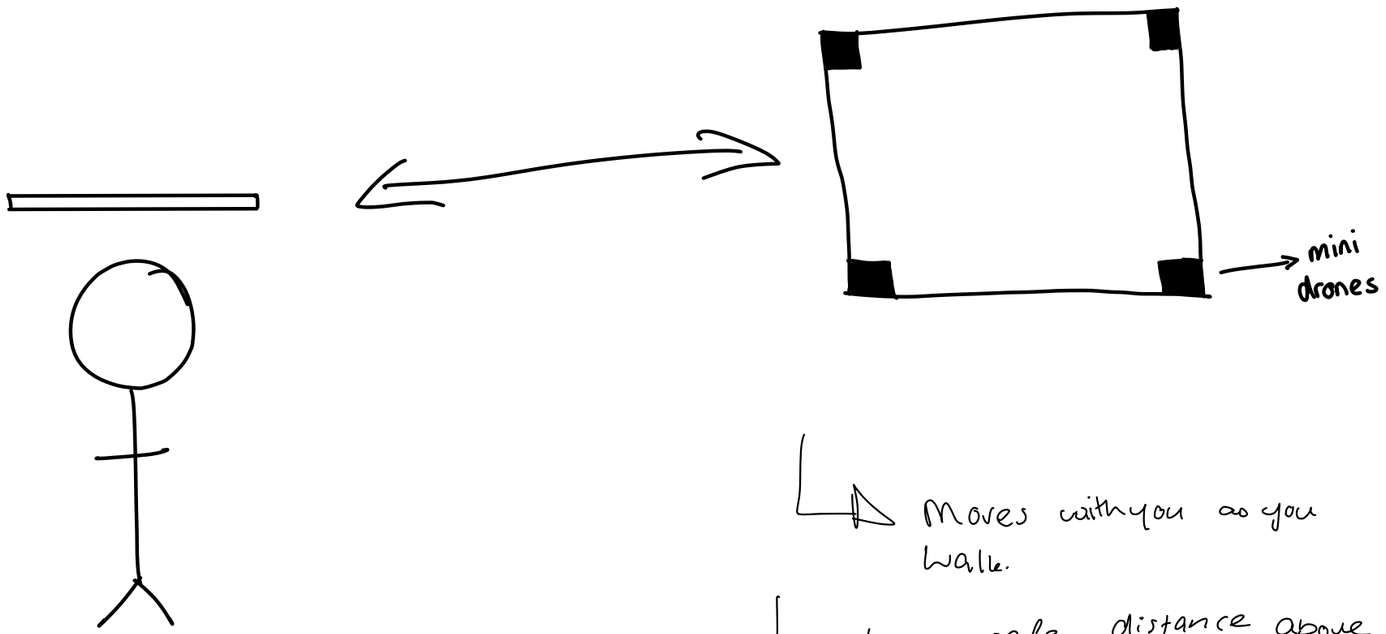
DDR CAPSTONE UNIT

Emily Weatherall | N10779418

UMBRELLA BRAINSTORM. INTIAL



↳ Moves with you as you walk.

↳ keeps a safe distance above your head.

↳ will fold up neatly and small so it fits in your pocket.

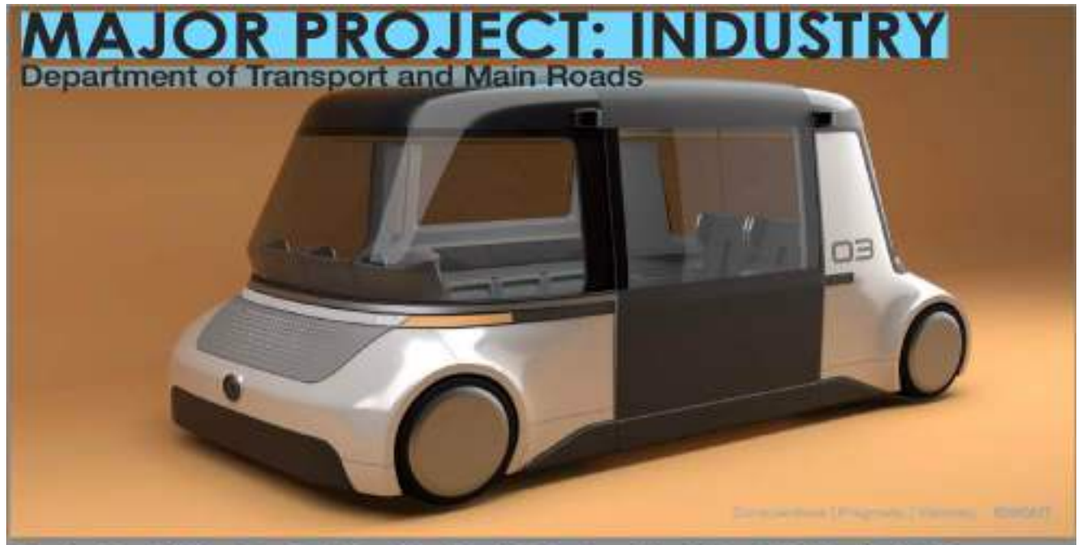
N10779418
Emily Weatherall

Major project interests

MAJOR PROJECT: SCIENTIFIC

Pollination System

Pollination mobility systems (x1 student)
Pollination services are a food security critical industry in Australia worth ~$16 Billion per annum. Beehives are moved in their thousands daily across Australia using trucks, forklifts and standard pallet systems. The largest cost in beekeeping is transport through fuel, vehicle capital expenditure and maintenance costs. The major risks in this industry come from biosecurity hazards such as disease spread. This project asks students to investigate how we can redesign beehive transport systems, products, and processes, from individual hive to road-train scale, to drive increased efficiencies and biosecurity in the pollination services industry.
Project Lead: Dr Dan Cook
d20.cook@qut.edu.au



MAJOR PROJECT: INDUSTRY

Department of Transport and Main Roads

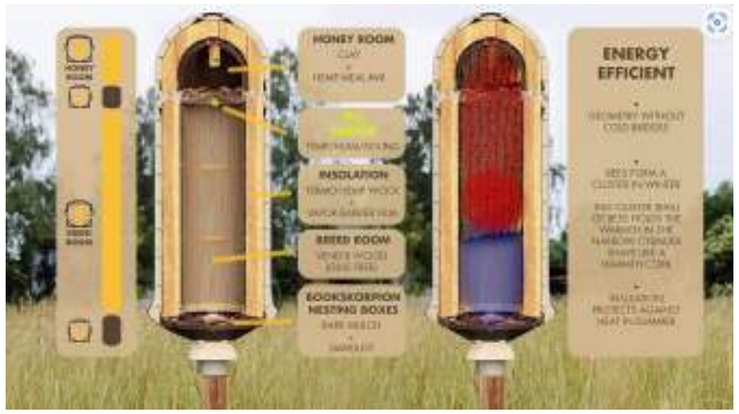
Qld Gov Department of Transport and Main Roads Accessible Autonomous Vehicle Concept (x2 students)
You will work with QUT and TMR research and design team on one of two key projects they are looking to develop. This is in respect to the future accessible autonomous vehicle
(1) Advanced accessible seating design
(2) Interactive haptics technologies for vehicle interfaces
Project Lead: Dr Rafael Gomez / James Dwyer / Andrew Peterson
r.gomez@qut.edu.au / james.dwyer@hdr.qut.edu.au / a.peterson@qut.edu.au

Applications due Monday 31st July 11:59pm

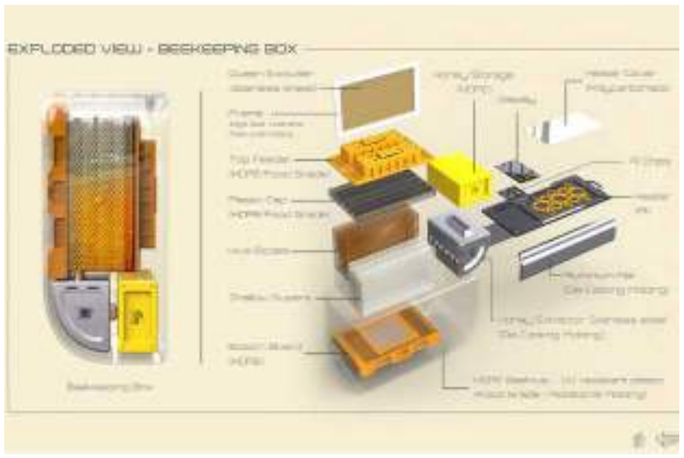
N10779418
Emily Weatherall

Mood board for pollination systems

https://www.yankodesign.com/2022/07/13/ai-powered-mobility-vehicle-is-the-answer-to-responsible-beekeeping-in-urban-farms/



https://designwanted.com/hiive-sustainable-beehive/

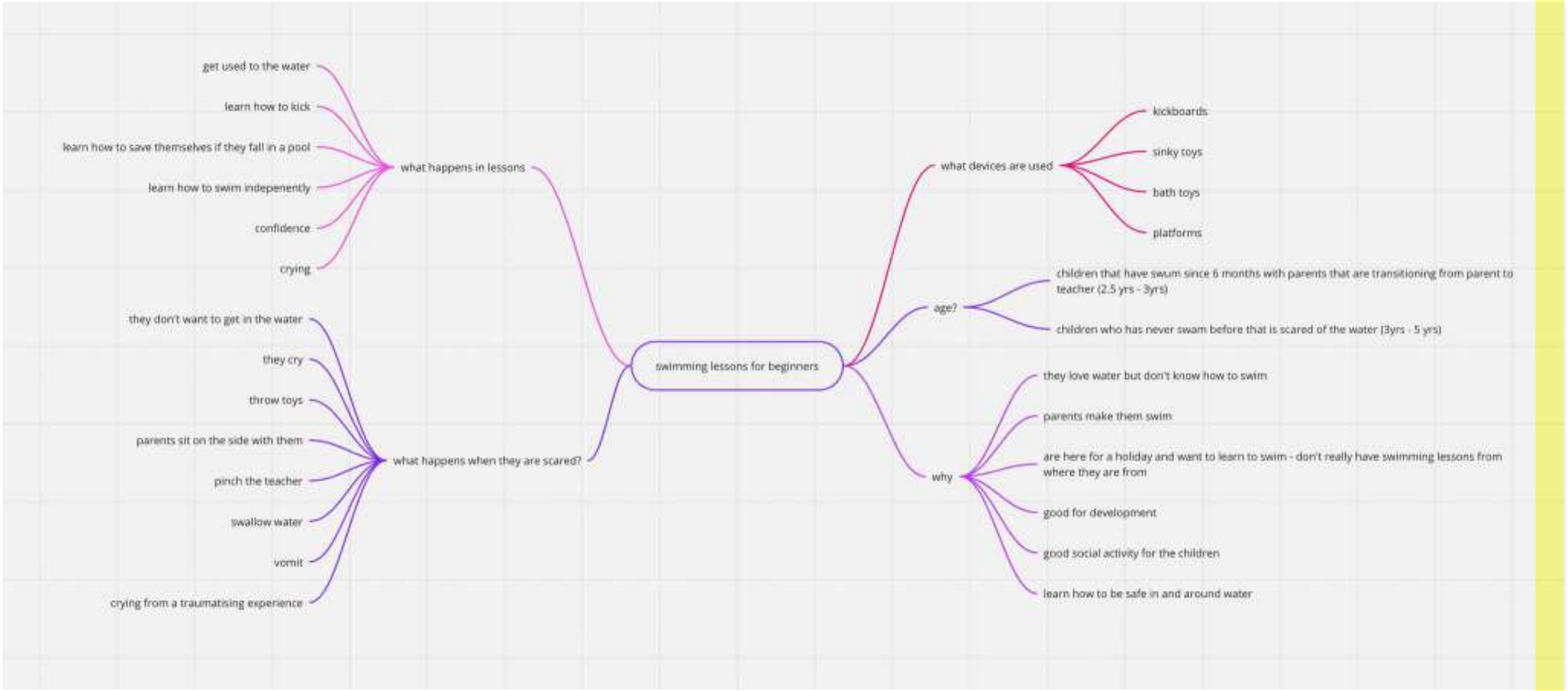


N10779418
Emily Weatherall

Self initiated project

Context: Swimming lessons for children beginning swimming

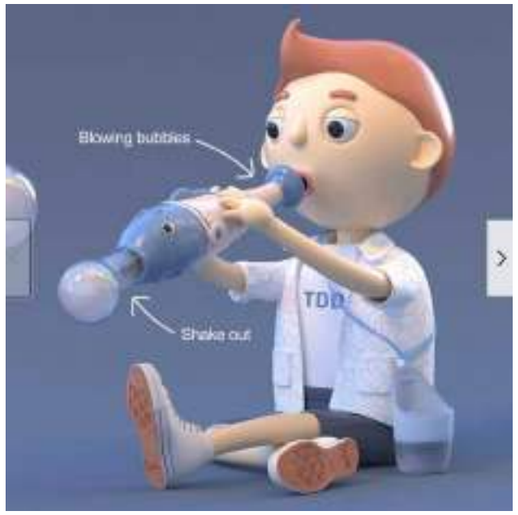
Initial brainstorm



- a device to help parents
- a device to help student get comfortable with water
- a device to help teachers

N10779418
Emily Weatherall

Mood board for self initiated project



https://www.ebay.com.au/itm/195538725624?chn=ps&norover=1&mkevt=1&mkrid=705-159824-816807-4&mkcid=2&mkscid=101&itemid=195538725624&targetid=4584619897046653&device=c&mktype=&googleloc=&poi=&campaignid=412352396&mkgroupid=129632450608251 3&rlsatarget=pla-4584619897046653&abcld=9300543&merchantid=136820&msclkid=dcded39c6686175877e0b75f73d88df9

Emily Weatherall
N10779418

Observations

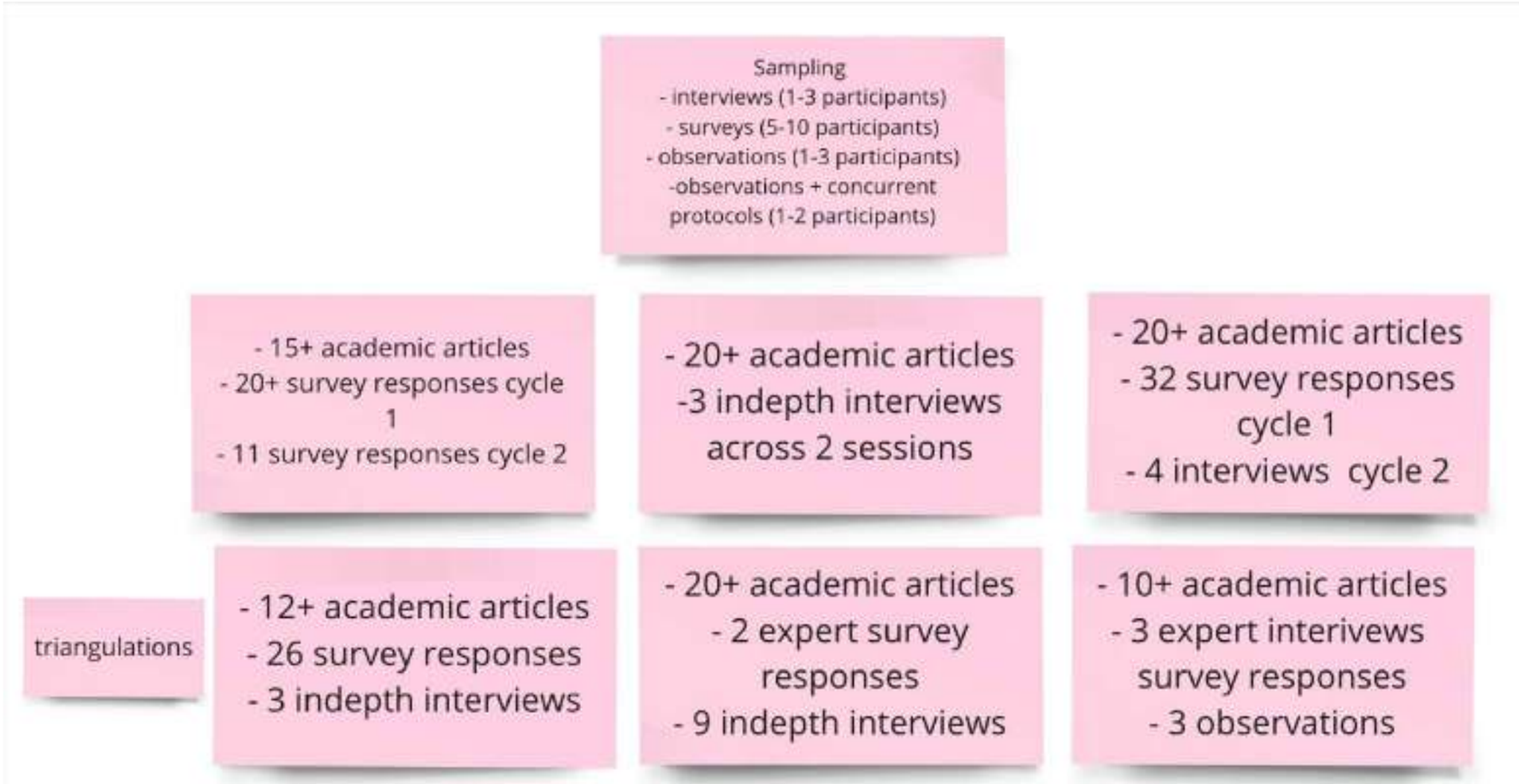
- focus on NWST for 3 weekends in a row
- listen for cues from teachers
- use research questions

Methodology

- what research ins are you answering
- how does your experiment answer this
- qualitative methods
- triangualtion
- participants
- conduct pilot study
- represent methodology graphically
- report needs to use graphics
-

Qualitative methods

- interviews
- surveys
- observations
- think/talk aloud protocols

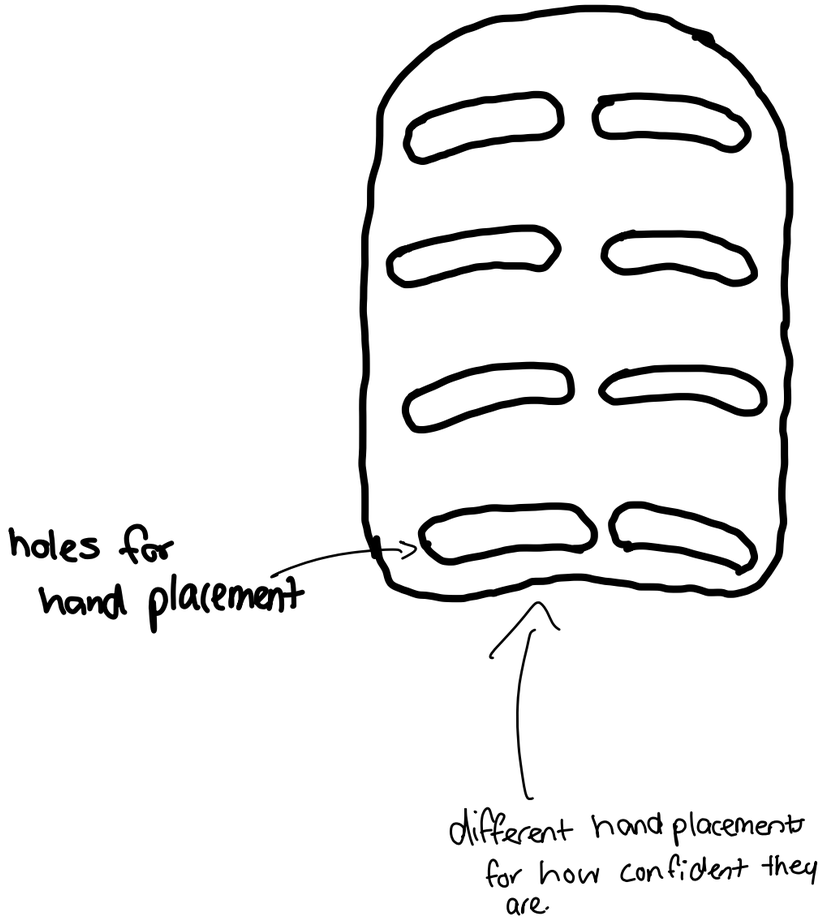


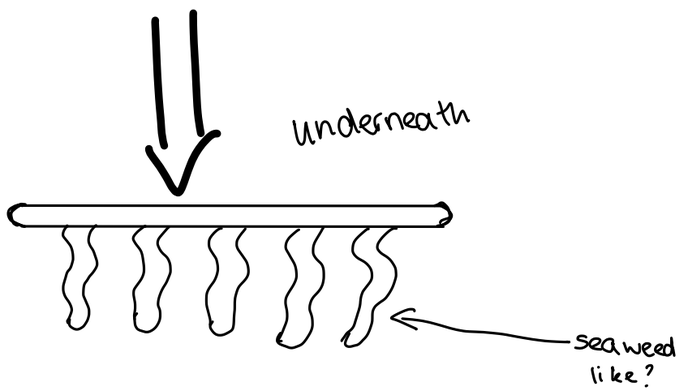
What you should be doing now

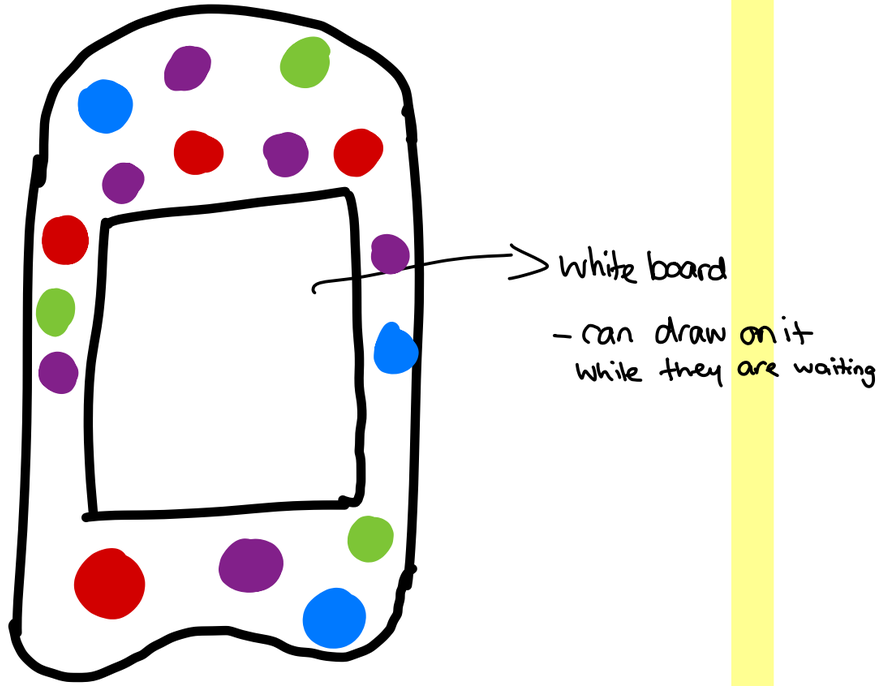
- research your topic
- benchmark existing products/ concepts
- decide how you will conducts your research
- reach out to participants
- conduct research

Emily Weatherall
N10779418

kick board initial concept development



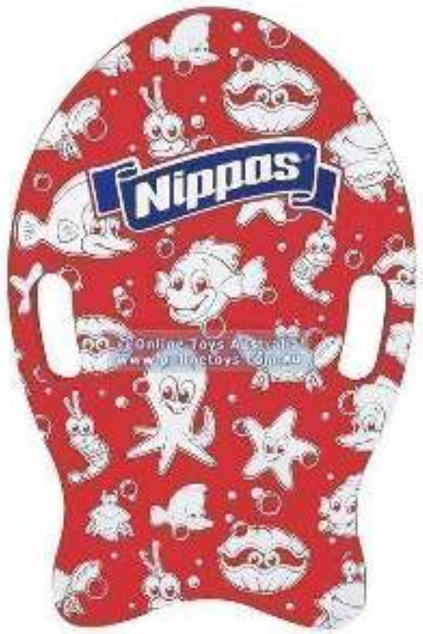




Emily Weatherall
N10779418

Current kick board design

usually used with kids 5+ or in squad.



good learning to hold on to the board

Emily Weatherall
N10779418

Equipment that kids bring to swimming

goggles

swimming caps

Swimming togs

towels

Emily Weatherall
N10779418

Equipment used in lessons

Divides lanes

Children Stand up on when they can't reach

Stored in here

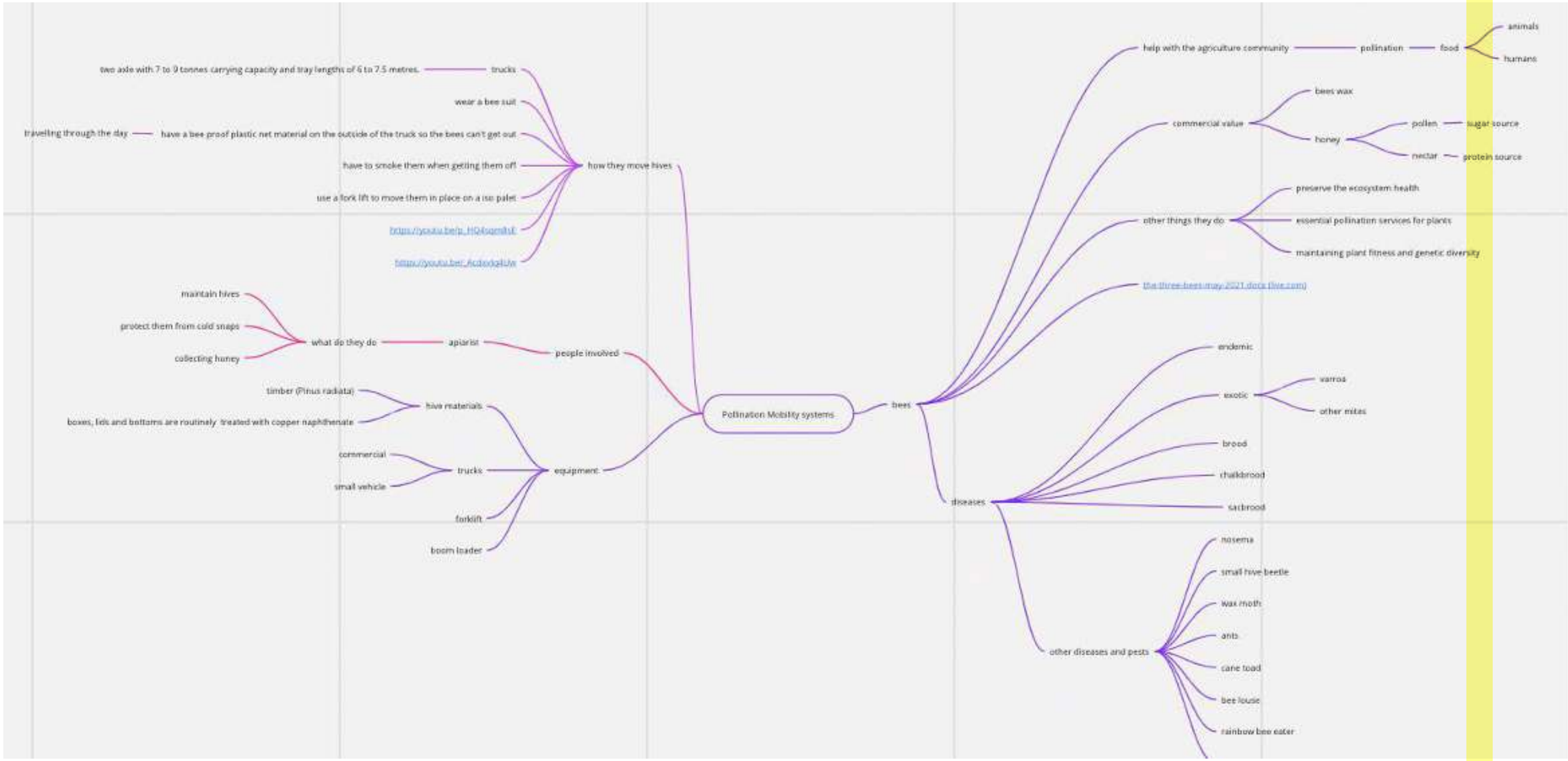
Used for kicking

toys used in lessons

Emily Weatherall
N10779418

Pollination systems

https://agrifutures.com.au/wp-content/uploads/publications/07-059.pdf



Current methods of transport

- loaded pretty high 2-3 hives stacked per palet
- strapped down
- uses fork lift to move them after driving

Types of hives

When they transport the hives it is easier to stack

Langstroth hive

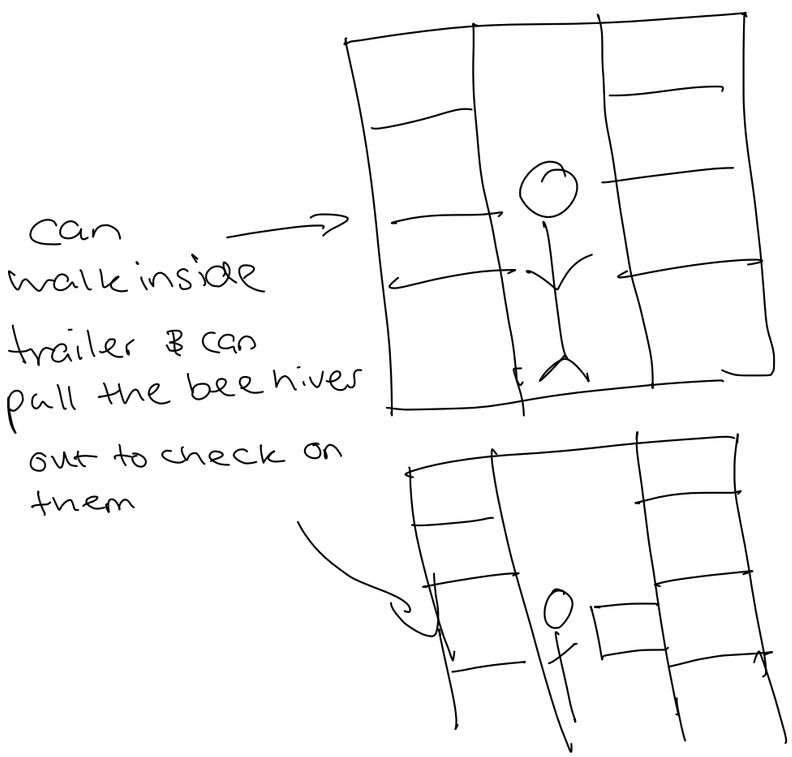
LD most common

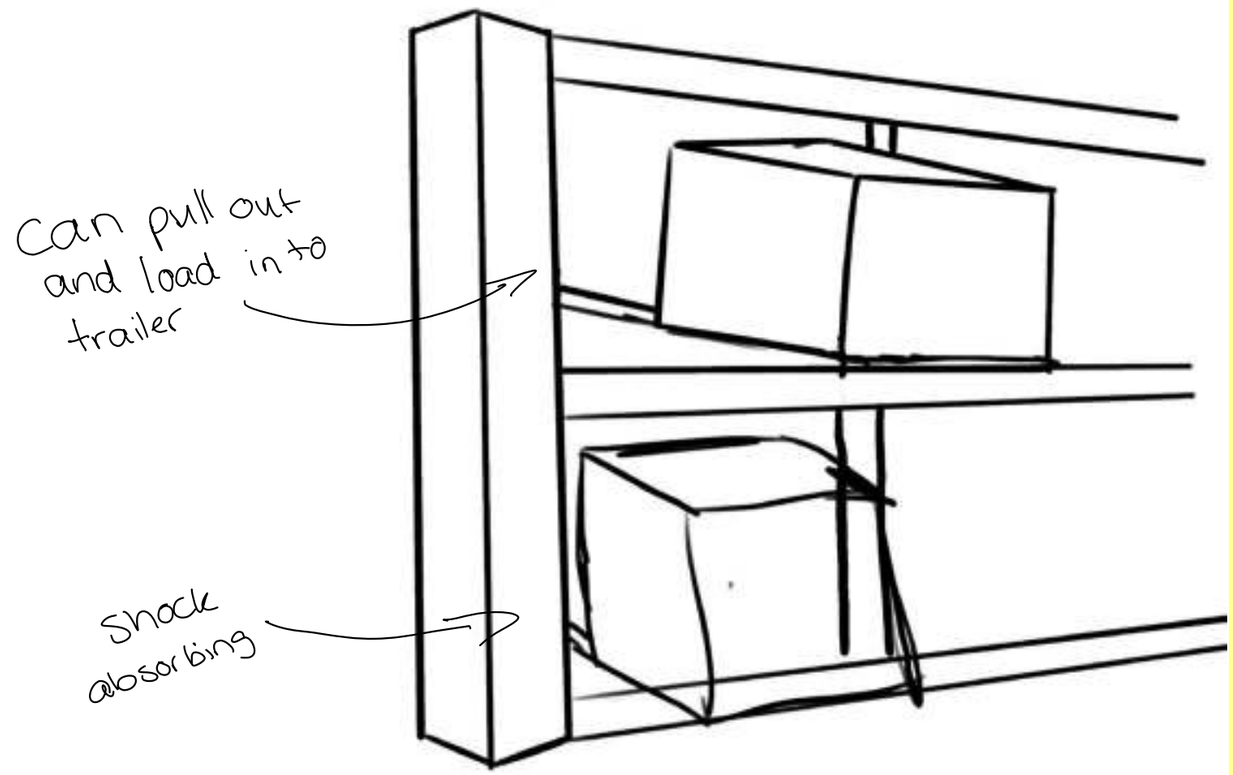
Warre hive

Top bar hive

Ideation 1

Problem: Movement of bee hives whilst transporting





surveys

- consent - need consent forms to conduct research and study
- can conduct with family or fiends prior to test out surveys - pilot study
- let research guide you
- ask the right questions
- element of good research - ethics of research, consistency across research group (surveys, interviews - conducting it the same way, consent form + questions + context + introduction)
- consistency of data collection - limitations (face to face and zoom) + inconsistencies
- observations - consistency - time of day, where, context, time when asking participants
- avoid leading the participants - instead of saying ‘ was that easy for you?’ say ‘ can you explain the difficulty level with this task’ - unbiased
- to get more info about a specific thing - ask if they can unpack of tell me more about
- have a general questionnaire - then can branch off into industry specific

industry

- make it look pretty - renders add people, context - materials aesthetically pleasing

Survey questions

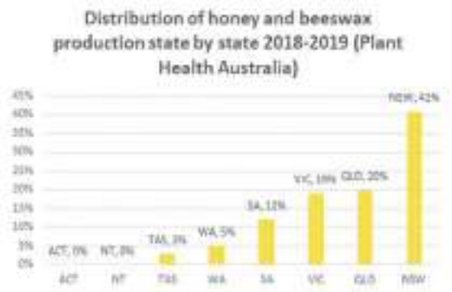
- How many bee hives do you own?
- What maintenance is required when bee keeping?
- Do you drive the trucks to the new sites
- How often do you collect honey during certain pollination seasons?
- When do you transport the hives?
- When transporting bee hives are there any losses of hives?
- What vehicle do you use to transport the hives?

Interview Qn's

- what steps are involved in loading bee hives on to trucks.
- What is the process once you reach the pollination site
- How do you keep track of the bee hives when moving them to different sites?

Bee keeping in Australia by State

Research



QLD

- https://qbabees.org.au/beekeeping-in-queensland/
- small industry
- has become a very popular hobby
- since 2017 the industry has increased in size by 114% with more than 9,200 beekeepers registered
- more than 6,600 beekeepers registered as keeping between 1-4 honey beehives
- beekeepers with 25-250 hives are commercial beekeepers
- more than 100,000 hives provide critical pollination service to qld farmers each year
- pollination for avocados, macadamias, almonds, melons, berries, cucurbits, stone fruits and seed crops from managed honey bees.
- avocado and macadamia pollination account for the majority of large-scale pollination events each year.
- Queensland produces approximately 69% of the total volume of avocados grown in Australia each year.
- crop pollination occurs between June and December in qld
- Commercial beekeepers migrate loads of 120 beehives at a time, from forest to farm gate providing critical pollination services to our farming friends.
-

SA

- https://saaa.org.au/about-the-saaa/about-beekeeping/
- Commercial apiary operations in Australia are migratory (meaning that the hives are shifted) due to different floral resources being available in different areas at different times of the year. In order for bees to be strong and healthy they must have access to a variety of pollen and nectar.
- During the winter, many apiarists move their bees to ‘wintering sites’. These sites are usually in a warmer and dryer environment where the bees can take advantage of pollen and nectar resources.
- Many of these hives are then transported to the almond orchards throughout the Riverland in readiness for the July-August flowering. Almond trees require cross-pollination by bees in order to produce almonds.
- Later in spring and into summer, hives may be moved to areas where there are stands of native trees to take advantage of nectar flows for honey production. Generally gums will produce most of their nectar when the weather is hot and sunny.

Research

TAS

- https://www.tasmanianbeekeepers.org.au/beekeeping-in-tasmania/
- European honey beens were first introduced in was in 1831
- industry produces bees wax and pollination services to the seed and fruit growing industries
- 2/3 of Tas honey production is from leatherwood production.
- the other 1/3 is clover, blackberry Manuka and gum
- the leatherwood flow is from early Jan to April and is the basis of the commercial industry in TAS
- Leatherwood grows in rainforests in south west areas of the state
- has a strong flavour and distinct aroma.
- unique to Tasmania and has a worldwide preutation as a distinct honey type

Production Sector

Production levels have peaked relative to available natural nectar resources. The following table shows the total number of beekeepers and hives per beekeeper for 2015-16. The figures are derived from official registration figures, and the great majority of these beekeepers are part-timers or hobbyists.

Statistic: **Number of hives per beekeeper, 2015-16**

Category	Hives	Beekeepers
1 - 5	532	170
6 - 22	735	56
21 - 50	1510	47
51 - 100	1510	47
101 - 200	937	11
200 - 1000	2670	7
1001+	10556	5
Total	**17656**	**254**

https://beekeepclub.com/keeping-honey-bees-safe-while-transporting-and-relocating-hives/#comments

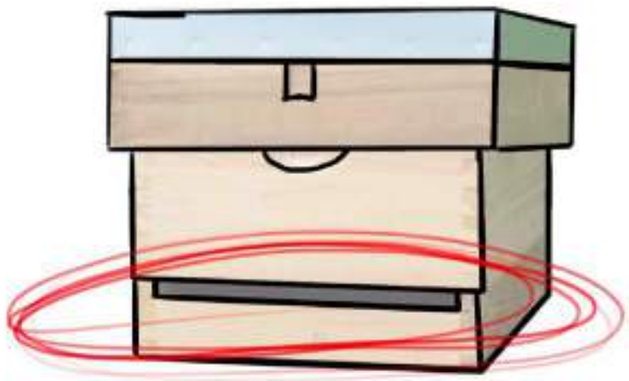
Moving hives

- Strap down the hives securely, and add some cushioning to minimize the jostling of the hives during the journey. Any stop during the trip will cause further disruption to the bees, so, if you are travelling a long distance, make sure the vehicle is roadworthy and has plenty of fuel.
-

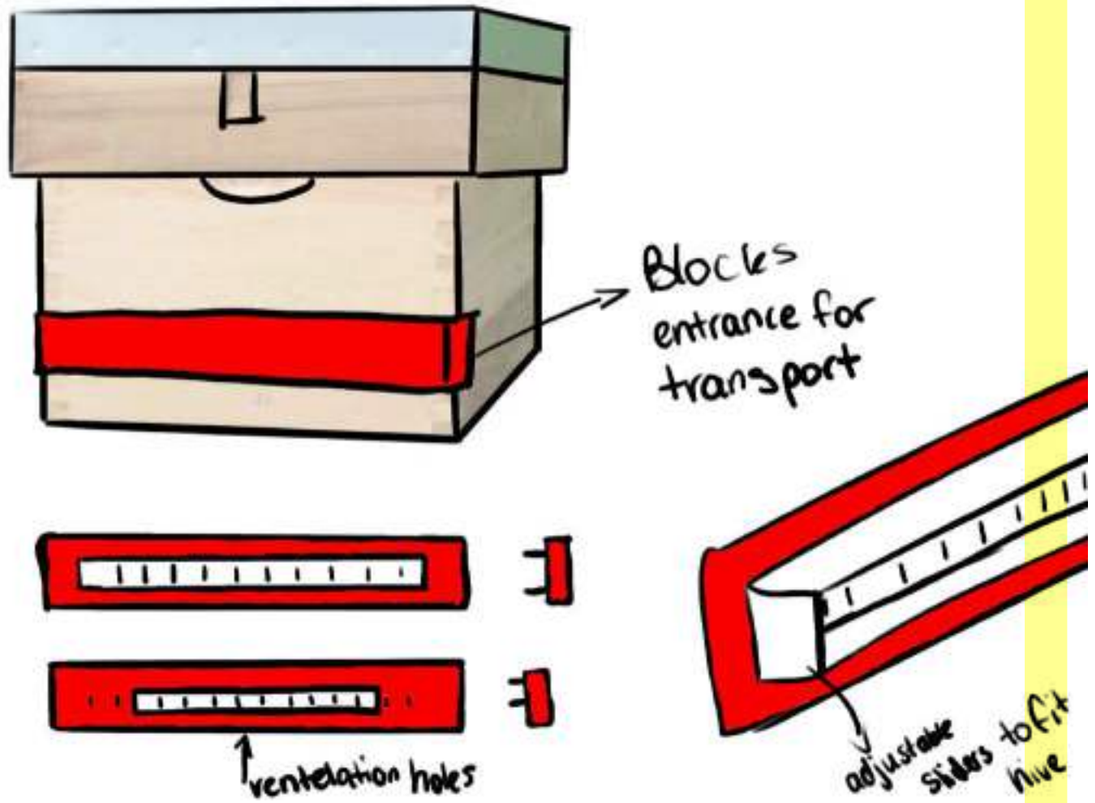
- must time the move perfectly.
- move at night
- keep the hives cool so they don't over heat
- Spraying water on the hives to keep cool
- using mesh travel screens - allows ventilation
- Bees are always in the hive at night
- Bee hive openings should be shut before moving
  - use duct tape so there are sufficient ventilation spots.
  - mesh with tape or staples / steel wool

Idea 2

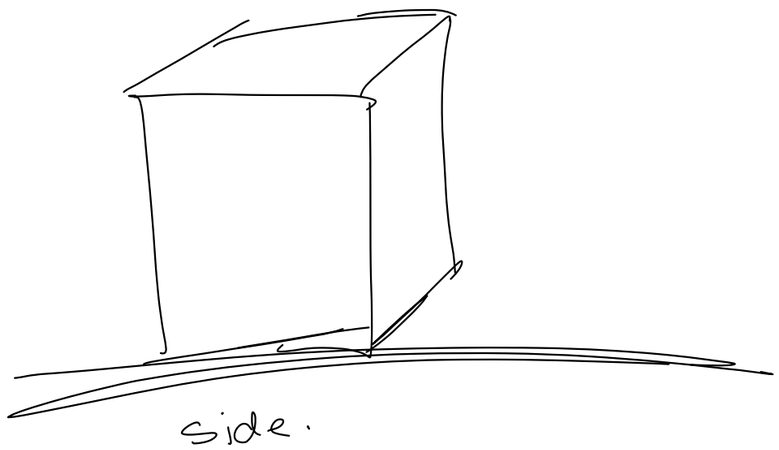
- Securing entrance holes to minimise wastage & reduce loss of bees



Currently using tape & steelwool to secure hole.

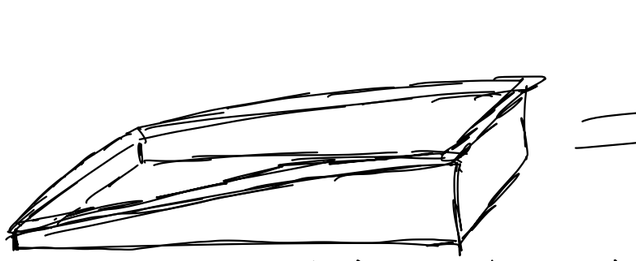


Portable hive tilter



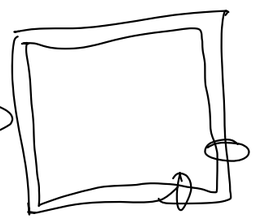
side.

— hive needs to be tilted when set up so that water can drain out from condensation.

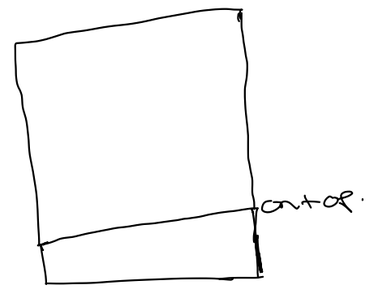


↳ sloped base board

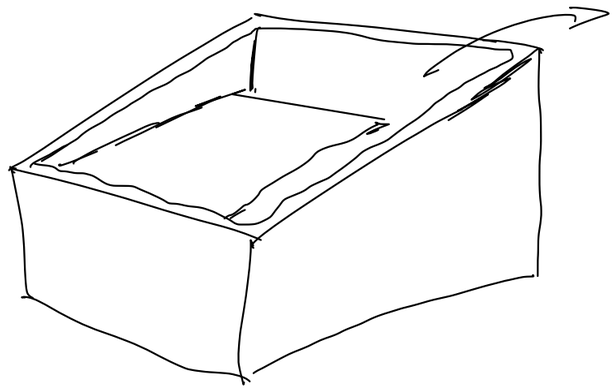
- plastic?



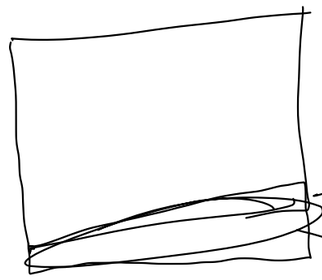
Sits on top



ontop.

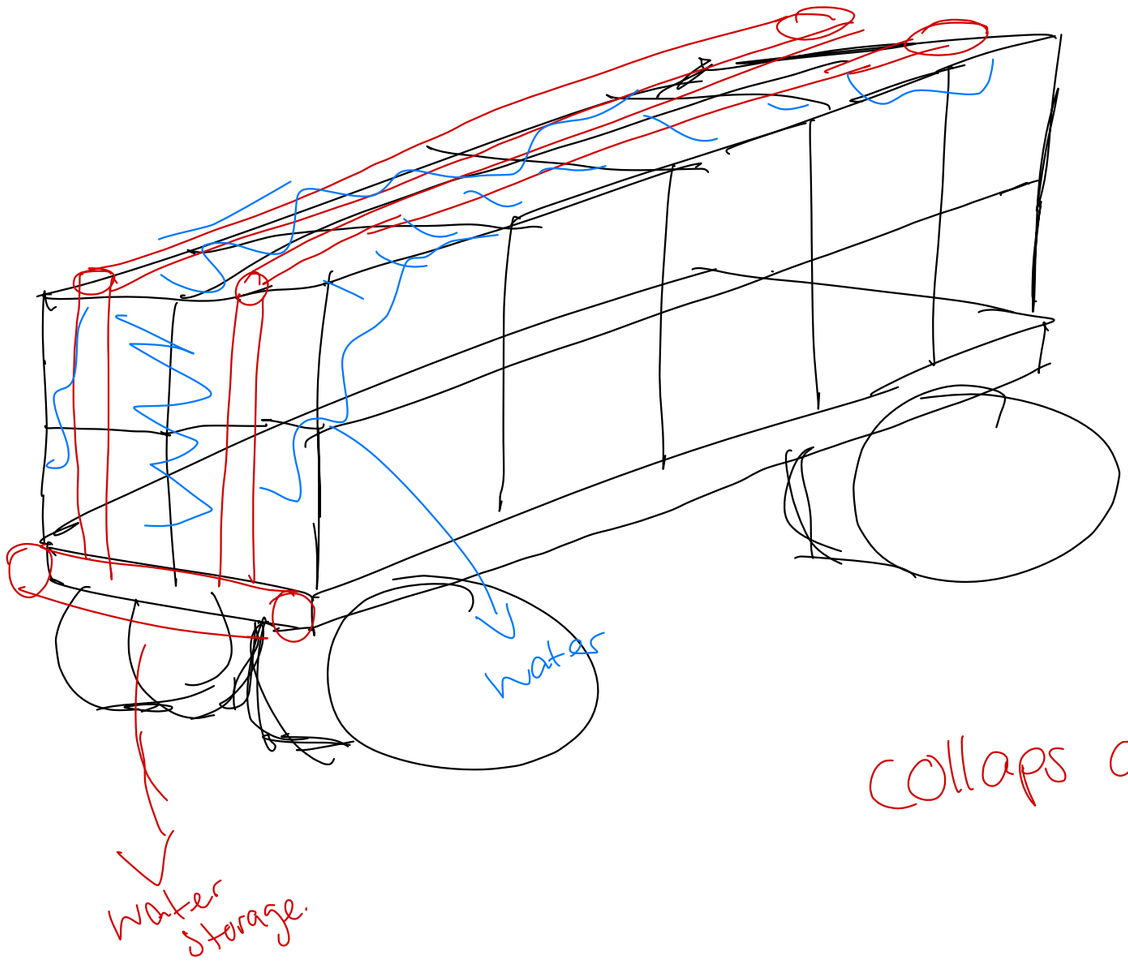


hive sits inside case.

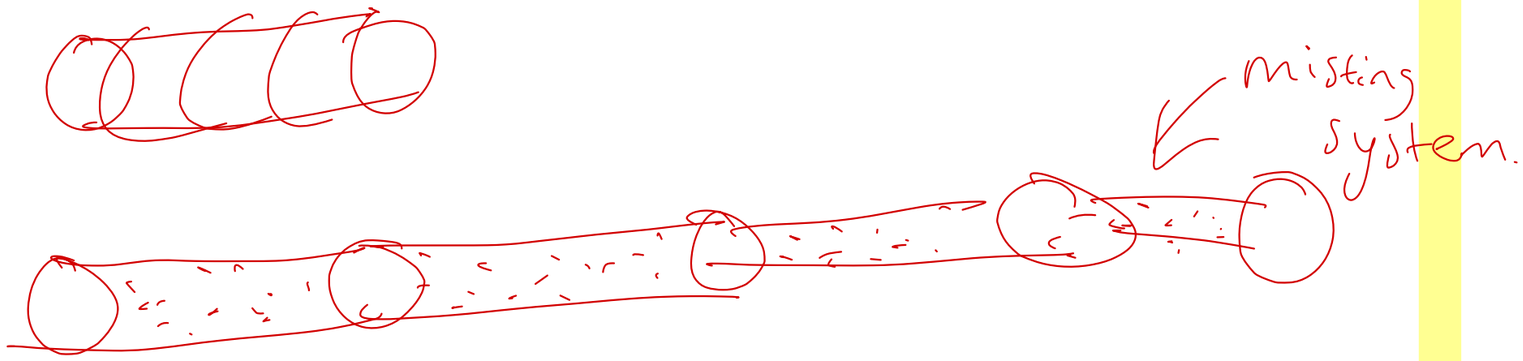


inside slight tilt.

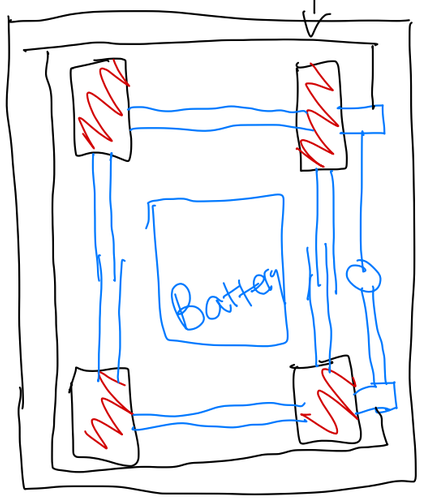
Water system.



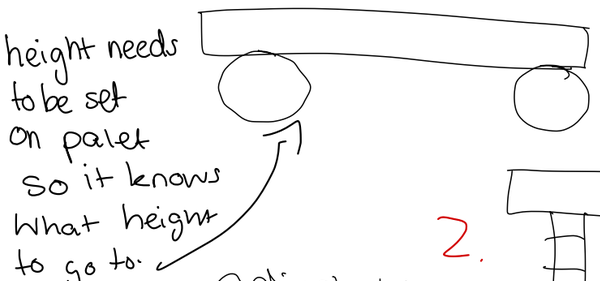
collaps able Pipe.

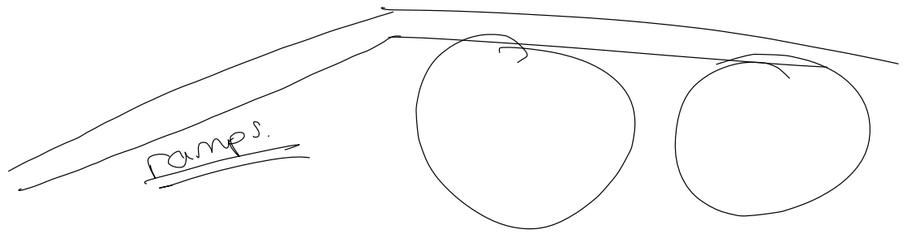


Pallet system

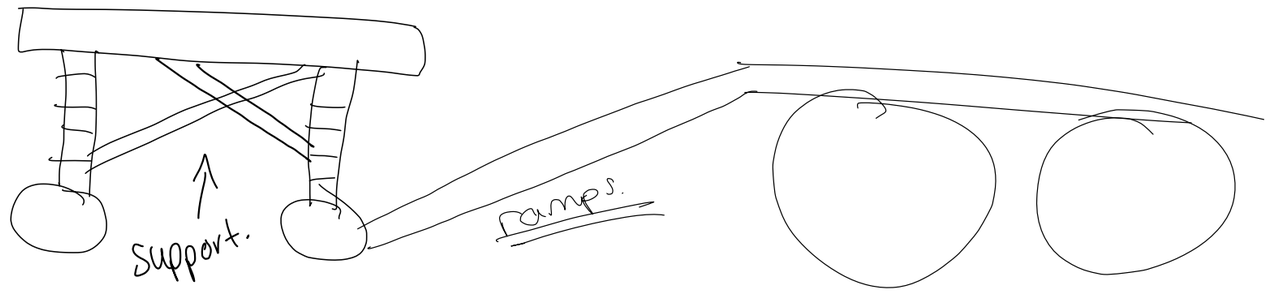


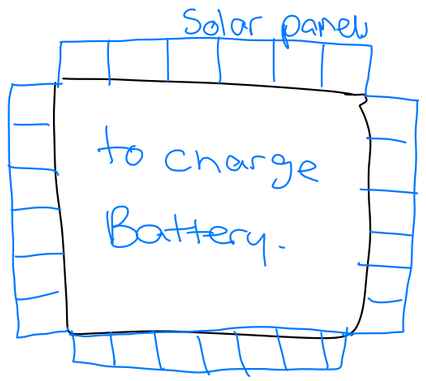
1.



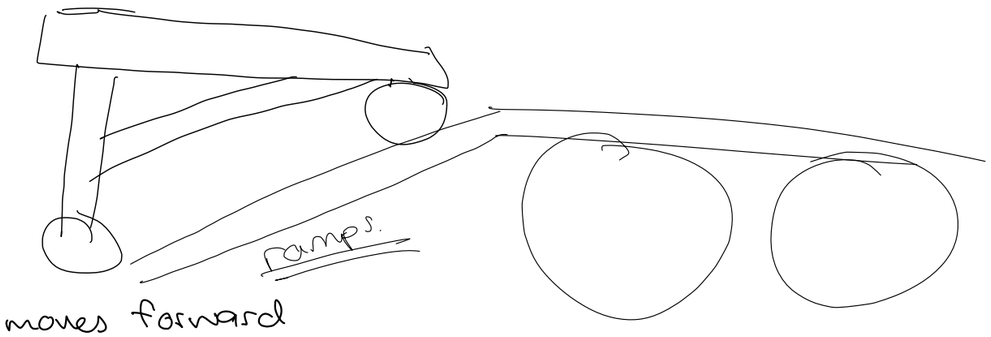


2.



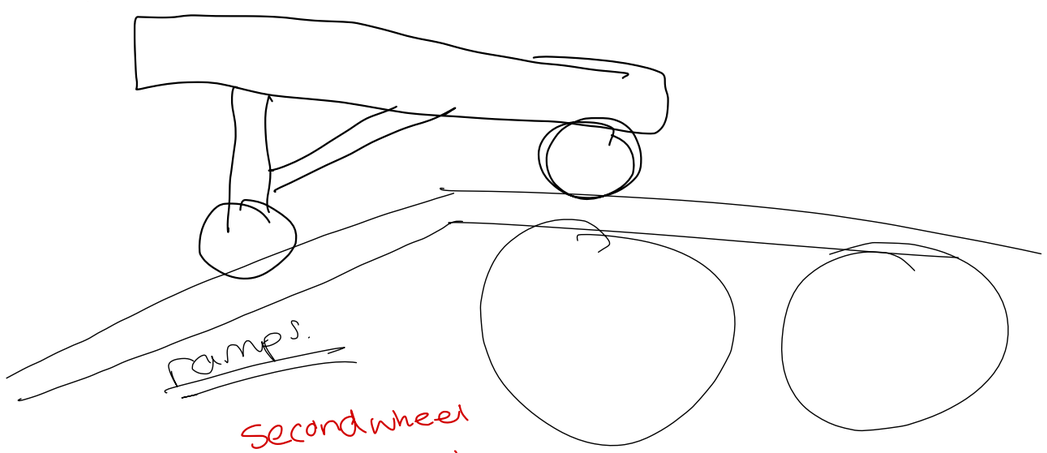


3.



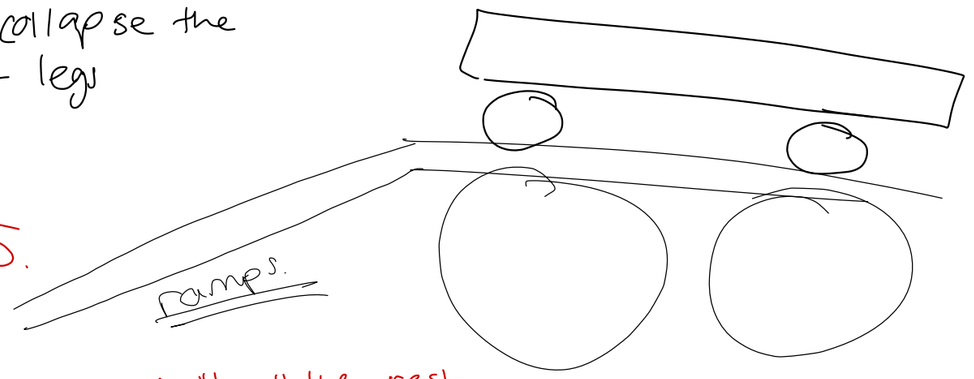
As it moves forward it will collapse the front legs

4.



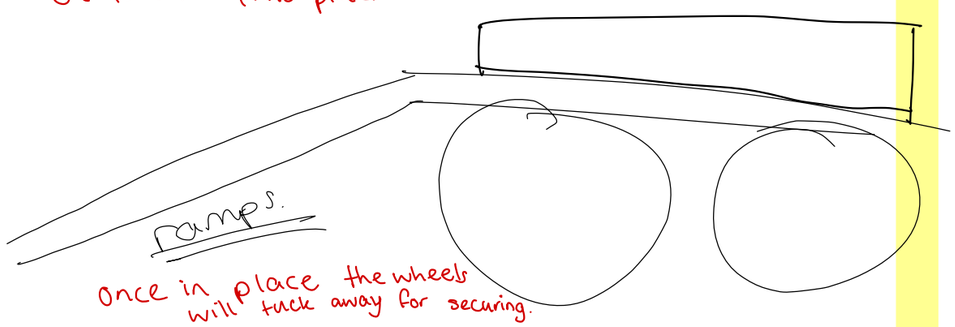
Second wheel will follow

5.



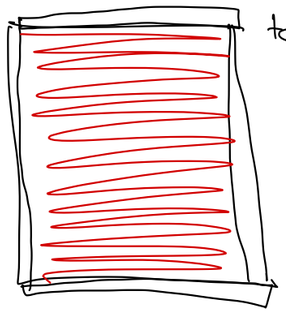
Will roll the rest of the way into place.

6.

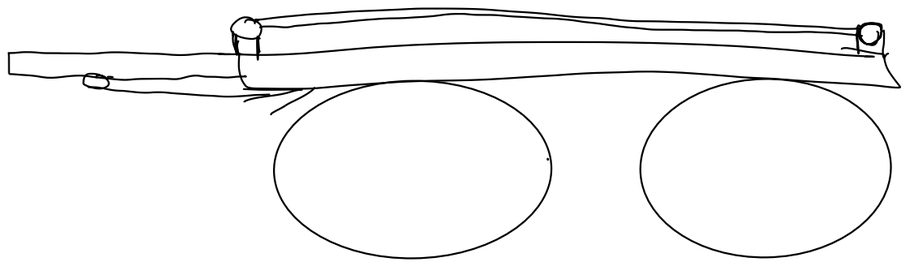


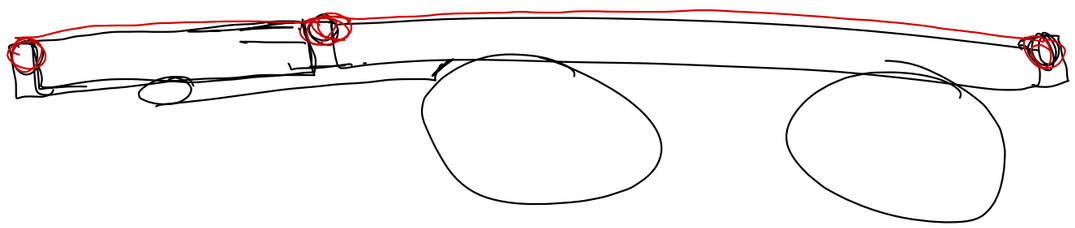
Once in place the wheels will tuck away for securing.

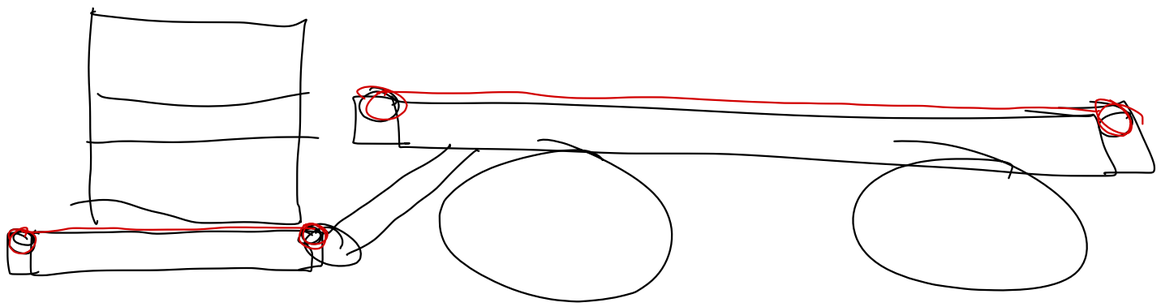
Conveyor Belt system

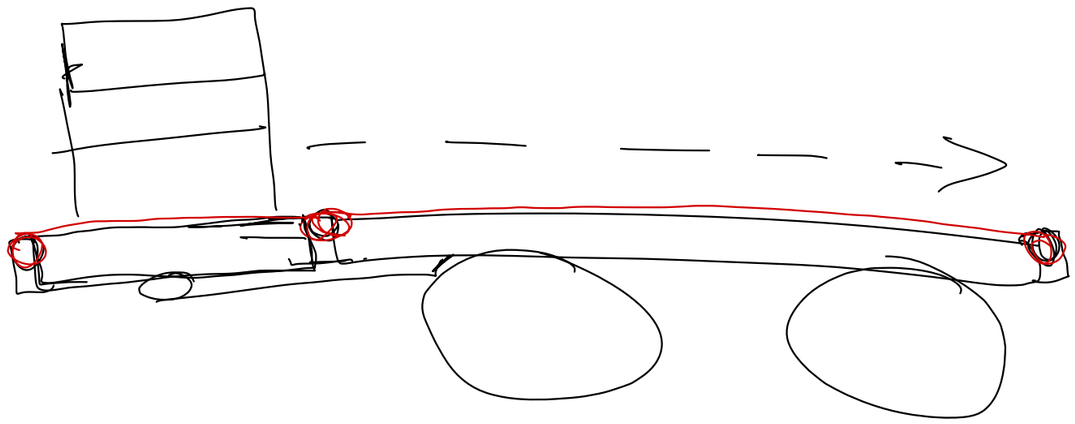


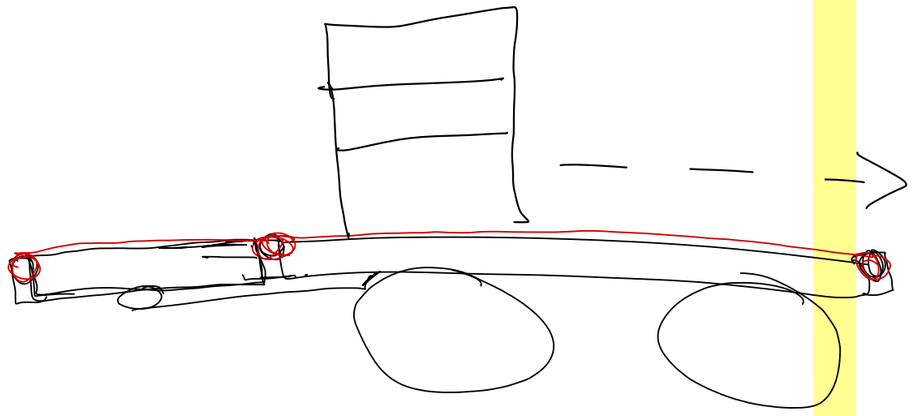
top view











What does an Apiarist do?

Though fresh honey is pretty great, you'd probably be too scared to get some from a hive of buzzing bees. That is, unless you're an Apiarist (or Beekeeper, as they're more commonly known). In this job, you get a natural high from this buzz as you care for bees and collect the honey they produce.

Since bees are fairly independent animals, the Apiarist's job of caring for them doesn't usually include providing clean water and plants to pollinate. Instead, Apiarists maintain hives, recapture them if they swarm, and help protect them against cold snaps. You might grow specific plants nearby for them to pollinate, but this is only necessary if you're trying to influence the taste of the honey, creating something exotic like lavender honey.

The main thing you're concerned with as an Apiarist is timing. Just like any farmed product, honey has a season for preparing and a season for harvesting. Beehives are usually set up in the winter, and then collection happens in spring. While honey is the primary product that comes from a hive, you might also collect honeycomb. You harvest by carefully opening up the hive and then cutting the tops off the individual combs to let the honey pour out.

While you're harvesting, you wear a long-sleeved, white suit which includes a mesh mask that covers your face. The color of the suit means you're not a predator, and the mask and long sleeves protect you from getting stung. Bee stings are an occupational hazard, so if you're allergic to bees, you should probably look for another job.

https://www.careermatch.com/job-prep/career-insights/profiles/apiarist/#:~:text=Maintain%20hives%2C%20harvest,more%20commonly%20known%29.

Research

Transporting honey bees (*Apis mellifera*) to provide pollination for agriculture is big business. Commercial pollination services maintain thousands or even tens of thousands of hives that are available for rent, and they deliver by the truckload all over the country. Hives may be moved multiple times and several thousand miles per year. Researchers at North Dakota State University and the U.S. Department of Agriculture are studying how honey bees are affected by the environmental stresses they face during transportation. (Photo credit: Wikimedia/Pollinator, CC-BY-2.5

https://entomologytoday.org/2019/04/01/road-trip-hive-transportation-stress-honey-bees/

When we think about going on a road trip honey bees probably don't come to mind, but bees spend a surprising amount of time on the nation's highways. Most of our food production by weight consists of just a few species of wind-pollinated grains, but more than 80 percent of crop species, including almost all fruits and vegetables, require some kind of pollinator. For this reason, transporting honey bees (*Apis mellifera*) to provide pollination for agriculture is big business. Commercial pollination services maintain thousands or even tens of thousands of hives that are available for rent, and they deliver by the truckload all over the country.

Deborah Melcher, Ph.D.

Growers have a narrow window to provide intensive pollination. Many pay commercial beekeepers to transport hives by truck to saturate their fields during the bloom. Most crops bloom during a brief, seasonal period that may be as short as couple weeks, and they need intensive pollination during this time to be profitable. Commercial pollinators can pollinate crops all over the country by taking advantage of variation in growing seasons. Hives may be moved multiple times and several thousand miles per year.

Bees have received a lot of attention recently, and for good reason. They face challenges from parasites and pathogens while demand for pollination services increases annually. The practice of transporting hives is monitored by state and federal agencies who release annual reports regarding the health, winter survival, and inventory of the nation's honey bees. While some research focuses on transporting hives, we found very little work has been done specifically investigating the effects of the road trip on colony stress and survival.

A colony may see the sun set in North Dakota and rise in California. In the intervening time, bees are confined in their hives, loaded onto trucks, and transported long distances at highway speeds, sometimes through mountain passes on the way to the West Coast. Hives meant for pollination are often staged in bee yards until they are needed and are moved again.

In research published this week in *Environmental Entomology*, colleagues and I at the U.S. Department of Agriculture's Edward T. Schafer Agricultural Research Center, in collaboration with North Dakota State University (NDSU), investigated transportation stress while bee hives are in transit to identify sources of stress that may affect survival and pollination ability. Collaborators on the study included Elisabeth Wilson and Julia Bowsher at NDSU, George Yocum and Joseph Rinehart at the USDA Agricultural Research Service, and Steve Peterson at AgPollen LLC. Through our study, we found that colonies experienced cold stress during shipping, with smaller colonies especially vulnerable.

Honey bees are one of the few insect species that can thermoregulate much higher than ambient temperatures. They do this through coordinated social behavior, and they have evolved to rely on stable, warm temperatures between 32-35 degrees Celsius (about 90-95 degrees Fahrenheit). Deviations from this range are stressful. Above this range a colony will quickly suffocate and die. Below this range, colonies often survive, at least for a time, but cold exposure in developing brood may cause developmental abnormalities. Commercial pollinators favor increased airflow because the consequences of a hive that overheats are immediate and obvious. Our research found, however, that smaller colonies lost their ability to thermoregulate the hive, and some never recovered. Smaller colonies also experienced a significant loss of population and had much lower long-term survival. Large, robust colonies maintained hive temperature and experienced less population loss.

My colleagues and I measured changes in stress response before departure, immediately after arrival, and after a two-week recovery period, using gene expression as indicators. We found that genes associated with chill stress, immune function, defense response, and methylation increased after the hives were relocated, which all decreased after the recovery period.

According to the Bee Informed Partnership, there are around 2.67 million honey bee colonies in the United States. Many of these colonies are used for agriculture, providing a vital service essential for a diverse and affordable food supply. There are many other potential sources of stress during transportation. While this study focused on cold stress, changes in barometric pressure, humidity, turbulent airflow, diesel exhaust, and vibration are also potential directions for research. Small sources of stress may have large consequences, especially if they are persistent or repeated (like noisy neighbors or trying to sleep with a mosquito in the room). Stress during transportation can be reduced with new or updated management practices, and this may have the additional benefit of allowing honey bee colonies to survive other challenges.

from imperial to metric produces awkward figures and are usually rounded off to whole numbers: using 20mm thick timber, 10 frame = 505mm x 405mm; 8 frame = 505mm x 350mm; full depth = 240mm.)

Full depth is the most popular depth for both brood nest and honey supers. Even when honey supers of another depth are used, the brood nest is nearly always a full depth.

Hives comprising a full depth bottom box, either 10 frame or 8 frame, and smaller size honey supers are common. The smaller size honey supers are usually WSP or Ideals. A few beekeepers use WSP size honey supers filled with Manley frames. Manley frames have wider end bars than standard frames, thus making eight Manley frames a snug fit in an Australian 10 frame box, resulting in plump, easily un-capped combs.

The all full depth 8 frame hive is popular and is used extensively in Victoria, and to a lesser extent, in New South Wales and Western Australia. The all Ideal size 8 frame hive is popular in Tasmania. All WSP or all Manley size hives are used, but are not common. A few beekeepers use an all 12 frame full depth hive.

Lids and Bottoms

Many commercial beekeepers make their own lids and bottom boards.

Migratory lids with a 50mm rim, either ventilated or not, are probably the most popular. They usually consist of a wooden rim and a hardboard or marine ply top, depending on whether or not they are covered with galvanised or Colorbond metal. It is common to paint lids white to reduce heat. Flat wooden lids cleated at the ends are common, and less commonly, flat covers with end cleats that extend downwards for 30mm or so over the ends of the top box. Telescopic lids are far less popular than formerly, but are still used in Tasmania.

Most beekeepers use an inner mat of some kind to discourage bees from building burr comb in the lid.

Common materials include heavy gauge plastic sheeting, hardboard and vinyl floor covering. Some beekeepers build an inner cover into the migratory lid, leaving a 10mm space between the inner cover and the top bars of the frames.

Bottom boards usually consist of a wooden riser of anything from 10mm to 50mm, with 22mm perhaps the most common. The bottom itself is made generally of either galvanised metal, timber or marine ply. Some beekeepers that move their hives on pallets build the risers directly onto the pallet. Whilst many bottom boards are still fitted with an entrance closer, the practice appears to be diminishing. Both fixed and loose bottom boards are used.

Queen Excluders

Queen excluders are used on the great majority of hives. They are less common in Tasmania where beekeepers using Ideal size boxes depend on the principal honey flow to push the queen out of the honey supers. The most popular excluder by far is the metal bound wire model.

Moving Hives

Trucks

Commonly, trucks are two-axle with 7 to 9 tonnes carrying capacity and tray lengths of 6 to 7.5 metres. Beekeepers that consistently operate close to home are more likely to have smaller trucks of 4 to 6 tonnes.

Local working conditions also influence the size and type of truck used. For example, some beekeepers working in large areas of sandy soil as found in South Australia favour four-wheel drive trucks.

Nearly all commercial beekeepers have a small vehicle for running around – either a utility (often with a limited-slip differential and long range fuel tanks) or a small diesel truck or a four-wheel drive of some kind.

The largest outfits use powerful trucks with a sleeper-cab, bogie drive and long range fuel tanks. Such a vehicle, when towing a tri-axle pig trailer can carry, say, 360 hives of bees on pallets, around 1,150 empty 10 frame full-depth supers or over 700 supers of honey. Its total length is likely to be 19 metres and its range around 1,400 km. It would carry a fork-lift of some kind.

Loaders

Almost all commercial beekeepers use a mechanical loader of some kind; mostly a forklift when hives are on pallets or a boom loader when hives are not on pallets. A few beekeepers wheel hives onto a powered tailgate, then wheel and lift them into position on the truck.

Skid-steer forklifts of the Bobcat type are popular, as are non-skid forklifts of one kind or another. Small tractors or four wheel drive vehicles converted, usually by the beekeeper, to forklifts are still in use, and commercially made non-skid forklifts are also available. The non-skid types are preferred by some beekeepers working in sandy country and by other beekeepers who consider them to be more environmentally friendly. Forklifts are either carried on the truck or towed on a purpose built trailer.

The range of types and brands of boom loaders has something of a regional bias. Regular loaders mounted immediately behind the cab are popular in New South Wales. Centre or rear mounted split booms are popular in New South Wales, Queensland, South Australia and Victoria. Powered tailgates are used by some beekeepers in Victoria and Tasmania. Western Australian beekeepers traditionally used gantry loaders, although boom loaders are also used. A few beekeepers have adopted hydraulic lifters.

Boom loaders are often employed when under-supering, prior to robbing.

Hive fasteners of some kind are widely used. The Emlock type, with stainless steel strapping, is probably the most popular.

Open Entrance

Hives are generally moved open entrance. When travelling during daylight the load is usually covered with a bee-proof plastic net.

On long hauls, beekeepers sometimes opt to not use a net but to stop shortly after dawn and let the bees fly off the load during daylight hours and resume the journey at dusk. To exercise this option it is important that the day-long stop be reasonably close to water and reasonably far from people.

It is probable however, that in the majority of moves the hives are loaded at dusk, the move is completed during the night and the hives unloaded at dawn.

Harvesting Honey

Robbing the Hives

From their beginning in early 1992 the packer Leabrook Farms would not accept honey that had been removed from hives by the use of chemical repellents. A few months later the Honey Corporation of Australia followed suit. Thus in a period of only a few months most commercial beekeepers abandoned all chemical methods of harvesting honey and adopted physical ones.

The most common method by far is the use of escape boards or clearer boards, as they are also known. Most beekeepers under-super with sticky combs, place the escape board above the stickies and return in twenty-four hours and remove the supers of honey. If escape boards are left in place too long robbing may occur.

Conditions permitting, many beekeepers place the removed super of honey on top of the hive (or on the previous hive, to make it easier) to allow any remaining bees to return to the hive.

Bee blowers are also commonly used to remove any bees still remaining in the supers. Some beekeepers prefer to make only one trip to the apiary to harvest honey, and use a bee blower only.

A few beekeepers rob by shaking bees off individual combs. These are more likely to be those using mobile extracting plants, though not exclusively.

For beekeepers extracting in central premises (most beekeepers), an additional expense is ensuring that the supers of honey stacked on the truck, or truck and trailer, are both bee-proof and dust-proof. Most beekeepers have purpose-built trays on which to stack supers and either spare lids or purpose-built covers.

Extracting Honey

Most of Australia's honey crop is extracted in central extracting premises, though mobile plants, many of them very efficient, are still in use. In South Australia for instance, a number of mobile plants have Quality Assurance accreditation. But, the trend for the past 50 years has been to central extracting. Bear in mind though, that some beekeepers always extracted in a central plant.

Honey extraction is a highly mechanised process; and since commercial extracting machinery is now made overwhelmingly of stainless steel, it is also a hygienic one.

Uncapping machines are in universal service, whether extracting in a central or a mobile plant. There are a handful of popular brands, all reliable and all effective. It is usual to have a conveyer to take the uncapped combs from the uncapping machine to the extractor or extractors.

Whilst there are still semi-radial extractors in use, radial extractors are more commonly used. Radial extractors, with a vertical shaft, were made in 42 and 72 and 100 frame sizes.

Vertical shaft extractors, whilst popular and effective, have the inherent disadvantage of requiring loading

https://agrifutures.com.au/wp-content/uploads/publications/07-059.pdf

4. Equipment

The equipment used by commercial beekeepers throughout Australia is fairly uniform. Full depth Langstroth hive bodies, either 8 frame or 10 frame, are most popular, with 10 frame outnumbering 8 frame.

Most hives are moved on diesel trucks and the longer the distances regularly travelled, the bigger the truck and the more likely that the truck will tow a trailer. Almost all hives are loaded mechanically.

Most hives are fitted with a queen excluder and are robbed with the aid of a bee blower or an escape board.

Honey is most commonly extracted in a central location in highly mechanised stainless steel extracting equipment.

Bulk honey is marketed in 1,000 litre intermediate bulk containers (IBCs) by the larger producers and in 200 litre closed head drums by smaller producers.

Packers encourage suppliers to enter into quality assurance schemes, as does the federal industry organisation, the Australian Honey Bee Industry Council (AHBIC).

Hive Materials

As beekeeping enterprises grow the need for uniformity of hive material becomes more important. There are advantages in having combs and boxes that are interchangeable, partly for easier hive manipulation but also to achieve standardised loading patterns on trucks and trailers and standardised extracting procedures.

For a commercial beekeeper the resale value of the enterprise is also an important consideration. Thus there is pressure to match the sizes and designs of one's material with those commonly used by other commercial beekeepers.

There is no standard hive size and configuration in Australia. Perhaps the most common is an all 10 frame full depth size, with a metal-bound wire excluder over the bottom box, a 50mm deep migratory lid and a bottom board with 22mm risers. Most beekeepers use nine frames in a ten frame box.

Make or Buy?

Traditionally beekeepers whiled away the winter months making and repairing hive material. However, due to big increases in enterprise size there is no longer the down-time in winter that there once was, hence beekeepers buy more material these days, even though modern wood working equipment makes the job easier.

Most woodware now comes from New Zealand, with its abundant supply of high-grade, kiln dried *Pinus radiata* (even when most woodware sold in Australia was made in Australia, the timber from which it was made often came from New Zealand).

Some beekeepers still make their own boxes. Tasmania is cited as an ideal location for do-it-yourself box making because of the availability of suitable quality timber and the beekeeping annual cycle allows sufficient time to manufacture equipment with existing labour.

Plastic or Timber?

Plastic frames and boxes have so far failed to displace wooden hives and hive parts. In the Northern Territory plastic cleats are sometimes used on bottom boards to help protect against termites. Plastic comb foundation is making a more serious challenge to beeswax foundation. Many commercial beekeepers, particularly those using different depth supers to bottom box, use both types of foundation. Beeswax is sometimes favoured in the brood nest because the bees more readily accept it and plastic is used in the supers. Some beekeepers paint molten beeswax onto plastic foundation to make it more acceptable to the bees. A paint roller is handy for this job.

The Australian designed plastic queen cell cup has been an outstanding success and is widely used throughout the country.

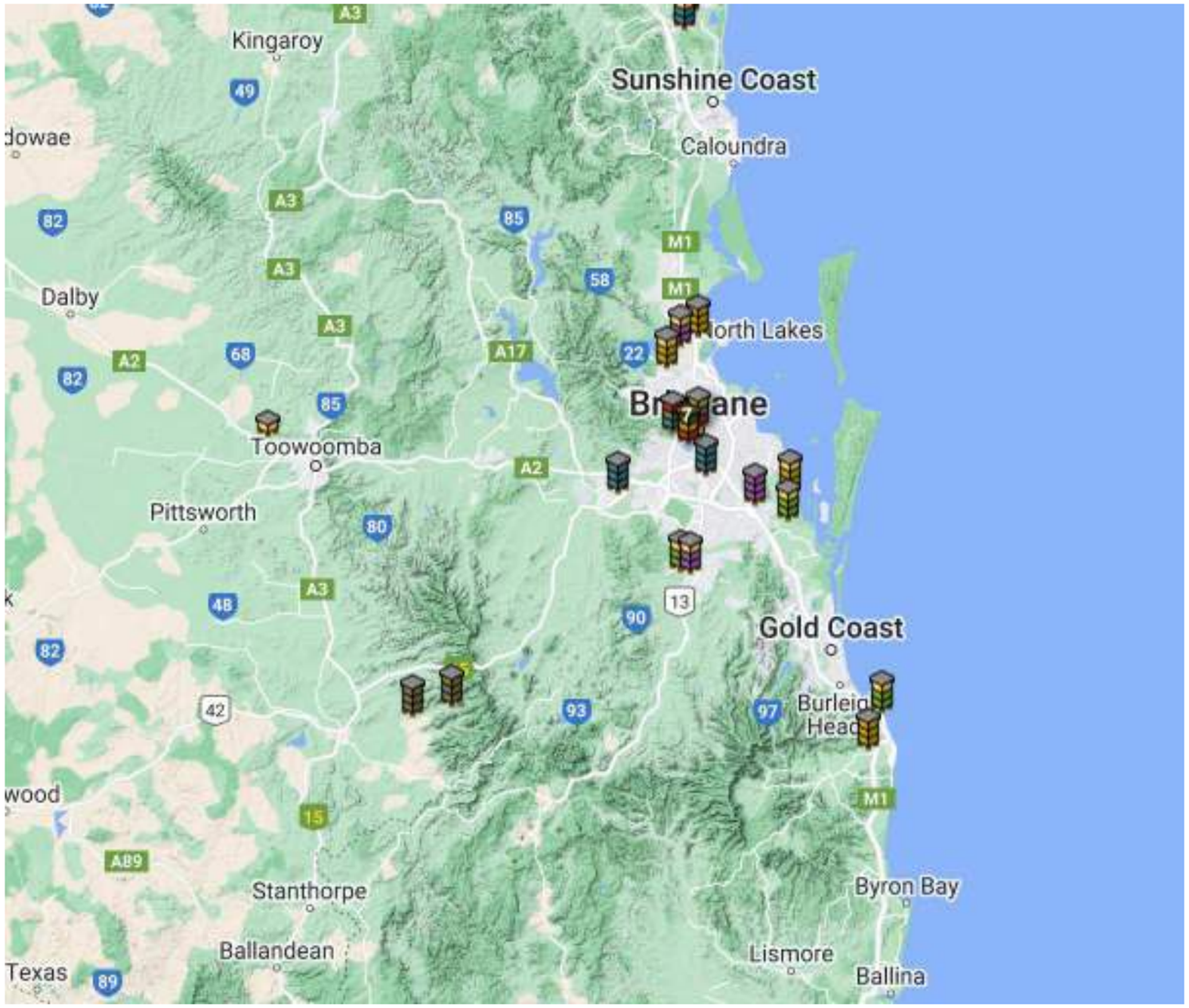
Preservatives

The majority of boxes, lids and bottoms are routinely treated with the wood preservative copper naphthenate prior to painting. Dipping boxes in hot paraffin wax is an alternative method of preserving boxes, though it is relatively uncommon.

Boxes

Using ⅞ inch thick timber, Australian ten frame hive bodies measure 20 inches by 16 inches, and eight frame hive bodies 20 inches by 13⅜ inches. (Exact conversion of these dimensions

https://agrifutures.com.au/wp-content/uploads/publications/07-059.pdf


Kingaroy
Sunshine Coast
Caloundra
Dalby
Toowoomba
Pittsworth
Gold Coast
Burleigh Head
Stanthorpe
Ballandean
Byron Bay
Lismore
Ballina
Texas
A3
A2
A17
M1
49
82
85
58
22
68
80
48
90
13
42
93
97
15
AB9
89

1. How many hives do you have?

More Details Insights

0-10	11
11-25	3
26-40	4
41-60	4
61+	27

2. What type of hive design do you currently use?

More Details

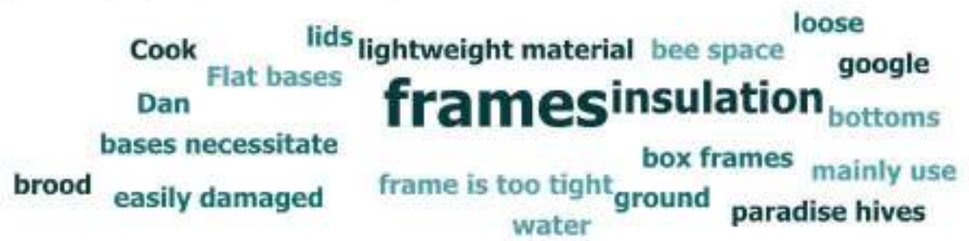
Self made hive	0
Langstroth hive	46
Warre hive	0
Top bar hive	0
Other	3

3. Do you think there are any faults in the current design of the hives that you have?

More Details Insights

Yes	11
No	38

3 respondents (**30**%) answered **frames** for this question.



5. Do you have any recommendations that could be applied to the hives?

More Details Insights

13
Responses

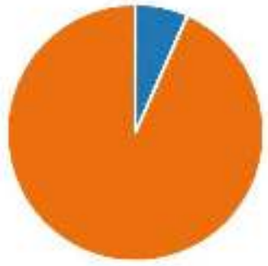
Latest Responses
"No"

2 respondents (**15**%) answered **hives** for this question.

11. When transporting the hives, are there any hive losses during the process?

More Details Insights

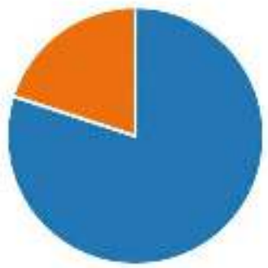
Yes	3
No	42



12. Do weather conditions affect the transportation of bee hives?

More Details Insights

Yes	36
No	9



17 respondents (**45%**) answered **Cool** for this question.

14. When transporting hives larger distances, what are the main concerns that arise during the process?

More Details Insights

42
Responses

Latest Responses

"Keeping them cool and not on the truck any longer t...

"N/A Max distance 1hour "

5 respondents (**12%**) answered **hives** for this question.

15. How do you cover the entrances of the bee hives, so they don't escape during transit?

More Details Insights

42
Responses

Latest Responses

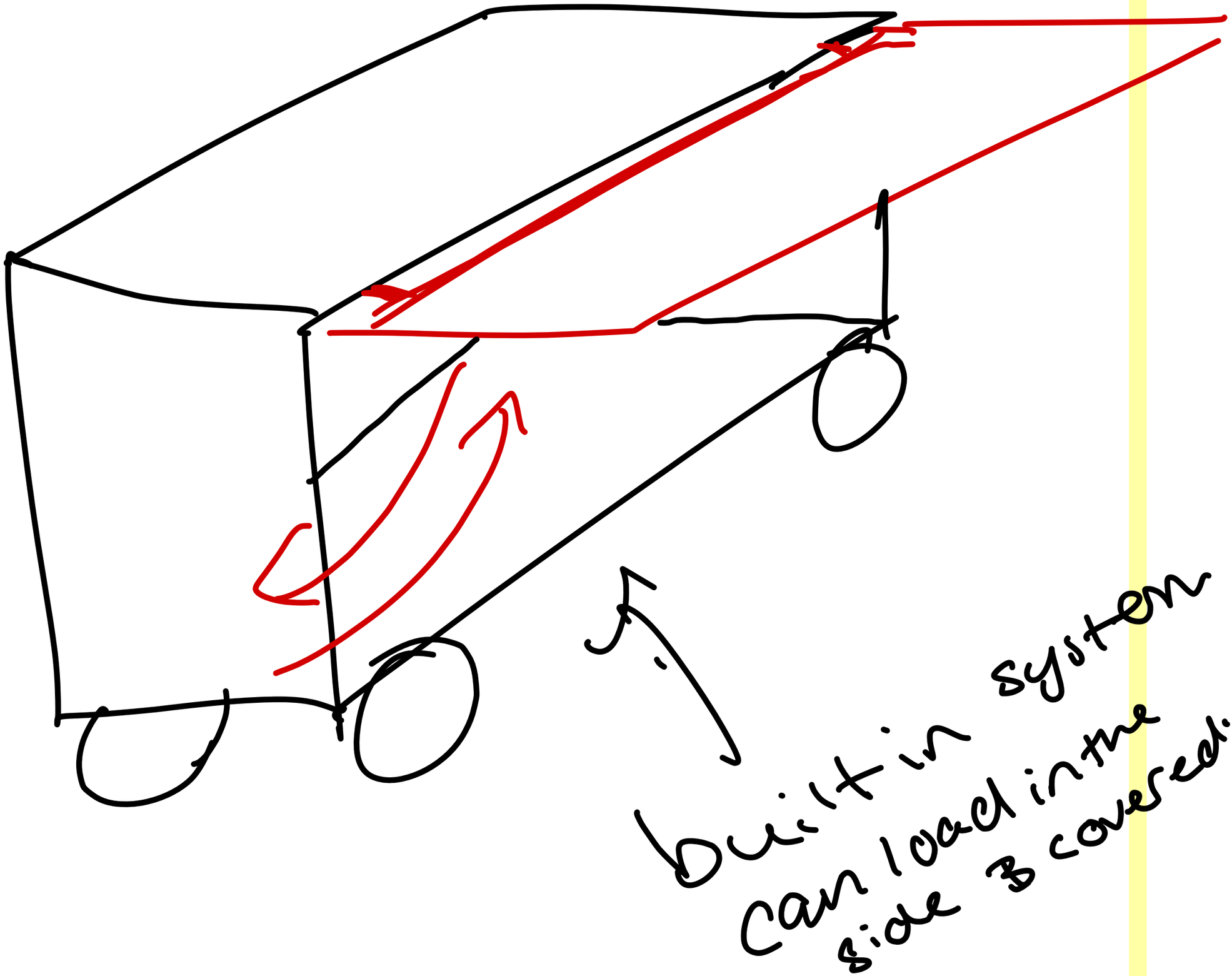
"I use Nuplas hives, which have doors that slot over th..."

"Net them"

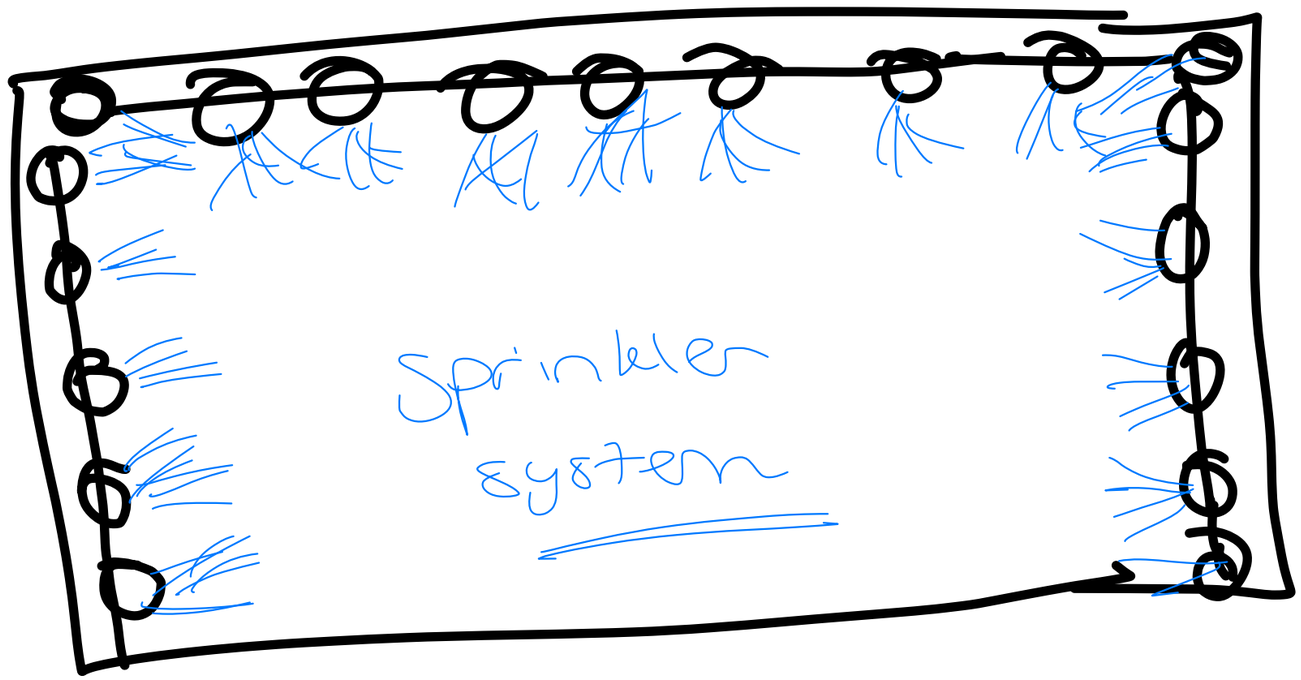
"Hive Closer and tape"

...

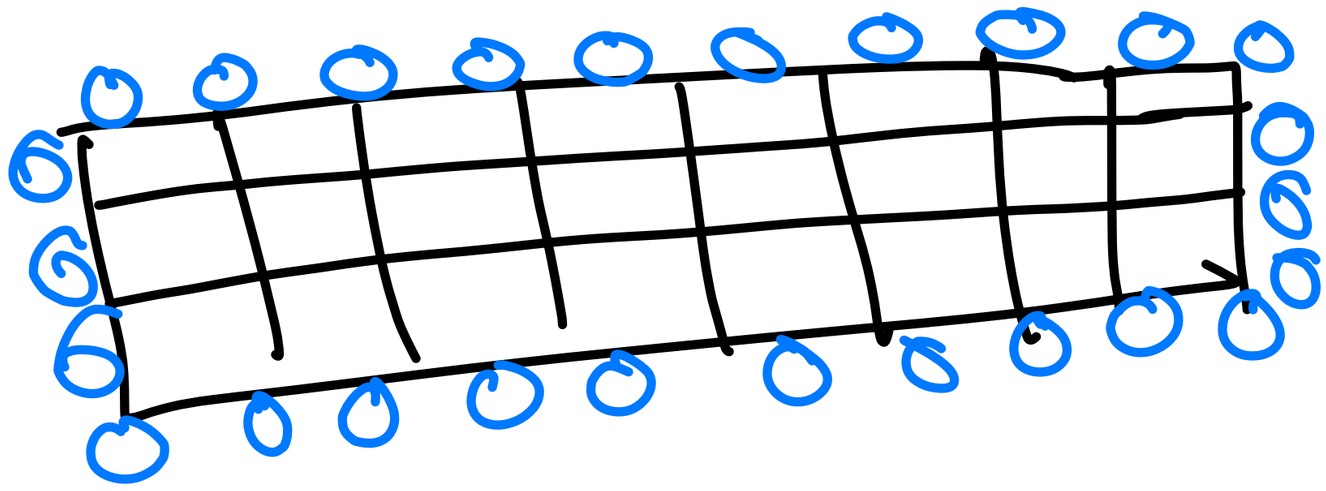
12 respondents (**29**%) answered **entrances** for this question.

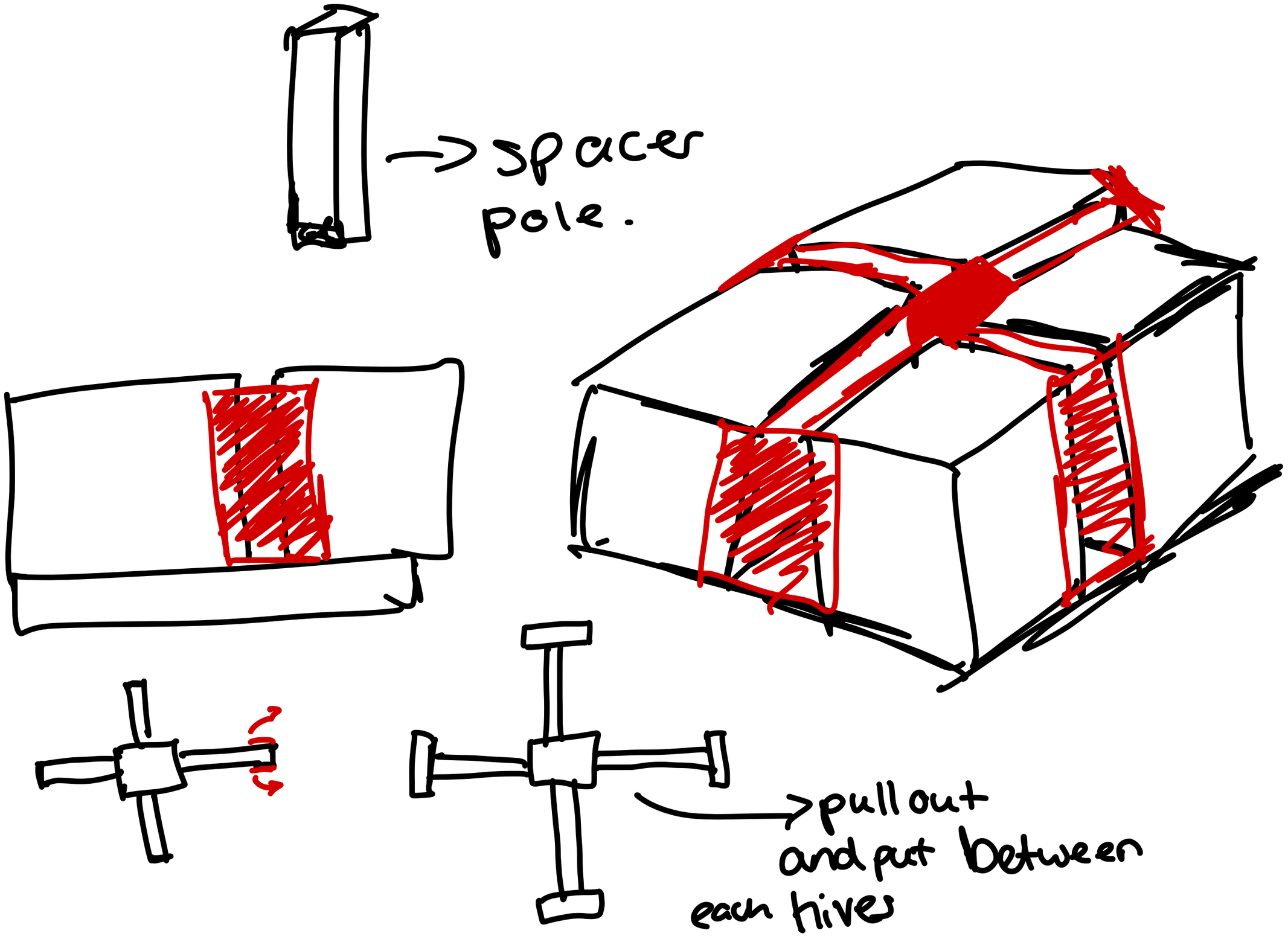

built in system
can load in the
side 3 covered

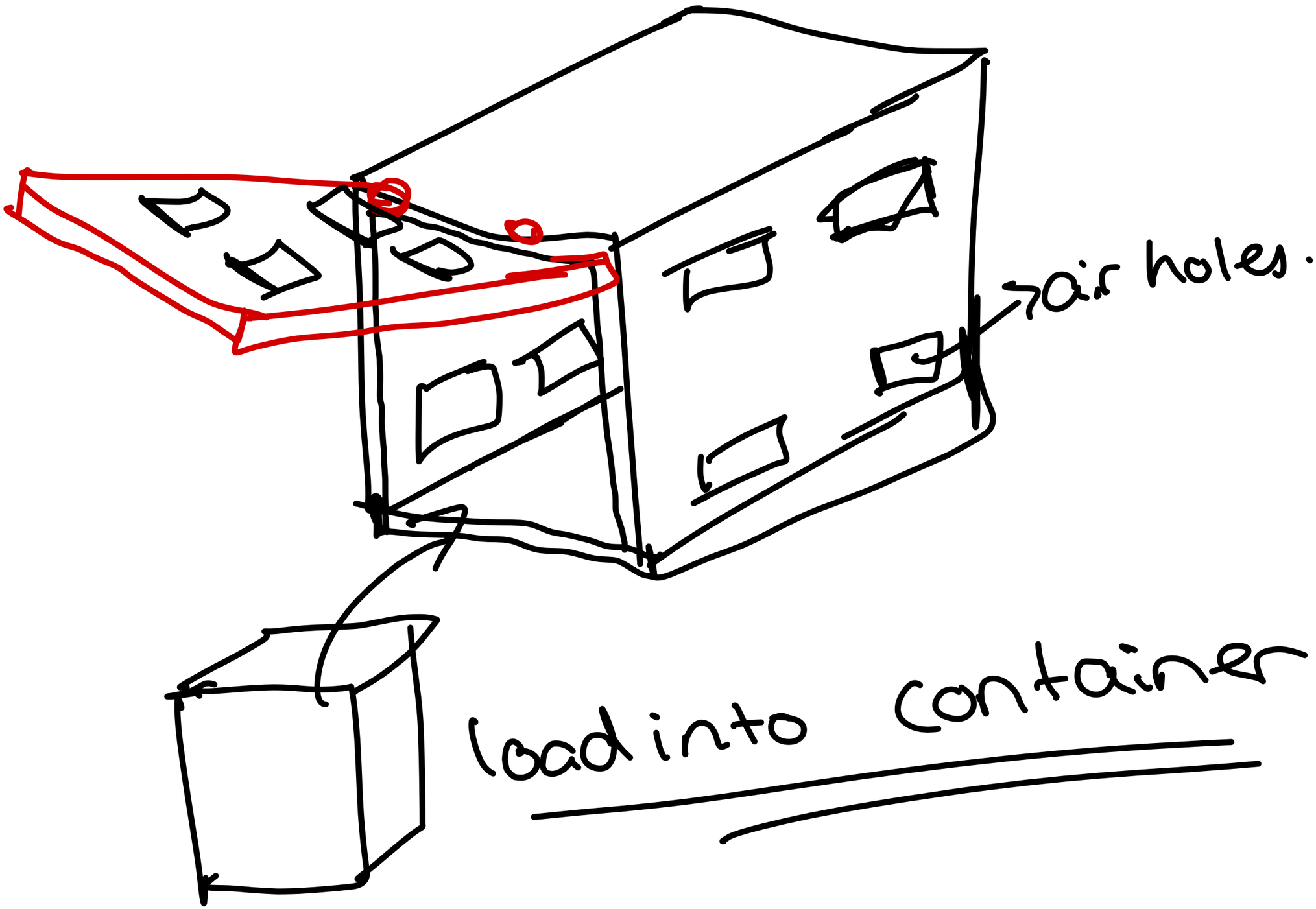
inside truck →



top view with bee hives. →




spacer pole.
pull out and put between each hives


air holes.
load into container

1. Has your vehicle got stuck (bogged) whilst transporting hives?

More Details

2. Can you elaborate on your answer?

More Details

3
Responses

Latest Responses

"A few times in the last 19 years. Never fun."

"4x4 and common sense goes a long way. "

"My truck gets bogged regularly but I can't afford a 4x4 truck Always f...

3. What materials are your hives made out of?

More Details

3
Responses

Latest Responses

"Timber and plastic "

"Finland Polly hives there lighter and I can carry more. "

"I have timber plastic and foam hives"

4. Have you tried other materials for the hives that you didn't like ? Please elaborate why you don't use them now

More Details

2
Responses

Latest Responses

"Polystyrene. The dimensions of the box aren't standard "

"Only timber I like timber its cheaper to make but they are a lot heavie...

5. How do you secure your hives for transportation?

More Details

3
Responses

Latest Responses

"Truck straps. And emlocks to pallets "

"Ratchet straps"

"Put up the gates and strap with pallet corners so I don't have to strap...

6. How do you prepare your hives for transport?

More Details

3
Responses

Latest Responses

"Smoke em and load em up."

"Not adding any supers two weeks away from mover you want to avoi...

"I normally close my hives of a night and get to the site within a coupl...

7. Once arrived at pollination site, how do you unload the hives?

More Details

3
Responses

Latest Responses

"Gently"

"Ezyloader "

"My truck has an easy loader crane"

8. How long roughly are your hives at a pollination site?

More Details

3
Responses

Latest Responses

"Honey producer'

"4 to 6 weeks depending how long the grower has payed for. '

"3-4weeks'

9. If the hives are at the pollination site for a longer period of time, do you go have to check on the hives?

More Details

3
Responses

Latest Responses

"Yes'

"No as the go 3 high. I might do a drive by if I'm bored '

"Early spring i generally check to make sure they don't swarm '

10. What do you do to a hive when it gets a disease or pest?

More Details

3
Responses

Latest Responses

"Fix it'

"Rip it out if in doubt. '

"Lots of different options depending on what the problem is from ign...

11. When at the pollination site and a hive has a disease or pest, what happens to the hive when transporting it back? Please elaborate.

More Details

3
Responses

Latest Responses

"Depends on the pest or disease. Either way deal with it properly. '

"Poison it at night and send for radiation. '

"The pests and diseases are not normally associated with pollination b...

12. How do you keep the temperature of the hives consistent/cool whilst transporting them?

More Details

3
Responses

Latest Responses

"Drive at night'

"I don't close hives. Just net them and drive at night. '

"My bases are ventilated '

13. Have you tried insulation for the hives to control the temperature of the hives? Please elaborate

More Details

3
Responses

Latest Responses

"No'

"No never have 40 mm thick is insulation enough. '

"I have some polystyrene hives however they are not as robust'

14. How far away do bee hives need to be separated when placed at pollination site?

More Details

3
Responses

Latest Responses

"Na'

"4 on a pallet meter away from the next. '

"It depends on the orchard '

15. Is there a limit of how many hives can be placed in the same area of site? Please elaborate if you can

More Details

3
Responses

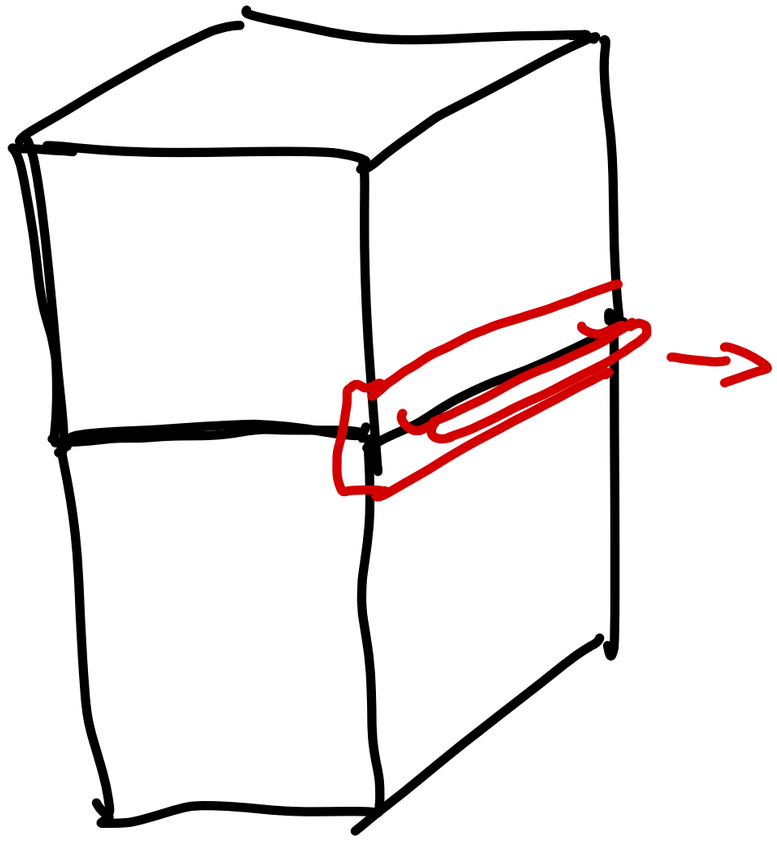
Latest Responses

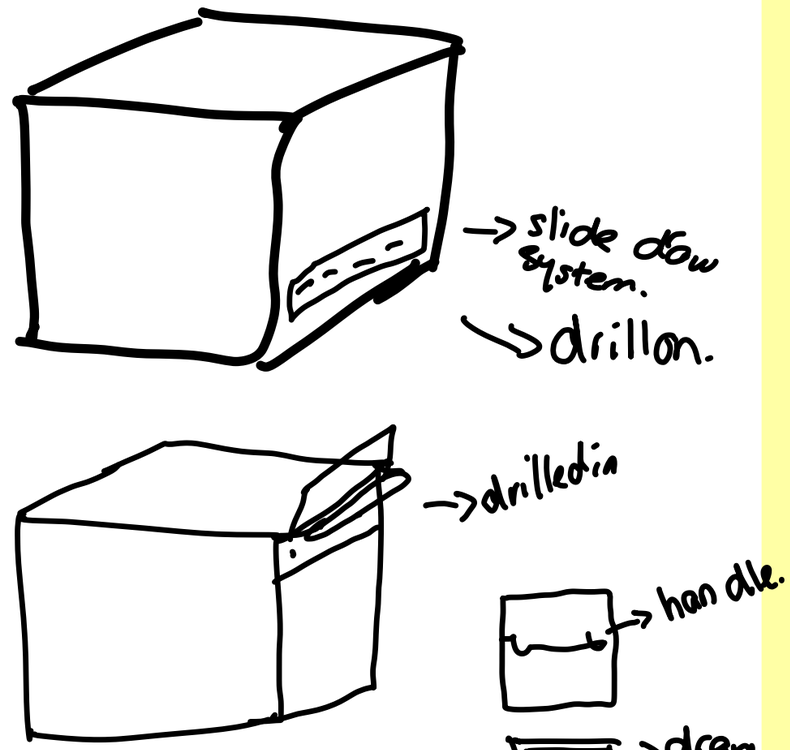
"N/a'

"I do two hundred a load never had any complaints '

"Each pollination has a recommended stocking rate per acre. This can ...

Temperature is a critical factor in colony health and is actively managed by *A. mellifera* using heating and cooling behaviors to maintain a stable nest temperature close to the ideal of 35°C, and within the range 32–36°C (Tautz 2008, Stabentheiner et al. 2010). The maintenance of "hive homeostasis" is a good indicator of colony health, state, and even pupation activity at a comb-cell level (Tautz et al. 2003, Becher and Moritz 2009, Meikle et al. 2015, 2017, Abou-Shaara et al. 2017).





keeps hive together + handle system.

https://www.cell.com/heliyon/pdf/S2405-8440(19)35593-8.pdf

4.1. Design recommendations and future ergonomics research considerations

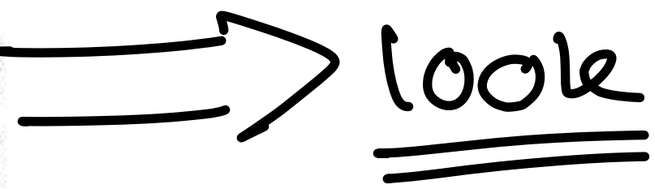
Understanding common beekeeping inspection practices and identifying ergonomics issues within them seems to be straight-forward tasks. However, developing solutions to these problems that would be acceptable and easy to use is a difficult task due to the resistance to change or technology attitudes that seem prevalent among the three beekeepers in our study. Some design suggestions arising from the case studies are:

4.1.1. Technological

a. Hand holds/handles could be fitted around the entire box and have clearance for the hand to wrap around to ensure good coupling for lifting (Lehto and Landry, 2012). Added or redesigned hand holds should not add much more weight to the box.
b. Construct boxes from lighter materials and/or investigate efficiency and efficacy of smaller boxes. In addition, alternative hive designs or infection control processes to reduce the frequency of physical inspections but maintain or improve hive health could be considered. Lighter materials must be able to withstand various weather conditions as well as protect the bees from extreme heat and cold conditions.
c. Integrate lift assist systems specific to the varying conditions used in frame inspection processes. Common lift mechanisms include manual pulley systems, and mechanical/pneumatic hoist systems. Efficiency will be an important consideration for this solution.
d. Examine the applicability of common manual-materials handling techniques for manual lifting such as use of an abdominal belt, reducing the frequency of lifts, providing training in safe lifting techniques and proper posture, and restricting the hive-heights to waist height (Bridger, 2017).
e. Develop a frame holder system so that frames can be placed in it and then turned for inspection. The system could also integrate a magnifier to support visual inspection of brood. The magnifier must be considered in conjunction with the visual obstructions associated with the mesh netting on the protective head gear.
f. Consider new smoker design (e.g., chemical, electronic) to remove smoke and fumes.
g. Develop or integrate a simple magnification system for inspecting brood.

4.1.2. Management

a. Investigate the relationship between current hive management and bee health.
b. Prepare and disseminate occupational health and safety training.
c. Investigate opportunities and venues to transfer individual/local innovations to the wider community beyond local workshops or club meetings, and an individual's online contributions.



2.7.3. Impacts of hive design

Colony temperature variation from the optimal impacts several stages of the honeybee lifecycle, but most critically, the brood stage, which is very stenothermic (depending on a narrow range of temperatures). Brood reared at ±1.5°C from ~35°C (32°C in Tautz et al.'s 2003 study)) demonstrated cognitive impairment, suggesting links between the development of the Central Nervous System (CNS) during the brood phase and temperature, leading to impaired development of the CNS and subsequent degradation of neural functions such as memory and cognitive ability (Groh et al., 2004; Tautz et al., 2003; Moritzet al., 2009; Stabentheiner et al., 2010). Meikle et al. (2017) found links between internal temperature and colony health, with temperature variation amplitudes linked to brood quantities; essentially indicating that honey bees maintain a stricter temperature control when a large amount of brood is present, demonstrating brood requires tight thermal control for correct development (Meikle et al., 2017). Brood temperature and humidity are more actively controlled for workers than drones, demonstrating a high degree of homeostatic granularity based on location within the colony (Li et al., 2016; Stabentheiner et al., 2010). Temperature stress caused during transportation has been cautiously linked to colony mortality rates, with

2.8. Sensing Technology

The monitoring of beehives has been an area of recent innovation with the application of common off-the-shelf components being used to measure the hive micro-environment, weight, sound and even count the number of bees moving to and from the hive (Bordier et al., 2017; Jiang et al., 2016). With the advent of easily accessible Wireless Sensor Networks (WSN) and Internet of Things (IoT) platforms, beehives are going online to share their data (Edwards-Murphy et al., 2015a 2015b, 2016; Jiang et al., 2016; Kridi et al., 2016). Measurements are used to sense changes in hives that have correlating activities, such as hive weight to monitor forager movements to and from the hive, honey stores and swarming activity or sudden changes in microclimate indicating that a hive has been opened, is absconding, or is suffering from severe disease or pest incursion (Zacepins et al., 2016).

Temperature is one of the most commonly used measurements, providing details on the colony's health and even providing data on pupation activity at a comb-cell level (Becher & Moritz, 2009). Temperature is measured using digital sensors placed at either single or multiple points within the hive (Becher & Moritz, 2009; Edwards-Murphy et al., 2016; Gil-Lebrero et al., 2016; Jiang et al., 2016; Kridi et al., 2016; Meikle et al., 2016, 2017; Stalidzans et al., 2017; Zacepins et al., 2016). Humidity may be used to indicate the processes of hive cooling and nectar evaporation as well as being an integral function of hive

https://eprints.qut.edu.au/232518/1/Daniel_Cook_Thesis.pdf

Keeping Cool

Moving at these cooler times of day will also prevent the hive from overheating. If you need to move your bees in the summer, bear in mind that in warm weather, a sealed hive full of stressed bees can get hot enough to melt the honeycomb. Using mesh travel screens to cover the hive will keep the bees securely inside but allow adequate ventilation to keep the hive cool. Have some water handy in your vehicle so you can spray a little into the hive for additional cooling. During colder times of the year, it's equally important that the temperature should not be below 50° F when moving. This is because the bees will cluster together if they are cold. Then when they are jostled on the journey, some may break away and die if they are unable to rejoin the group.

It will occasionally be necessary for you to move a hive, although any disruption to your bees should be kept to a minimum. By taking steps to prepare your vehicle, time your relocation well, and have everything in place at the other end, the move should go without a hitch, and your bees will quickly settle at their new location.

→ very important

Moving Beehives at Night

As a beekeeper, you will be forced at some point to move a beehive, despite the fact that a chosen spot might be perfect for your bees. The skill to move the hive therefore, necessary since it not only ensures the colony is safeguarded during and after the move but also helps minimize losses on the part of the beekeeper. Proper planning is recommended unless it is an emergency situation. Nonetheless, moving beehives at night is recommended for beekeepers.

Reasons for Moving Beehives at Night

Among the top reasons to move beehives include:

- Your neighbors are wary of your bees and you have no choice but to move the bees to another location.
- You have had tremendous success in your beekeeping and it is time to split a hive or share some of your bees with an upcoming beekeeper.
- You have been requested by an organic farmer to put some of your hives on their property.

Reasons for moving hives are diverse and if you need to, then you have to follow the recommended way of moving them.

https://beekeepclub.com/keeping-honey-bees-safe-while-transporting-and-relocating-hives/#comments

Transportation and Hive Management

Hives were provided by AgPollen, LLC. Hives were prepared for departure on 10 October 2012. Four hundred eight hives were placed on pallets, loaded on a flatbed trailer, and covered by a net. Each pallet had four hives, columns of three pallets formed two rows on the bed of the trailer with an aisle between pallets in the center. Ten of the 408 hives were selected for monitoring, and these represented different locations and orientations on the flatbed trailer. Hives are identified by their orientation, facing Outward or Inward (O, I), and their location, Front, Middle, or Back (F, M, B), on the trailer (Fig. 1). The truck departed Towner, ND (48.361755, -100.402613) on 10 October 2012 and arrived in Sheep Ranch, CA (38.209894, -120.464346) on 14 October 2012. Hive strength was measured by visual inspection of frames to determine the number of active, colonized frames per hive. Hive strength was assessed on departure (day 1, October 10), and on days 6, 26, 119, 146, and 170 (Fig. 2). Colonies received supplemental protein patties (454 g, 15.7% protein by weight) on days 10, 33, 87, 107, and 123 and 3.8 liters of supplemental high fructose corn syrup on days 10 and 123. Hives received antifungal treatments (fumagillin, 9 g per hive) on days 26 and 40. For a full calendar of hive management see Supp. Table S1.

overheating

https://academic.oup.com/ee/article/48/3/691/5423020

Fig. 1.

slides into truck

rollers

→ hive holders

slides to truck

4. Discussion

The major finding from this study was that HPG sizes were consistently and negatively affected by transportation. Results showed that the volume of HPG acini were significantly smaller in bees from transported colonies than that from stationary ones (Figure 2). This was true for all three trials conducted in different locations, and also for both young (7-day-old) and old (17-day-old) bees in the Michigan trial. Previous studies have shown that consumption rate of protein diets had a positive correlation with the development of HPG [27, 28]. In this study, the worker bees in T group showed consistently smaller HPG sizes, possibly due to their inability to find or consume pollen normally. It is also possible that trophallaxis was adversely affected such that the initial flow of jelly to very young bees (1–4 days old) from nurses occurred at a lower frequency such that normal HPG development was affected [16]. Yet another possibility is that the queen stopped laying during transportation and the overall level of brood pheromone would be lower in the transported colonies, and this could have affected their HPG development negatively. It is a bit surprising that 17-day-old bees were also affected in their gland size, because these bees were 13 days old when the transportation took place in the MI trial. Workers should have attained their maximum gland size around 12–14 days old [29], however, transportation during this time period still significantly negatively impacted their gland size. It is possible that these 17-day-old bees were actively nursing brood during transportation but they were unable to balance their protein input with proper pollen feeding. This suggests that all in-hive workers (workers that are performing preforaging duties) are affected by transportation. It is puzzling that while HPG acini sizes showed consistent differences in all trials, the head protein or thorax protein content did not show the same pattern. Head protein includes HPG and brain, plus head salivary glands and muscles for the mandibles. Our data here suggest that HPG size responded more consistently to transportation stress. Thorax protein content mainly reflects the mass of the flight muscles, for some reason it also does not show a consistent effect. It is possible that HPGs respond more rapidly, but changes in head or thorax protein content have more variability and do not show the same sensitivity to stress-related events. A recent study also failed to find any differences in bees from healthy and colonies exhibiting colony collapse disorder (CCD) in weights or protein content of head, thorax, abdomen [30].

Interview transcript

Speaker 1:
Perfect. So when you transport them, what type of vehicle do you use?
Speaker 2:
I have a small flatbed truck and trailer.
Speaker 1:
Perfect. And could you describe the process of loading the bees onto that vehicle?
Speaker 2:
Okay, so the bee, I've got what's called an easy loader. What I can do is, I'll text your phone, see what it looks like. It's basically, it's Australian made in Ballina in Northern New South Wales and it's like a crane that goes underneath individual hives. So they're not on pallets, but they're individually text you a photo right now so you can see it. So it's on the back of the truck.
Speaker 1:
Okay. Have you tried using the pallet system to transport them?
Speaker 2:
Oh, okay. Good question. The reason why I don't use pallets, because a lot of my sites are very, very remote. I might have to cross creeks and that type of thing. And I'm only small scales only run about two 50 hives. And the reason is I've also got a four-wheel drive ute and the photo I sent you with the truck, I can actually get the ute and trailer into these sites. So I've got a lot of little sites that I use. So then I've also, obviously for the big stuff I can use the trailer. But yeah, for pallets it's not suited for me.
Speaker 1:
Okay. That's all good. So when you transport the hives, do you close off the entrance way?
Speaker 2:
Yes, I do actually, yes, I close the entrance off when I transport.
Speaker 1:
What do you use for that?
Speaker 2:
Ironically, I just used a, was bit different is a cloth to blocked the entrance. So then I use that because find it actually the easiest way. I've tried hive closes and all sorts of things over the years, but with a cloth, once you're on site, all I've got to do is quickly run around and pull the cloth and it releases the bees. And for me it's, it's a primitive way of doing it, but I found that the best way.
Speaker 1:
Yeah. Okay. How far do you take the bees? Does that depend on the season or?
Speaker 2:
Yeah, so how far? So from what would be say, Yarra Valley and they go to just near Robin Vale. So that's in a truck that's about a seven hour drive
Speaker 1:
In a truck
Speaker 2:
And it's about 500 something, just over 500 kilometres.
Speaker 1:
That's a lot.
Speaker 2:
I know I was doing that the other day. I had to do it twice. Yeah.
Speaker 1:
Oh gosh. So do you have to do anything in particular before transporting the beers to get 'em ready for it or anything?
Speaker 2:
Probably, yeah, good question. If I'm doing sort of big moves and there's not that many throughout the year, they're mostly sort of smaller ones. But I do, the bigger shift that I do is I just consolidate 'em at one site so they're all in one area and then I can do that, then I can move them from one area rather than going to all these different areas, loading 'em and then going have them all consolidated in one spot.
Speaker 1:
Okay. Yep. So when you move them, how do you keep track of them?
Speaker 2:
Track of got stickers that are on top of the hives and it's got, usually it's more got to do with strength of hive and what queen or genetics are inside each hive. But there is a room for notes, so I can go usually as far as where they've come from, I usually put the suburbs, so that could be Mansfield, could be Yara Junction, could be kangaroo grounds, so I can use that. It's pretty basic, but it kind of works.
Speaker 1:
Yeah. So with the var mites spreading, how do you keep the hives from getting those diseases? Or is there no way to stop it?
Speaker 2:
No, there's no way to stop it because the particular mites actually, they grow exponentially and if there's an infected hive close by, your hive can easily get it easily. It's transported by the bees.
Speaker 1:
Oh, right, okay. Yes. Yep. So when you load the hives onto the truck, do they need a certain amount of room in between them or can they be jam packed together?
Speaker 2:
No, they can be jam packed. The bases of each hive I use is ventilated, so I don't use ventilated lids, but the bases are ventilated and I do it at nighttime, so they're the coolest part of the night, so know's where I leave at, sort of midnight at night to actually move my phone. That's the best time of day, best time to actually do it so they don't overheat.

Speaker 1:
Oh yeah, perfect. Do you have to take regular stops to spray them down or anything?
Speaker 2:
No. No. Okay. Because the time of year being that spring, it's cool enough to do it. The big trips I do is always this time of year where if I'm doing smaller trips, once again it's at nighttime. Even on a hot night it's okay because I'm only a couple of hours driving and because you've got that wind driving, that keeps 'em cool. So I don't have to actually spray myself. And that's with the spots I'm usually in is a little bit more temperate as opposed to crazy hot. So that's not a concern.
Speaker 1:
So when you are preparing them moving into one side, do you manually do that with hands or do you use something else?
Speaker 2:
So there's fundamentally three ways. So let's say I've got the crane on the truck but doing big loads. I've also got a lifter, it's called a lift, carta lift, and that's made in Hungary and that's like a trolley and it's got a lifter on it. Yeah, electronic sort of lifter.
Speaker 1:
Yep. And I can see that you've got the straps going around the truck.
Speaker 2:
Yes.
Speaker 1:
Do they move, do the hives move around?
Speaker 2:
Oh, good question. If I've done the straps correctly. No they don't. Okay.
Speaker 2:
It's actually funny, the other day I lose track of days. I work full on this time of year, but I had a strap come off on the back of my trailer with five hives tied down to it and a truck was passing me and he sort of gave me the toot and fingers pointing towards the back of the trailer because I can't see it in my mirror. And I pulled over and actually the strap had come off and so the end, the hives were just sitting there. I'm quite embarrassing actually, but I'm a careful driver. So it's luckily they didn't fall off because that'd be devastating and dangerous. And dangerous too.
Speaker 1:
Yeah. Oh god,
Speaker 2:
I know. It's the sort of things where happened, you got to be careful because the other day it's a 19 hour solid working, so 19 hours solid and when you're tired, that's when you make mistakes. I hadn't done it really tight and it just happened to come loose.

Speaker 1:
So when you get to the different sites, do you use the loader to put them on the ground?
Speaker 2:
Not always. Sometimes I like to actually use a bit of physical movement, so if the hives crazy heavy, quite often I'll just lift them off by hand. I'll manually do it. Probably the reason so much driving involved is your body gets a bit stagnant and so to actually use some physical muscular sort of energy and actually I don't mind doing that so often, not always, but I'll often just manually do it. Probably not too crazy heavy.
Speaker 1:
And I assume that you can't put all the hives in one area?
Speaker 2:
Yeah, that's right. Yeah, generally not. Yeah, you've got to be spread out. Right.
Speaker 1:
And then do you put a mesh cover over the top of it as well or just leave it open? No,
Speaker 2:
No, I don't. Each hive is individually blocked. Yeah, I actually, because I don't shift them when they're with open entrances, yeah. I don't have to put a mesh over 'em. Alright.
Speaker 1:
Do you have anything else you could add or anything I should know?
Speaker 2:
I suppose tell me, so the project, I guess, what do you want to achieve with the project? You're doing
Speaker 1:
Better
Speaker 2:
Idea.
Speaker 1:
It is F for a design project, so I either have to, I'm trying to focus on the actual transporting the hives onto the trucks and just understanding that area of it because does it affect the bees a lot if they're being moved around?
Speaker 2:
Oh, good question. That's a good question. I think there is a certain amount of stress involved. Yeah, there's a certain amount of stress, but you know what I mean, it's obviously, yeah, but it's not detrimental. What I mean, so if I was to be in at a hive, I wouldn't be locked up and sort of thrown on and bounced around for hours and hours, but it doesn't, it's not detrimental to 'em. Okay. So it's got to settle down. Usually within four to six hours they've settled down, they've orientated and they've flat out foraging for pollen and nectar. So it's sort of not that bad.

Speaker 2:
Yeah, so if you're thinking like a design, they're called molden, pretty sure it's Molden honey, he's come up with a system for moving hives. So it's like a truck. The big trucks have got the curtains on the side and he's got a set up where there's a mister can set on a pump and it basically miss with water all that internal of inside the truck. So he moves his bees zone in hot weather so he can do that. So it's a bit done in a sort of quite unique sort of way. So that's one thing he does. As far as the loading aspect goes, having an all terrain forklift with pallets is definitely easier. But the problem is, it's kind of funny because the beekeepers you see that have pallets and forklifts, they're always fat. That true, always fat because they're not using any physical sort of movement. You know what I mean? So it's kind of funny. So that's how they do and that is a better way of doing it, more efficiency as far as loading, because loading is, other than the driving from site to site, it is quite time consuming. Loading bees onto a vehicle of sorts, there's a lot to it.
Speaker 1:
So the project is to drive increased efficiencies and biosecurity in the pollination service industry.
Speaker 2:
Okay, okay. Yeah, it's an interesting one. And as far as diseases that pests diseases go, the biggest culprits are beekeepers moving their bees and I'm guilty of moving bees and that's where this particular role might. Whereabouts are you based, Emily? Whereabouts are you?
Speaker 1:
Brisbane.
Speaker 2:
Oh, Brisbane, okay. So yeah, as far as have you've sort of seen in Sydney, Newcastle, it's spreading everywhere. I think there's over 230 IPS infected premises and all of them is because of beekeepers, even their bees. So they're the ones to blame as such. I do the same thing. So as far as biosecurity, as far as I suppose, yeah. What else? There's safety aspect, you know what I mean? I think the old straps around them, that works. You know what I mean? Whether it's pellets or singly, loaded hives during winter's, almond pollination on, there's always a beehive sitting on the side of the road where it's come off.
Speaker 1:
Oh wow.
Speaker 2:
Always. Yeah, always. Yeah. So it's kind of, I think maybe increasing that safety, but I think it's because it's the busiest time of year for beekeepers. Once again, once you're tired and you've got suffering from fatigue, that's when mistakes happen. So being fatigued, that's when that's more likely that be a problem than happen. Yeah, yeah. I'm trying to think of anything else I can add to it.
Speaker 1:
Any products or processes,
Speaker 2:
So processes of moving bees? Yeah,

Speaker 2:
Well the easy load is good. An Australian, I text you what it is, you can Google that, not all that far from you in Bona. So it's Australian design, they've been around for 30, 40 years or something. And that's a great, and they've got different models and definitely look at their website. We've got different models as to what they do from a small sort of sideline, hobbyist, beekeeper right up to big commercial beekeepers who can actually move one pallets. So these cranes can actually lift I think two box pallets. So that's a great sort of design. There's positives with using an easy loader. A crane is, it takes less footprint on a truck so that that's a negative when it comes to forklifts. So if you've got a forklift, you've got a big footprint on the truck so that all of a sudden that bigger footprint means you take less hives. So yeah, that's negative for that where a crane is efficient in aspects. As I said, for other beekeepers, for smaller beekeepers, there's this called comfort lift, so I'll send you that so you can sort of visualise that and that's a really good design for doing, finding that. Okay, there we go. So yeah, someone's sort of running 2050 pipes is a good, great way of doing it too. So I've got one of them as well, which is great for, yeah, as far as products go, I'll just text that to you. Yeah, yeah.
Speaker 1:
Oh yeah,
Speaker 2:
You said that's a little truck? Yeah, I think Where are the photos? Oh, oh, actually another one. Yeah, another. Okay. I'm just, sorry, I'm looking at photos and I'm going to send you a photo. You can see what happened to me. This happened to me a couple of days ago. A big, big problem with getting bees into various areas is getting bogged, getting stuck, you know what I mean? So there is something that some beekeepers have, it's hugely expensive, which is really good on putting on trucks. It's called C T I, which stands for Central Tyre Inflation. And having that on a vehicle, what it does is it basically makes your tyres go flat and when your tyres are flat, you've got more surface area to drive on sand and things like that.
Speaker 1:
Yep, that's a good idea.
Speaker 2:
Yeah, it is. Yeah, they do it. It's big in the logging industry in America, Canada and so forth. So the big trucks that moving logs or wood, they use it this C T I, but it is his expensive. That's the only problem. What else else can I tell you? Yeah, so I think transportation getting bogged all the time. Beekeepers get bogged because you're dealing with a big weight and I mean vehicles, some beekeepers use four wheel drive trucks, problems with a four wheel drive truck, you add another $50,000 onto the price, you know what I mean? So it's not necessarily the efficiency of it's not necessarily that good and they don't drive as well. All our trucks on the highways. Yeah. What else can I tell you? Really?
Speaker 1:
I don't know.
Speaker 2:
I think that's send you a couple of photos. This is one of me, so you can sort of visualise it. There's one of me workers there, it's on Corolla. I'll sent a couple of photos last few days. So you get to sort of see
Speaker 1:
How long do they stay on the sites for?
Speaker 2:
Oh, good question. It does vary from crop to crop, any the sort of nuts and things they stay on usually three to four weeks, depending on weather dependent apples. All your stone fruits are the same, berries are different. Boobies, raspberries, blackberries, they can stay on for an extended period of time because what happens, you get the flowers coming on at different times. So yeah, so that's where they don't just have this big flowering period and then they stop. You know what I mean? Flowers can trickle. So especially breweries can go for sort of two months. You get big air flashers
Speaker 1:
And you don't have to do anything to maintain them or anything.
Speaker 2:
Yeah, it depends on how long in a short period of time. So less than a month, the answer's no, if it's that two months, usually enough to do one visit to make sure that they're happy and healthy bees. So it's usually that's enough to, for 'em to just make sure. Sometimes, obviously depending on the crops, a lot of crops can be very poor. Their flowers nutritional, their nutritional value can be quite poor. They've got low levels of proteins in a pollen and minimal nectar, so like apple's, pears, it can be really quite bad for these in that aspect, but it's for a short period of time. So it's not a big concern in that aspect. It does vary from crop to crop.
Speaker 1:
And if they do get diseases, what do you do with the hives?
Speaker 2:
Good question. It depends on the disease. So generally bees are going to, if you look at say chalk brood, that's a fungal infection that's usually got to do with the genetics of the bees and weather conditions and nutrition. So usually it's a case of increasing nutrition of the bees is enough, and sometimes reque introducing new genetics, that's enough to clear up chalk brood you are up in brey, so if you've got bees up there, they have issues what's called African small hive beetles a real problem, you know what I mean? Sort of northern New South Wales, right up Queensland for the sheer fact is the beetles, the larval stage is like a maggot and they can kill hives like slime 'em out. So they're problem because it's cold and temperate down here, it's not a problem for us in Victorians, they don't have in Tasmania, upper small high Beatles as far as trying, you do see from time to time European fery disease and the worst ones American foul brew disease. It does happen from time to time, but those bees ever, it does happen. They're euthanized. And then what I do is any of the equipment, the box and frames and things goes to a place called stereo tech and they use the type of a microwave gamma radiation and the box is sterilised so I can use them again. Okay. So it's a way of minimising infection and that type of thing. And that just helps that more prevention as far as that type of thing.
Speaker 1:
So if you took it to a site and then one hive managed to get a disease like that, would you take it back with the rest of them or would you do a separate trip?

Speaker 2:
No, no, I'll take it back with the rest of them. But they're locked up. Yeah, so they're locked up, so there's no way they could be transferred that disease. Yeah.
Speaker 1:
Okay. Your hives are made out of wood.
Speaker 2:
Yes. So I try and keep things as sustainable as possible. So it's Australian pine, sometimes it's New Zealand pine, so you buy 'em as a flat pack and we assemble 'em here. The boxes are treated in a very unique way. There's not a heap of beekeepers do it, but it's called wax dipping. So think of it like a potato, like a chip. So the boxes are cooked in wax at 180 degrees Celsius for 10 to 15 minutes. And so that dries out the wood and helps ate it. And then they're painted four times with white concrete paint that really? Yeah, you literally get decades out of them. That's a way of preserving the wood. I hate plastic, but the bases I use are made out of plastic. They're a ventilator plastic base. They're good for the fact they don't rot, you know what I mean? Wood rots over time. But being a plastic base that works really, really well. They're made here in Victoria in Swan Hill and they use a certain amount of recycled plastics, so they're quite plastics go. It's quite sustainable in a roundabout way.
Speaker 1:
Yeah. Have you tried different materials for the hives?
Speaker 2:
I've tried everything, absolutely. If there's a hive out there, I've tried it from e p s, which is expanded polystyrene to plastic hives to different types of wood and that type of one. So I've done all different types. I've found wood to be the best. I mean I try and keep the bees as natural as possible. So yeah, so I found that's the best product to use. But there's positives and negatives with all different types. So if you look at say polystyrene hives, they've got the best thermal properties. So their thermal properties are absolutely fantastic because actually they're three times better insulation than wood. So the bees will actually consume less honey over winter. They're known to produce more honey because they can once again due to the thermal properties, but they're negative is been polystyrene. They break easy. The wax moth, which is another pest, can chew holes in it, mice can bird can glass cockatoos. So that can be a bit of a problem. And I've tried them, there's two brands that I've tried, one out of Finland and the other one out of pond tried them, they're good, but once again, you tie a strapped to 'em, even though it's expanded poly historian. So it's hardened, it still can actually bend and break. So I'm not a fan of them and that's just me personally.
Speaker 1:
Yeah. So when you have them just not on the truck, when they're just on the ground, are they elevated?
Speaker 2:
No, not at all.
Speaker 2:
No, just go straight the ground, no issues with rot or anything. I use those plastic bases. I said every other component of the hives would, I don't use plastic beeswax sheets, so I use pure bees wax, which are embedded onto stainless steel wire. So I find they're really, really good. Once plastic's got its positives, but once again, it's prefer not plastic. If you give a frame of plastic to inside a bee, Ivan and natural wax, the bees always go for natural wax. They always prefer it. Yeah.
Speaker 1:
Okay. Can't think of anything else.
Speaker 2:
Yeah, I think if you've got any other questions or you don't be scared, just let me know if there's anything. Yeah, yeah. Shoot you for a message or yeah, let us know. Am I the first beekeeper you've spoken to?
Speaker 1:
Yes.
Speaker 2:
Have you talk to beekeepers? A little trick for you. You've got to hassle on. Okay. Yeah, don't be scared with beekeepers, don't be scared to pester 'em. Send them five messages a day. Beekeepers, generally you struggle to get 'em during the daytime, so yeah, after dinner is usually the best time to get 'em. What's your job, Emily? What do you do outside of studying? What do you
Speaker 1:
Do? I'm a swimming teacher. Oh, cool. Okay. Awesome. Cool. Very different.
Speaker 2:
No, it is different. Yeah, so you'll find, yeah, so don't be scared if you want to talk to other beekeepers, hustle 'em. Don't be timid, you've got to just hustle 'em. Call 'em even. Call 'em five times a day. But yeah, generally speaking, during the daytime it's a bit tricky getting beekeepers if it's nice weather. But yeah, if you need to talk to others, even after dinner, if you're not working, beekeepers will talk at nighttime.
Speaker 1:
Well thank you very much.
Speaker 2:
My pleasure. No worries. Anything. No, happy to help. And thank you for your patience too. Thank you. That's okay. And if you need any other help, I'm there for you. So if there's anything else, just lemme know. Happy to help.

Observations

Observations

Picture from interview

Based on research

Areas of design intervention

Ergonomics of products

- The ergonomics need to be explored more throughout the hive design. All the interviews showed the importance of making sure that the hives are easier to carry. The design of the current hives, still use the plans from the original Langstroth hive. The modifications that are currently being placed on to the hives allow for easier and more efficient way of moving hives. Current Langstroth hives create a larger risk of injury to beekeepers, especially hobbyists as they are more likely to more their hives by hand. Other products including pallets and smokers have not changed despite modern technology. By improving the ergonomics, it will increase efficiencies of moving the hives, creating less injuries and allowing for easier movement of the hives.

Transportation opportunities

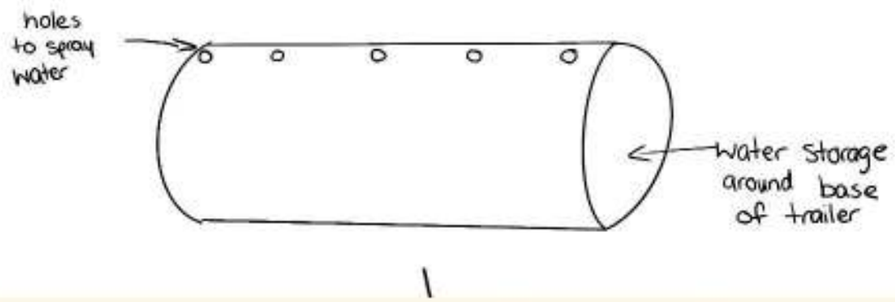
- Although there is limited research into the transportation of beehives, the surveys, interviews, and observations allowed for a justified area for opportunity. Most beekeeper use a forklift and truck to move their hives for pollinations services, with pallets that are either the wrong size or have been modified. These methods have not changed sice the start of commercial beekeeping and thus highlight an area of opportunity by incorportation modern technology. There could also be an area of opportunity with the type of vehicles that are currently being used, instead of using trailers and trucks.

Management opportunities

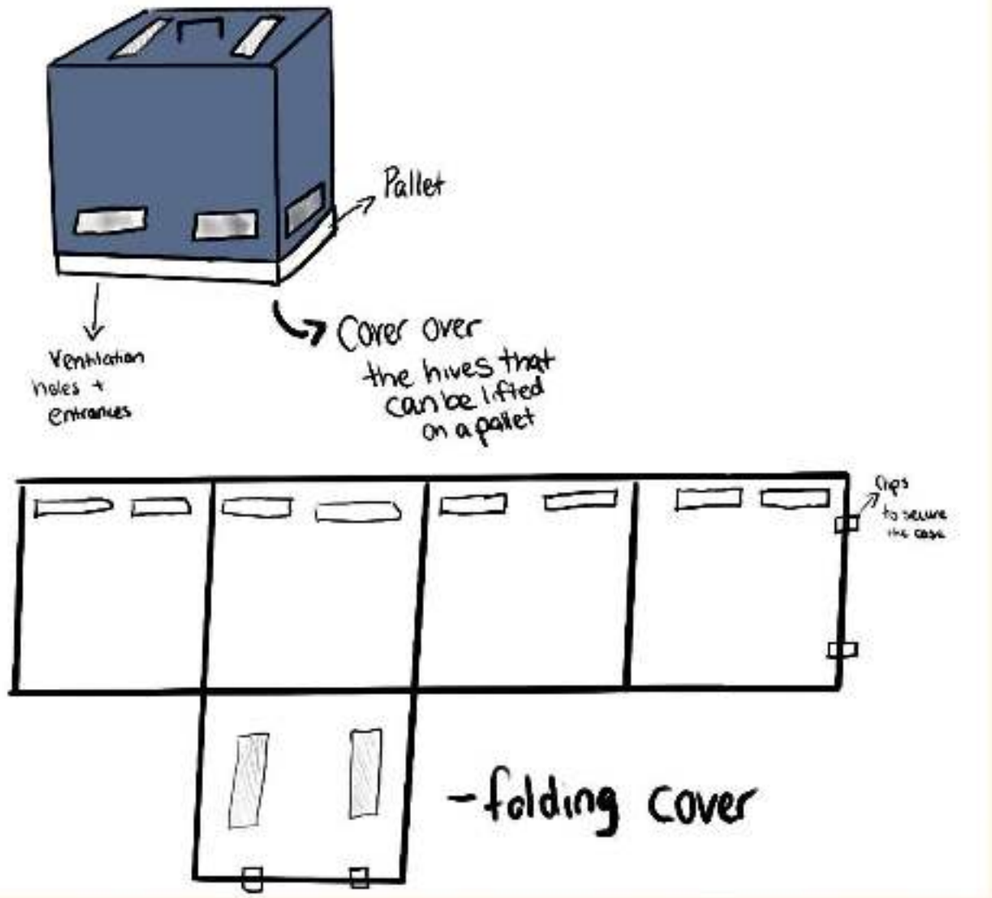
- All literature research pointed towards the management of the hives during transportation as well as the interivews. The importance of keeping a hive healthy is fundamental to beekeepers as it is a very large industry. Whilst also producing honey, the bees must pollinate the crops in our food security industry. Overheating was the main issue whilst transporting the hives and this creates aother area for opportunity. When on the truck the orientation of the hives matter as different parts of the truck get different airflows whilst driving. A cooling system could enhance the safety of the bees and thus keeping the food security and agricultural industry flowing.

COOLING SYSTEM

- Can be attached to different trucks
- Stores water
- Small holes to spray hives
- Pumping system
- Adjustable

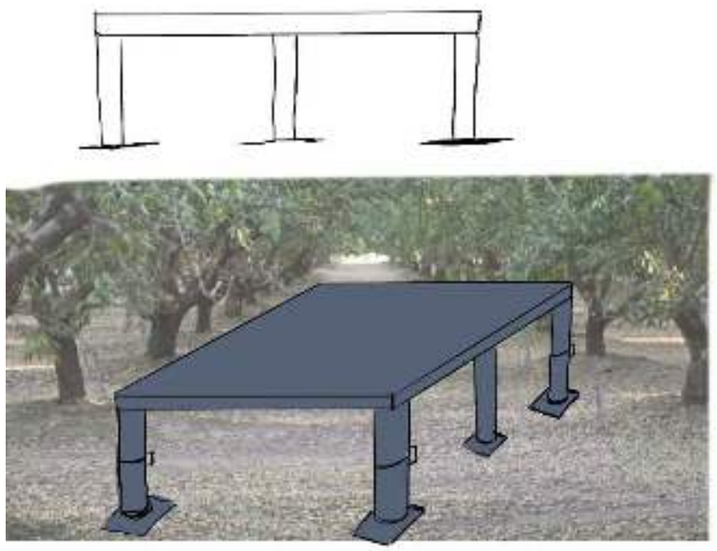


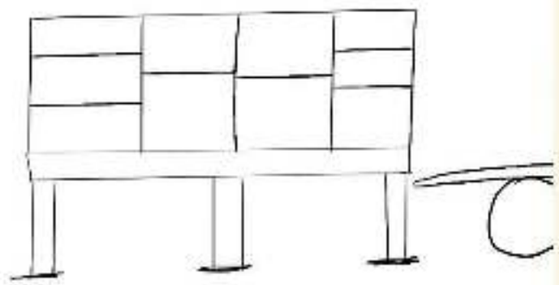
HIVE CASE

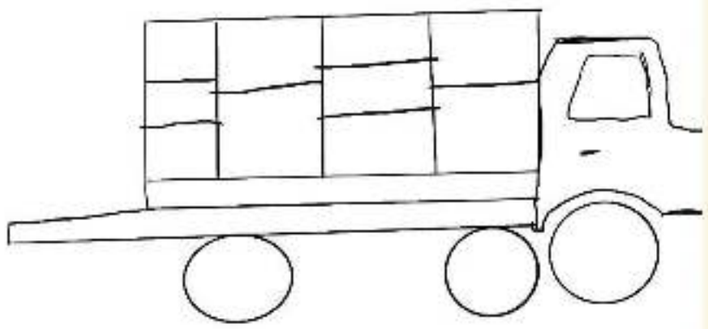


- Box design that clips on the pallet
- One unit
- Foldable when not being used
- Clips for securing
- Entrance ways for airflow and flying in and out of the hive
- Kept on the pallet when at pollination site

TRAY SYSTEM

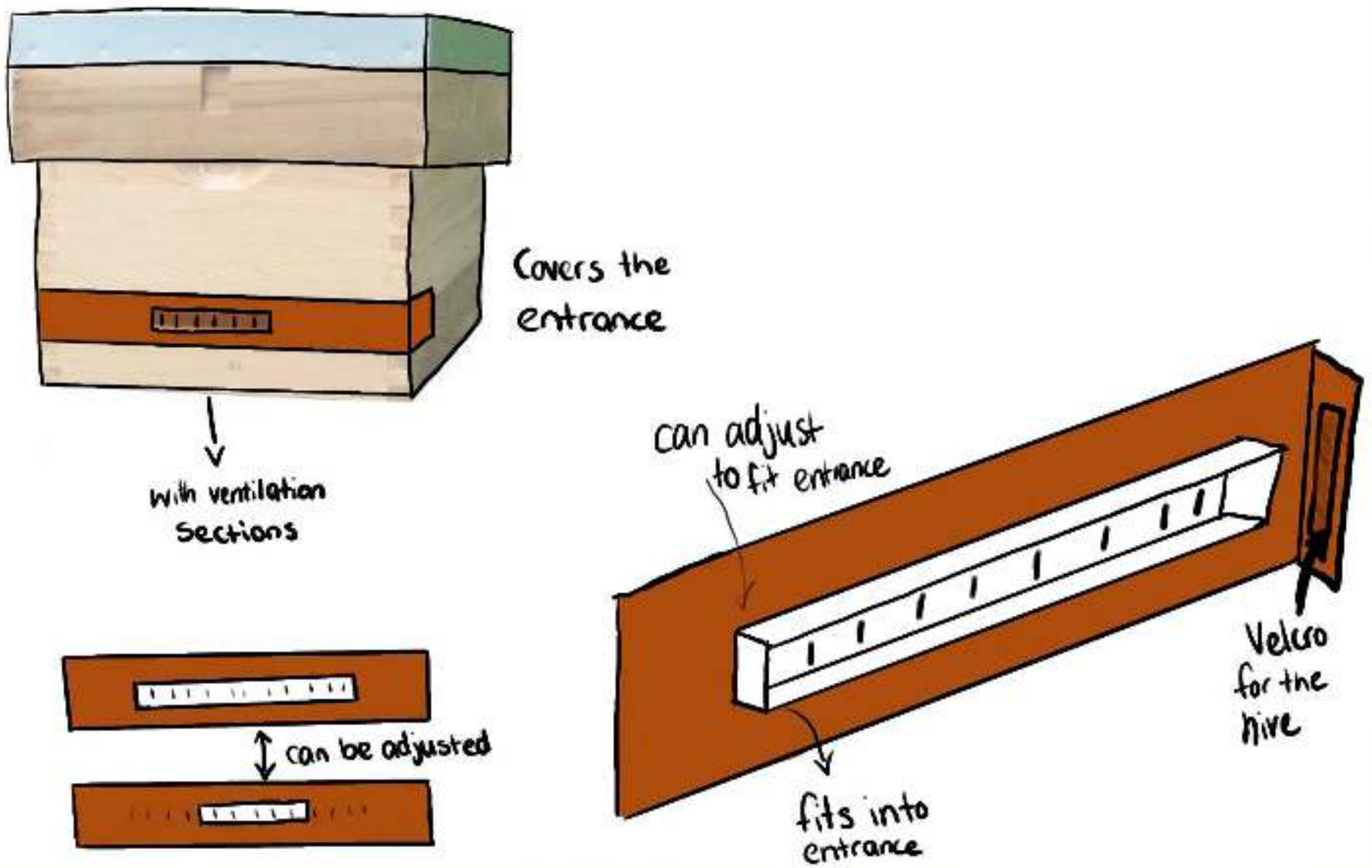






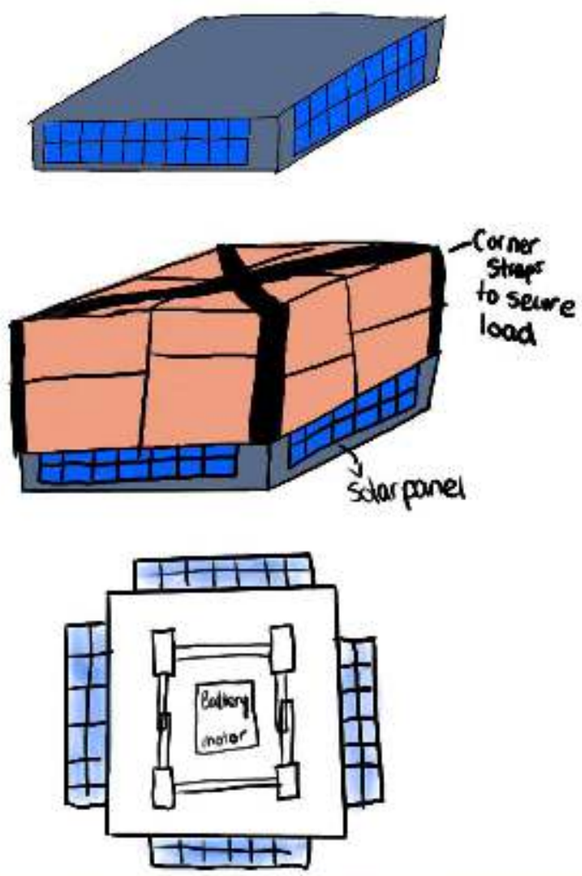
- Incorporates a tray bed getting loaded onto the tray
- Will be a fixed design
- Adjustable legs to get the truck bed underneath the tray
- Can fit 6-8 hives onto the tray
- Uses straps to secure load

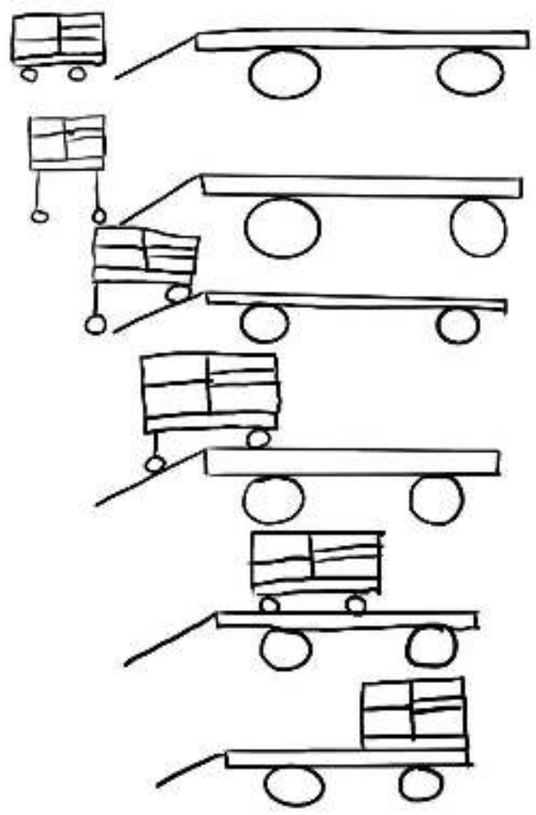
ENTRANCE COVER



- Sustainable design
- Adjustable for different entrance sizes
- Attach to the hive
- Slits in the front to maintain airflow
- Suitable for modified hives

HIVE PALLET

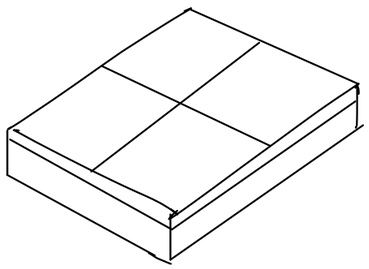


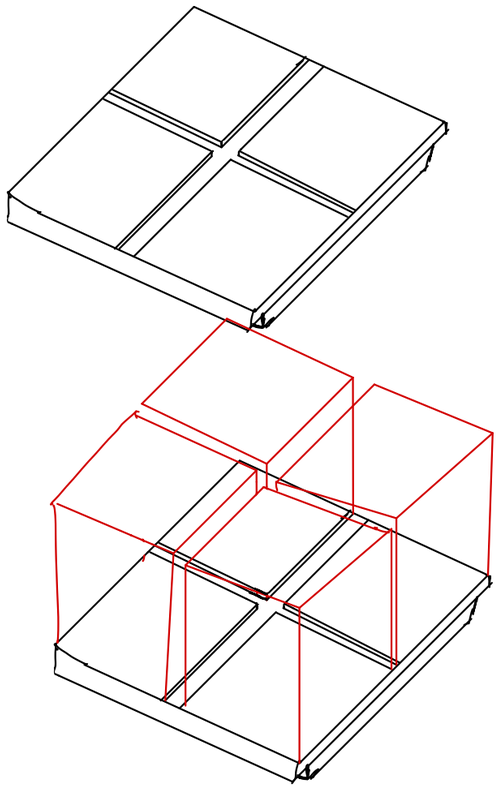


- Remote controlled
- Solar powered
- Self-adjusting
- Fits 4 hives perfectly
- Secure straps that go on the corners of the hives and clip together at the top
- Will lock on to the truck bed for transport
- 4wd wheels and suspension for different terrains

Assessment 2 - refining ideas - hive pallet and cover

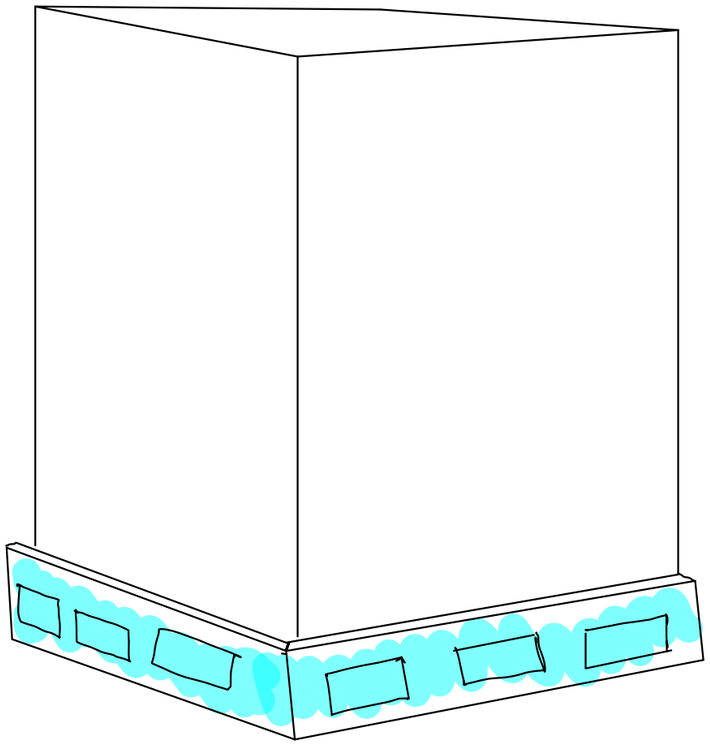
Concept development

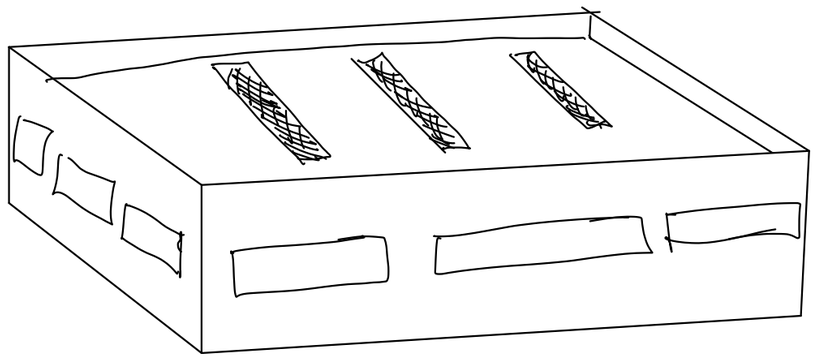


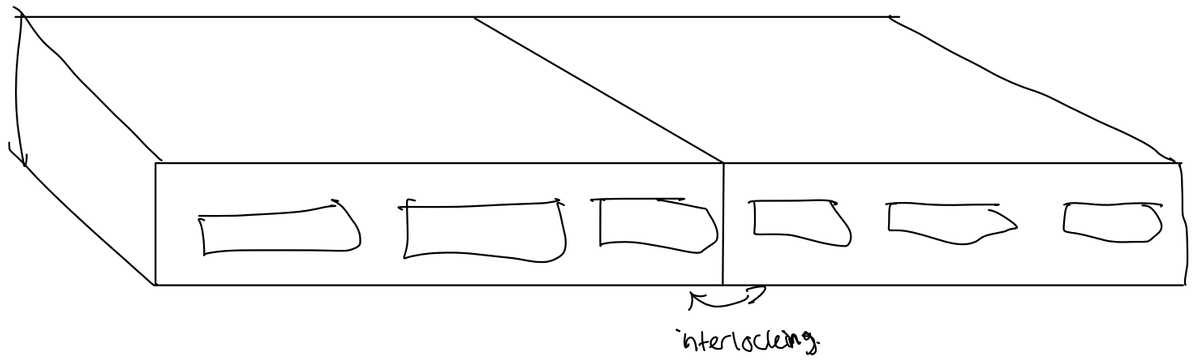


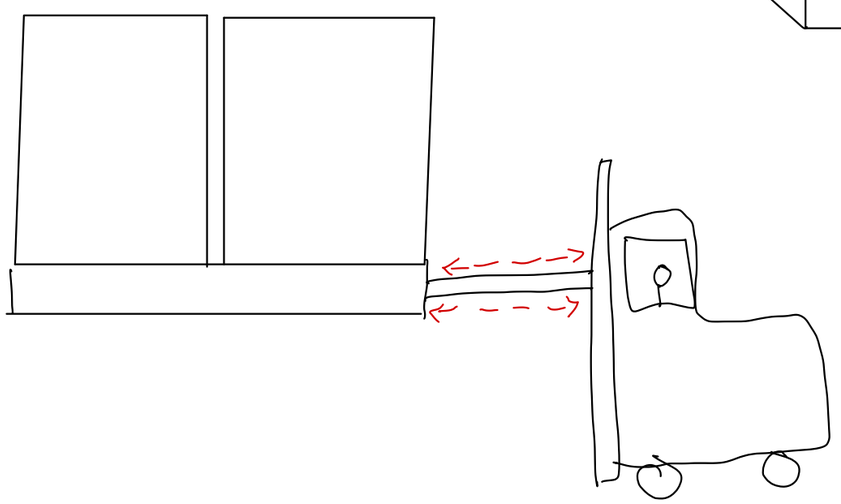
https://www.youtube.com/watch?v=VUnFL9P8Z_E&ab_channel=MobileIndustrialRobots

Concept development







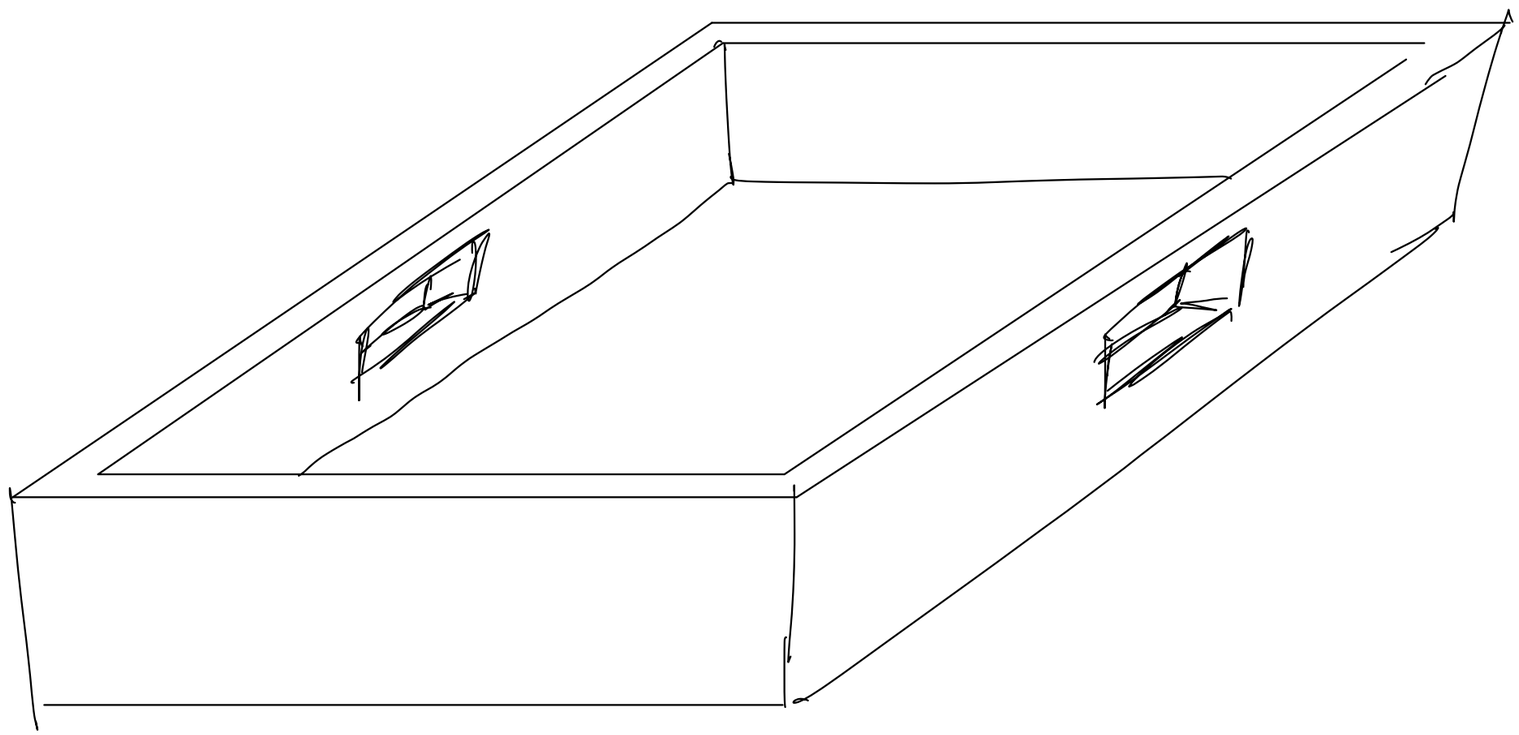


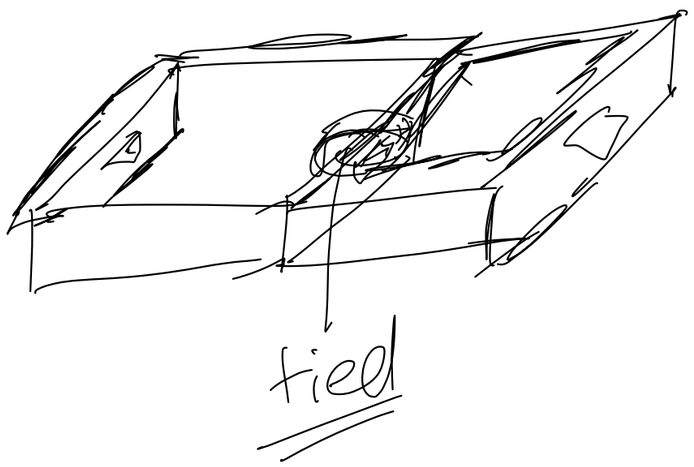

EZYLOADER - M & K Stafford Engineering Pty Ltd

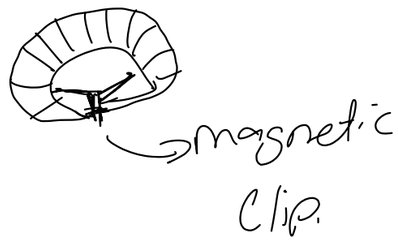

EZYLOADER - M & K Stafford Engineering Pty Ltd

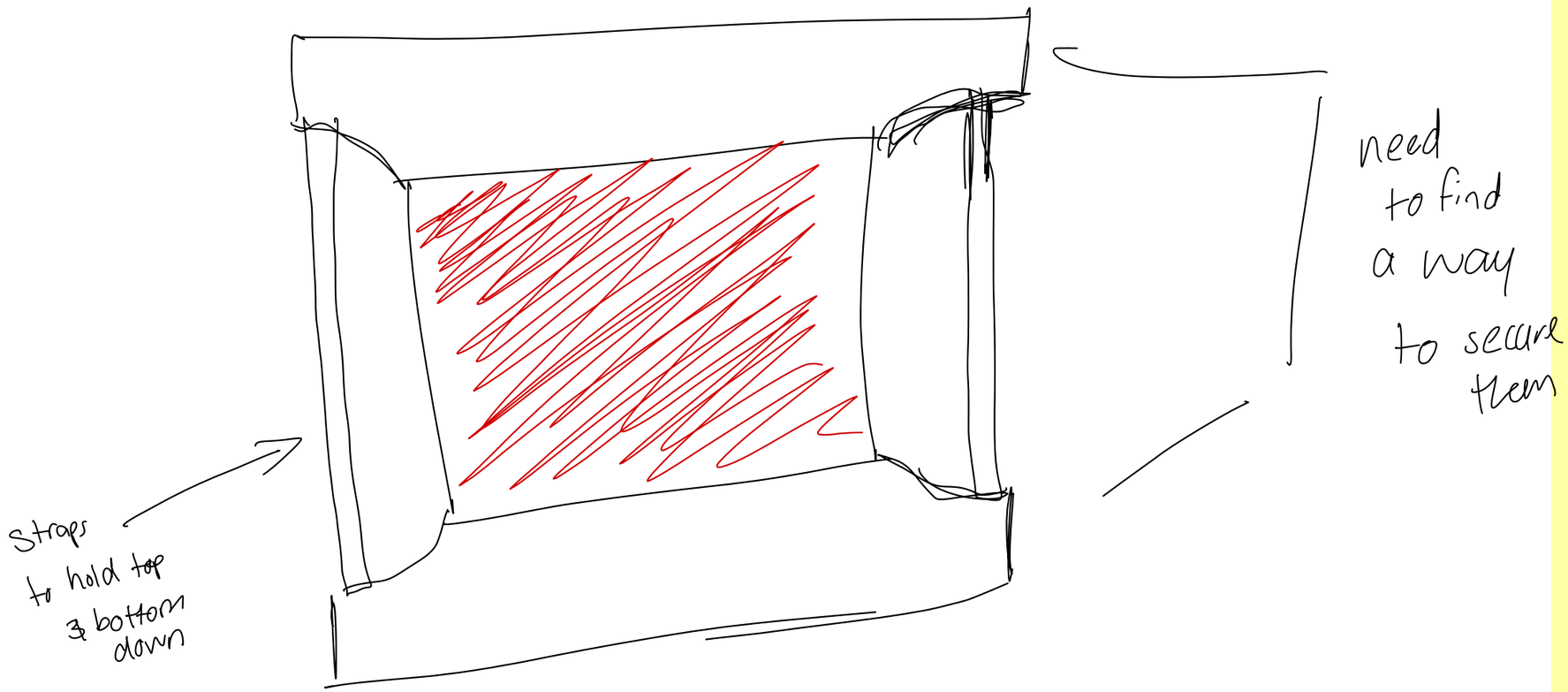

EZYLOADER - M & K Stafford Engineering Pty Ltd

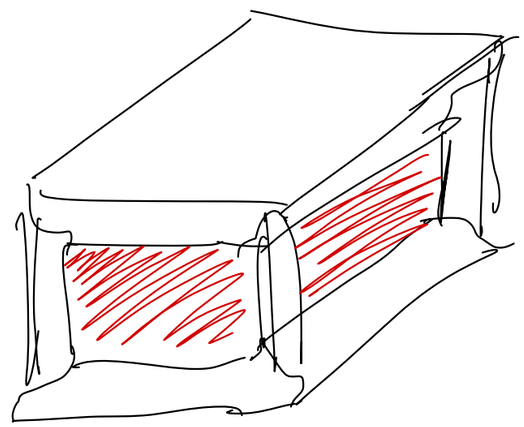
Concept development



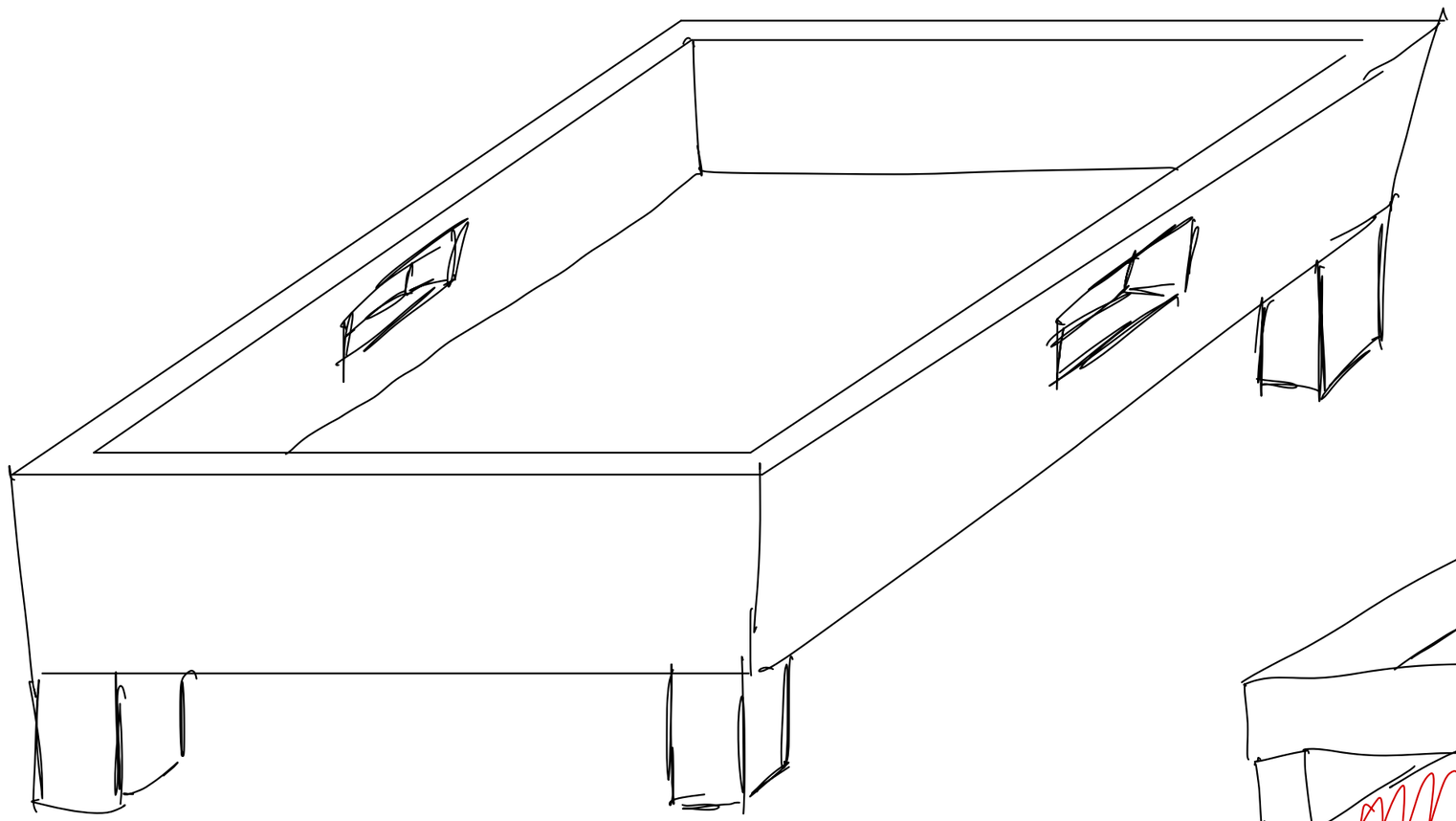


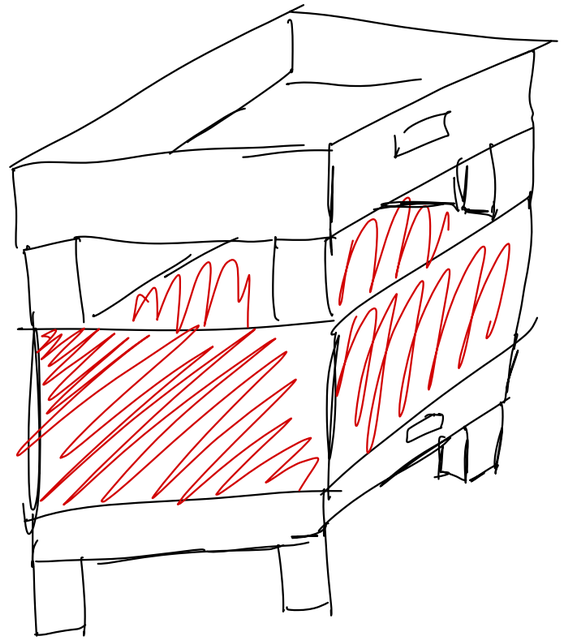


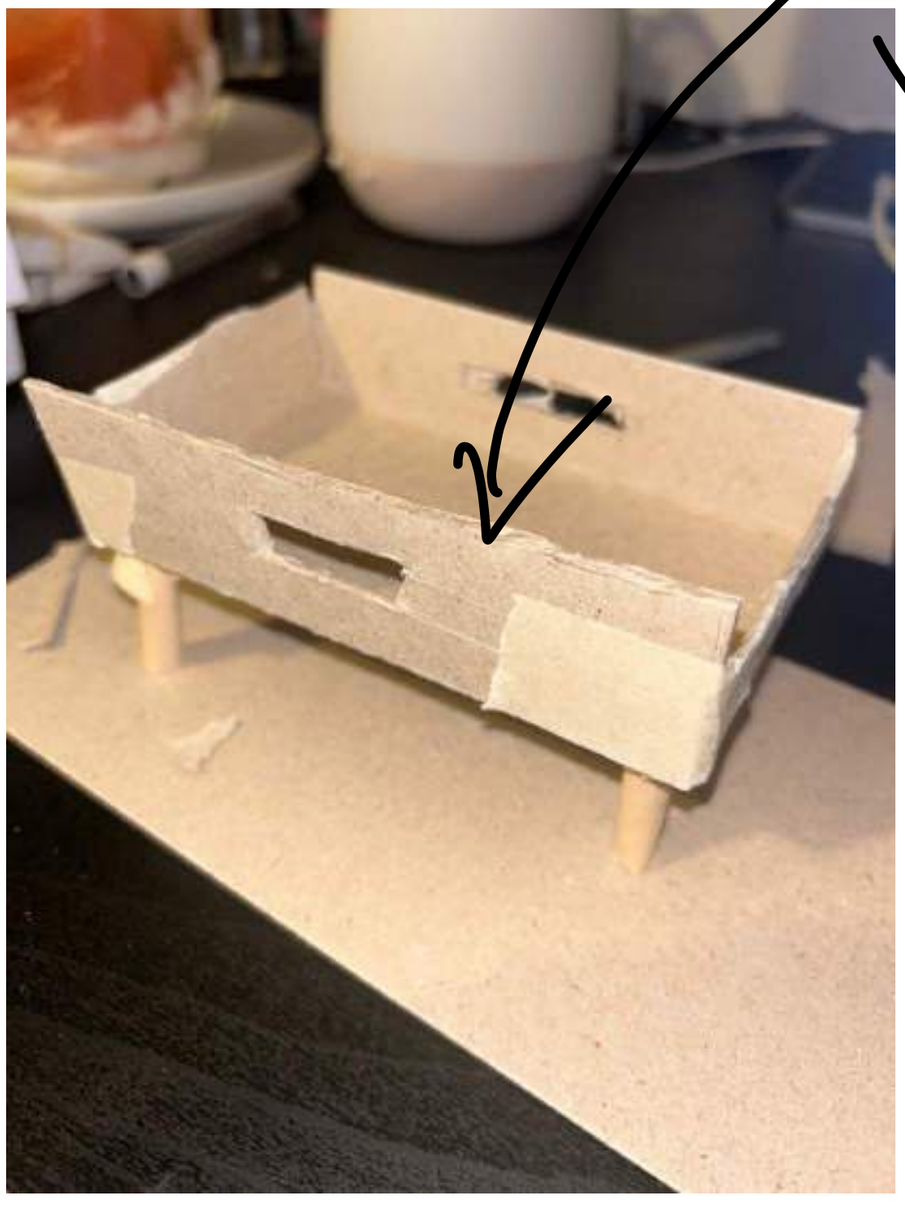

need
to find
a way
to secure
them
Straps
to hold top
& bottom
down

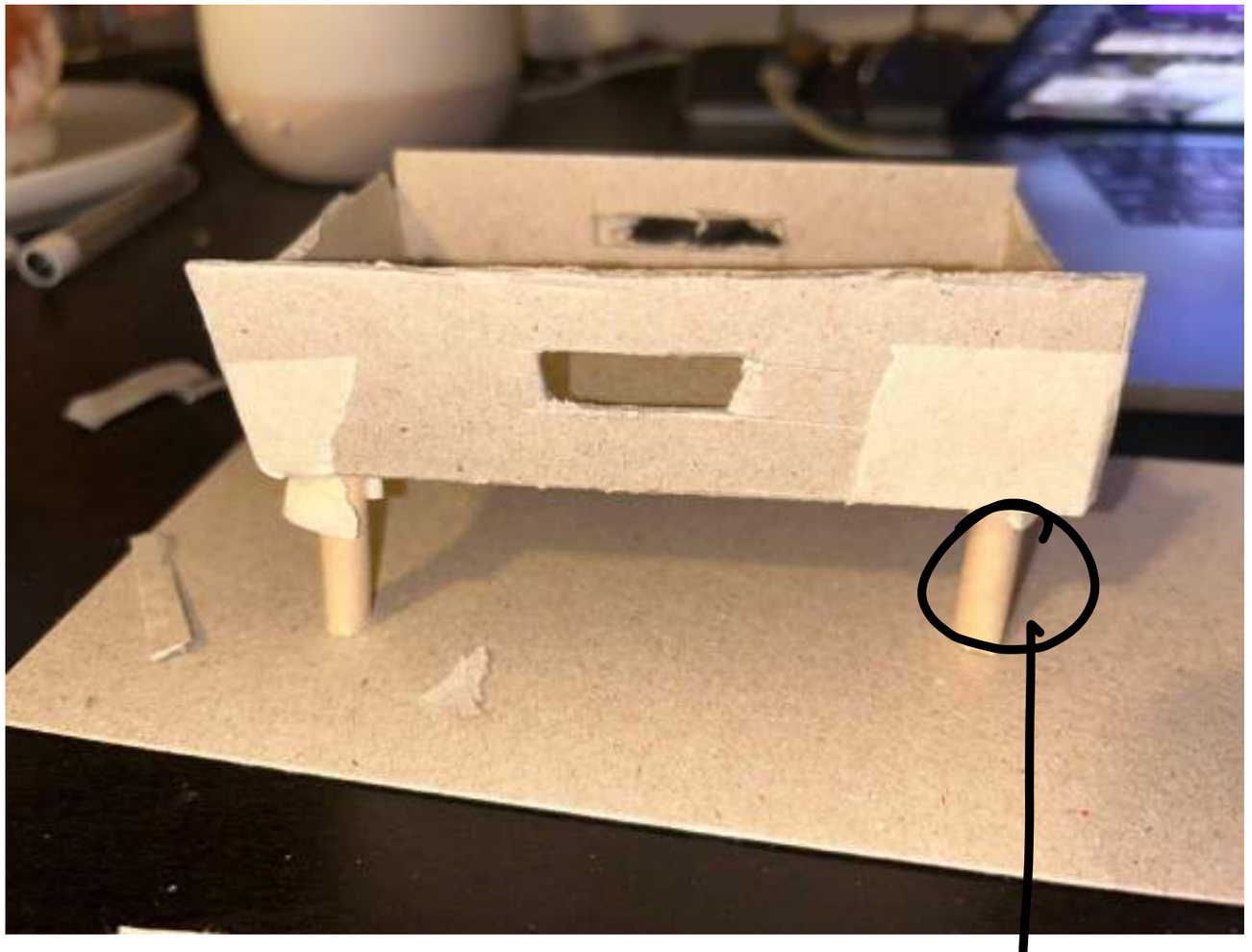


Concept development

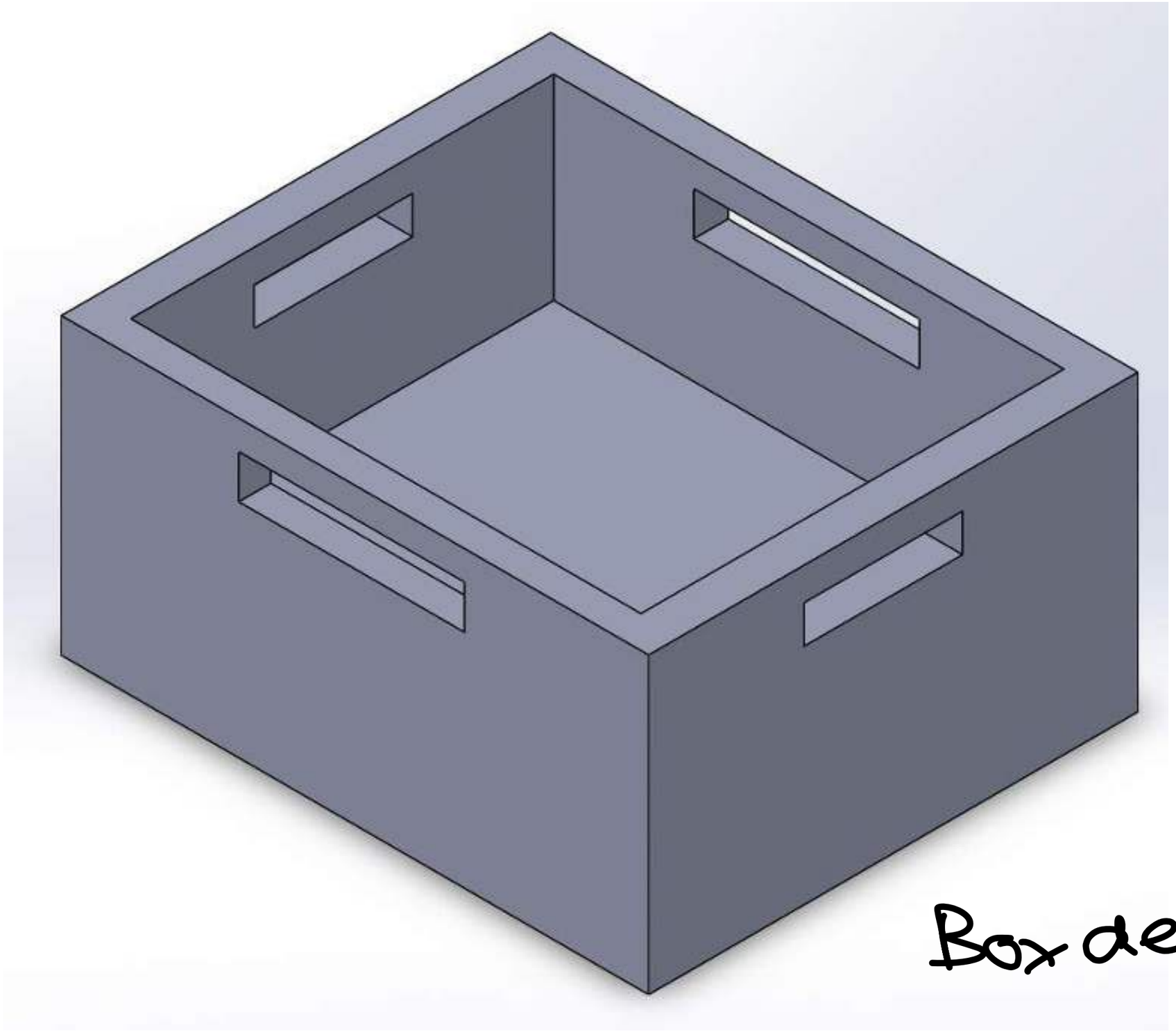





adds handles

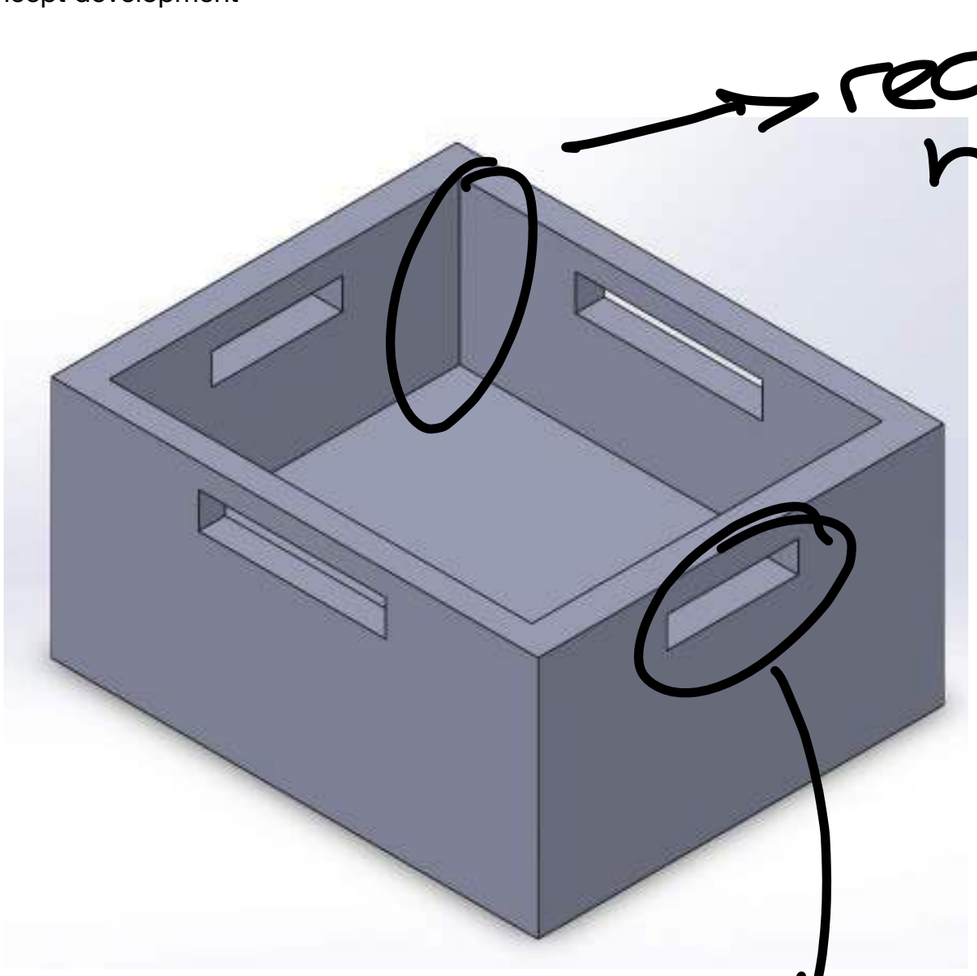

Stand like basket.

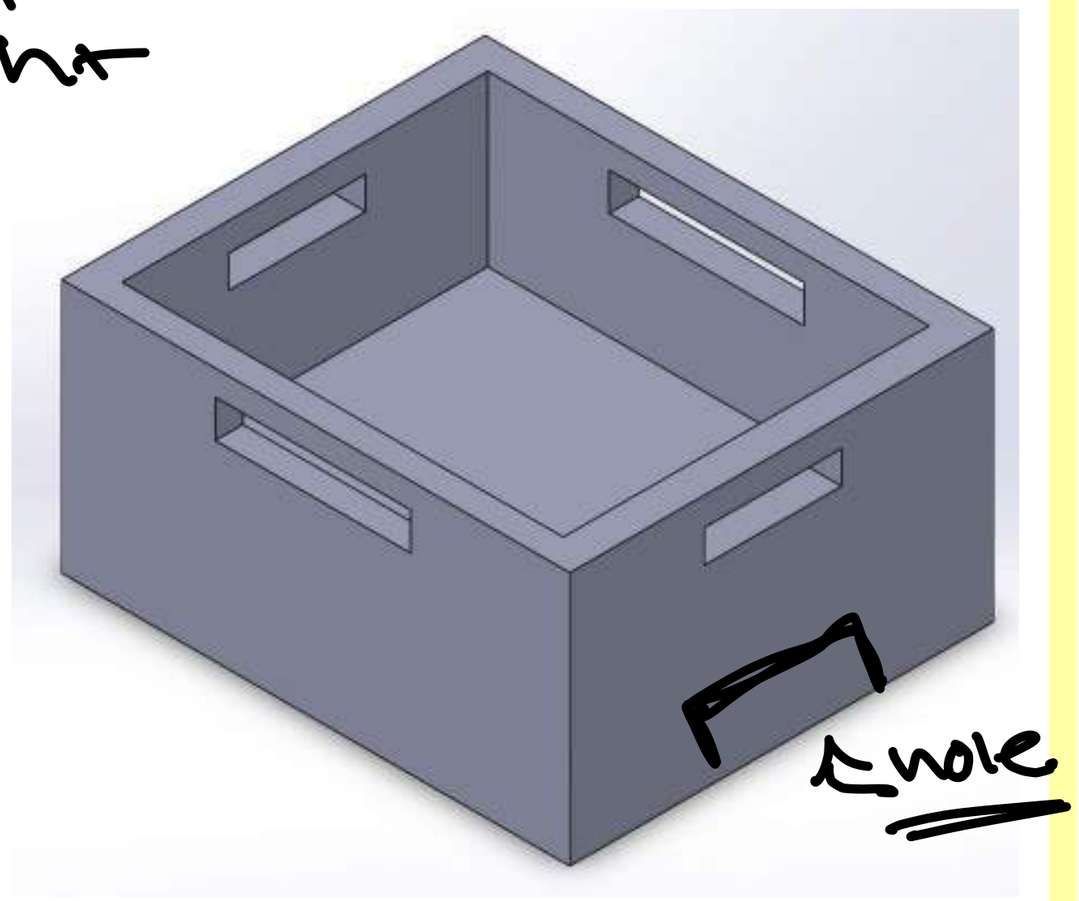
Concept development

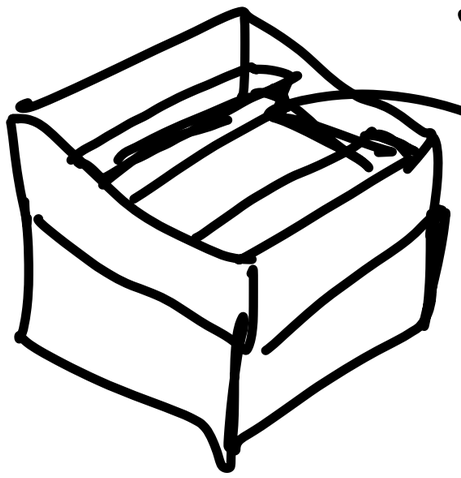


Box design

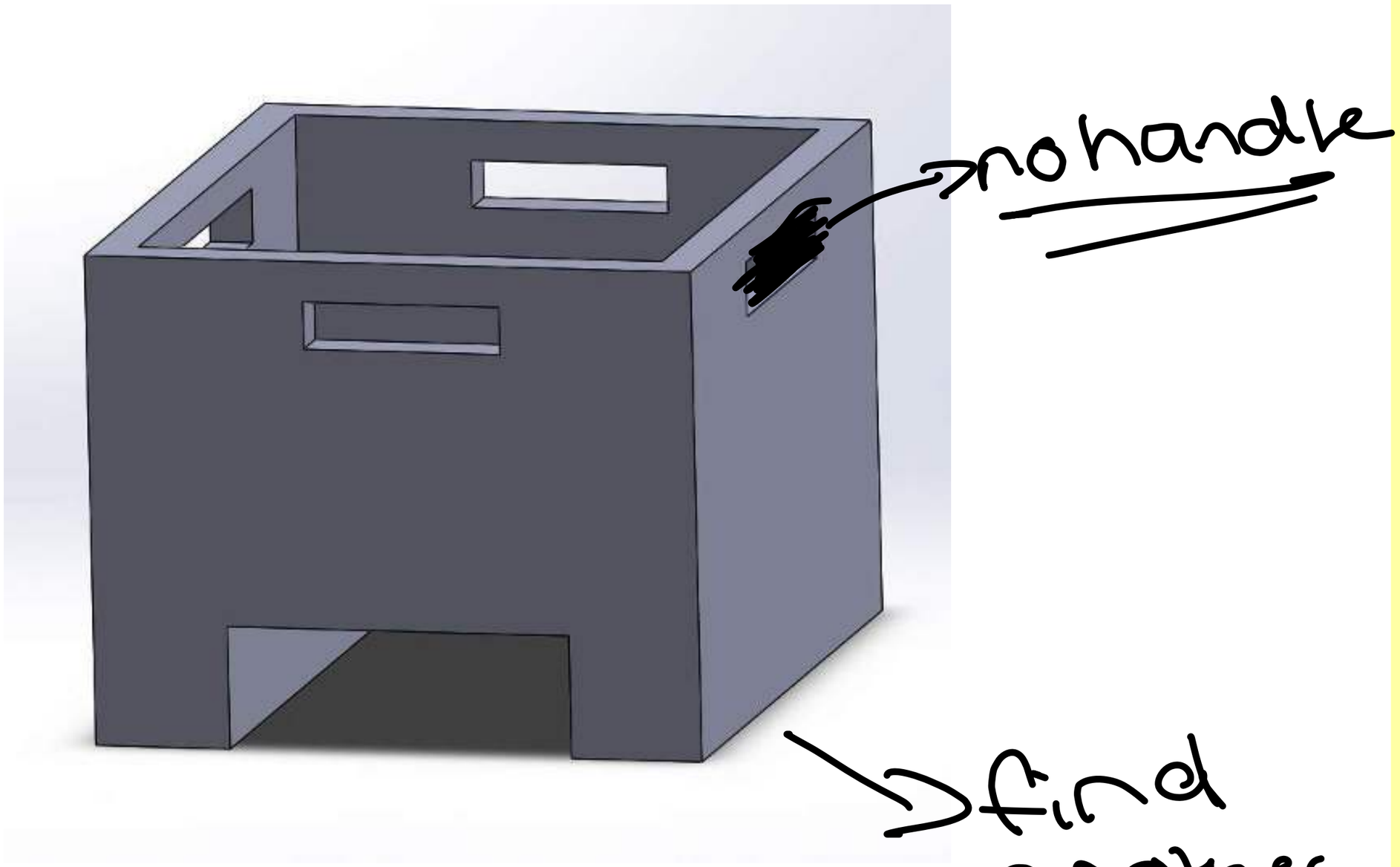
Concept development



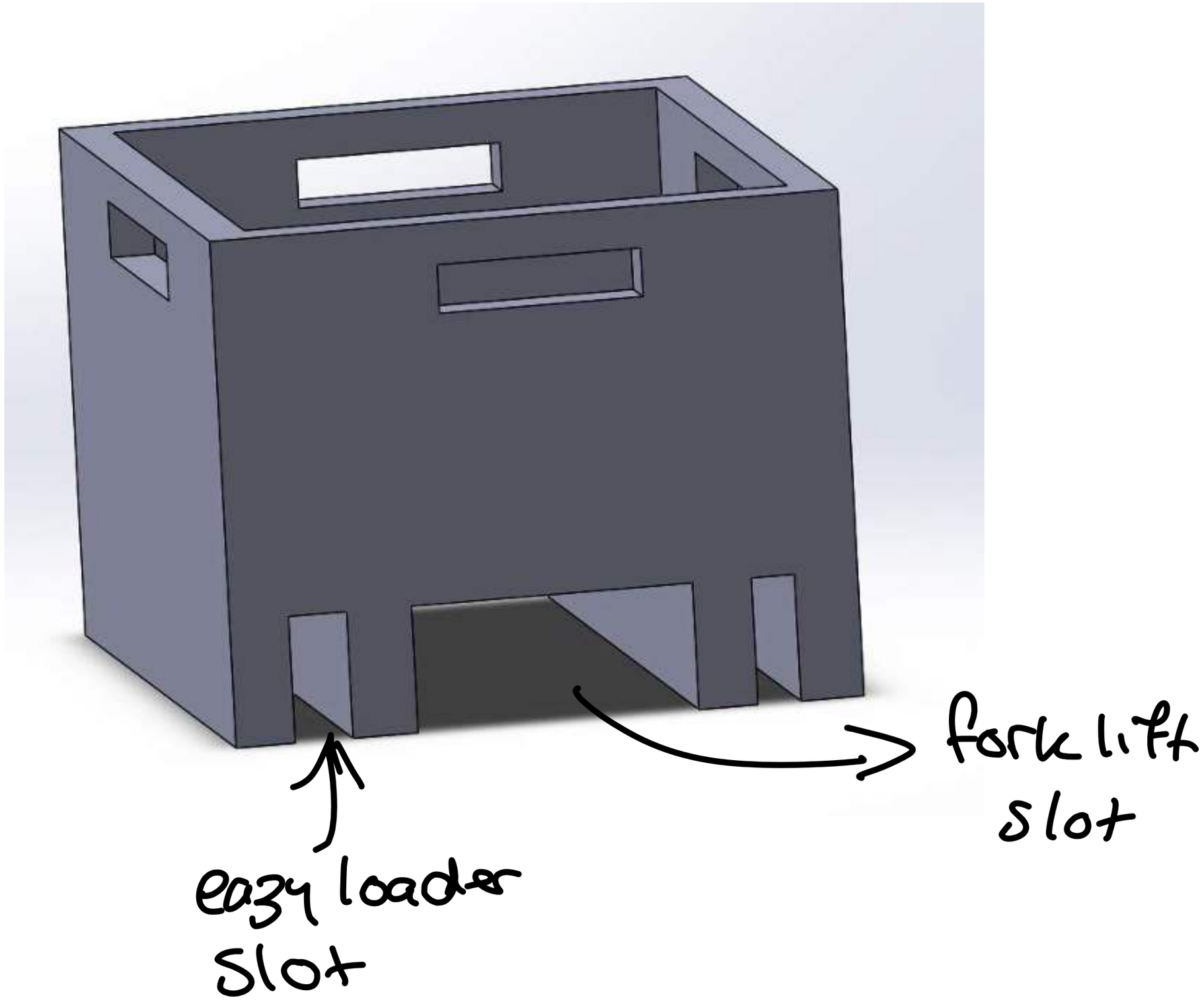




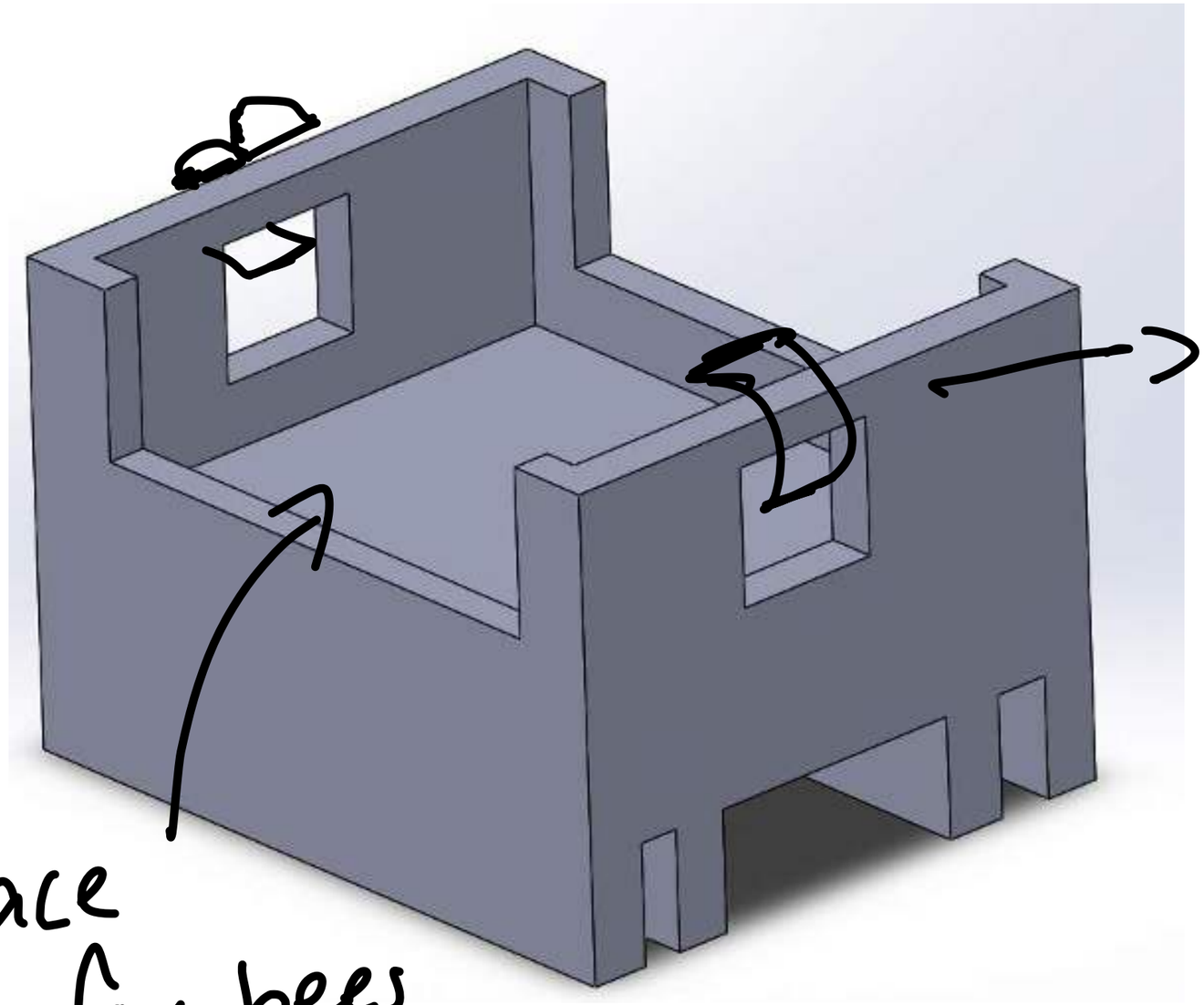
Concept development

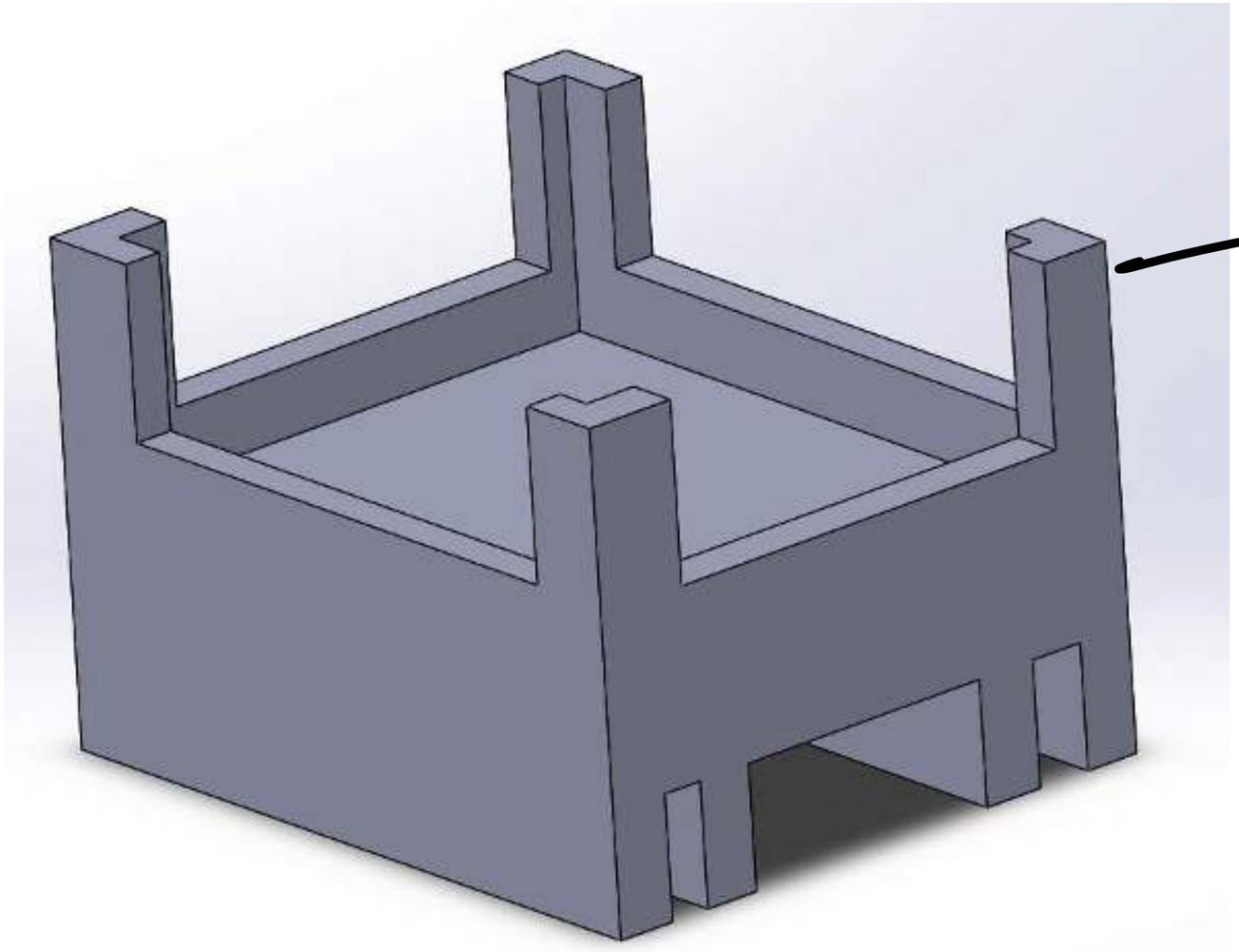


Concept development



Concept development

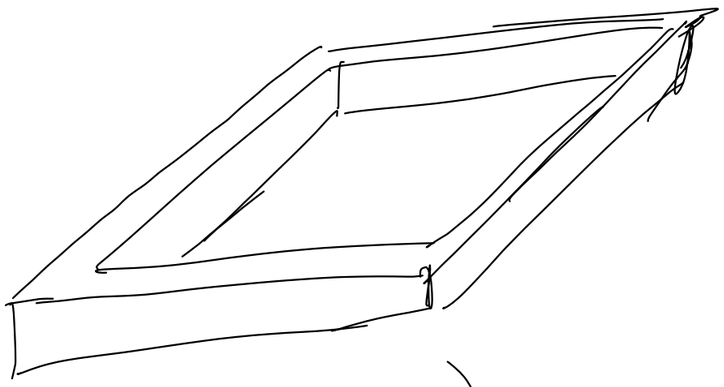




Structure

Stability

Concept development



add spot for forklift prong.

base for beehive to sit in.

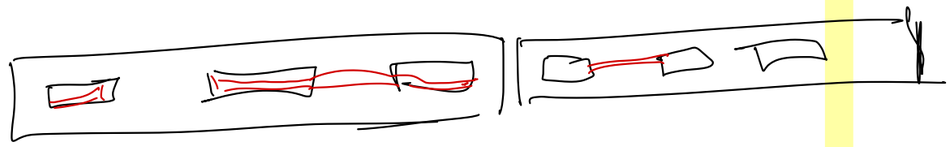
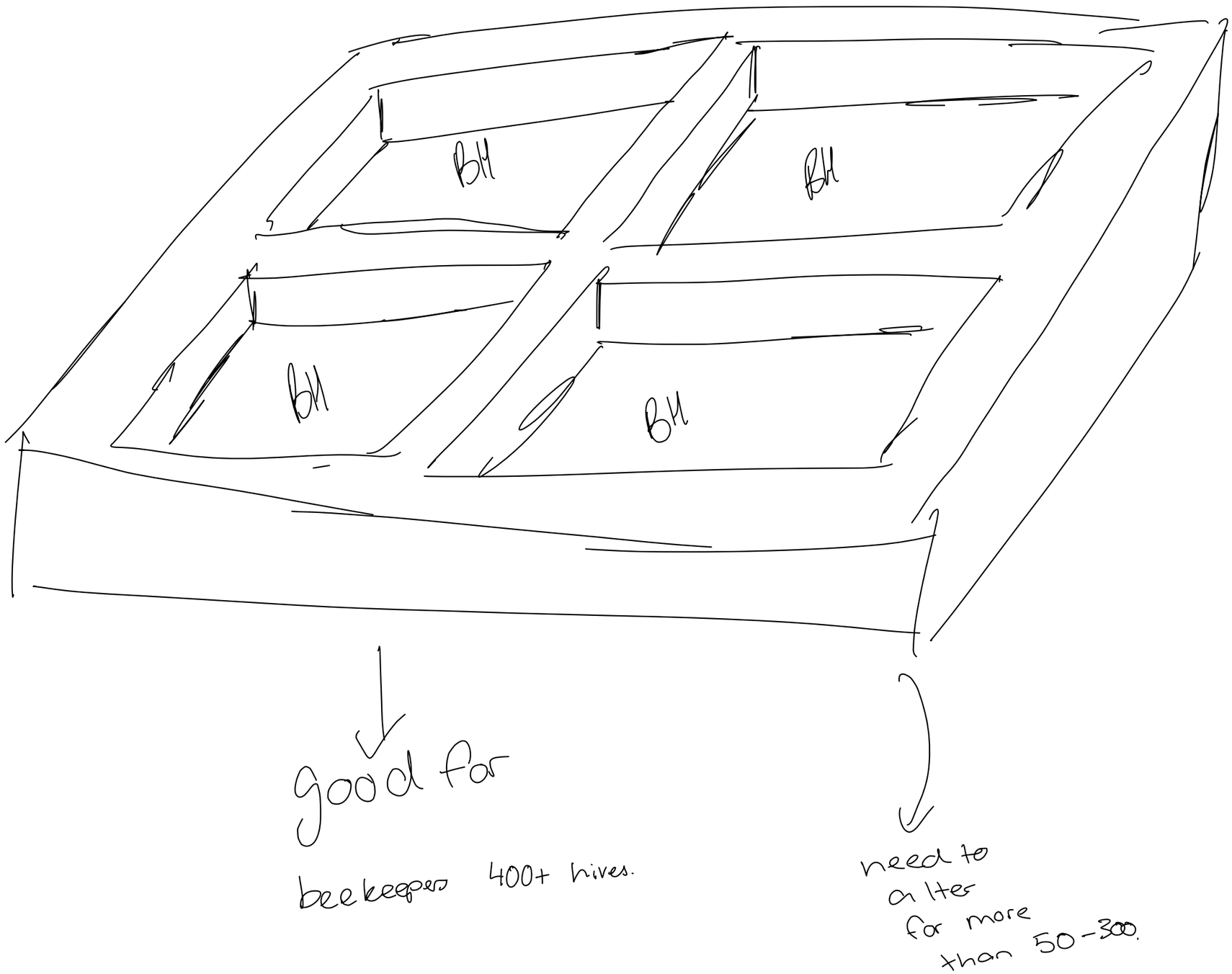
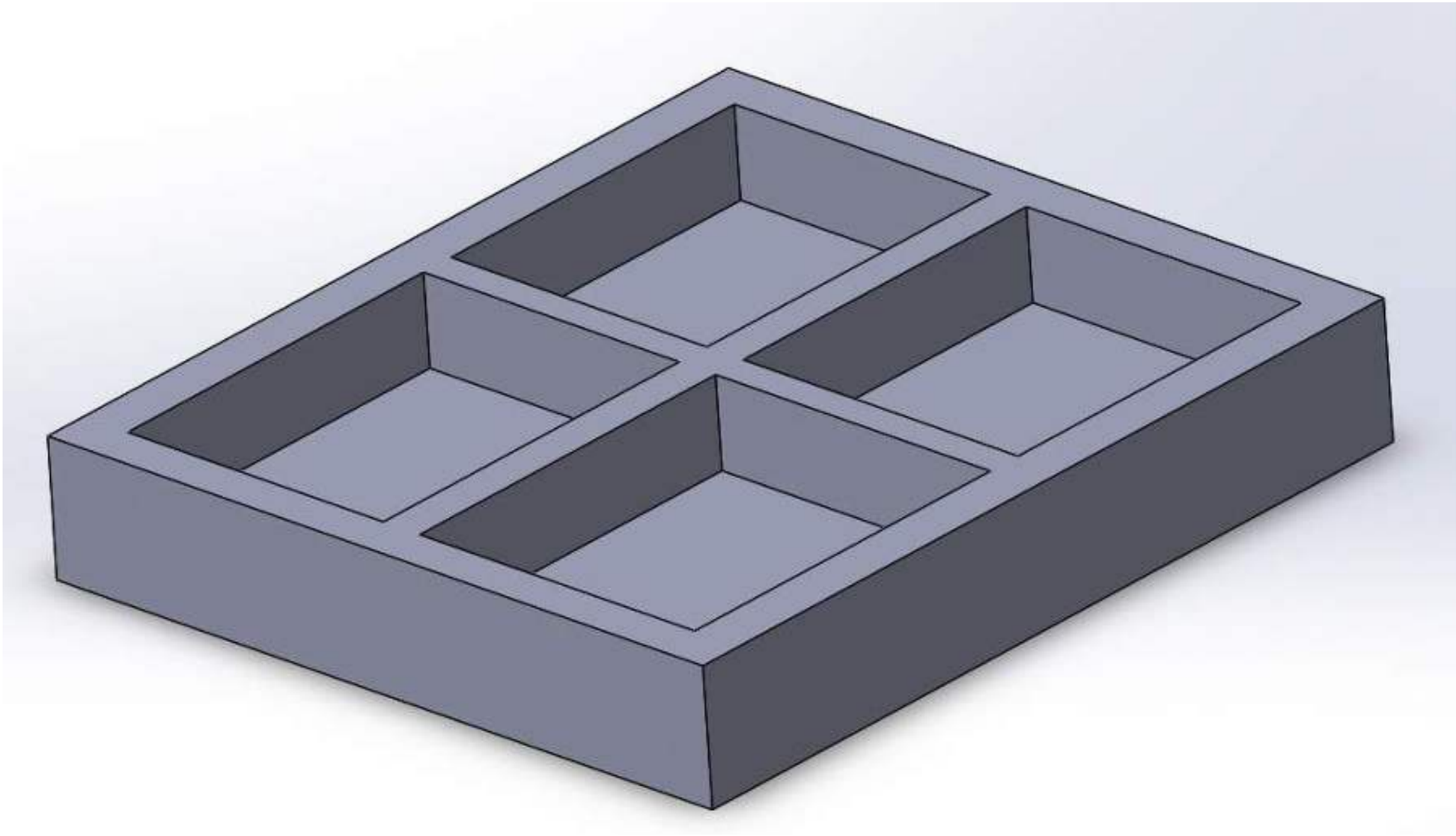


figure how to join them together.

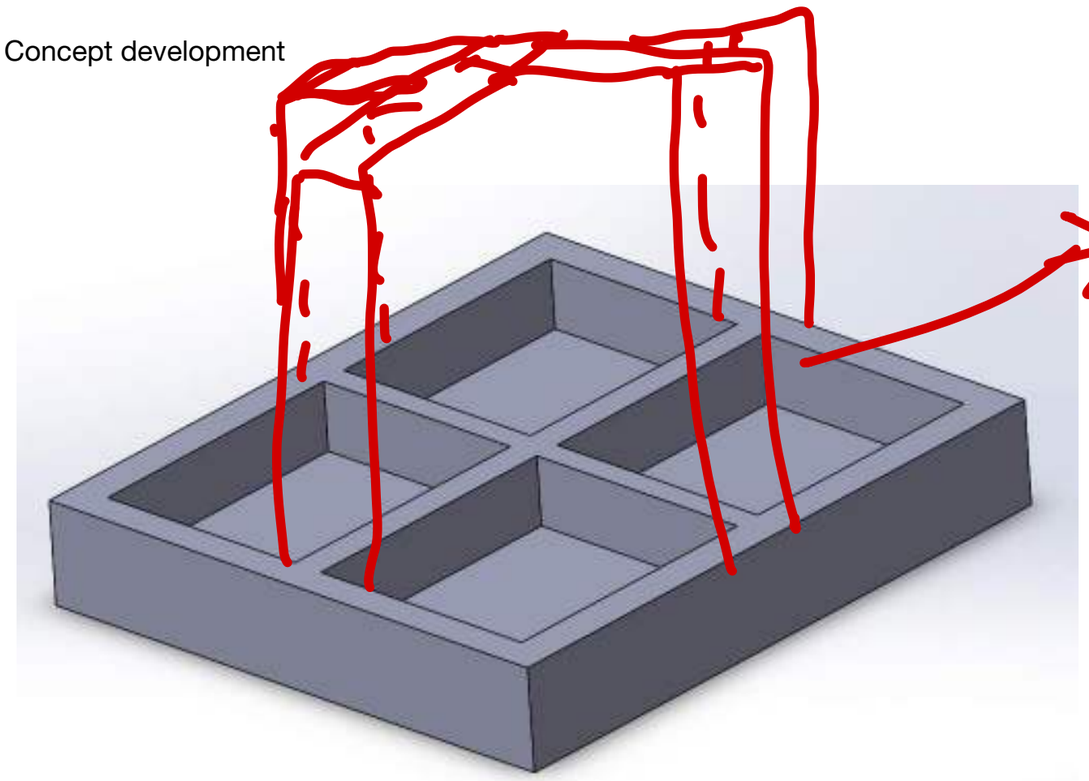
Concept development



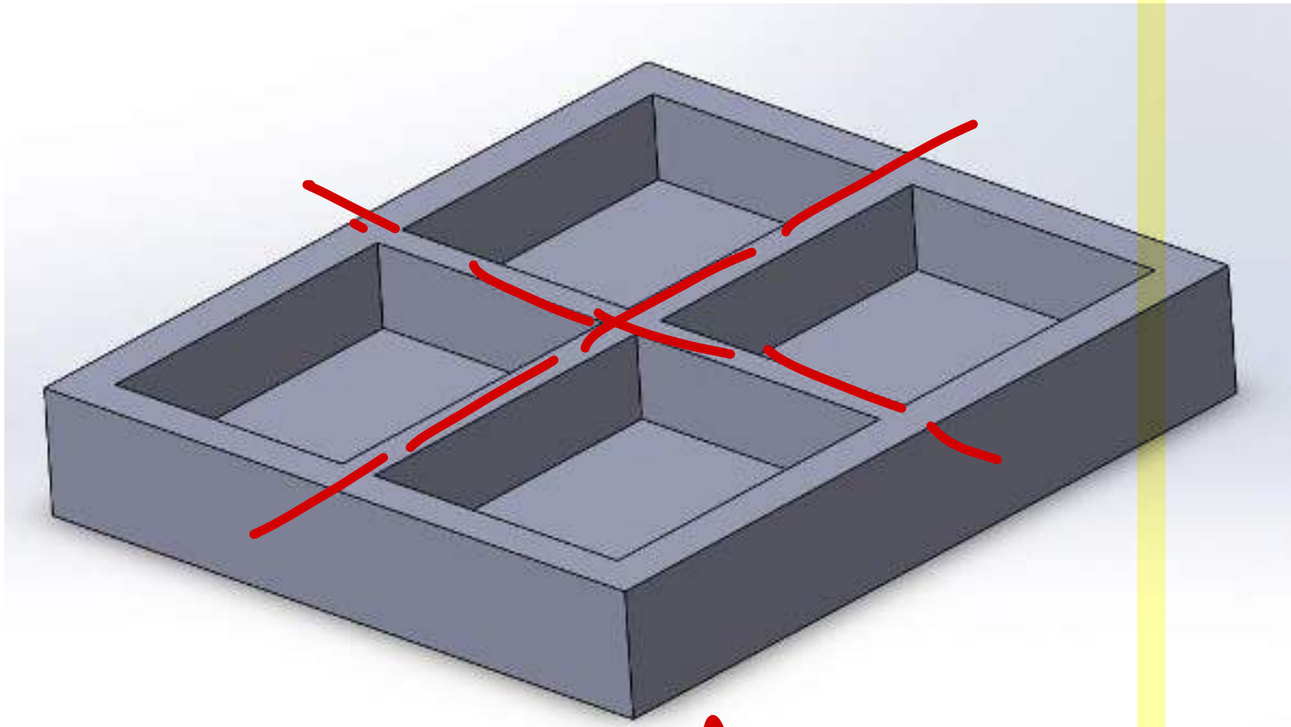
Concept development

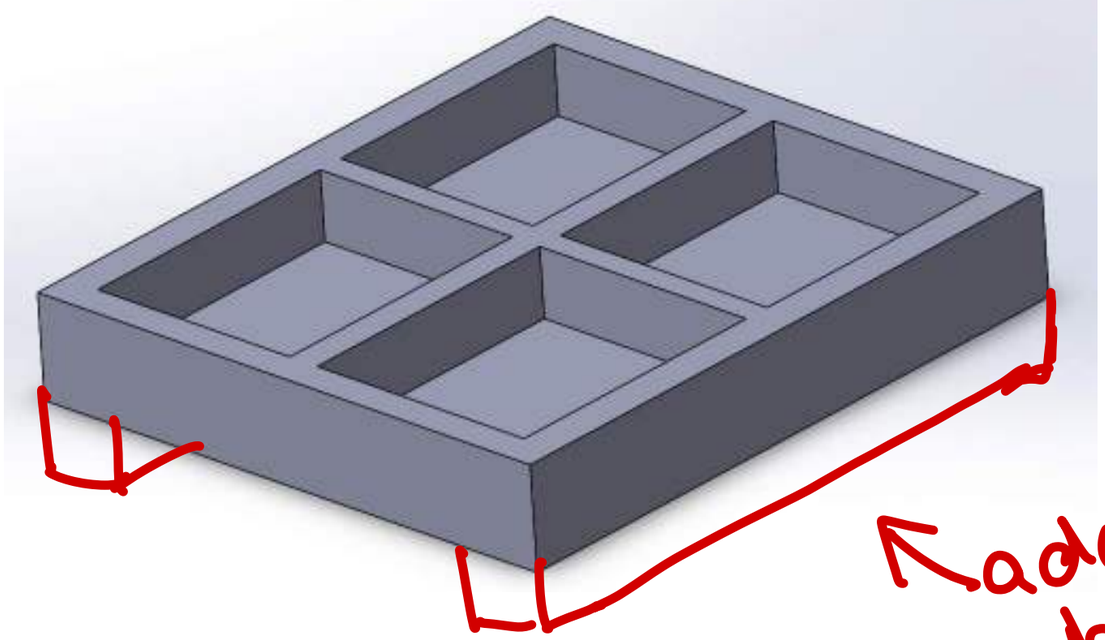


Concept development



straps that go over all 4 hives.





adding base.

individual that make apallet.

Prototyping

Adhesive Bonding:

- Glue: Using various types of glue, such as wood glue or super glue, to bond the edges or surfaces of the box together.
- Hot Glue: Molten adhesive applied through a glue gun for quick bonding of materials like cardboard and lightweight plastics.
- Epoxy: A strong adhesive that forms a durable bond and is suitable for joining different materials like wood, metal, or plastic.

Joints

Mechanical Fasteners:

- Screws: Commonly used in wooden boxes, screws provide a strong and durable connection when drilled into the material.
- Nails: Nails can be used for joining wooden boxes. They are hammered into the material and can be reinforced with glue for added strength.
- Staples: Staples are often used in cardboard and thin wooden boxes. They are applied using a staple gun.
- Brackets and Corner Braces: Metal brackets or corner braces can be attached to the corners of the box for reinforcement.
- Dovetail Joints: A strong and decorative woodworking joint where pins and tails are carved to interlock, commonly used in high-quality wooden boxes.

Joints

Interlocking Joints:

- Tongue and Groove: A joint where a protruding "tongue" on one piece fits into a matching slot (groove) on another piece, creating a snug fit.
- Mortise and Tenon: A traditional woodworking joint where a tenon (a protruding piece) fits into a mortise (a hole) creating a strong connection.
- Box Joints: Similar to dovetail joints, box joints are created by interlocking fingers of two pieces, providing a sturdy connection.

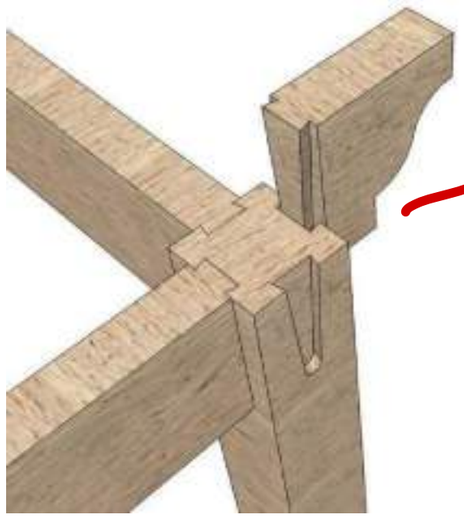
Folded Joints:

- Finger Joints: Also known as comb joints, they are created by interlocking rectangular cuts in corresponding pieces. This joint is common in plywood boxes.
- Dovetail Fold: Folded interlocking joints resembling dovetail joints, often used in folded cardboard or plastic boxes.

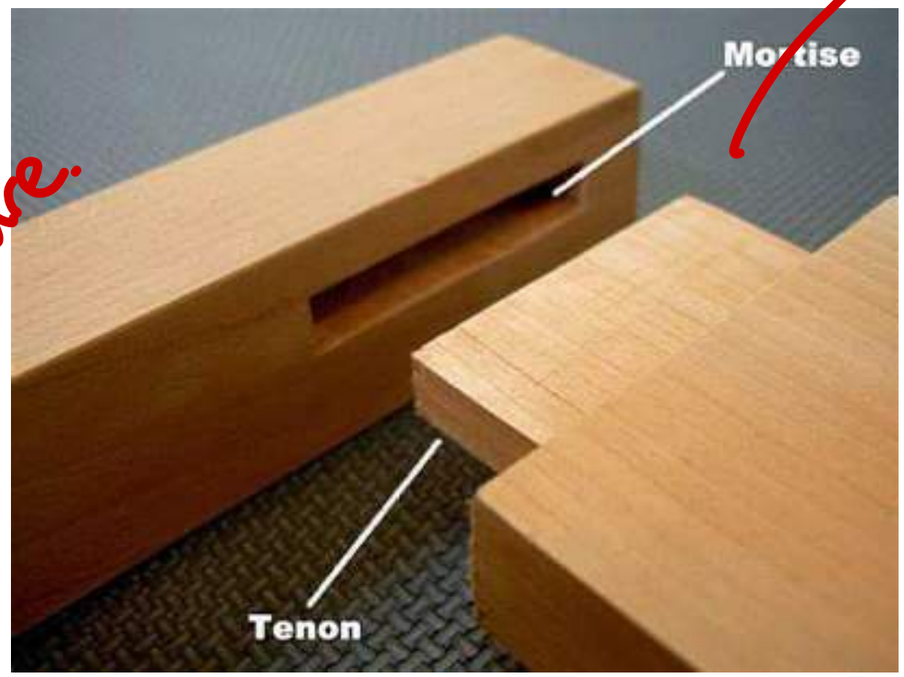
Snap-Fit Joints:

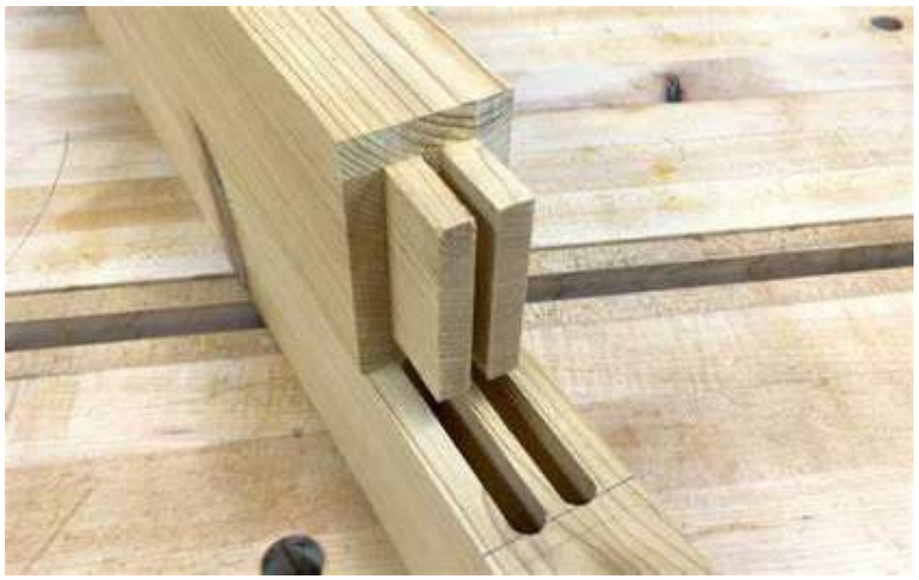
- Snap-Locks: Small plastic protrusions designed to snap into corresponding holes, securing parts together without the need for additional fasteners.
- Tabs and Slots: Tabs on one piece fit into slots on another, creating a secure connection without adhesives or fasteners.

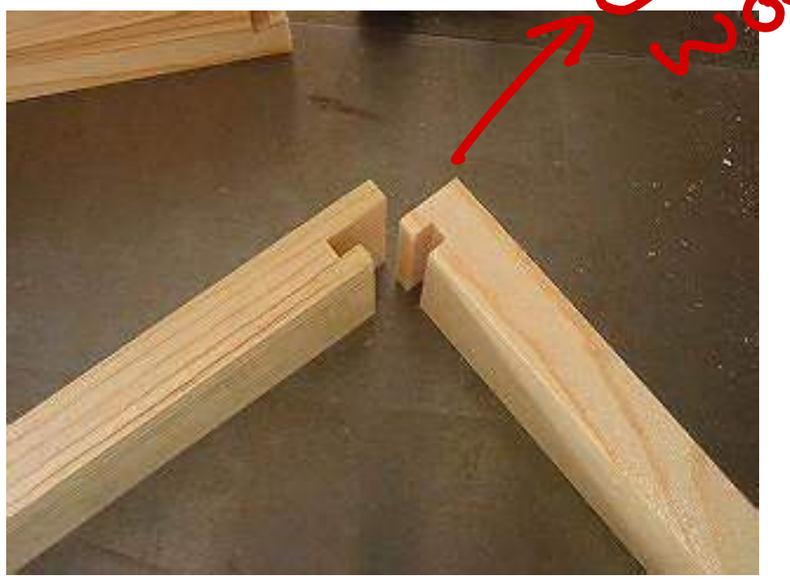
Types of joints that can be used



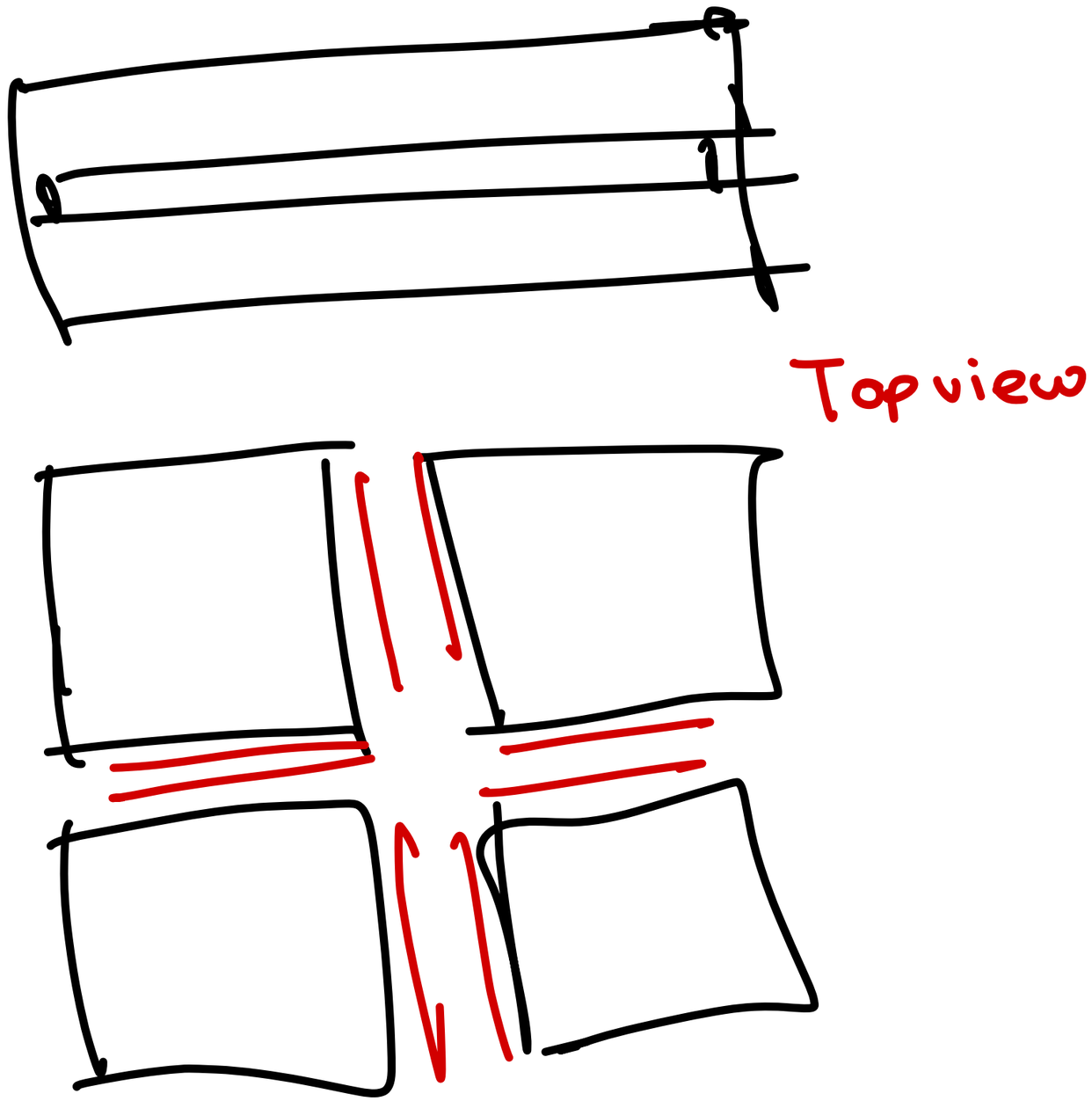
Tenon



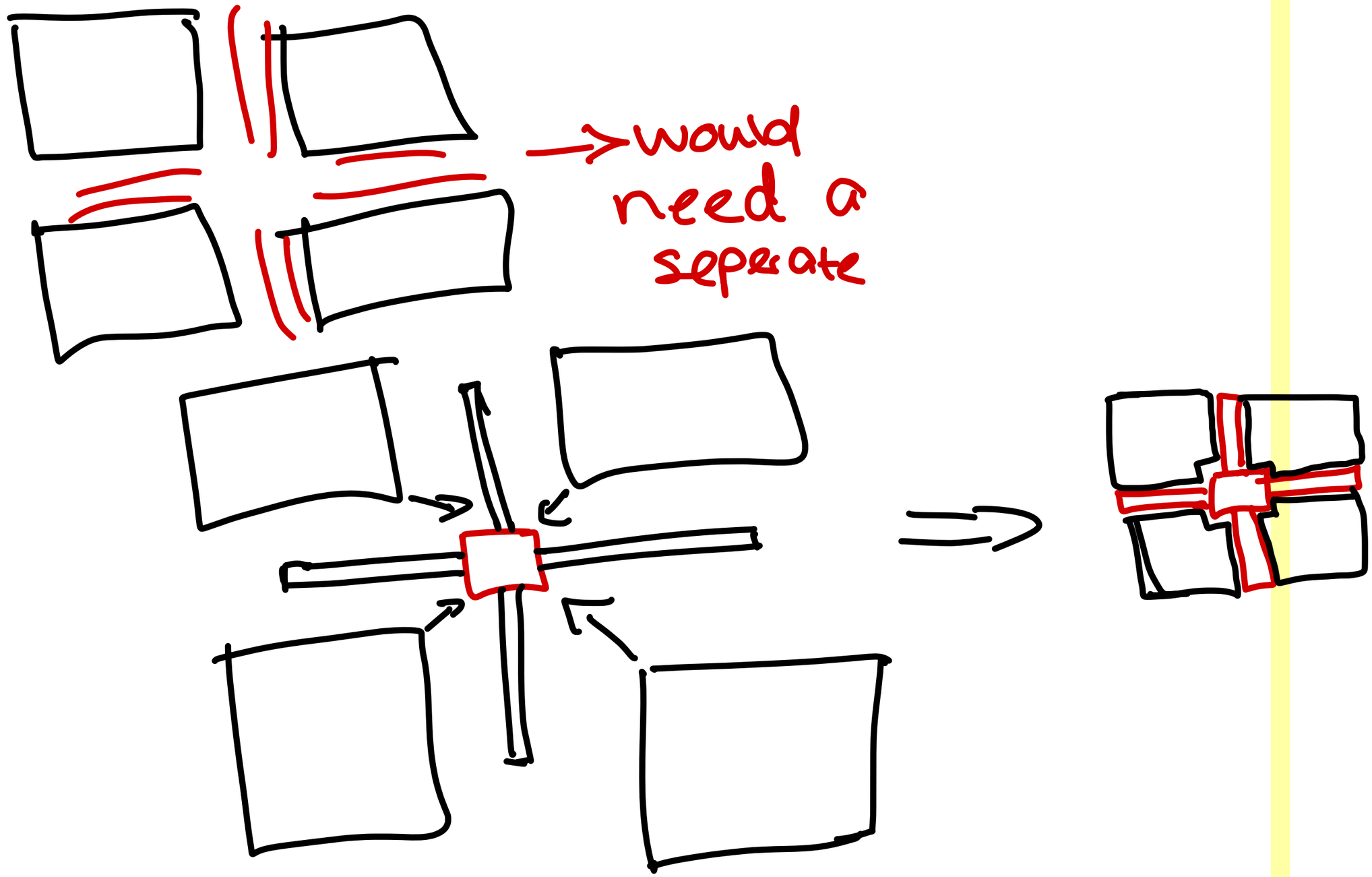




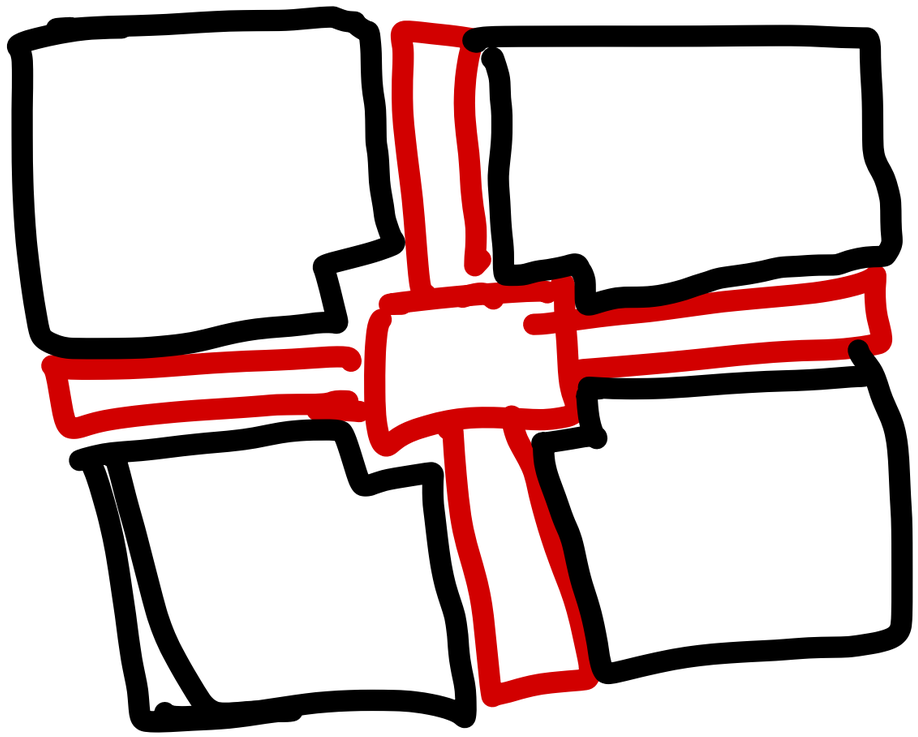
Concept development

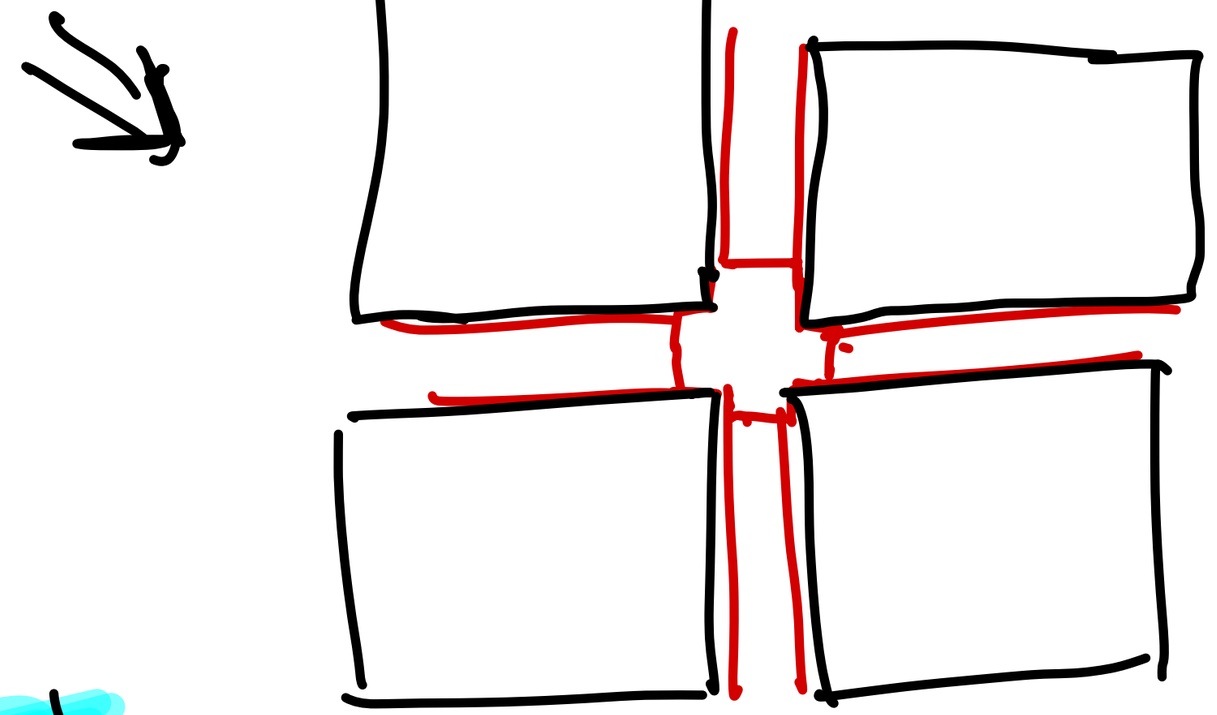


Concept development



Concept development

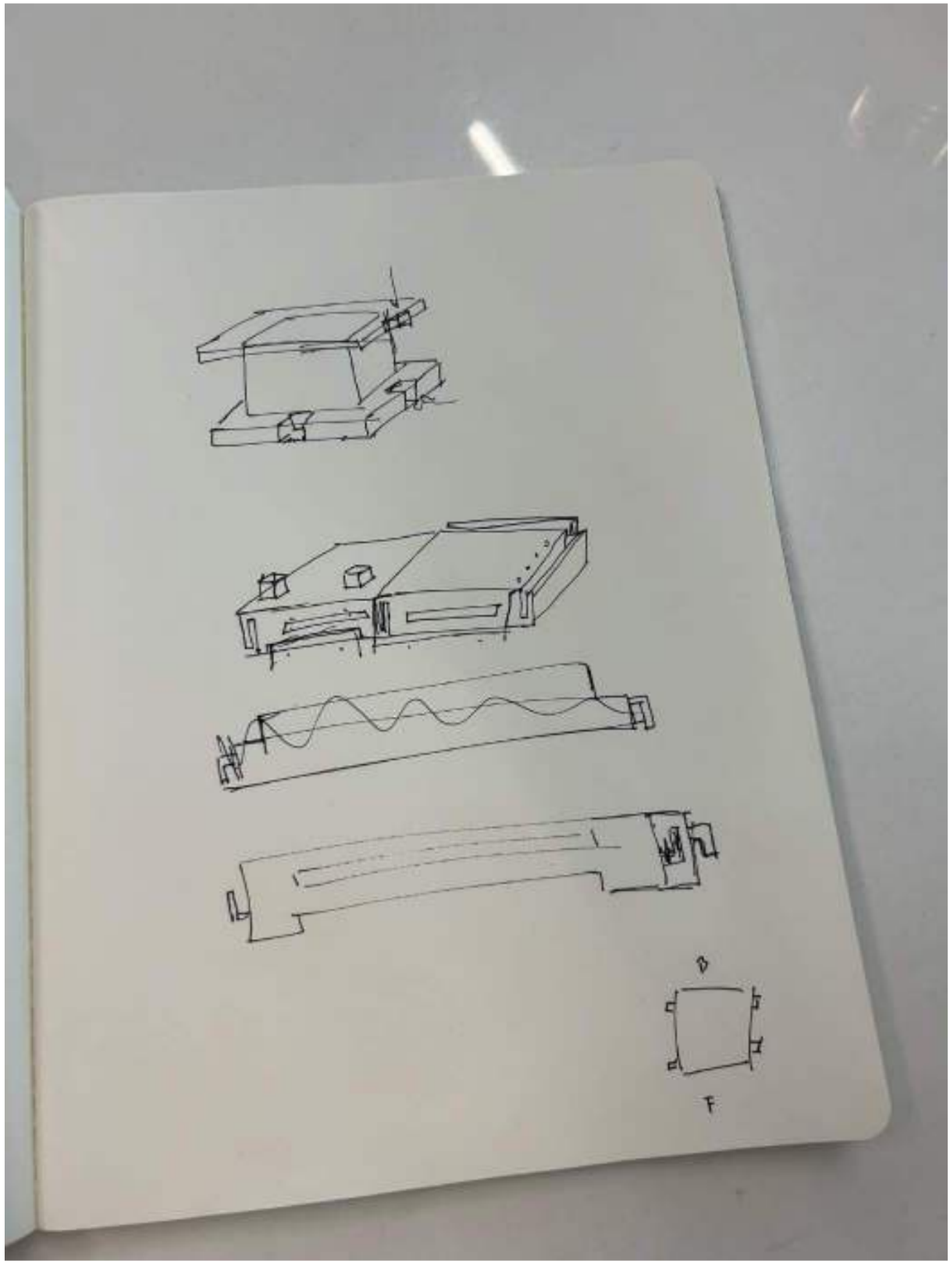




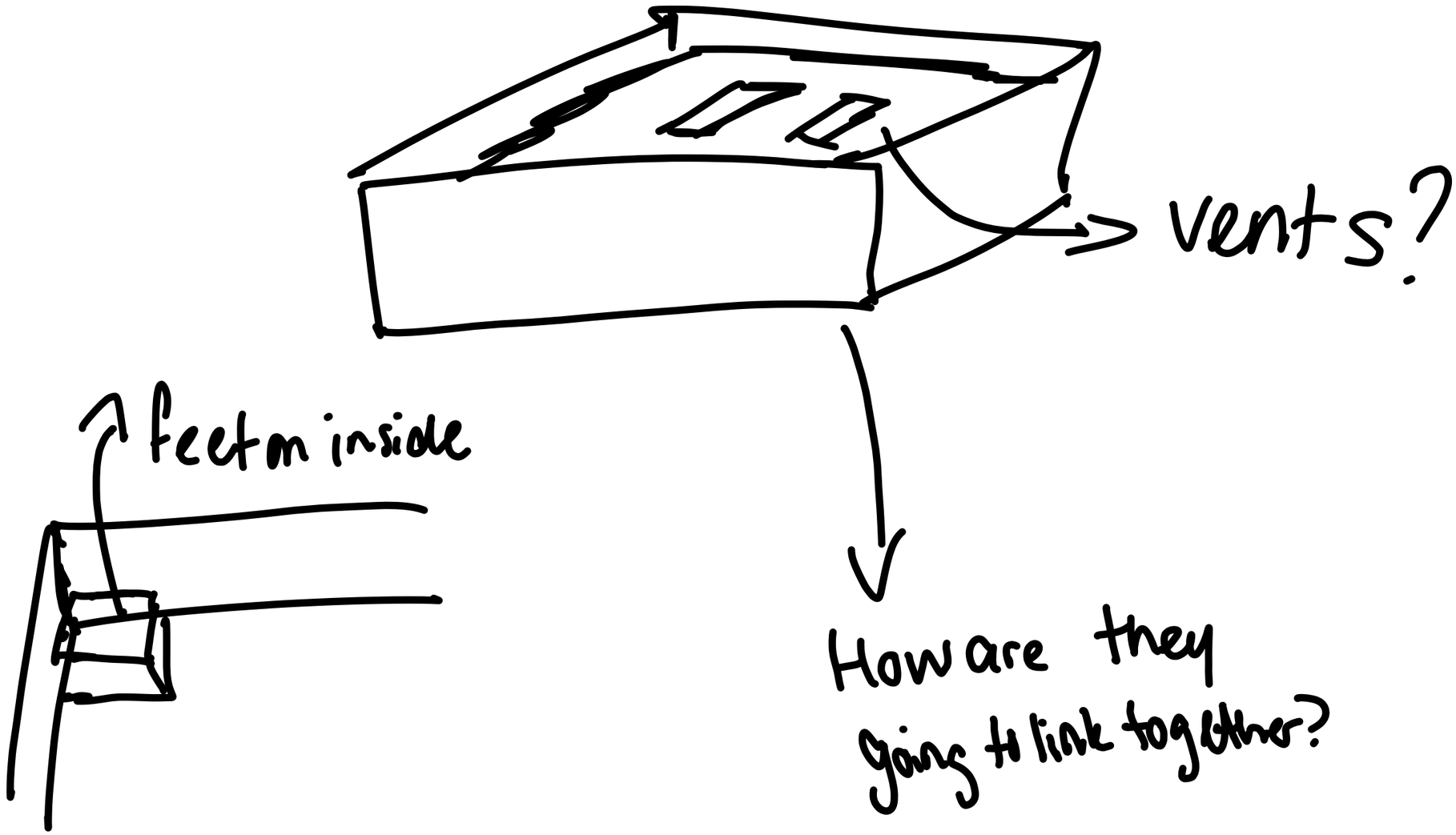
not practical...

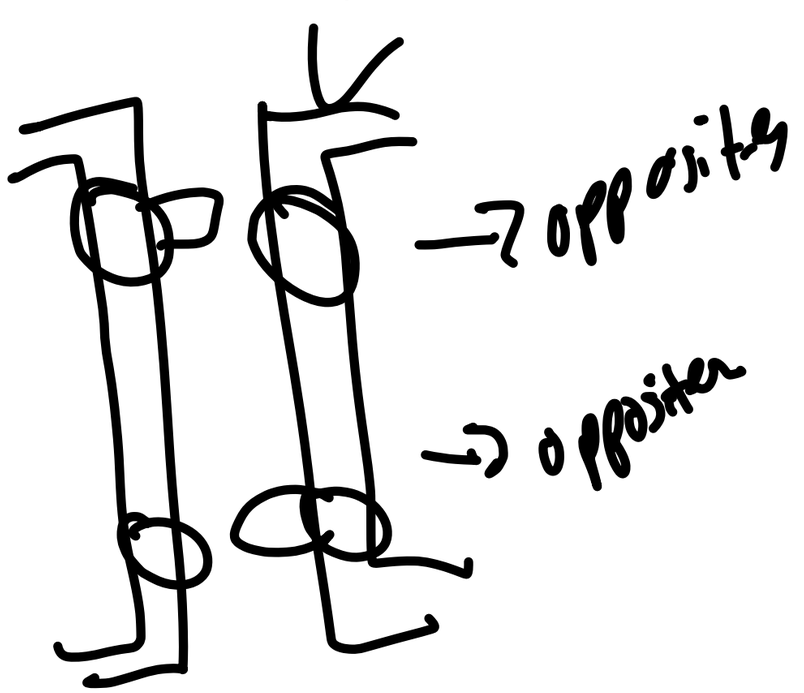
won't be secure on one side.

Prototyping



Prototyping


vents?
feet on inside
How are they going to link together?
Clips? Straps?



Would need to be attached Only to one side.

Snap lock Joint.

not sure
how it will work large scale.

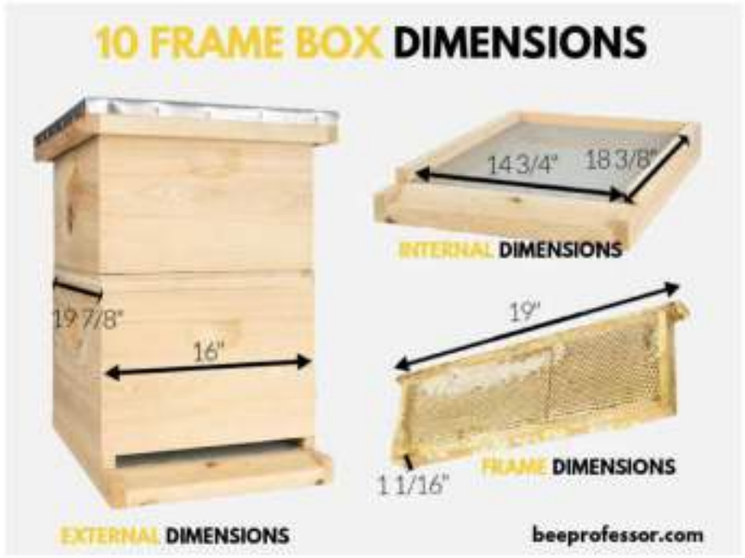
could work

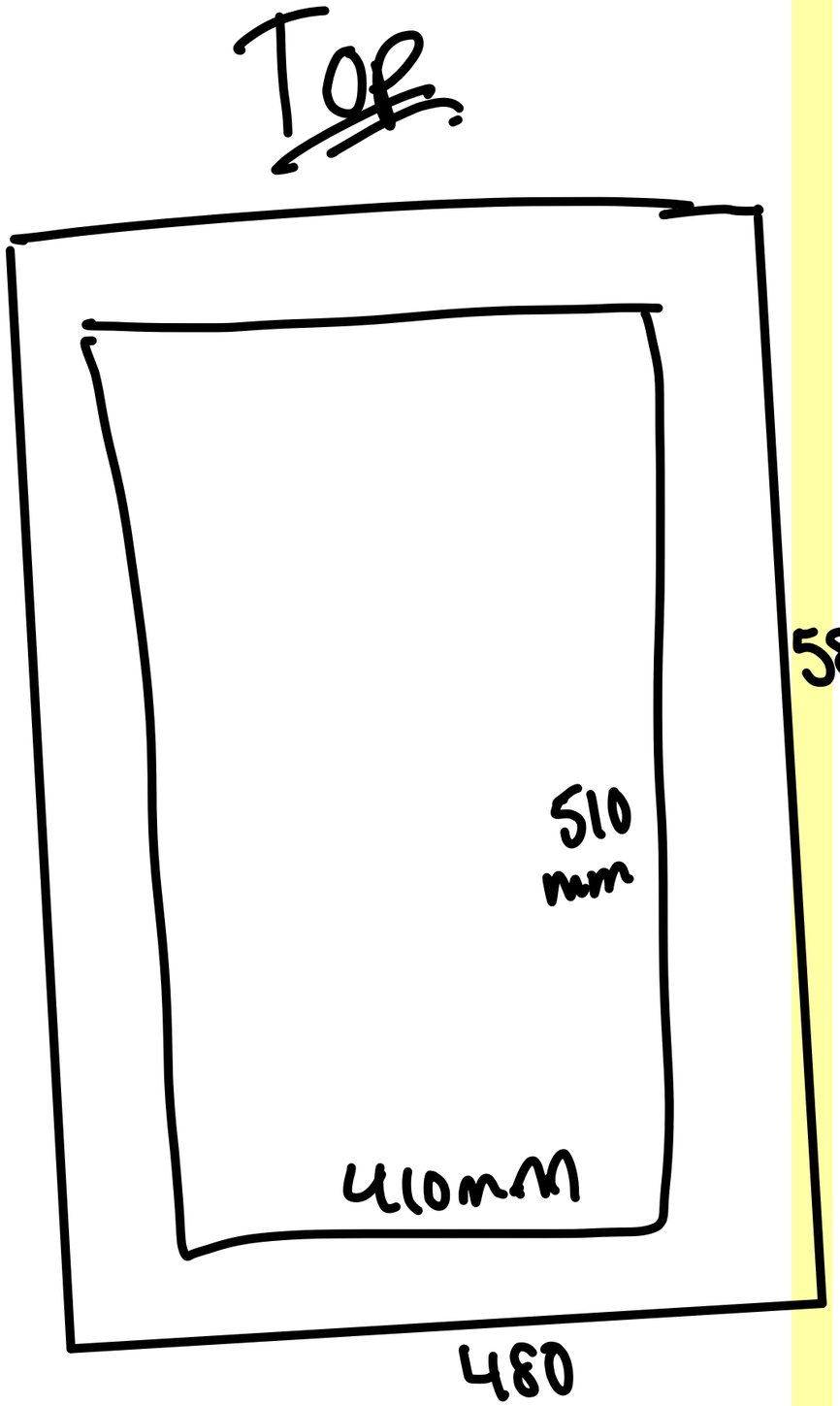
Summary of 8 frame box dimensions

Box type	Interior Width	Interior length	Depth
Deep	12 ¼"	18 ⅜"	9 ⅝"
Medium	12 ¼"	18 ⅜"	6 ⅝"
Shallow	12 ¼"	18 ⅜"	5 11⁄16"

Summary of 10 frame box dimensions

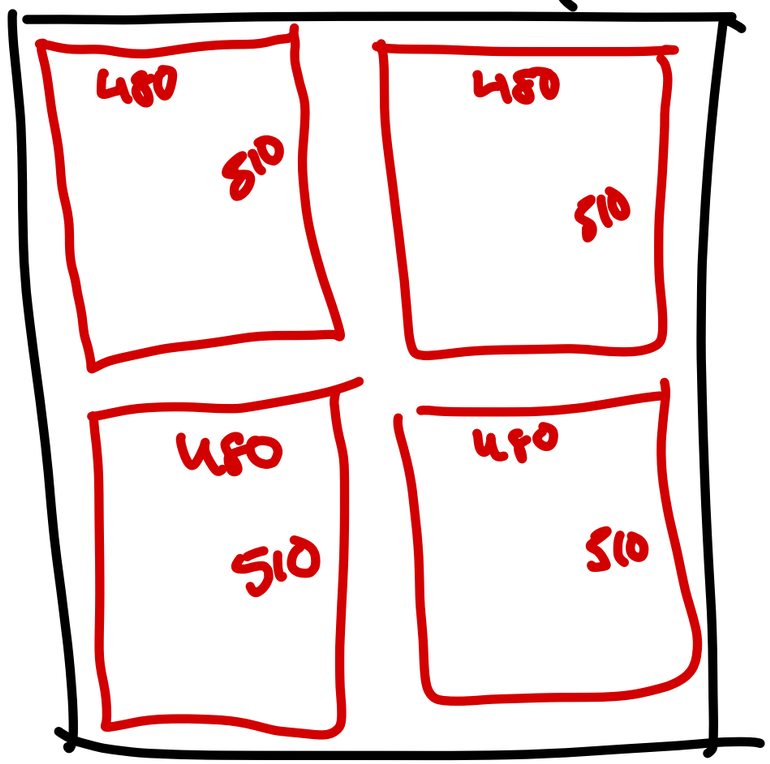
Box type	Interior Width	Interior length	Depth
Deep	14 ¾"	18 ⅜"	9 ⅝"
Medium	14 ¾	18 ⅜"	6 ⅝"
Shallow	14 ¾"	18 ⅜"	5 11⁄16"





iso pallet

1016mm

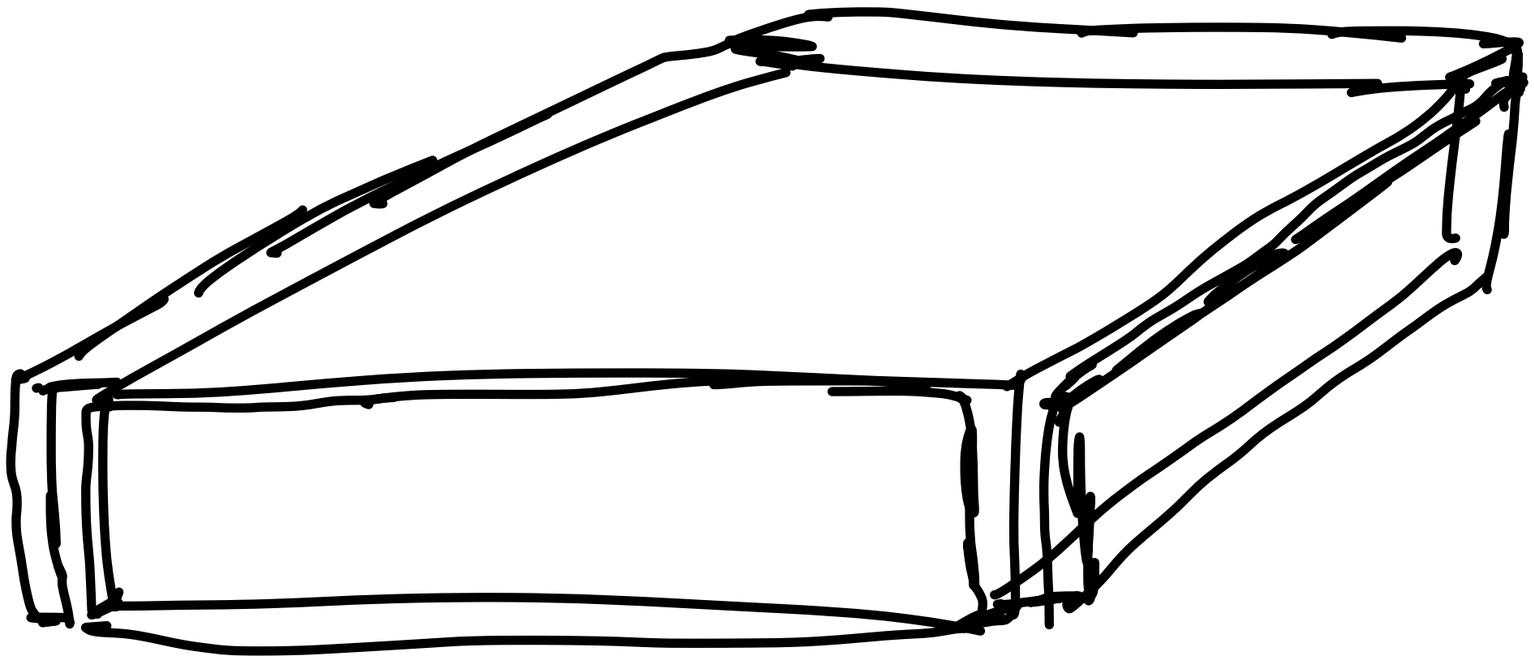


1219.2mm

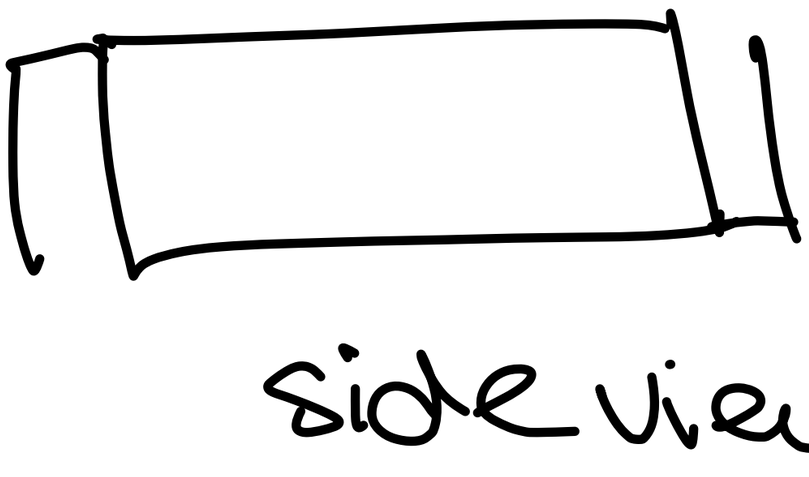
||

Still smaller than an iso pallet.

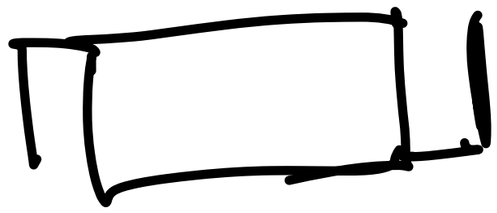
Concept development



Concept development

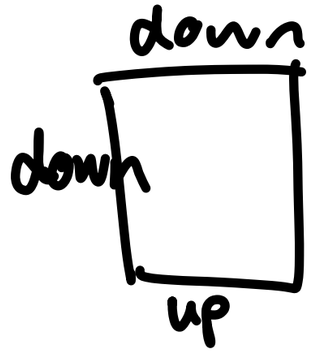


side view



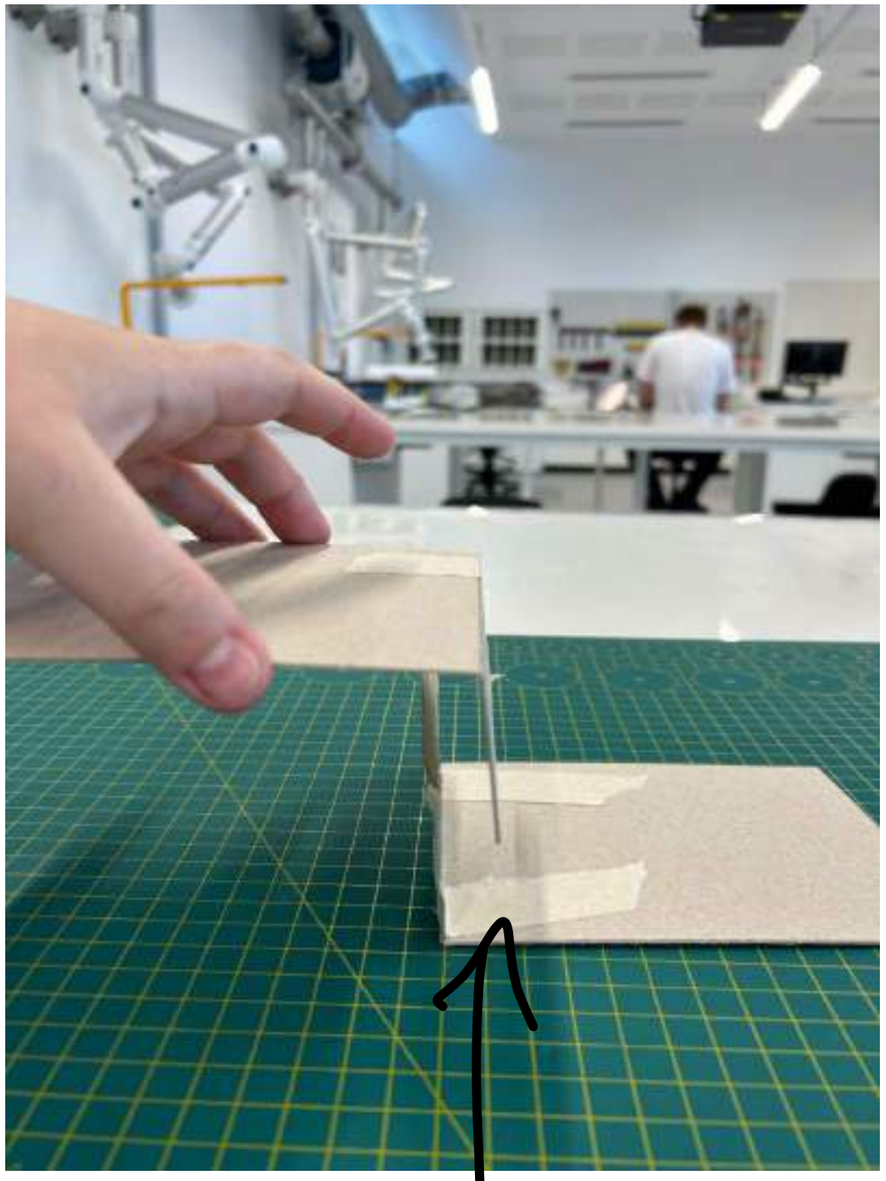
front view

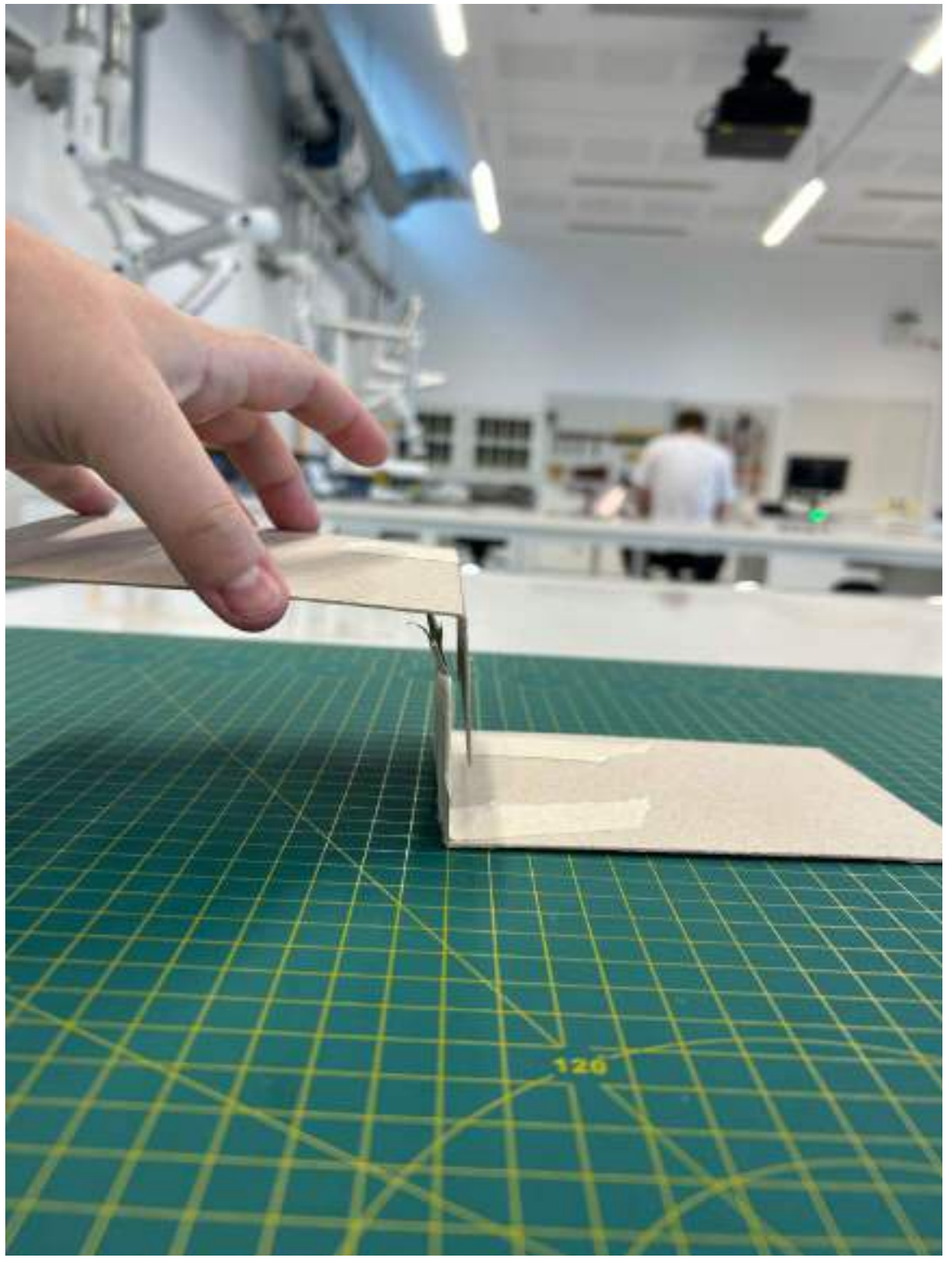
— will need to be



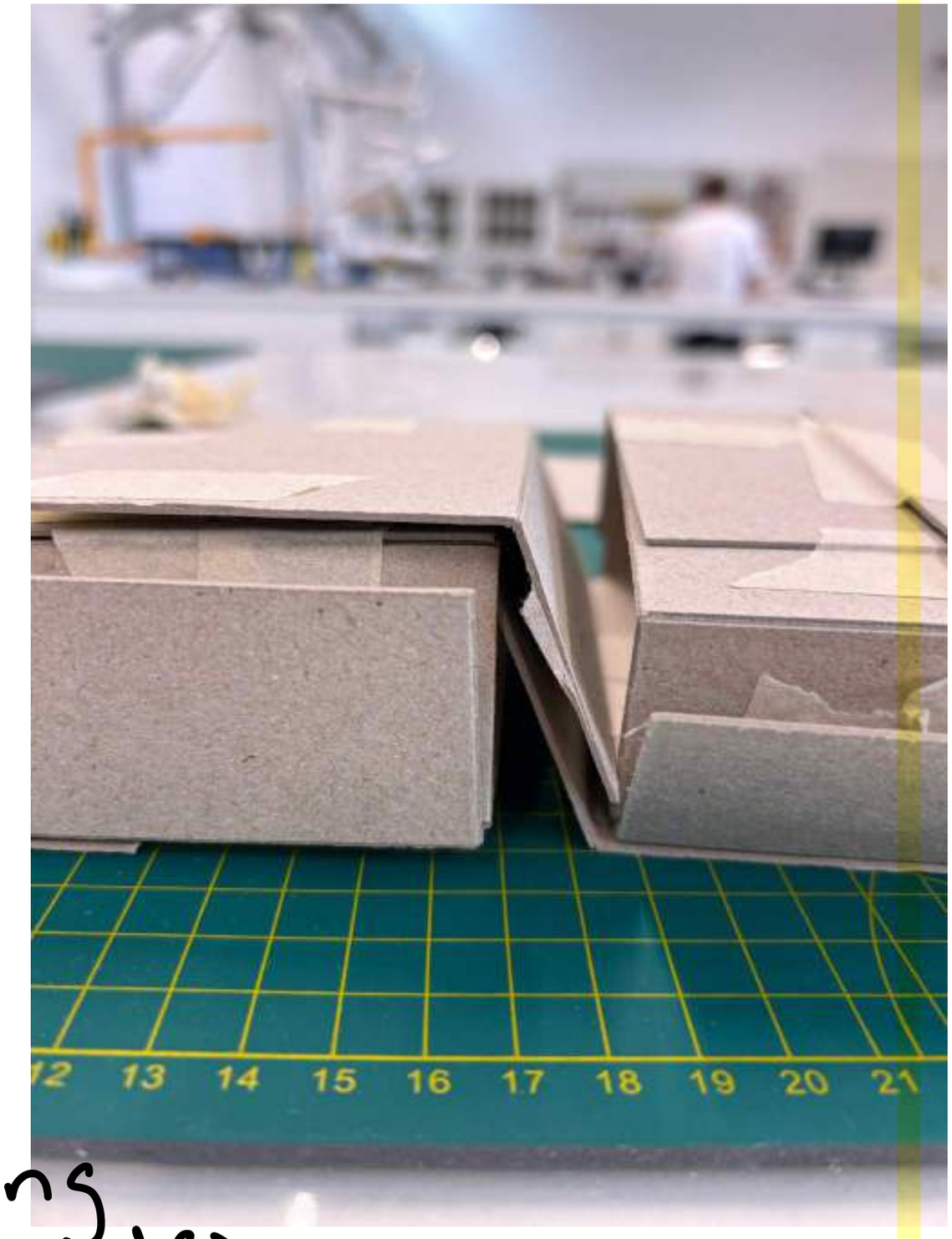
sothey can be interlocked

Prototyping

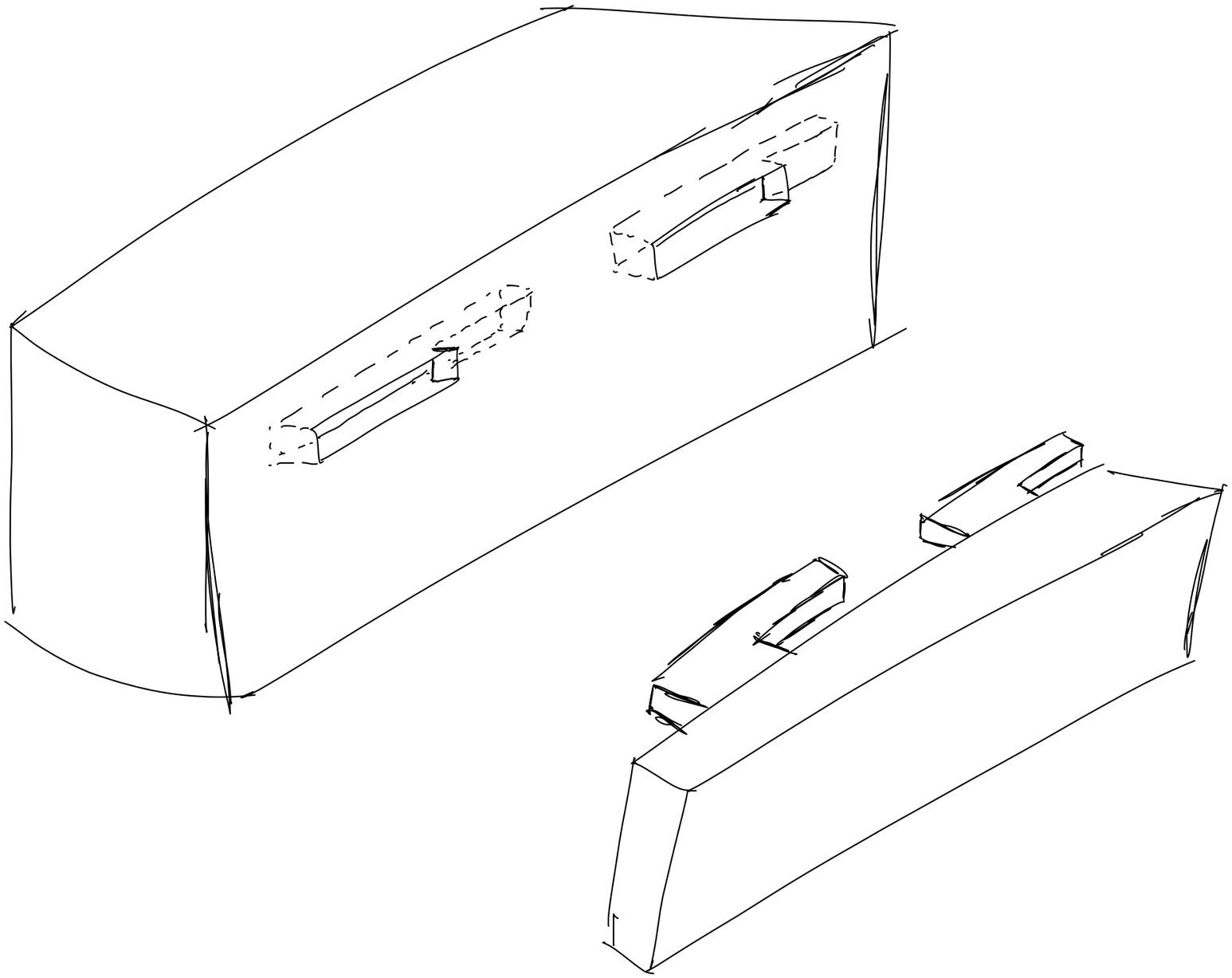




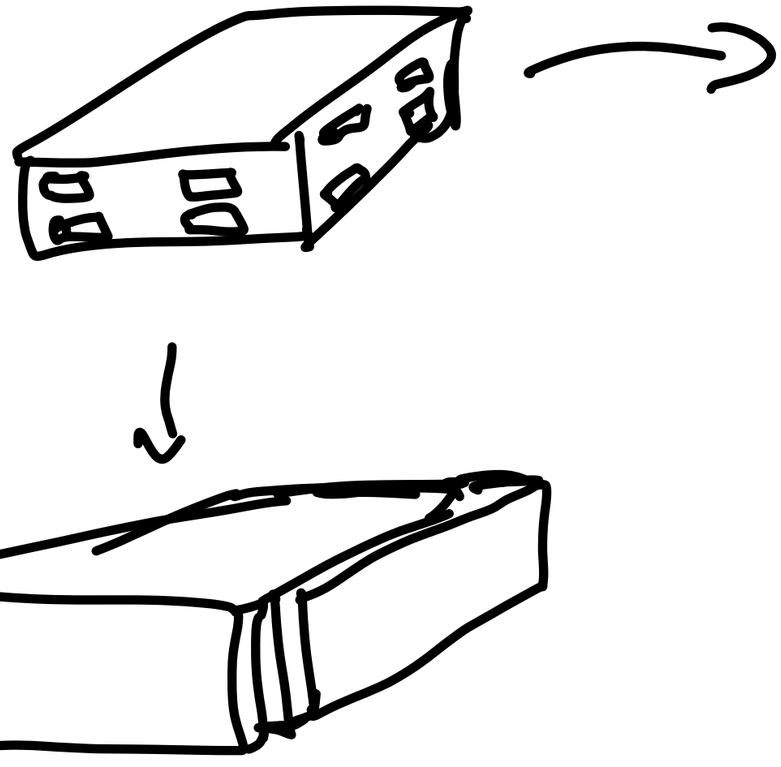
Prototyping



Modular hive box

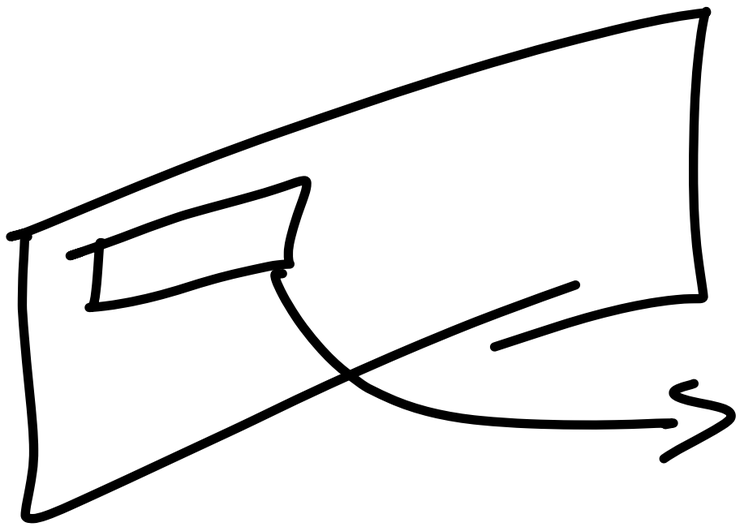


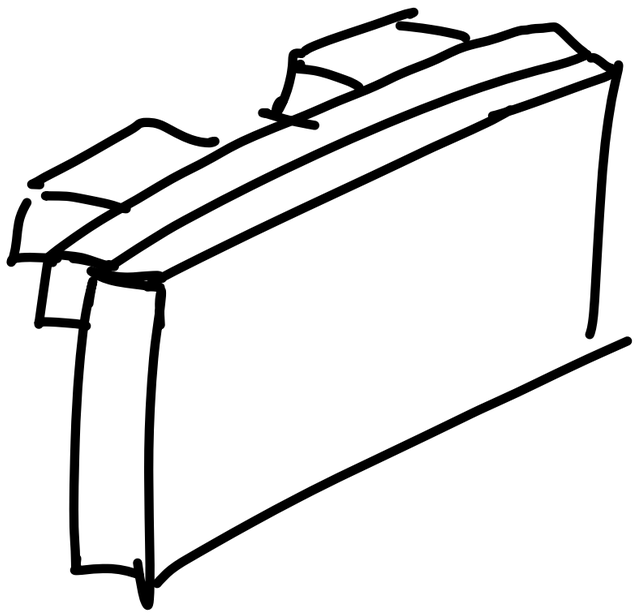
- can arms be modular?

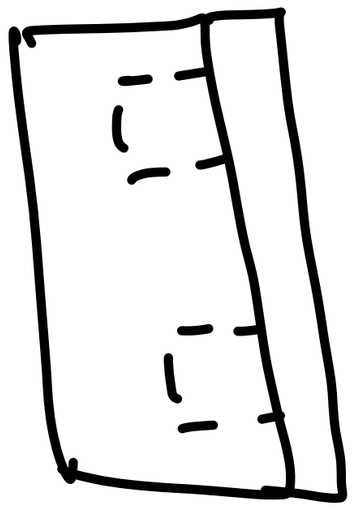


bee keeper can interchange arms.

or have none at all.







mortise & tennon joint

↳ not very secure if being joined to multiple hive boxes.

found in bunnings.

modular so can be replaced.

Prototyping

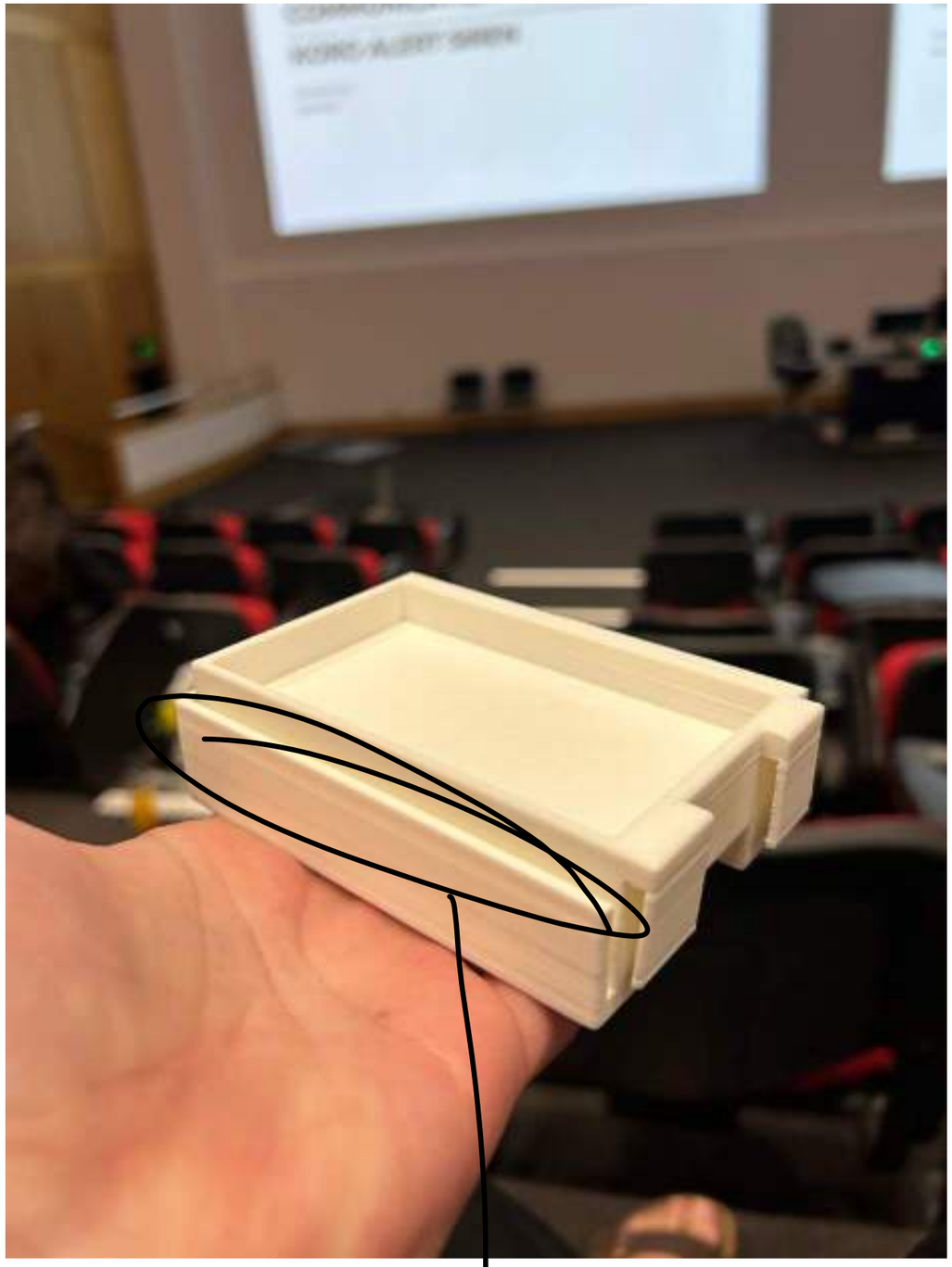
Prototyping

Prototyping

Can't use on a larger scale as Joint is too small for a full scale product.

fit all together

Prototyping



Materials

Current materials

Wood:
- Softwood (Pine, Spruce): Softwood pallets are lightweight and cost-effective. They are commonly used for one-way shipments and are recyclable.
- Hardwood (Oak, Maple): Hardwood pallets are more durable and suitable for heavy loads. They have a longer lifespan and are often used for multiple trips. They are also recyclable and can be repaired easily.

Plastic:
- Plastic pallets are lightweight, durable, and resistant to moisture, chemicals, and insects. They are easy to clean and are often used in industries where hygiene is crucial, such as pharmaceuticals and food processing. Plastic pallets have a longer lifespan than wooden pallets but are more expensive.

Metal:
- Metal pallets, usually made from aluminum or steel, are exceptionally strong and durable. They are resistant to fire, insects, and chemicals. Metal pallets are often used for heavy machinery and equipment. They have a long lifespan but are considerably heavier than wooden or plastic pallets.

Paper:
- Paper pallets are lightweight and often used for light to medium loads. They are eco-friendly, recyclable, and biodegradable. Paper pallets are commonly used in industries where weight is a concern, such as air freight.

Composite:
- Composite pallets are made from a combination of different materials, such as wood and plastic. They aim to combine the durability of plastic with the cost-effectiveness of wood. These pallets are often used for medium to heavy loads and offer a balance between strength and affordability.

Materials

Types of plastics

Polypropylene (PP)
- Durability: Polypropylene is known for its toughness and durability, making it suitable for various applications where impact resistance is essential.
- UV Resistance: PP has good resistance to ultraviolet (UV) radiation, making it suitable for outdoor applications where prolonged exposure to sunlight is a concern. UV-stabilized PP grades are available for enhanced UV resistance.
- Weatherproof: Polypropylene is naturally resistant to moisture and weathering, making it suitable for outdoor use without significant degradation.
- Injection Molding: PP is widely used is injection molding processes due to its excellent flow properties, allowing for complex and detailed mold designs.
- Affordability: Polypropylene is relatively inexpensive compared to some other engineering plastics, making it a cost-effective choice for many applications.

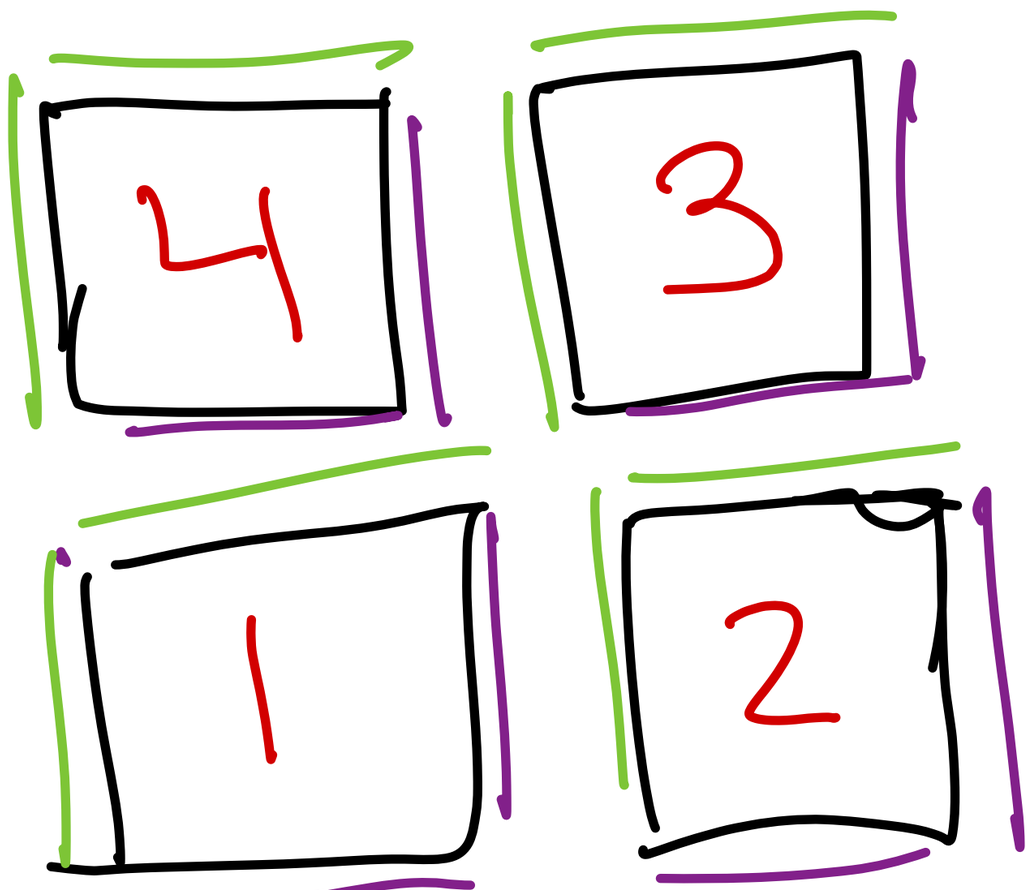
High-Density Polyethylene (HDPE)
- Durability: HDPE is known for its high strength-to-density ratio, providing excellent durability and impact resistance. It can withstand heavy loads and harsh handling.
- UV Resistance: HDPE has natural UV resistance and is often used in outdoor applications such as playground equipment, outdoor furniture, and storage tanks. It can resist the damaging effects of sunlight over extended periods.
- Weatherproof: HDPE is resistant to moisture and weather conditions, making it suitable for outdoor use. It does not absorb water and is resistant to mold, mildew, and rot.
- Injection Molding: HDPE is well-suited for injection molding processes, allowing for the production of complex shapes and intricate designs. It has good flow properties, facilitating the molding process.
- Affordability: HDPE is cost-effective and widely available, making it one of the most economical choices among engineering plastics.

Polycarbonate
- Durability: Polycarbonate is highly impact-resistant and shatterproof, making it suitable for applications where durability and strength are critical, such as safety glasses, protective shields, and outdoor signage.
- UV Resistance: Polycarbonate has inherent UV resistance, and it can withstand prolonged exposure to sunlight without significant degradation. This property makes it suitable for outdoor use where UV protection is necessary.
- Weatherproof: Polycarbonate is resistant to moisture, and it can withstand various weather conditions. It does not degrade or become brittle due to exposure to rain or humidity.
- Injection Molding: Polycarbonate can be injection molded to produce complex shapes and intricate designs. It has good flow properties, allowing for the production of detailed and precise parts.
- Transparency and Optical Clarity: Polycarbonate is transparent and offers excellent optical clarity, making it ideal for applications such as lenses, windows, and displays.
- Impact Resistance: PC is extremely impact-resistant and virtually unbreakable, even at high strengths. It is often used in applications where impact resistance is crucial.

Going to use polycarbonate as it:

- is impact resistant and transparent
- uv resistant and heat resistant

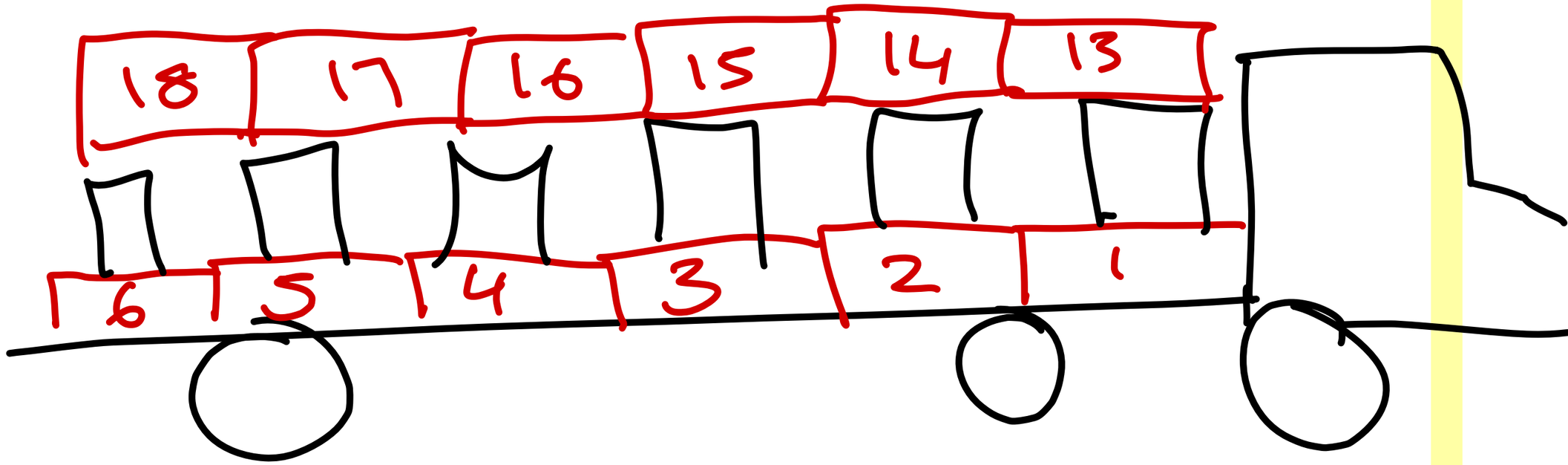
renders



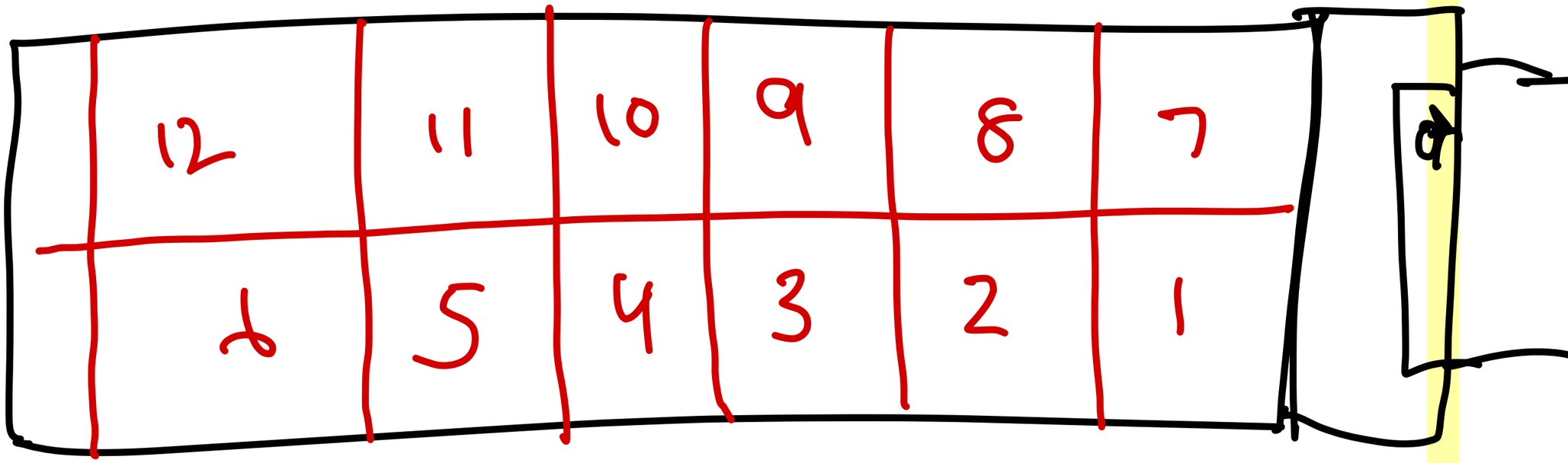
up
down

order to interlock boxes.

front view

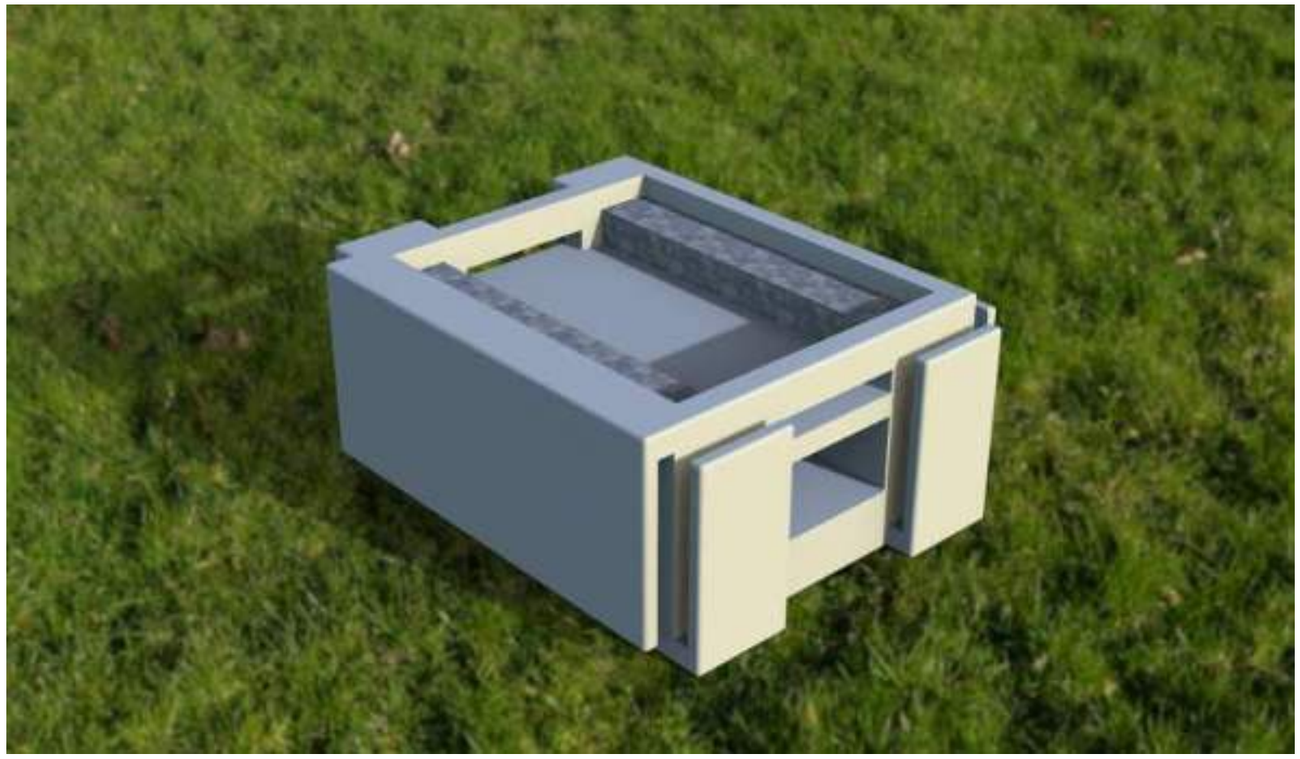


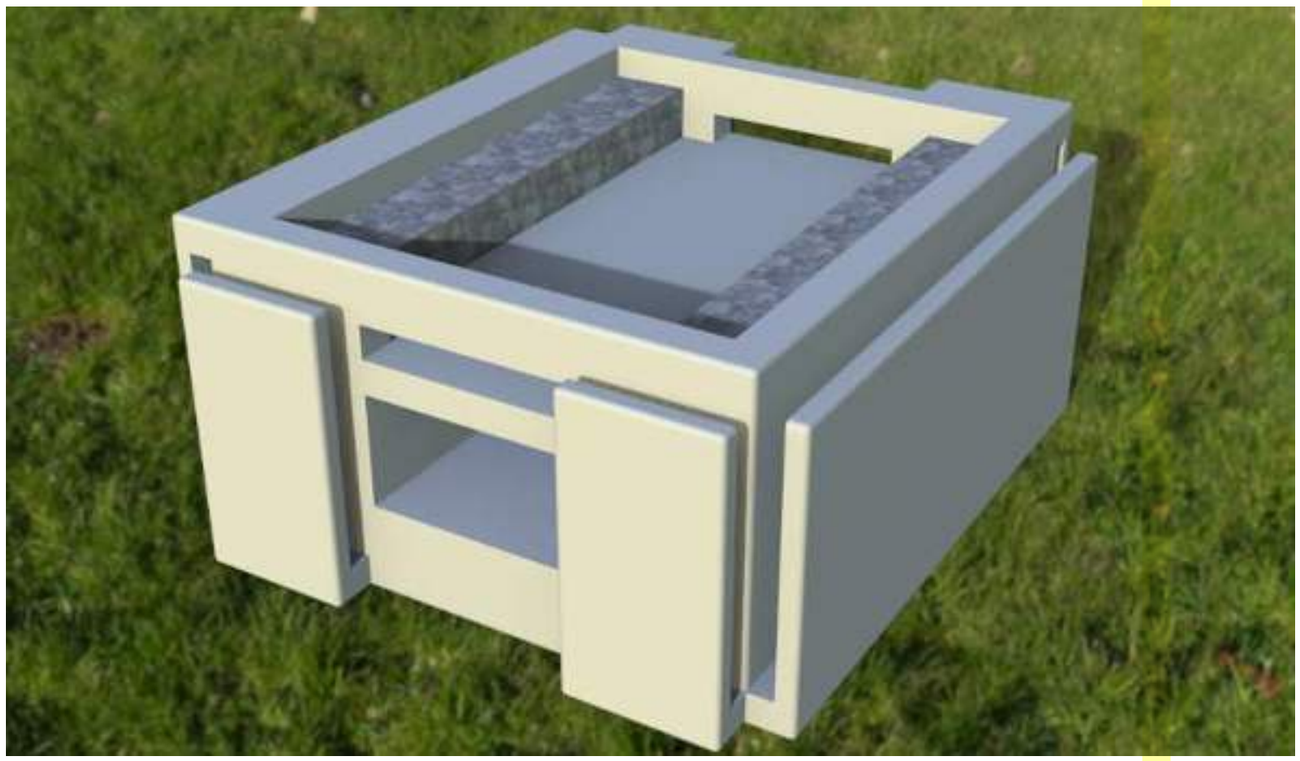
top.



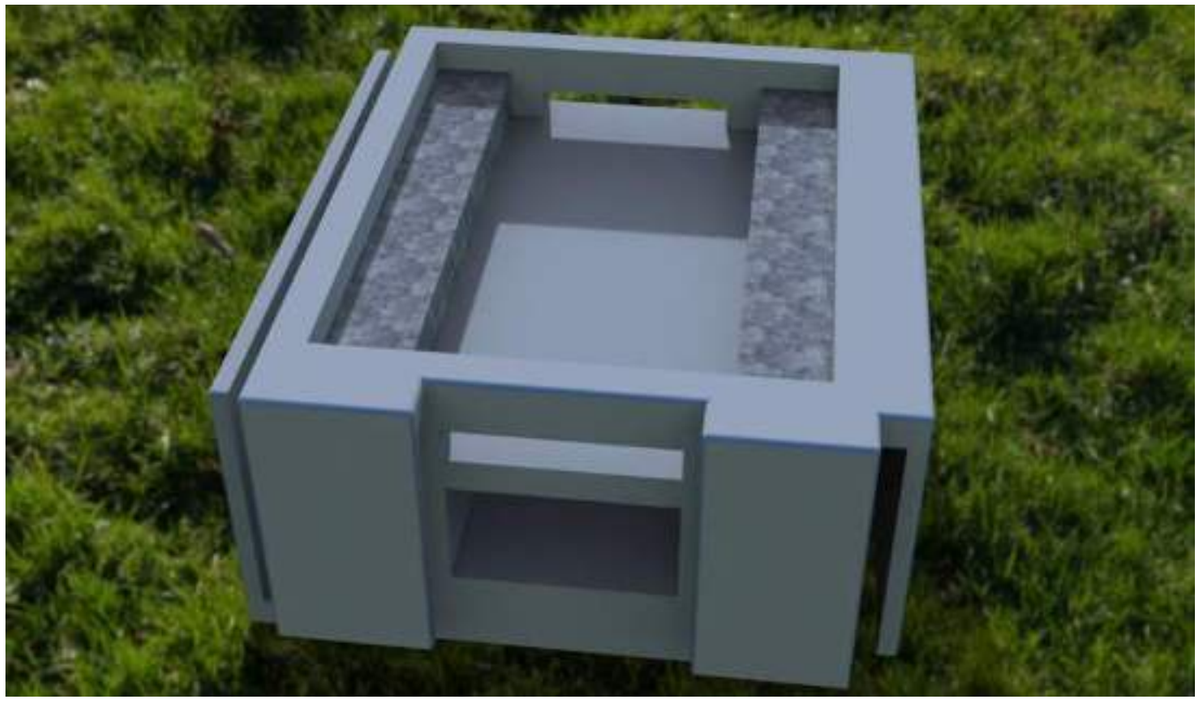
Final renders - exploded view

Final renders



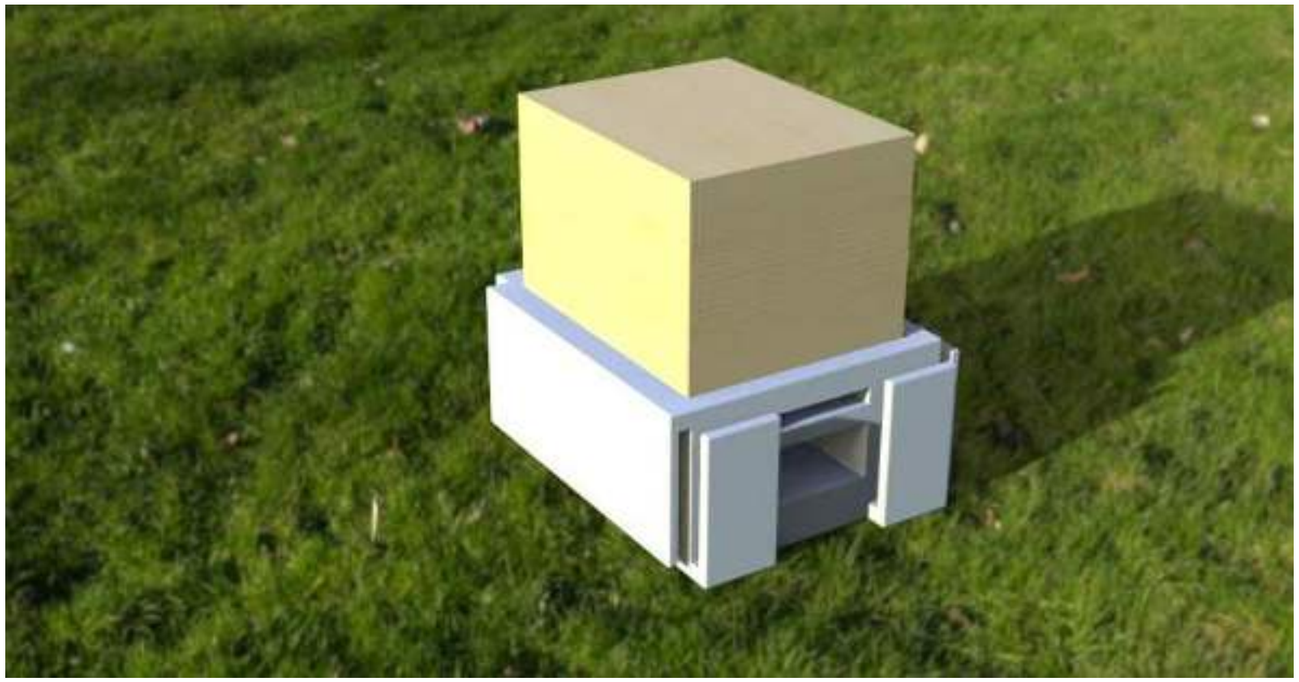


Final renders



exploded view

Final renders



Final renders

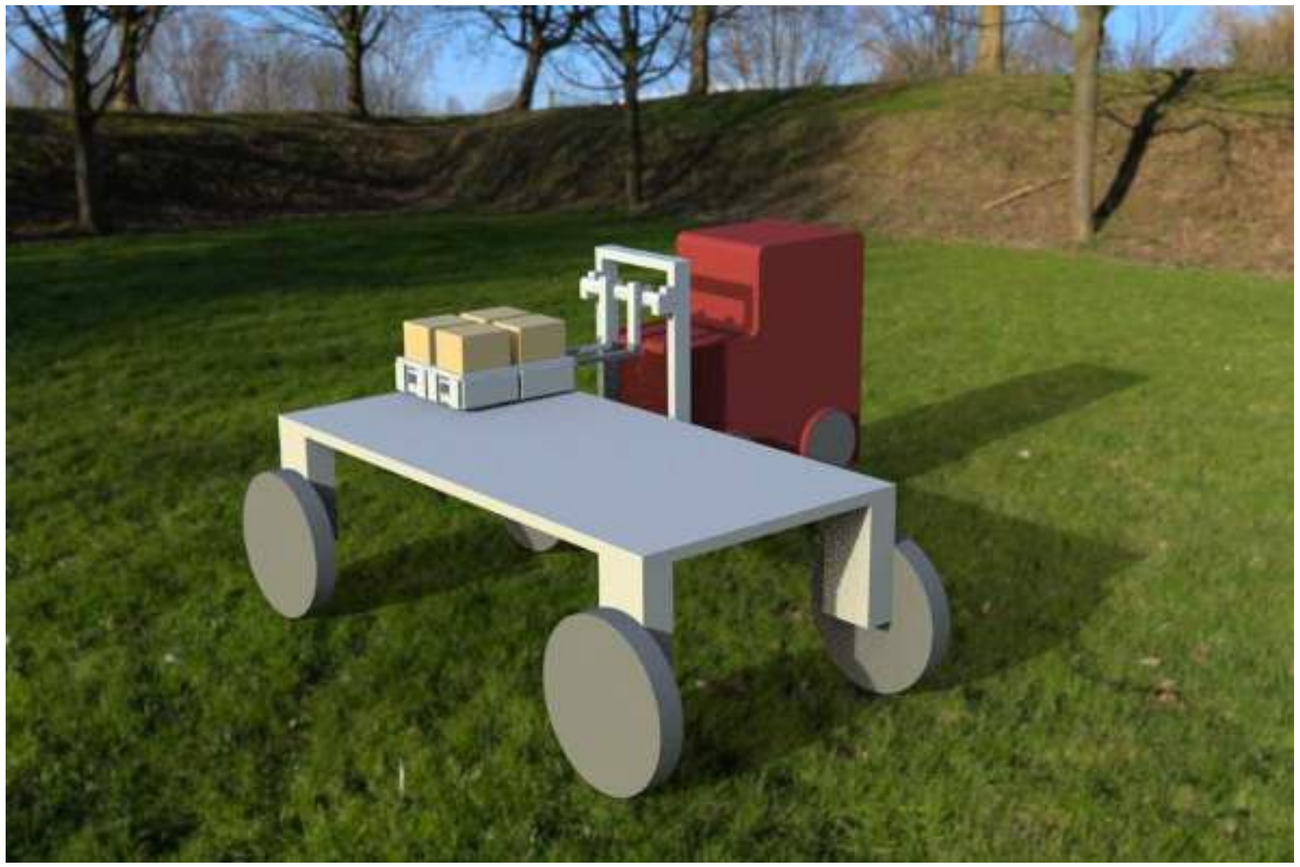
Final renders

2

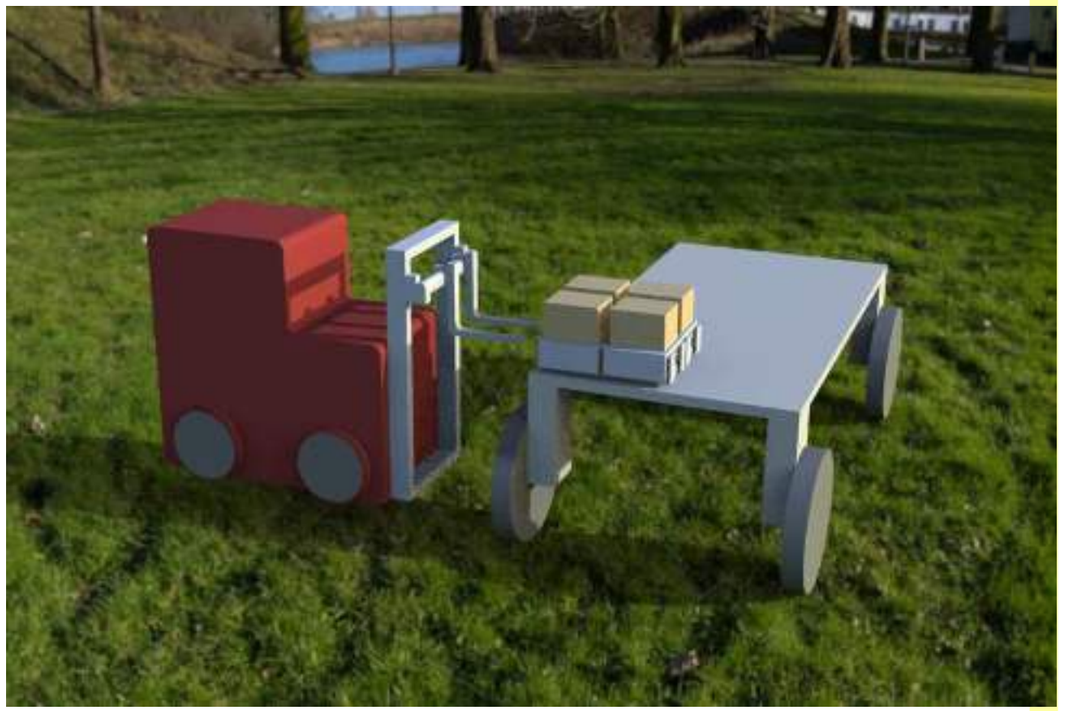
3

Final renders

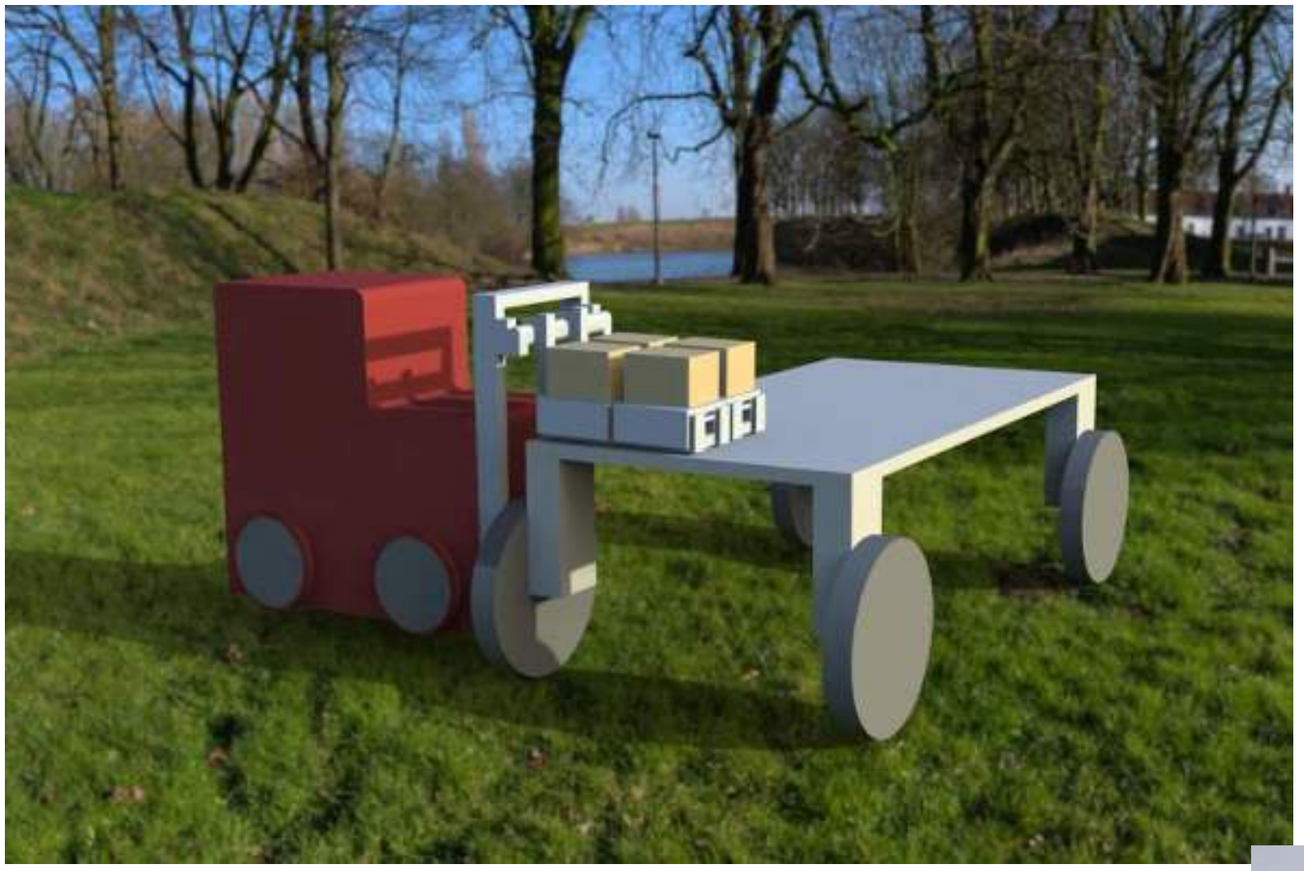
Final renders

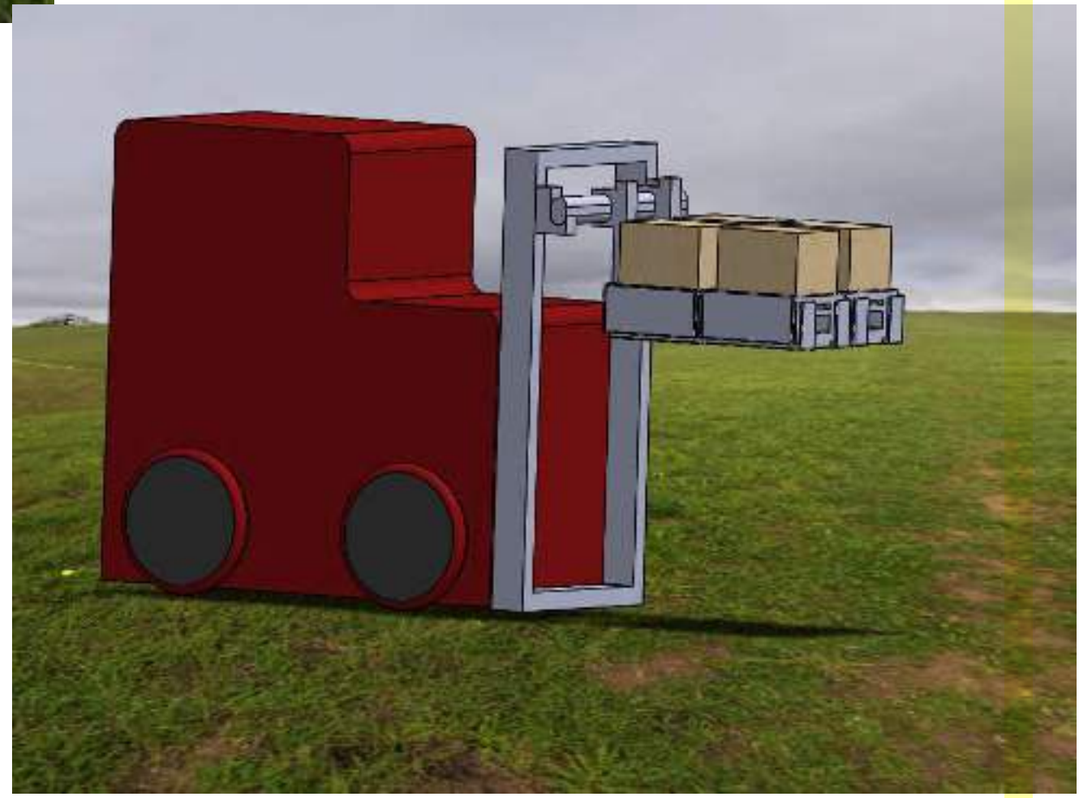


How to put on truck.

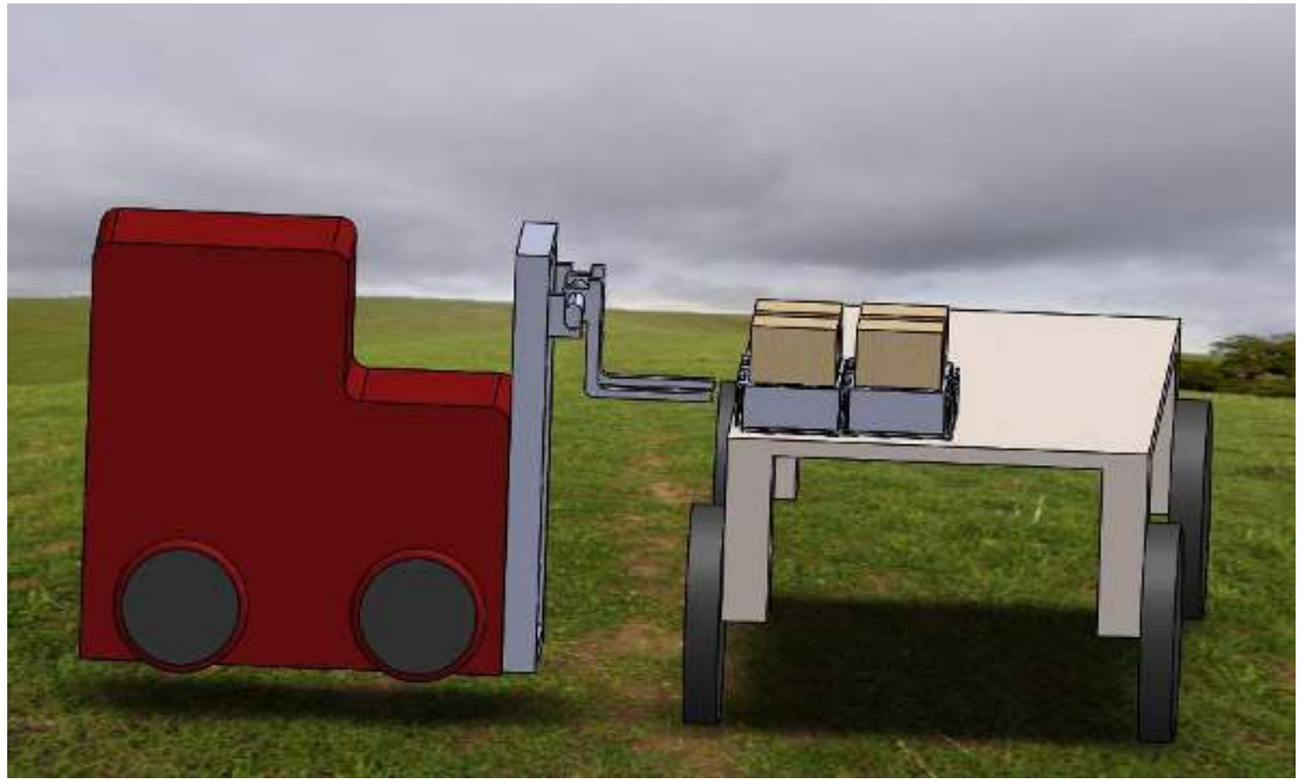


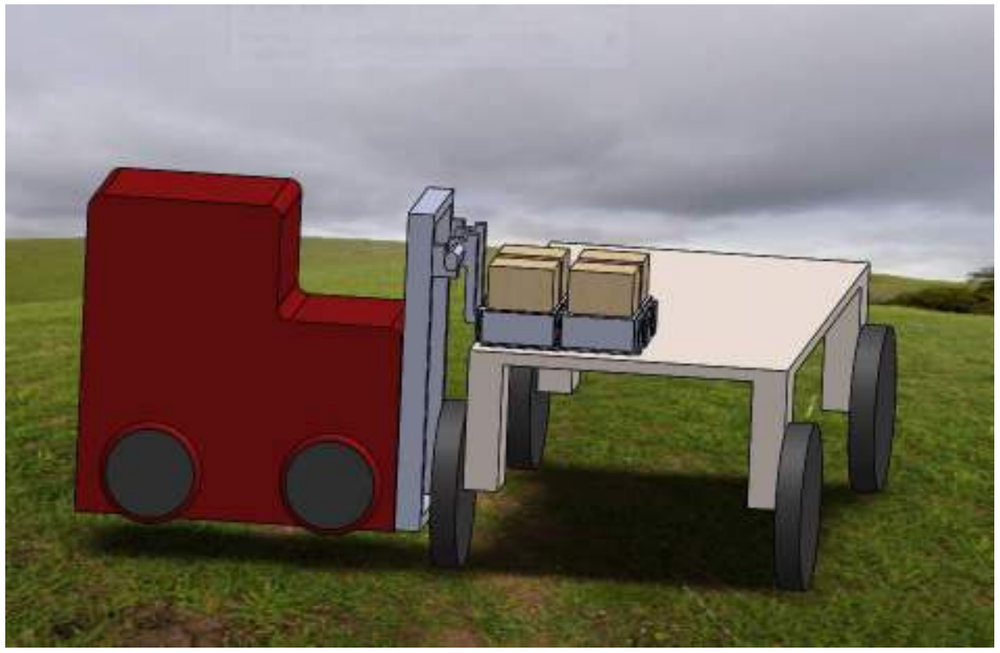
Final renders



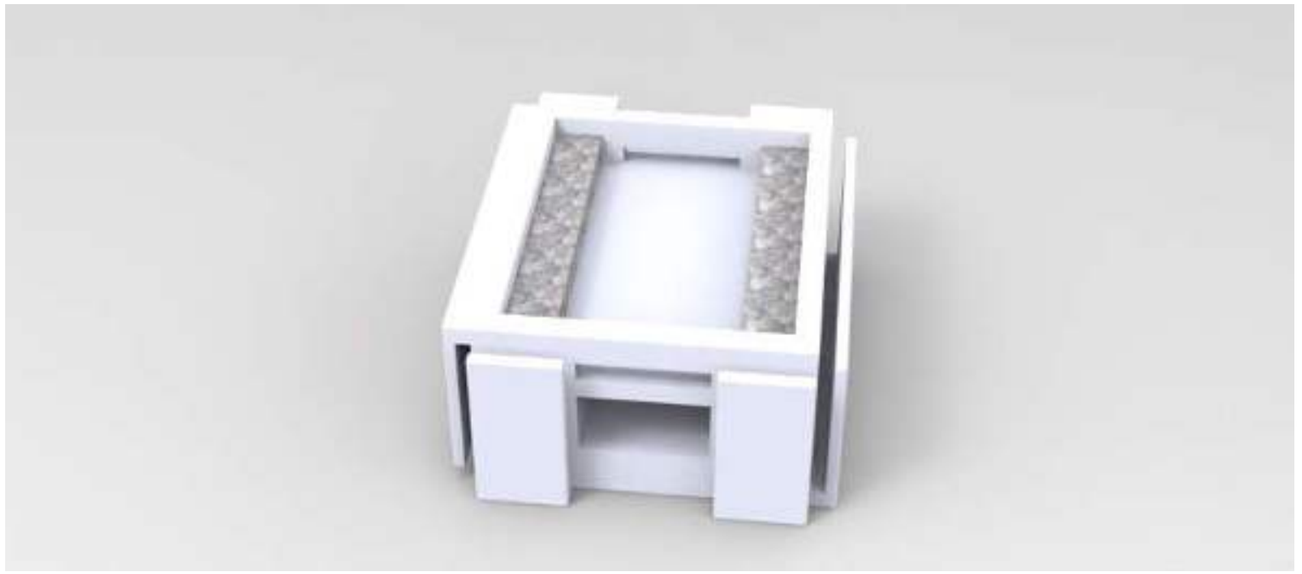


Final renders

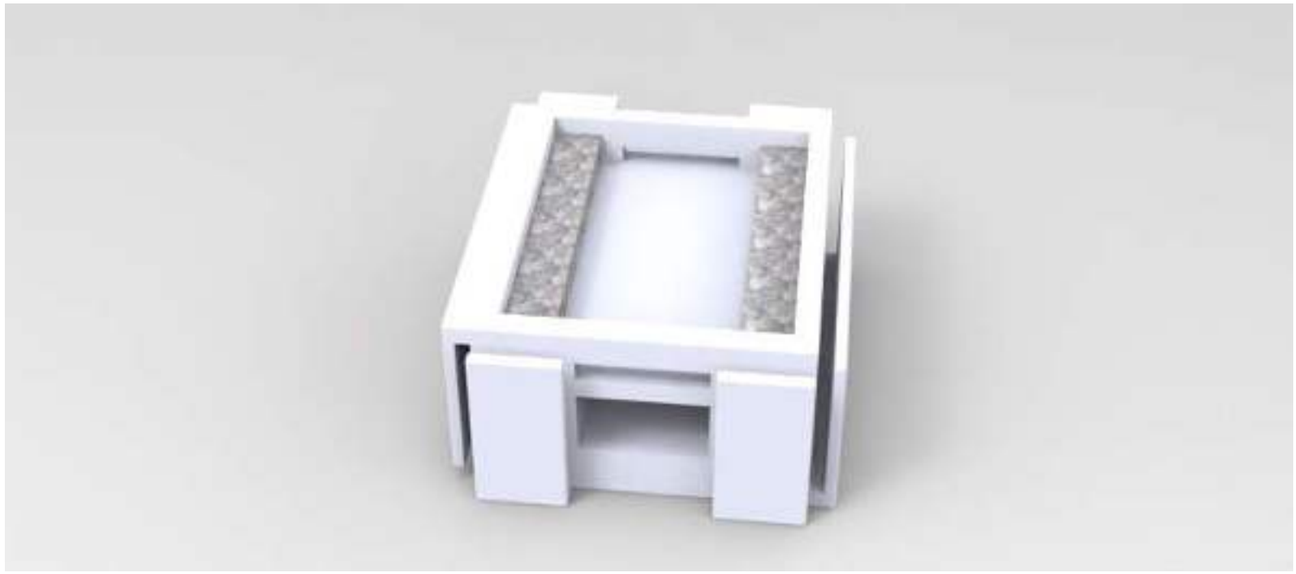


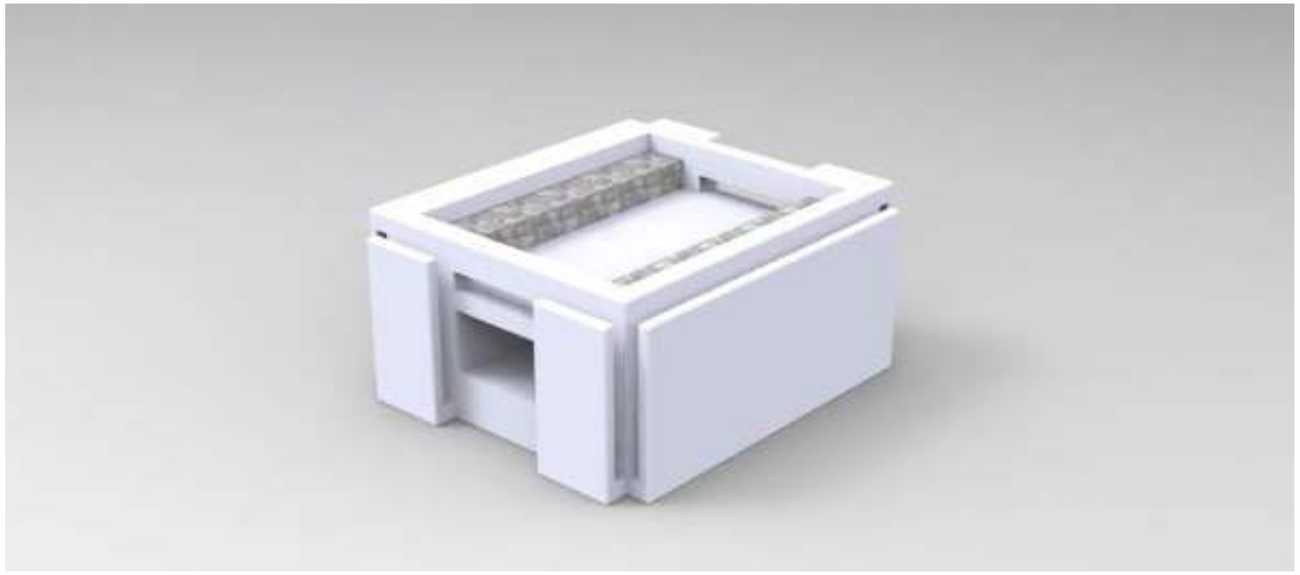


Final renders

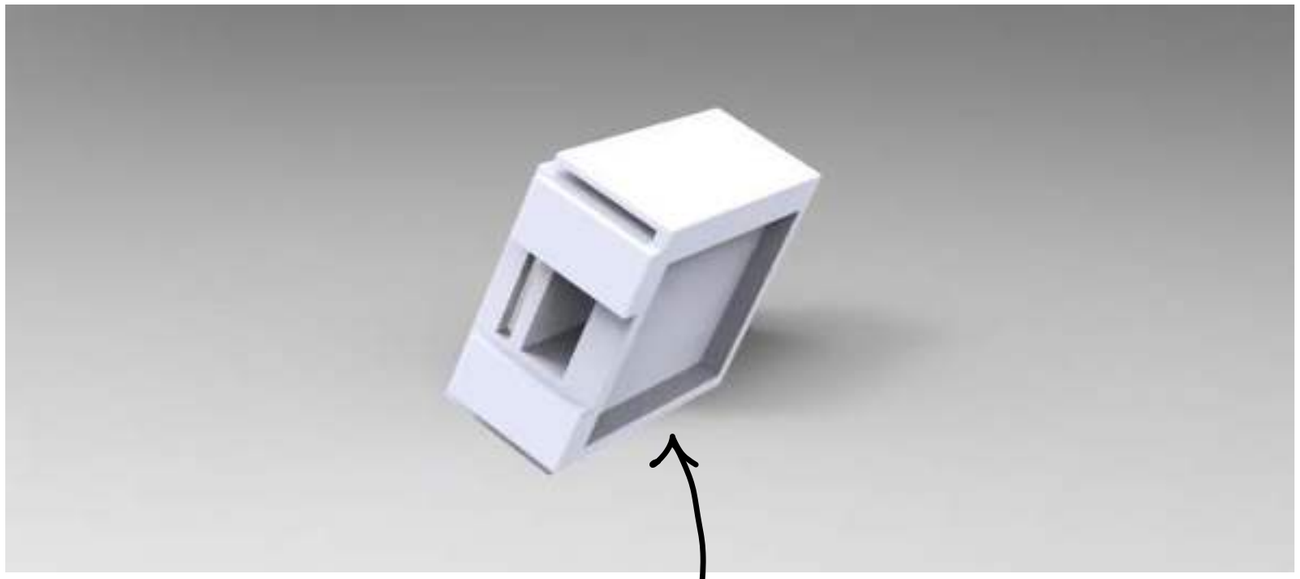


Final renders

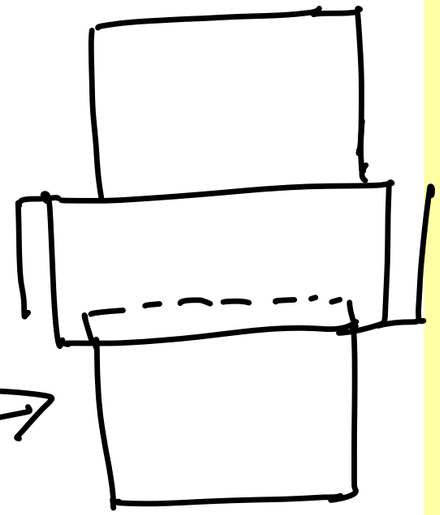




Final renders

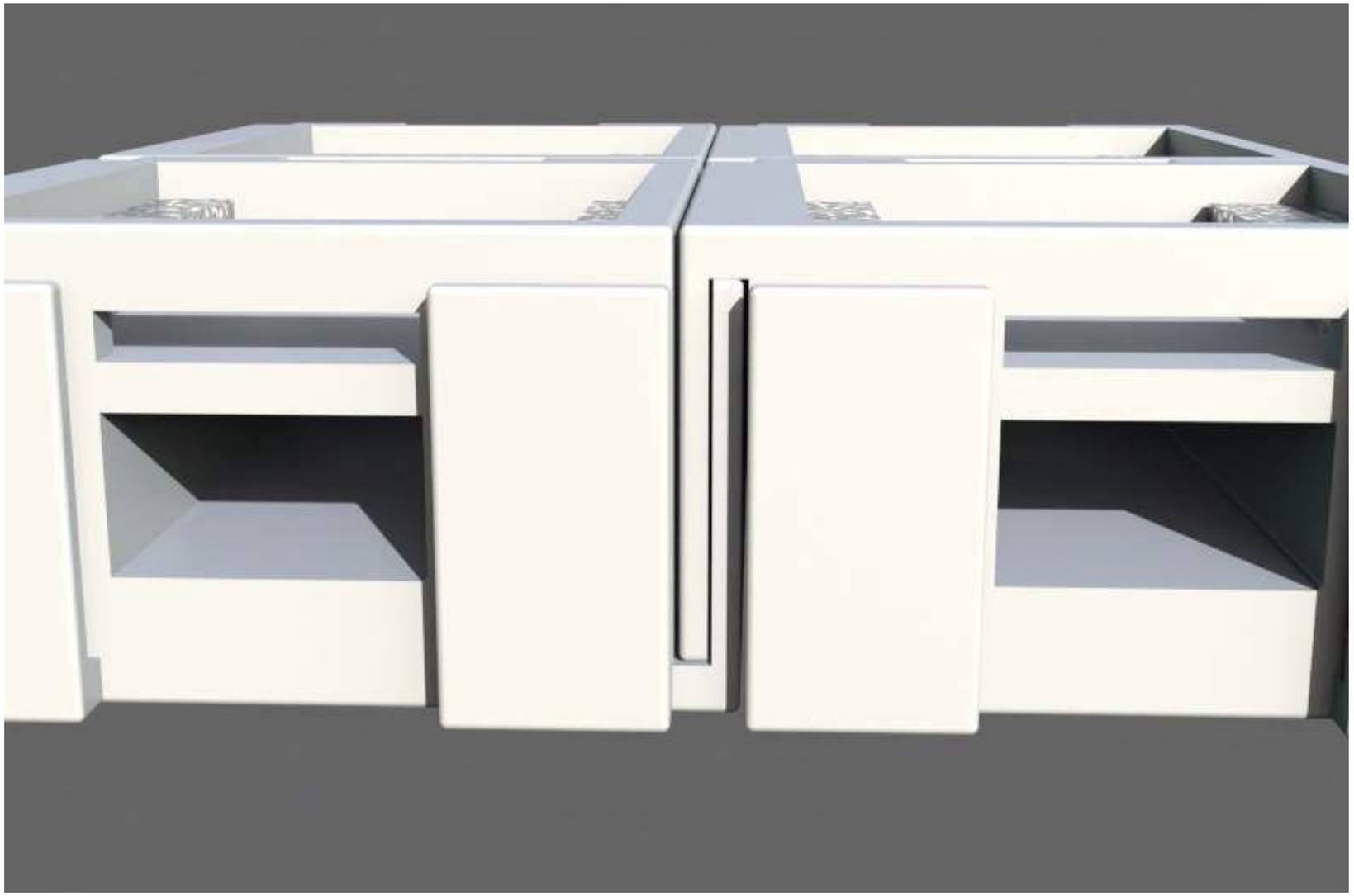


allows for beehive to go underneath



Final renders

Final renders



Final renders

Final renders