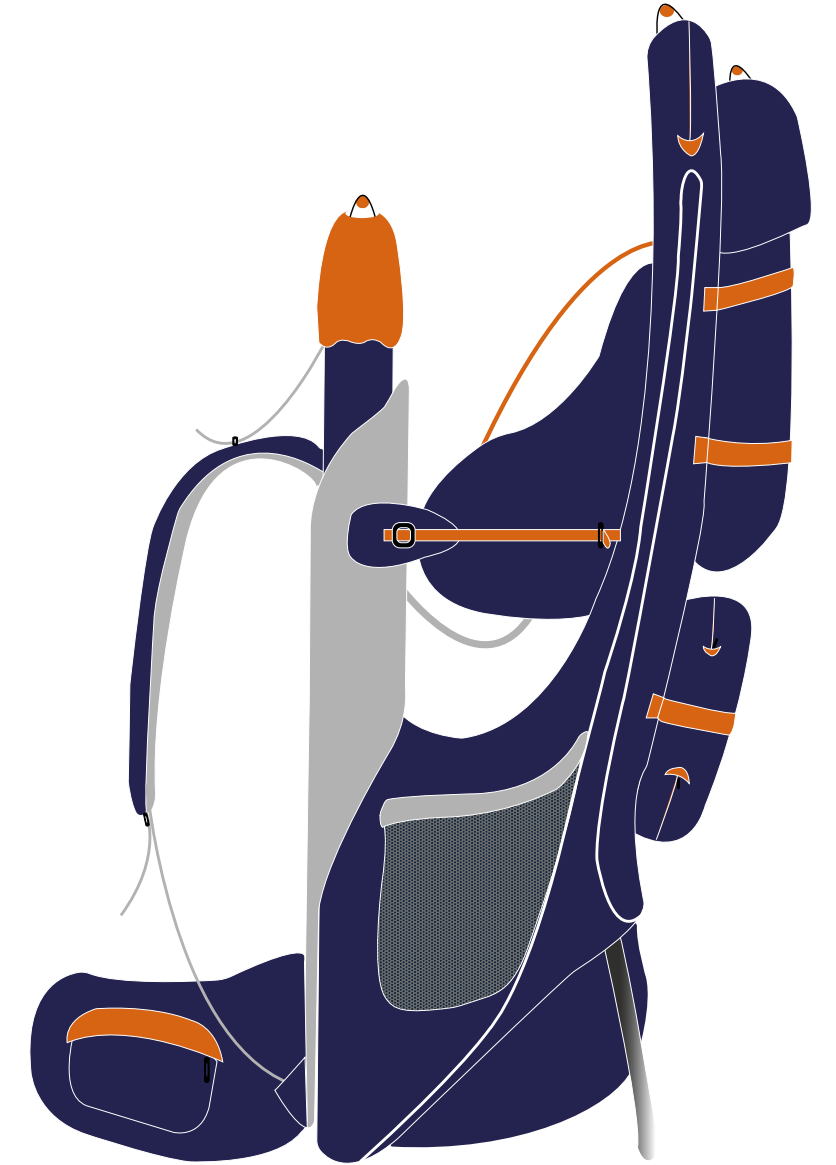
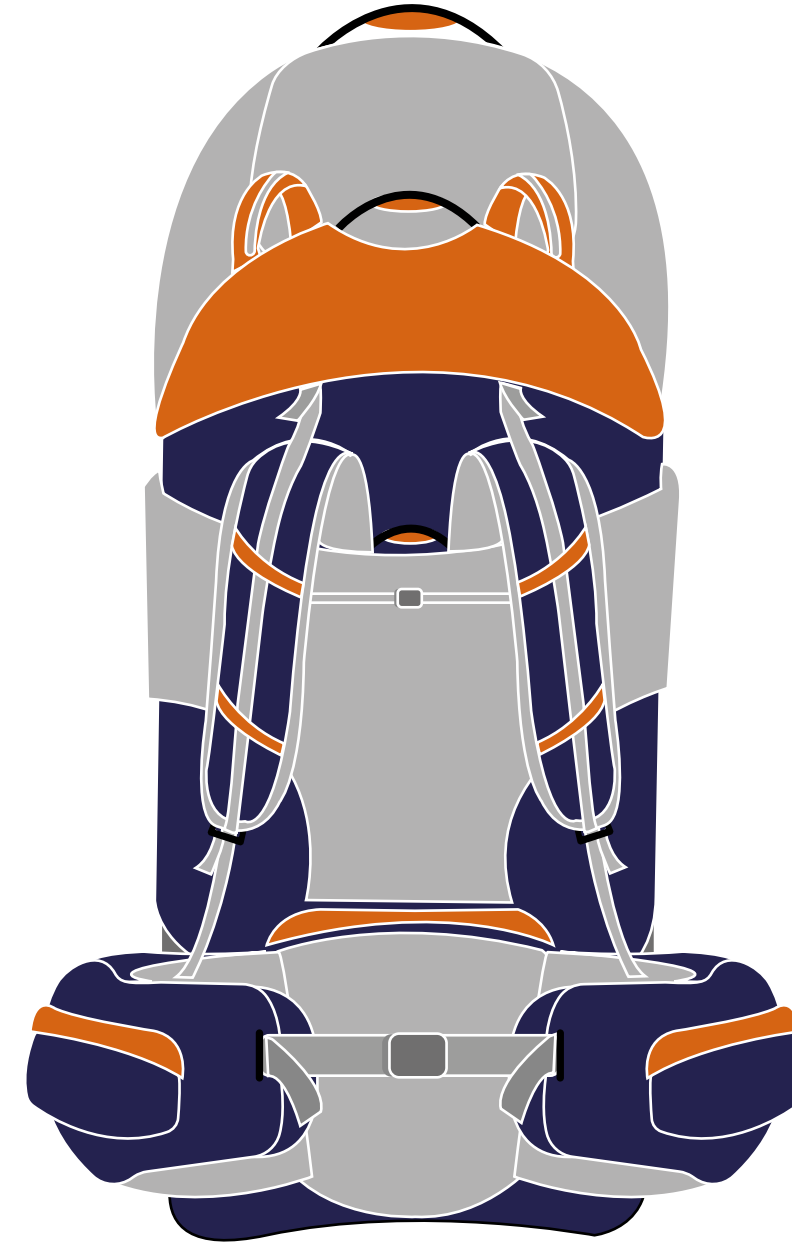
### *Form*

The form and shape of the carrier lends itself to the rounded, slightly bulging style found in Berghaus rucksacks. It is more compact than bulky, with striking lines, panels and contours following through the features, breaking up the curved form with the use of reflective piping to accentuate the design. Each line and shape has a function, with only the logo having a more decorative purpose and therefore directing attention straight towards the brand.

### *USP*

Thorough development lead to the concept of modular storage. This carrier consists of two packs - one being a daypack and the smaller being an extra storage pack. They can be arranged and rearranged to the user's desire in accordance with the planned out day, simply using adjustment straps and (branded) clips - a small yet common feature that is familiar to almost any user. They also double up as compression straps, thus allowing the user to help spread the load evenly, almost unknowingly.

*the final design*



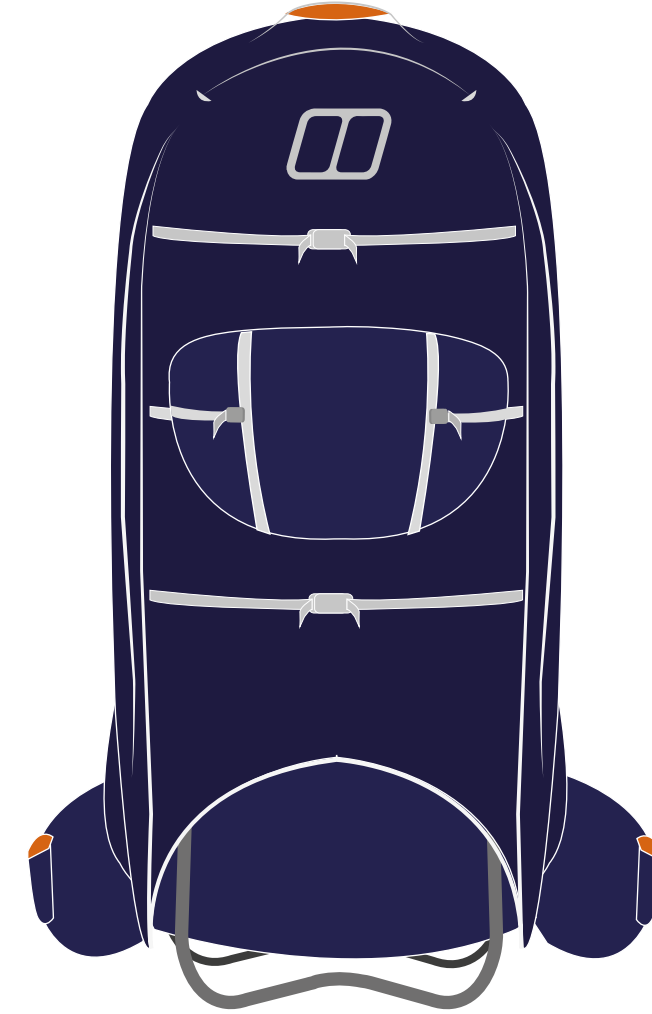
*the final concept - storage system*



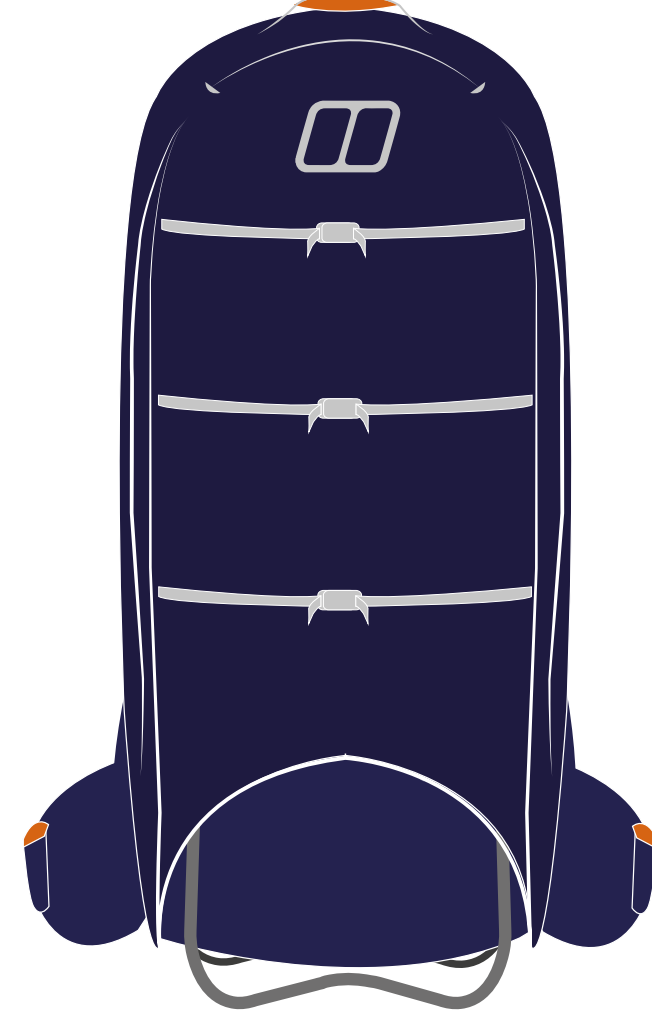
*option 1*



*option 2*



*option 3*



*option 4*

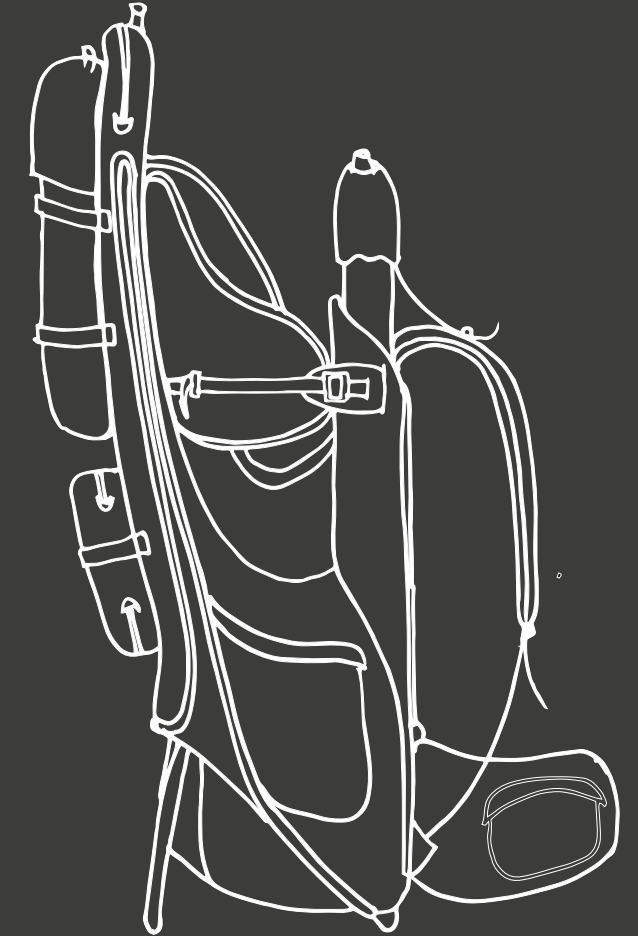
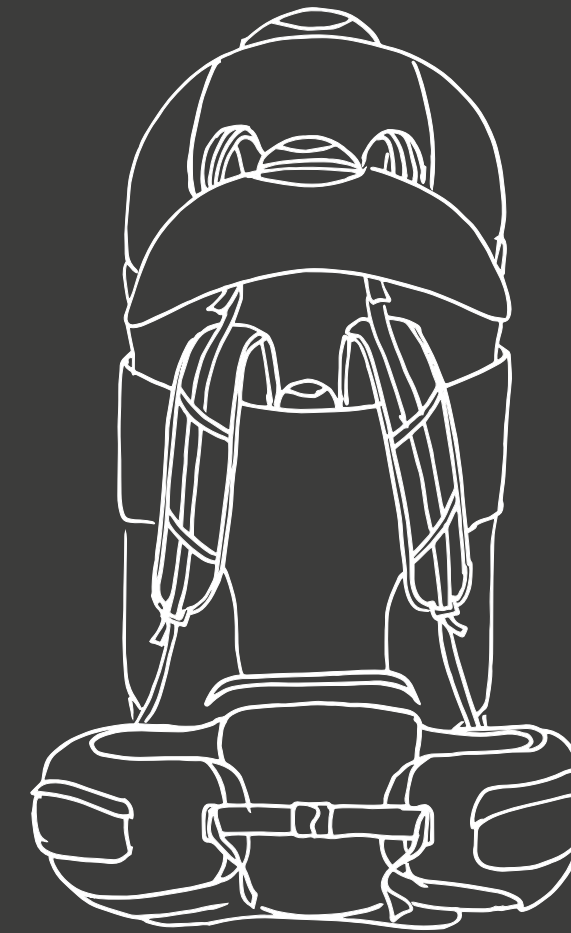
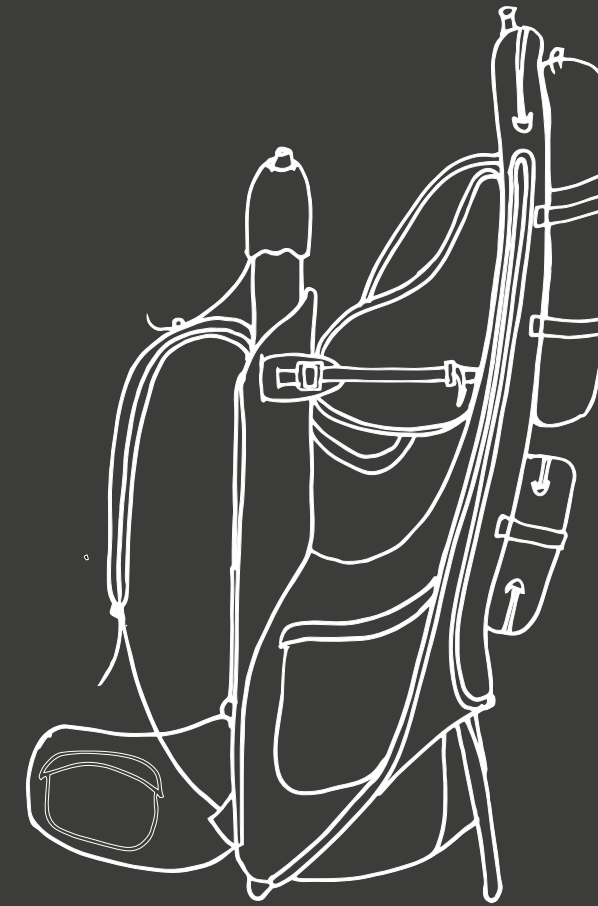
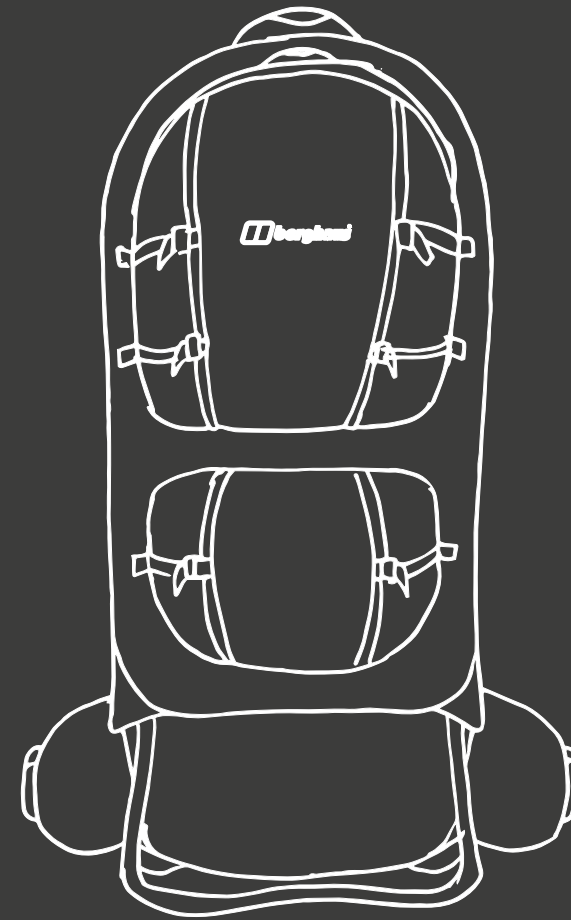


## features, specifications

Removable daypack  
Removable extra storage pack  
Permanent base storage  
Removable, washable, hook and loop dribble pad  
Aluminium alloy kickstand  
Folding frame  
1x side elasticated mesh pocket  
1x side zip pocket  
2x zipped hip belt pockets  
Reflective piping  
Built-in sunshade  
2x grab handles  
Changing mat included  
Hydration system compatible

5-point child harness  
Adjustable child seat  
Adjustable back system  
Adjustable shoulder straps  
Load adjuster straps  
Redirected strap hip belt

Max dimensions: (mm) 730(l) x 310(w) x 300(d)  
Daypack dimensions: (mm) 270(l) x 230(w) x 90(d)  
Extra storage pack dimensions: (mm) 260(l) x 190(w) x 85(d)  
Weight: approx. 3.5kg



## *materials & manufacturing*

The aluminium alloy frame would be cut/bent to shape and connected with plastic injection moulded (PP?) connectors, riveted in place. The locking system in the hinge of the connector would also be injection moulded.

Using 420D RipStop nylon, compression moulded closed cell foam would be stitched in, forming the overall curved body. Ideally the RipStop nylon could be coated in PU for waterproofing, too. This method is applicable to all padded parts of the carrier (straps, the seat, belt, back padding). Approximately 8 twin stitches per inch would be sewn using nylon thread - nylon thread being chosen due to its rot resistant and strong properties.

Padding that comes in contact with the adult for prolonged periods of time would also be stitched over with a nylon air mesh, to allow air circulation/breathability. A similar mesh would be used for one of the side pockets, too.

All connectors and hinges would be covered by the RipStop nylon outer shell (above), thus avoiding any safety issues and legislations relating to children getting fingers trapped etc.

A combination of YBS regular plastic and waterproofed plastic coil zips would be used, to reduce the likelihood of material catching. Waterproof zips would be used where a fabric flap is not used to cover the zip in the design (e.g. the small storage pack) to reduce manufacturing costs slightly.

The shoulder straps for both adult and child, load adjuster straps, and the adjustment belt for the seat height and back system would have 22mm wide nylon webbing, due it's (tensile) strength. The hip belt would have approx. 35mm wide nylon, due to the majority of the load being spread to the hips.

The 'cockpit' of the carrier would be lined with a soft polyester fleece.

Grab handles would also be made using nylon webbing, 25mm wide, heat bonded EVA foam and covered in 160D Taslan nylon, stitched with nylon thread, too.

All loops and clips would be made from injection moulded POM, due it's creep resistance, strength, hardness, stiffness, fatigue resistance and toughness. Most would be existing designs used by Berghaus.

The removable storage packs would be lined with 160D Taslan nylon.

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