



BULL CARRIER
Motorised decent and lifting system



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01 Introduction

Background

◦ This project focuses on “4G” and “5G” tower construction and the workers, better known as cell site technicians, who tirelessly work to ensure that the mobile/telecom connections function seamlessly throughout the globe. Cell site technicians are people whose responsibility is to build, maintain and repair a group of telecom cell sites (masts), radio towers etc. Their line of work entails them to operate in many different environments as well as weather conditions. Furthermore they are often required to climb towers despite the harsh weather to regulate and inspect these cell sites. They are well trained in their line of work and often work in groups of two people (depending on the situation). To successfully operate as a cell site technician one must have endurance, concentration and a strong sense of team work to accomplish everyday tasks.

◦ **Ericsson AB.** is a Swedish telecommunications company founded in 1876 by Lars Magnus Ericsson. Today the company is one of the leading providers of Information and Communication Technology to service providers in the world. Ericsson invests in leading companies that drive innovation in new areas and thus has offices all around the world. Total number of employees around the world: 99.826. Even though Ericsson had already achieved a strong position in the world of mobile telephony with the analog NMT (Nordic Mobile Telephony) standard, it was with the development and launch of the 1992 digital GSM standard that made mobile phones become a consumer product.



02 Method

Field Studies

- Field studies were organised in two groups of students and took place at two cell sites across two weeks. During this time together with our programme director Thomas Degn, we had the opportunity not only to see but also help out the workers from Telog during the construction of a 4G mast as well as setting up new equipment in a ski resort. This gave us an enormous amount of insight to their line of work which in term gave us a better understanding of the hardships these people face on a daily basis.

Week 2- Sälen

- During the second part of the research trip a group of students had the opportunity to experience a totally different work environment than that of the Gävle group. From the swampy marshlands near the sea, to a ski resort near the border with Norway. The group had a chance to see the management of an existing cell site during which a new radio (4G+) had been added. Unlike the open swampy cell site of Mårtsbo, the site in Sälen required the technicians to operate in closed and confined spaces (attics, cellars, ventilation systems) which had its own array of difficulties. The contrast between the two situations gave us plenty of insights to further discuss and work from.

Umeå

Sälen

Mårtsbo



•Lisa



•Gunnar

Week 1- Mårtsbo

- The beginning of our research journey starts in the village of Mårtsbo near Gävle, where we had a chance to see the process of building and lifting a 4G mast. Going through every part of the process gave us an extensive insight to the daily tasks but also difficulties that the cell site technician might face during the construction and set up of the mast. We had the chance of getting to know the people responsible for assembly, installation and maintenance of cellular and radio tower components, equipment, towers and so on. The task was to get a better understanding of the people who work on these sites, their lives, their struggles and the things they love about the job as well as their values.

02 Method

Field Studies

Week 1-Gävle, Mårtsbo

- **Day 1.** We arrived at the location of the soon to be cell site. There we met with Gunnar and Lisa (cell site technicians) who started planning and preparing for the mast segments to arrive. After the arrival the initial linking of the various parts and safety rails took place (aided via truck crane).
- **Day 2.** Started with checking the safety rails as well as the foundations for the mast. Later came the long and tedious work on organising, measuring and cutting of the wires. We had the privilege to help out during this process after which we had a chance to reorganize a segment of the mast as it required repositioning.
- **Day 3.** Upon the arrival of the mast radio equipment and antennas as well as two more technicians (Emmanuel and his son), final preparation for the tower to be lifted had begun. During the day the helicopter had arrived which lead to the first segments being raised into place and fastened with the aforementioned cables.
- **Day 4.** During the fourth and final day of our trip to Mårtsbo the final segments of the tower were lifted using the helicopter (to lift) and technicians to fasten in place. After which the tower light was installed, the antennas were aligned as well as the inspection of the mast.

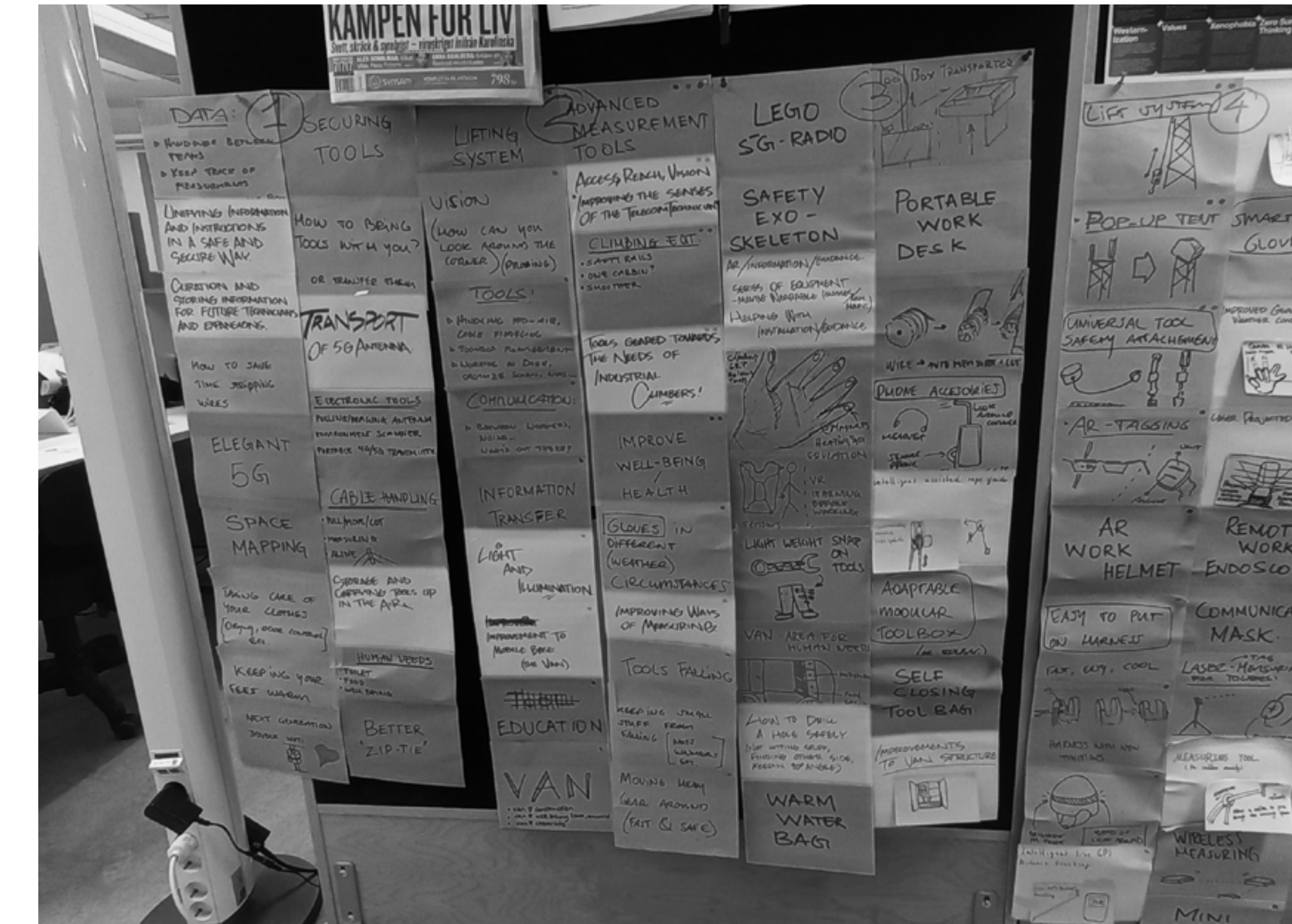


02 Method

Problem analysis

Group work

- The next step after the research trip was to gather, process and organize the material we had accumulated. We have arranged and presented our data using digital media such as the Miro board and video editing (structured and edited by Jacob Kohnle). With the help of Linda Borgen we have managed to create user journey boards to better explain and represent the different aspects of our findings.
- Using these boards we were able to identify possible design opportunities that could then be used for the initial ideation stage. In the course of the next 3 days we were assigned new groups of three people to work together during a workshop. The aim of the workshop was to through a brainstorm session after which we would pick ideas and discuss them further. This method allowed us to get a better understanding of the possible project topics we would like to develop.
- After this period we have tried various methods from the book “This is service design doing” to identify new areas or to double-check some design opportunities. We have also tried imagining different situations that could help us during this process.



02 CONCLUSION

Design opportunities/Pain points

Chosen areas of interest:

Lifting System / Moving heavy Gear around / Improving Wellbeing / Health

◦ Tool and equipment management

In most cases workers carry their tools by attaching tool bags on to the harnesses. The same applies to equipment needed to be installed. This can result in large load that the worker has to carry for even hundreds of meters up into the tower in certain situations. Working this way could result in fatigue and even injury, moreover it is a highly inefficient way to manage the tools as they can fall out of the bags, get tangled together and so on and so forth. How might we help the workers carry the necessary loads and tools?

◦ Safety

Having in mind the potentially dangerous environment cell site technician's work in, safety is a serious concern and a lot of attention goes in to preparation before climbing the towers / masts. For this reason looking into ways of improving their working conditions is crucial topic and must be taken with great consideration. Usually the "Tower dogs" work in groups of two people and though not so frequent, accidents occur that can sometimes be fatal. However, sometimes help can't arrive so swiftly, so how might we improve the time it takes to lower an injured person from a tower safely and securely?

"..If something happens up there... we only have each other."



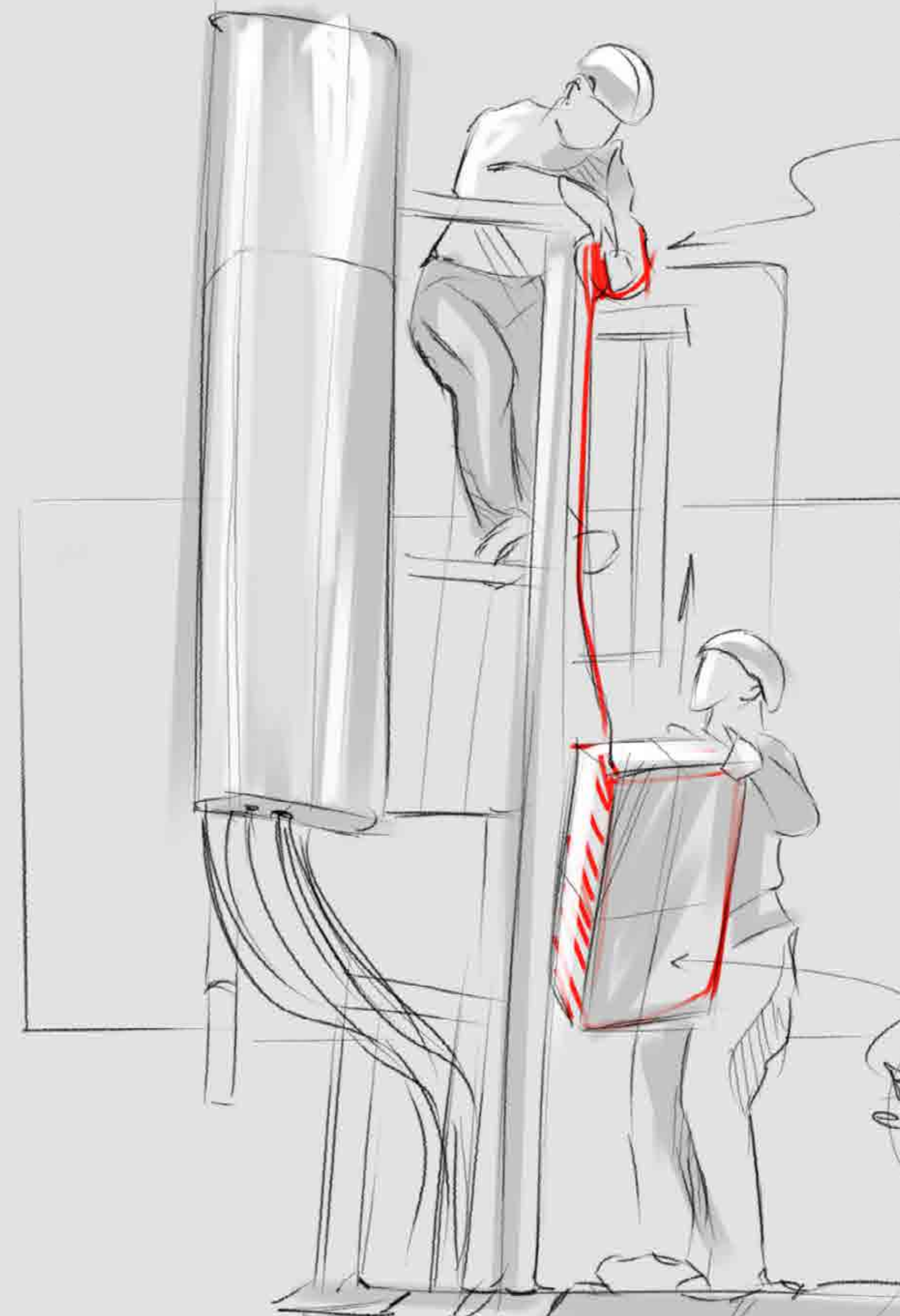
02 Scenario 01

Lifting difficulty's

How might we help the workers carry the necessary loads and tools?

SCENARIO 1

Tools
Danglers
underneath



Using
Pully's
to lift

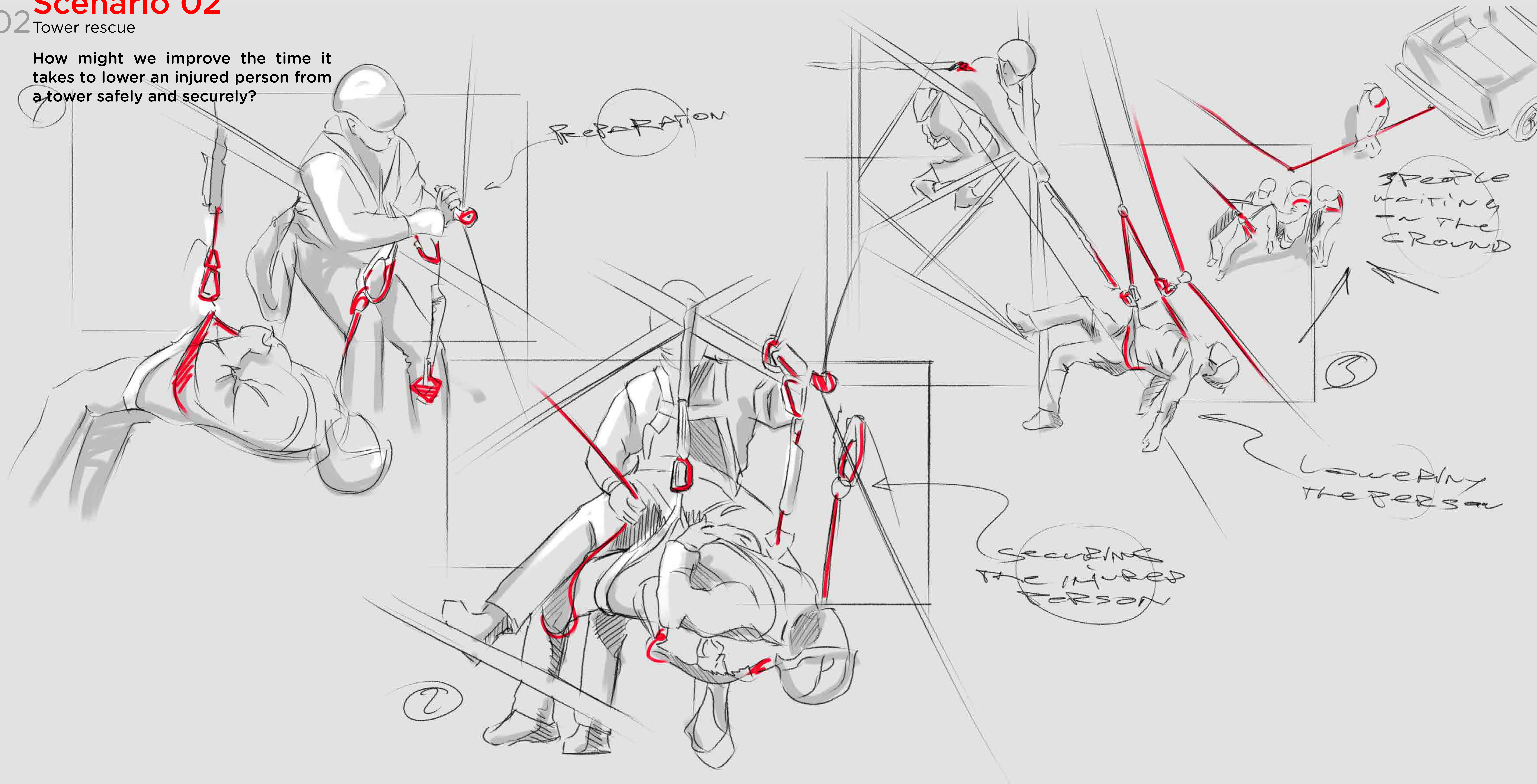
SCENARIO 2

Bulky
equipment

02 Scenario 02

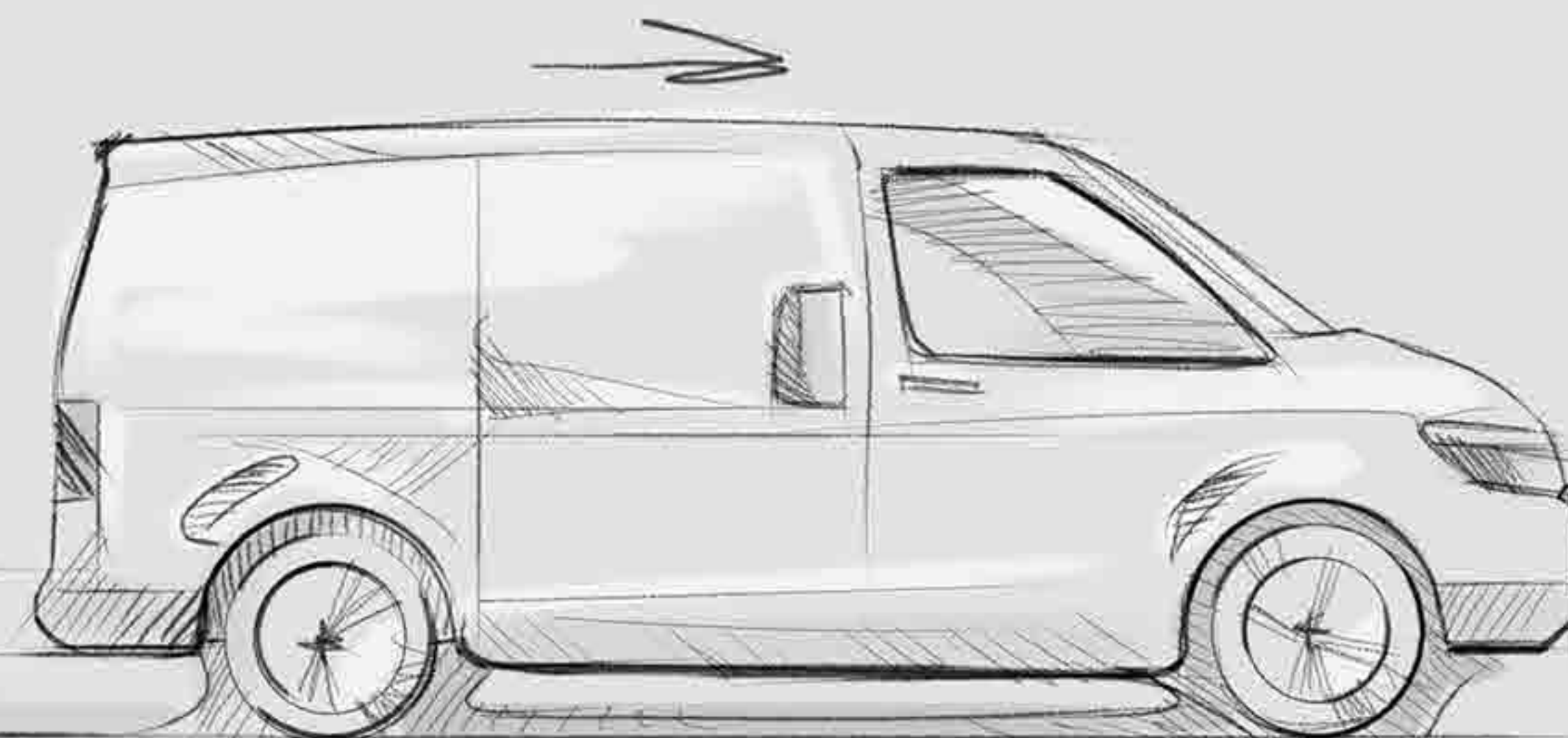
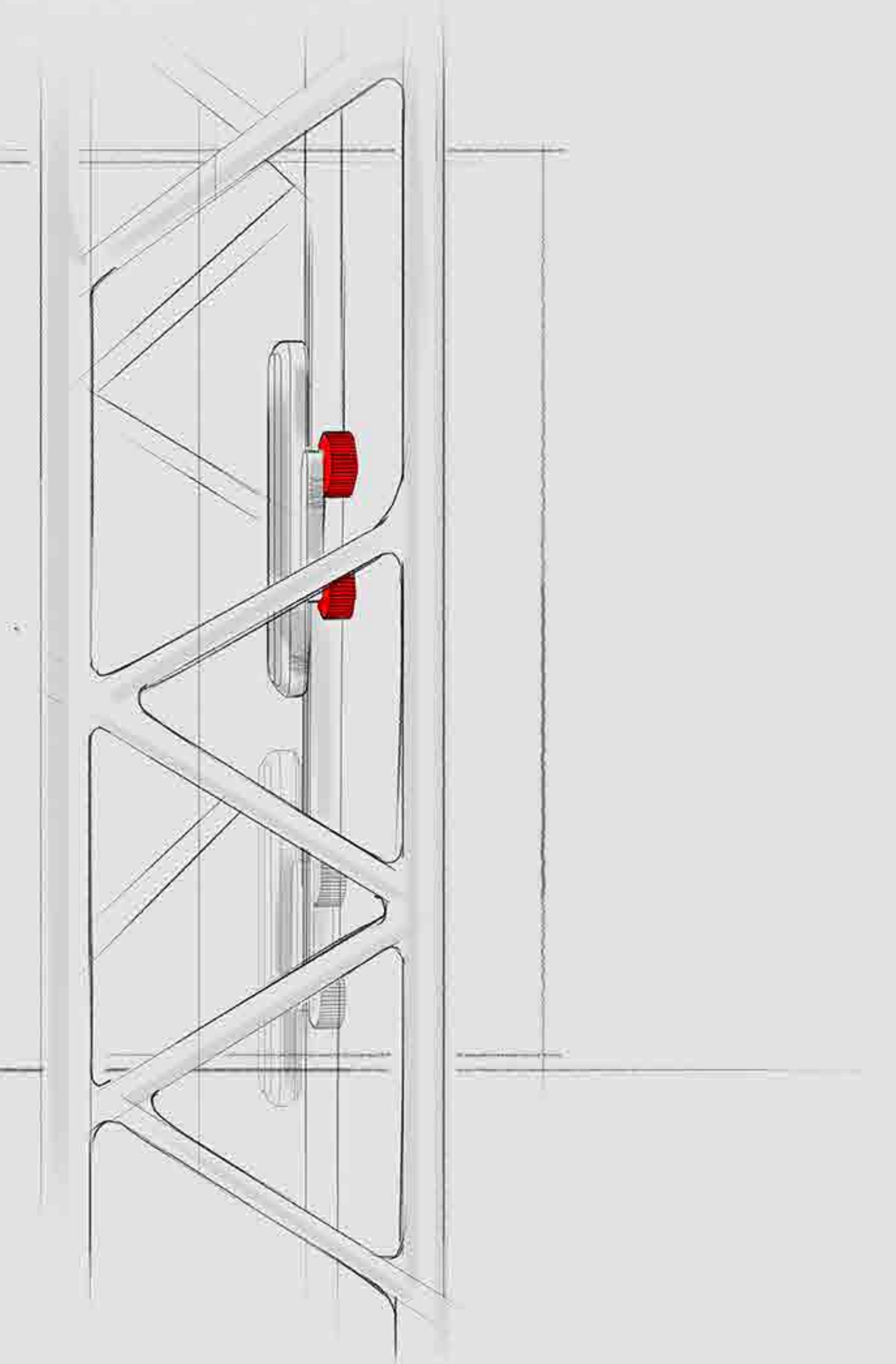
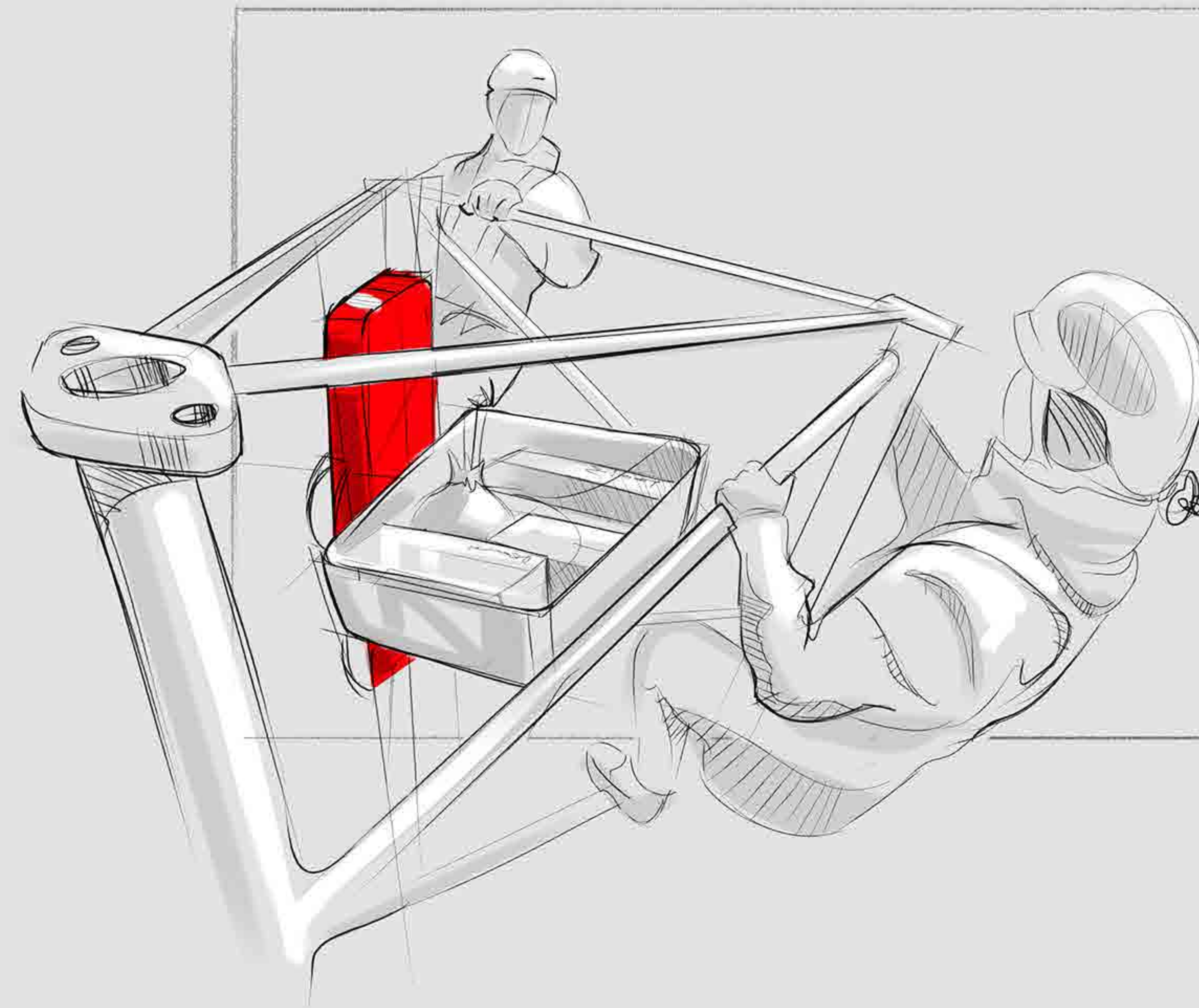
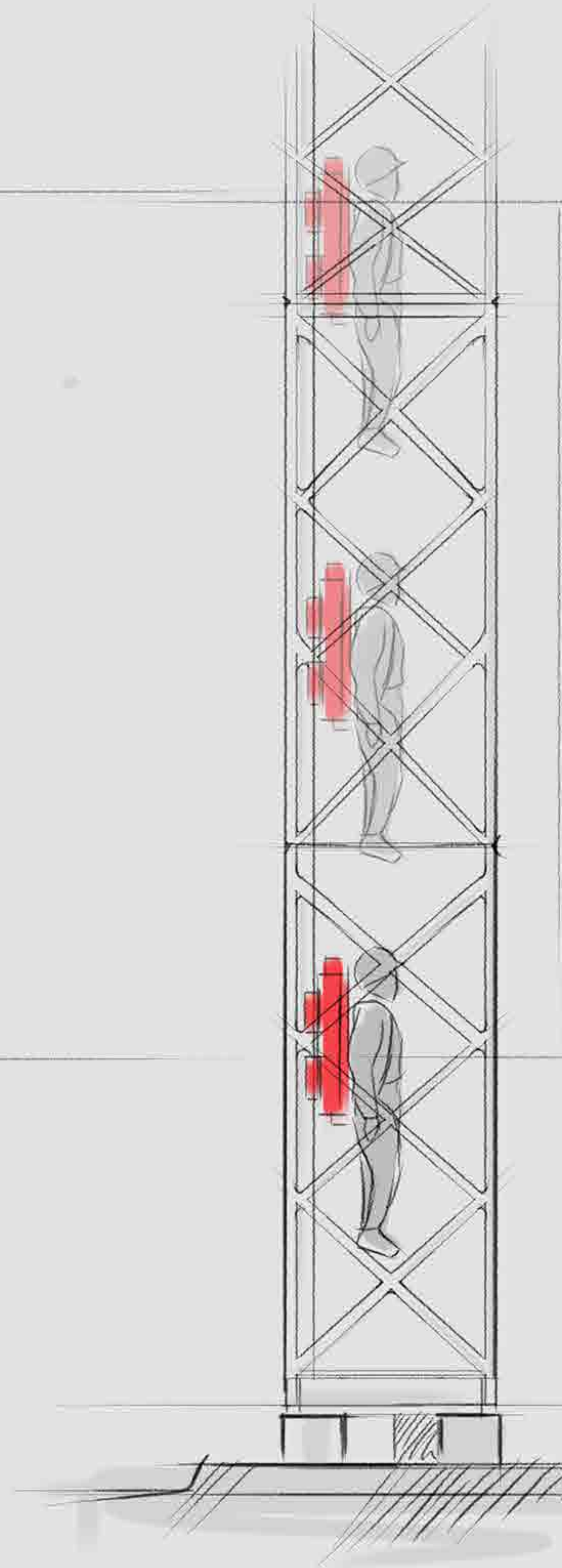
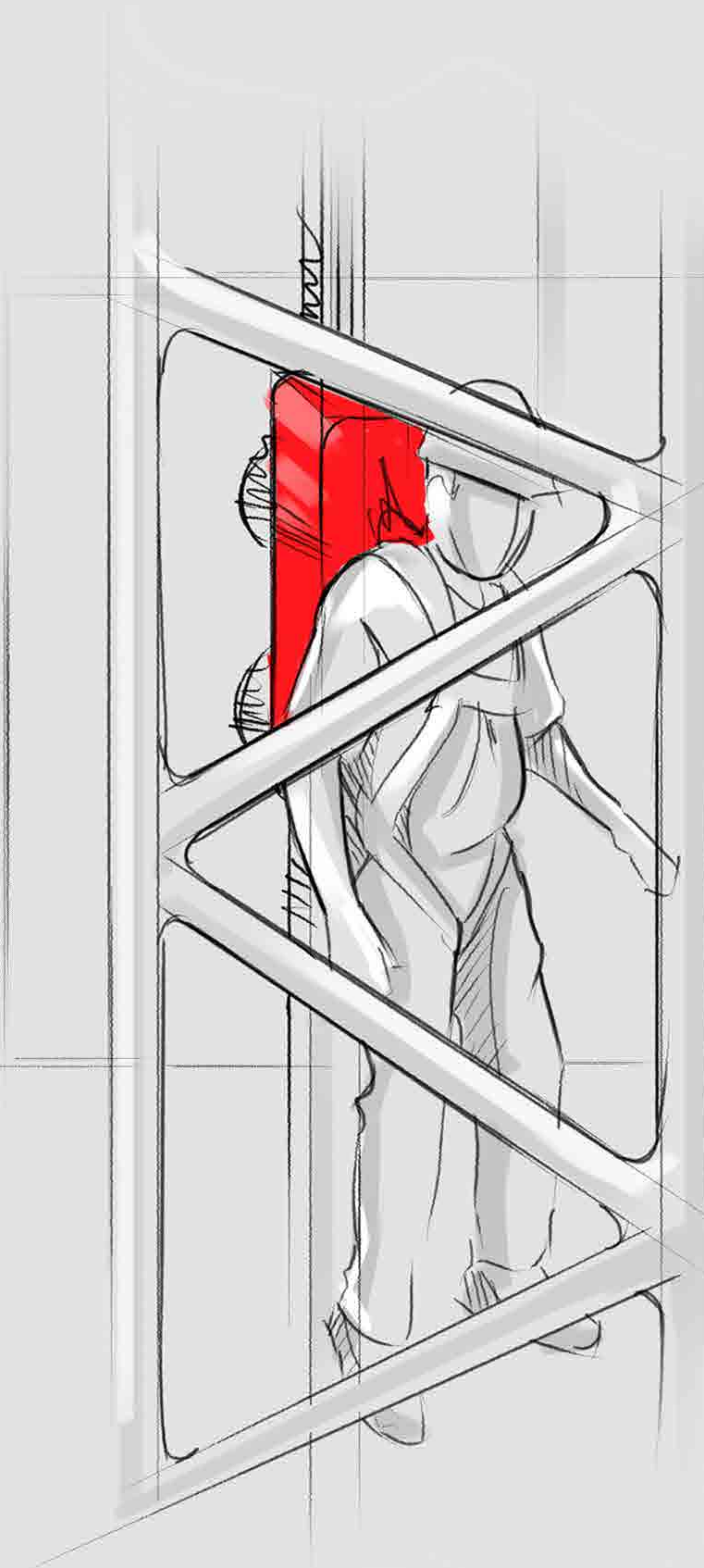
Tower rescue

How might we improve the time it takes to lower an injured person from a tower safely and securely?



02 Initial concept

Goals and wishes

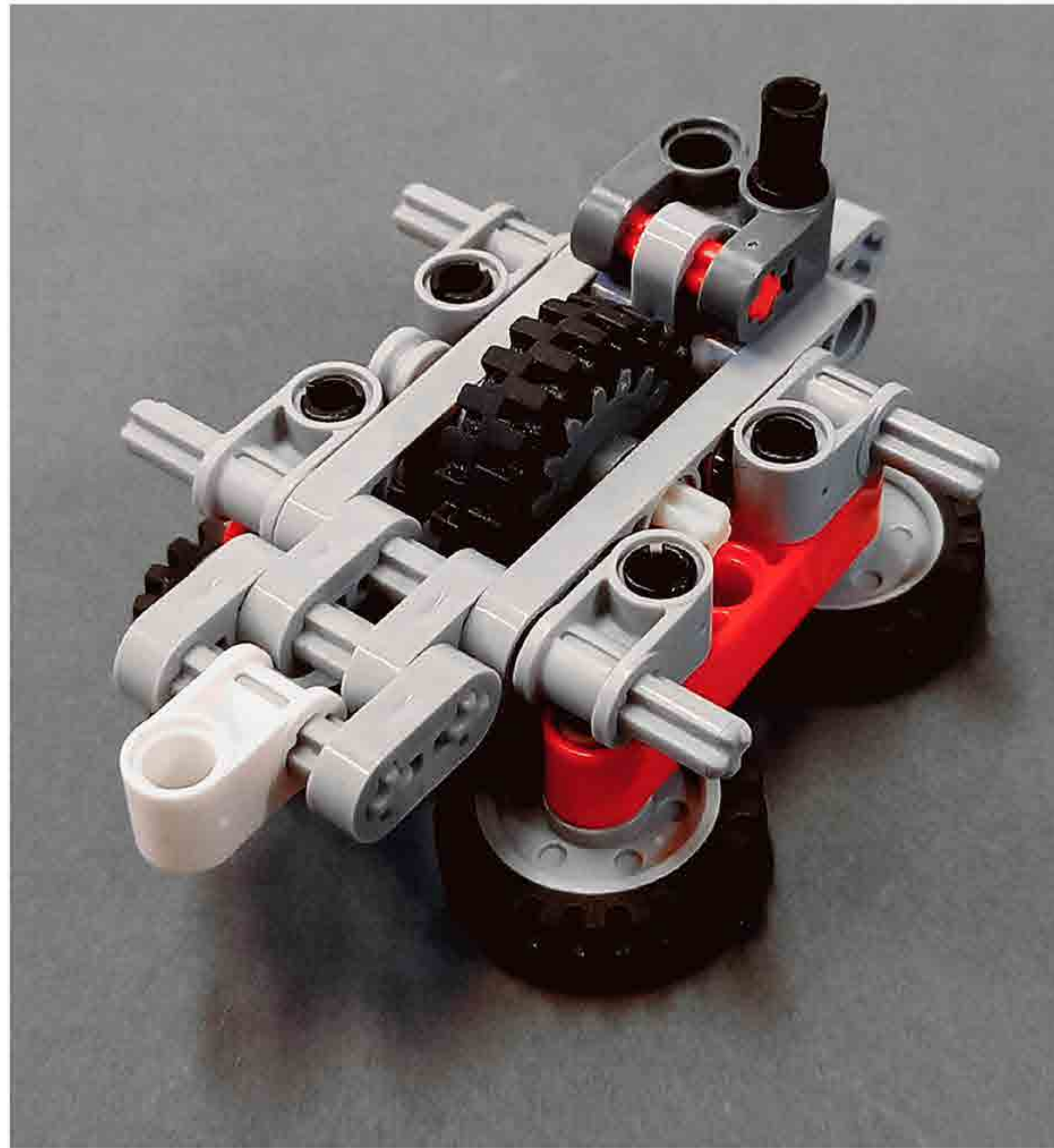
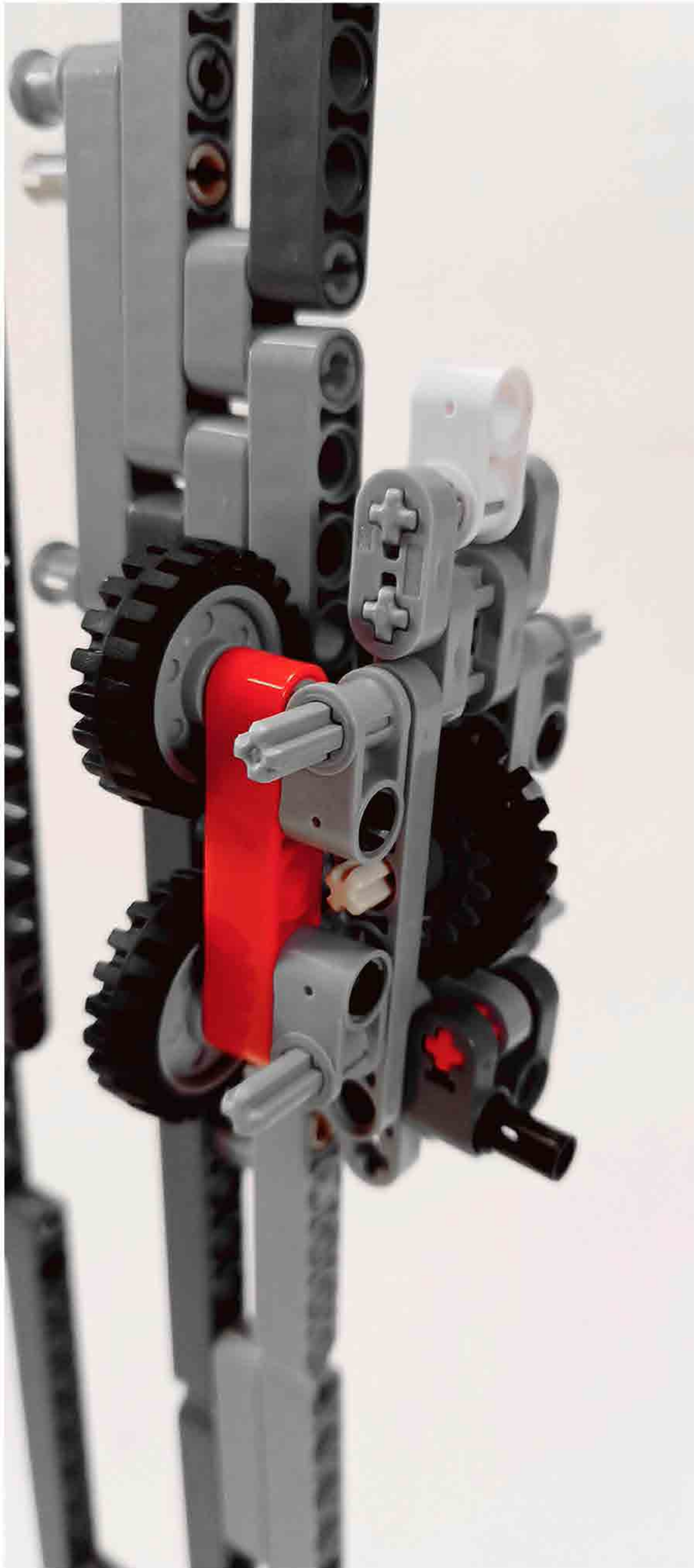


Goals

- Improve equipment and tool management
- Reduce the load of the workers while climbing
- Provide better aid during an emergency

Wishes

- Motorising the lifting system
- Provide a faster way of lowering a person from the tower
- Keeping the design as compact as possible (size, weight)



02 Concept idea 01

Mono rail

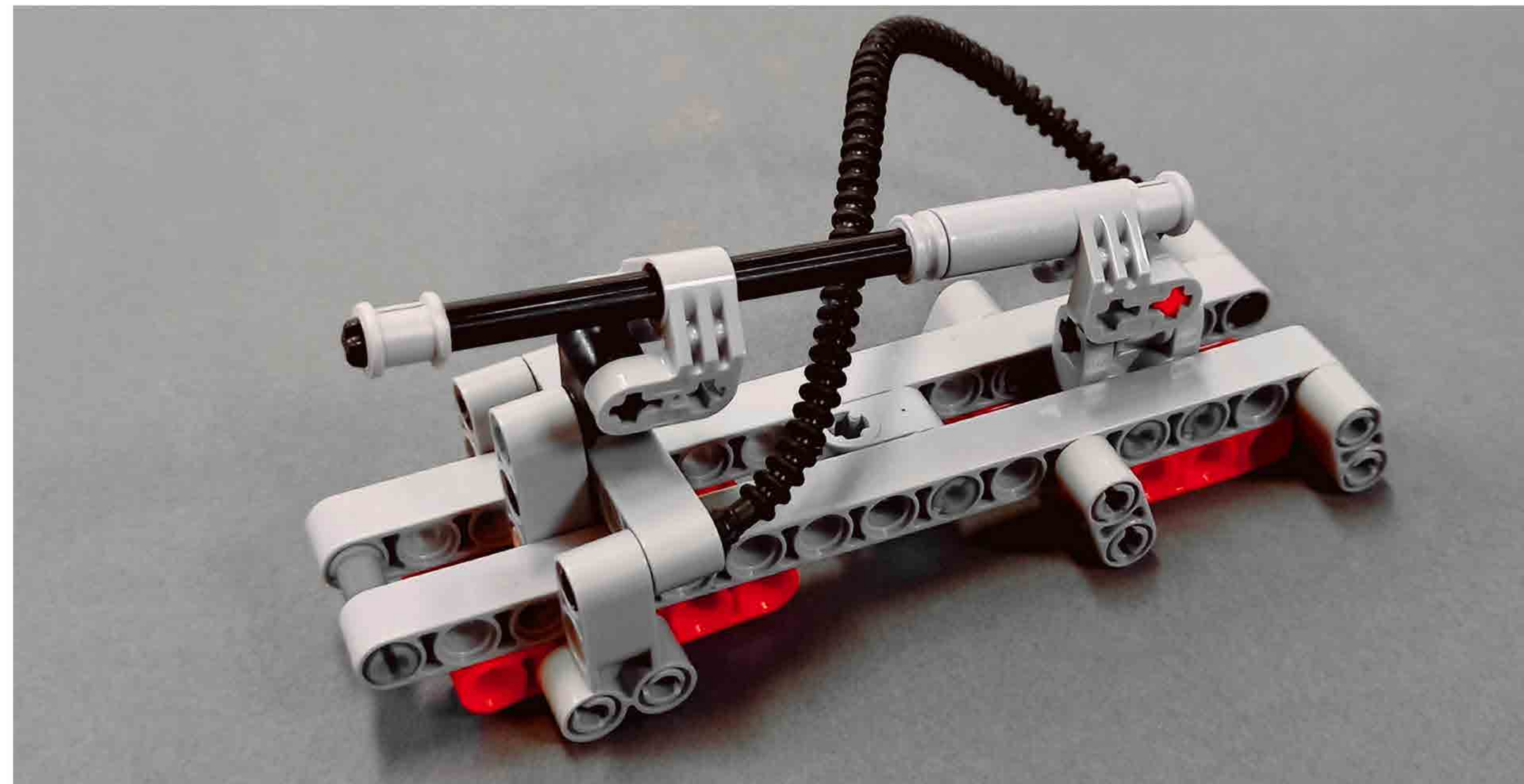
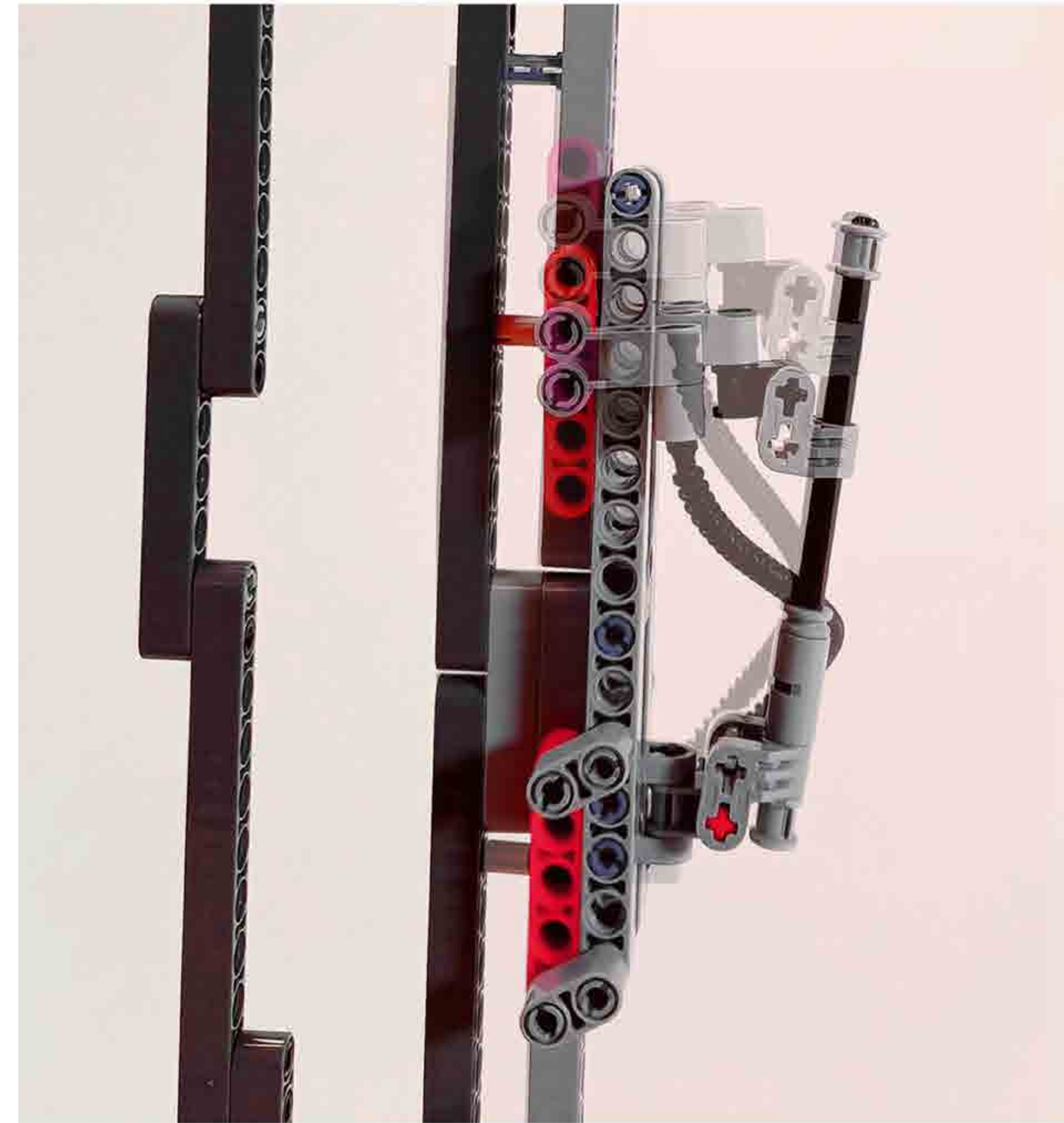
- Inspired by the “Mono rail” the concept idea 01 provides a smooth and seamless ride for equipment and utilities that might be needed by the Telecom technicians. The design could be integrated to the existing railing systems and could provide a fast way of lifting lighter loads.

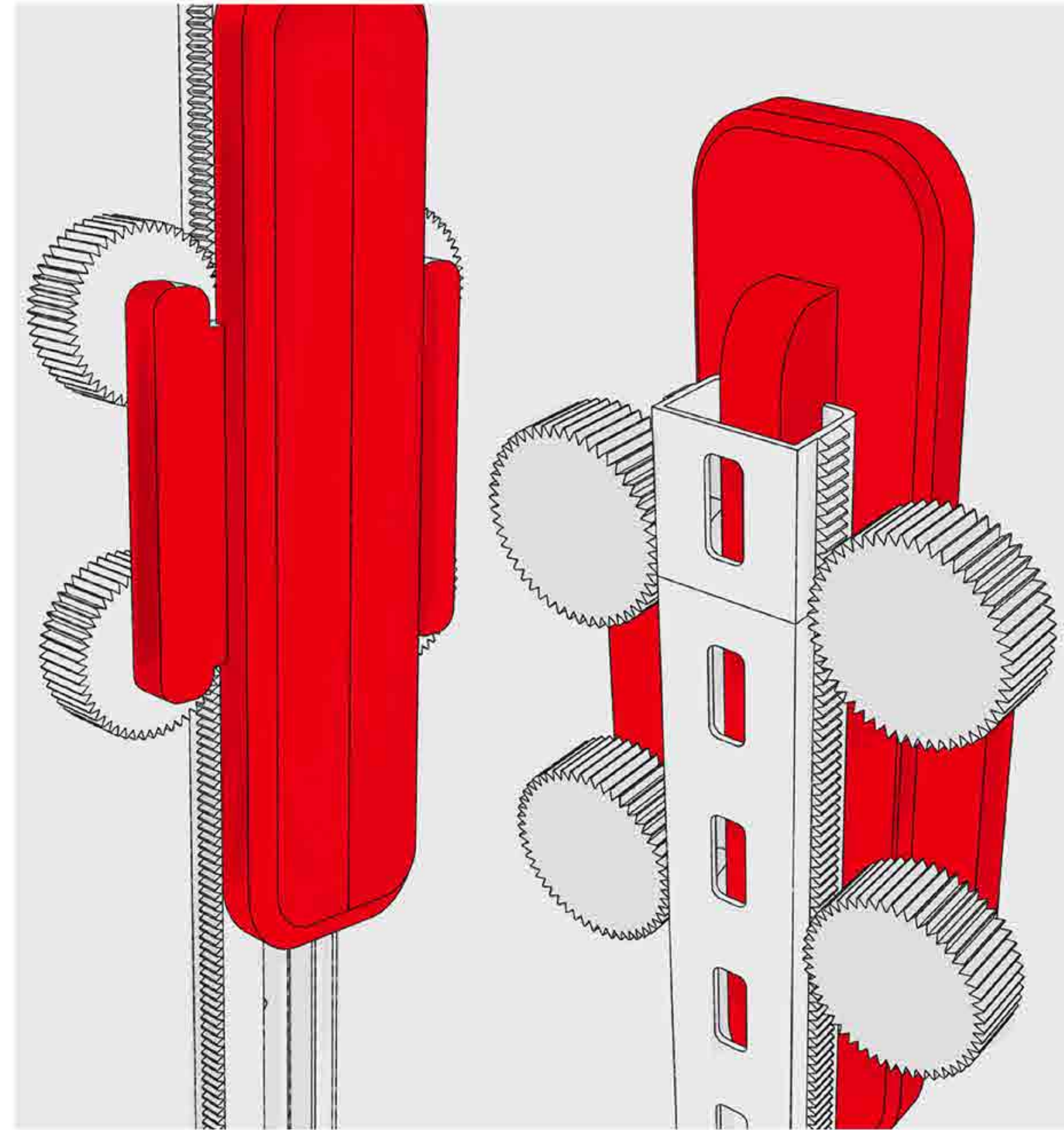


02 Concept idea 02

Hydraulics

- Utilising hydraulics into the lifting system, higher lifting potential could be achieved. With the movement resembling that of a caterpillar one part of the system would always be secured to the mast while the other does the heavy lifting.

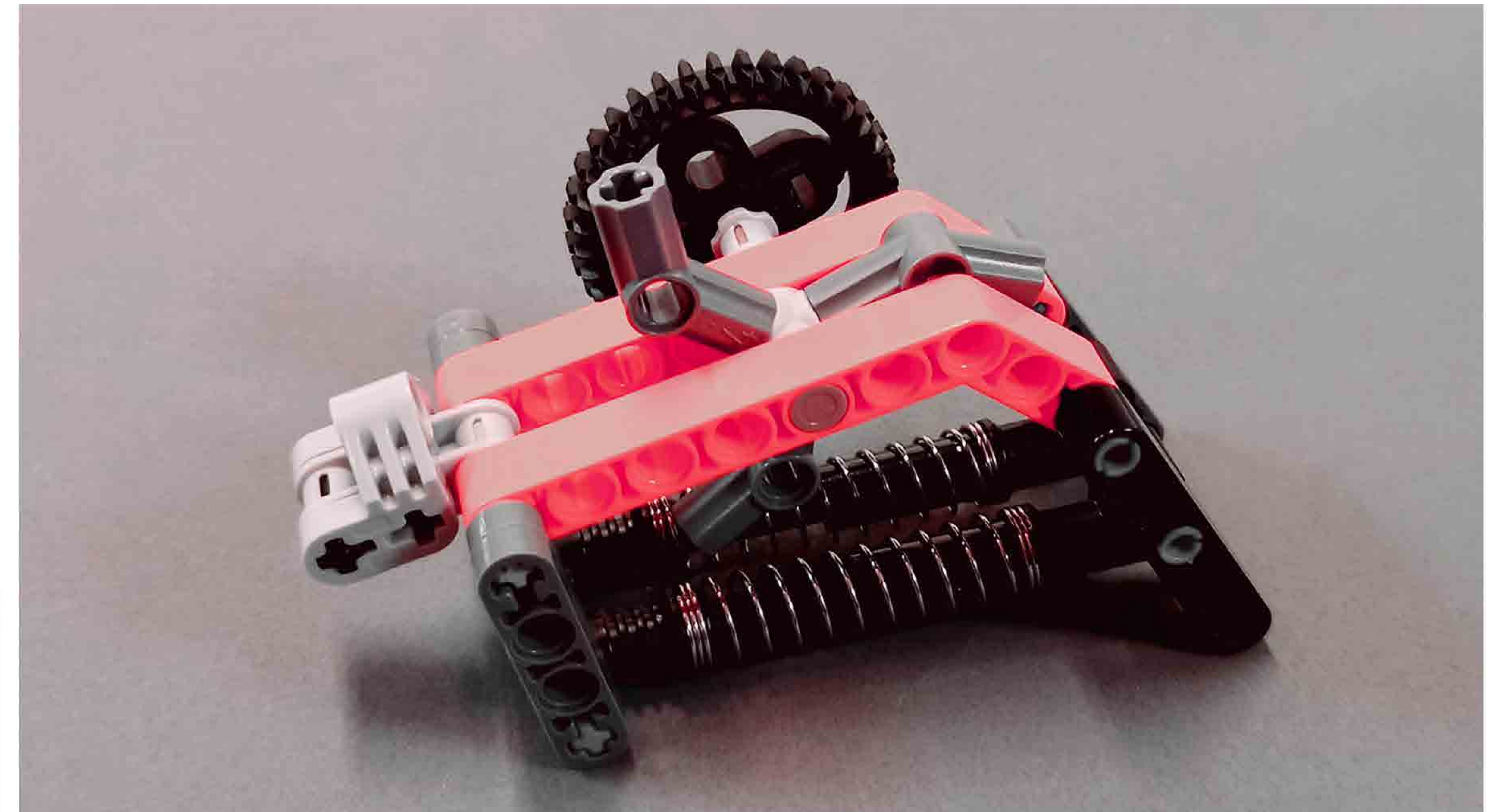
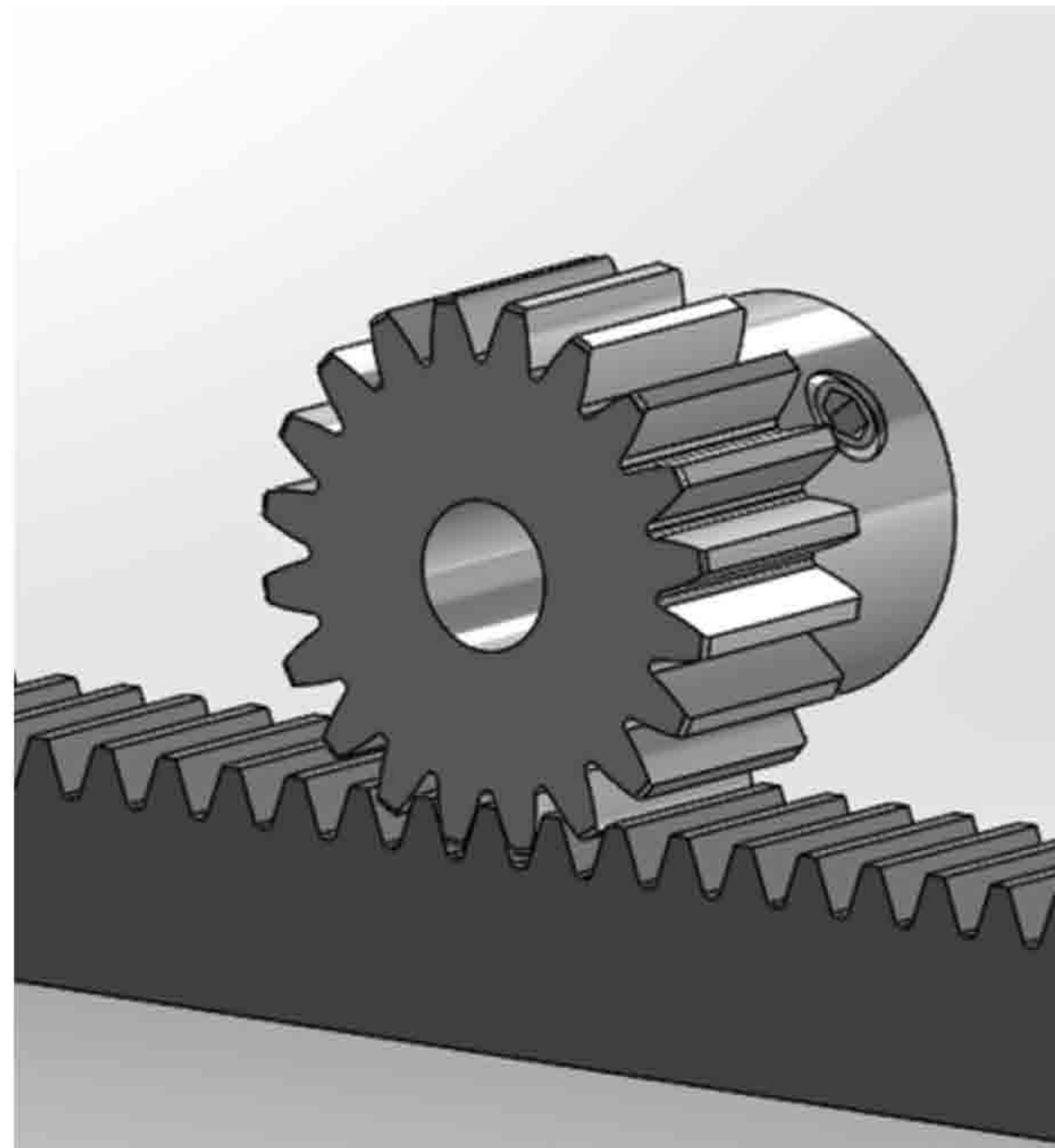




02 Concept idea 03

Kog driven/rack and pinion

- The kog drive, also known as the rack and pinion system, is a staple in the industrial elevator industry. A sturdy and secure system that provides stability and high lifting potential.



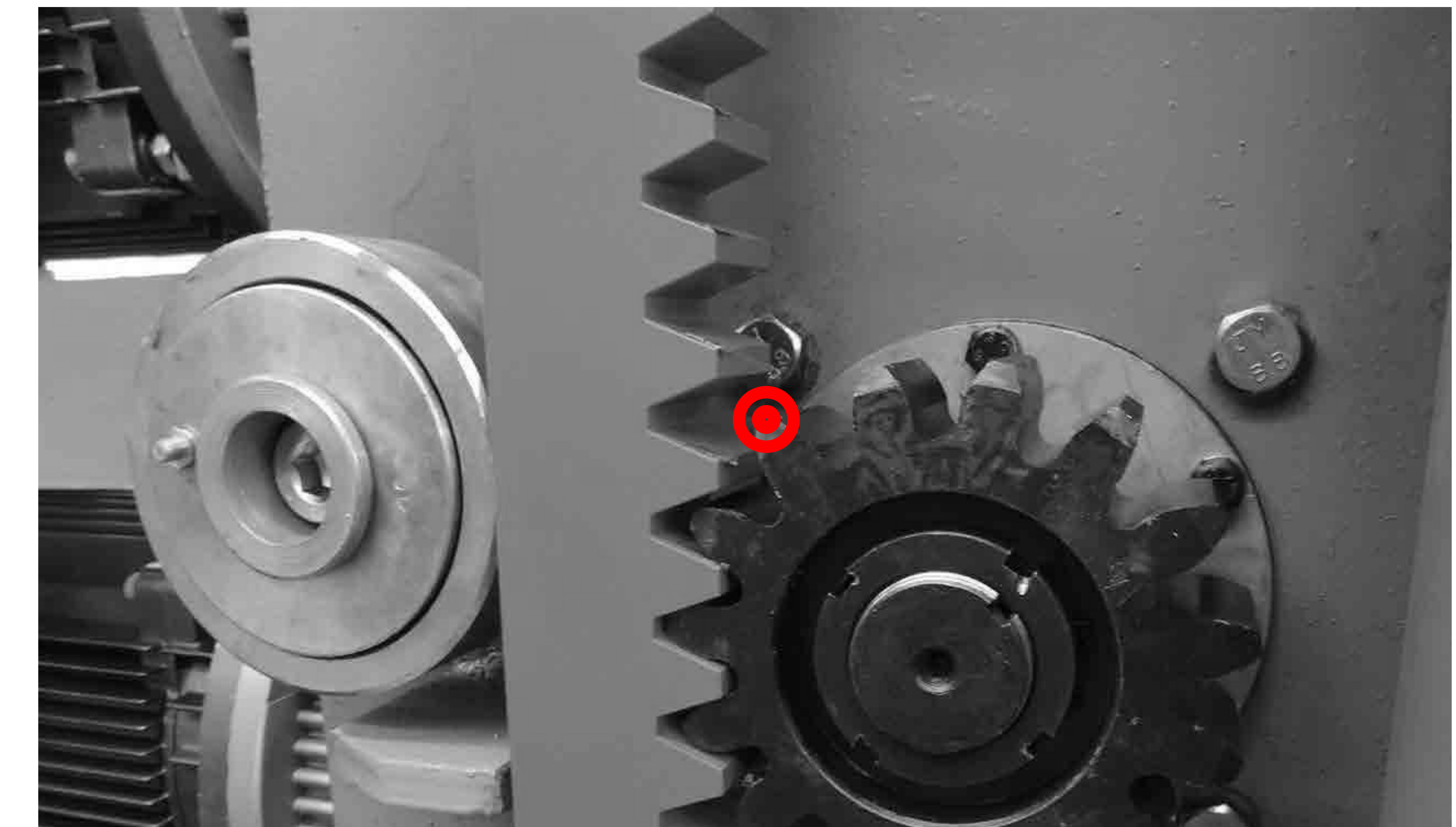
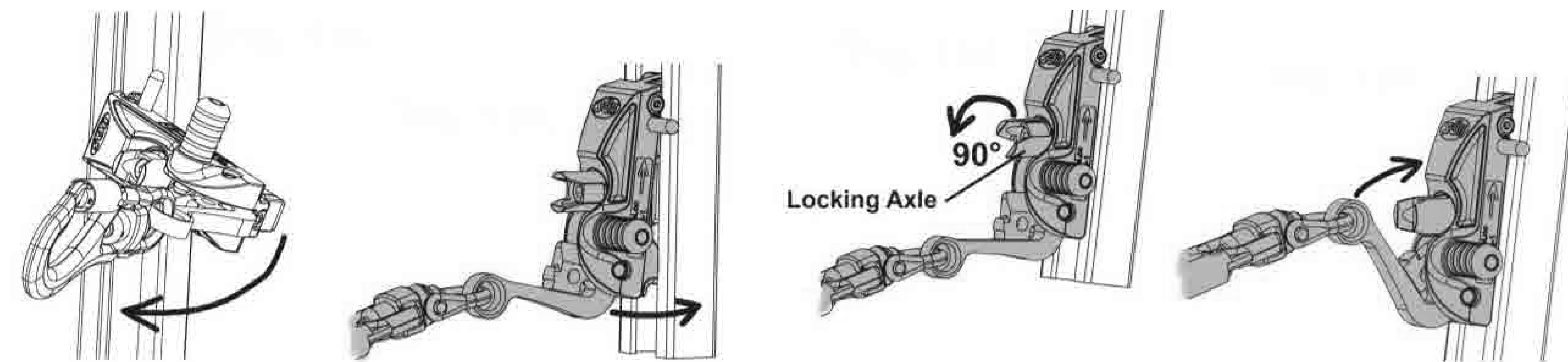
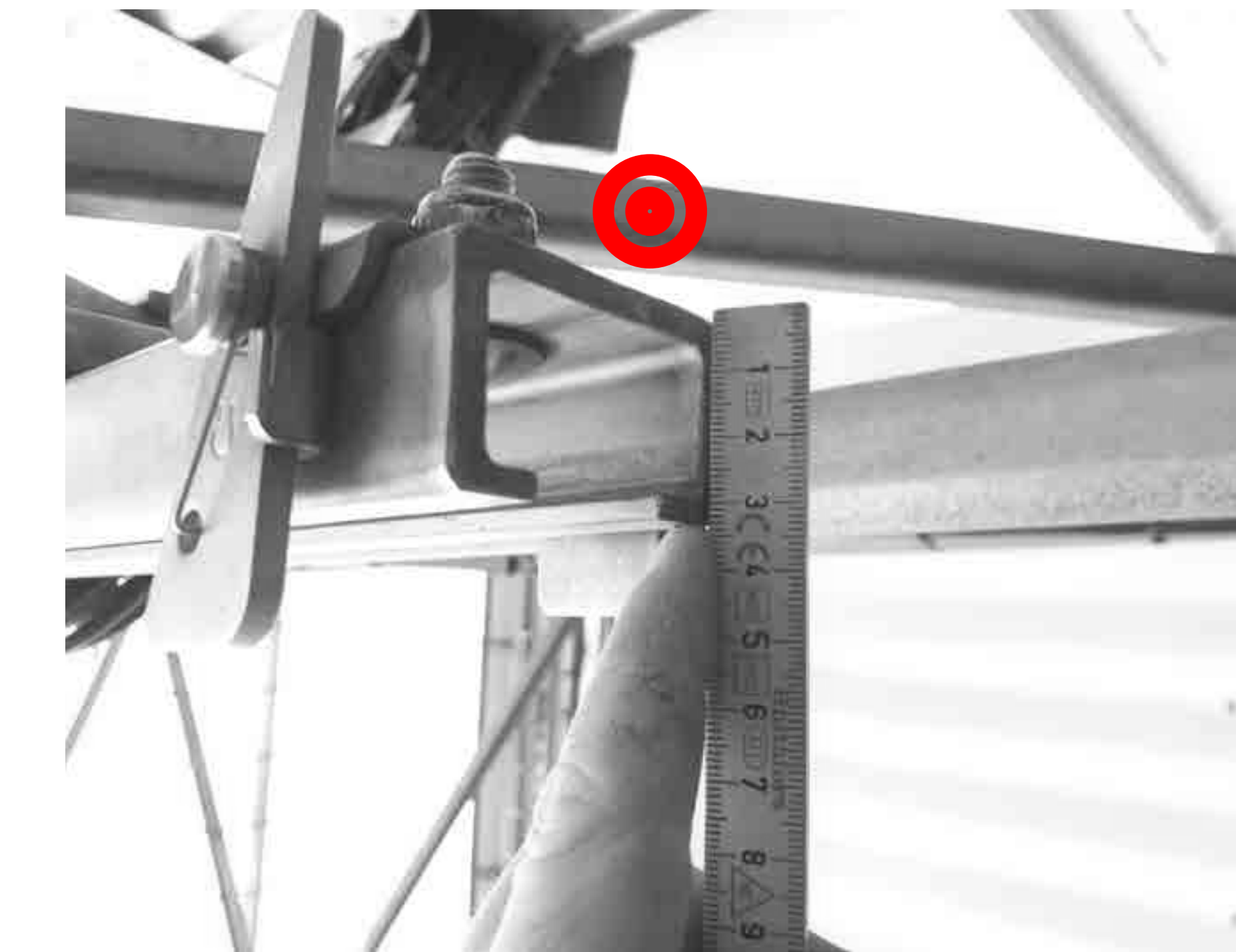
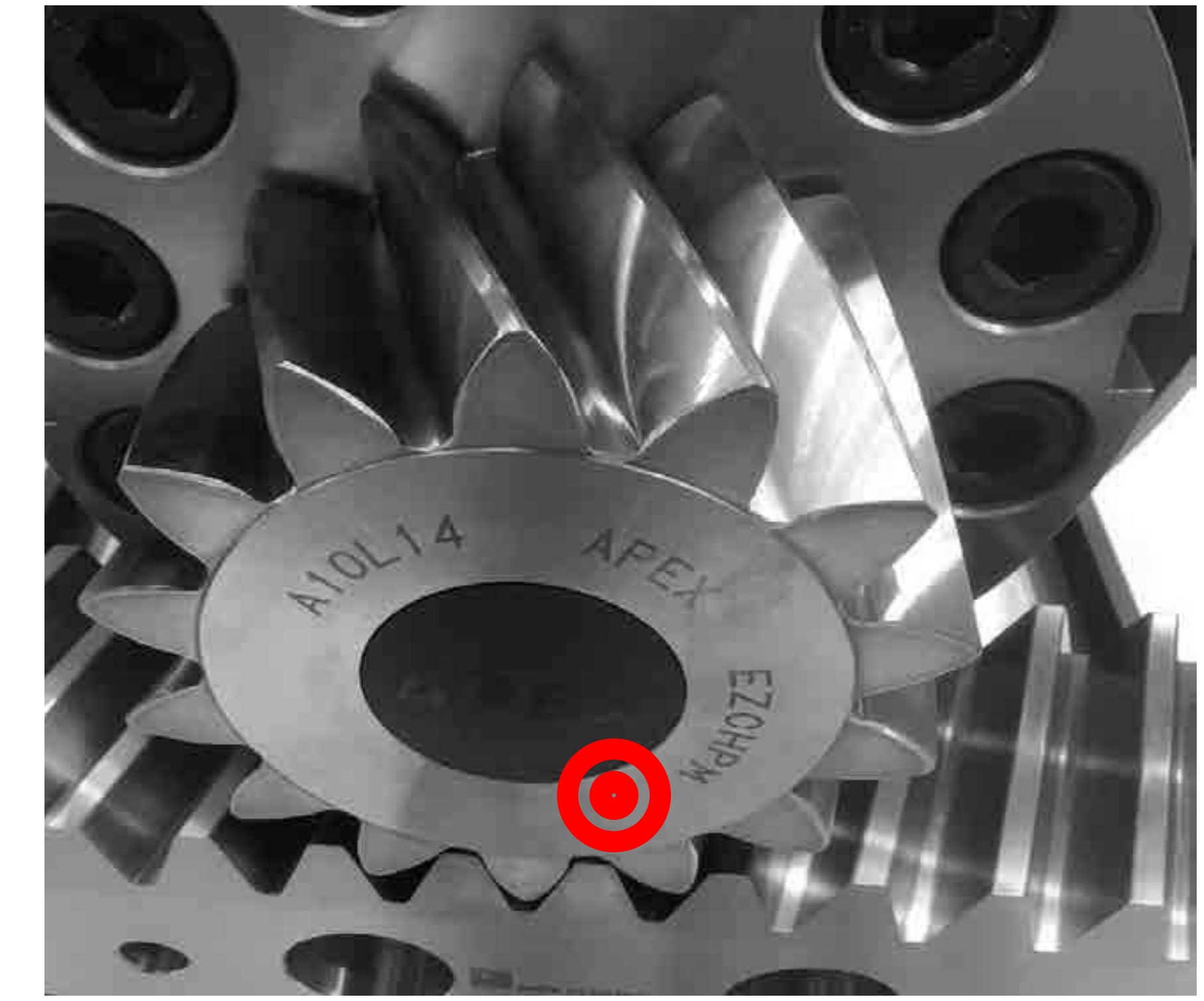
02 Research

Fall arrest system/Tehnology

Additional research

- After presenting the initial concepts, next step was to define a final concept having in mind the feedback given by both Ericsson and Telog. This involved researching the technology that would be used for the design, but also looking into the existing elements of a telecom tower and safety lines (safety rail, general size of the mast and its ladder). By doing so a better image of the constraints could be visualised on which the project could be developed. For instance, the safety rail is a patent system that exists in a vast number of towers.

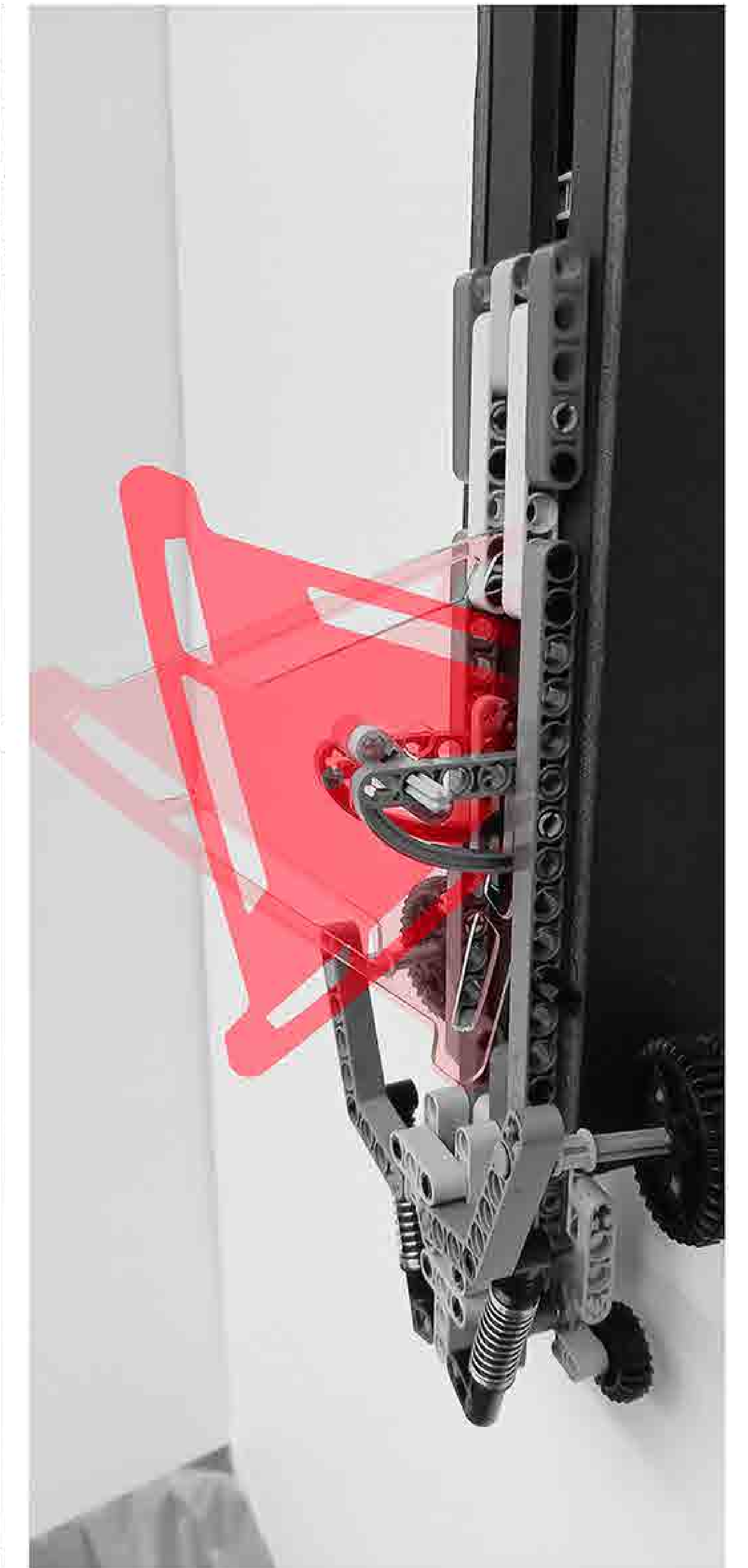
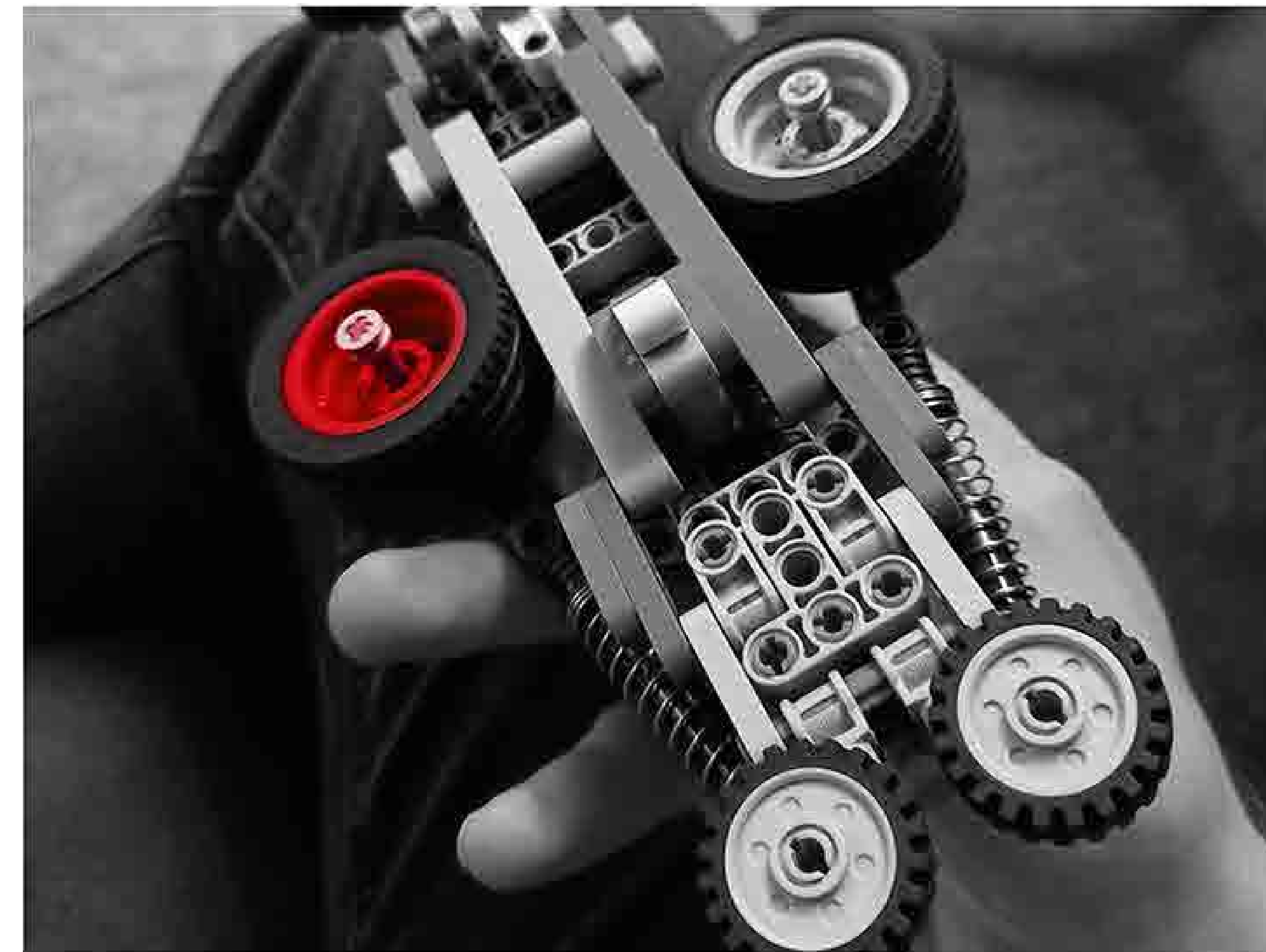
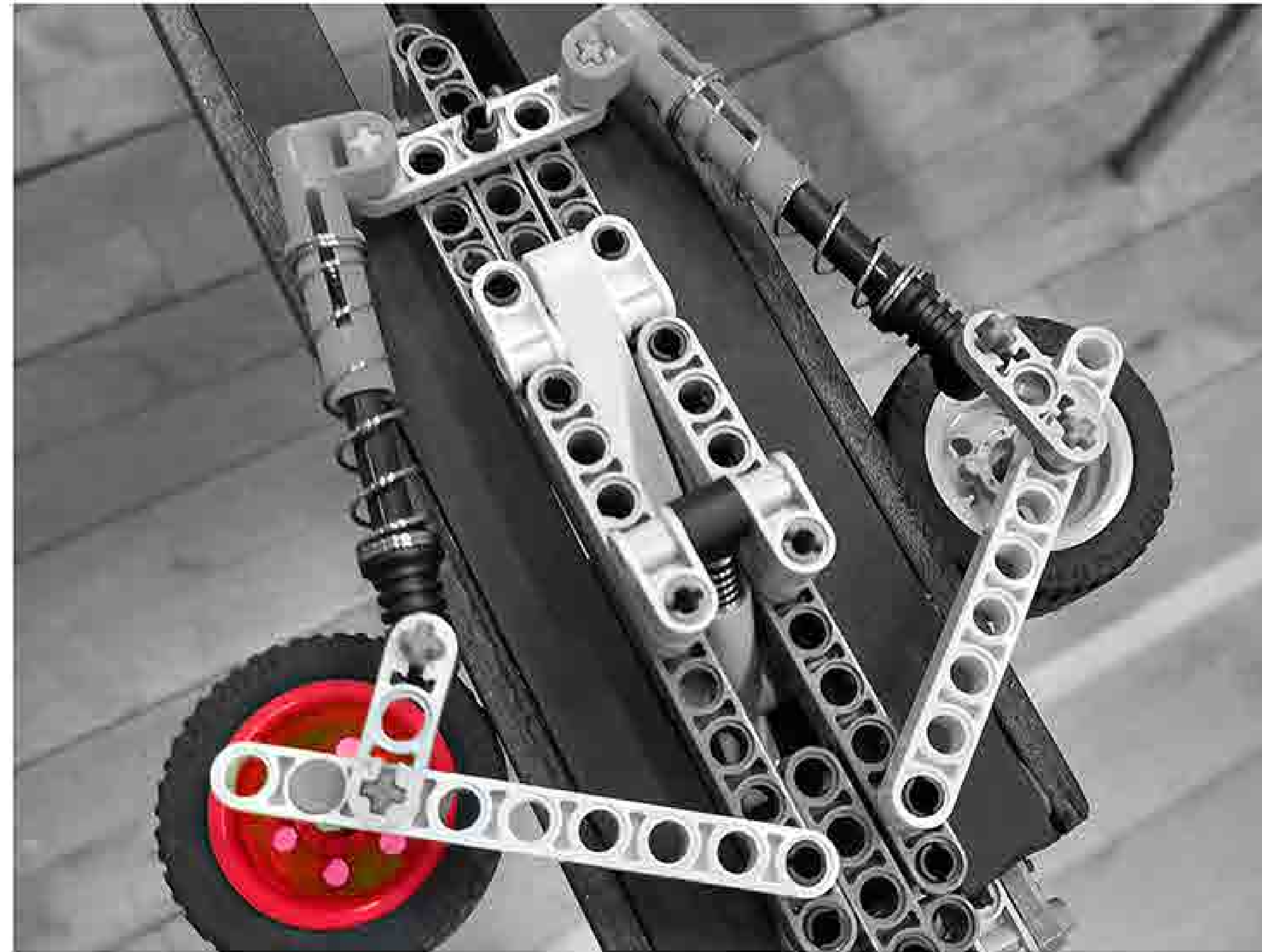
The size of the rail has also proven to be sufficient for the challenge at hand so using it as a part of the design was the best option. The final direction would utilise the rail as a part of the design, using it as a rack for the kog drive within the product.



03 Further development

03 Lego exploration

- Utilising Lego's as a tool in this project was really helpful. Trying out different mechanisms to create a somewhat working prototype influenced the final design greatly. It was possible to utilise a mock-up of the safety rail to try out the mock-ups. With addition of laser cut kogs it was possible to try different sizes and explore the behaviour of the concept in different situations.

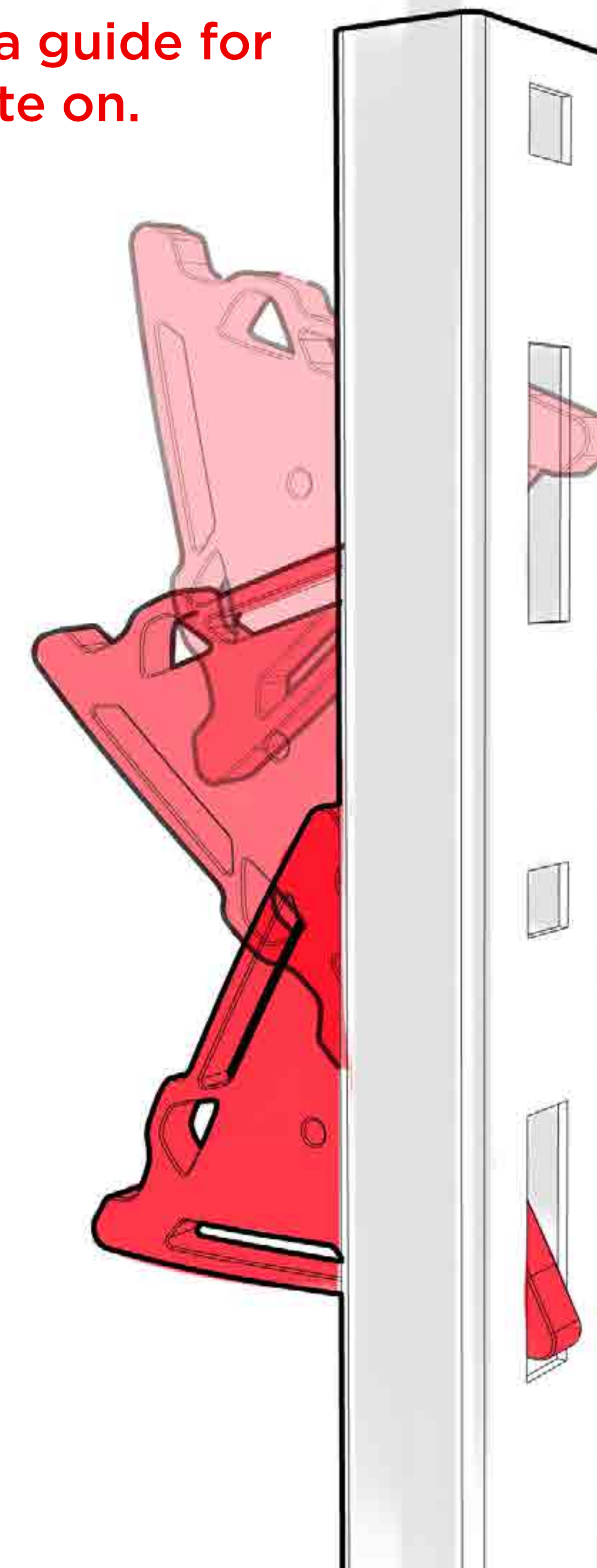


03 Proof of concept

Final direction

The final direction utilises a kog system to deliver lift with the additional help from a set of wheels that provide stability while in use. Lowering heavy equipment and/or injured personnel is achieved by a “controlled decent” via motorised braking. This gives the design a possibility to become compact which in term makes it easier to carry and manage.

Using the rail as a guide for the kog to operate on.

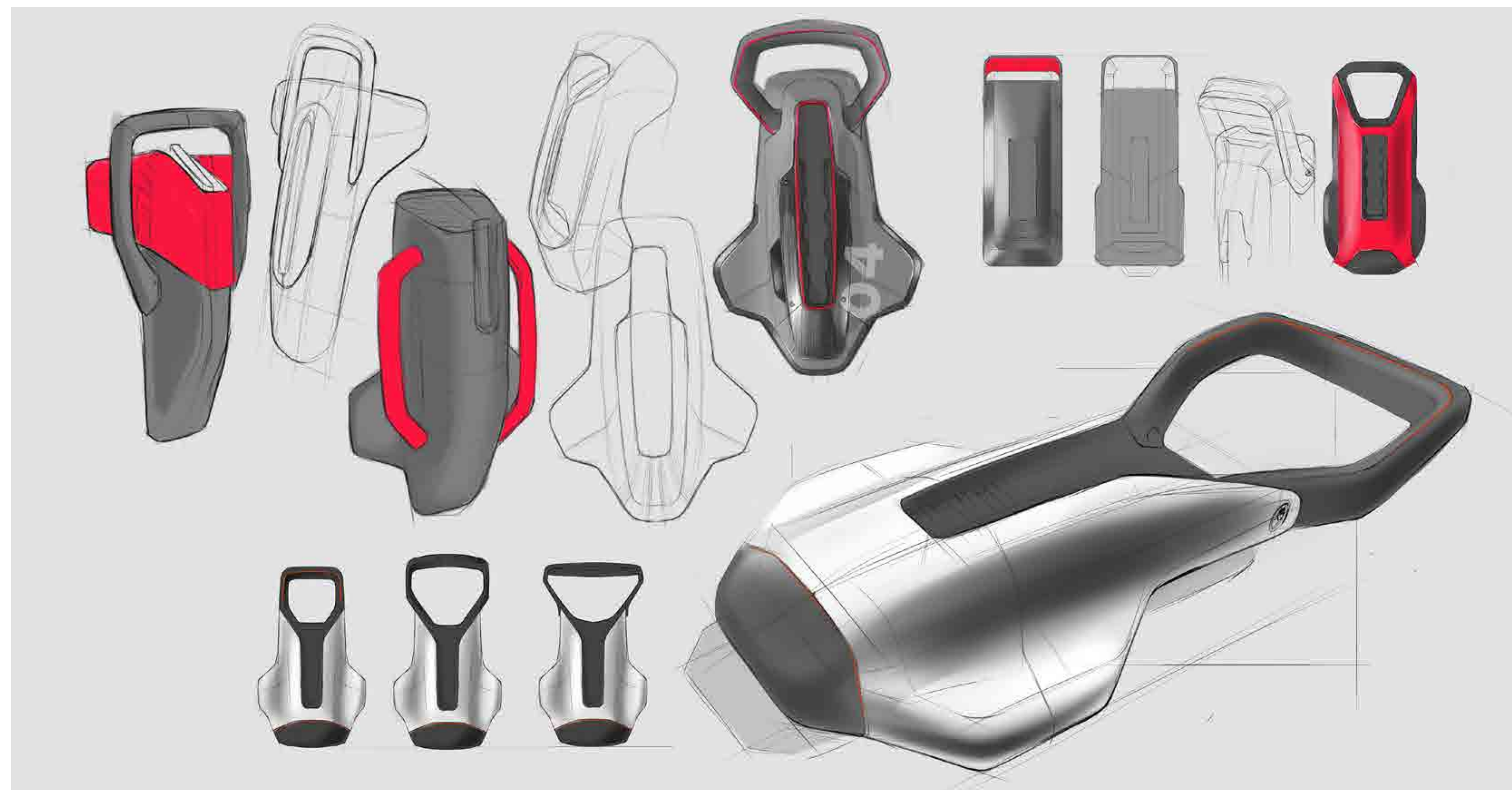


03 Taking a step back

Initial sketches

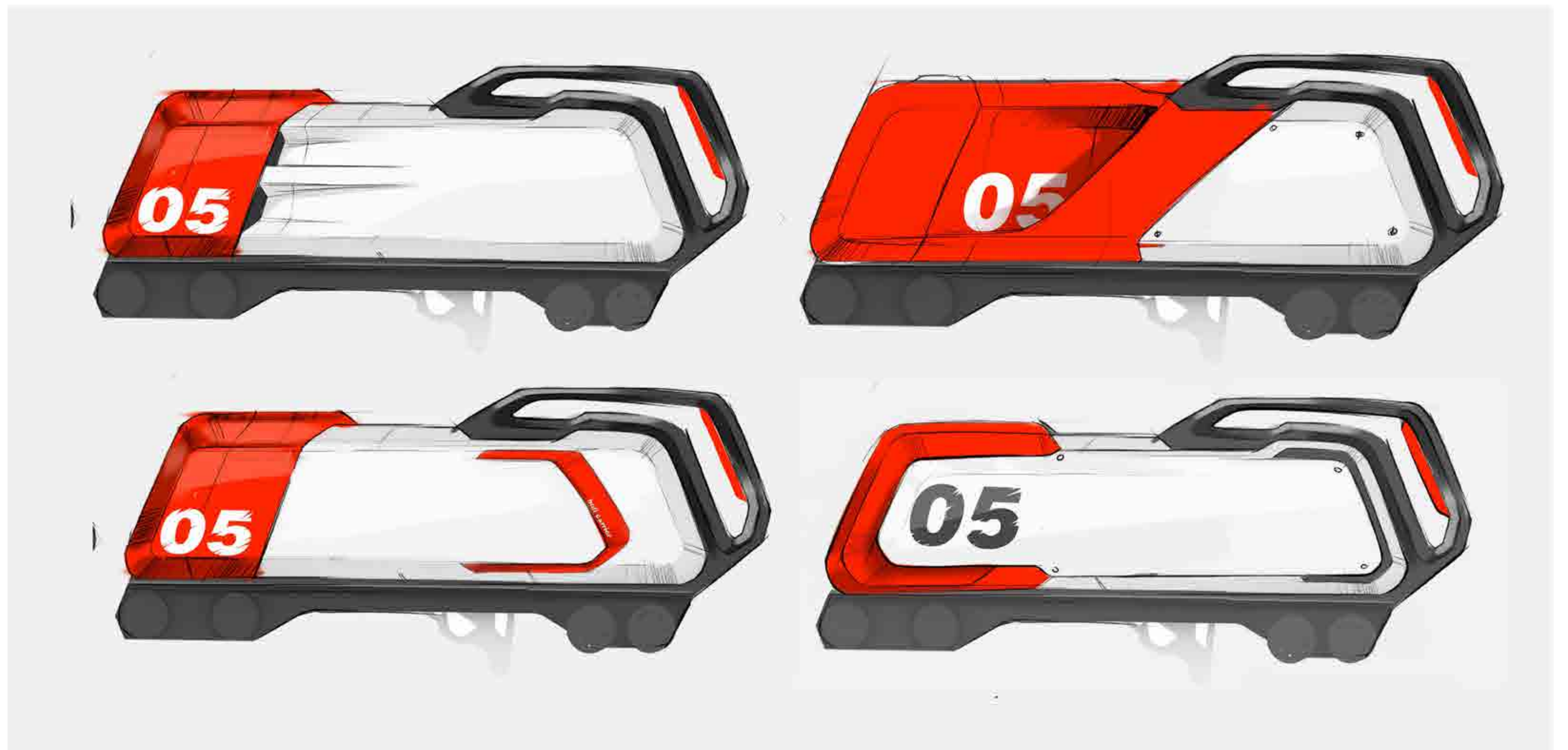
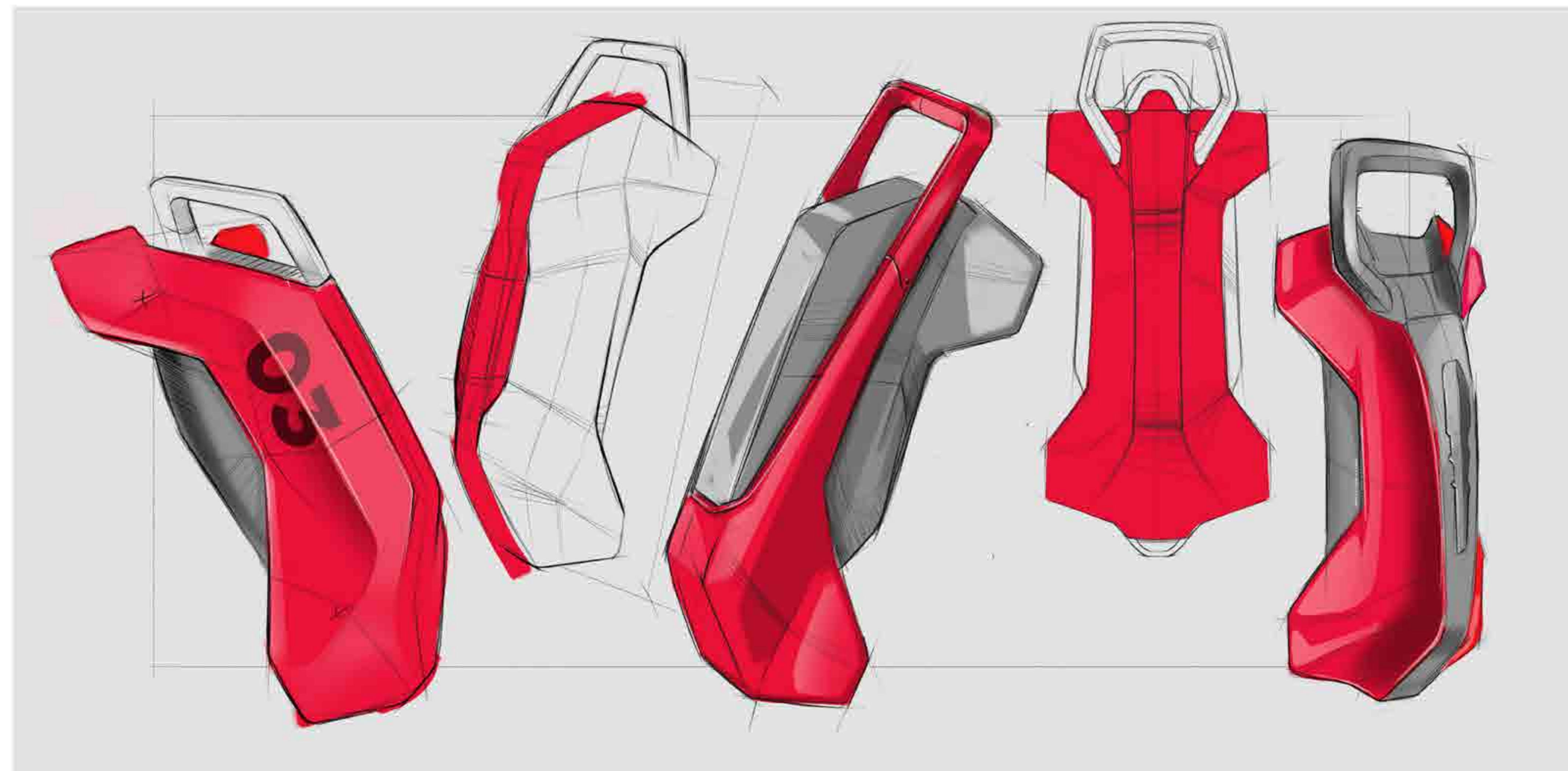
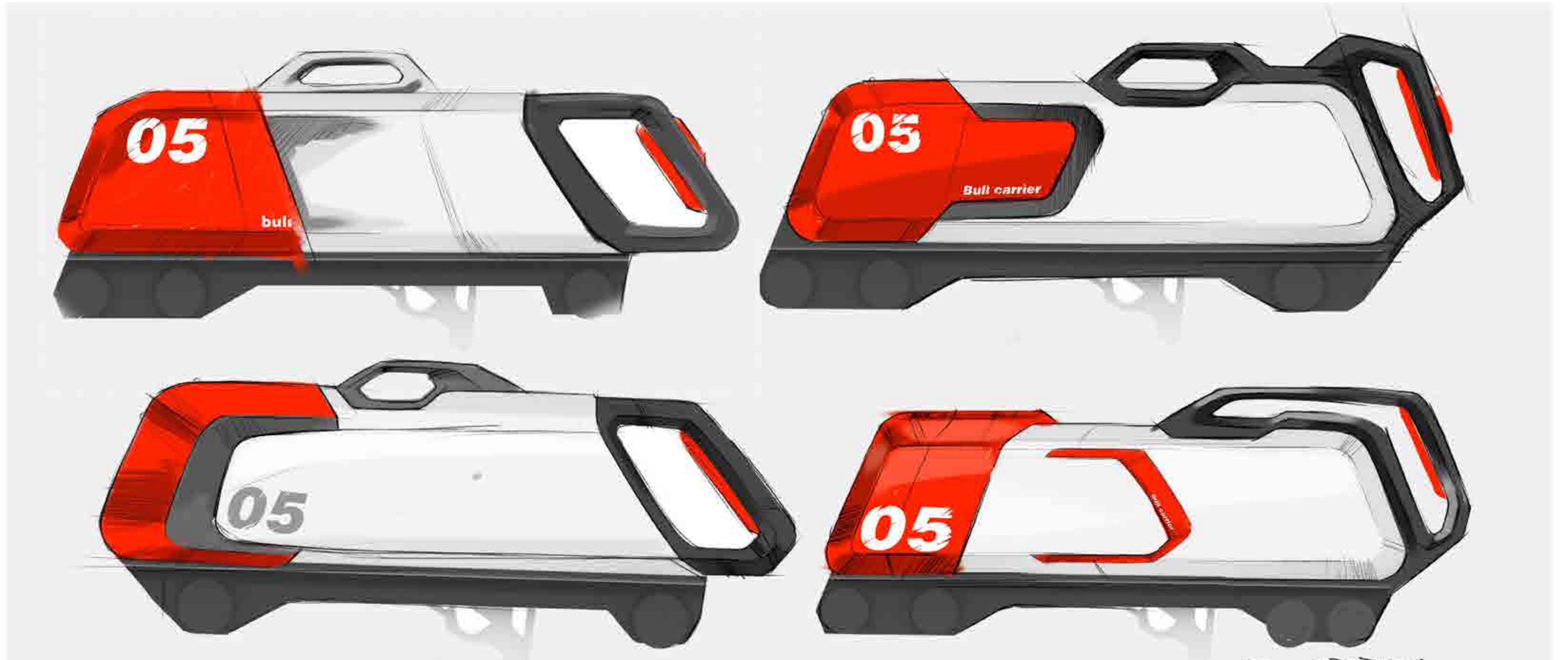
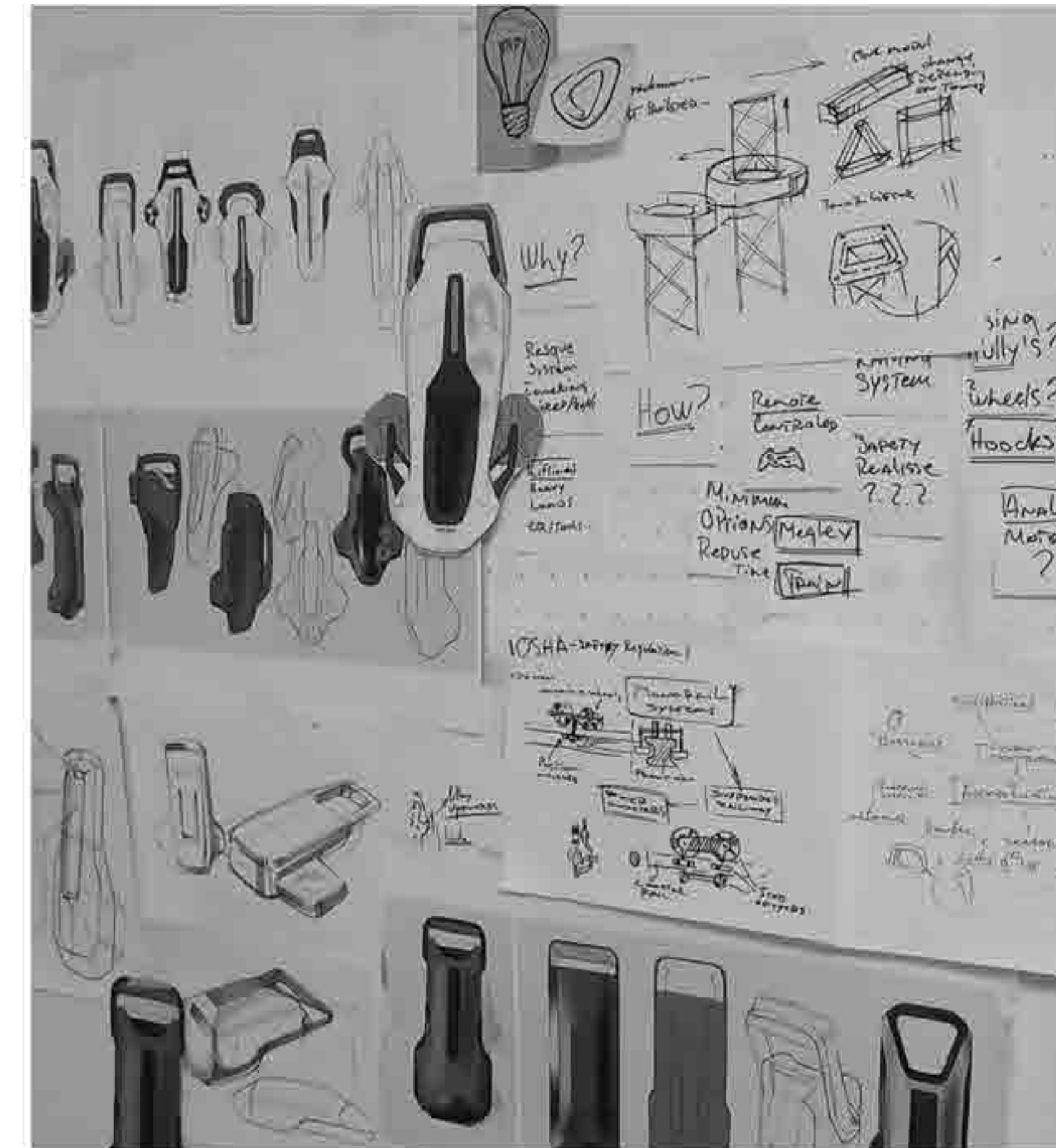
- Upon finishing the initial visualisation and feedback sessions the decision was made to take a step back and reconsider the representation of the design. The initial sketches while promising, communicated a more futuristic and non B for B design language. This as a result might have hindered the impression of the product. The sleek dynamic lines give us a feeling of fragility and speed, which could hinder the feeling of ruggedness and durability of the design.

This resulted in taking a more B for B (Business for Business) design approach, starting with simpler geometrical shapes, designing from the inside out. Having materials and production in mind for the sake of a more realistic presentation.



03 Design and form identity

Final design

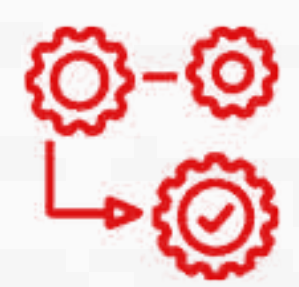


03 Final design

Overview

- The final design is a motorised lifting system that utilises a kog drive to lift equipment up into the telecommunication tower. The unit is compact, leaving room for the workers to move around it. The handle situated on top of the product is used to carry and put into place on to the tower.
- The design incorporates a central construction on which the components are attached to. This provides a sturdy construction on which equipment and tools could be secured on to. The final result decreases the work load and the chances of tools falling while climbing and working in the tower.

◦ Better tool and equipment management



◦ Saves time



◦ Lower risk of tools falling



◦ Decreases physical work load



◦ Safer decent in case of injury



03 Final design

Overview



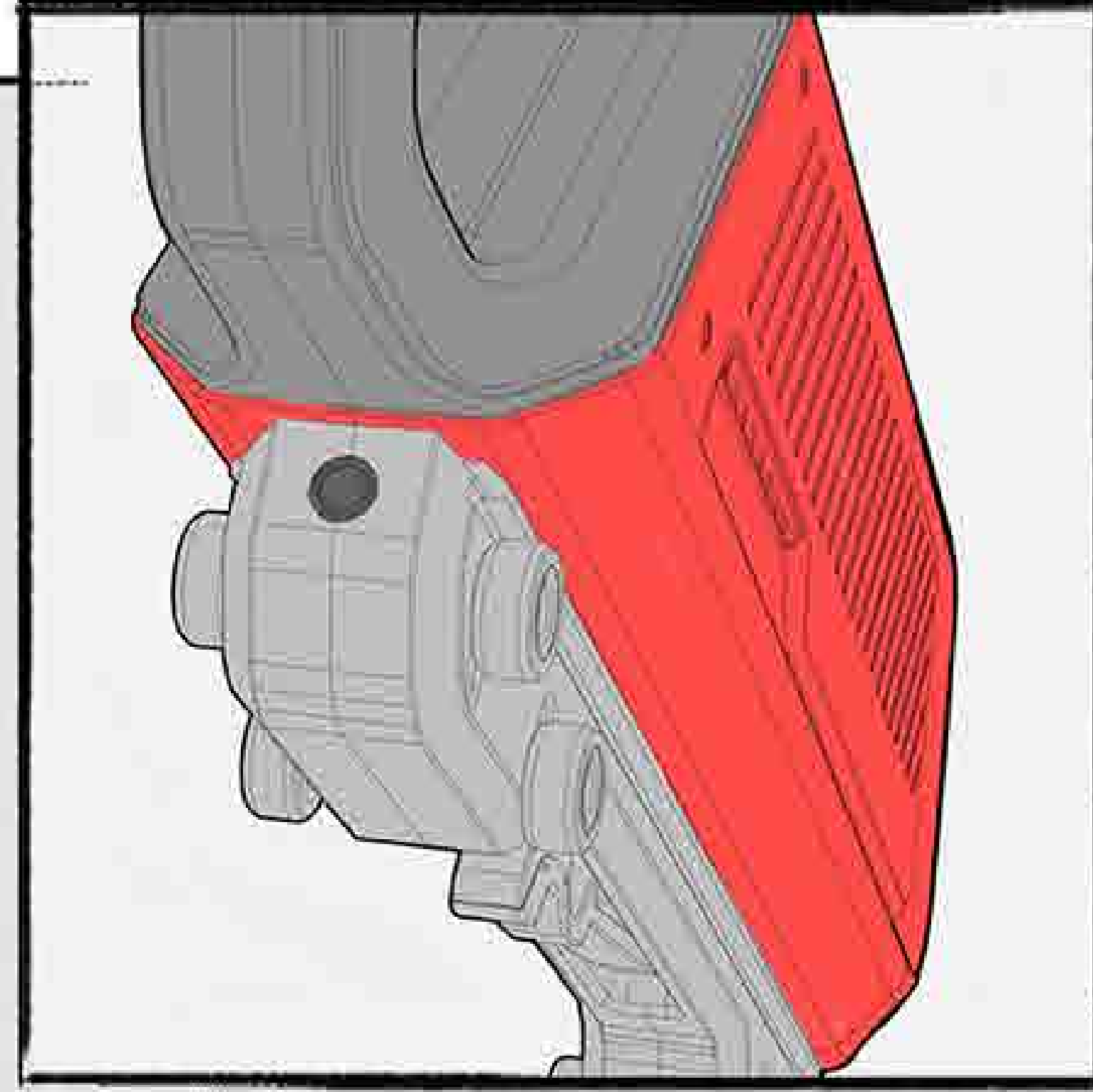
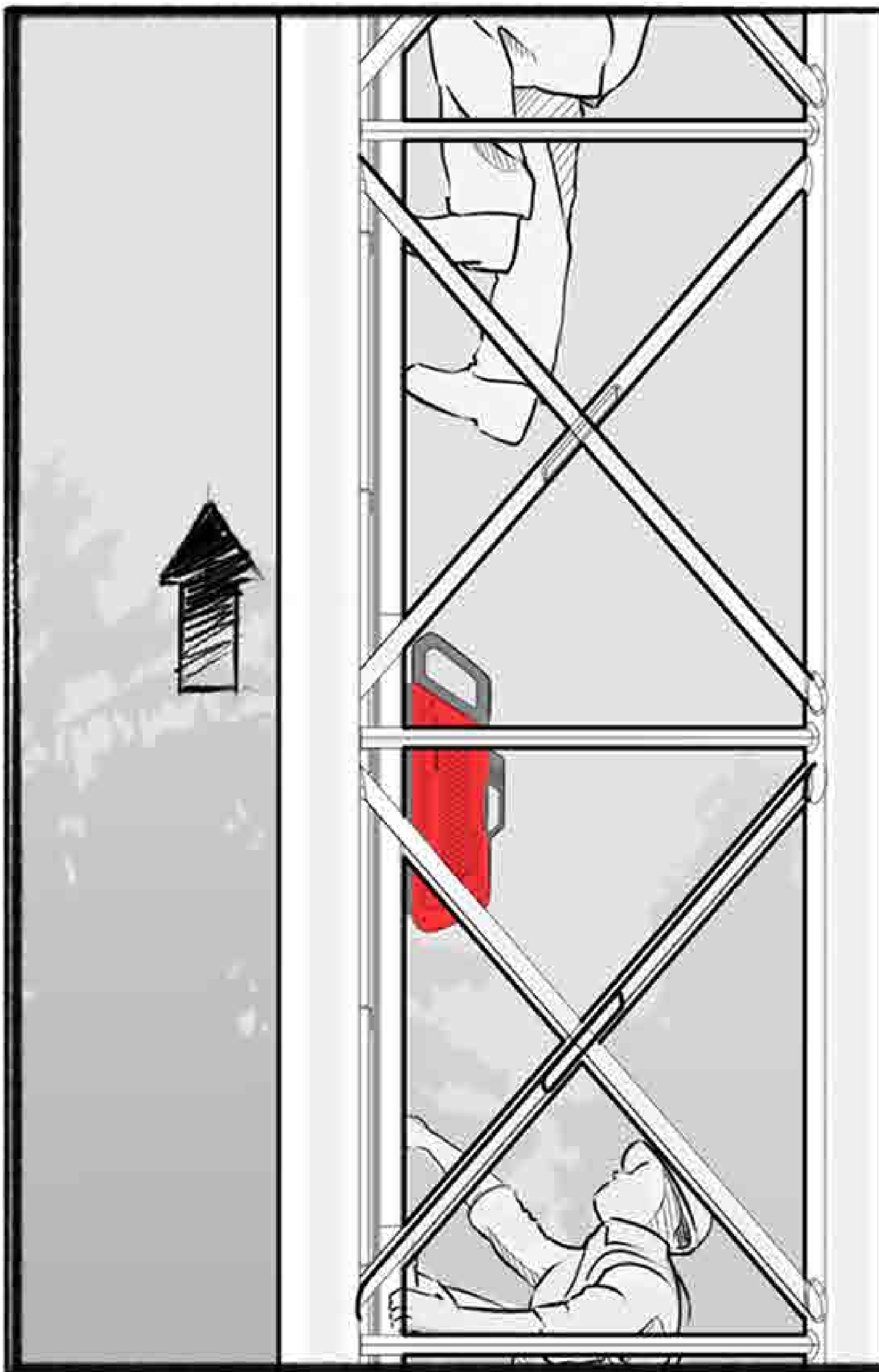
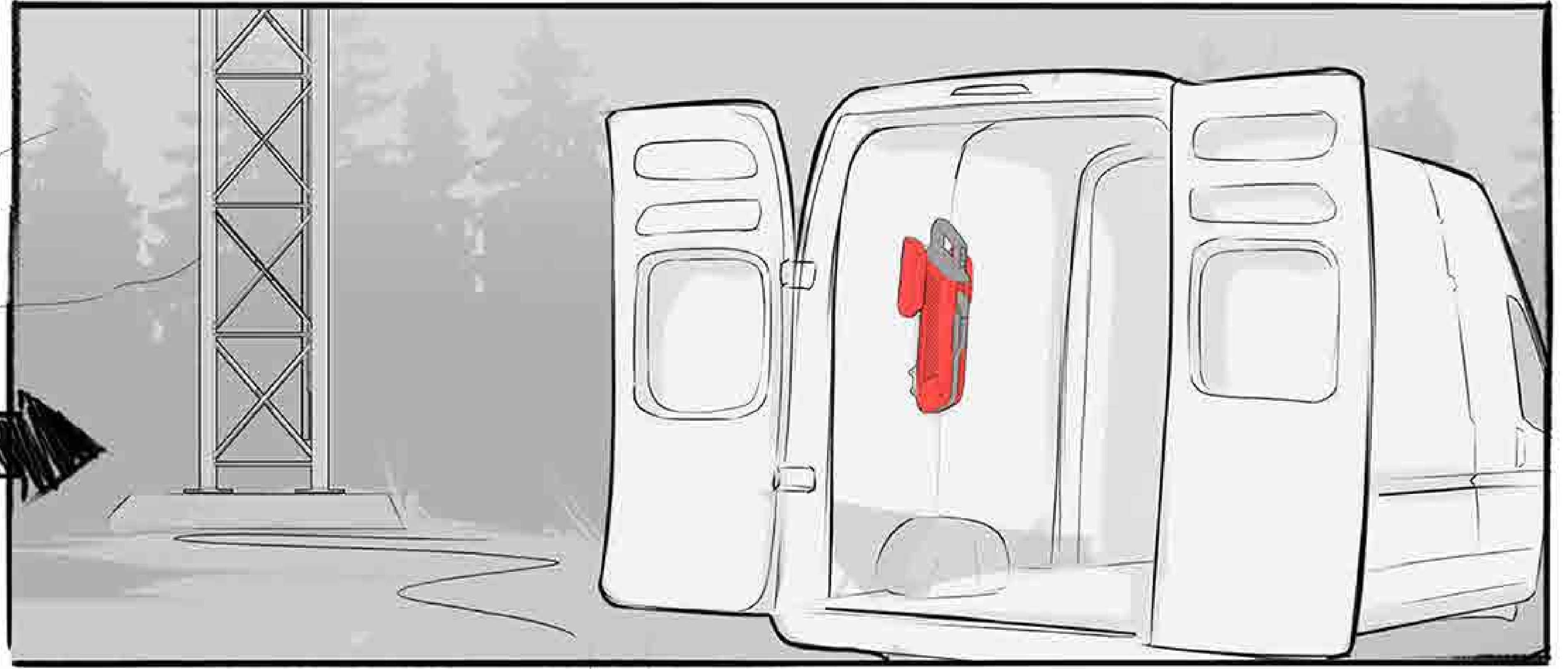
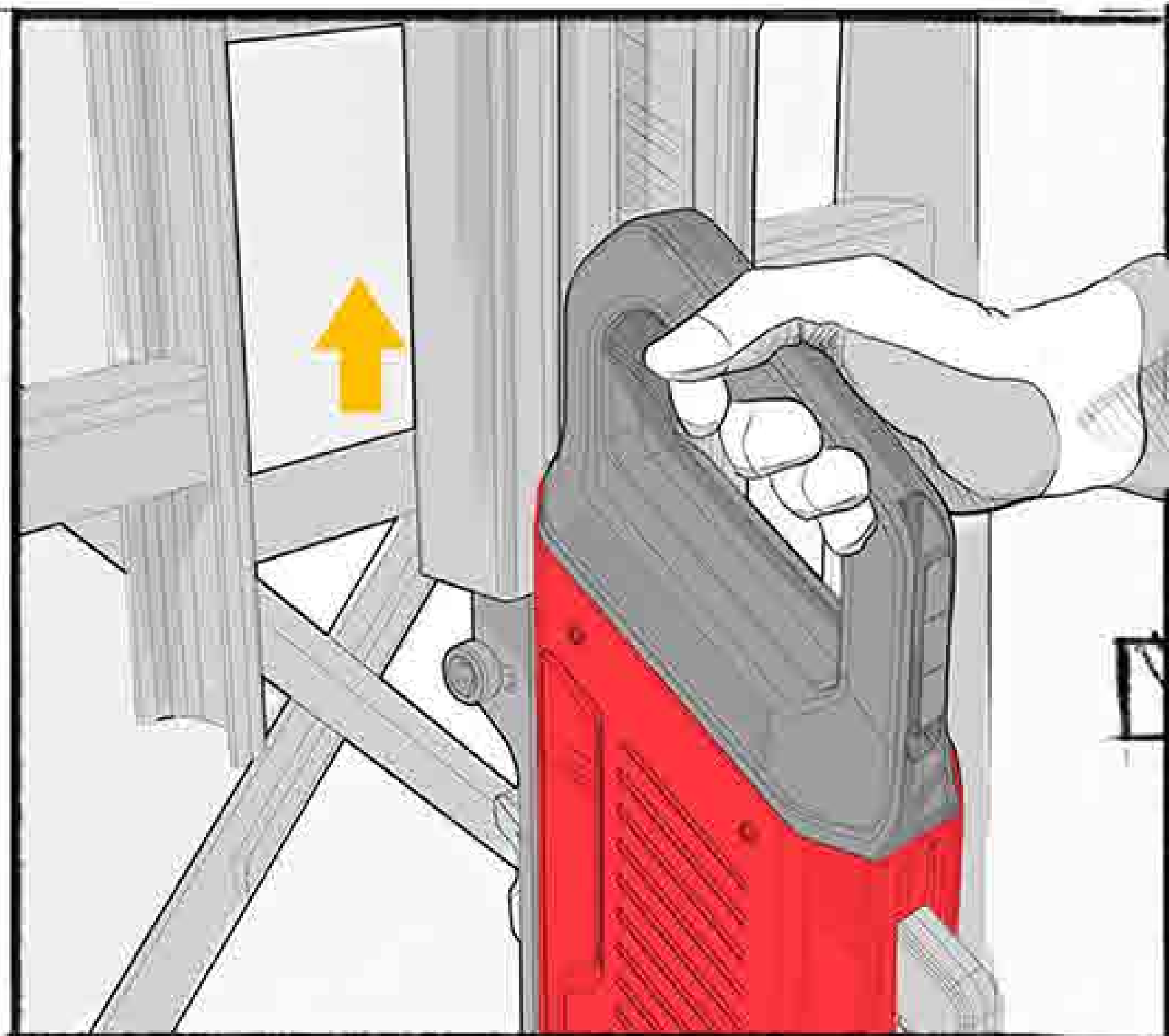
03 Final design

Overview



Story board 1
Everyday use

The unit is mounted on the **existing safety rail**.



Movement sensors detect workers both above and under to **avoid collision**.



It is operated via **clip-worn remote control**.



“..If something happens up there... we only have each other.”

03 Final design

Controlled fall system

- In most cases “Tower dogs” work in groups of two people. Having in mind that a great number of towers are located in remote areas brings the question of urgent help. If a worker gets injured or possibly loses their conciseness on impact, the process of lowering this person could take up to an hour before even transporting them or providing first aid. Furthermore the person is lowered from the outside which exposes the injured person to the weather.
- The controlled fall system provides a faster and safer decent that minimises the time needed for a worker to get help. The controlled fall system release is located behind the central hook. It is secured with a safety cap to prevent users from accidental deployment. When needed the cap slides up revealing the deployment lever. Buy pulling it the system prepares for the decent. The motors start working as brakes. This way it is possible for a small unit to hold the weight of a human.



Story board 2

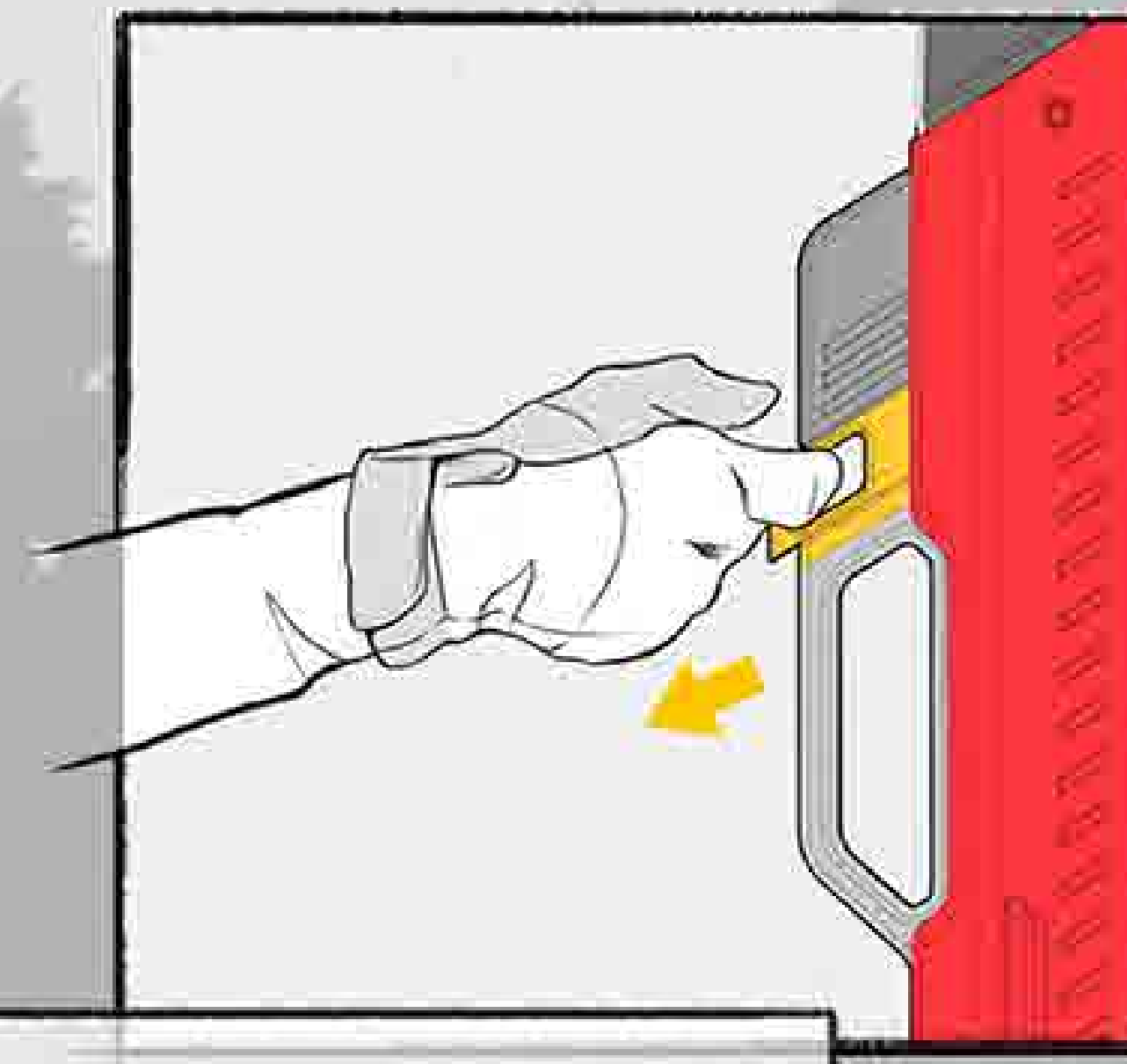
Emergency situation



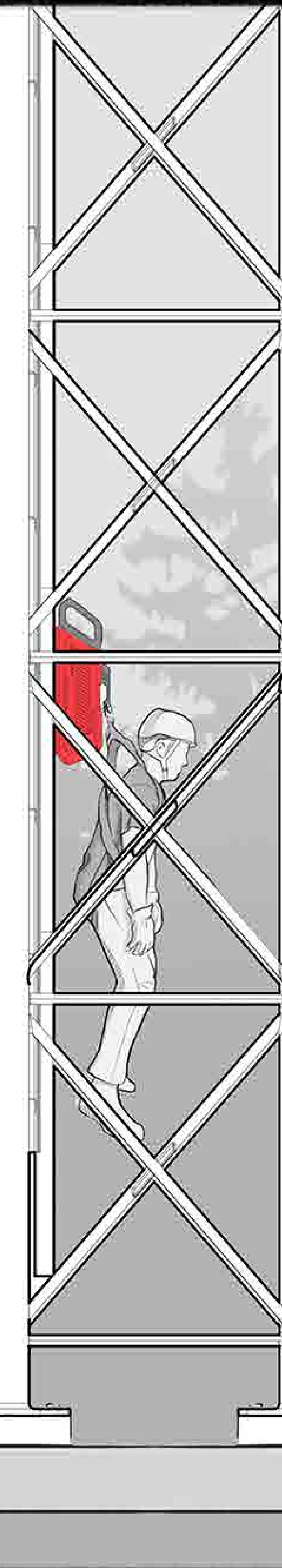
The controlled fall system provides a **safer decent** that **minimises the time** needed for a worker to get help.



When needed the safety cap slides up revealing the **deployment lever**.



By pulling it the system **prepares for decent**.



The injured person could be **lowered safely in matter of minutes**.

Giving them more time to acquire help.

