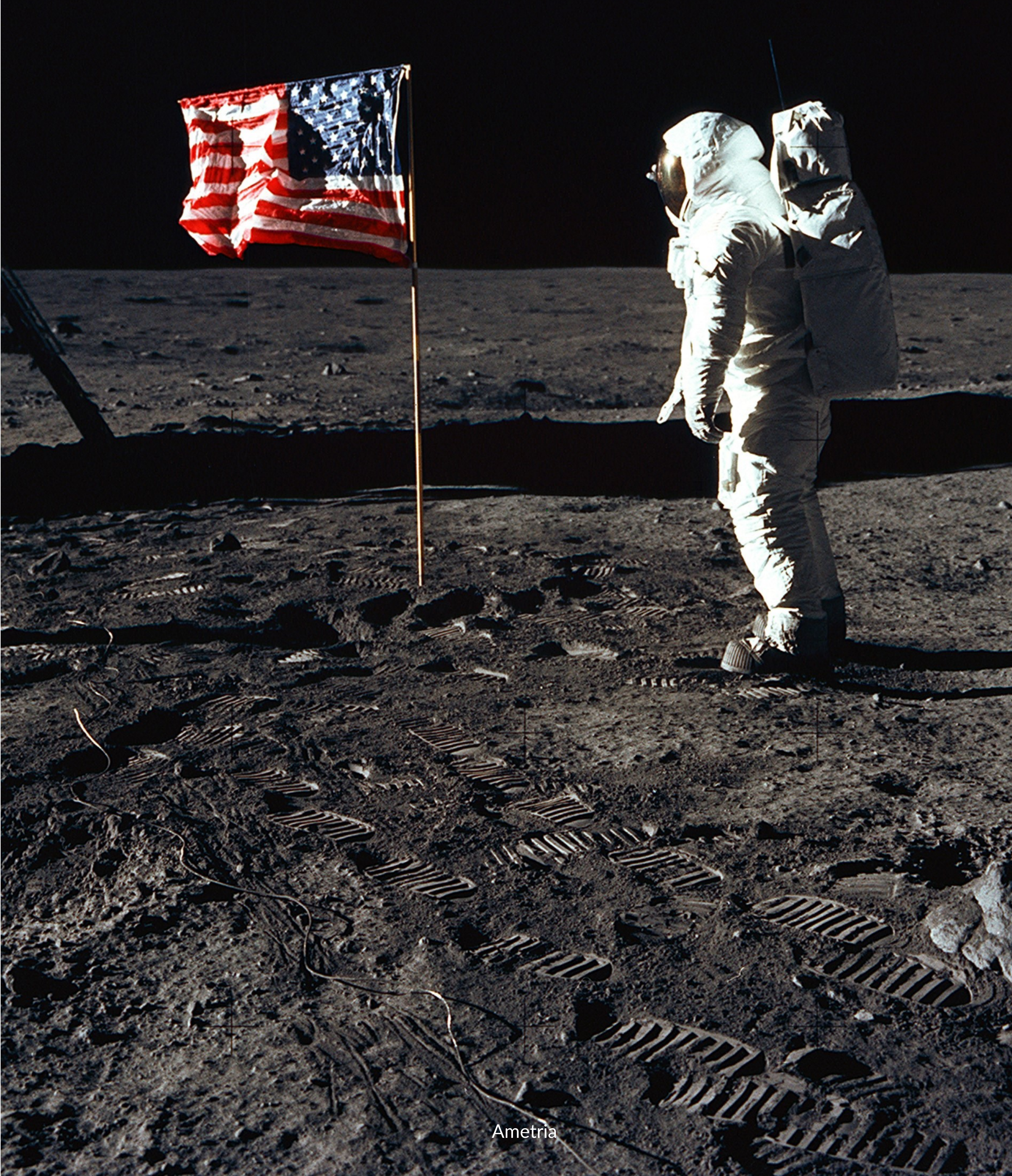
Bricks in Space

Volume II

Part 1 - Moonshot!



Ametria

AMETRIA VERLAG
Berlin, Berlin, Germany

www.ametria.org/lego

Wolfram Broszies (ed.): Bricks in Space, Volume II, Part 1: Moonshot!, Berlin 2019

The text of this book is available under the licence GPL 3.0—http://www.gnu.org/licenses/gpl-3.0.html
Images used are, unless otherwise noted, in the public domain and might have different licensing arrangements, please refer to the copyright holders for details.

The instructions in this book are copyright by their respective creators.

Lego is a trademark of LEGO Denmark. This book is not associated with LEGO in any form, other than using their products for recreational and educational purposes.

First Published 2019

Cover Inage: (20 July 1969) --- Astronaut Edwin E. Aldrin Jr., lunar module pilot of the first lunar landing mission, poses for a photograph beside the deployed United States flag during Apollo 11 extravehicular activity (EVA) on the lunar surface. The Lunar Module (LM) is on the left, and the footprints of the astronauts are clearly visible in the soil of the moon. Astronaut Neil A. Armstrong, commander, took this picture with a 70mm Hasselblad lunar surface camera. Credit: NASA

Quote on p. 15: John F Kennedy, Address at Rice University, September 12 1962, quoted in Logsdon, John M: John F. Kennedy and the Rate to the Moon, McMillard 2010, p.1

Bricks in Space

Modelling Spaceflight with Lego

Volume II: Moonshot!

Edited by Wolfram Broszies

First Edition, 2019

To my wife

Contents

Acknowledgements XI
Introduction: „These and the other Things“ XV
Saturn I 21
Saturn Ib 43
Launch Complex 34-37 57
The Milkstool 97
Little Joe II 137
Saturn V 147
Astrovan 149
M-113 Astronaut Rescue Vehicle 153
Lunar Rover 157
Helicopter 66 161
Mobile Quarantaine Facility 169
Skylab 173
The Crawler 191
References 214

Acknowledgements

This second volume of the Lego in Space series took me longer than expected. Various personal projects, work, and some other Lego distractions took precedence and lead to a much longer editing process than I would have liked. The delay has had its advantages, since a couple of smaller models can now be included, and I hope the quality of Vol II. can keep up with its predecessor.

In the year since Volume I was published, the little Facebook community this work was intended for has grown to more than 3000 members. Many of the newcomers were new to modelling and the world of Lego MOCs. Since for some of my readers these books might also be the first step into modelling with Lego, I would like to reiterate something I should have probably stated more forcefully in the first volume:

The digital models, builds and instructions posted on Lego Ideas and in the Facebook group are the result of dedicated and hard work by many different designers, who then decided to share their creations for free with everyone.

The models come with all possibilities and restrictions of something that is for free

- You can download, print and use them completely for free,
- You can modify them, change them, adapt as you like
- You can kindly ask, but you don't have any right to receive support or help or further material
- You should not attempt to sell or otherwise profit from work that is not yours.

The same is true about this book: It comes completely free of charge. Should you have paid for it someone somewhere, ask for your money back. I sincerely believe that building Legos should be a game of passion and creativity, and while it is more than adequate that we pay for bricks, I will never charge for any of the work I put into this or other projects. This is not to say that I begrudge others charging for their creation. After all, the amount of work going into a single model can be quite daunting. But at least this series will only ever contain models available for free, and will remain free itself.

Quite obviously, what I decided to do with the different instructions I found is to collect them and to repackage them in the form of a printable PDF with a pleasurable layout. Equally obvious is that this book rests on the dedication, creativity and efforts of a lot of people, all of which put a lot more work into this project than me, since I am just assembling their work into one collection. These acknowledgements are thus more than a list of supportive people, since the people named here deserve the true credit for the contents of this book.

As with the first volume, my gratitude belongs first and foremost to Valerie Roche (a.k.a. whatsuptoday) and Felix Stiessen (a.k.a. saabfan), who started everything with their model set of the Saturn V. After a successful run on Lego Ideas the Saturn V was turned into the only official LEGO set of this collection, the 21309 NASA Apollo Saturn V. Valerie and Felix continued to contribute to the community with the SpaceX collection and a wonderful model of the LUT.

While this book contains the instructions to the LUT (in fact, they make up the complete second part), they are not the instructions to Valerie's LUT, but those to the model by Nathan Readioff. There are several other LUT models out there, since constructing or at least digitally modelling the red tower has become something of the mark of a true Lego space builder. The models and builds of Michael Cameron, Bailey Fullarton and Kremer all show the LUT in different aspects, each model with its distinct strengths. Nathan's LUT is included here because he is the only one who tackled the enormous effort to create, render and layout the massive 400+ pages of instructions it takes to build this monster. For this, and the permission to basically repurpose his instructions within this series, I owe Nathan thanks.

And of course I am deeply grateful to Grant Passmore aka eiffleman for his designs of the crawler, Skylab and many other models depicted in this book. His designs and construction methods have been inspiring to me, and his encouraging and helpful comments are one of the reasons the whole idea of modelling NASA's space race with Lego bricks took off.

David Welling took upon himself the monumental task of faithfully recreating not only the Saturn I and Saturn Ib rockets, but also their two launch systems, Launch Complex 34 and the “milkstool” built for Launch Complex 39. The Saturn I poses particular challenges to the modeler. Being a testbed and in a constant state of overhaul, not a single launched rocket looked alike. Modifications, incremental improvements, and various payloads all contributed to an unique appearance of every single Saturn I rocket at launch. For the reason of brevity, we elected not to include David's full set of instructions for all models. You can find his own, complete instructions by following the link in the datasheet. I am deeply grateful David granted me permission to include parts of his instructions in this collection.

This list would not be complete without expressing my deepest gratitude to Sebastian Schön. By creating instructions for Mark Balderama's Helicopter 66 he closed the last remaining gap of this volume, and his help and support with other models enabled me to profit from his experience in modelling and CAD. I am very much looking forward to covering more of his models in the Soviet volume of this series.

The countless editors of Wikipedia, whose articles on the individual rockets and spaceships provided the base of most of the model descriptions and the historical background. I hope I did not violate the spirit of Wikipedia by copying parts of their texts into this book. Whatever is well written and concise in these chapters is theirs – the complicated and convoluted sentences are mine.

I will be forever indebted to Mark Wades astronatix.com which provided an inexhaustible source of information on even the most exotic rocket model variants. Any error contained in this work are clearly mine, probably based on a wrong reading on Mark's excellent encyclopedia.

My deepest respect and gratitude goes to the women and men of NASA. If this book can convey only a fraction of the inspiration their work has been to me, I would be honored.

Finally, this book would not have happened without the love, support and help of my family. My kids curiosity and questions as well their help in assembling models were a driving force to get this book done. Without the patience and writing skills of my wife, who did the proofreading and shaped this collection of various historical reminiscences into a coherent narration, it would be a much lesser work.

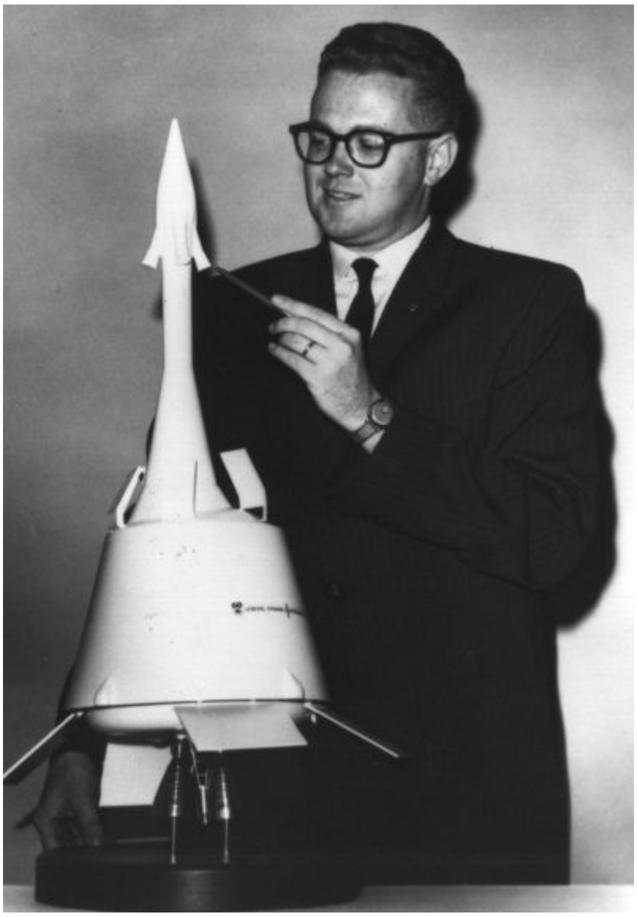
Introduction

The Space race, which the US unilaterally declared won with the moon landing, was the biggest technological and scientific project of its time, and ever since. To put those two men onto the surface on the Moon, awkwardly hopping round in stiff suits for a couple of hours, billions of dollars had bought factories, laboratories, launch towers and assembly buildings of a size hitherto unseen, and had occupied more than a quarter of a million people for a decade. It was a magnificent triumph of science and engineering, even if it turned out to be hollow.

The Apollo program was conceived during the Eisenhower administration in early 1960, as a follow-up to Project Mercury. While the Mercury capsule could only support one astronaut on a limited Earth orbital mission, Apollo would carry three astronauts. Planned missions included ferrying crews to a space station, circumlunar flights, and eventual manned lunar landings. The program was named after the Greek god of light, music, and the sun by NASA manager Abe Silverstein.

In November 1960, John F. Kennedy was elected president after a campaign that promised American superiority over the Soviet Union in the fields of space exploration and missile defense. Despite Kennedy's rhetoric, he did not immediately come to a decision on the status of the Apollo program once he became president. On April 12, 1961 however, Soviet cosmonaut Yuri Gagarin became the first person to fly in space, reinforcing American fears about being left behind in a technological competition with the Soviet Union. On May 25, 1961, twenty days after the first US manned spaceflight Freedom 7, Kennedy proposed the manned Moon landing in a Special Message to the Congress on Urgent National Needs:

President John F. Kennedy in his historic message to a joint session of the Congress, on May 25, 1961
Credit: NASA



William Rector of General Dynamics Corp. describes the design his company proposed for the Apollo circumlunar mission (1960-61 feasibility study), May 1961.
Credit: NASA

“I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth.”

At the time of Kennedy's proposal, only one American had flown in space—less than a month earlier—and NASA had not yet sent an astronaut into orbit. Even some NASA employees doubted whether Kennedy's ambitious goal could be met. By 1963, Kennedy even came close to agreeing to a joint US-USSR Moon mission, to eliminate duplication of effort.

With the clear goal of a crewed landing replacing the more nebulous goals of space stations and circumlunar flights, NASA decided that, in order to make progress quickly, it would discard the feasibility study designs of Convair, GE, and Martin, and proceed with Faget's command and service module design. The mission module was determined to be useful only as an extra room, and therefore unnecessary. NASA used Faget's design as the specification for another competition for spacecraft procurement bids in October 1961. On November 28, 1961, it was announced that North American Aviation had won the contract, although its bid was not rated as good as Martin's. Webb, Dryden and Robert Seamans chose it in preference due to North American's longer association with NASA and its predecessor.

Managing the Apollo program required an expansion of launch and control facilities. Until then, Robert R. Gilruth's Space Task Group had been directing the nation's crewed space program from NASA's Langley Research Center. In September 1961 the Manned Spacecraft Center (MSC) was founded in Houston, Texas on a land grant donated by Rice University, which also included a new Mission Control Center. The MSC was completed in September 1963. It was renamed by the US Congress in honor of Lyndon Johnson soon after his death in 1973.

On July 1, 1960, NASA established the Marshall Space Flight Center (MSFC) in Huntsville, Alabama. MSFC designed the heavy lift-class Saturn launch vehicles, which would be required for Apollo.

On Cape Canaveral itself, the two newest launch complexes were already being built for the Saturn I and IB rockets at the northernmost end: LC-34 and LC-37. But an even bigger facility would be needed for the mammoth rocket required for the crewed lunar mission, so land acquisition was started in July 1961 for a Launch Operations Center (LOC) immediately north of Canaveral at Merritt Island. The design, development and construction of the center was conducted by Kurt H. Debus, a member of Dr. Wernher von Braun's original V-2 rocket engineering team. Debus was named the LOC's first Director. Construction began in November 1962. Upon Kennedy's death, President Johnson issued an executive order on November 29, 1963, to rename the LOC and Cape Canaveral in honor of Kennedy. The LOC consisted of several large structures that have since become iconic: Launch Complex 39, the Vehicle Assembly Building containing at that time the largest interior space for any building, a Launch Control Center and a Operations and Checkout Building. Between them, two Nasa crawlers carried the mobile launch platforms with the red lattice structures of two Launch Umbilical Towers, towering 150 meters over the launch pad to enable access to the Saturn V rockets when assembled and erected for launch.

After a long internal discussion of various mission profiles, NASA decided in 1962 for a Lunar Orbit Rendezvous, with a single launcher sending an Apollo space Ship and a dedicated lander to the Moon, where the Lander would undock and land, while the Apollo Spaceship would remain in orbit. Apart from enabling a launch with just a single rocket, the LOR method had the advantage of allowing the lander spacecraft to be used as a "lifeboat" in the event of a failure of the command ship. In 1964 an MSC study concluded, "The LM [as lifeboat] ... was finally dropped, because no single reasonable CSM failure could be identified that would prohibit use of the SPS." Ironically, just such a failure happened on Apollo 13 when an oxygen tank explosion left the CSM without electrical power. The lunar module provided propulsion, electrical power and life support to get the crew home safely.

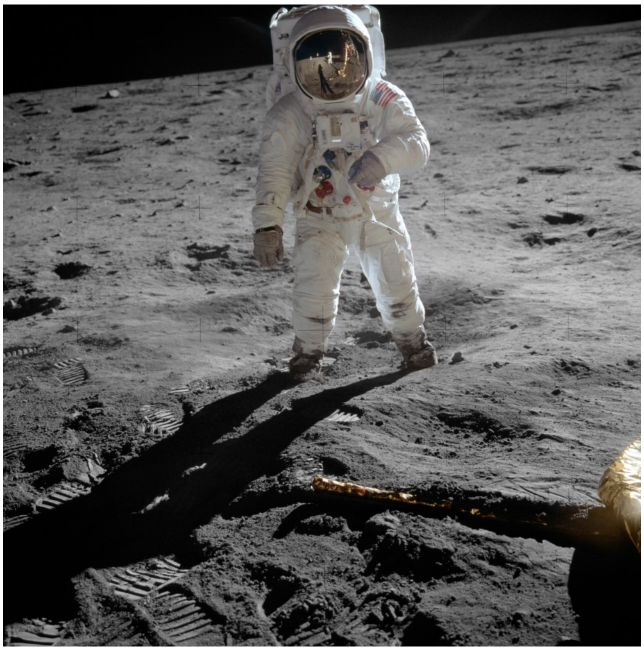
Thirty-two astronauts were assigned to fly missions in the Apollo program. Twenty-four of these left Earth's orbit and flew around the Moon between December 1968 and December 1972 (three of them twice). Half of the 24 walked on the Moon's surface, though none of them returned to it after landing once. The Apollo astronauts were chosen from the Project Mercury and Gemini veterans, plus from two later astronaut groups. All missions were commanded by Gemini or Mercury veterans. Crews on all development flights (except the Earth orbit CSM development flights) through the first two landings on Apollo 11 and Apollo 12, included at least two (sometimes three) Gemini veterans.

Complex 39 reflection shot of the Vehicle Assembly Building (VAB) under construction with the Launch Control Center (LCC) and Service Towers as seen from across the Turning Basin.. 5 January 1965
Credit: NASA

Portrait of the Apollo 1 prime crew for first manned Apollo space flight. From left to right are: Edward H. White II, Virgil I. "Gus" Grissom, and Roger B. Chaffee. 1 April 1966
Credit: NASA

Delays and accidents with an undertaking of such a size had to be expected. Still, it came as a shock when on January 27th, 1967 a static launch test in preparation for a planned first manned launch of the Apollo spaceship resulted in a fire inside the Apollo capsule and the death of three NASA astronauts, Grissom, White, and Chaffee. The subsequent inquiries identified many shortcomings in the Apollo capsule, and a massive redesign was initiated. For all the criticism heaped at the bureaucracy and the red tape of a government funded enterprise, it took only six months to implement all changes. And it took less than a year from the first flight of Apollo 7 on October 11, 1968 to the Moon landing on July 20th, 1969, when Buzz Aldrin and Neil Armstrong finally set foot on the Moon.

In November 1969, Gemini veteran Charles "Pete" Conrad and rookie Alan L. Bean made a precision landing on Apollo 12 within walking distance of the Surveyor 3 uncrewed lunar probe, which had landed in April 1967 on the Ocean of Storms. The command module pilot was Gemini veteran Richard F. Gordon Jr. Conrad and Bean carried the first lunar surface color television camera, but it was damaged when accidentally pointed into the Sun. They made two EVAs totaling 7 hours and 45 minutes. On one, they walked to the Surveyor, photographed it, and removed some parts which they returned to Earth.



Astronaut Buzz Aldrin, lunar module pilot, stands on the surface of the moon near the leg of the lunar module, Eagle, during the Apollo 11 moonwalk. July 20th, 1969
Credit: NASA

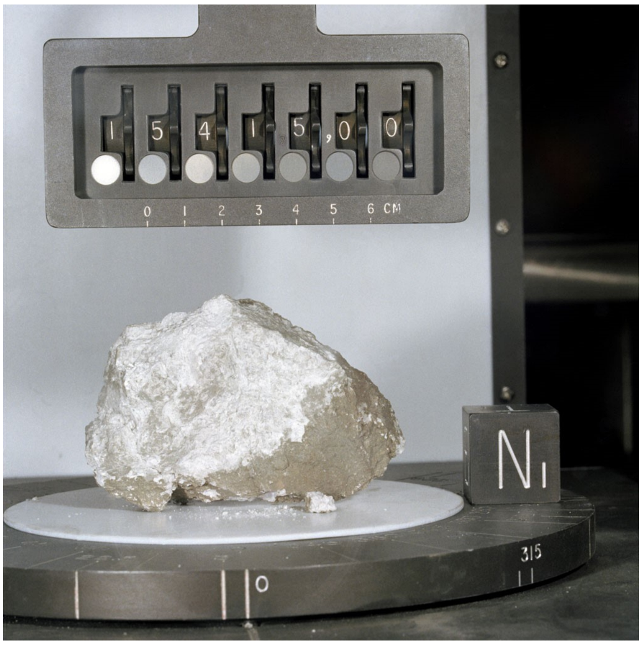
The success of the first two landings allowed the remaining missions to be crewed with a single veteran as commander, with two rookies. Apollo 13 launched Lovell, Jack Swigert, and Fred Haise in April 1970, headed for the Fra Mauro formation. But two days out, a liquid oxygen tank exploded, disabling the service module and forcing the crew to use the LM as a "lifeboat" to return to Earth. Another NASA review board was convened to determine the cause, which turned out to be a combination of damage of the tank in the factory, and a subcontractor not making a tank component according to updated design specifications. Apollo was grounded again, for the remainder of 1970 while the oxygen tank was redesigned and an extra one was added.

Buzz Aldrin removing the passive seismometer from a compartment in the SEQ bay of the Lunar Lander, 21 July 1969.
Credit: NASA

The contracted batch of 15 Saturn Vs was enough for lunar landing missions through Apollo 20. NASA publicized a preliminary list of eight more planned landing sites, with plans to increase the mass of the CSM and LM for the last five missions, along with the payload capacity of the Saturn V. These final missions would combine the I and J types in the 1967 list, allowing the CMP to operate a package of lunar orbital sensors and cameras while his companions were on the surface, and allowing them to stay on the Moon for over three days. These missions would also carry the Lunar Roving Vehicle (LRV) increasing the exploration area and allowing televised liftoff of the LM. Also, the Block II spacesuit was revised for the extended missions to allow greater flexibility and visibility for driving the LRV.

Apollo 17 was the last of the Apollo program, landing in the Taurus–Littrow region in December 1972. Eugene Cernan commanded Ronald E. Evans and NASA's first scientist-astronaut, geologist Dr. Harrison H. Schmitt.

The Apollo program returned over 382 kg (842 lb) of lunar rocks and soil to the Lunar Receiving Laboratory in Houston. Today, 75% of the samples are stored at the Lunar Sample Laboratory Facility built in 1979.



The most famous of the Moon rocks recovered, the Genesis Rock, returned from Apollo 15.
Credit: NASA

Project Apollo cost $25.4 billion (or approximately $153 billion in 2018 dollars when adjusted for inflation via the GDP deflator index). Of this amount, $20.2 billion ($122 billion adjusted) was spent on the design, development, and production of the Saturn family of launch vehicles, the Apollo spacecraft, space suits, scientific experiments, and mission operations. The cost of constructing and operating Apollo-related ground facilities, such as the NASA human spaceflight centers and the global tracking and data acquisition network, added an additional $5.2 billion ($31.4 billion adjusted).

For this price, Apollo fulfilled its main goal, which was political: Enabling the US to declare the “Space Race” to be won, and reaffirming the belief in the superiority of the US technology and engineering prowess. This reassurance of course arrived at a time when widespread political disaffection was questioning the value of continuous economic and technological progress. A nascent environmental movement concerned itself with the pollution that resulting from of mostly absent regulation. Counterculture movements questioned the whole concept of national strength. By the time the last Moon landings took place, other, more earthly concerns like the Vietnam war and the first oil crisis were seen as much more important nationally and international, The space program of the US practically collapsed, the flawed concept of the Space Shuttle tying up the scarce ressources for a whole generation. While the Soviets were busy developing modular space stations, fund-stricken NASA aimlessly pursued a program which lacked its destination, since the space station that the Shuttle was to visit never materialized. The lack of an objective other than a purely political demonstration proved detrimental to the US space efforts, with the effects still seen today.

Ironically, the Apollo program contributed decisively to the technological advancement of the US and the microchip revolution that finally enabled the US to outspend its ideological rival, the USSR. Apollo stimulated many areas of technology, leading to over 1,800 spinoff products as of 2015. But the most crucial part proved to be the flight computer design used in both the lunar and command modules. This was, along with the Polaris and Minuteman missile systems, the driving force behind early research into integrated circuits (ICs). By 1963, Apollo was using 60 percent of the United States' production of ICs.

What remains today, despite rocks and rockets in museums, is the cultural legacy, the experience of a generation for which the Moon landing truly was a step for mankind, and who considered it an adequate pursuit for the best and brightest to try to conquer the stars.

Taken by Apollo 8 crewmember Bill Anders on December 24, 1968, at mission time 075:49:07 (16:40 UTC), while in orbit around the Moon, showing the Earth rising for the third time above the lunar horizon. The lunar horizon is approximately 780 kilometers from the spacecraft. Width of the photographed area at the lunar horizon is about 175 kilometers. The land mass visible just above the terminator line is west Africa.
Credit: NASA

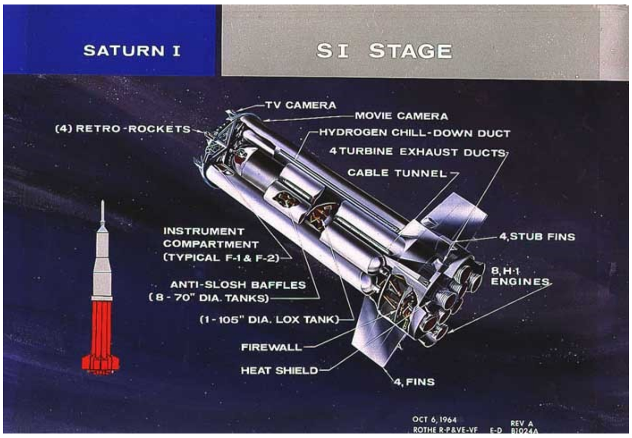
Saturn I

The Saturn I (pronounced "Saturn one") was the United States' first heavy-lift dedicated space launcher, a rocket designed specifically to launch large payloads into low Earth orbit. Most of the rocket's power came from a clustered lower stage consisting of tanks taken from older rocket designs strapped together to make a single large booster, leading critics to jokingly refer to it as "Cluster's Last Stand".

For the longest time, the development of long-range and orbital rockets in the US had mainly been under the provenance of the US Army. The Army's development efforts were severely hampered on November 26, 1956 when responsibility for long-range weapons was turned over to the Air Force by Defense Secretary Charles E. Wilson. However, since the Wilson memorandum covered only weapons, not space vehicles, the Army Ballistic Missile Agency (ABMA) saw this as a way to continue development of their own large-rocket projects. In April 1957, von Braun directed Heinz-Hermann Koelle, chief of the Future Projects design branch, to study dedicated launch vehicle designs that could be built as quickly as possible.

In order to fill the projected need for loads of 10,000 kg or greater, the ABMA team calculated that a first stage with a thrust of about 1,500,000 lbf (6,700 kN) thrust would be needed, far greater than any existing or planned missile. For this role they proposed using a number of existing missiles clustered together to produce a single larger booster. Using existing designs the team combined tanks from one Jupiter as a central core, with eight Redstone tanks attached to it. This relatively cheap configuration allowed existing fabrication and design facilities to be used to produce this "quick and dirty" design.

In July 1959 a change request was received from ARPA to upgrade the upper stage to a much more powerful design using four new 20,000 lbf (89 kN) liquid hydrogen/liquid oxygen powered engines in a larger-diameter 160" second



stage, with an upgraded Centaur using two engines of the same design for the third stage.

In order to reach some sort of accommodation, a group pulled from newly established NASA, Air Force, ARPA, ABMA, and the Office of the Department of Defense Research and Engineering formed as the Silverstein Committee in December. Originally skeptical, the Committee convinced von Braun that liquid hydrogen was the way to go on upper stage development. Once these changes had been made, NASA's booster project was now entirely free of any dependence on military developments.

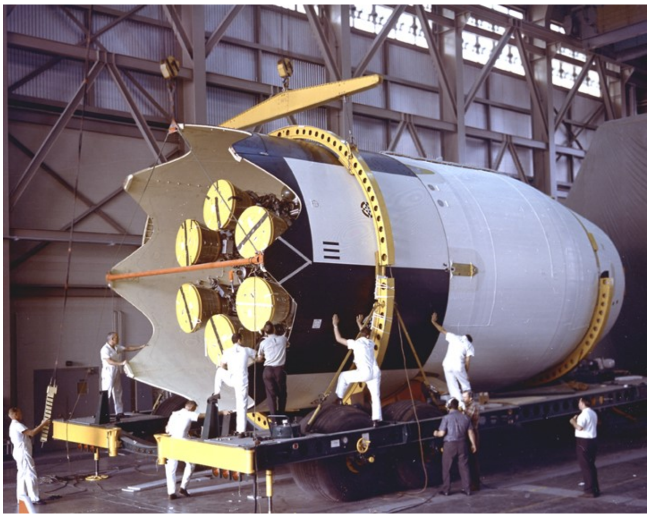
The Saturn I made its maiden flight on October 27, 1961 with a dummy upper stage and partially fueled first stage. Tension in the blockhouse were high, since any failure was probably going to be highly destructive considering the size

Wernher von Braun, left, explains the Saturn rocket system to President John F. Kennedy at Cape Canaveral, Fla., on Nov. 16, 1963.
Credit: NASA

of the launcher. In the end, however, these worries subsided as the booster lifted and performed a flawless test flight. Three more flights with dummy upper stages followed over the next 17 months, which were all completely or mostly successful. Two of them had the S-IV filled with water and detonated at high altitude after stage separation to form an ice cloud that was then photographed.

Flight #5 in January 1964 was the first to carry a live S-IV, which restarted its engine in orbit to boost to a high altitude where it would remain until decaying two years later. Another two flights followed during the year with boilerplate Apollo CSMs.

By this point however, the advent of the Titan III had robbed the Saturn of a role as a DoD launcher and with the newer, improved Saturn IB in development (as the Apollo CSM ended up being heavier than originally expected and so needed a more powerful launch vehicle), the booster quickly became orphaned and no practical use could be found for it.



The S IV stage of Saturn 1 SA9. Credit: NASA

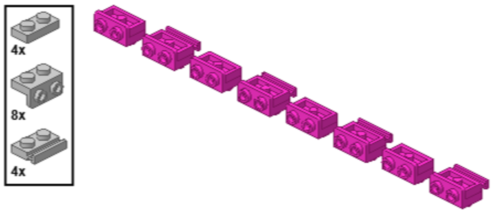
Datasheet Saturn I

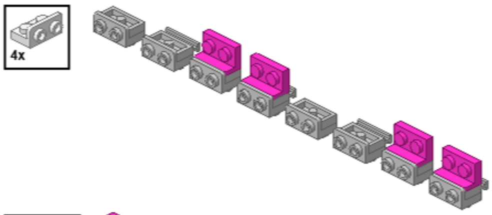
General	
Name	Saturn I
Function	Expendable launch system
Manufacturer	Chrysler for the ABMA
Country of origin	United States
Cost per Launch	US$10.83m (1985)
Family	
Size	
Height	55 m (180 ft)
Diameter	6.52 m (21.39 ft)
Width	6.52 m (21.39 ft)
Mass	1,124,000 lb (510,000 kg)
Stages	2 or 3
Capacity	
Payload suborbital	
Payload to LEO	20,000 lb (9,070 kg)
Payload to GEO	
Payload to TLI	4,900 lb (2,220 kg) (2 stage)
Payload to escape	
Launch history	
Status	Retired
Launch sites	LC-37 & LC-34, Cape Canaveral
Total launches	10
Successes	10
Failures	0
Partial failures	0
First flight	October 27, 1961
Last flight	July 30, 1965
Notable payloads	Boilerplate Apollo CM
First stage	**S-I**
Engines	8 H-1
Thrust	1,500,000 lbf (6.7 MN)
Isp	289 sec
Burn time	150 sec
Fuel	RP-1/LOX
Gross mass	432,681 kg (953,898 lb)
Empty mass	45,267 kg (99,796 lb)
Length	24.48 m (80.31 ft)
Diameter	6.52 m (21.39 ft)

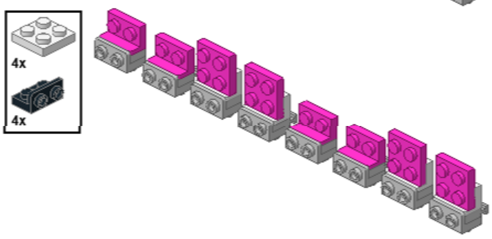
Second stage	S-IV
Engines	6 RL10
Thrust	90,000 lbf (400 kN)
Specific impulse	410 sec
Burn time	~482 seconds
Fuel	LH2/LOX
Gross mass	50,576 kg (111,500 lb)
Empty mass	5,217 kg (11,501 lb)
Length	12.19 m (39.99 ft)
Diameter	5.49 m (18.01 ft)
Model	**Saturn 1 SA-5/SA-10**
Year Created	2019
Author	David Welling
Parts count	753 (SA-5) 655 (SA-10)
Diameter	9,6 cm
Height	44,9 cm
Weigth	539,7 g
Link	https://drive.google.com/drive/folders/1uu6MCx2cQPG3yJA8QB

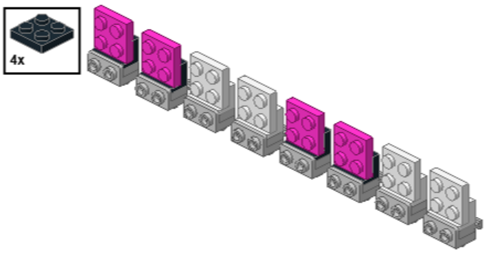
Saturn I Block 2 First Stage

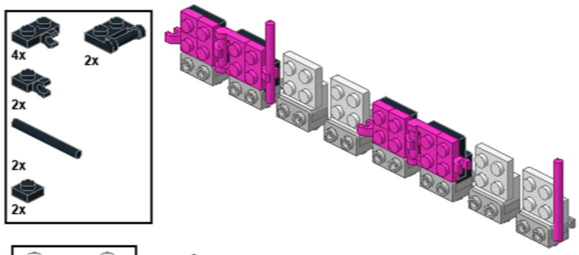
© David Welling, 2018

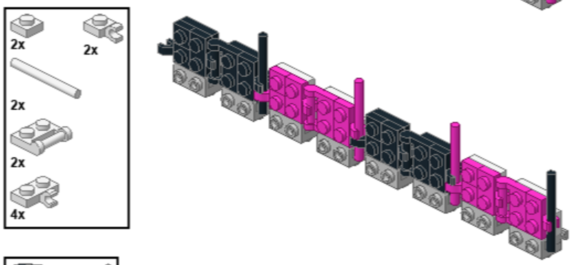
1


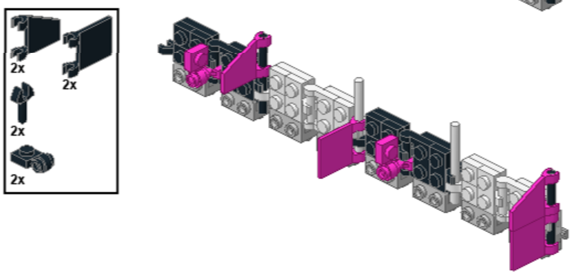
2


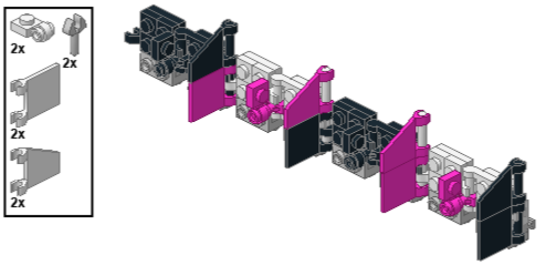
3


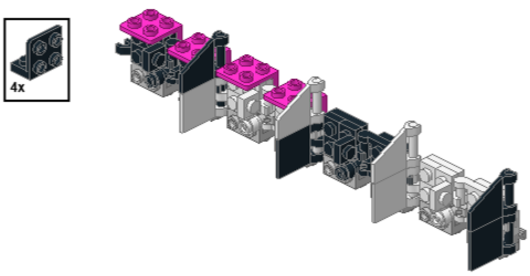
4


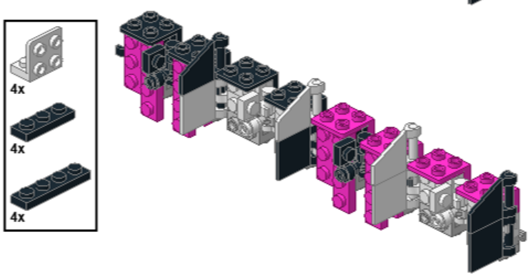
5


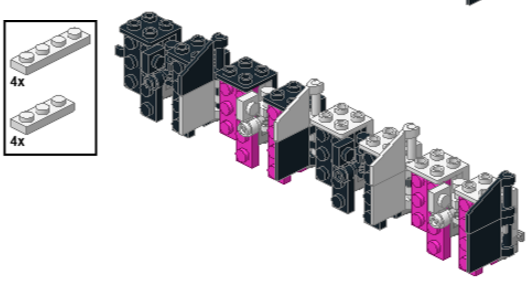
6


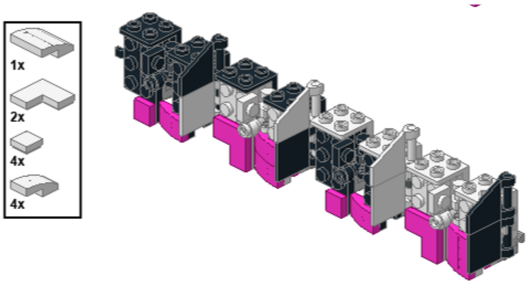
7


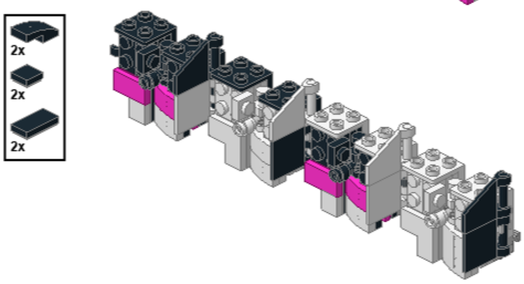
8


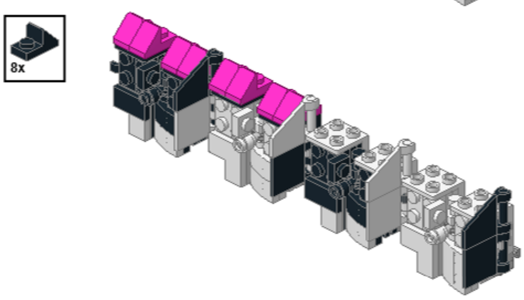
9


10


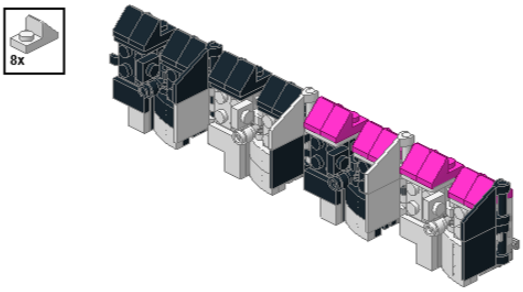
11


12


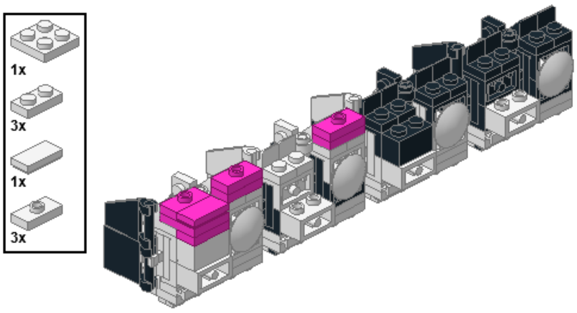
13


14


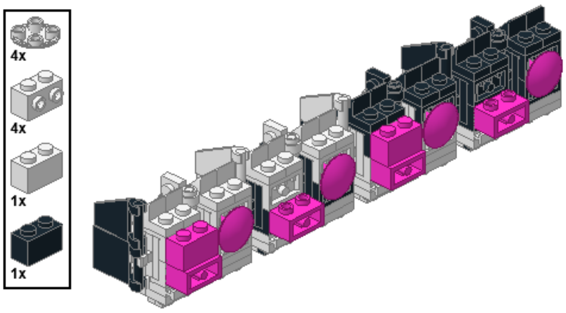
15



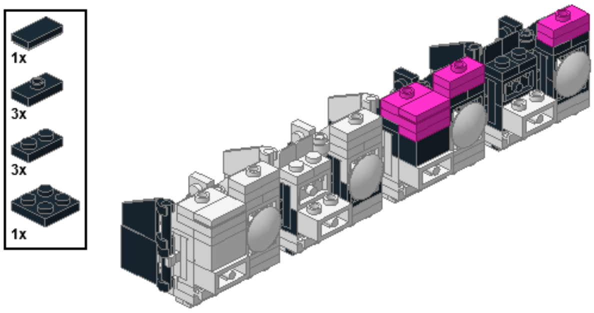
17



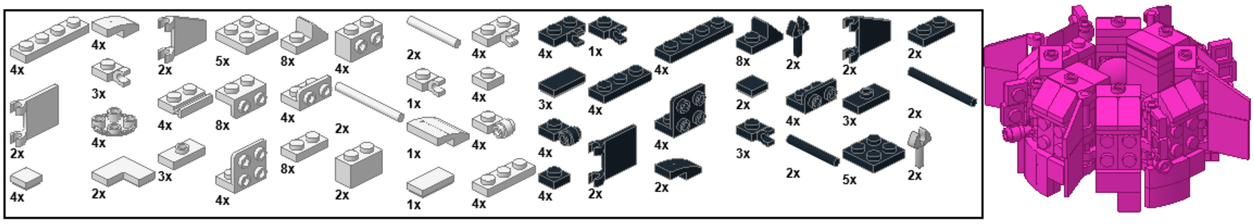
16



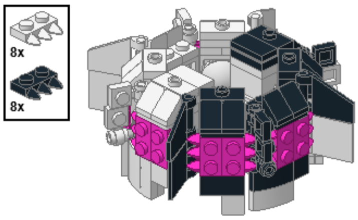
18



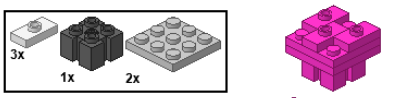
1



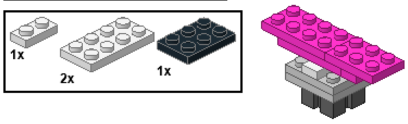
2



1

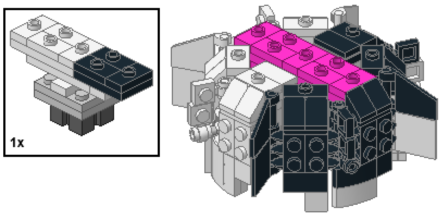


2

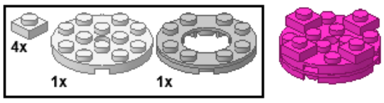


3

3

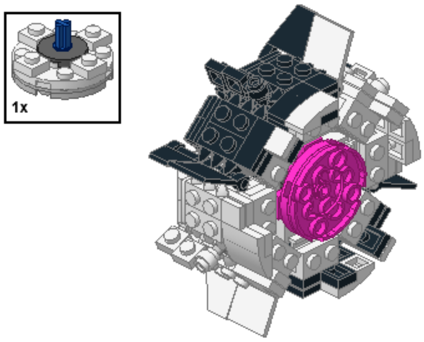


1

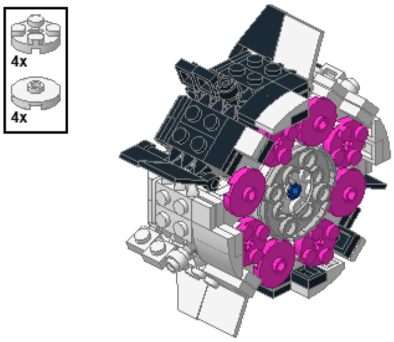


2

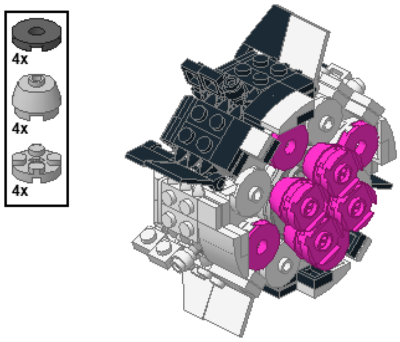
4



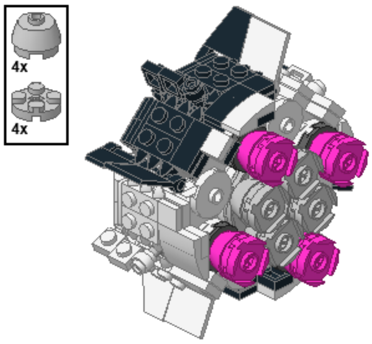
5



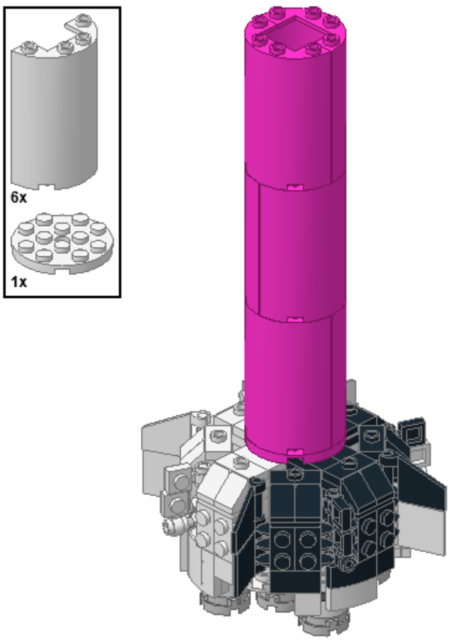
6

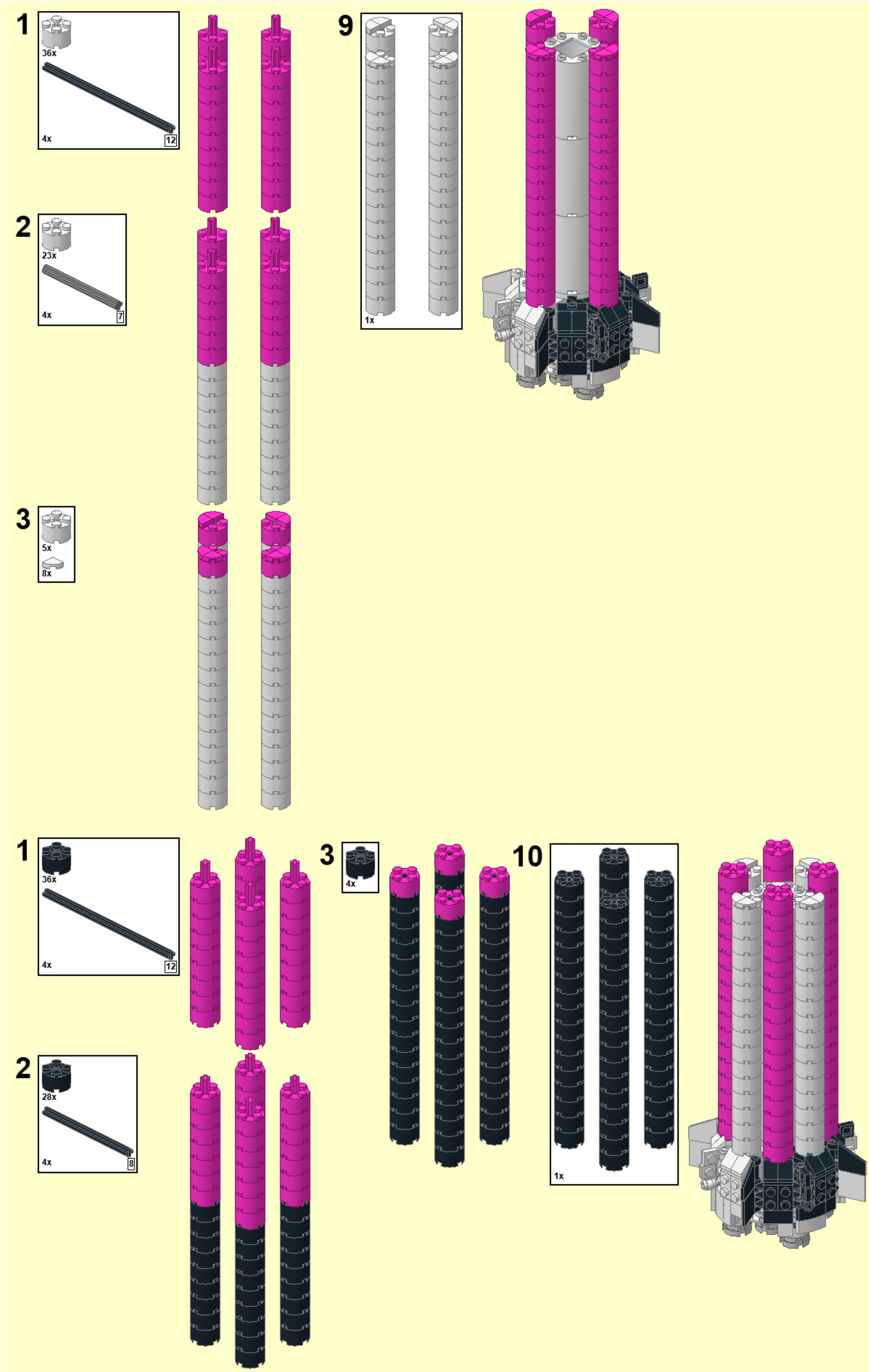


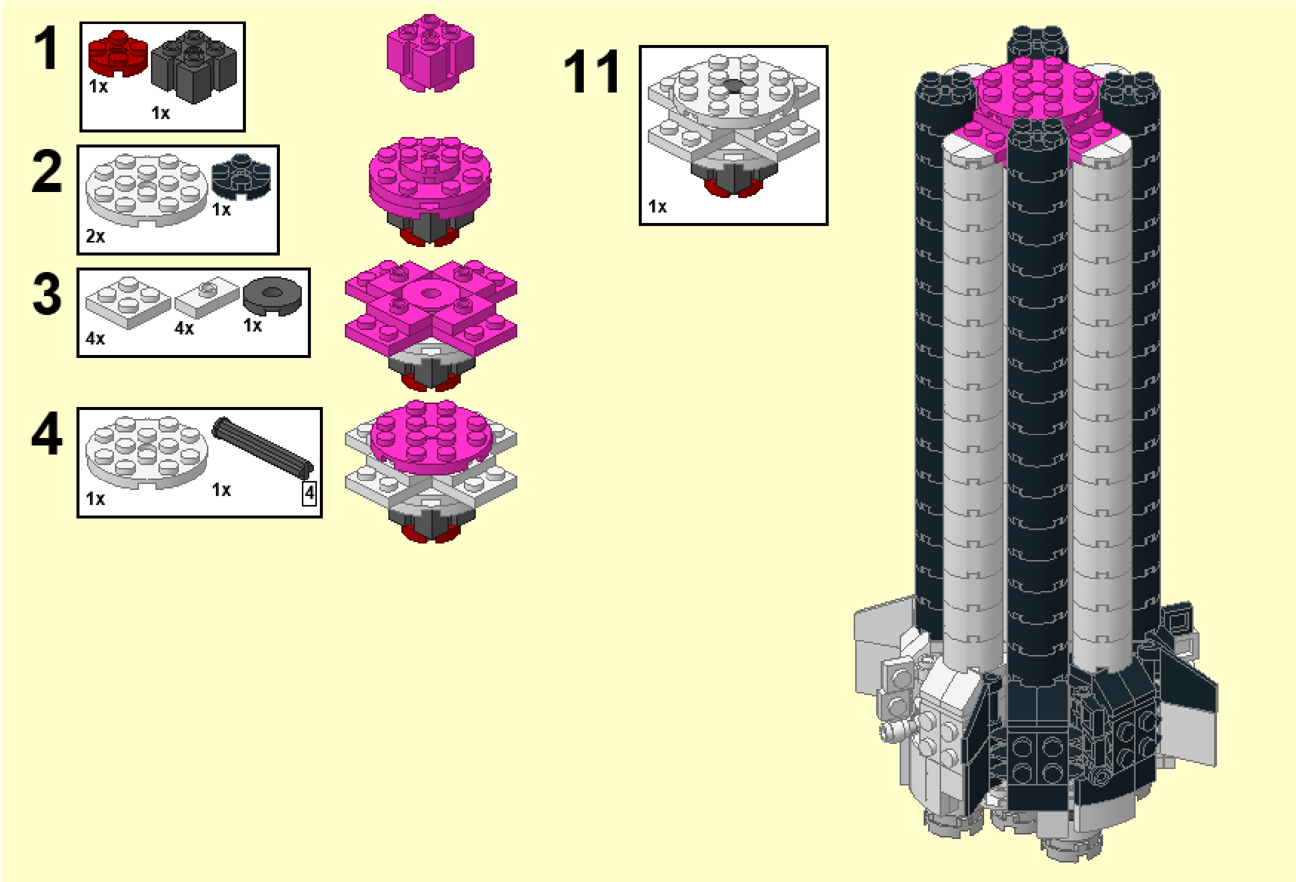
7

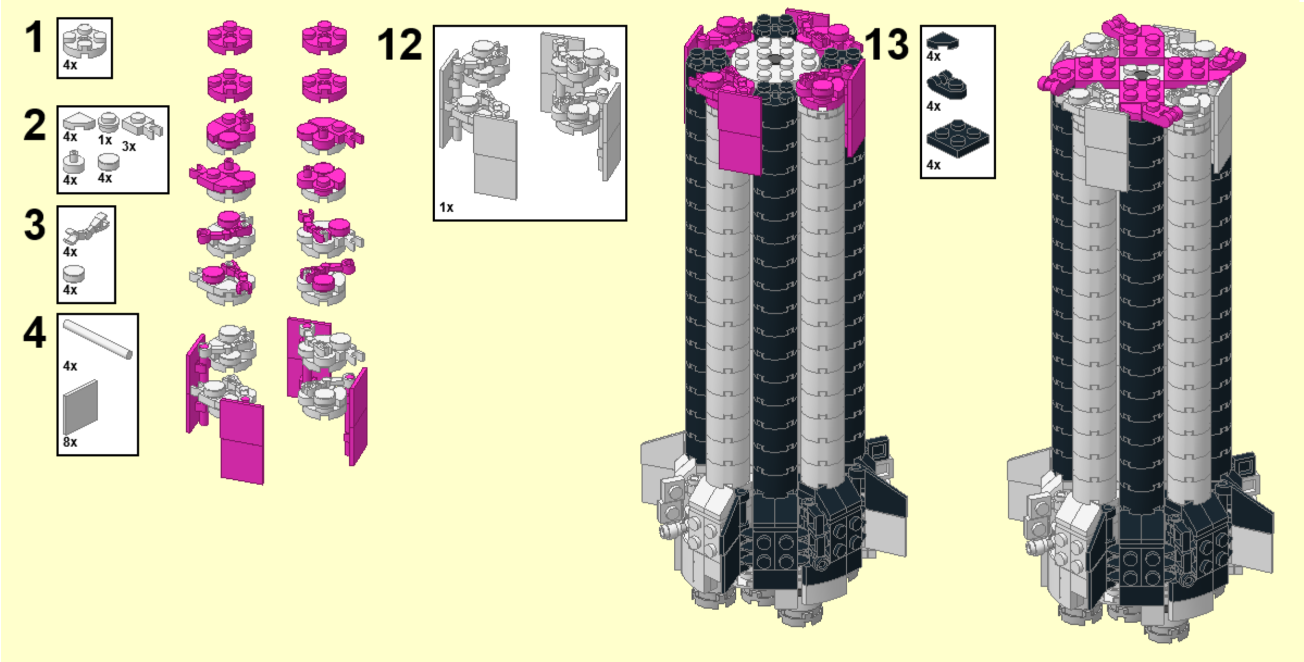


8

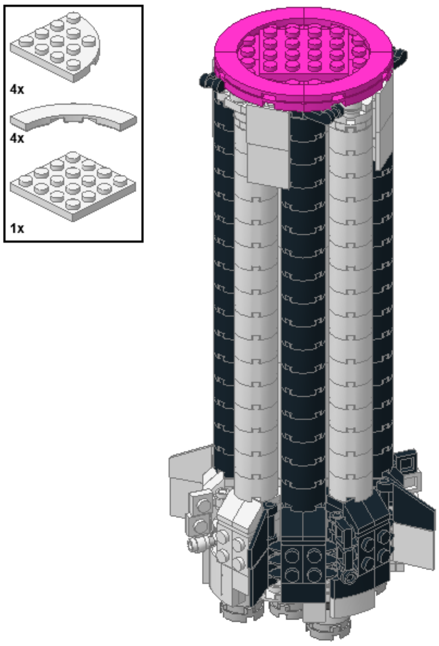



1
36x
4x
12
2
23x
4x
7
3
5x
8x
9
1x
1
36x
4x
12
2
28x
4x
8
3
4x
10
1x

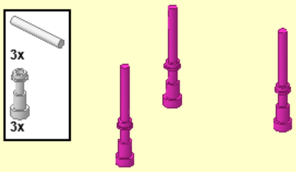

1
1x
1x
2
2x
1x
3
4x
4x
1x
4
1x
1x
4
11
1x


1
4x
2
4x
1x
3x
4x
4x
3
4x
4x
4
4x
8x
12
1x
13
4x
4x
4x

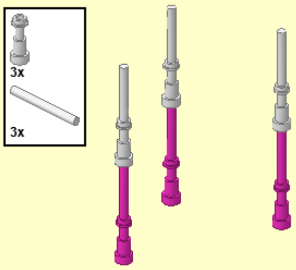
14



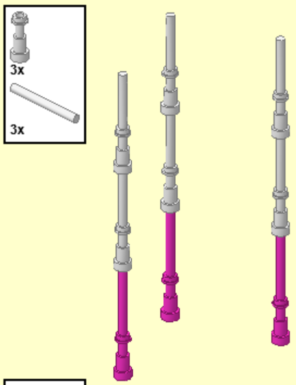
1



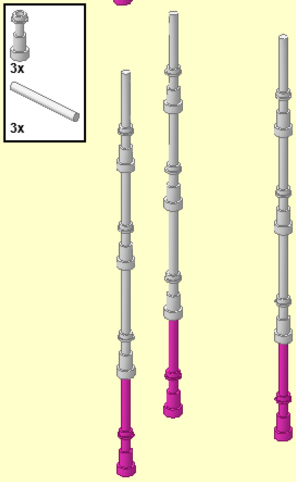
2



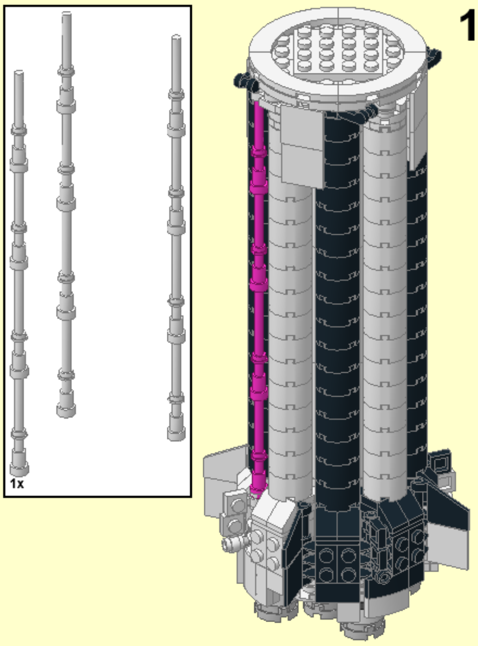
3



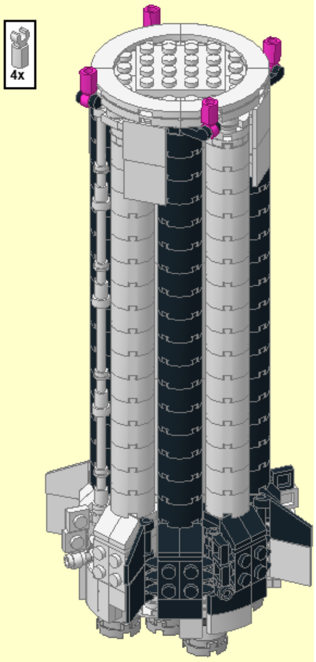
4

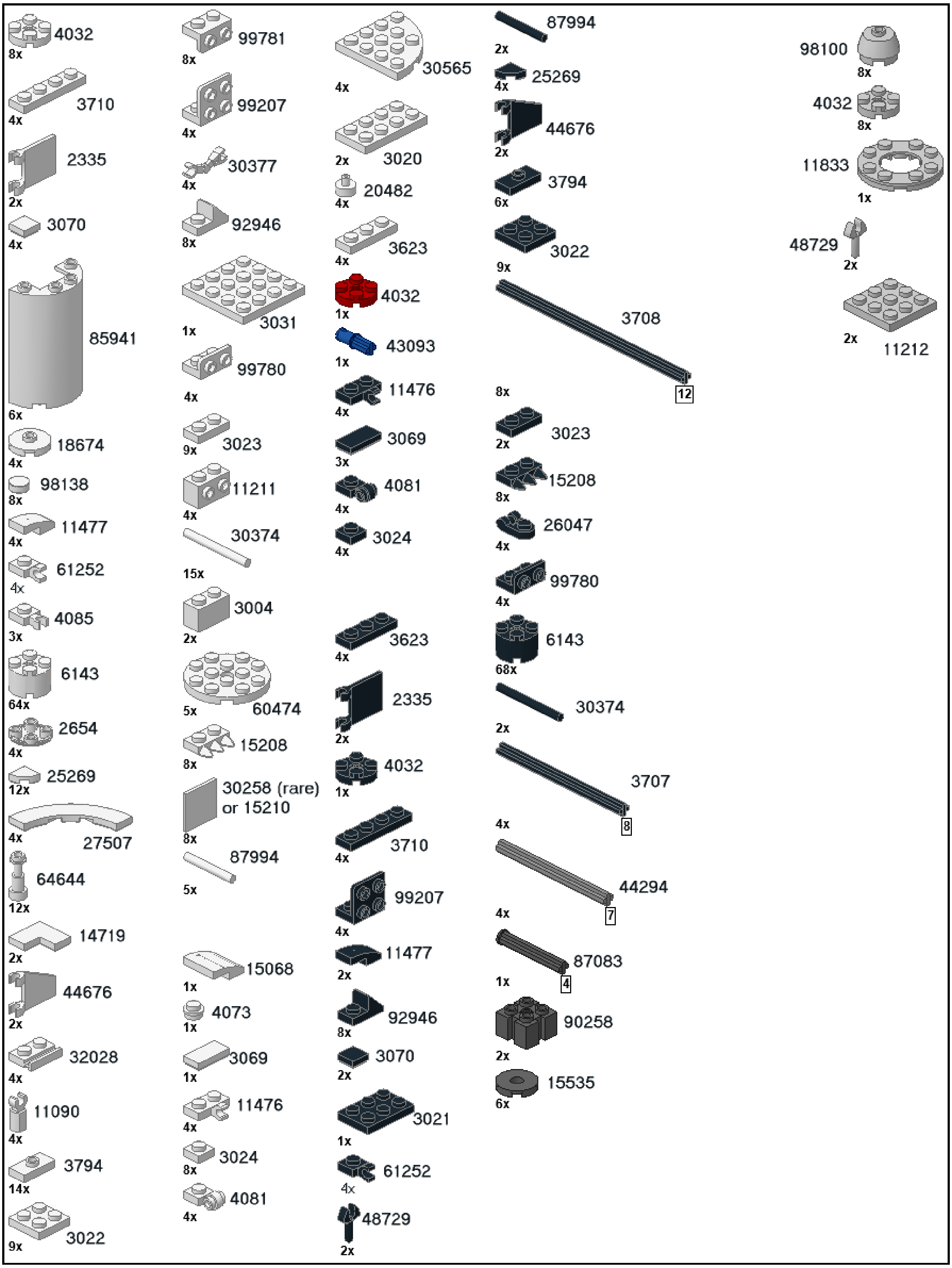


15



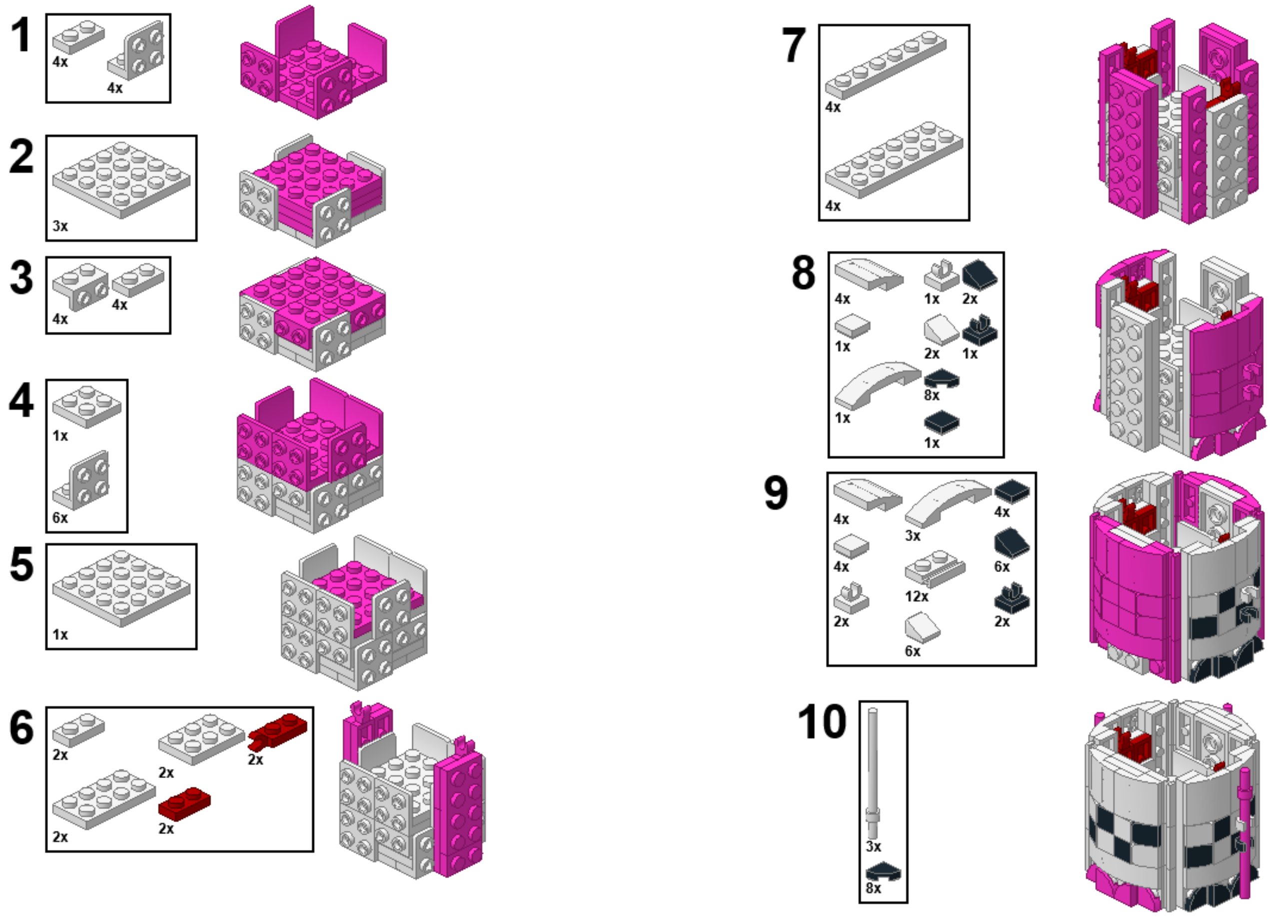
16

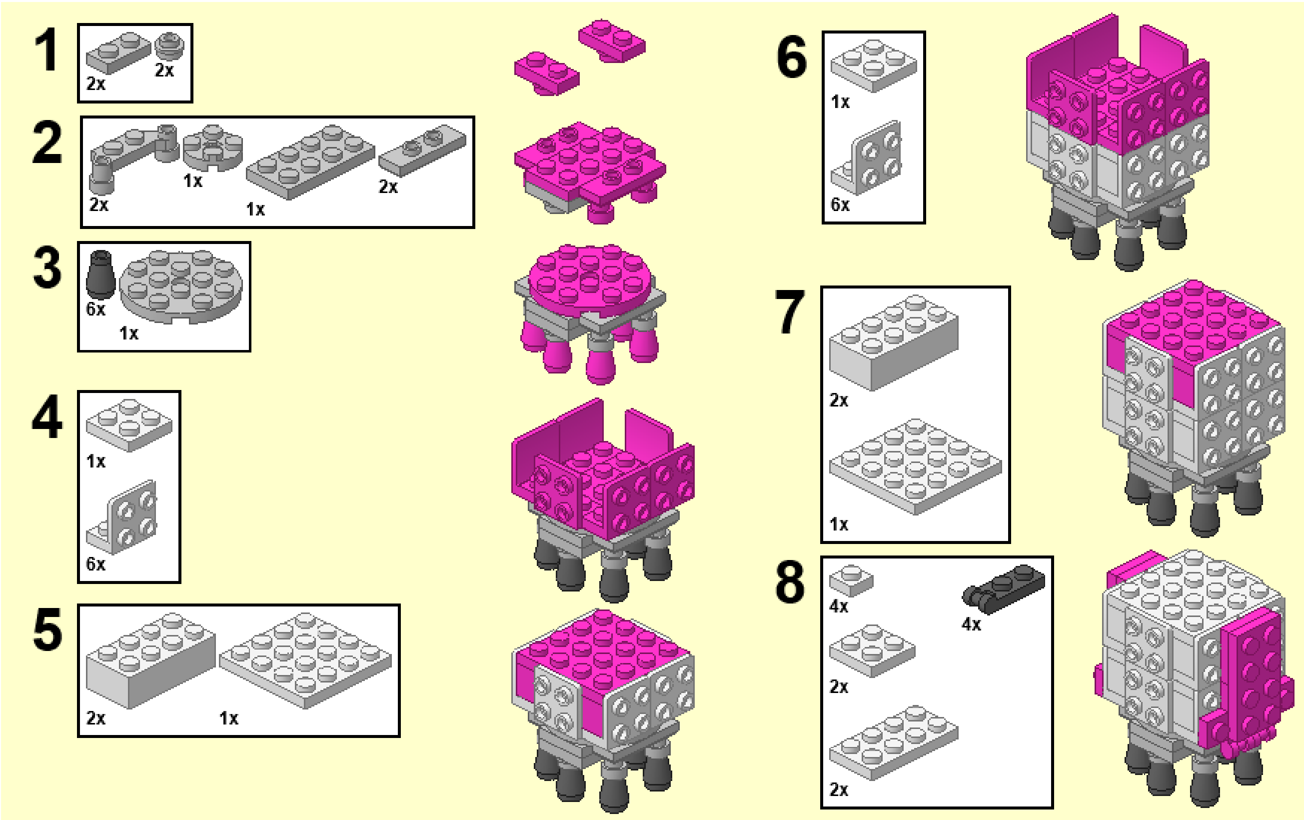


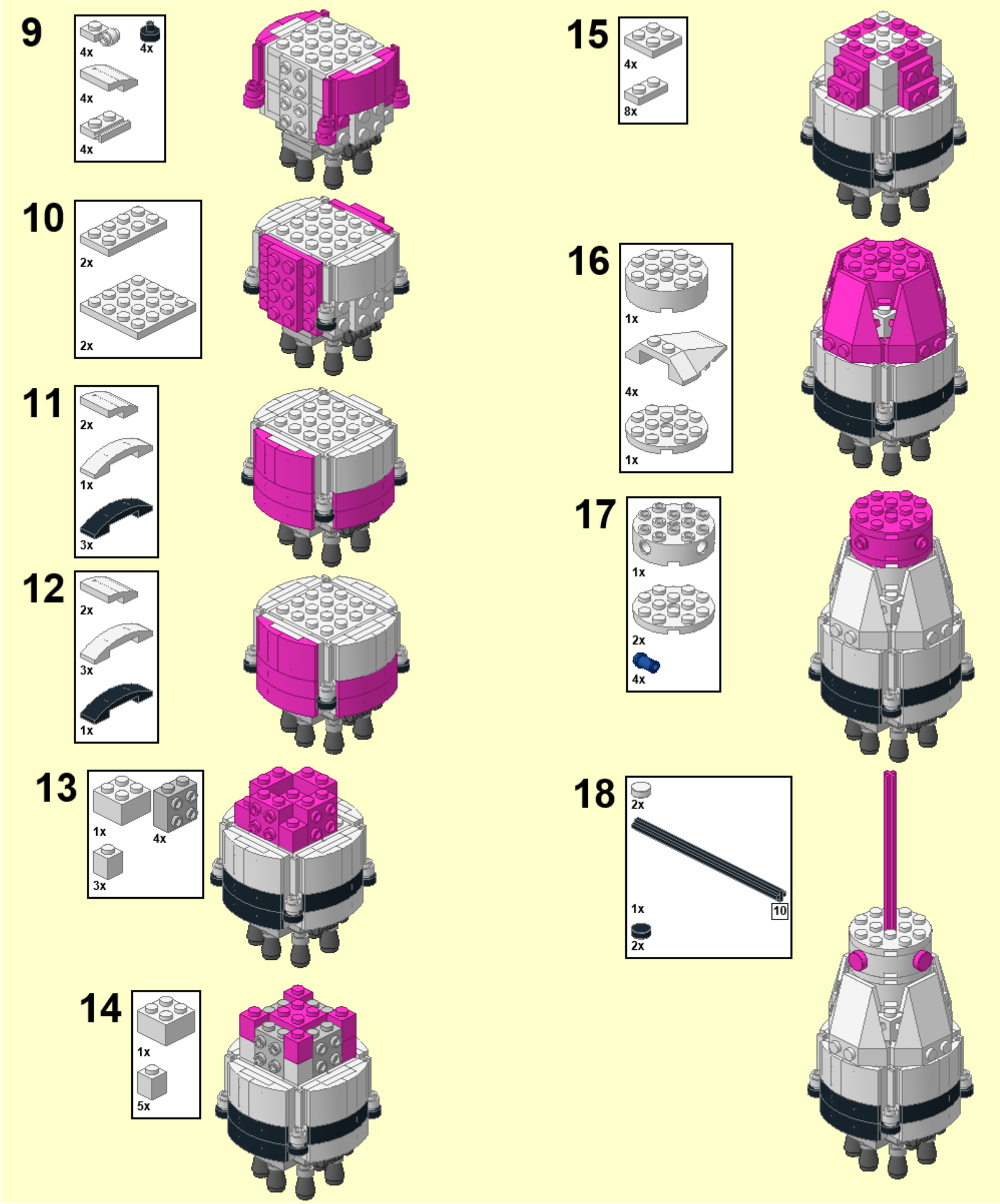

4032
8x
3710
4x
2335
2x
3070
4x
85941
6x
18674
4x
98138
8x
11477
4x
61252
4x
4085
3x
6143
64x
2654
4x
25269
12x
27507
4x
64644
12x
14719
2x
44676
2x
32028
4x
11090
4x
3794
14x
3022
9x
99781
8x
99207
4x
30377
4x
92946
8x
3031
1x
99780
4x
3023
9x
11211
4x
30374
15x
3004
2x
60474
5x
15208
8x
30258 (rare)
or 15210
8x
87994
5x
15068
1x
4073
1x
3069
1x
11476
4x
3024
8x
4081
4x
30565
4x
3020
2x
20482
4x
3623
4x
4032
1x
43093
1x
11476
4x
3069
3x
4081
4x
3024
4x
3623
4x
2335
2x
4032
1x
3710
4x
99207
4x
11477
2x
92946
8x
3070
2x
3021
1x
61252
4x
48729
2x
87994
2x
25269
4x
44676
2x
3794
6x
3022
9x
3708
8x
12
3023
2x
15208
8x
26047
4x
99780
4x
6143
68x
30374
2x
3707
4x
8
44294
4x
7
87083
1x
4
90258
2x
15535
6x
98100
8x
4032
8x
11833
1x
48729
2x
11212
2x

Saturn I Block 2 Second Stage, SA-5

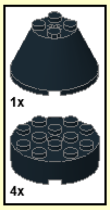
© David Welling, 2018

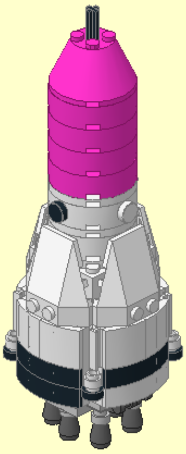




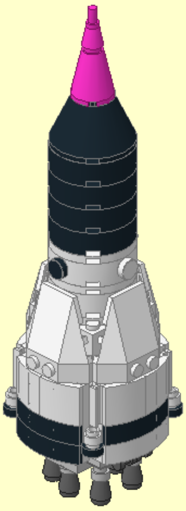

9
4x
4x
4x
4x
10
2x
2x
11
2x
1x
3x
12
2x
3x
1x
13
1x
4x
3x
14
1x
5x
15
4x
8x
16
1x
4x
1x
17
1x
2x
4x
18
2x
1x
10
2x

19

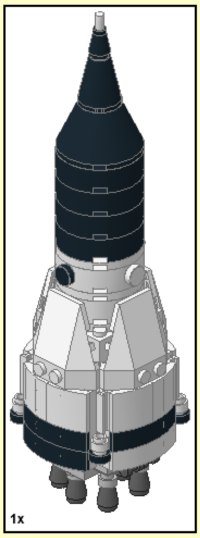


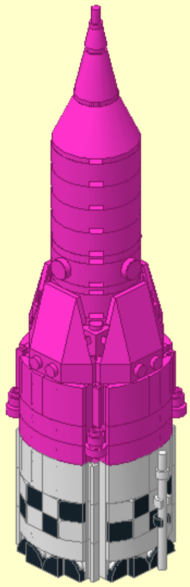


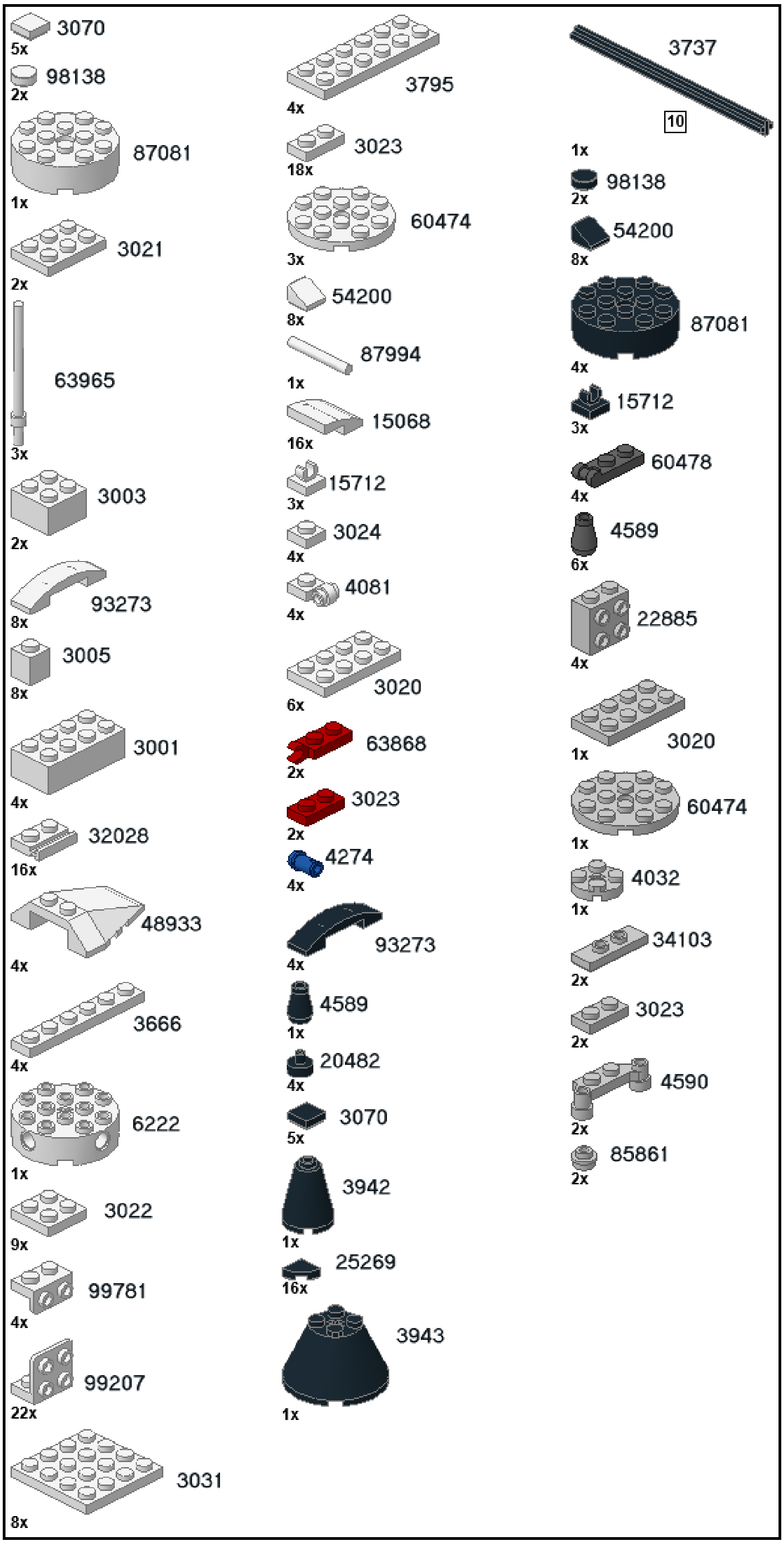
20

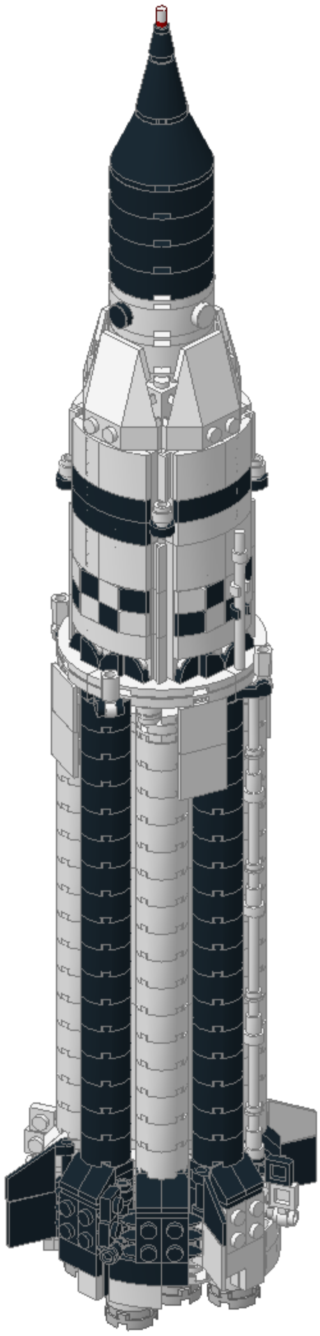


11



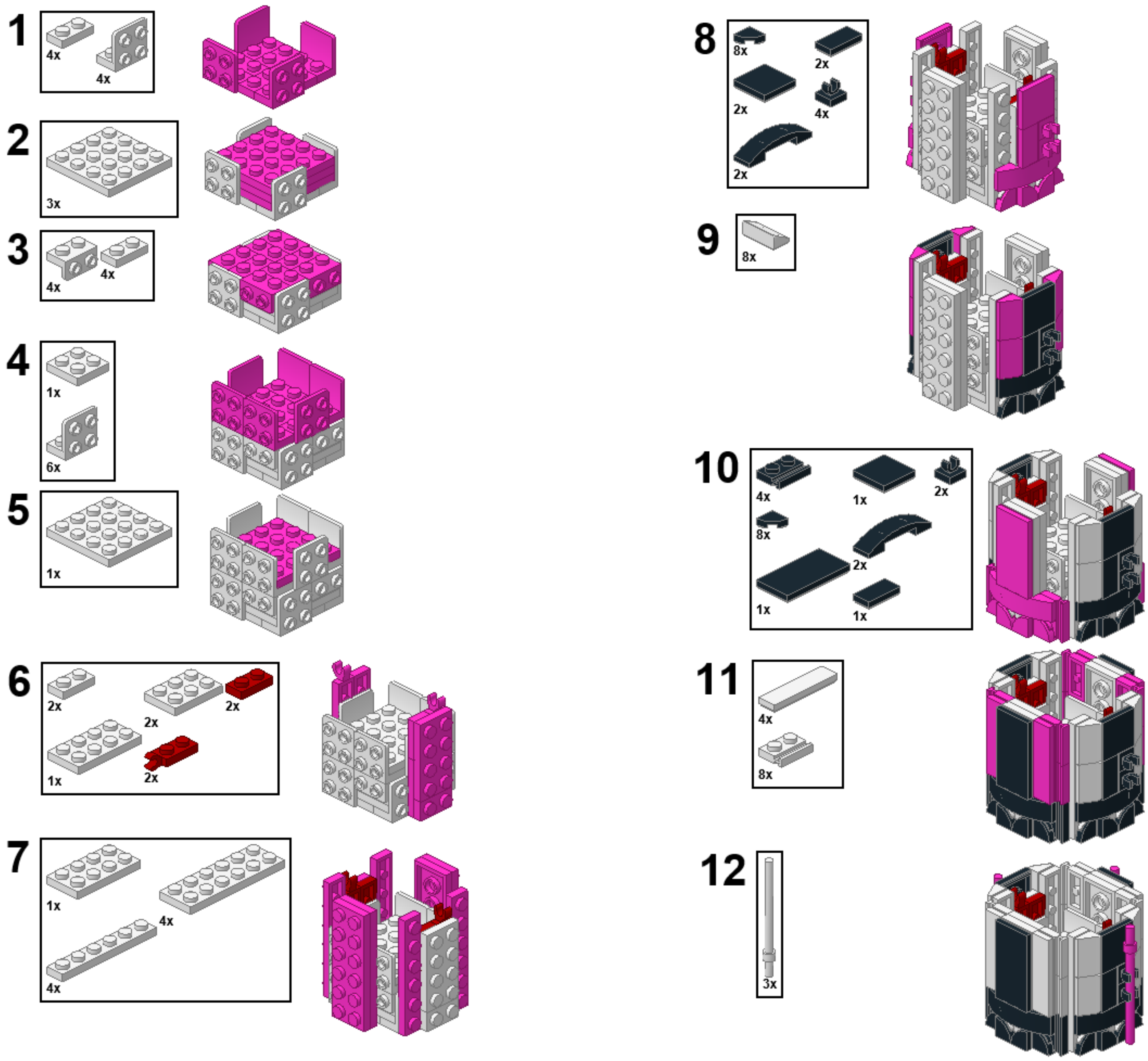


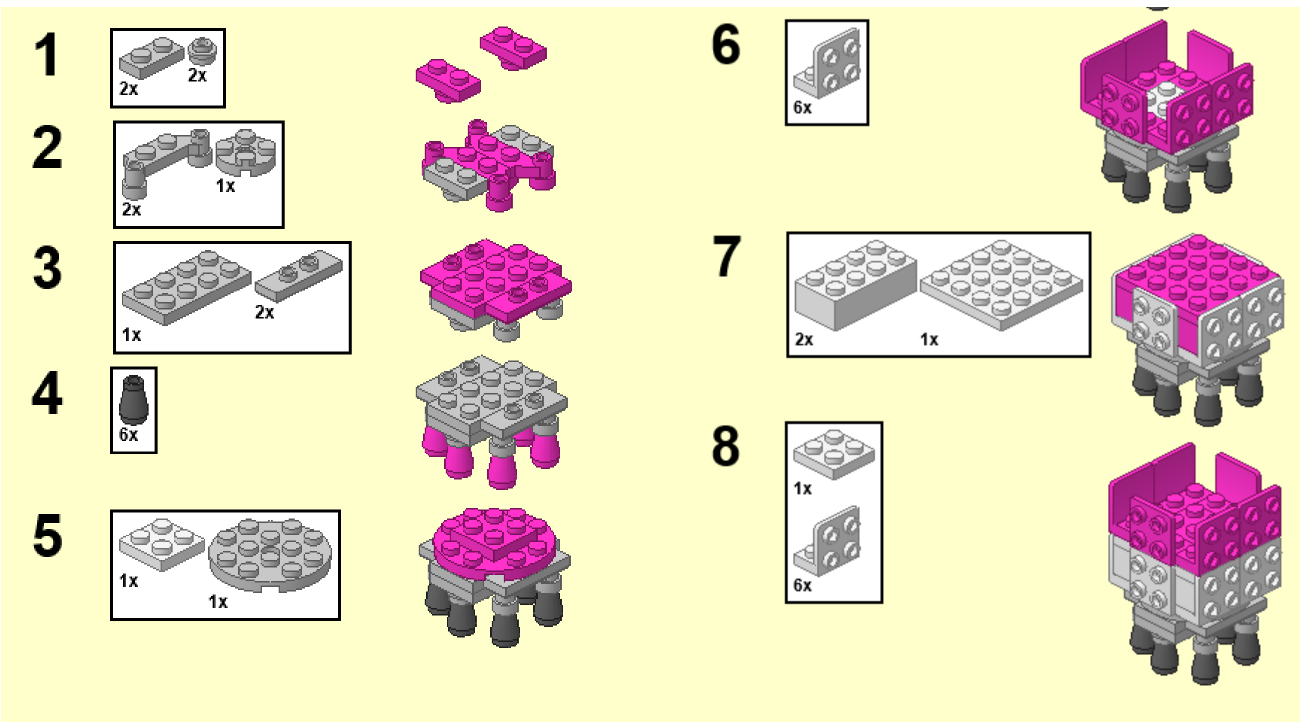

3070
5x
98138
2x
87081
1x
3021
2x
63965
3x
3003
2x
93273
8x
3005
8x
3001
4x
32028
16x
48933
4x
3666
4x
6222
1x
3022
9x
99781
4x
99207
22x
3031
8x
3795
4x
3023
18x
60474
3x
54200
8x
87994
1x
15068
16x
15712
3x
3024
4x
4081
4x
3020
6x
63868
2x
3023
2x
4274
4x
93273
4x
4589
1x
20482
4x
3070
5x
3942
1x
25269
16x
3943
1x
3737
10
1x
98138
2x
54200
8x
87081
4x
15712
3x
60478
4x
4589
6x
22885
4x
3020
1x
60474
1x
4032
1x
34103
2x
3023
2x
4590
2x
85861
2x

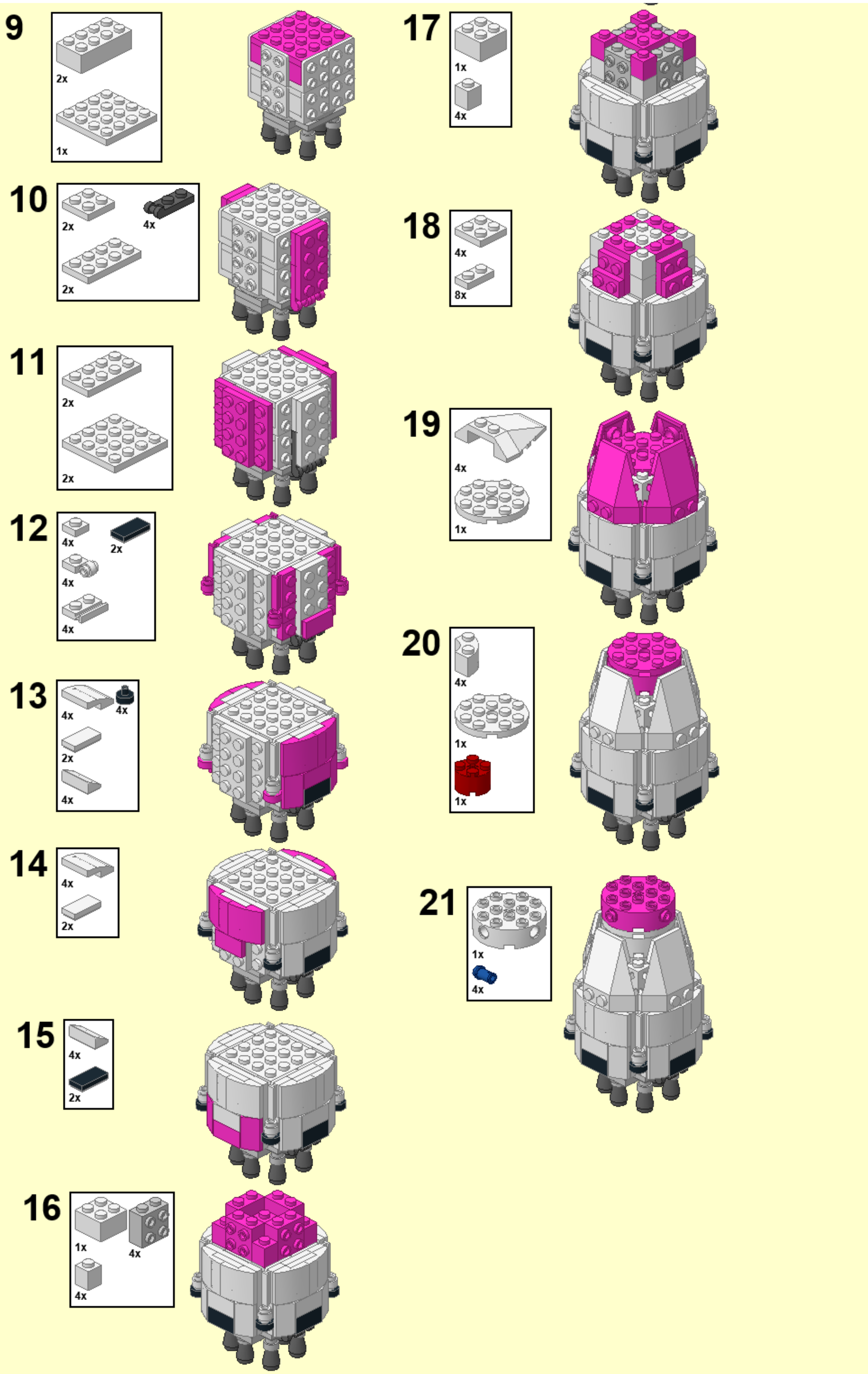


Saturn I Block 2 Second Stage, SA-10

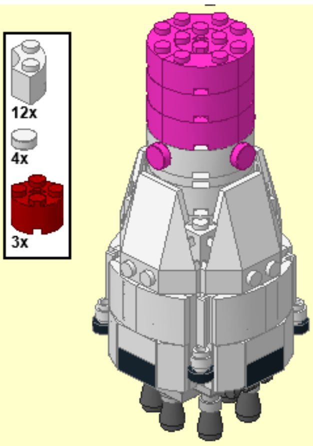
© David Welling, 2018



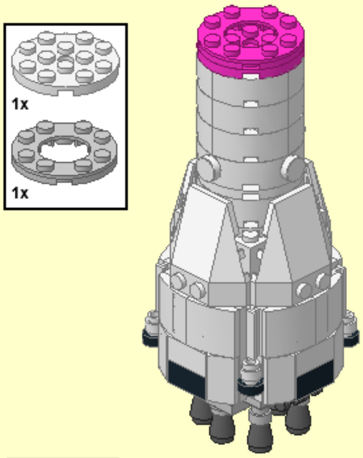



9
2x
1x
10
2x
4x
2x
11
2x
2x
12
4x
2x
4x
4x
13
4x
4x
2x
4x
14
4x
2x
15
4x
2x
16
1x
4x
4x
17
1x
4x
18
4x
8x
19
4x
1x
20
4x
1x
1x
21
1x
4x

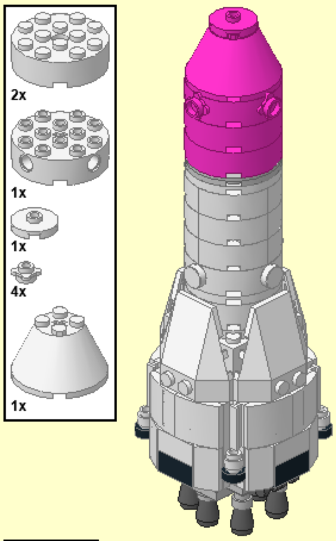
22



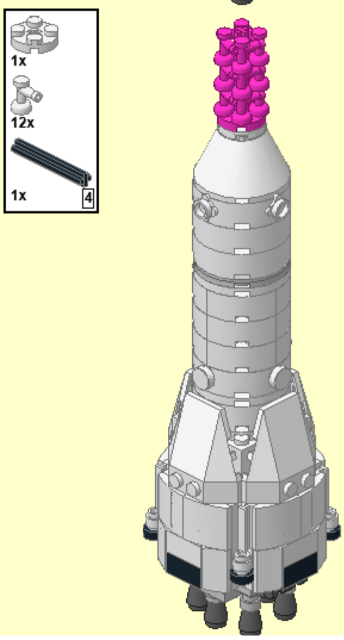
23



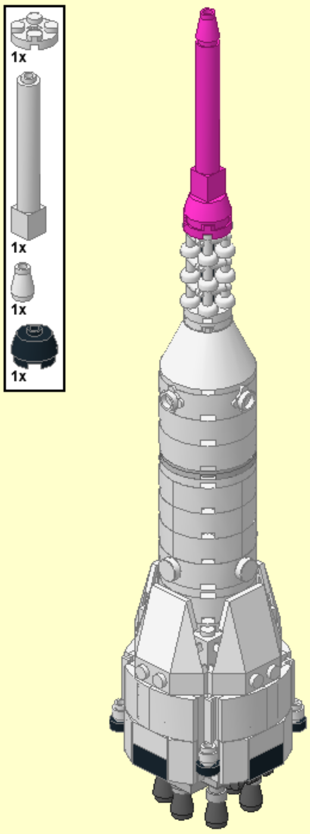
24

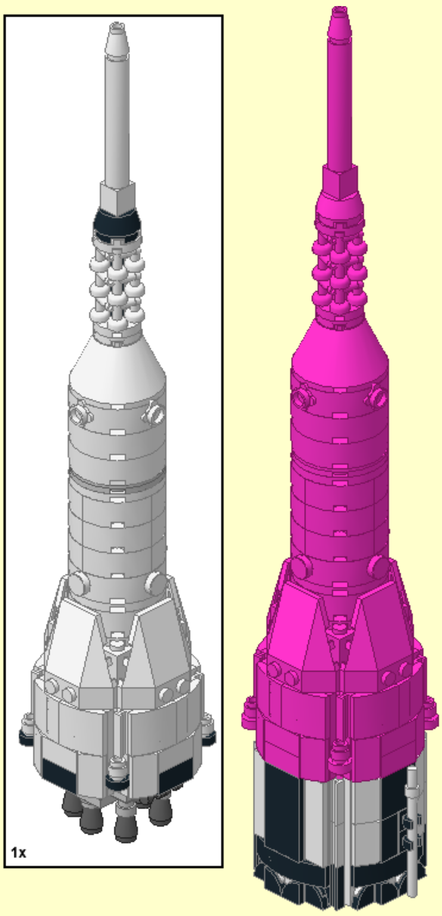


25

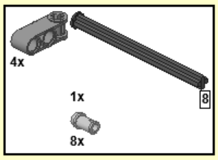


26

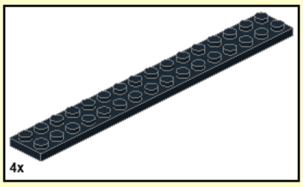




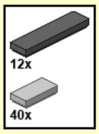
1

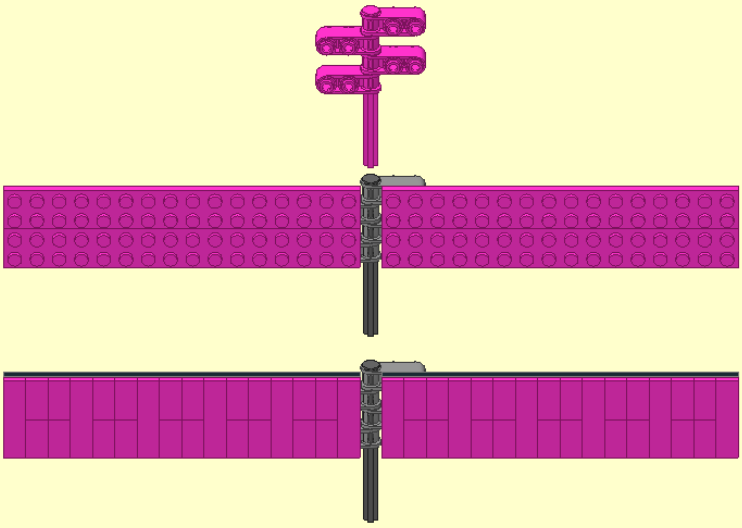


2

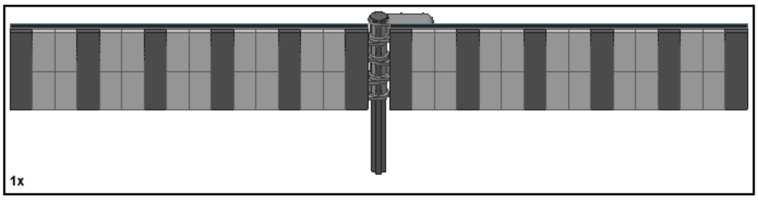


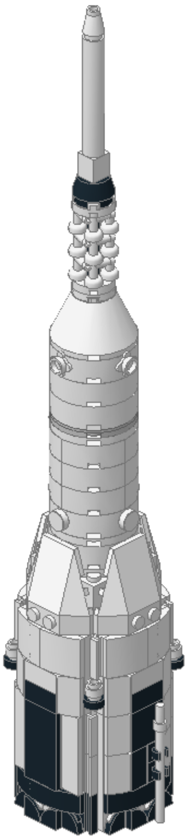
3

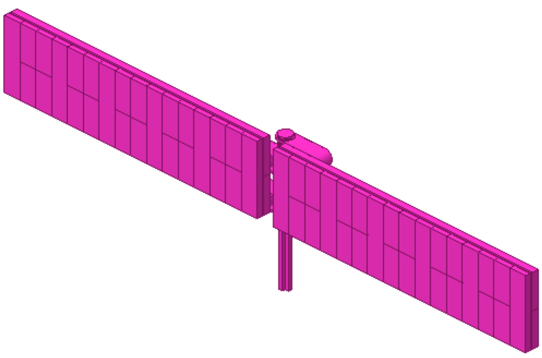


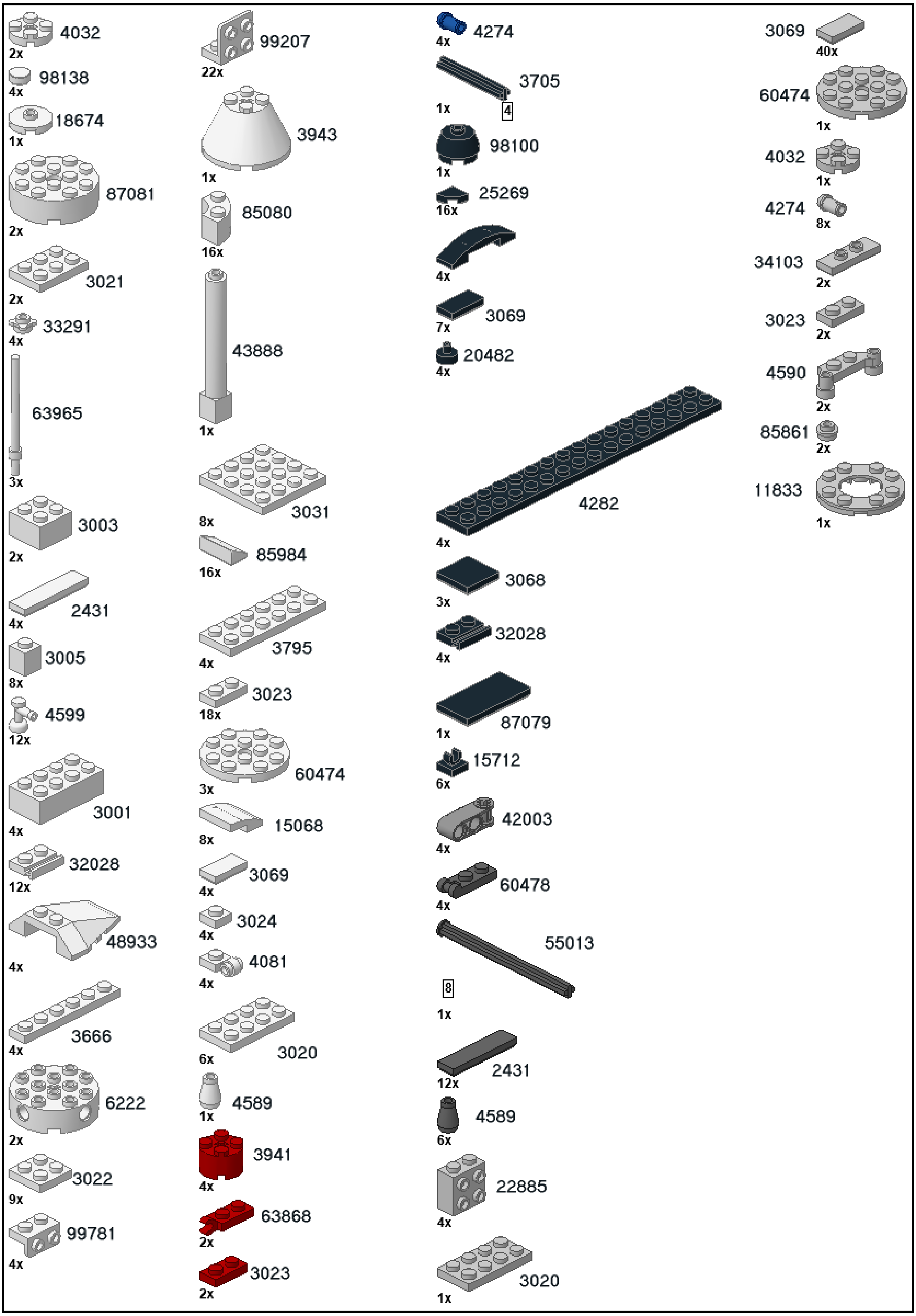


14







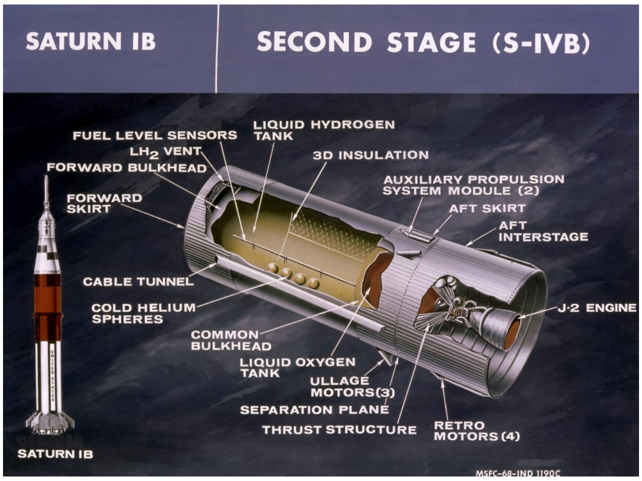

4032
2x
98138
4x
18674
1x
87081
2x
3021
2x
33291
4x
63965
3x
3003
2x
2431
4x
3005
8x
4599
12x
3001
4x
32028
12x
48933
4x
3666
4x
6222
2x
3022
9x
99781
4x
99207
22x
3943
1x
85080
16x
43888
1x
3031
8x
85984
16x
3795
4x
3023
18x
60474
3x
15068
8x
3069
4x
3024
4x
4081
4x
3020
6x
4589
1x
3941
4x
63868
2x
3023
2x
4274
4x
3705
4
1x
98100
1x
25269
16x
4x
3069
7x
20482
4x
4282
4x
3068
3x
32028
4x
87079
1x
15712
6x
42003
4x
60478
4x
55013
8
1x
2431
12x
4589
6x
22885
4x
3020
1x
3069
40x
60474
1x
4032
1x
4274
8x
34103
2x
3023
2x
4590
2x
85861
2x
11833
1x

Saturn Ib – the forgotten rocket

The Saturn Ib was the successor to the Saturn I and reflects the adaption of the launch vehicle for the nascent Apollo program. It replaced the S-IV second stage of the Saturn I with the much more powerful S-IVB, able to launch a partially fueled Apollo command and service module (CSM) or a fully fueled lunar module (LM) into low Earth orbit for early flight tests before the larger Saturn V needed for lunar flight was ready.

In spring 1961 US president John F. Kennedy set a manned moon landing as the primary goal for the US space program. Since the Soviets were ahead in development, speed was deemed important, and NASA chose the only already available heavy orbital lift launcher, the Saturn I, for Earth orbital test missions. However, the Saturn I's payload limit of 9,100 kg would allow testing of only the command module with a smaller propulsion module attached, as the command and service module would have a dry weight of at least 11,900 kg. In July 1962, NASA announced selection of the C-5 (the future Saturn V) for the lunar landing mission, and decided to develop another launch vehicle by upgrading the Saturn I, replacing its S-IV second stage with the S-IVB, which would also be modified for use as the Saturn V third stage.

The new S-IVB second stage was the first to feature the J-2 engines, which burned liquid hydrogen and oxygen. As with the H-1, the J-2 was a completely new engine developed by Rocketdyne. One J-2 provided 15 times the thrust of the RL-10 used in the previous S-IV, and so a single engine was sufficient to push the second stage and any payload atop to Earth orbit. The innovative isolation created for the propellant tanks of the S-IVB reduced the losses though vaporization enough to stretch flight time from ten minutes to more than four hours. This made it possible to test technologies to restart a rocket stage. Since a modified S-IVB was also to serve as the third stage of the Saturn V, where it had to be



relit in order to push the Apollo CSM and the lander into a Moon Rendesvouz, this was an essential requirement for the whole design.

The S-I first stage would also be upgraded to the S-IB by improving the thrust of its engines and removing some weight. The new Saturn IB, had a payload capability of at least 35,000 pounds (16,000 kg), allowing the command and service module to be flown with a partial fuel load. It would also allow launching the 32,000-pound (15,000 kg) lunar excursion module separately for unmanned and manned Earth orbital testing, before the Saturn V was ready to be flown. After finishing development, the Saturn IB payload capability had increased to 41,000 pounds (19,000 kg). By 1973, when it was used to launch three Skylab missions, the first-stage engine had been upgraded further, raising the payload capability to 46,000 pounds (21,000 kg).

Saturn IB rockets boosted Apollo CSM spacecraft bearing

Montage of the first stage of the Saturn 1b at KSC, Summer 1967 Credit: NASA

astronauts into low-Earth orbit just five times. The first piloted Saturn IB, designated SA-205, launched Apollo 7 on 11 October 1968. The rocket lifted off from Launch Complex 34, located at Cape Canaveral Air Force Station, just south of NASA's Kennedy Space Center. Astronauts Wally Schirra, Donn Eisele, and Walter Cunningham tested the first piloted CSM in orbit for 11 days before splashing down in the North Atlantic Ocean on 22 October 1968.

The Saturn IB was then used between 1973 and 1975 for three manned Skylab flights, and one Apollo-Soyuz Test Project flight. The last Saturn IB to fly, SA-210, lifted off on 15 July 1975, bearing Thomas Stafford, Vance Brand, and Donald Slayton. On 17 July, the three astronauts docked their Apollo CSM, designated simply "Apollo," with the Soviet Soyuz 19 spacecraft in a symbolic rendevouz that was designed to signal dentente between the US and the USSR.

Above: The new designed Satun 1b second stage, the S-IV of A-204, Apollo1, being lifted by the Service Structure to be mounted atop the first stage. Credit: NASA

Overleaf: Early morning view of Apollo–Soyuz Test Project (ASTP) Saturn IB on KSC pad 39B on July 2nd, 1975. Credit: NASA

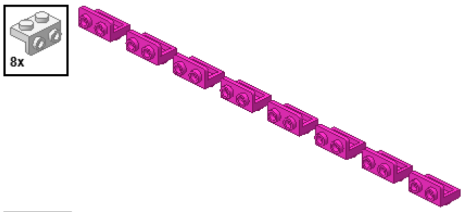
Datasheet Saturn Ib

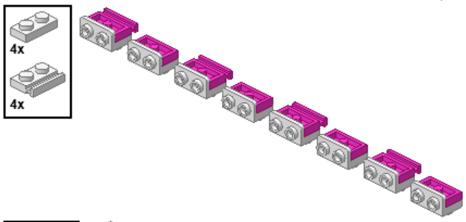
General	
Name	Saturn Ib
Function	Apollo spacecraft development; S-IVB stage development in support of Saturn V; Skylab crew launcher
Manufacturer	Chrysler (S-IB),
Country of origin	USA
Cost per Launch	
Family	Saturn
Size	
Height	141.6 ft (43.2 m) without payload
Diameter	21.67 ft (6.61 m)
Width	
Mass	1,300,220 lb (589,770 kg) without payload
Stages	2
Capacity	
Payload suborbital	
Payload to LEO	
Payload to GTO	46,000 lb (21,000 kg)
Payload to TLI	
Payload to escape	
Launch history	
Status	Retired
Launch sites	LC-37 & LC-34, Cape Canaveral LC-39B, Kennedy Space Center
Total launches	9
Successes	9
Failures	0
Partial failures	0
First flight	February 26, 1966
Last flight	July 15, 1975
Notable payloads	Unmanned Apollo CSM Unmanned Apollo LM Manned Apollo CSM

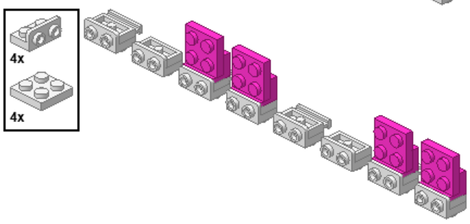
First stage	S-I
Engines	8 × Rocketdyne H-1
Thrust	1,600,000 lbf (7,100 kN)
Isp	272 seconds (2.67 km/s)
Burn time	150 seconds
Fuel	RP-1 / LOX
Gross mass	92,500 pounds (42,000 kg)
Empty mass	973,000 pounds (441,000 kg)
Length	80.17 feet (24.44 m)
Diameter	21.42 feet (6.53 m)
Second stage	**S-IVB**
Engines	Rocketdyne J-2
Thrust	200,000 lbf (890 kN)
Specific impulse	420 seconds (4.1 km/s)
Burn time	480 seconds
Fuel	LH2 / LOX
Gross mass	23,400 pounds (10,600 kg)
Empty mass	251,900 pounds (114,300 kg)
Length	58.42 feet (17.81 m)
Diameter	21.42 feet (6.53 m)
Model	
Year Created	2019
Author	David Welling
Parts count	783
Diameter	9,6 cm
Height	54,8 cm
Weigth	557,7 g
Link	https://drive.google.com/drive/folders/1_7mIlcAIYwA9LeOgNpZmDecpwDdZaCAk

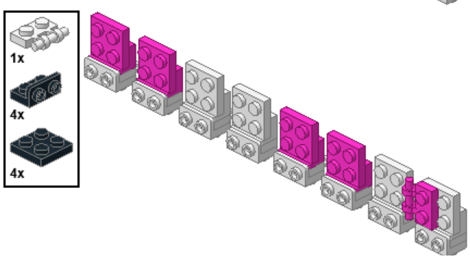
Saturn Ib Apollo 7, First Stage

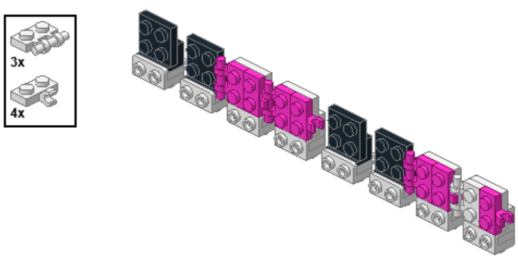
© David Welling, 2018

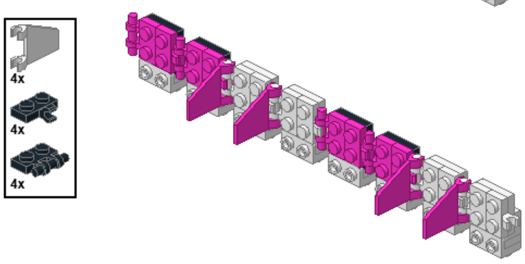
1


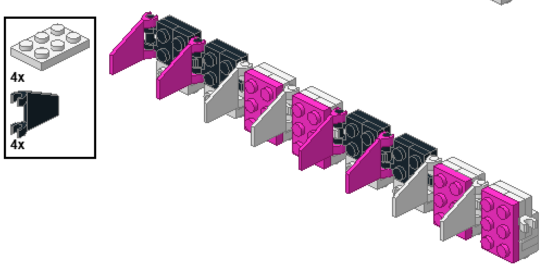
2


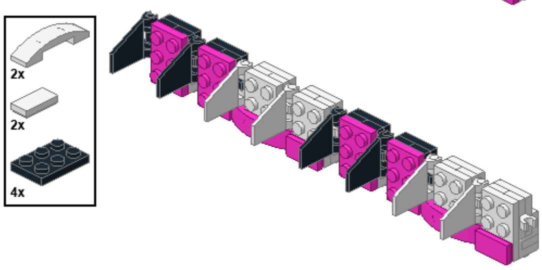
3


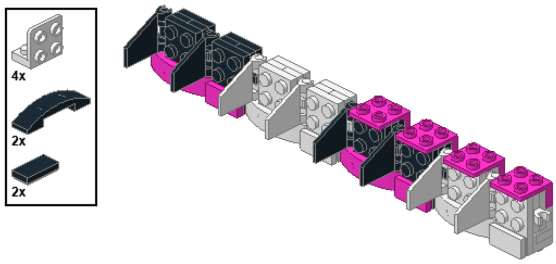
4


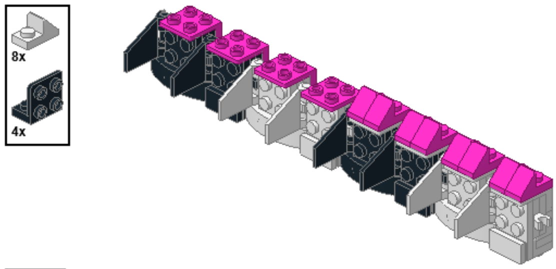
5


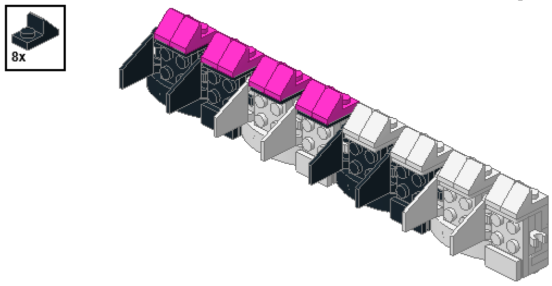
6


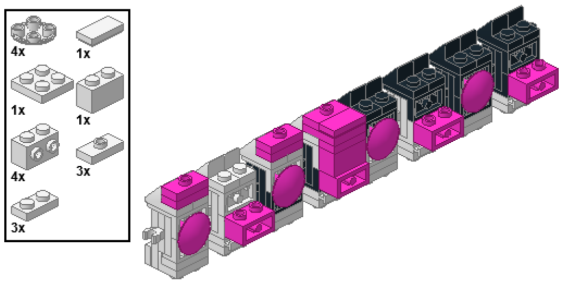
7


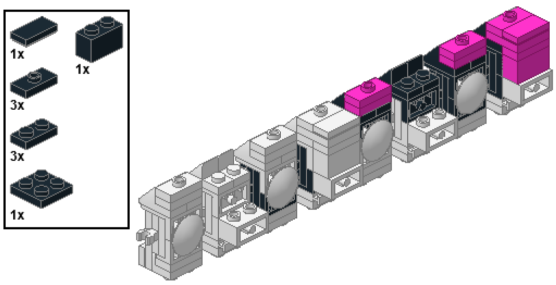
8


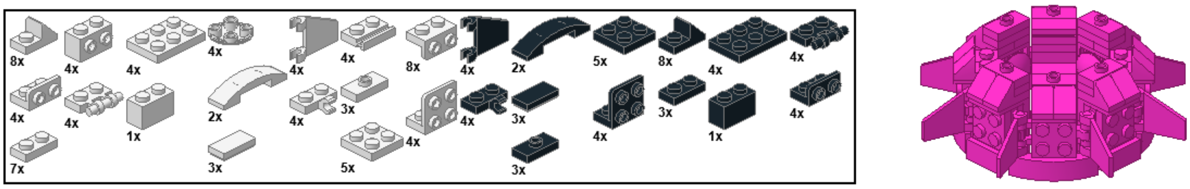
9


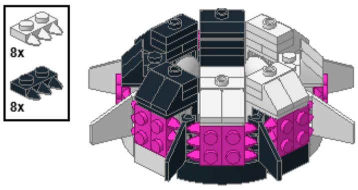
10


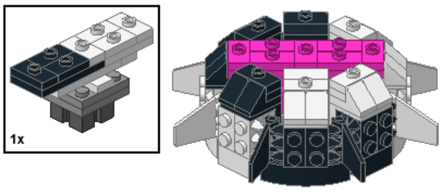
11


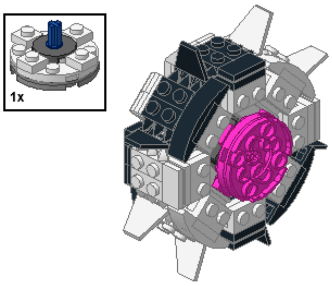
12


13


1


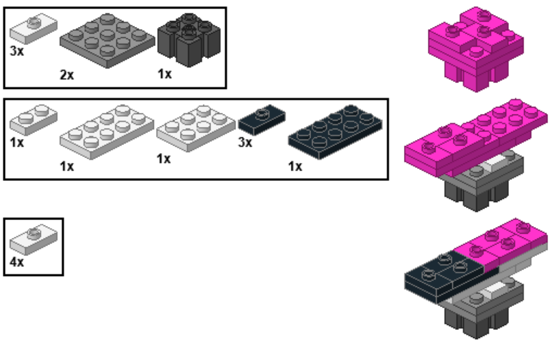
2


3


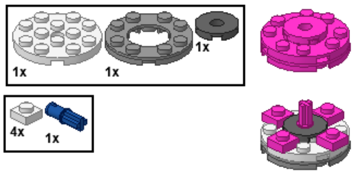
4


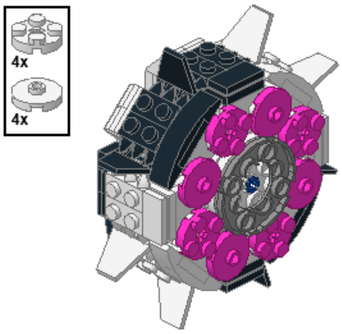
1

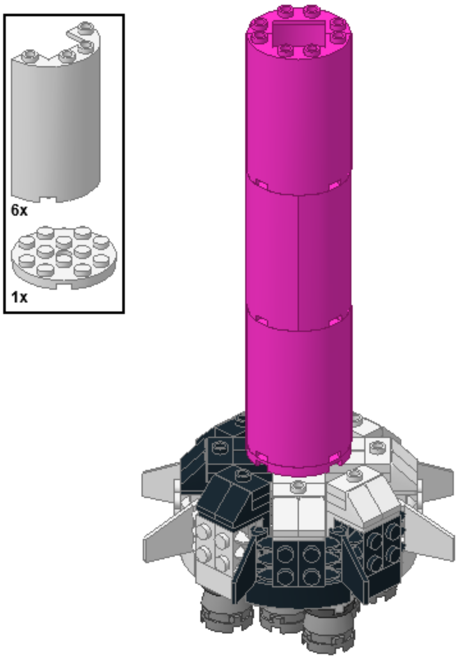
2

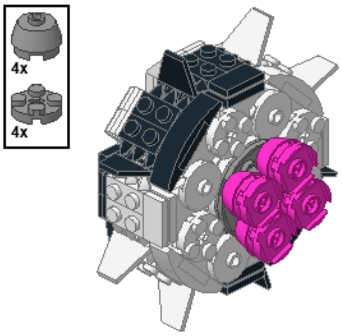
3


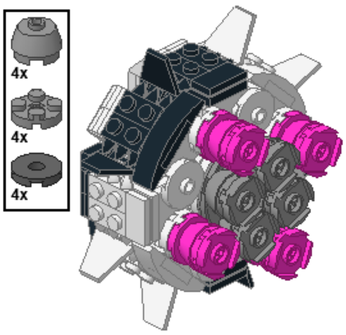
1

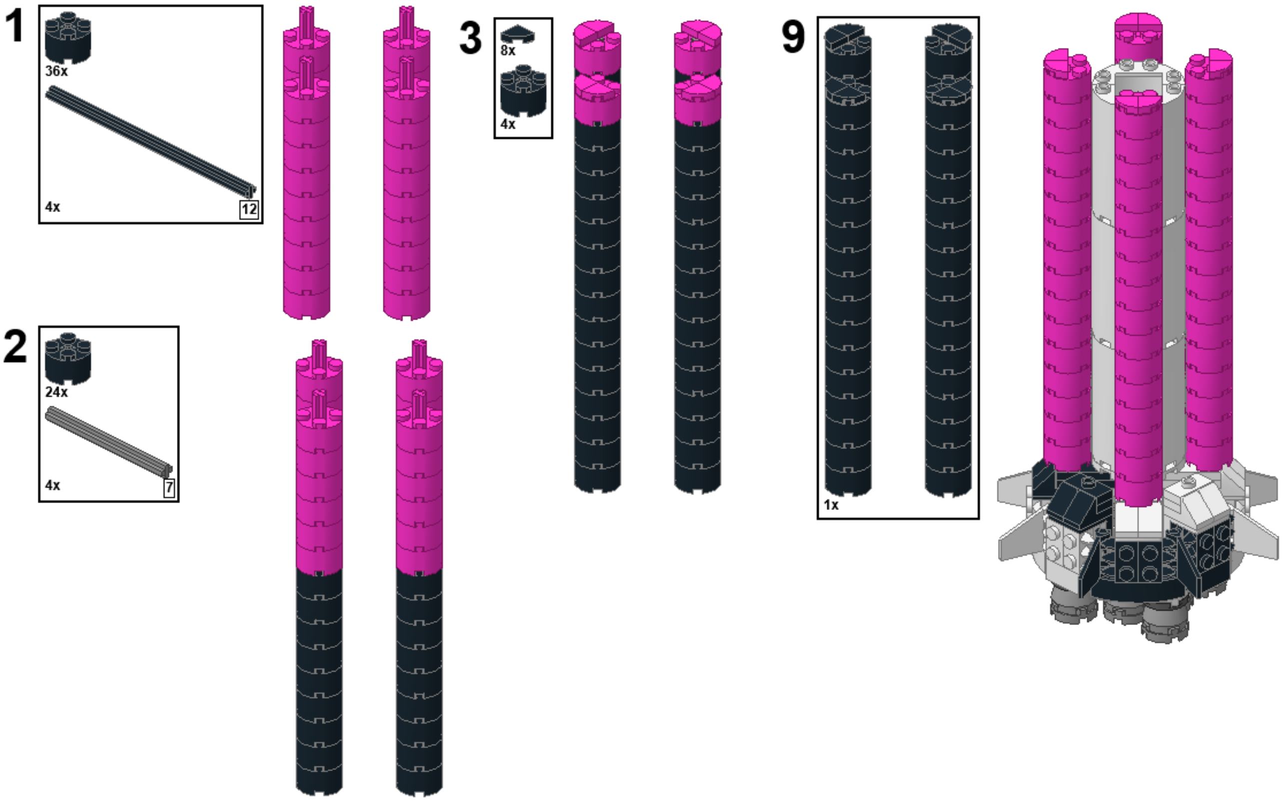
2


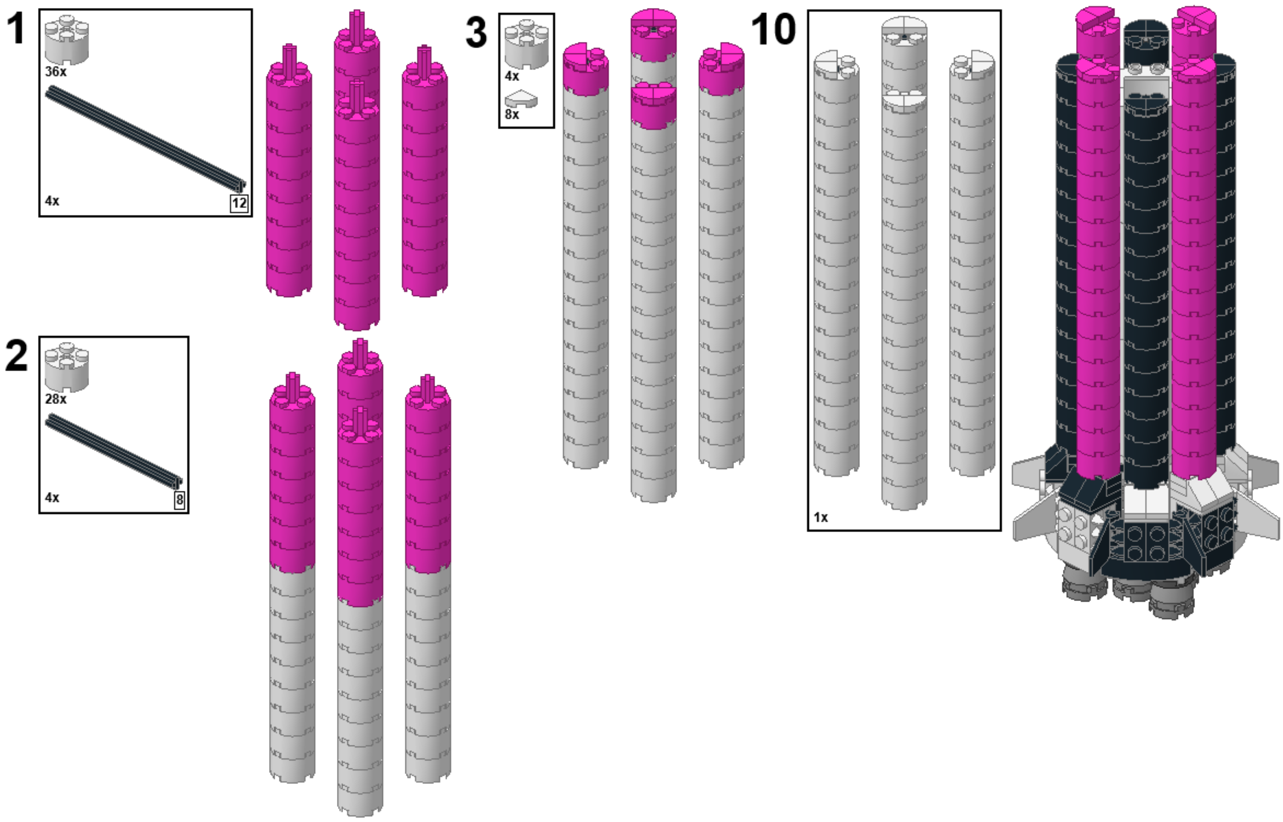
5


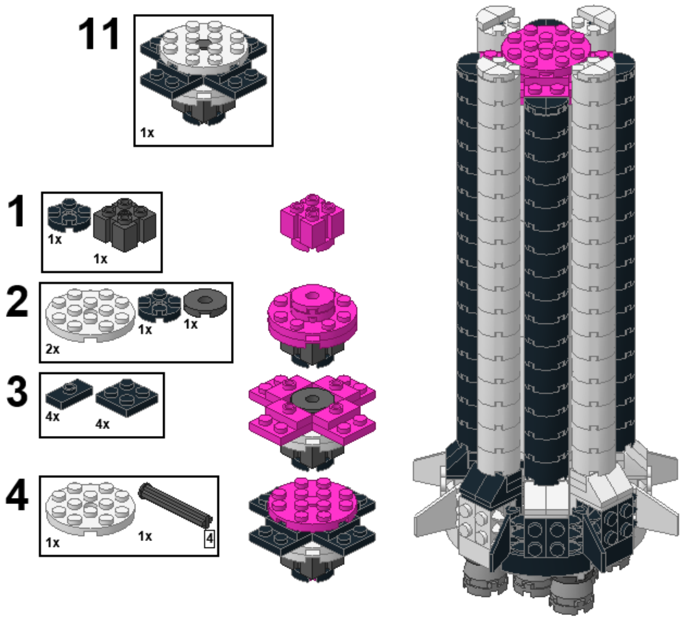
8


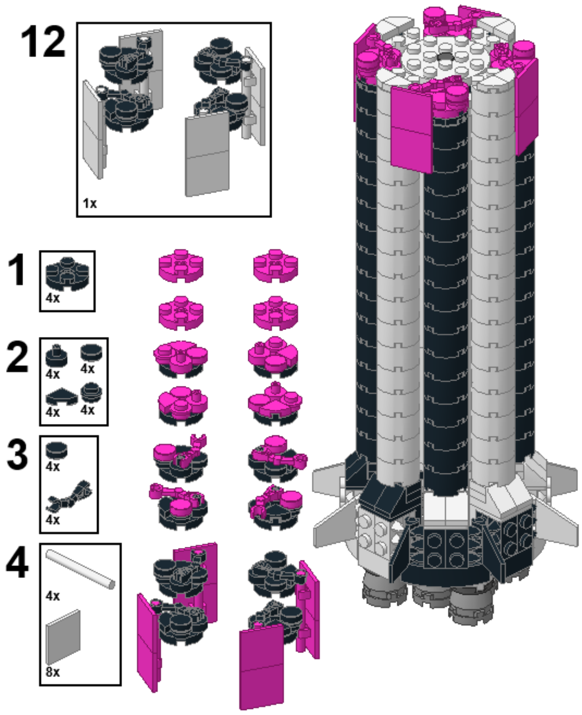
6


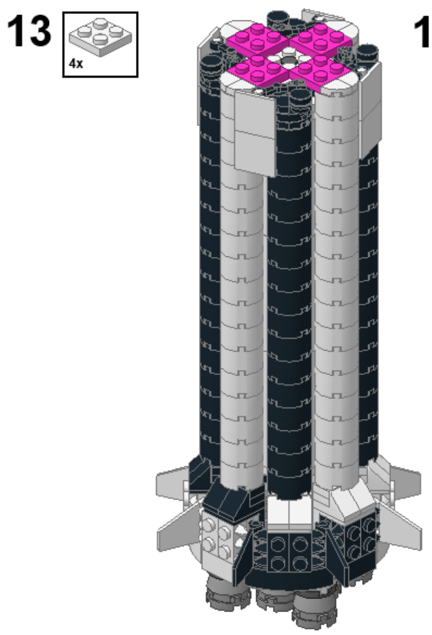
7


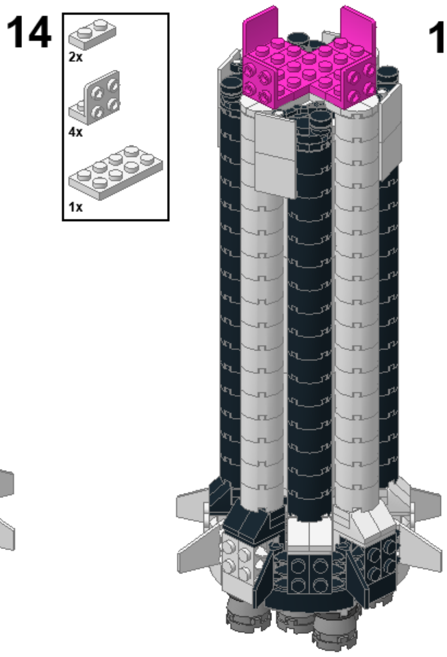

1
36x
4x
12
2
24x
4x
7
3
8x
4x
9
1x

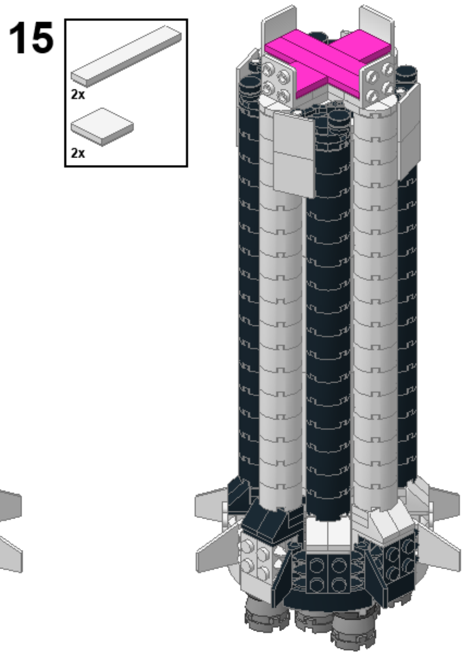

1
36x
4x
12
2
28x
4x
8
3
4x
8x
10
1x

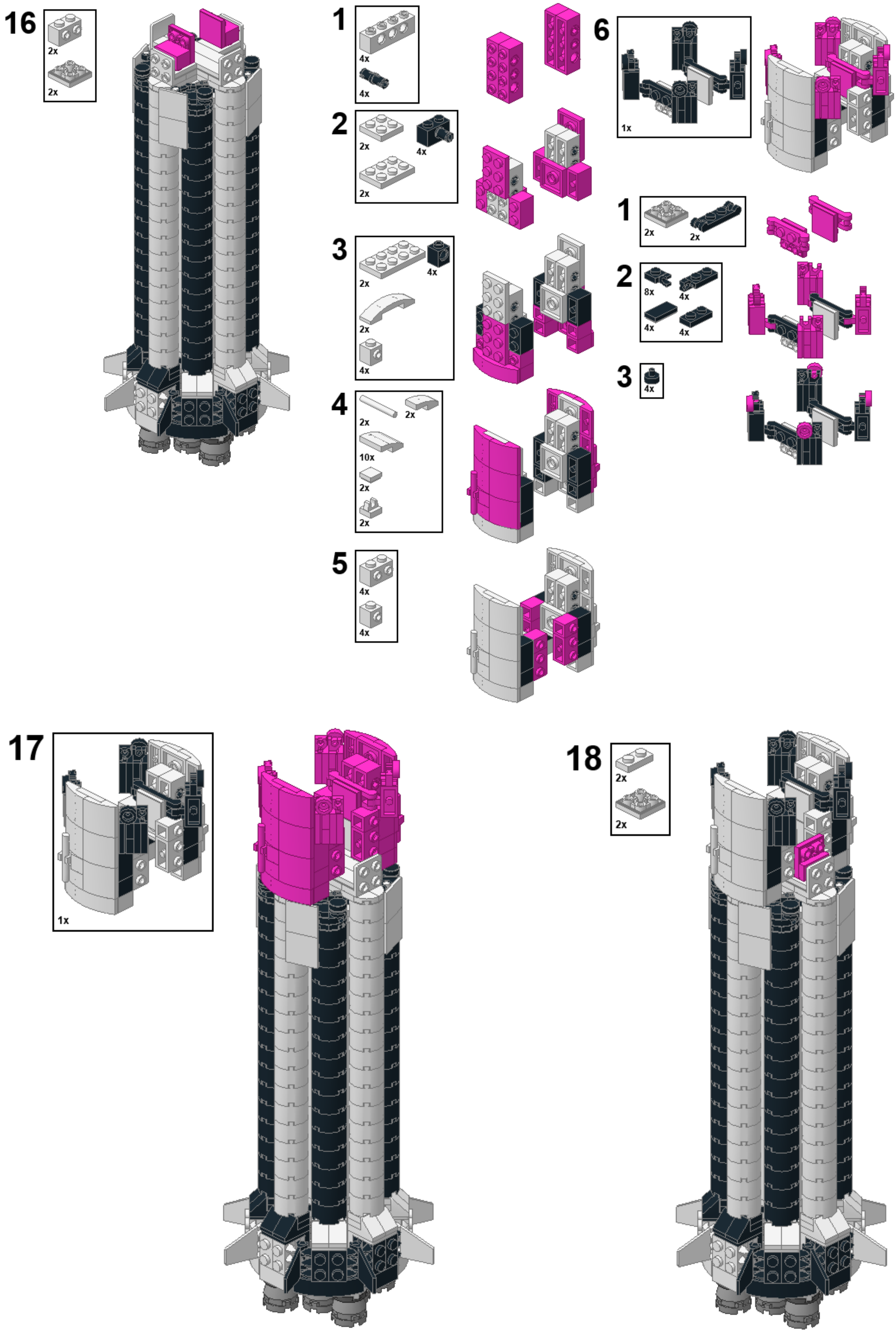

11
1x
1
1x
1x
2
2x
1x
1x
3
4x
4x
4
1x
1x
4

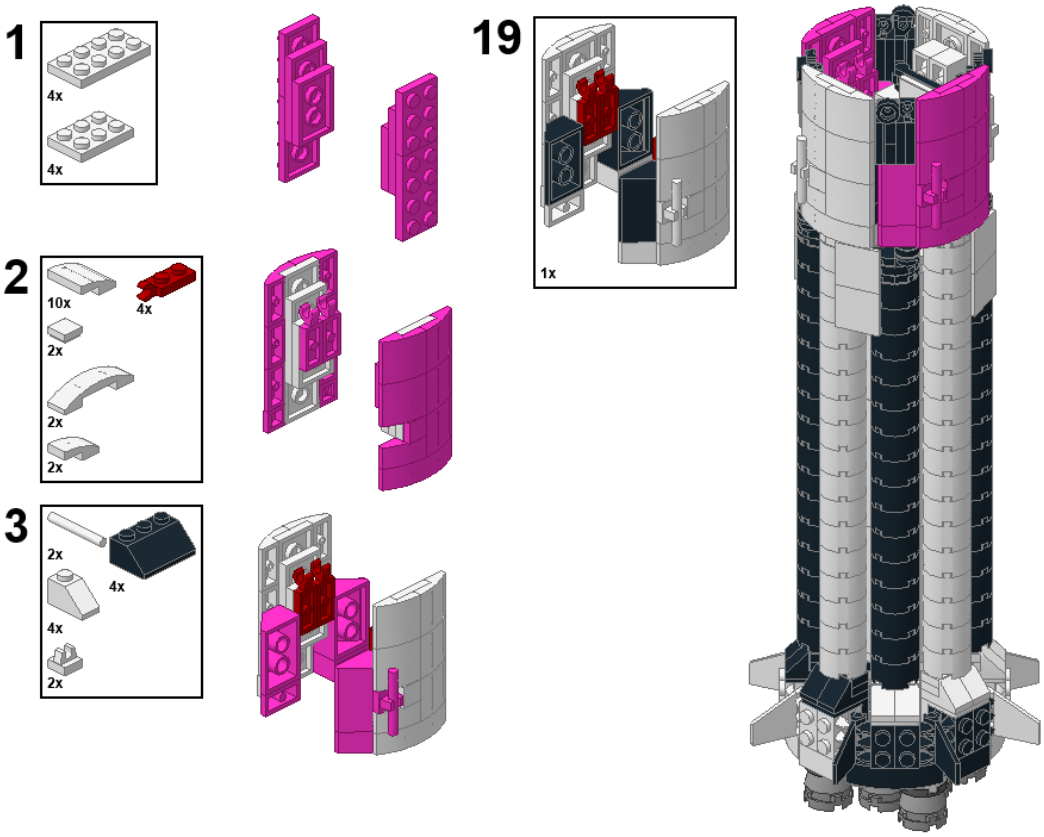

12
1x
1
4x
2
4x
4x
4x
4x
3
4x
4x
4
4x
8x

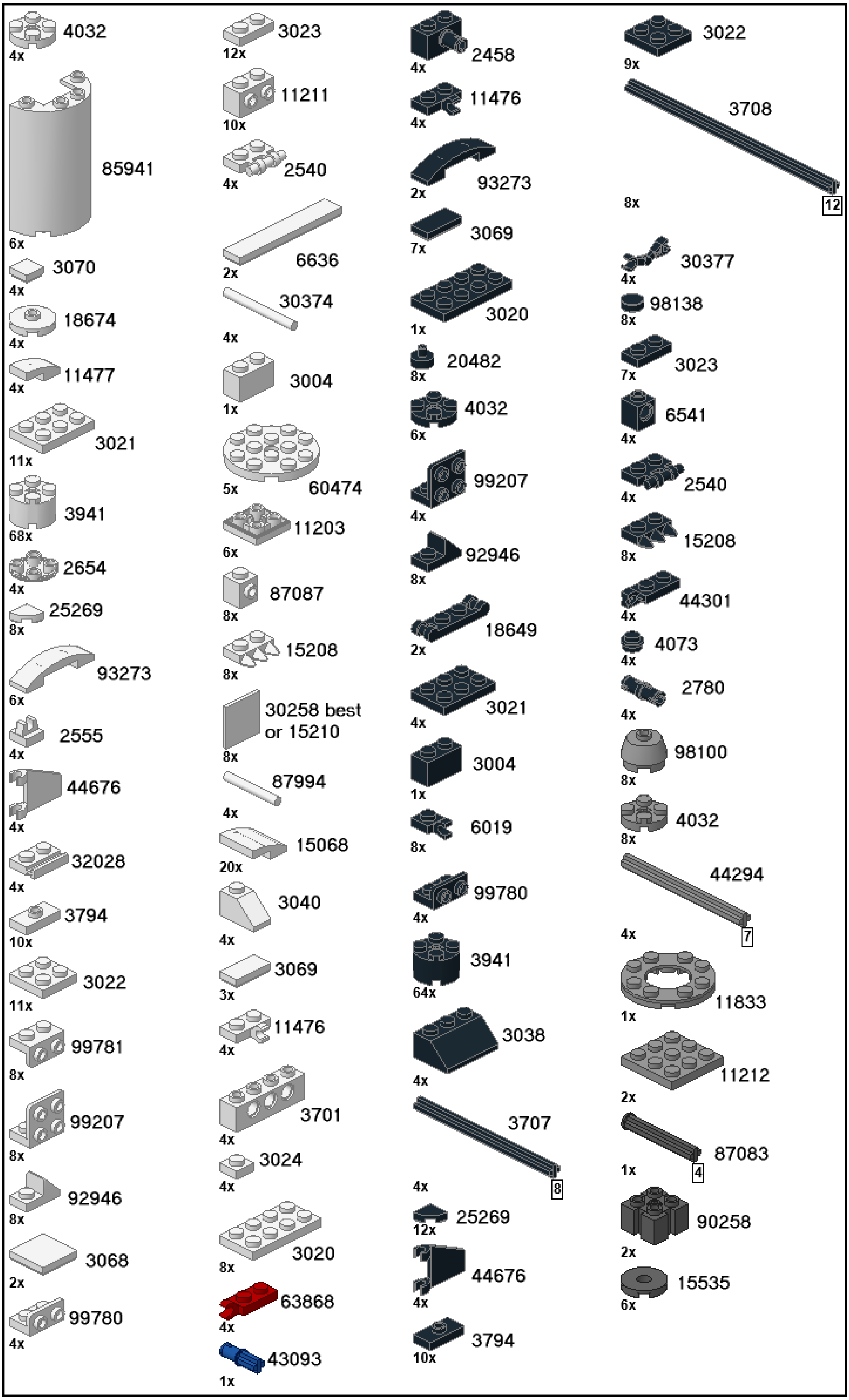

13
4x


14
2x
4x
1x


15
2x
2x


16
2x
2x
1
4x
4x
2
2x
4x
2x
3
2x
4x
2x
4x
4
2x
2x
10x
2x
2x
5
4x
4x
6
1x
1
2x
2x
2
8x
4x
4x
4x
3
4x
17
1x
18
2x
2x

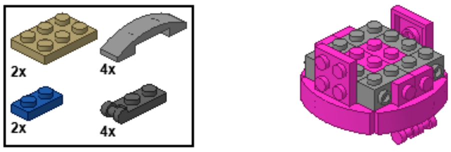

1
4x
4x
2
10x
4x
2x
2x
2x
3
2x
4x
4x
2x
19
1x


4032
4x
85941
6x
3070
4x
18674
4x
11477
4x
3021
11x
3941
68x
2654
4x
25269
8x
93273
6x
2555
4x
44676
4x
32028
4x
3794
10x
3022
11x
99781
8x
99207
8x
92946
8x
3068
2x
99780
4x
3023
12x
11211
10x
2540
4x
6636
2x
30374
4x
3004
1x
60474
5x
11203
6x
87087
8x
15208
8x
30258 best
or 15210
8x
87994
4x
15068
20x
3040
4x
3069
3x
11476
4x
3701
4x
3024
4x
3020
8x
63868
4x
43093
1x
2458
4x
11476
4x
93273
2x
3069
7x
3020
1x
20482
8x
4032
6x
99207
4x
92946
8x
18649
2x
3021
4x
3004
1x
6019
8x
99780
4x
3941
64x
3038
4x
3707
4x
8
25269
12x
44676
4x
3794
10x
3022
9x
3708
8x
12
30377
4x
98138
8x
3023
7x
6541
4x
2540
4x
15208
8x
44301
4x
4073
4x
2780
4x
98100
8x
4032
8x
44294
4x
7
11833
1x
11212
2x
87083
1x
4
90258
2x
15535
6x

1

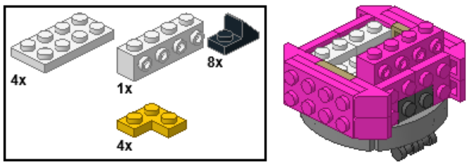
2

3

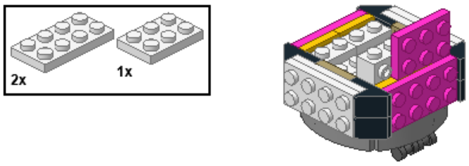


4

5

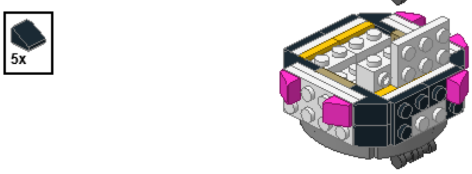


6

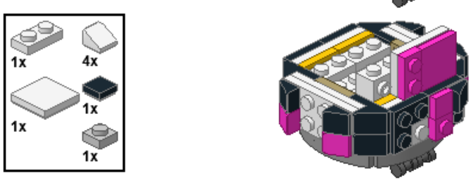


7

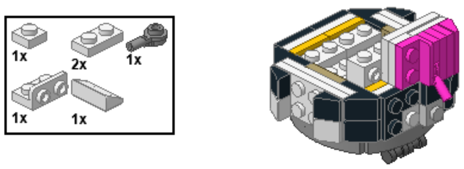
8



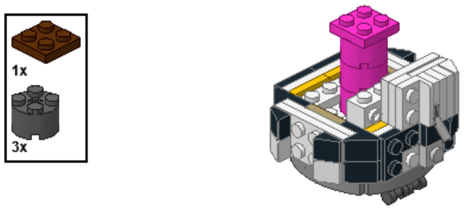
9



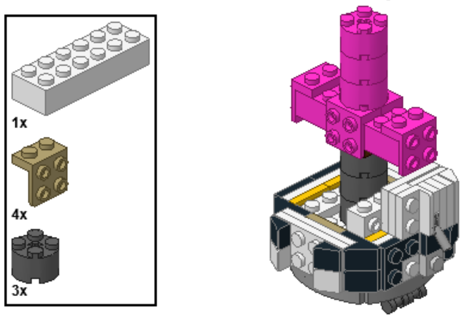
10



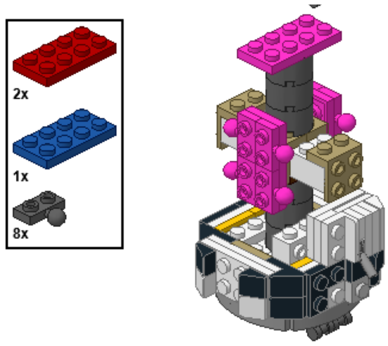
11



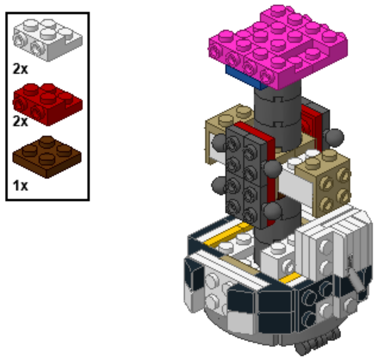
12



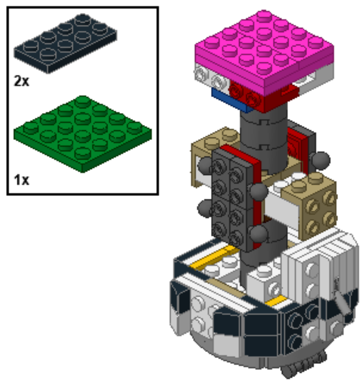
13



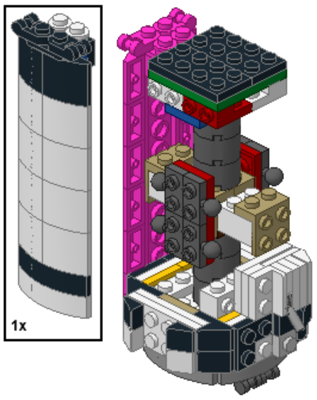
14



15



16

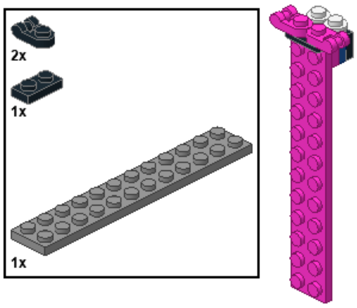


Saturn Ib Apollo 7, Second Stage,

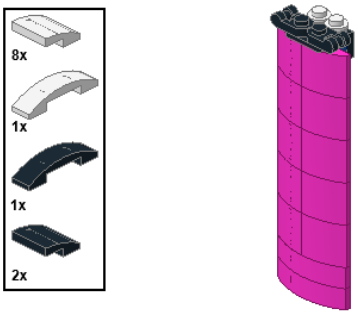
© David Welling, 2018

1

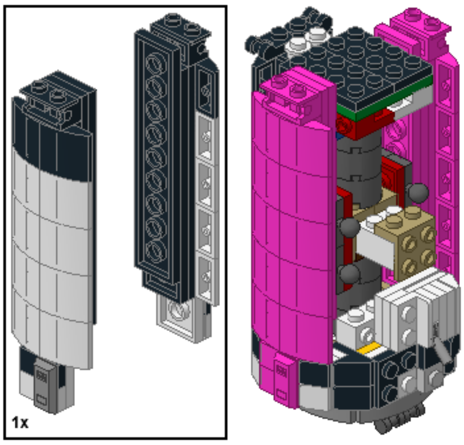
2



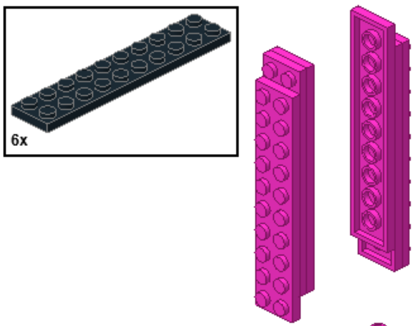
3



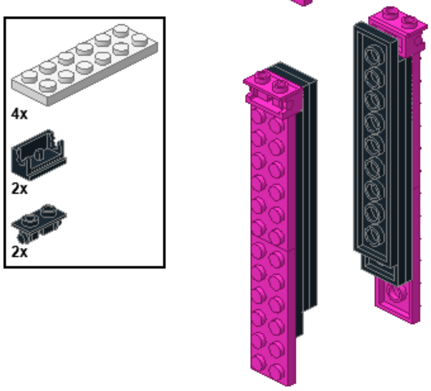
17



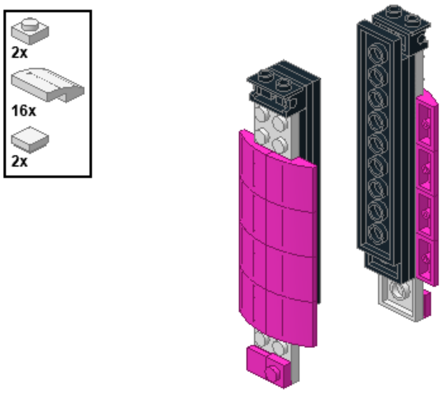
1



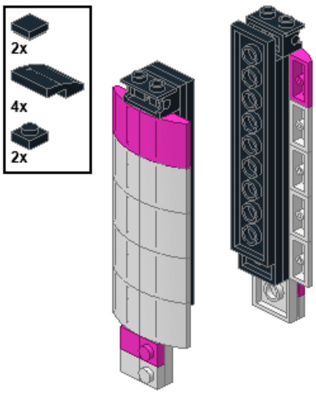
2



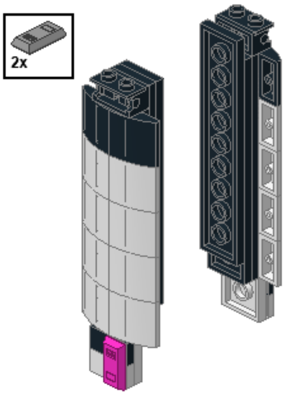
3



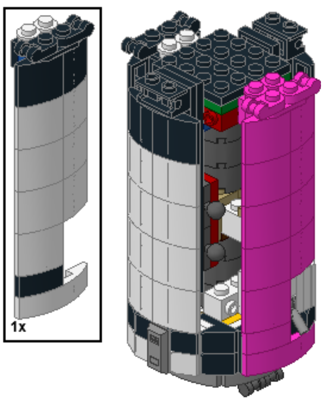
4



5

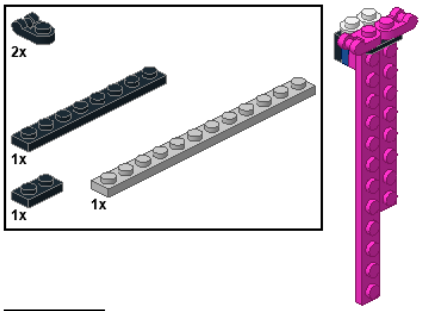


18

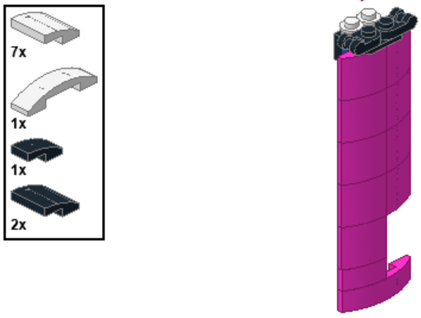


1

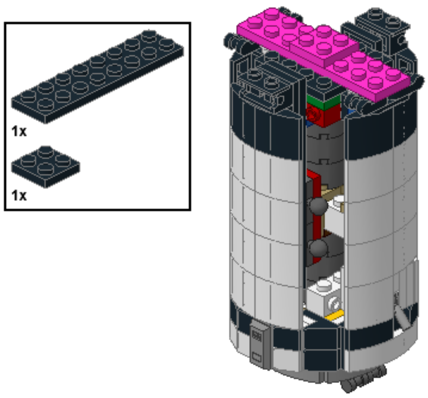
2



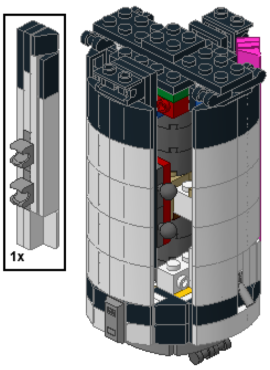
3



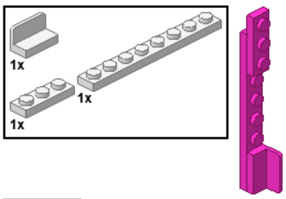
19



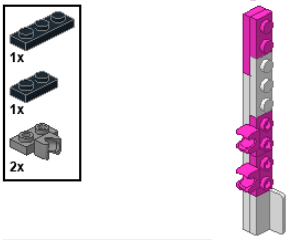
20



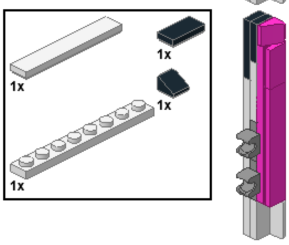
1



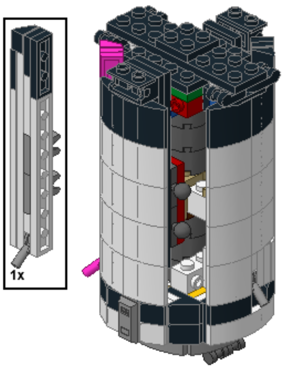
2



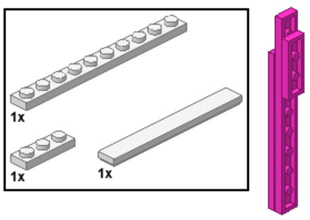
3



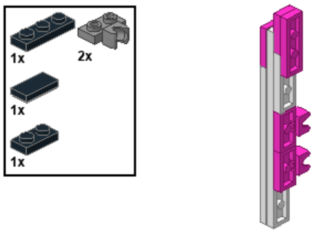
21



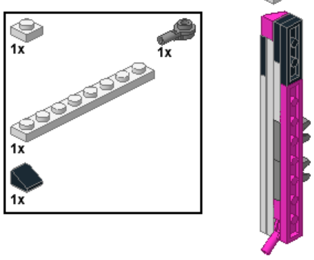
1



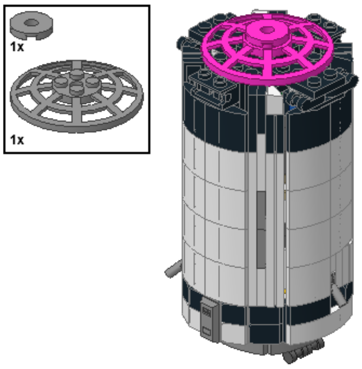
2



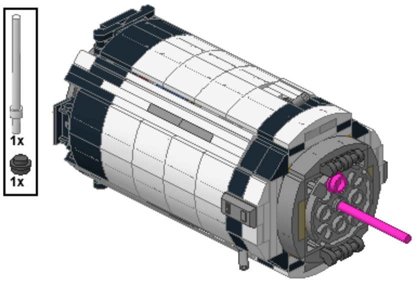
3



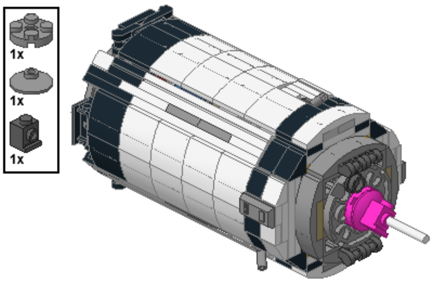
24



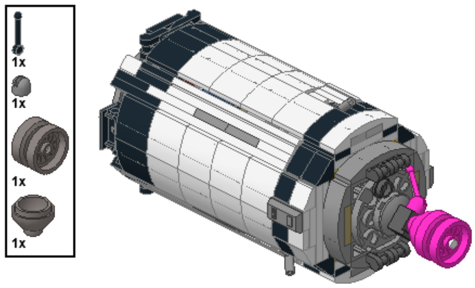
25



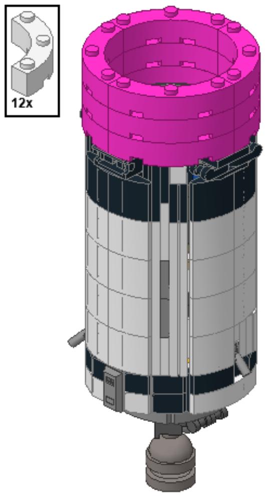
26



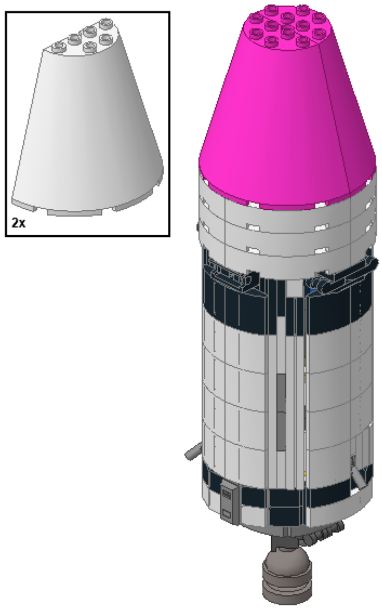
27

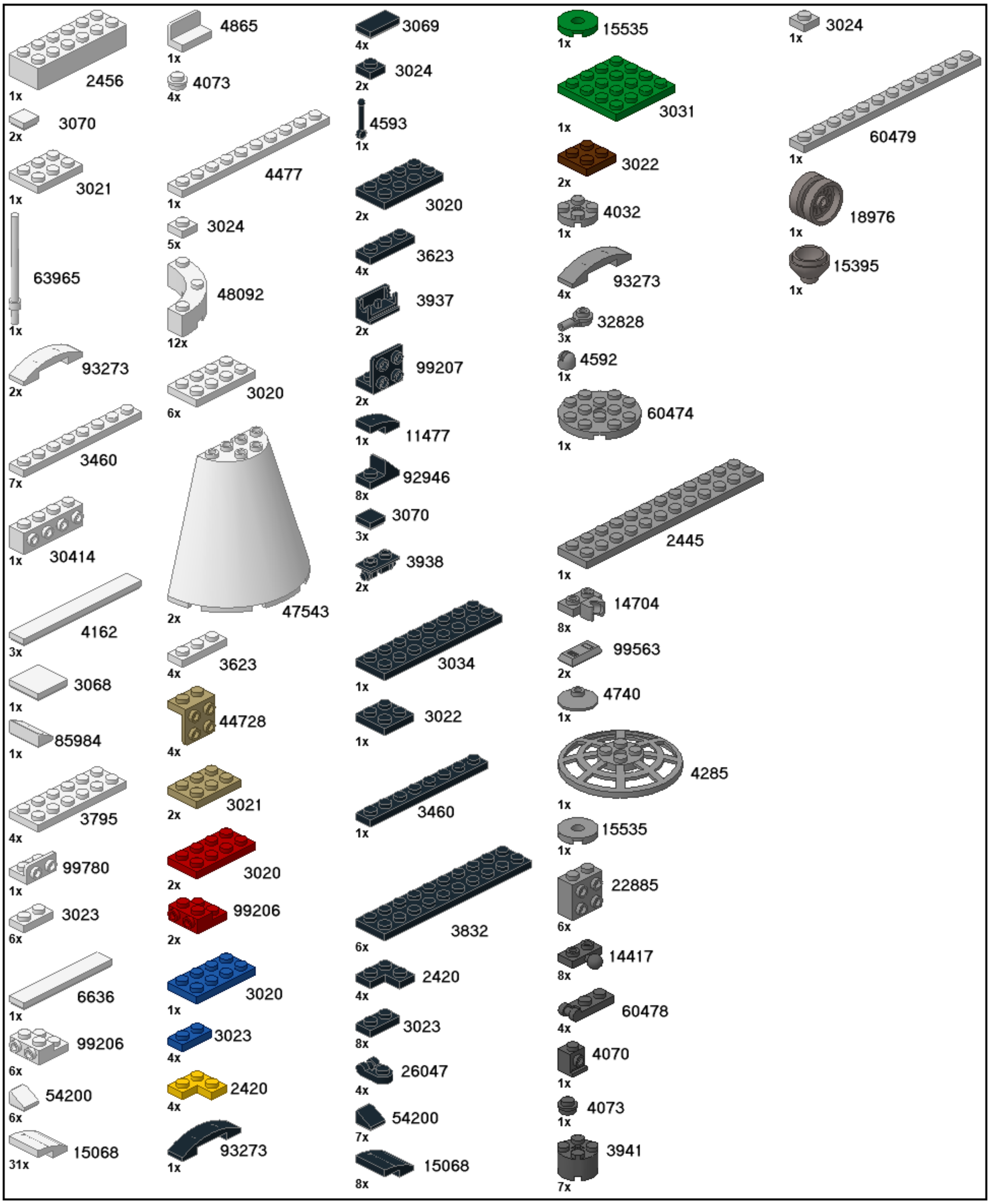


28



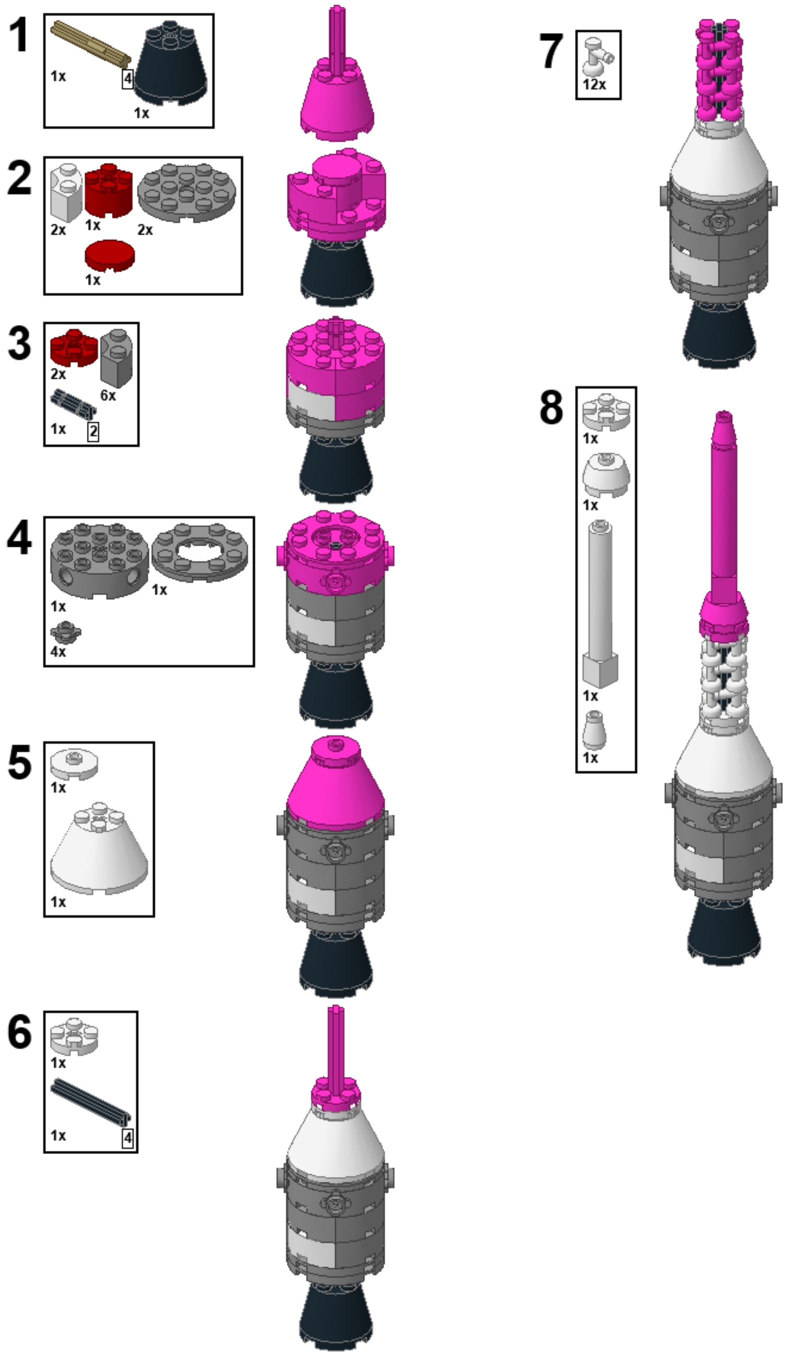
29

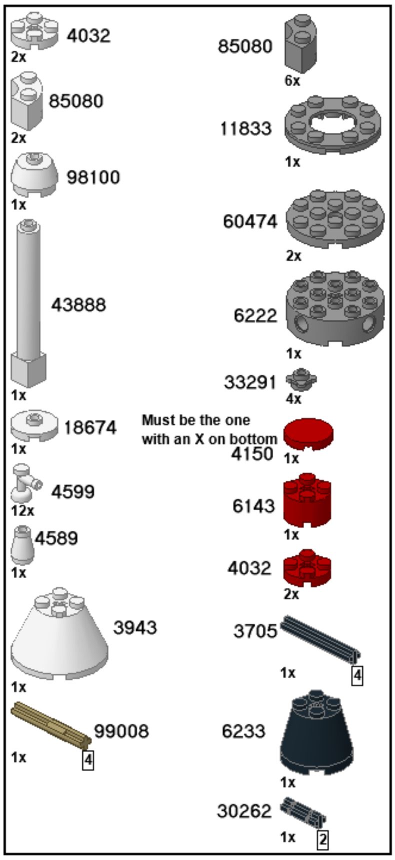



1x 2456
2x 3070
1x 3021
1x 63965
2x 93273
7x 3460
1x 30414
3x 4162
1x 3068
1x 85984
4x 3795
1x 99780
6x 3023
1x 6636
6x 99206
6x 54200
31x 15068
1x 4865
4x 4073
1x 4477
5x 3024
12x 48092
6x 3020
2x 47543
4x 3623
4x 44728
2x 3021
2x 3020
2x 99206
1x 3020
4x 3023
4x 2420
1x 93273
4x 3069
2x 3024
1x 4593
2x 3020
4x 3623
2x 3937
2x 99207
1x 11477
8x 92946
3x 3070
2x 3938
1x 3034
1x 3022
1x 3460
6x 3832
4x 2420
8x 3023
4x 26047
7x 54200
8x 15068
1x 15535
1x 3031
2x 3022
1x 4032
4x 93273
3x 32828
1x 4592
1x 60474
1x 2445
8x 14704
2x 99563
1x 4740
1x 4285
1x 15535
6x 22885
8x 14417
4x 60478
1x 4070
1x 4073
7x 3941
1x 3024
1x 60479
1x 18976
1x 15395

Saturn Ib Apollo 7, CSM

© David Welling, 2018





Launch Complex 34-37

Cape Canaveral Air Force Station Space Launch Complex 34 (SLC-34), previously Launch Complex 34 (LC-34), is a former launch complex on Cape Canaveral. LC-34 and its companion LC-37 to the north were used by NASA from 1961 through 1968 to launch Saturn I and IB rockets as part of the Apollo program. It was the site of the Apollo 1 fire, which claimed the lives of astronauts Gus Grissom, Ed White, and Roger Chaffee on January 27, 1967.

Umbilical Tower and Service Structure of LC-34 with Saturn 1 SA-4 on the launch pad.
Credit: NASA

With the Apollo program requiring larger launch facilities, work began on LC-34 in 1959, and it was formally dedicated on June 5, 1961. As the work was being considered an Army program, the design was underfunded , which lead to some challenges in later use. The complex consisted of a launch platform, umbilical tower, mobile service tower, fueling facilities, and a blockhouse. Two steel flame deflectors were mounted on rails to allow placement beneath the launch platform. The service tower was likewise mounted on rails, and it was moved to a position 185 meters west of the pad before launch. At 95 meters high, it was the tallest structure at LC-34. Its newer sibling, LC-37, was designed by NASA engineers in 1961 with a better understanding of Saturn requirements; its service structure, launch umbilical tower, and blockhouse were more appropriately sized to IB operations.

The blockhouse, located 320 meters from the pad, was modeled after the domed reinforced concrete structure at LC-20. During a launch, it could accommodate 130 people as well as test and instrumentation equipment. Periscopes afforded views outside the windowless facility.

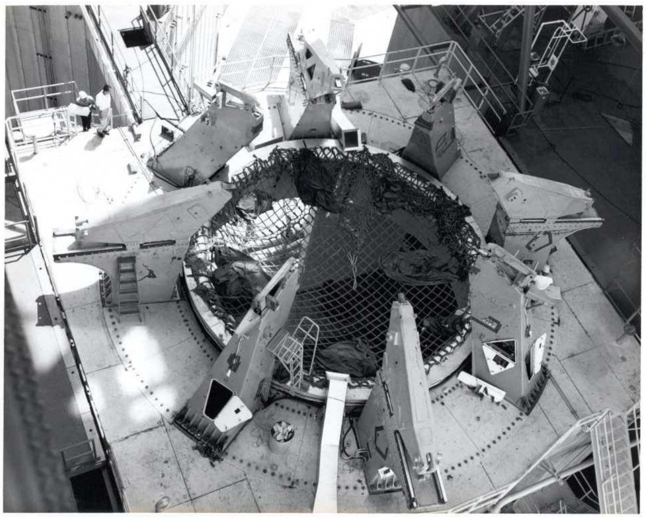
LC-34 saw its first launch on October 27, 1961. The first Saturn I, Block I, mission SA-1, lofted a dummy upper stage

The interior of LC34's blockhouse during the countdown of SA-1. note the perioscopes.
Credit: NASA

on a suborbital trajectory into the Atlantic. The subsequent three Saturn I launches took place at LC-34, ending with SA-4 on March 28, 1963. The six ensuing Saturn I, Block II launches were conducted at LC-37.

LC-34 had to be extensively modified from its original spartan state to support Saturn IB launches, which began in February 1966. New anchor points were built to fasten the service structure in place during high winds. Access arms on the umbilical tower were rebuilt to match the larger rocket. At the 67-meter level, the swing arm was outfitted with a white room to permit access to the command module at the top of a rocket.

Two Saturn IBs (AS-201 and AS-202) were successfully launched from LC-34 in 1966 before the Apollo 1 fire brought Apollo activities at the spaceport to an abrupt halt. Apollo 1, initially designated AS-204, was the first crewed



The flame pit and holding structures of LC-34
Credit: NASA

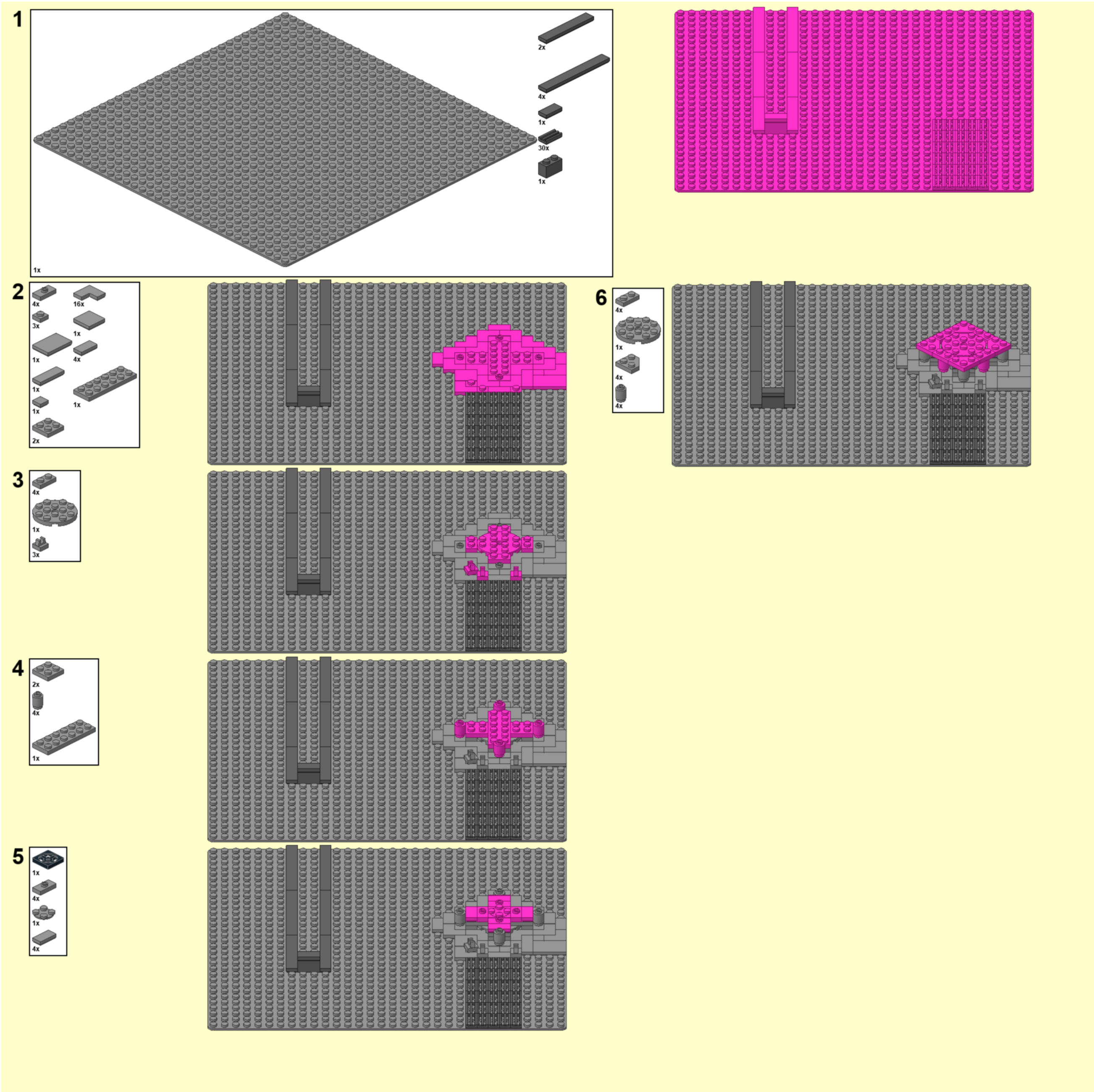
mission of the Apollo program. Planned as the first low Earth orbital test of the Apollo command and service module with a crew, to launch on February 21, 1967, the mission never flew; a cabin fire during a launch rehearsal test at Cape Kennedy Air Force Station Launch Complex 34 on January 27 killed all three crew members—Command Pilot Virgil I. "Gus" Grissom, Senior Pilot Ed White, and Pilot Roger B. Chaffee—and destroyed the command module (CM). As part of the extensive efforts to identify and remove the causes of the accident, extinguishing equipment was installed at the top of the umbilical tower, and a slide wire was set up to provide astronauts a quick escape in the event of an emergency.

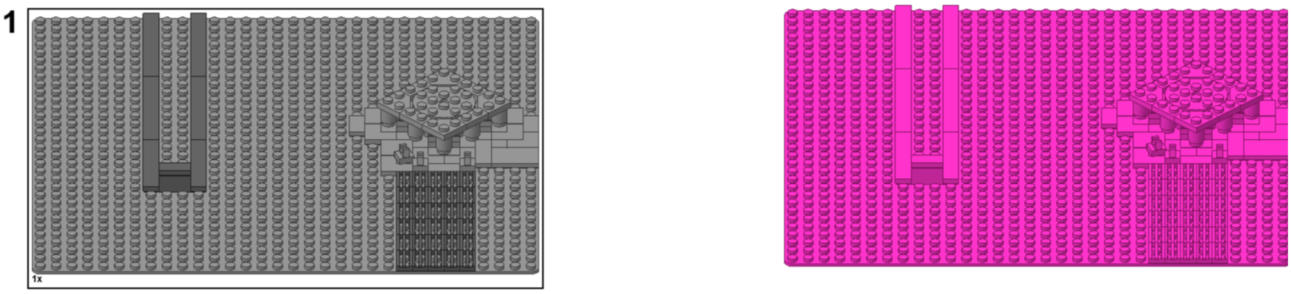
The first manned Apollo launch—Apollo 7 on October 11, 1968—was the last time LC-34 was used. NASA considered reactivating both LC-34 and LC-37 for the Apollo Applications Program, but instead LC-39B was modified to launch Saturn IBs, it received the famous "milk stool".

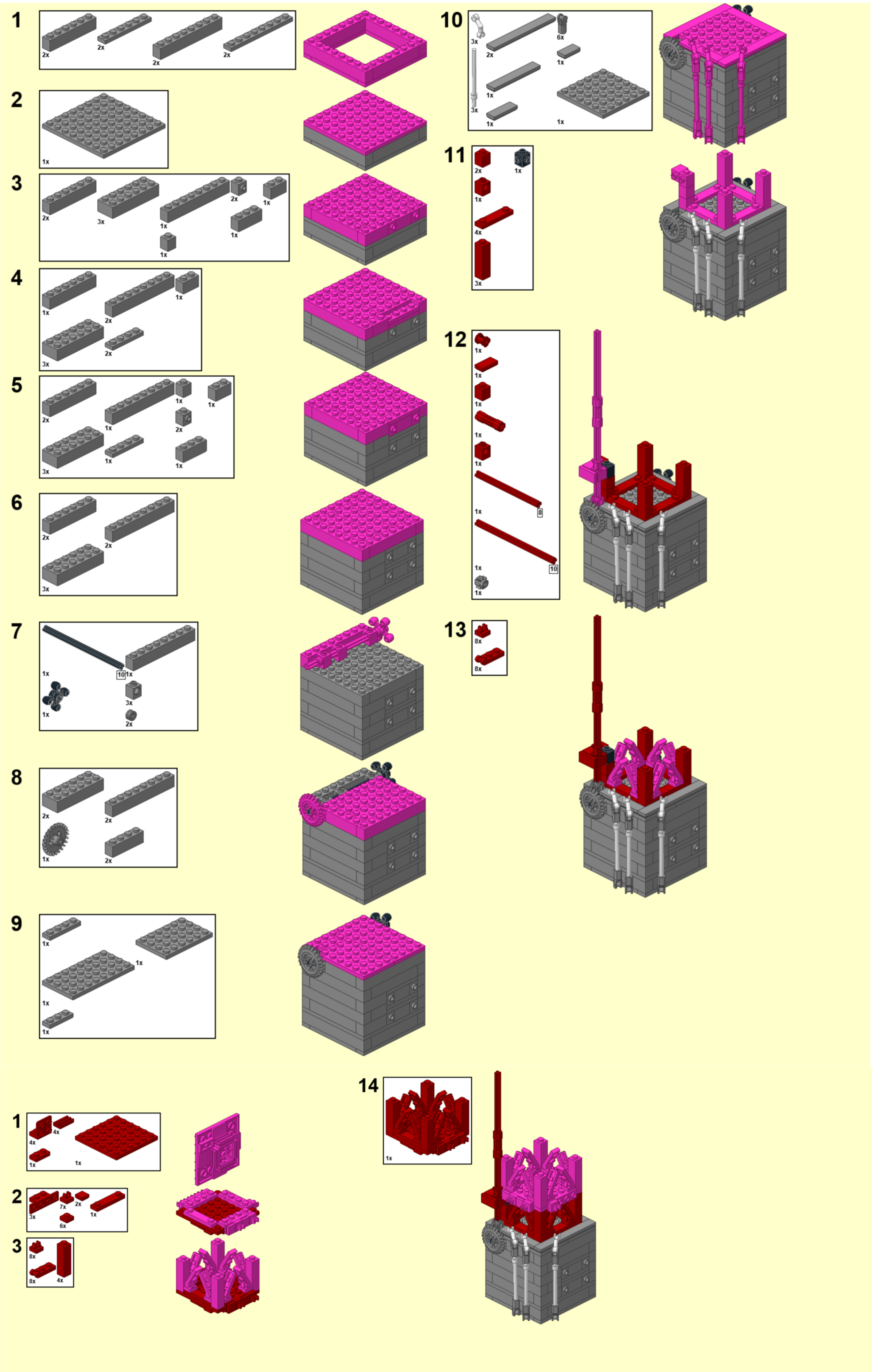
After the decommissioning of LC-34, the umbilical tower and service structure were razed, leaving only the launch platform standing at the center of the pad. It serves as a memorial to the crew of Apollo 1.

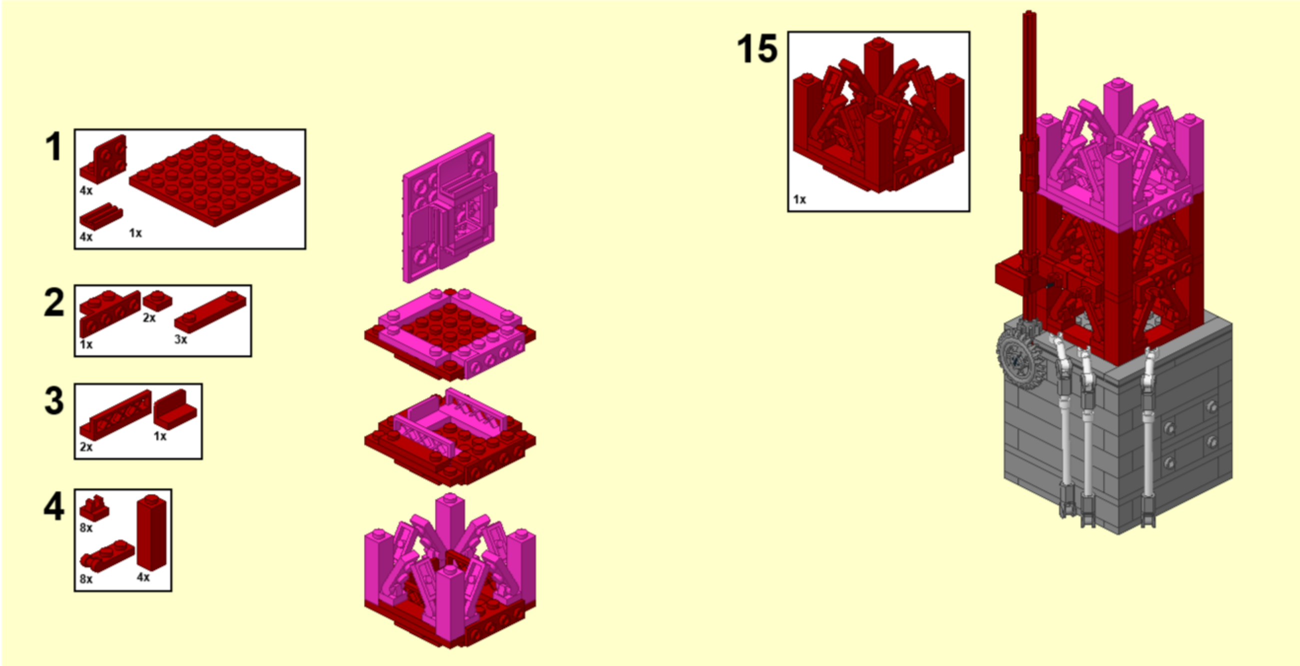
Launch Complex 34

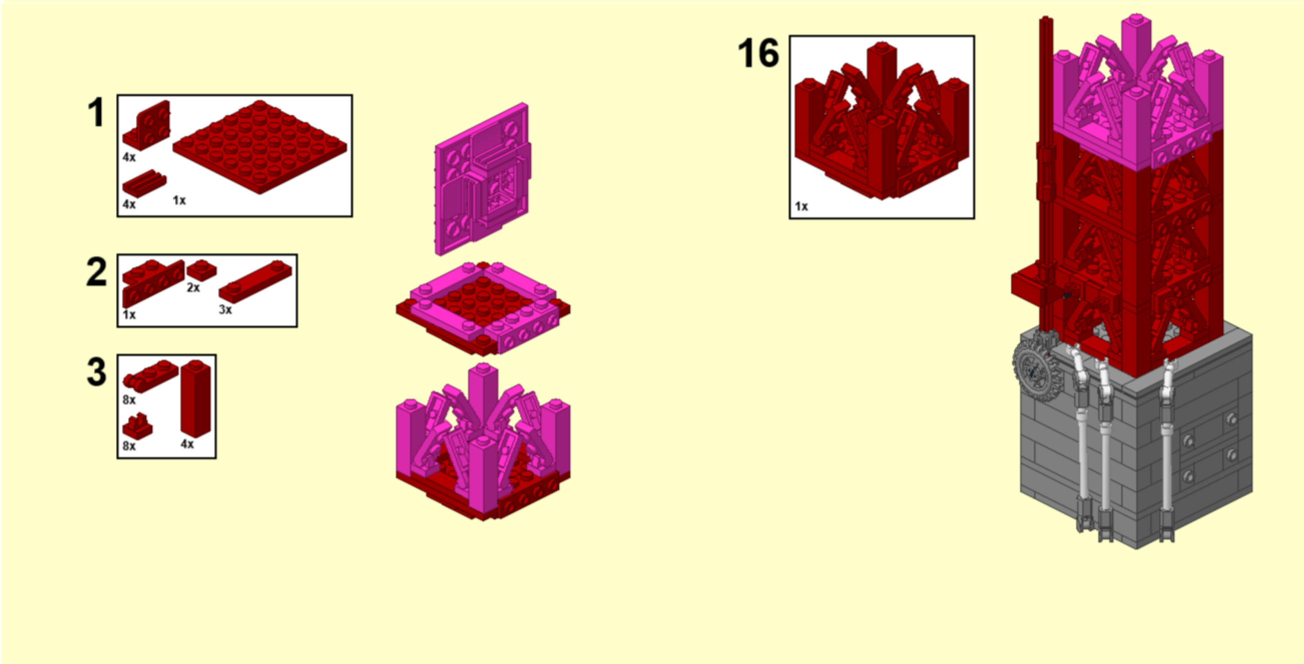
© David Welling, 2018

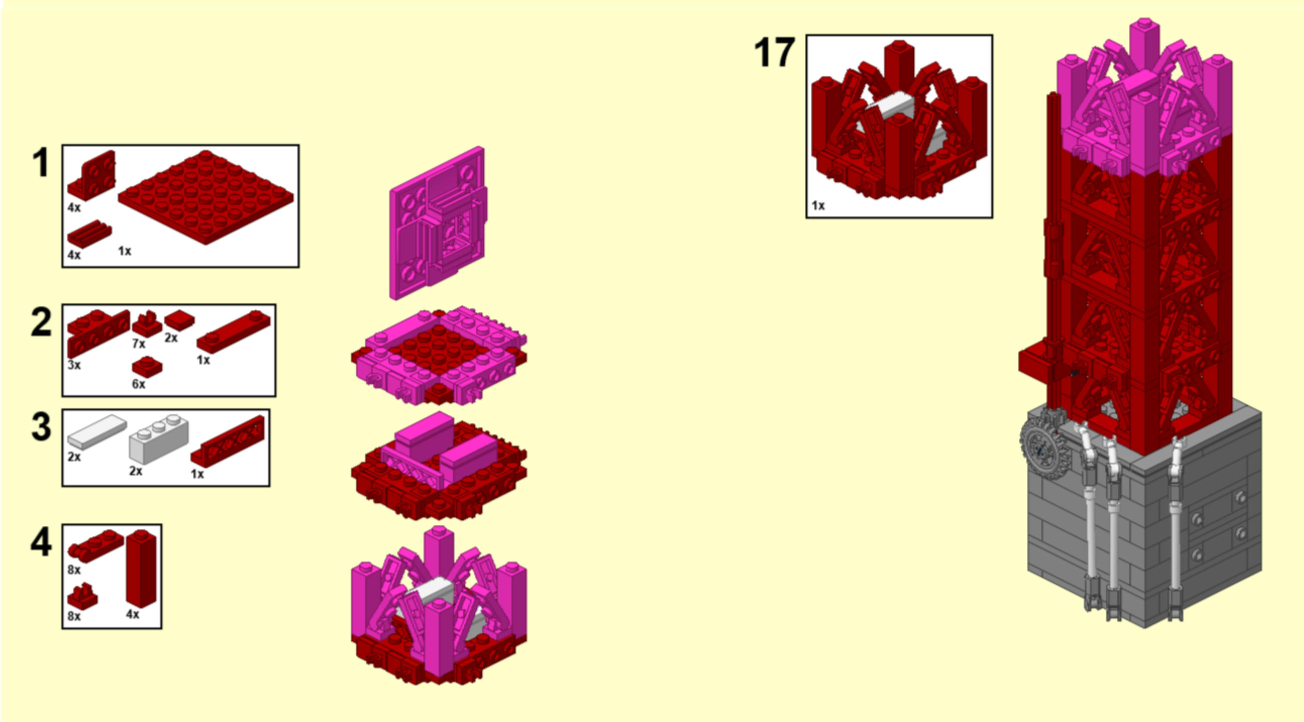


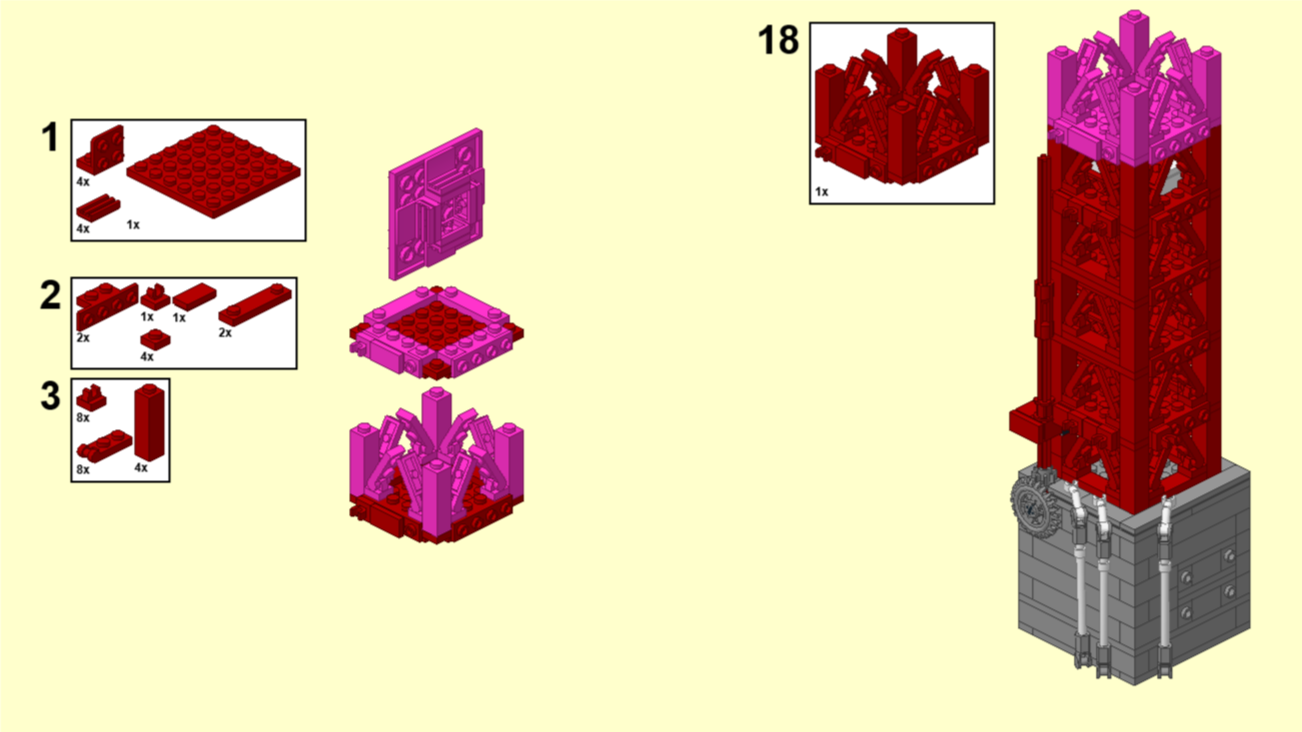


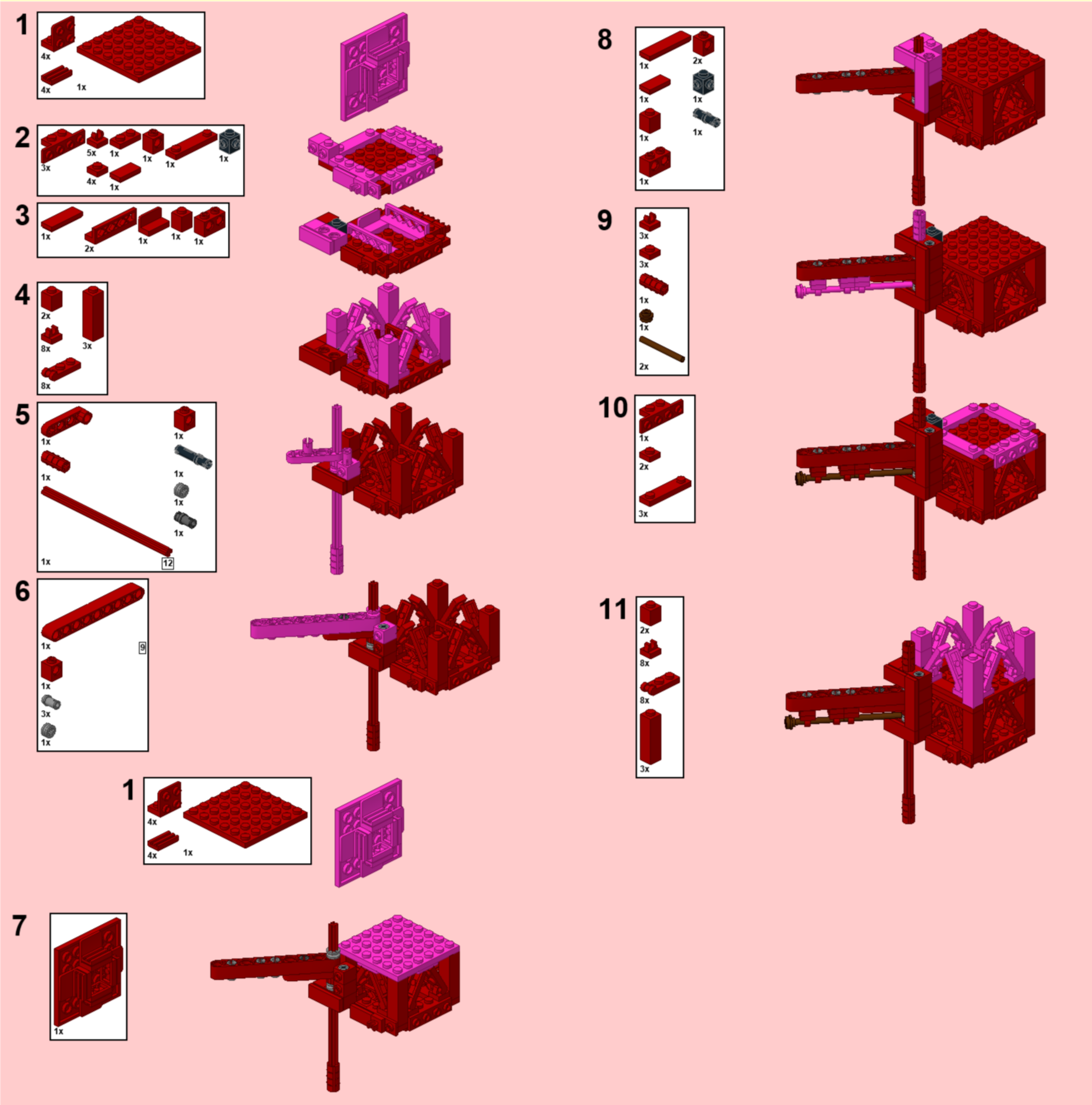

1
2
3
4
5
6
7
8
9
10
11
12
13
1
2
3
14

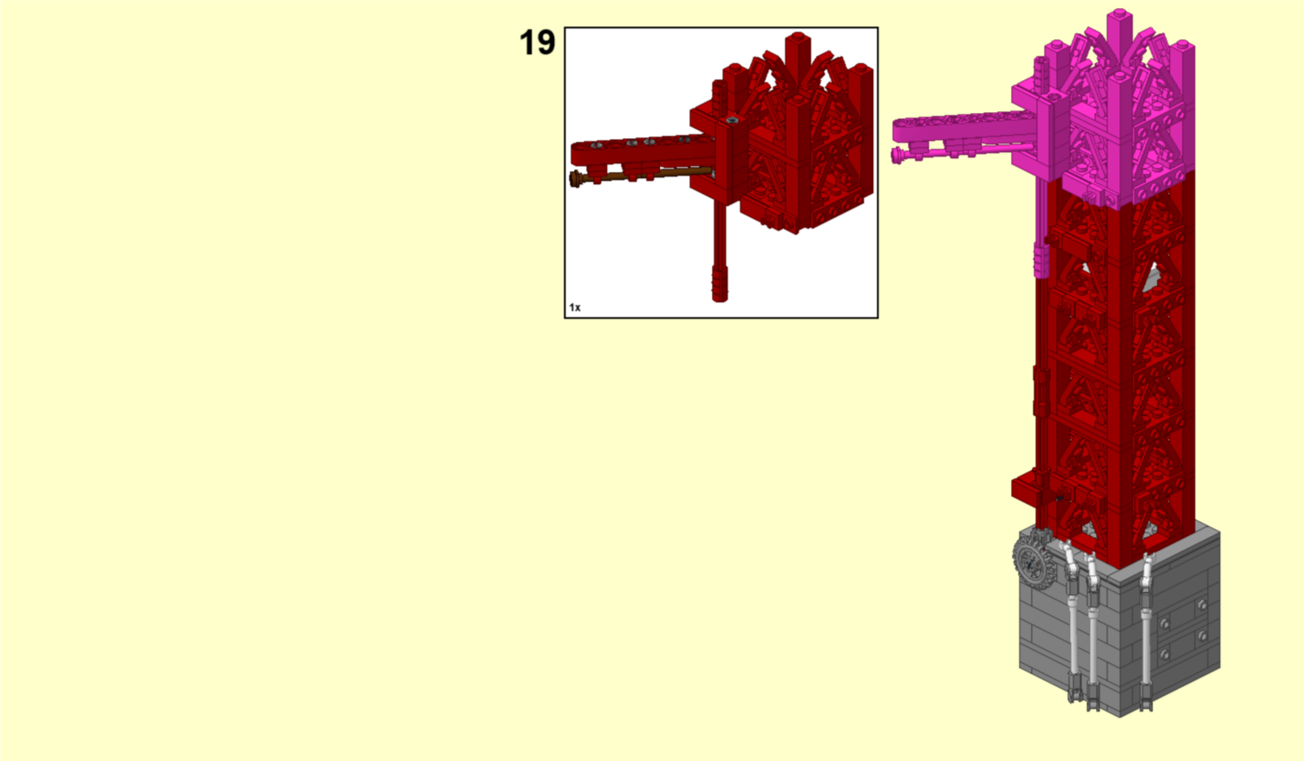

15
1x
1
4x
4x
1x
2
2x
1x
3x
3
2x
1x
4
8x
8x
4x

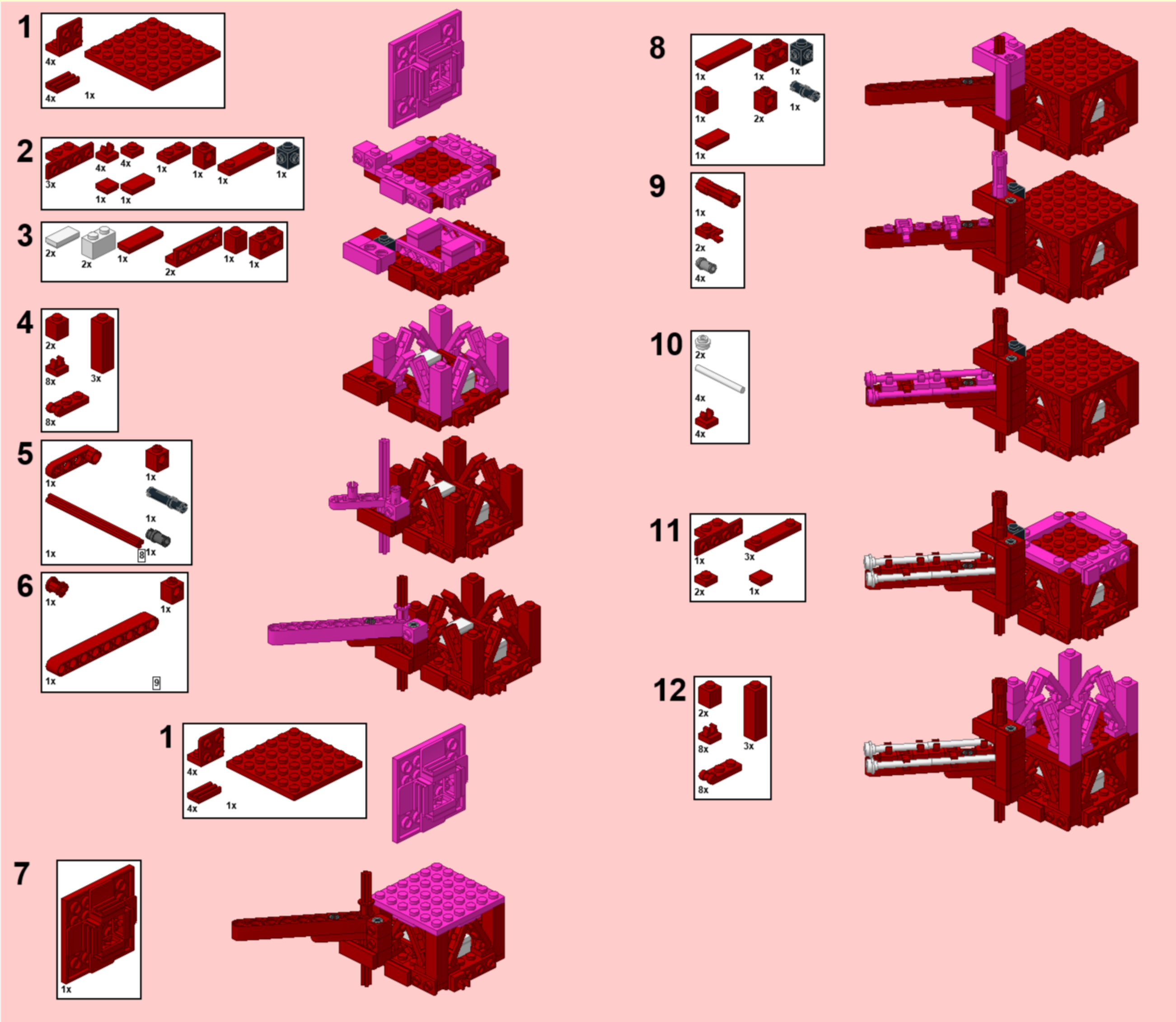

16
1x
1
4x
4x
1x
2
2x
1x
3x
3
8x
8x
4x


17
1x
1
4x
4x
1x
2
7x
2x
3x
1x
6x
3
2x
2x
1x
4
8x
8x
4x

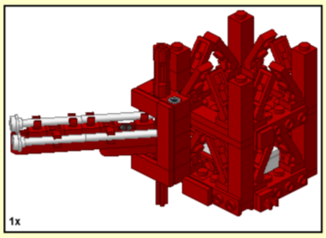

1
4x 4x 1x
2
2x 1x 1x 2x 4x
3
8x 8x 4x
18
1x

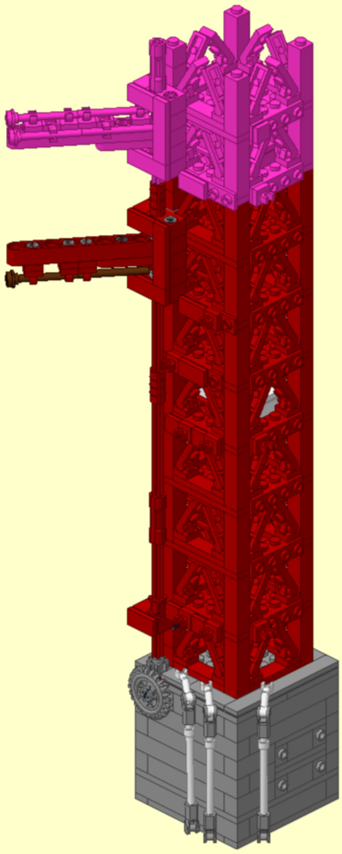

1
4x 4x 1x
2
3x 5x 1x 1x 1x 1x 4x 1x
3
1x 2x 1x 1x 1x
4
2x 8x 8x 3x
5
1x 1x 1x 1x 1x 1x 1x 12
6
1x 9 1x 3x 1x
1
4x 4x 1x
7
1x
8
1x 2x 1x 1x 1x 1x 1x
9
3x 3x 1x 1x 2x
10
1x 2x 3x
11
2x 8x 8x 3x


19
1x

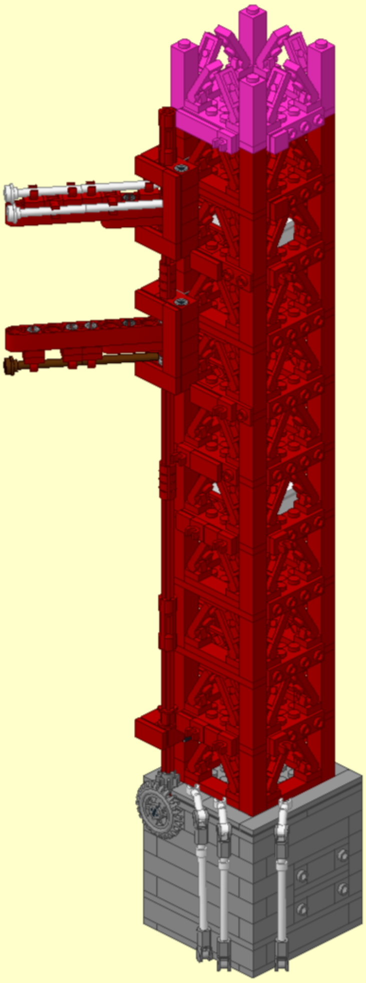

1
4x
4x
1x
2
3x
4x
4x
1x
1x
1x
1x
1x
1x
3
2x
2x
1x
2x
1x
1x
4
2x
8x
3x
8x
5
1x
1x
1x
1x
8
1x
6
1x
1x
1x
9
1
4x
4x
1x
7
1x
8
1x
1x
1x
1x
2x
1x
1x
9
1x
2x
4x
10
2x
4x
4x
11
1x
3x
2x
1x
12
2x
8x
3x
8x

20

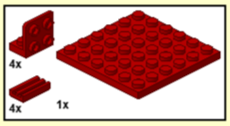




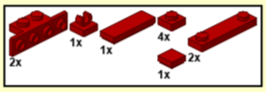
21



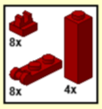
1

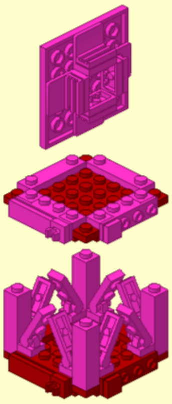


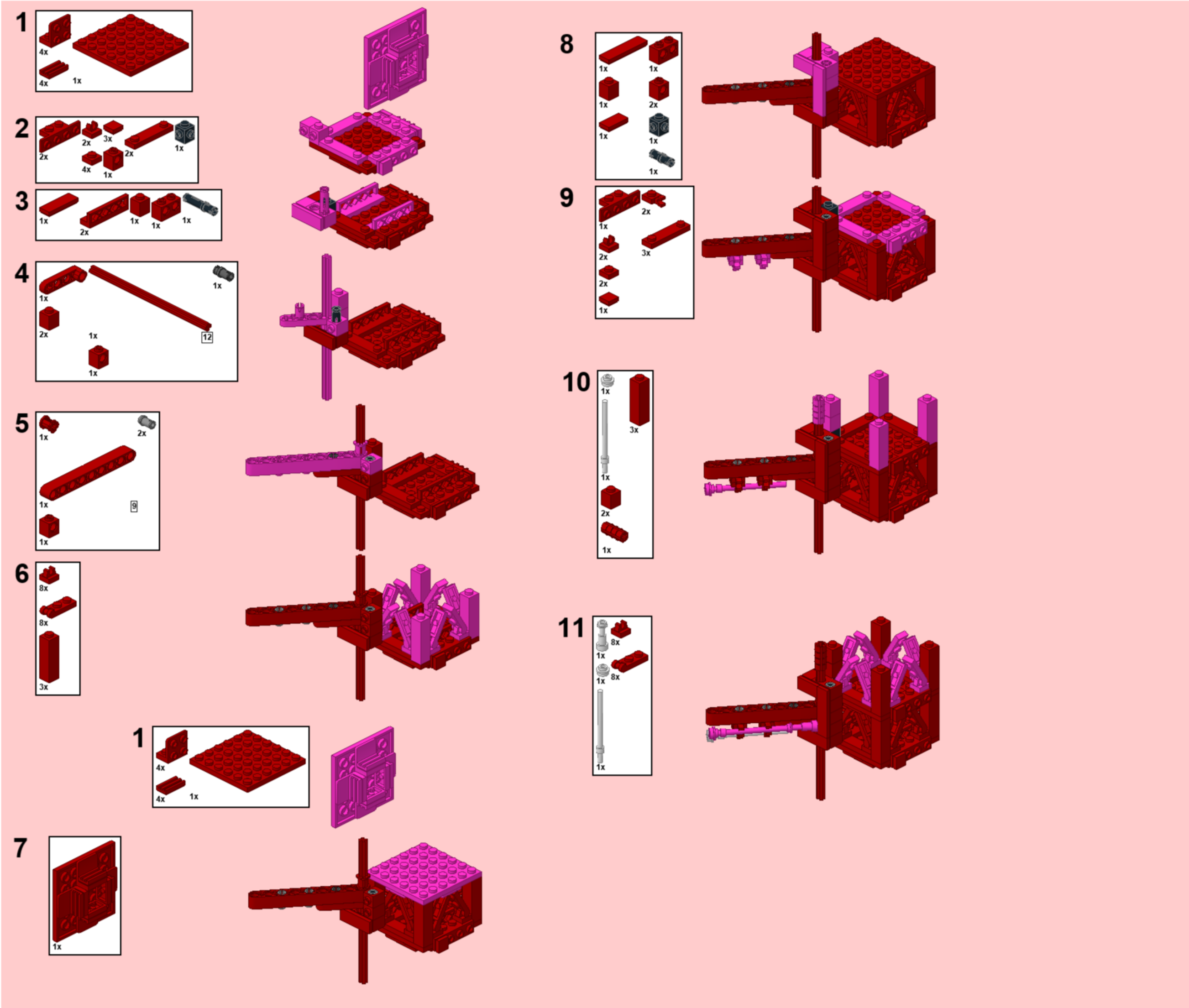
2



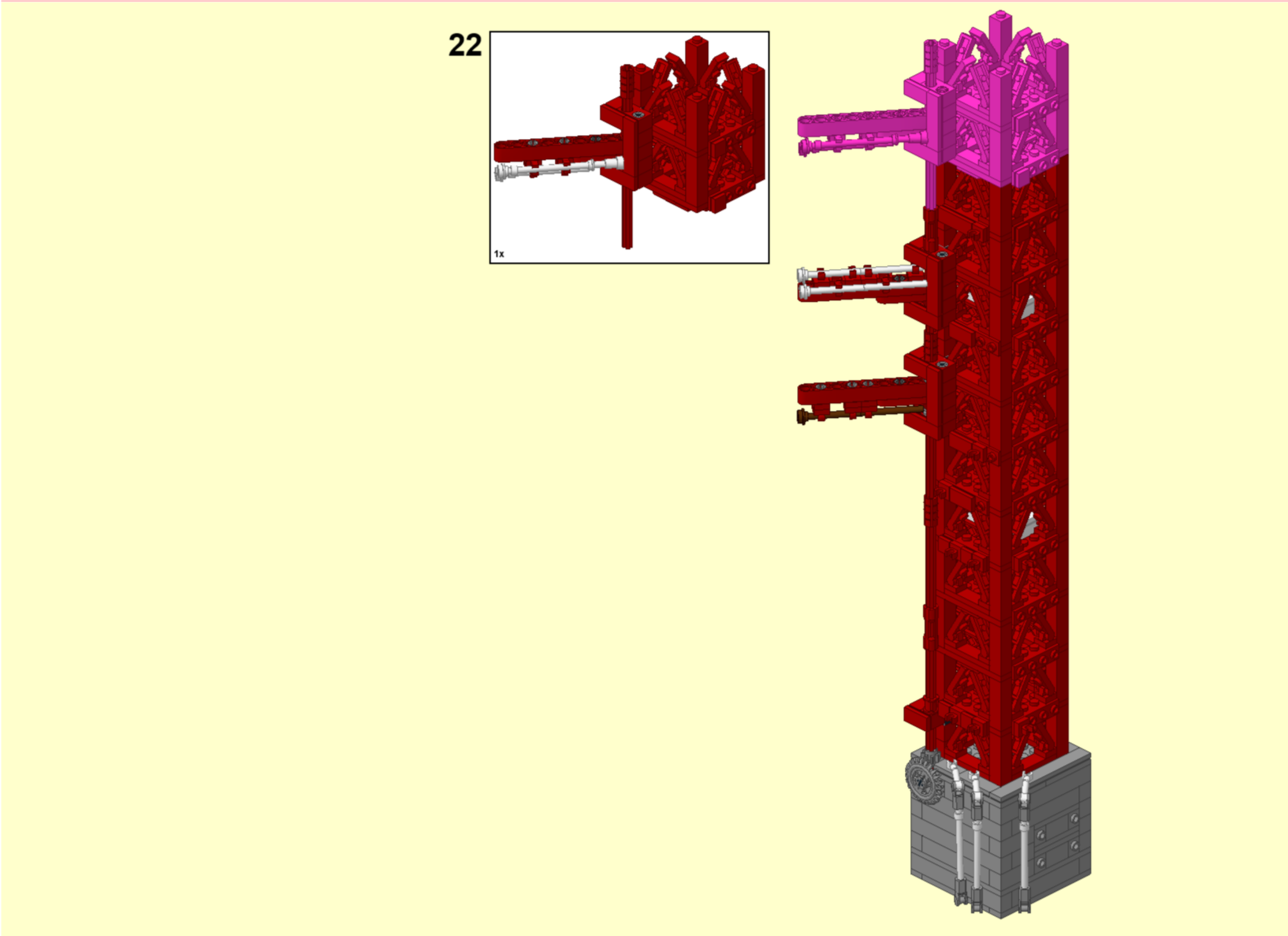
3



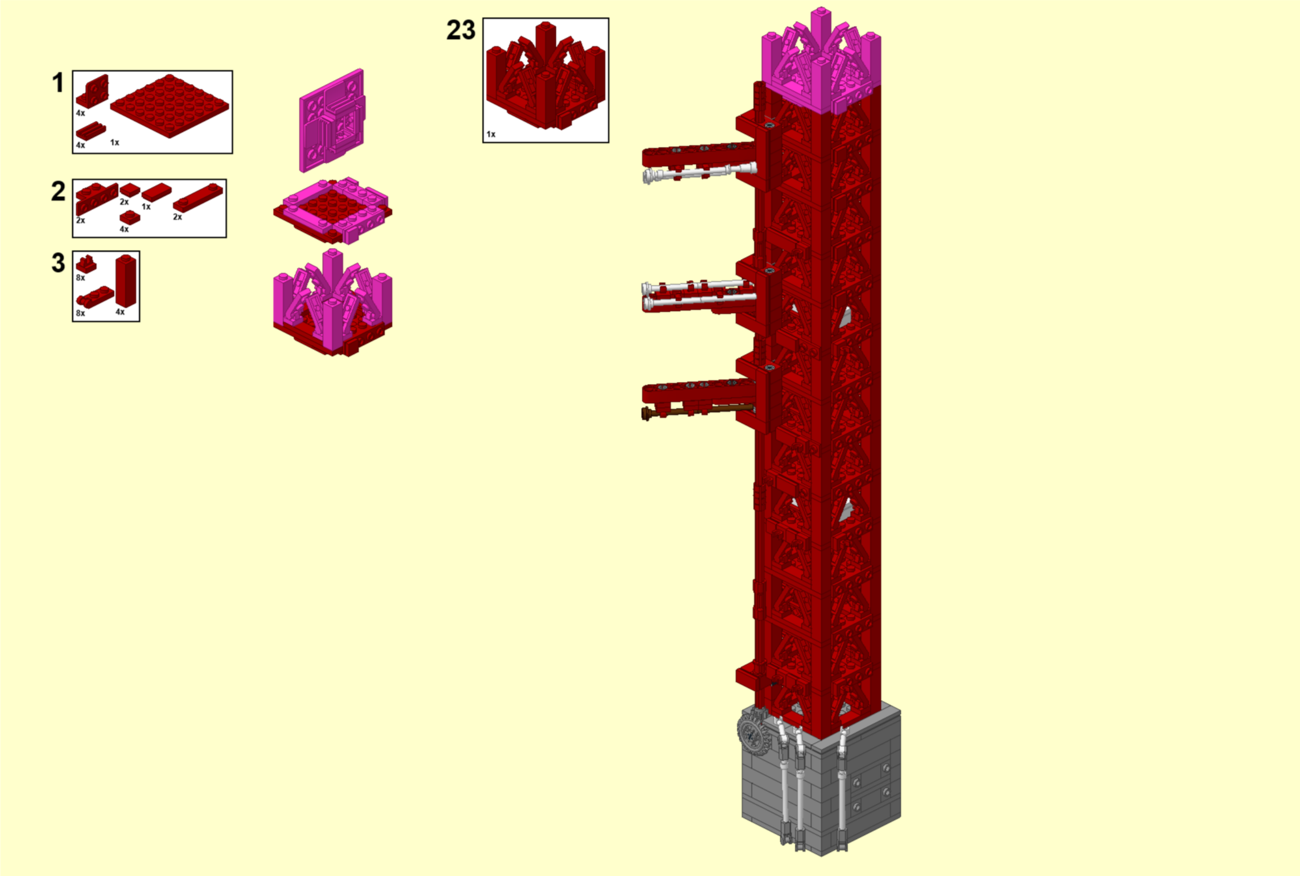


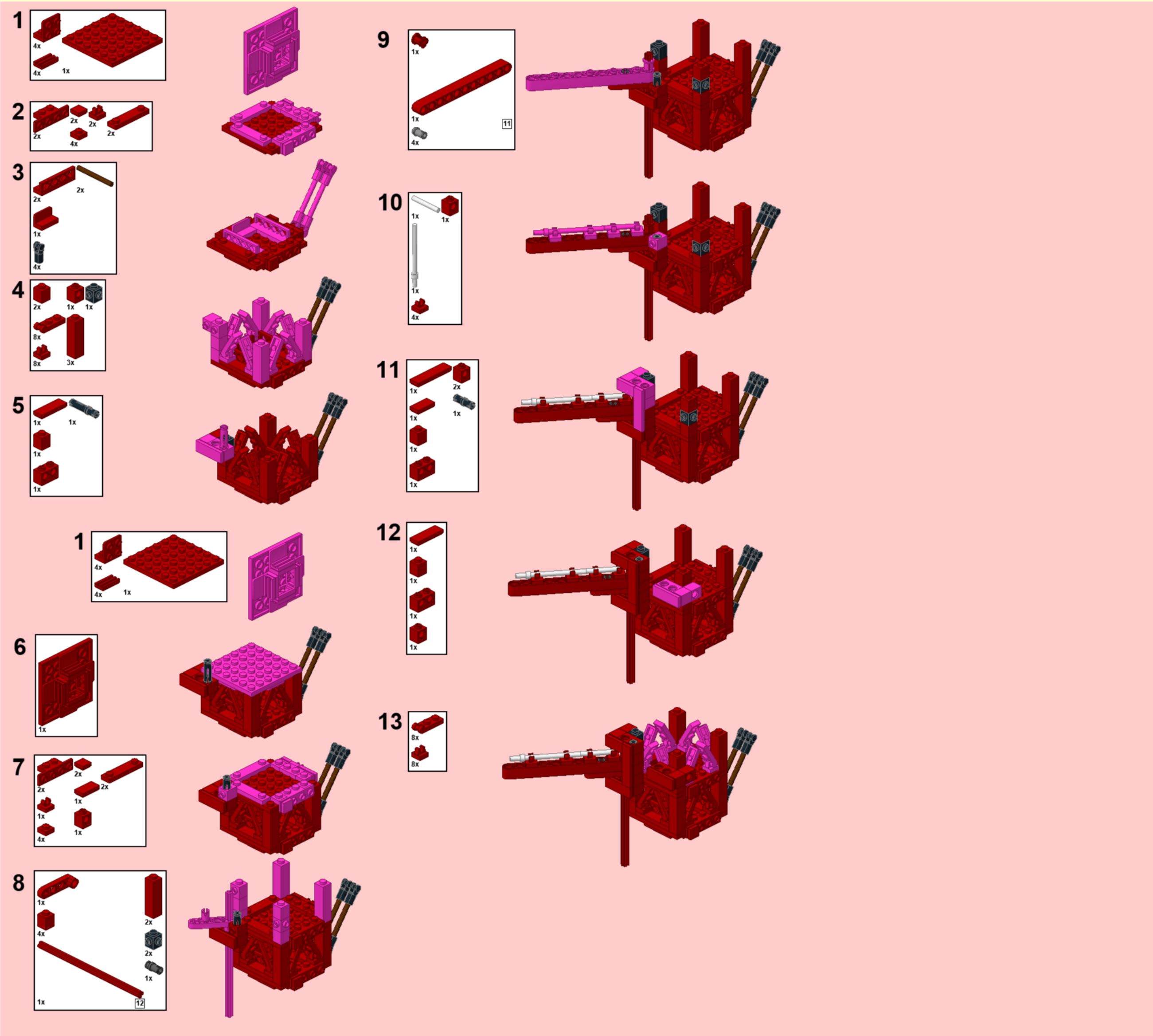


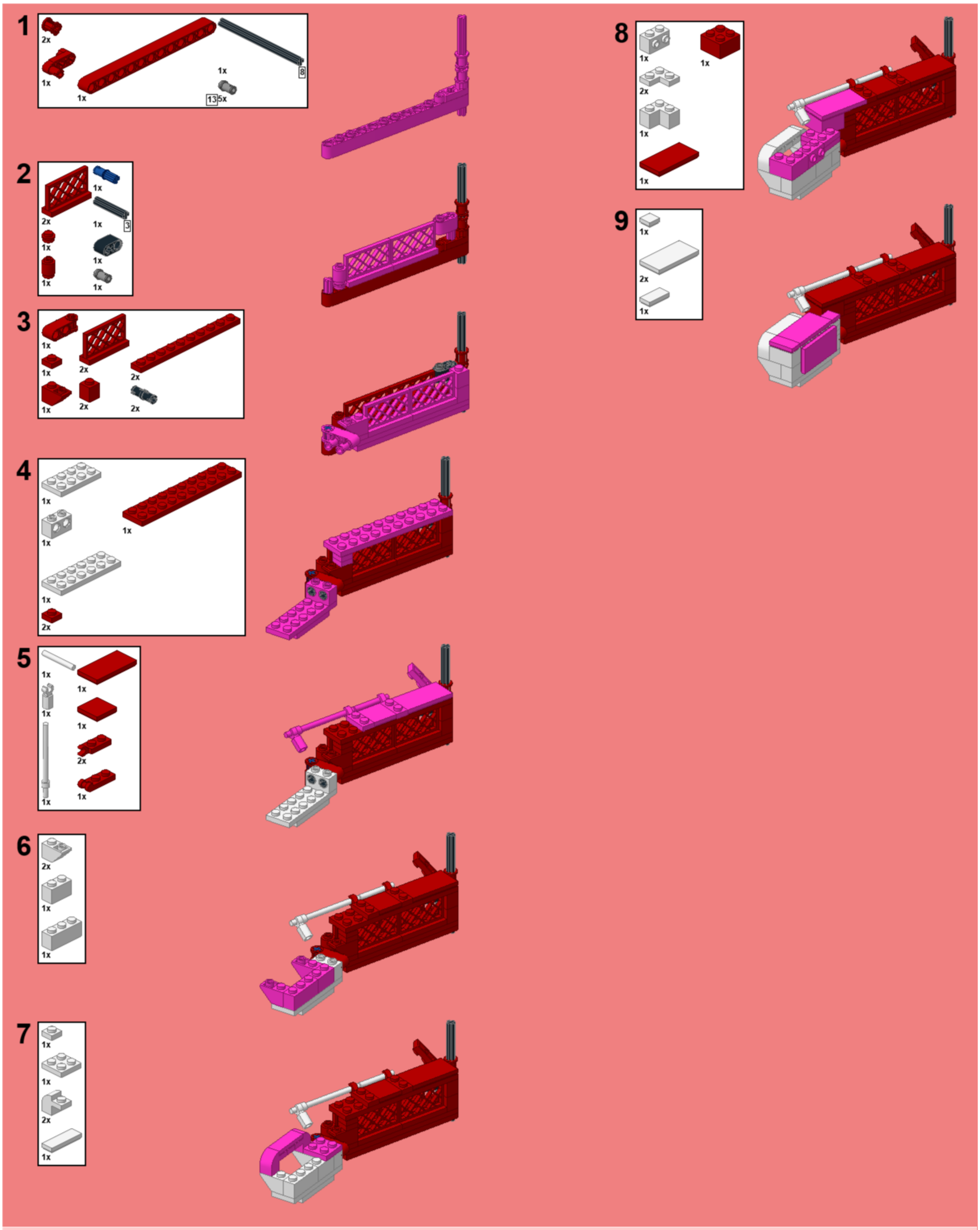
1
2
3
4
5
6
1
7
8
9
10
11

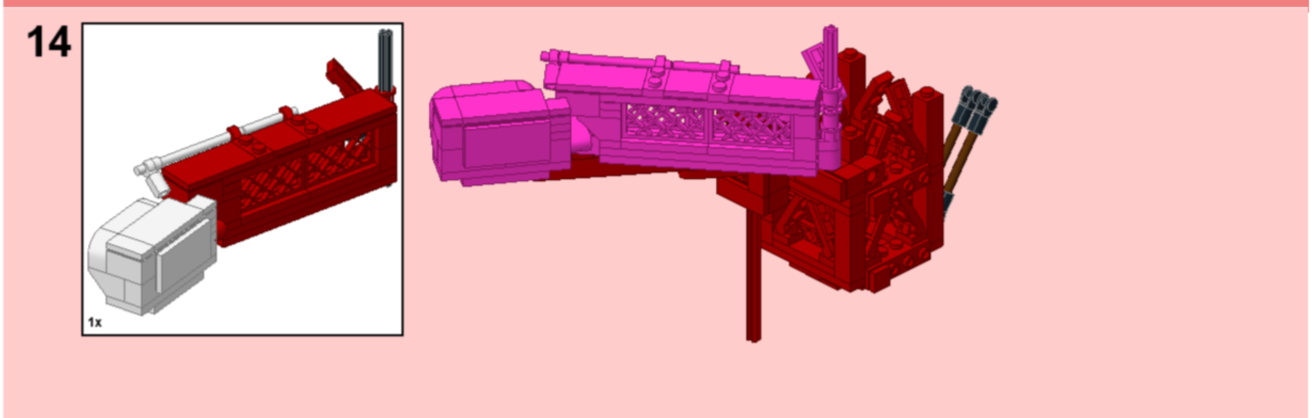


22
1x


1
2
3
23


1
2
3
4
5
1
6
7
8
9
10
11
12
13


1
2
3
4
5
6
7
8
9


14

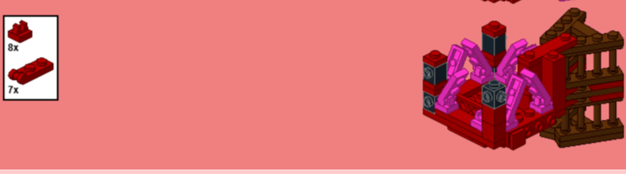
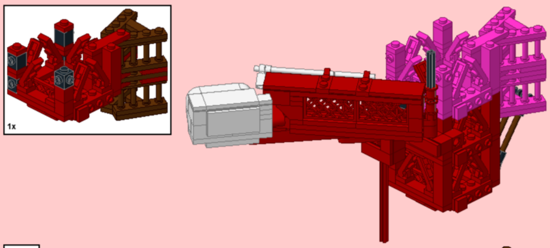
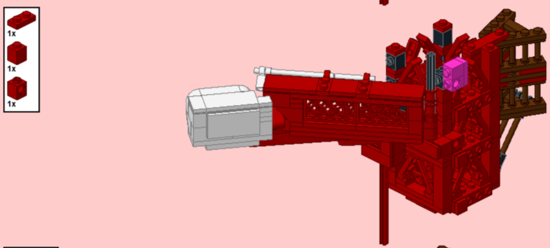
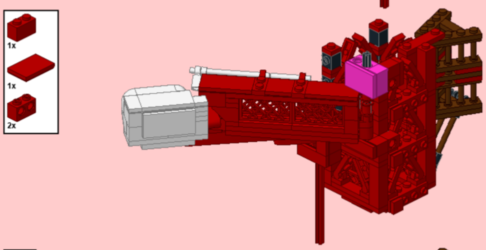
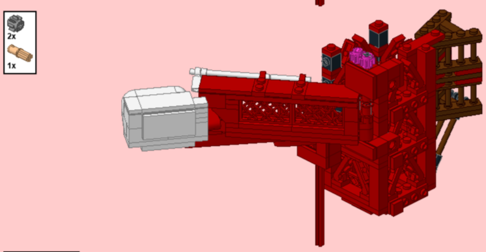
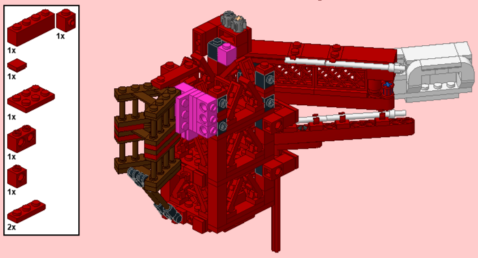
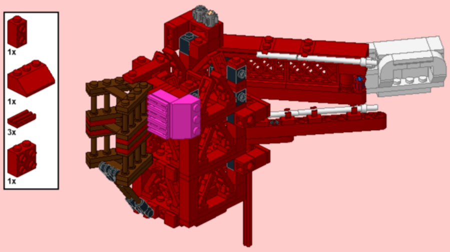
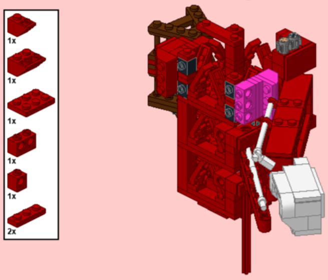
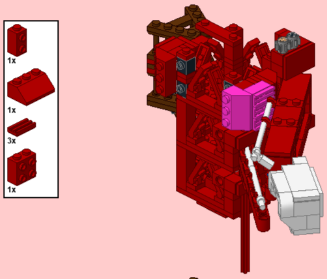
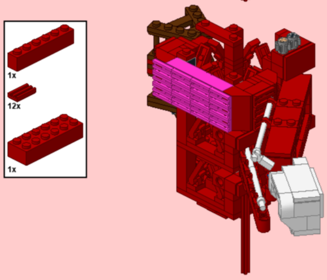
1

2

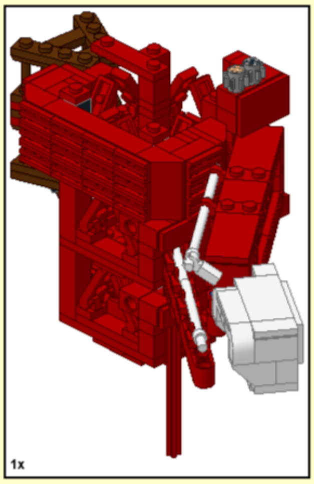
3

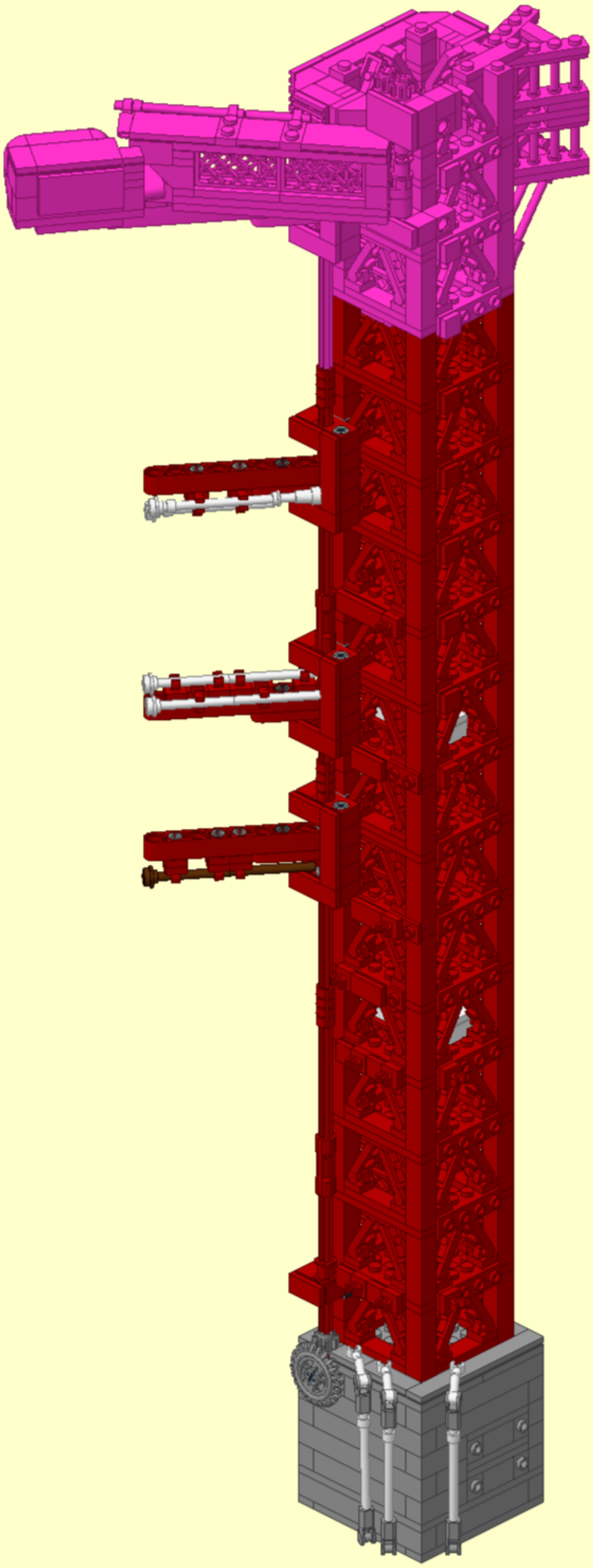
4

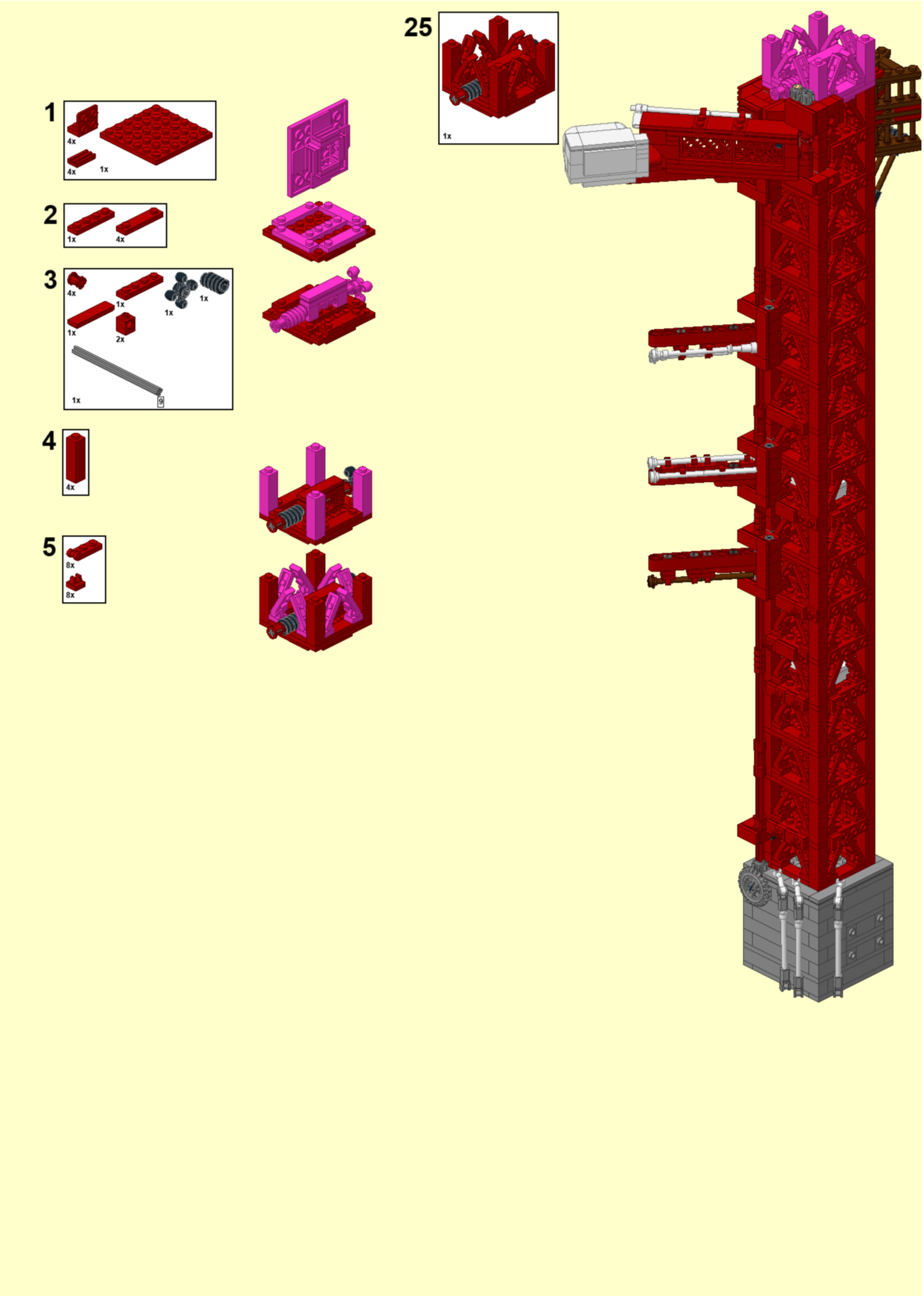
5

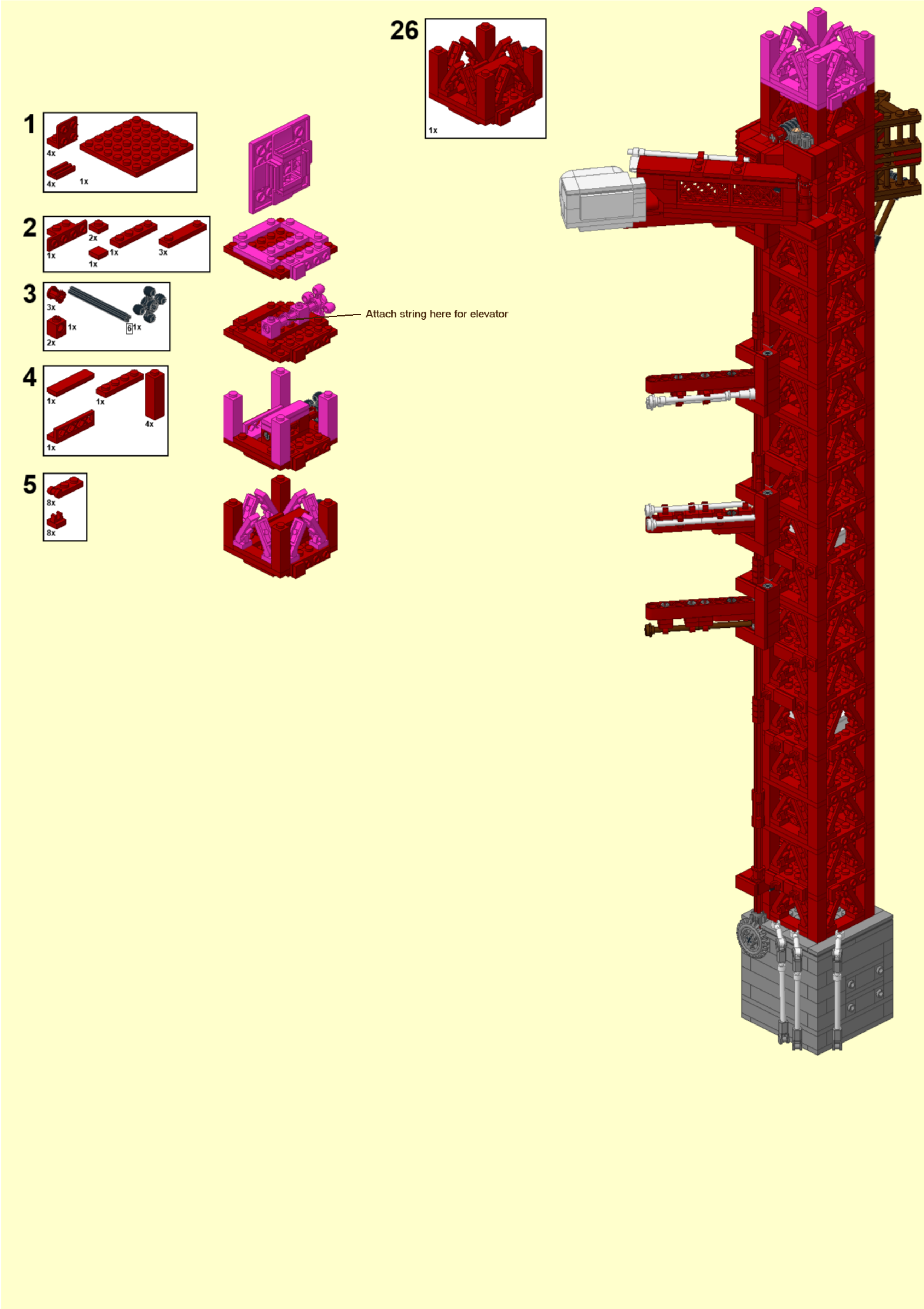
6

15

16

17

18

19

20

21

22

23


24

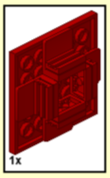




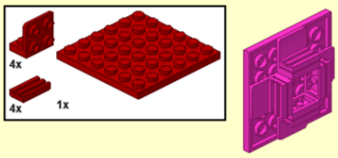

25
1x
1
4x
4x
1x
2
1x
4x
3
4x
1x
1x
1x
1x
2x
1x
9
4
4x
5
8x
8x

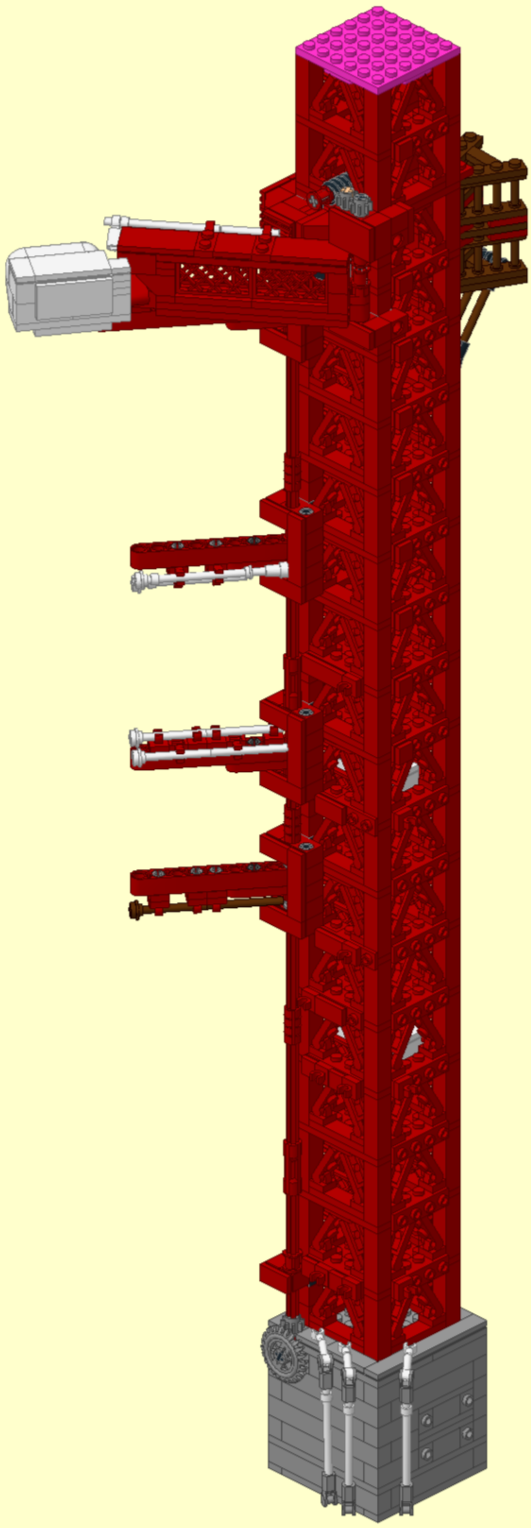

26
1x
1
4x
4x
1x
2
2x
1x
1x
1x
3x
3
3x
1x
6
1x
2x
Attach string here for elevator
4
1x
1x
4x
1x
5
8x
8x

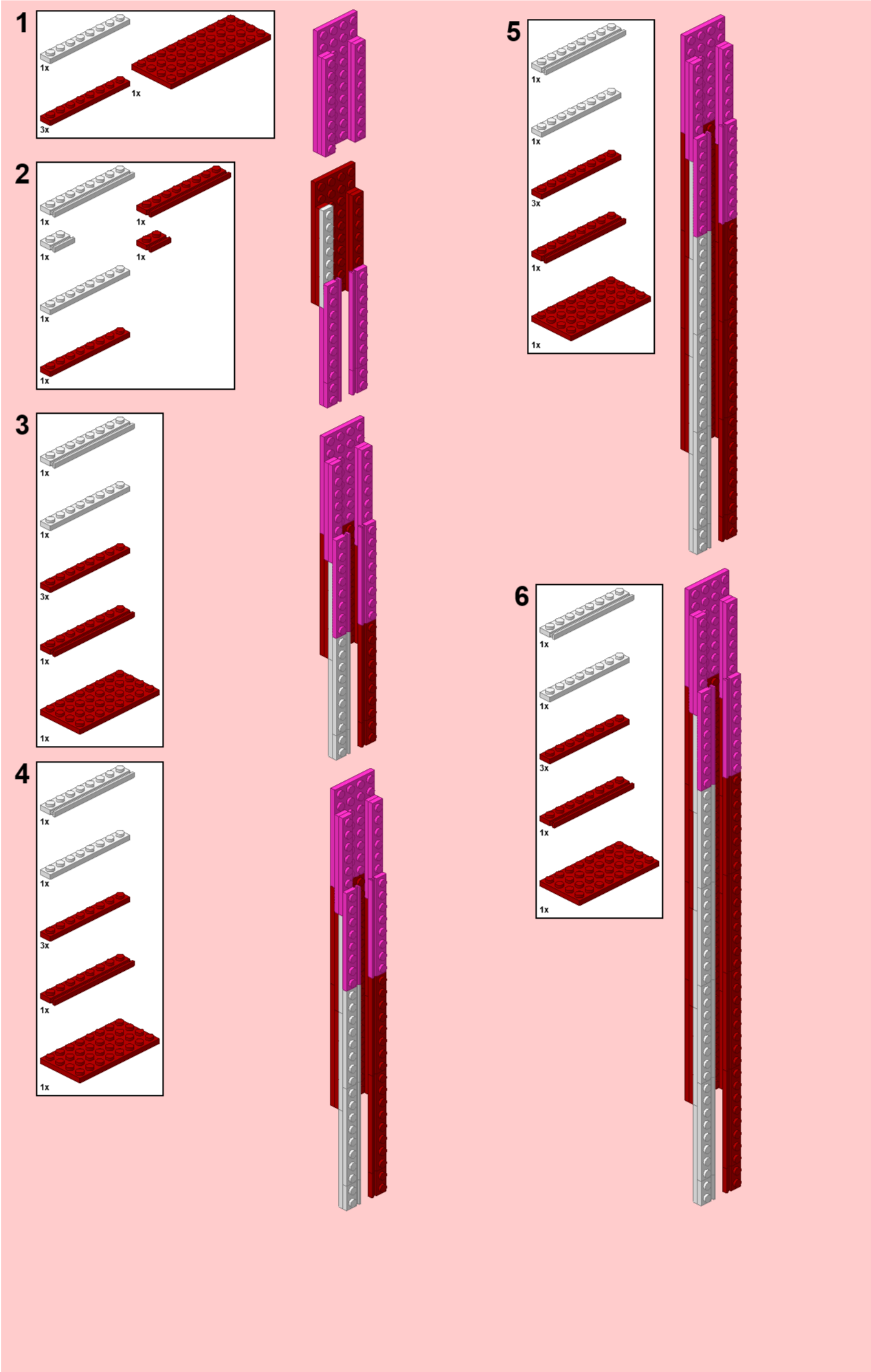
27



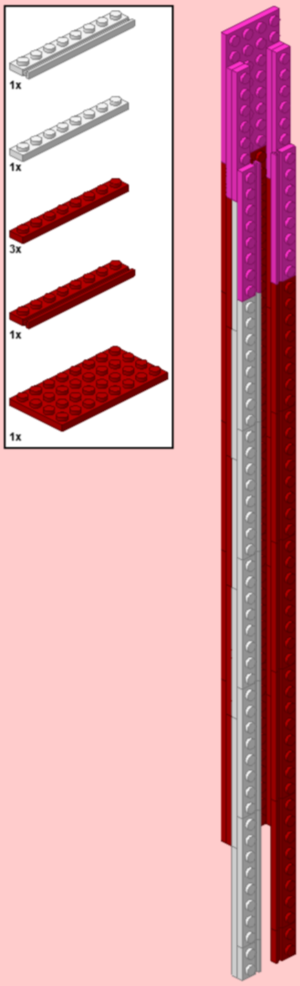
1



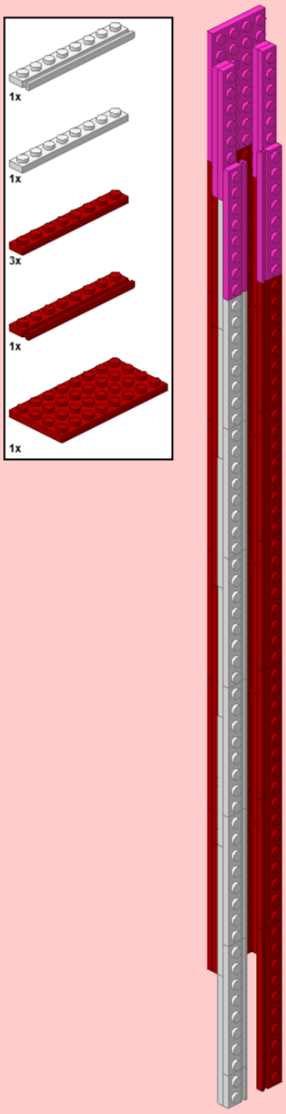



1
1x
1x
3x
2
1x
1x
1x
1x
1x
1x
3
1x
1x
3x
1x
1x
4
1x
1x
3x
1x
1x
5
1x
1x
3x
1x
1x
6
1x
1x
3x
1x
1x

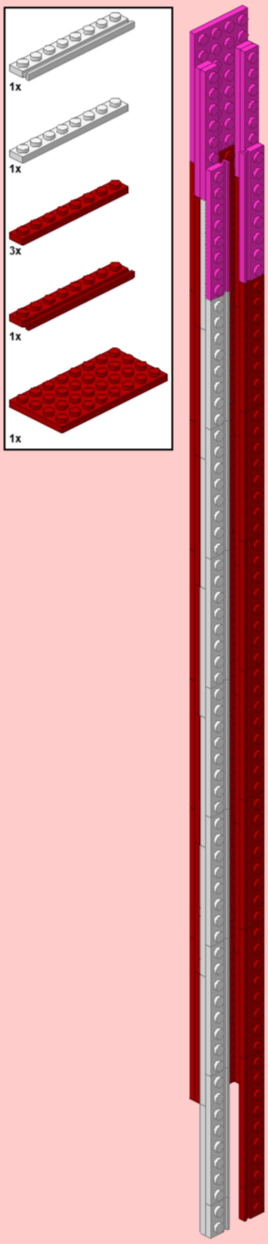
7



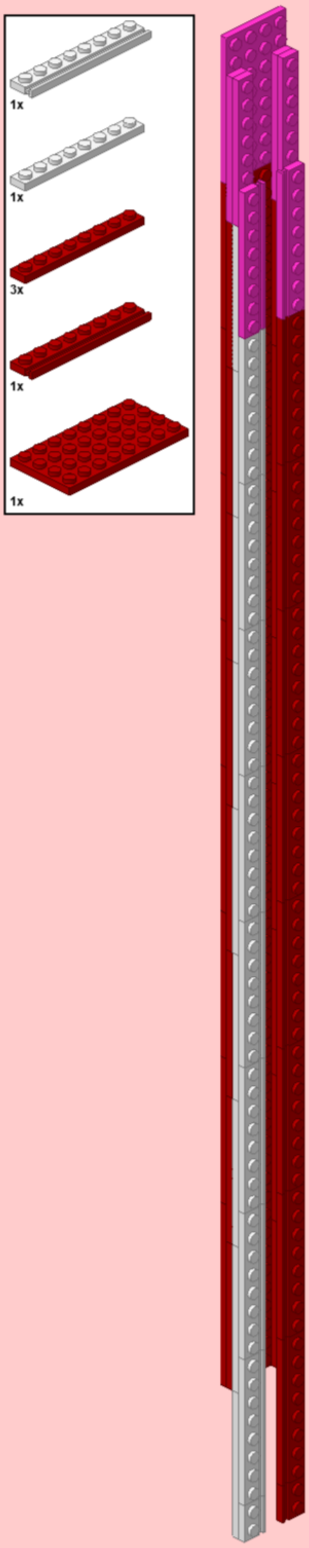
8



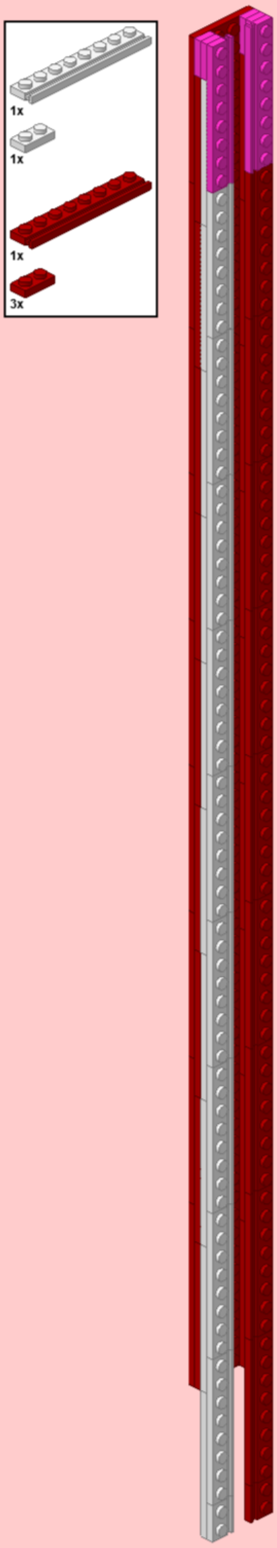
9



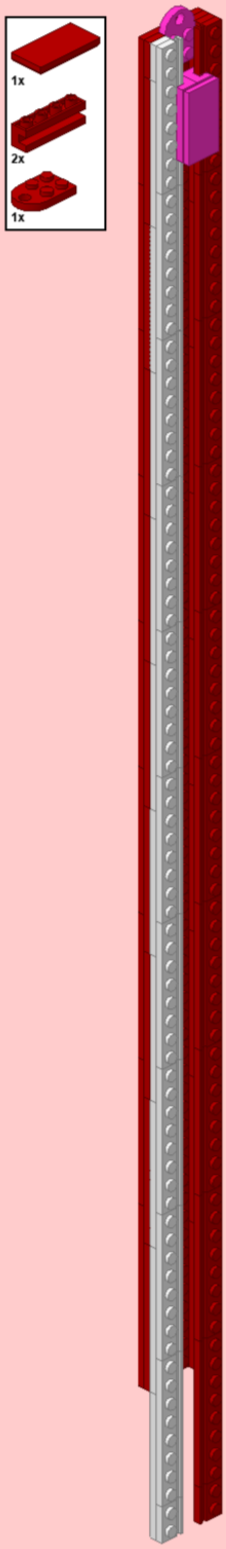
10



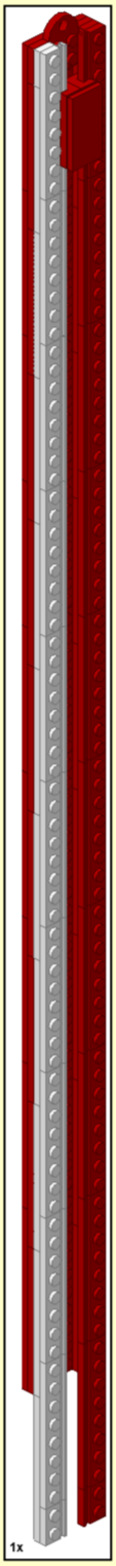
11

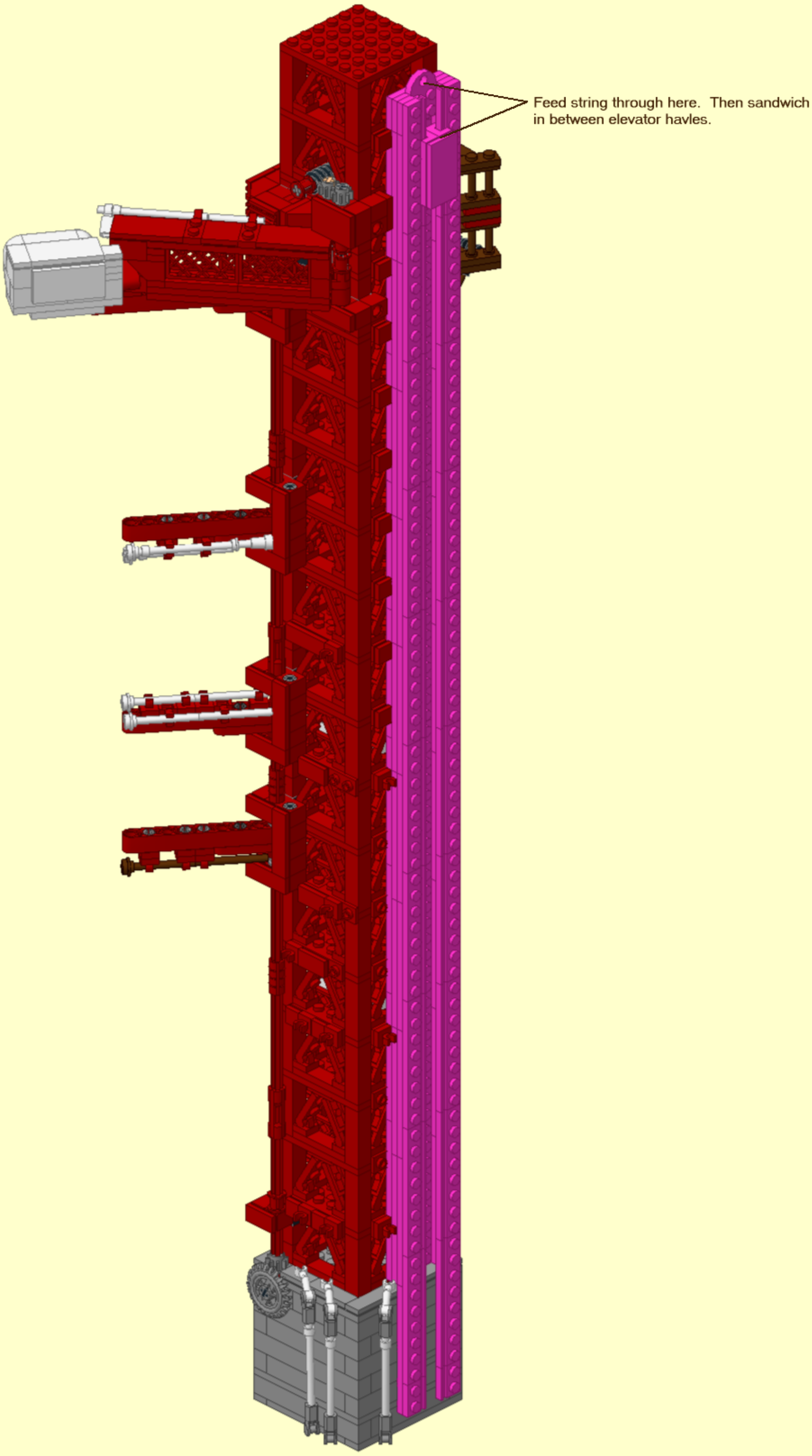


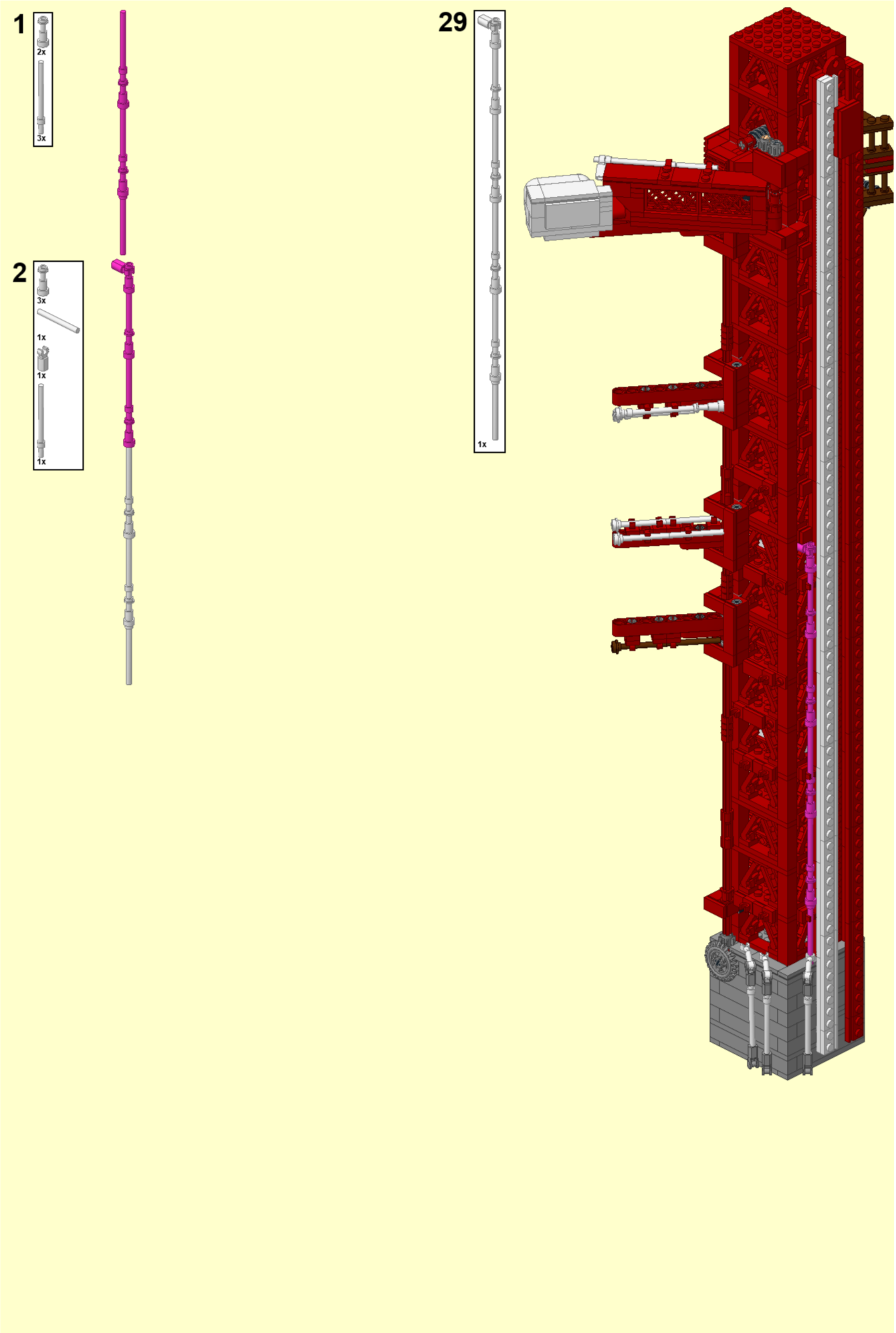
12



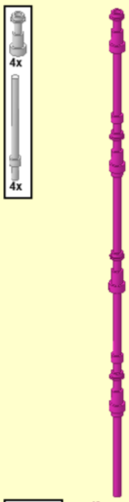
28


1x


Feed string through here. Then sandwich in between elevator havles.

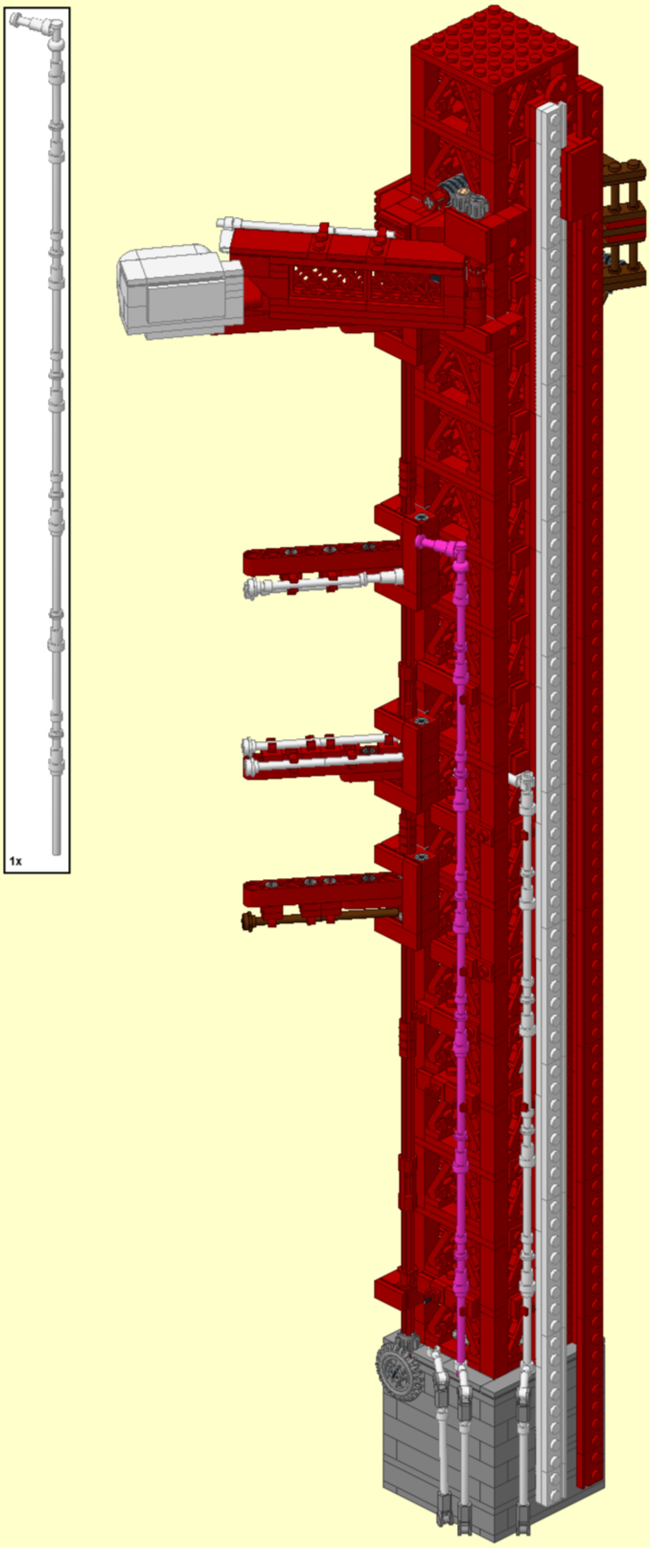

29
1x
1
2x
3x
2
3x
1x
1x
1x

1

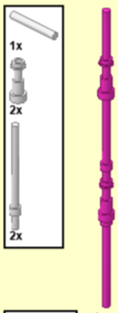


2

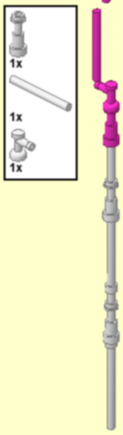
30



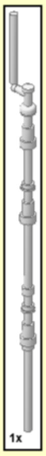
1

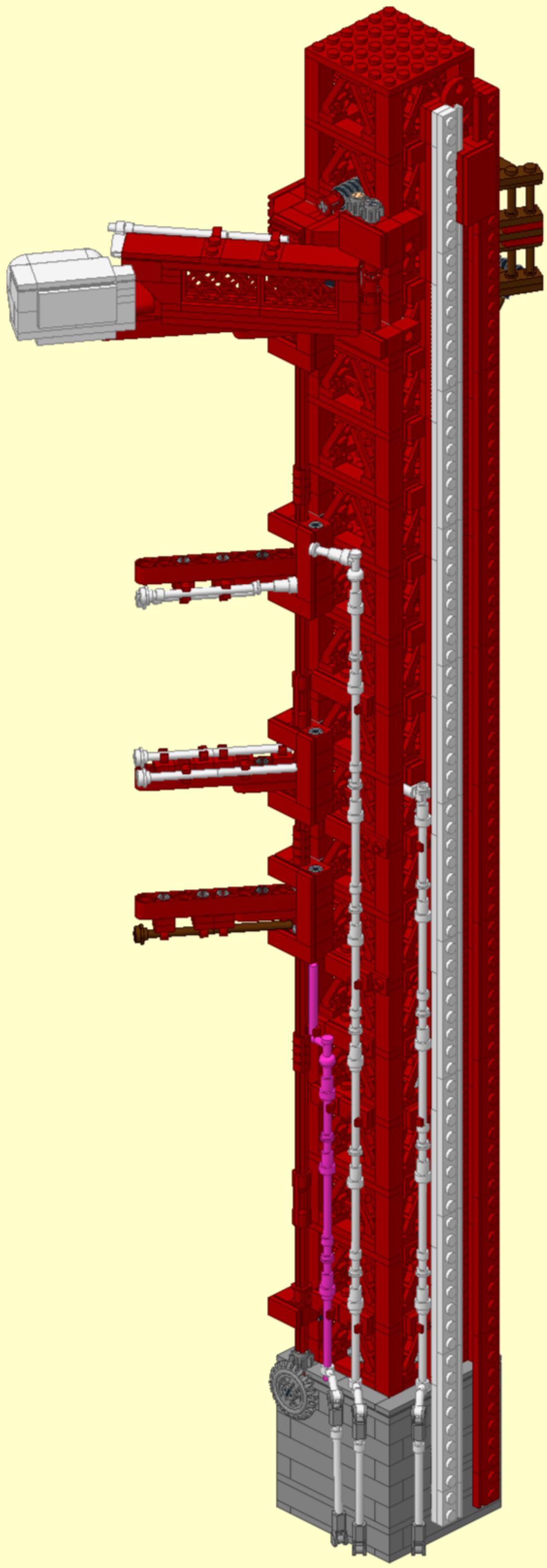


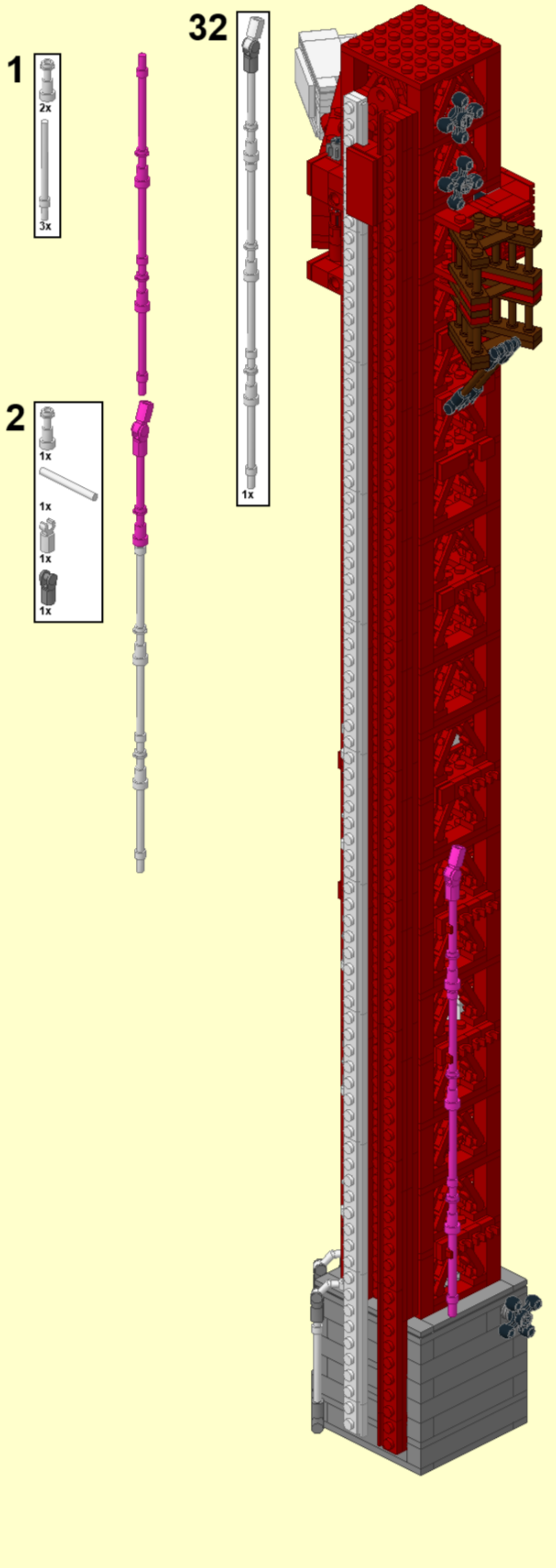
2

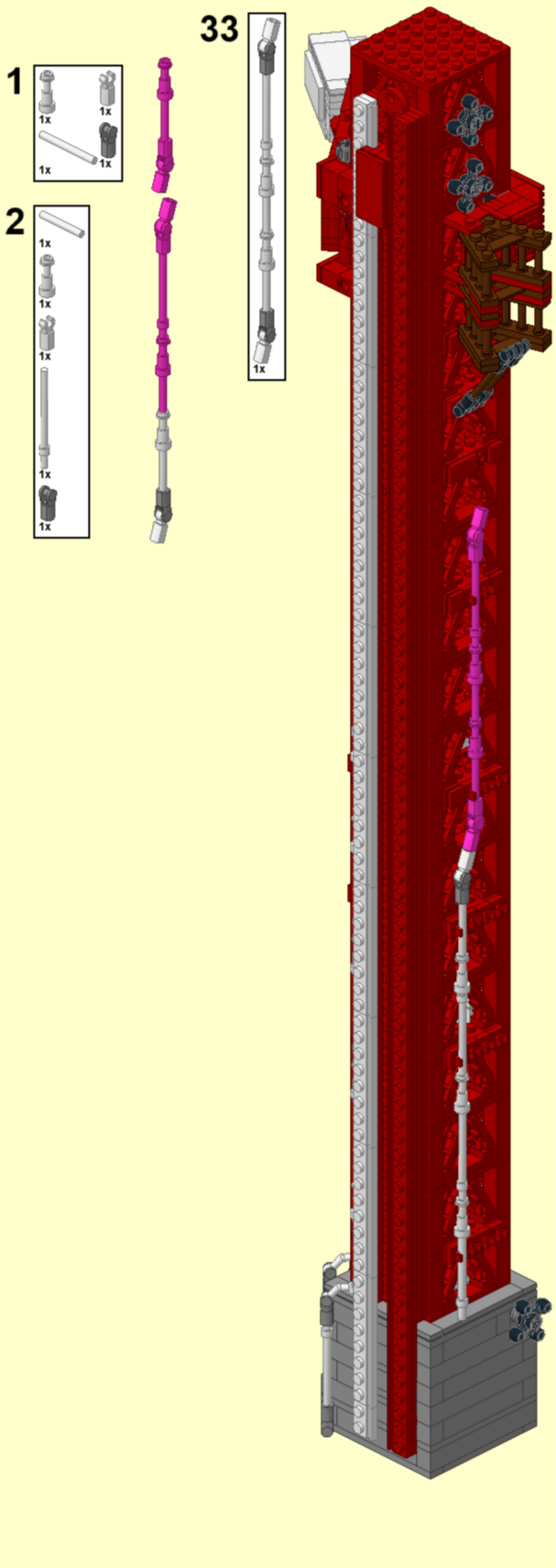


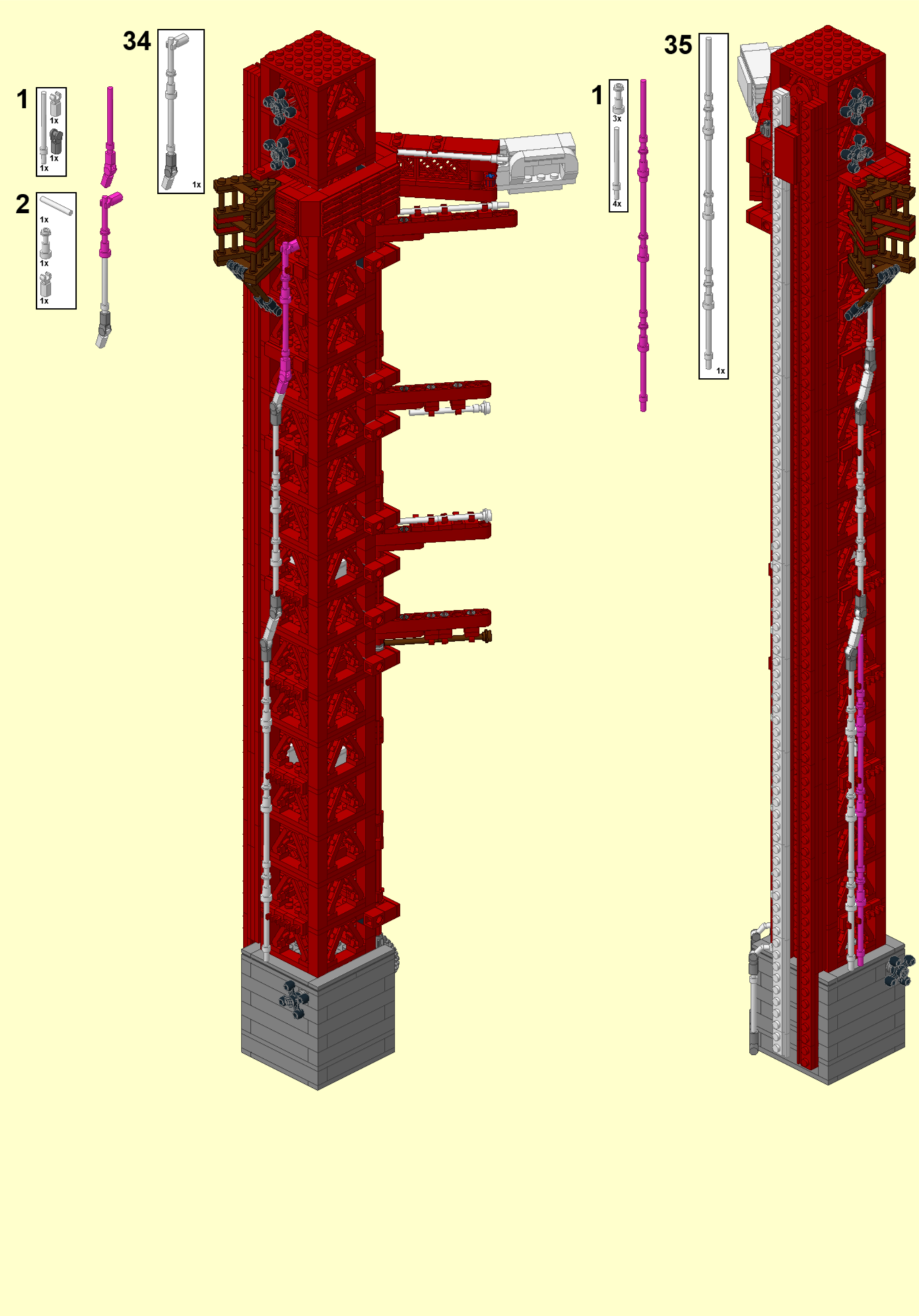
31

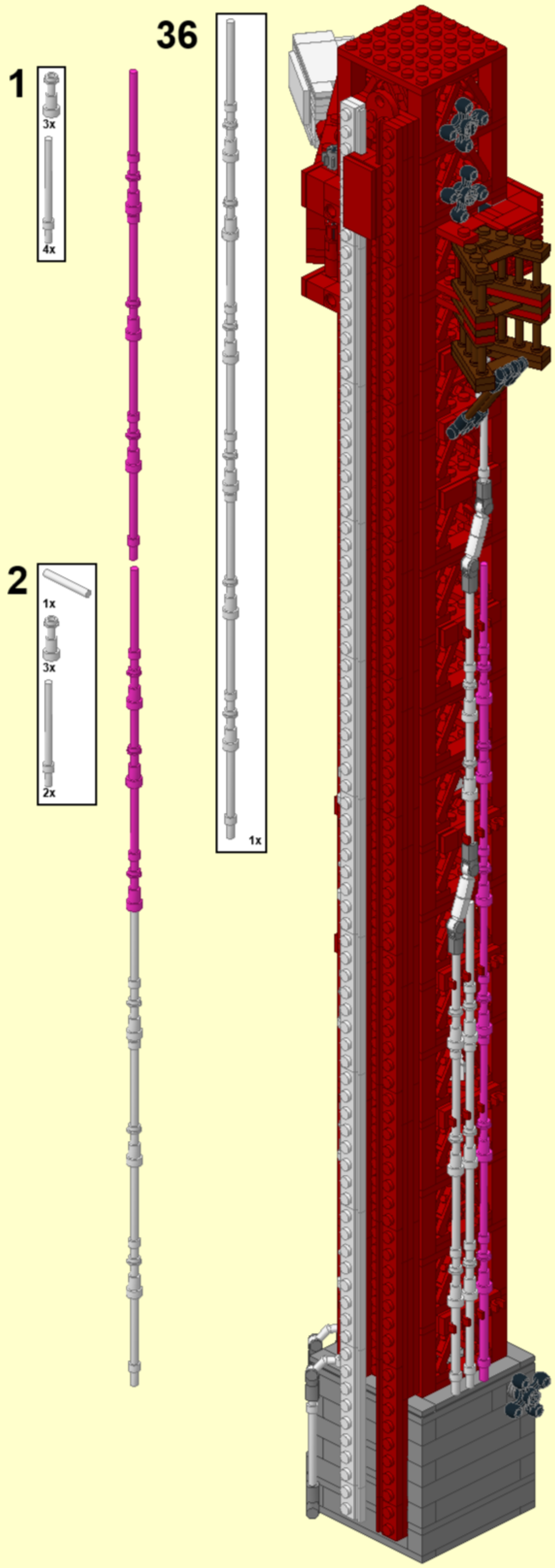


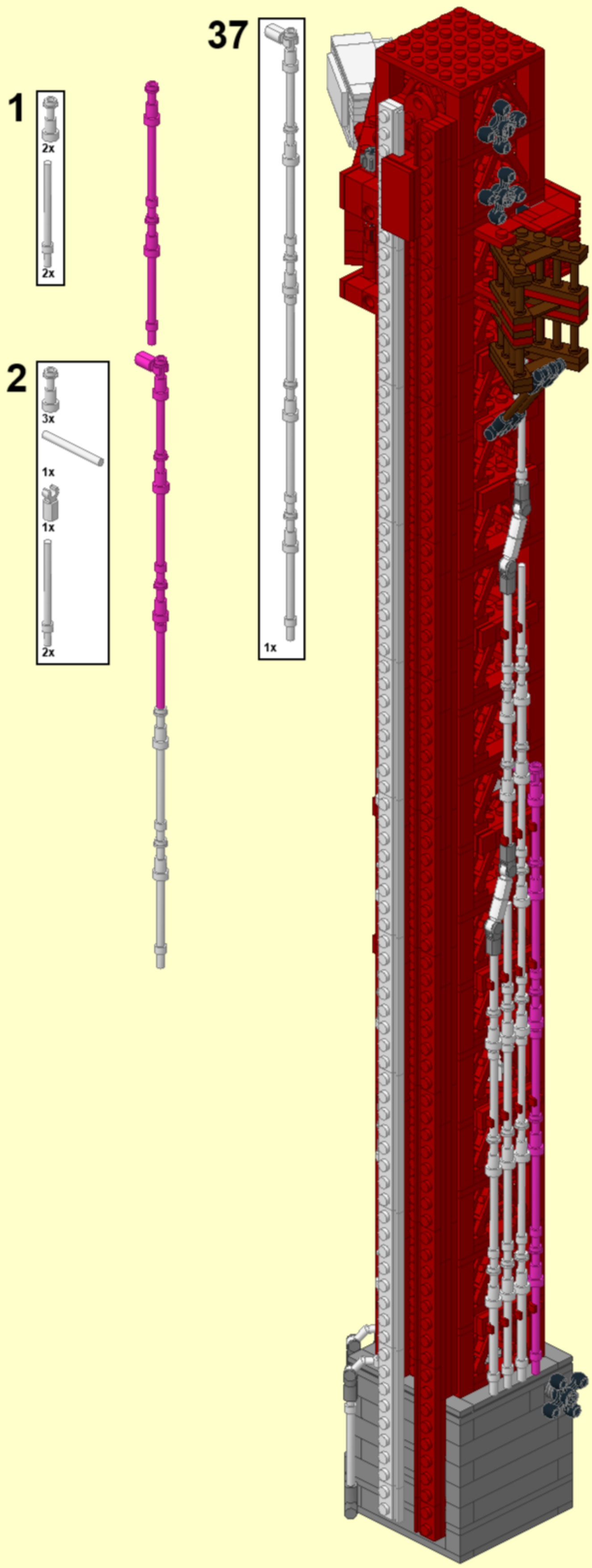



32
1
2x
3x
2
1x
1x
1x
1x
1x


33
1x
1
1x
1x
1x
1x
2
1x
1x
1x
1x
1x


34
1
1x
1x
1x
2
1x
1x
1x
1x
35
1
3x
4x
1x

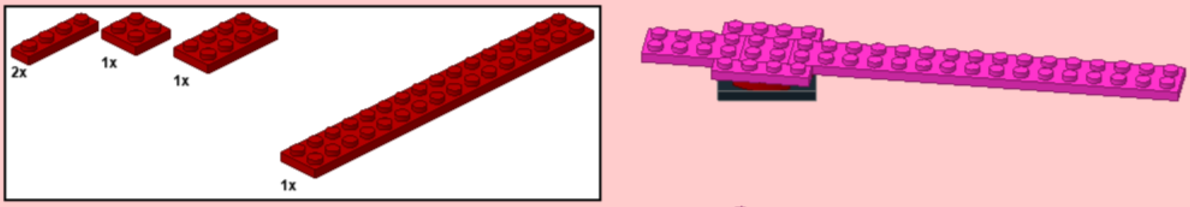

36
1
3x
4x
2
1x
3x
2x
1x


37
1
2x
2x
2
3x
1x
1x
2x
1x

1


1x
1x

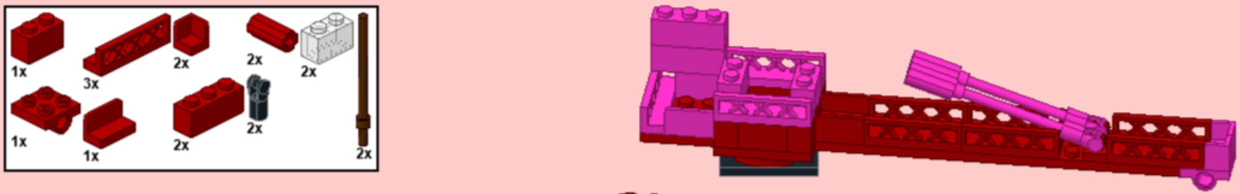
2


2x
1x
1x
1x

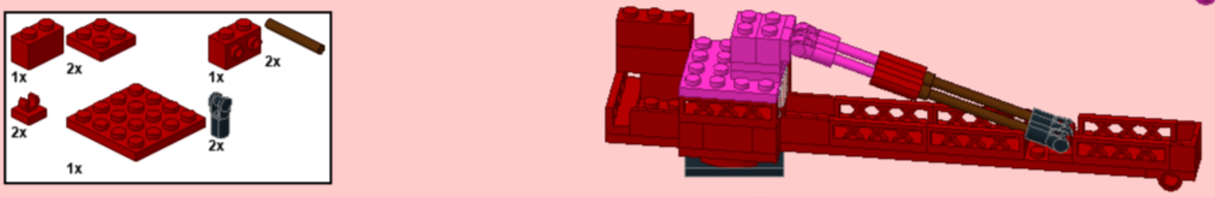
3


2x
2x
2x
6x
2x
2x

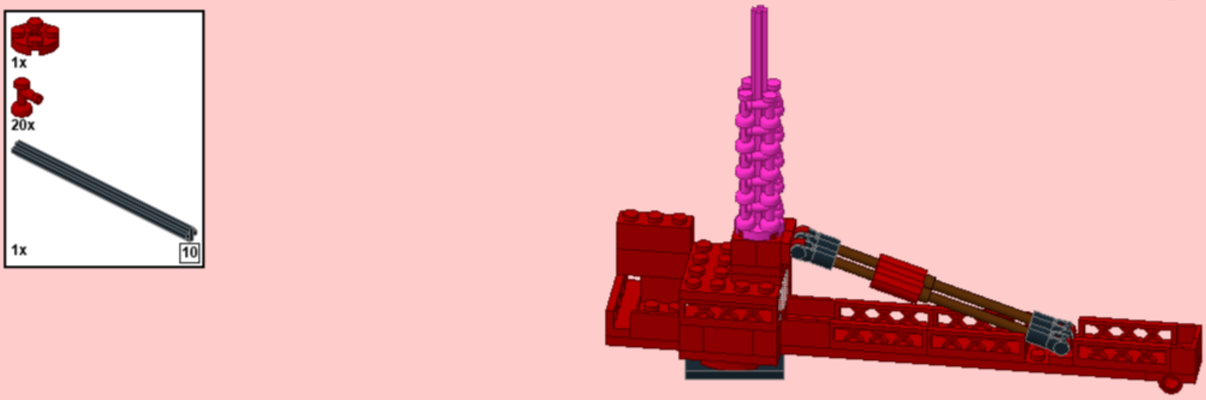
4


1x
3x
2x
2x
2x
1x
1x
2x
2x
2x

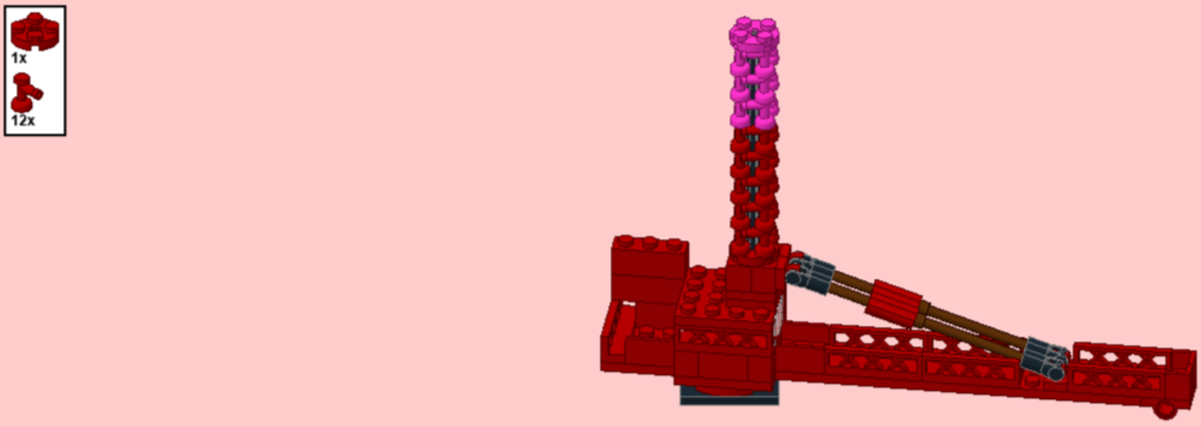
5


1x
2x
1x
2x
2x
1x
2x

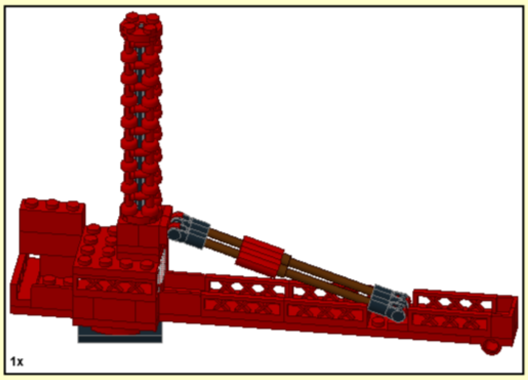
6

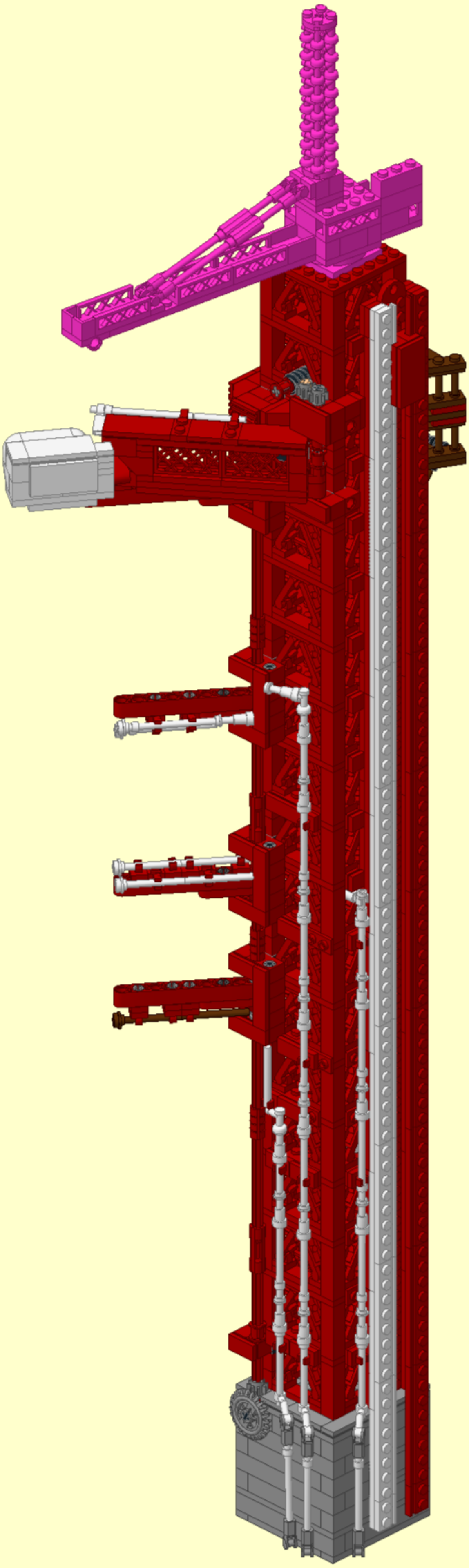

1x
20x
1x
10

7

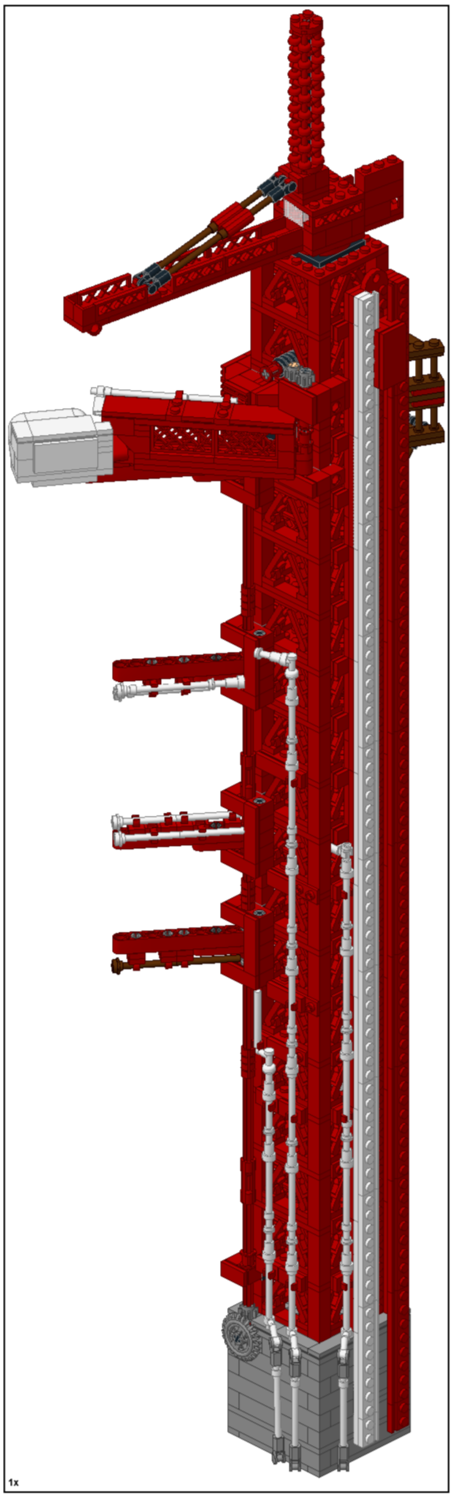

1x
12x

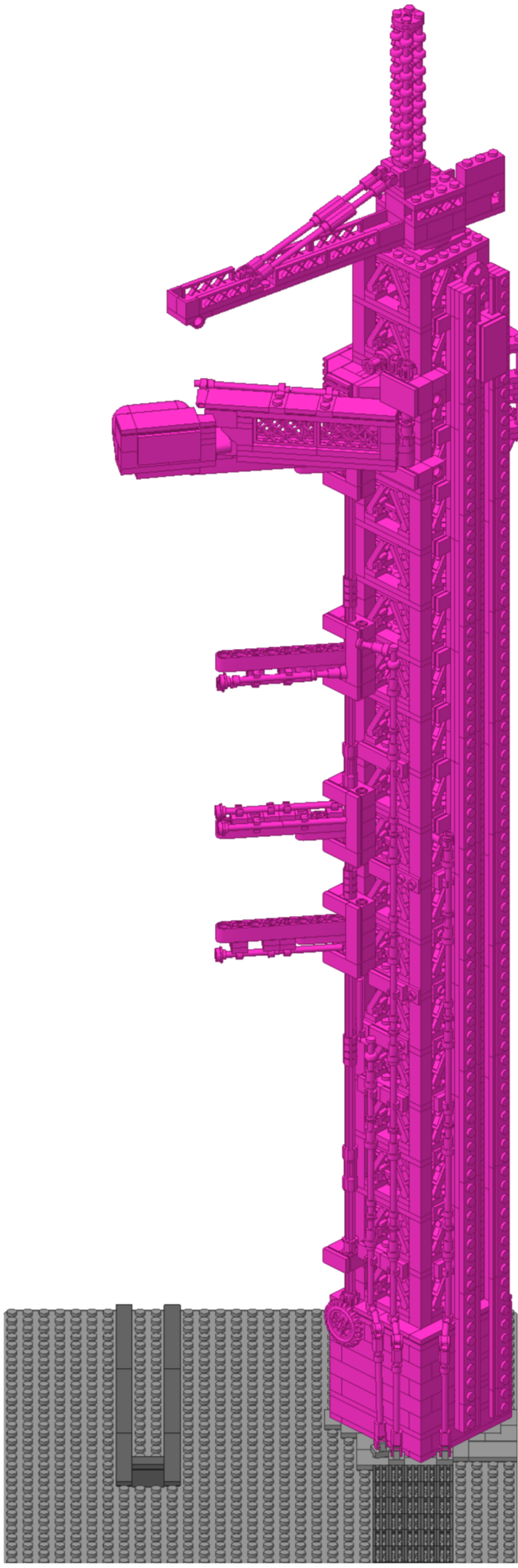
38



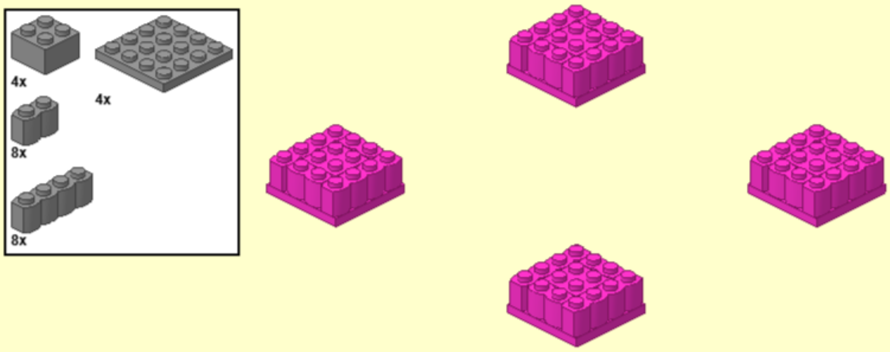


2

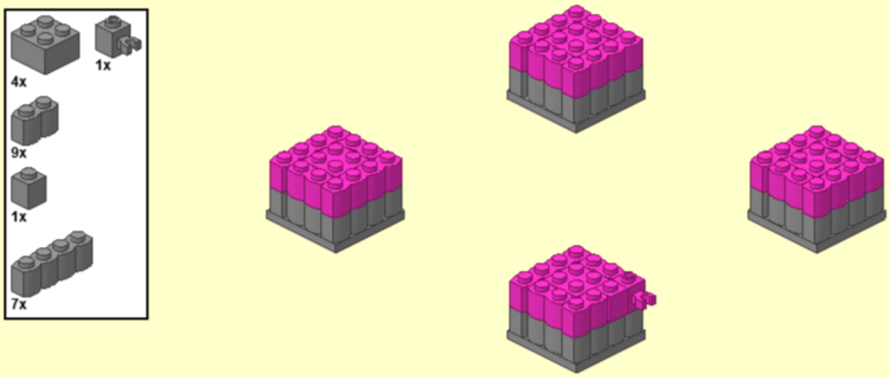




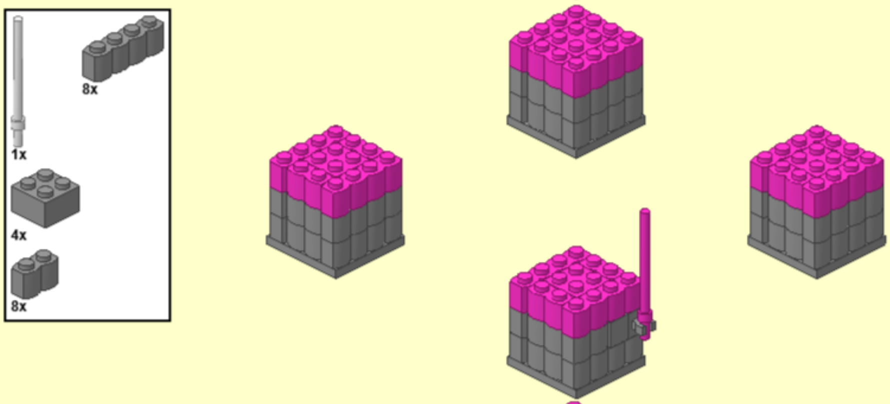
1



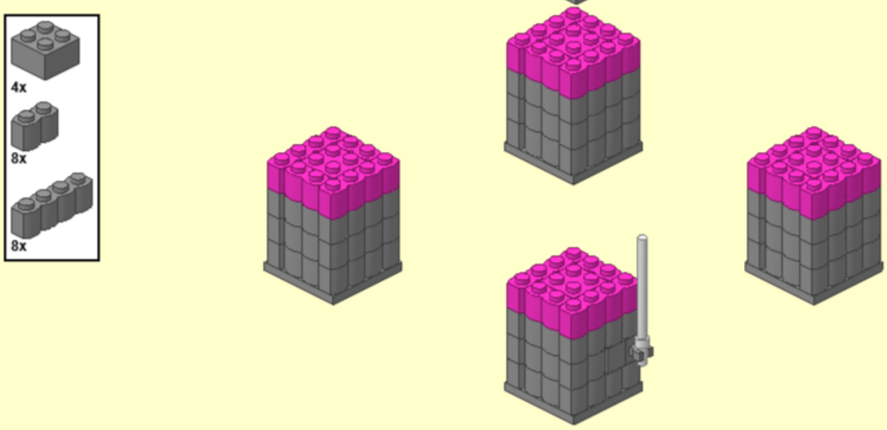
2



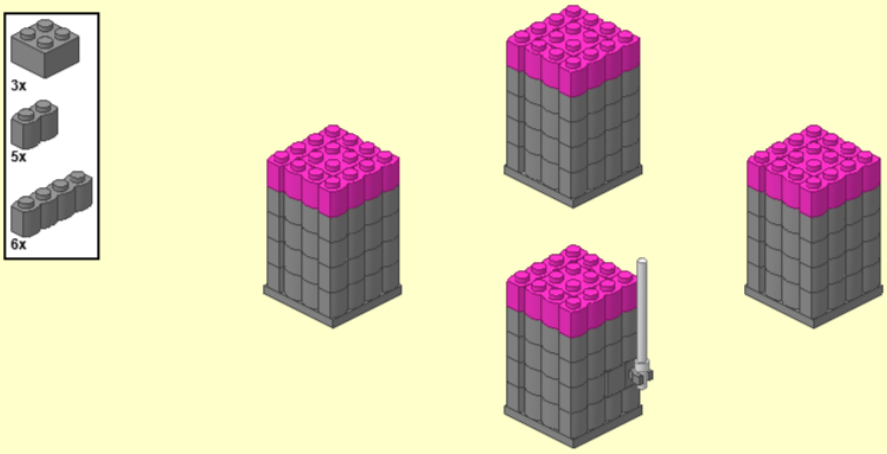
3

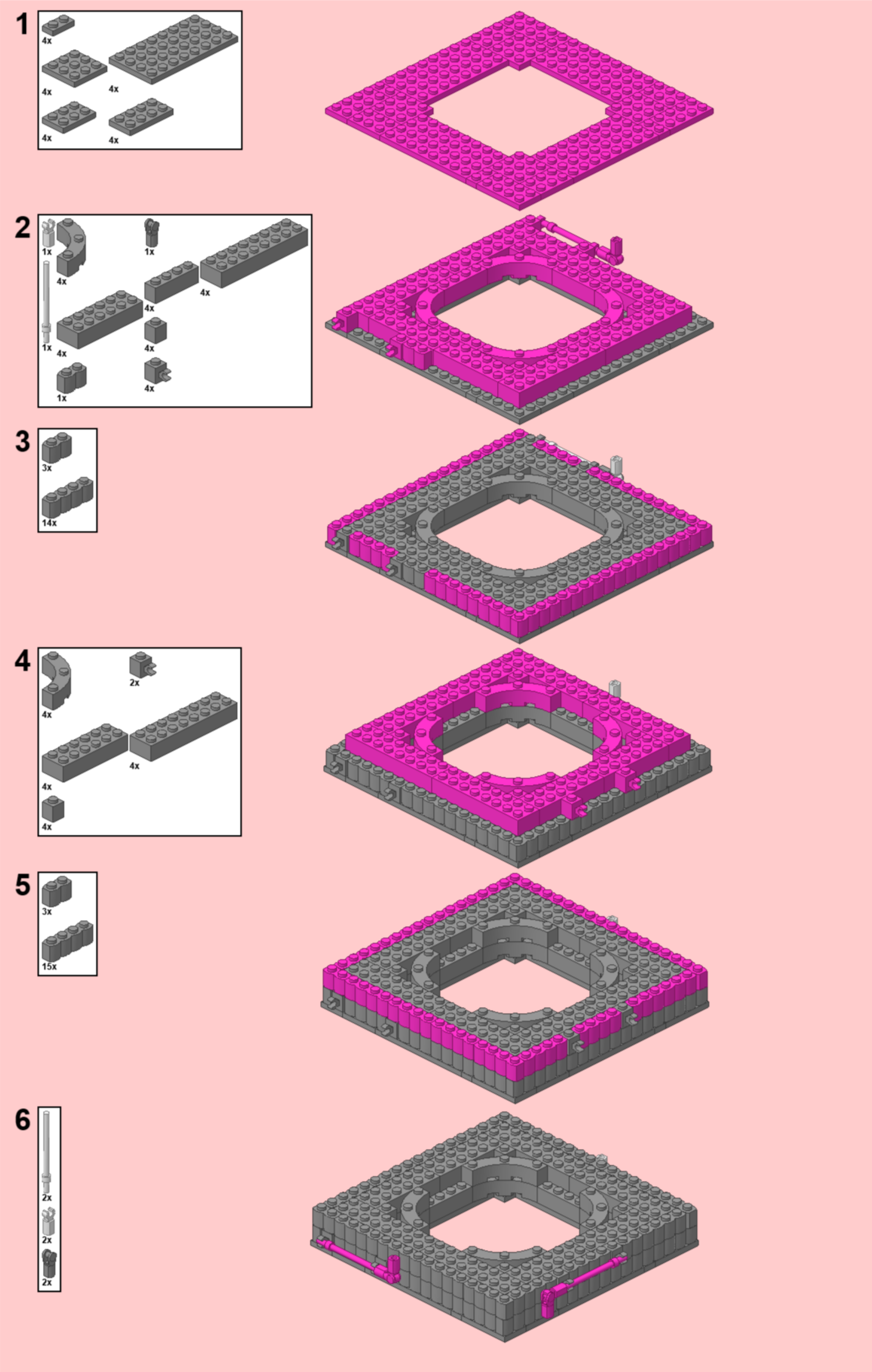


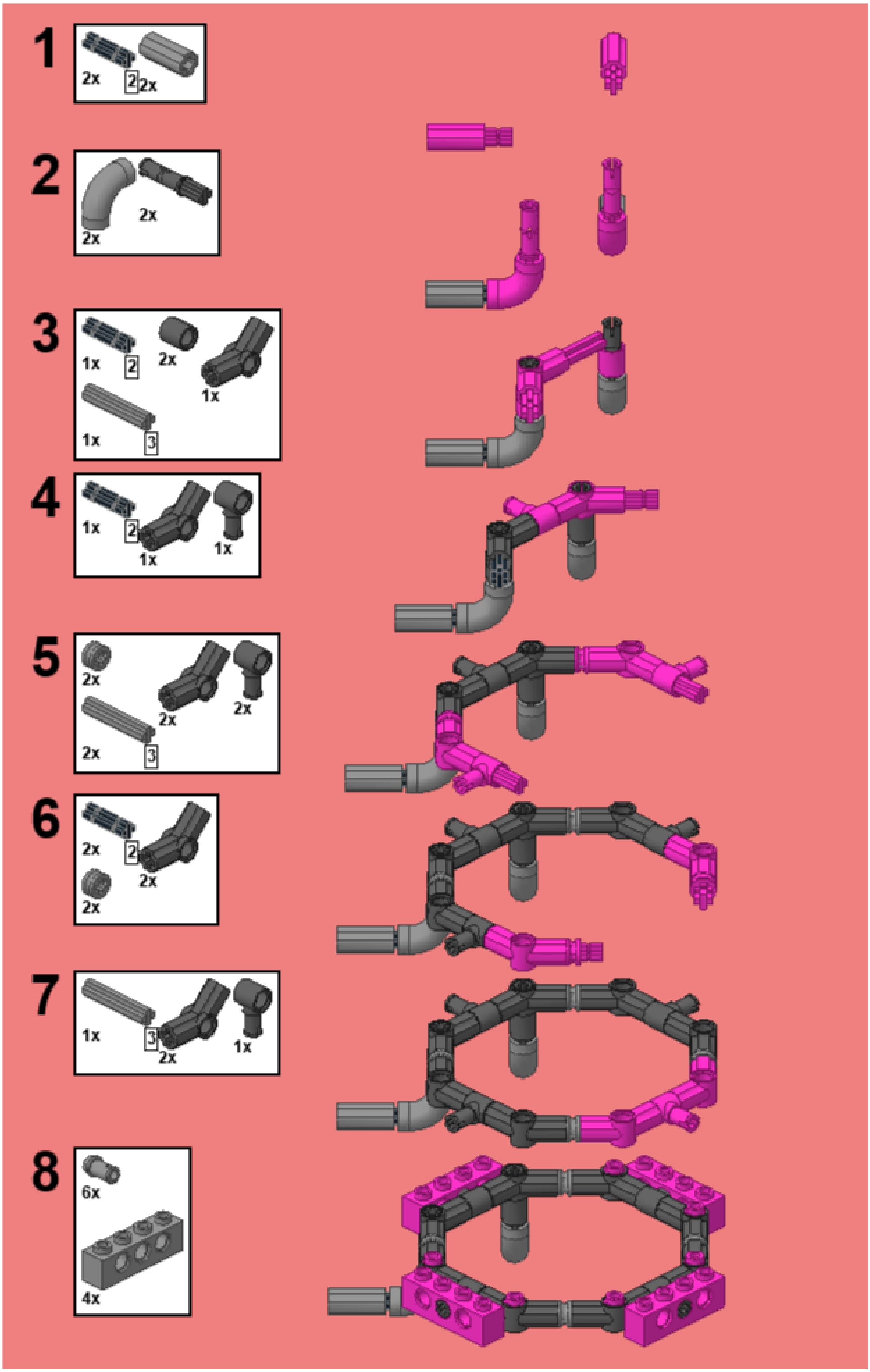
4



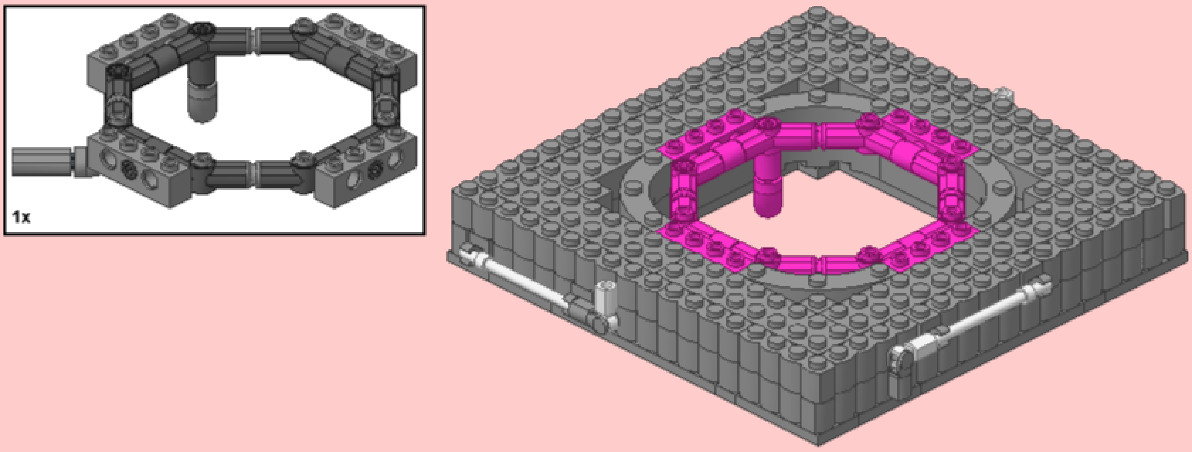
5



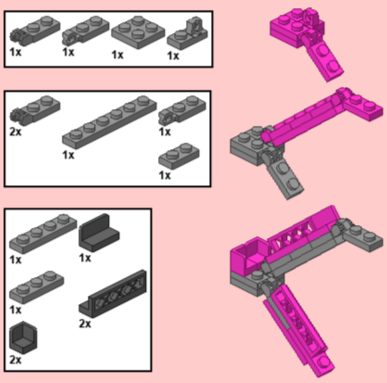

1
4x
4x
4x
4x
4x
2
1x
1x
4x
4x
4x
4x
1x
4x
4x
1x
4x
3
3x
14x
4
2x
4x
4x
4x
4x
5
3x
15x
6
2x
2x
2x


1
2x
2
2x
2
2x
2x
3
1x
2
2x
1x
1x
3
4
1x
2
1x
1x
5
2x
2x
2x
2x
3
6
2x
2
2x
2x
7
1x
3
2x
1x
8
6x
4x

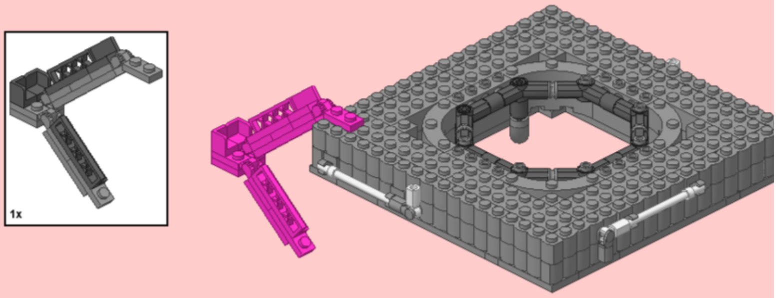
7



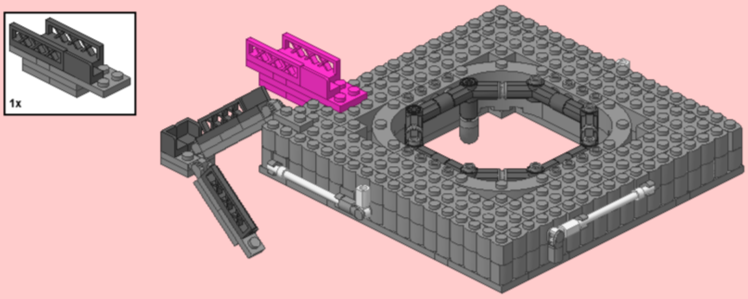
1
2
3



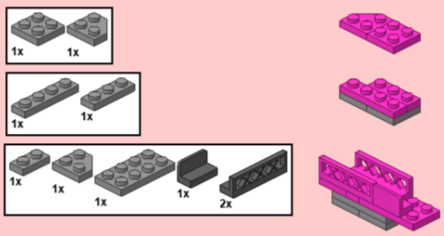
8



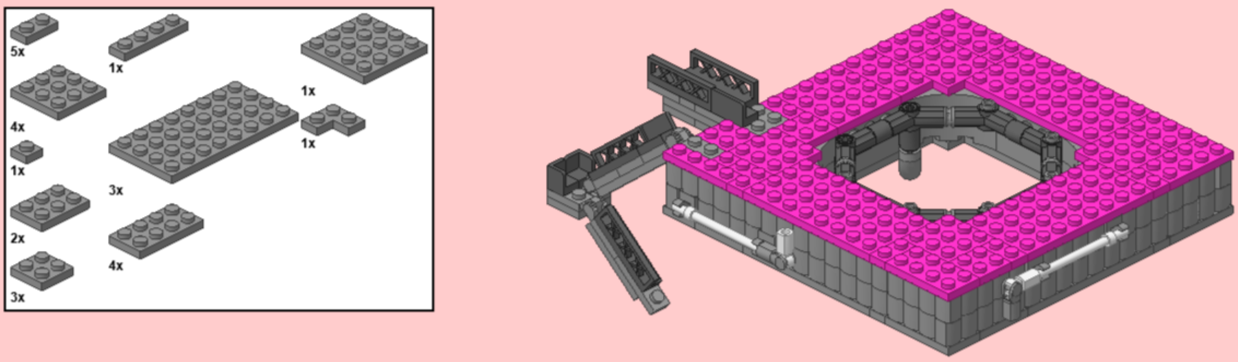
9



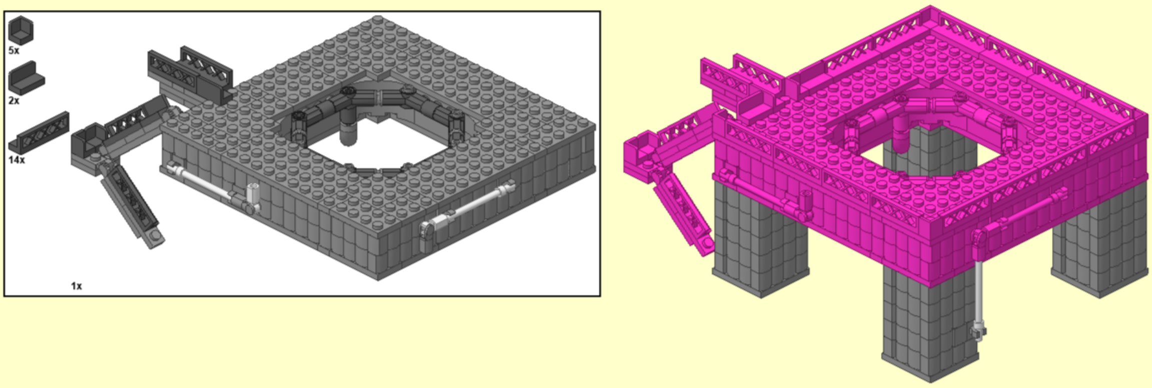
1
2
3



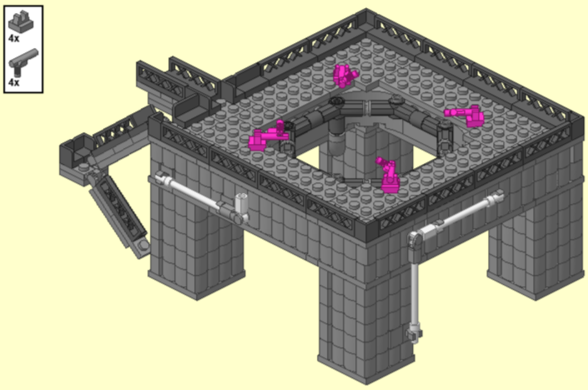
10



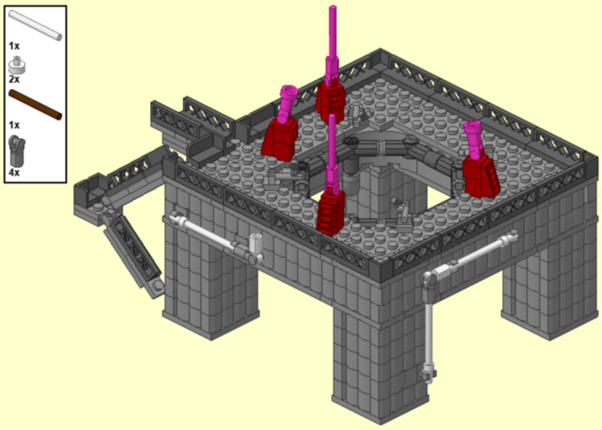
6



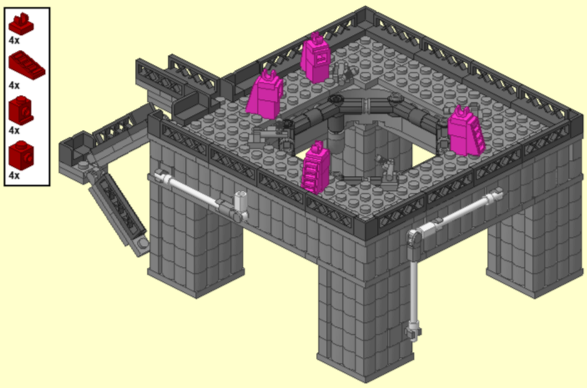
7



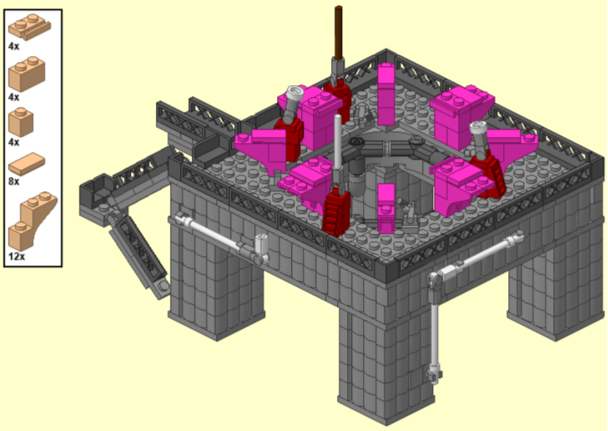
9



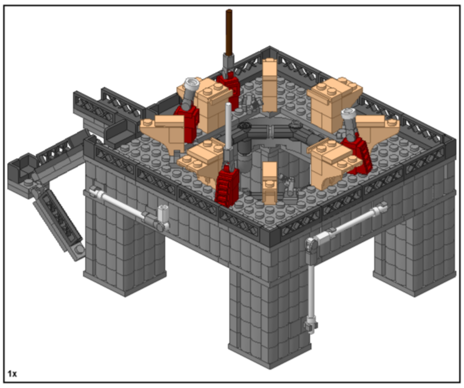
8

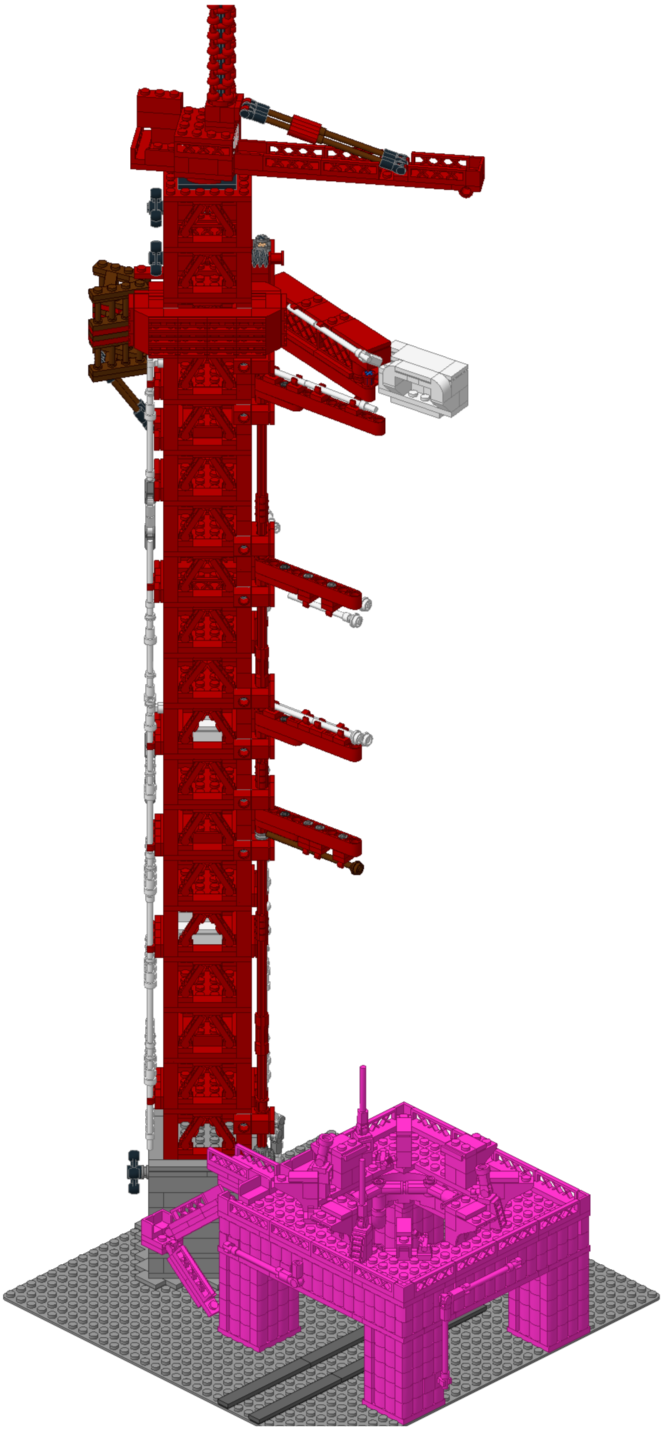


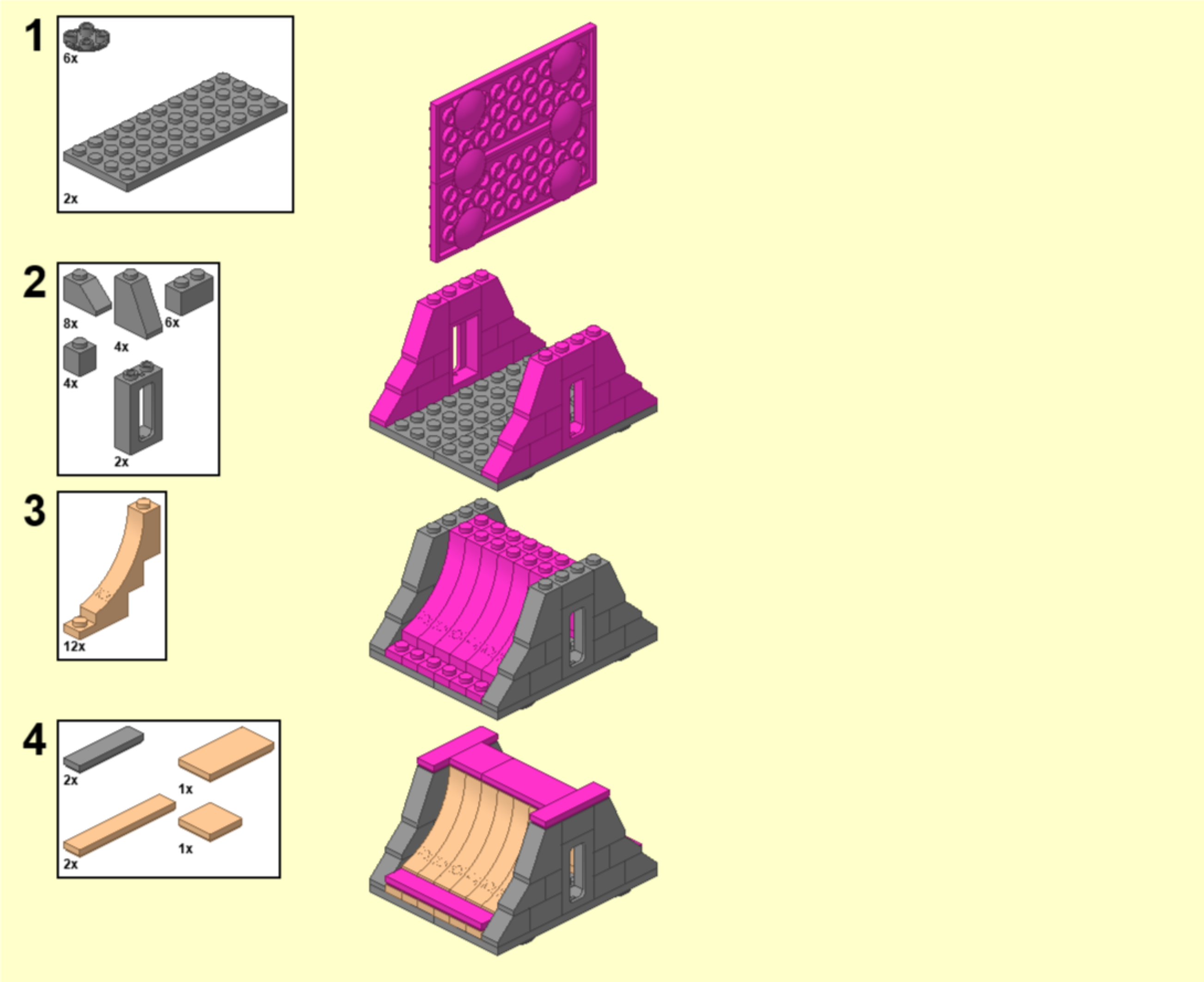
11



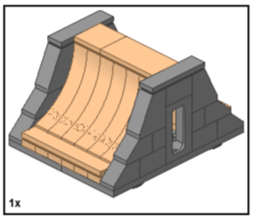
3

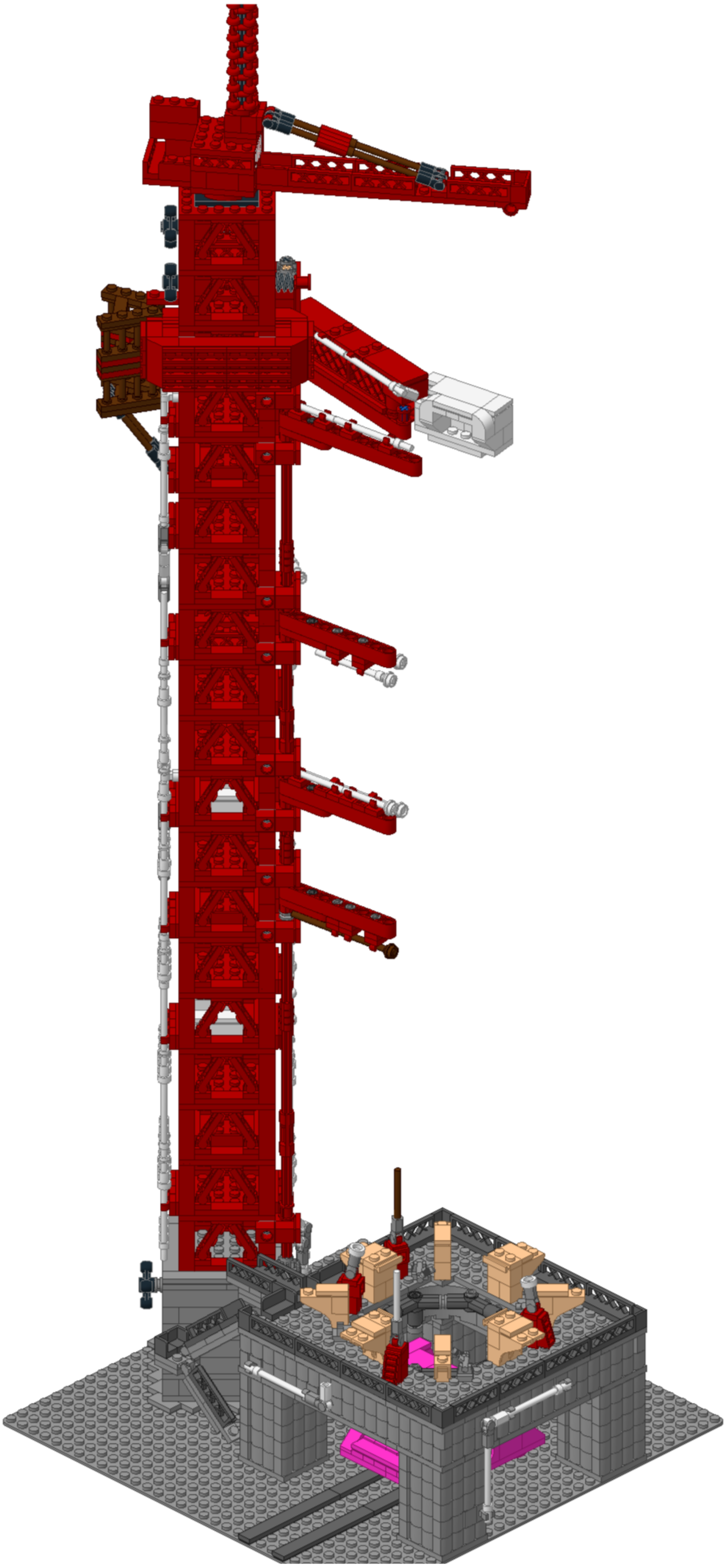


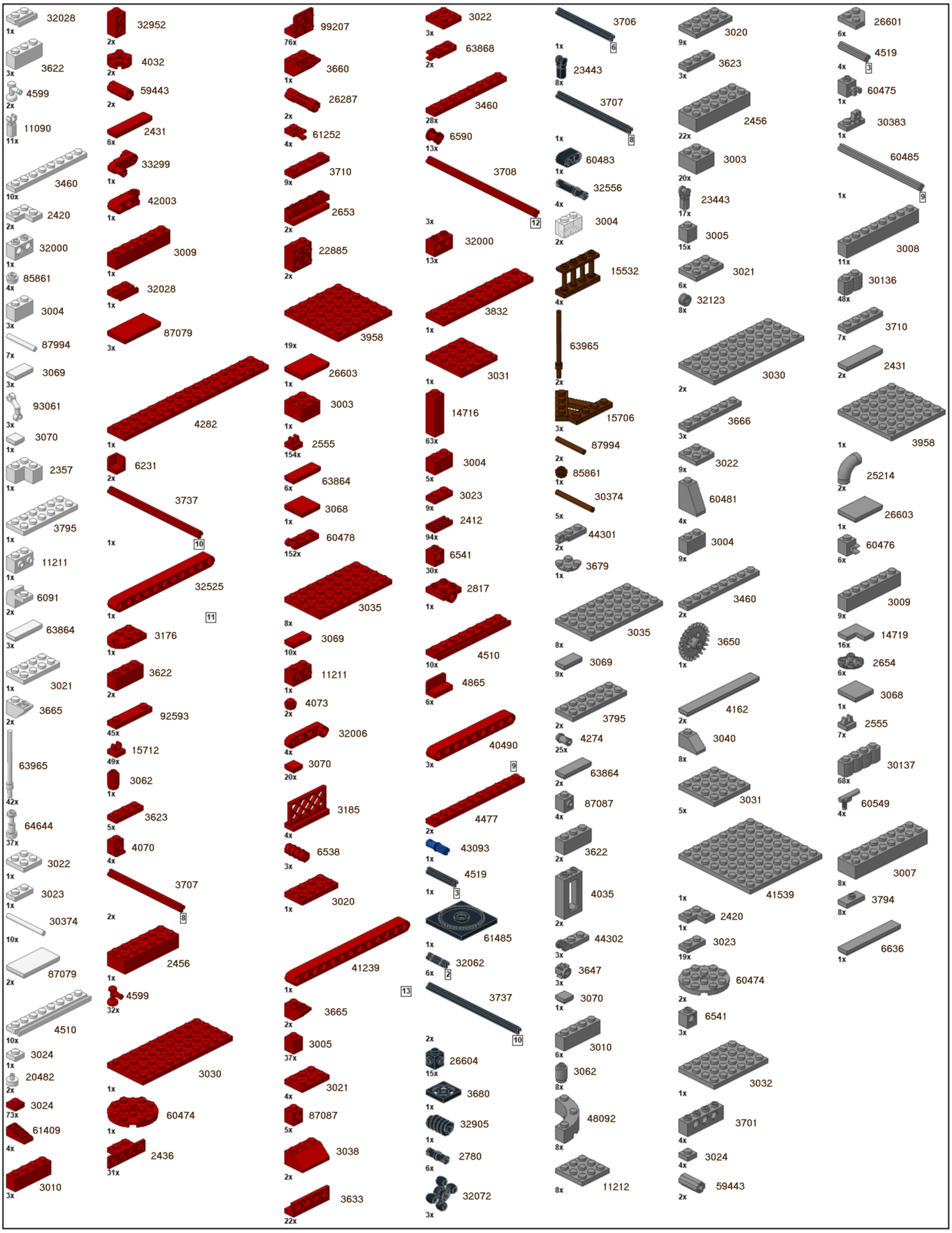



1
6x
2x
2
8x
4x
6x
4x
2x
3
12x
4
2x
1x
2x
1x

4



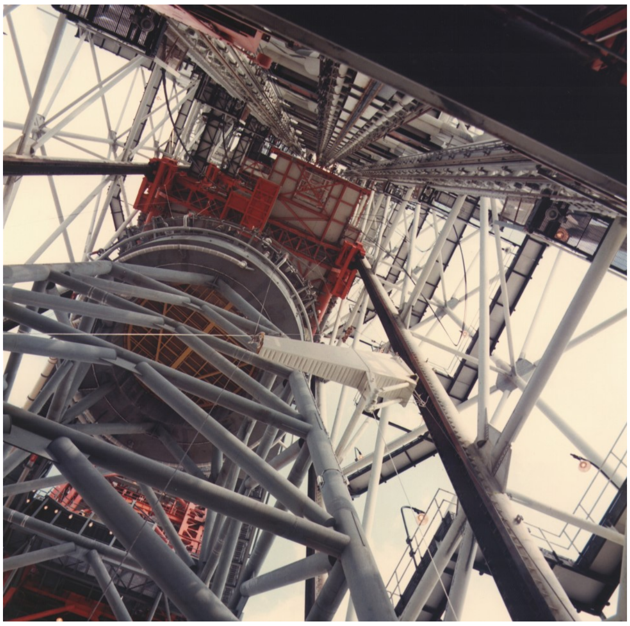



32028 1x
3622 3x
4599 2x
11090 11x
3460 10x
2420 2x
32000 1x
85861 4x
3004 3x
87994 7x
3069 3x
93061 3x
3070 1x
2357 1x
3795 1x
11211 1x
6091 2x
63864 3x
3021 1x
3665 2x
63965 42x
64644 37x
3022 1x
3023 1x
30374 10x
87079 2x
4510 10x
3024 1x
20482 2x
3024 73x
61409 4x
3010 3x
32952 2x
4032 2x
59443 2x
2431 6x
33299 1x
42003 1x
3009 1x
32028 1x
87079 3x
4282 1x
6231 2x
3737 1x 10
32525 1x 11
3176 1x
3622 2x
92593 45x
15712 49x
3062 1x
3623 5x
4070 4x
3707 2x 8
2456 1x
4599 32x
3030 1x
60474 1x
2436 31x
99207 76x
3660 1x
26287 2x
61252 4x
3710 9x
2653 2x
22885 2x
3958 19x
26603 1x
3003 1x
2555 154x
63864 6x
3068 1x
60478 152x
3035 8x
3069 10x
11211 1x
4073 2x
32006 4x
3070 20x
3185 4x
6538 3x
3020 1x
41239 1x 13
3665 2x
3005 37x
3021 4x
87087 5x
3038 2x
3633 22x
3022 3x
63868 2x
3460 28x
6590 13x
3708 3x 12
32000 13x
3832 1x
3031 1x
14716 63x
3004 5x
3023 9x
2412 94x
6541 30x
2817 1x
4510 10x
4865 6x
40490 3x 9
4477 2x
43093 1x
4519 1x 3
61485 1x
32062 6x 2
3737 2x 10
26604 15x
3680 1x
32905 1x
2780 6x
32072 3x
3706 1x 6
23443 8x
3707 1x 8
60483 1x
32556 4x
3004 2x
15532 4x
63965 2x
15706 3x
87994 2x
85861 1x
30374 5x
44301 2x
3679 1x
3035 8x
3069 9x
3795 2x
4274 25x
63864 2x
87087 4x
3622 2x
4035 2x
44302 3x
3647 3x
3070 1x
3010 6x
3062 8x
48092 8x
11212 8x
3020 9x
3623 3x
2456 22x
3003 20x
23443 17x
3005 15x
3021 6x
32123 8x
3030 2x
3666 3x
3022 9x
60481 4x
3004 9x
3460 2x
3650 1x
4162 2x
3040 8x
3031 5x
41539 1x
2420 1x
3023 19x
60474 2x
6541 3x
3032 1x
3701 4x
3024 4x
59443 2x
26601 6x
4519 4x 3
60475 1x
30383 1x
60485 1x 9
3008 11x
30136 48x
3710 7x
2431 2x
3958 1x
25214 2x
26603 1x
60476 6x
3009 9x
14719 16x
2654 6x
3068 1x
2555 7x
30137 68x
60549 4x
3007 8x
3794 8x
6636 1x


3811
1x
4162
4x
32192
8x
32002
4x
15100
4x
6231
7x
6636
2x
2412
30x
18654
2x
4865
4x
3069
1x
3633
18x
3004
1x
11214
2x
3068
1x
6636
2x
87079
1x
88292
12x
3004
4x
30099
12x
3069
8x
3005
4x
32028
4x
6562
1x

The Milkstool

The LC-39 pedestal or “milkstool” was a scaffolding added to Launch Complex 39 so that the Saturn Ib could be prepared for lift off from a launch structure built for the much larger Saturn V. It was used for the last three Saturn Ib missions since the launch pad originally built for the Saturn 1 and Saturn 1b had to be mothballed for budgetary reasons.



Looking up beween the „milkstool“ and the Mobile Service Structure serving the Saturn 1b before launch.
Credit: NASA

Even before NASA reached its goal of landing men on the Moon it became clear that a financial reckoning was in the making. National priorities were shifting fast: The Vietnam War proved costly, Counterculture made the US face inward, and the first strains on the economy were beginning to show. Decisions had to be made how to proceed after the massive Saturn V would be history, and NASA began collecting ideas in the “Apollo Applications Program (APP), a program designed to push Apollo hardware beyond lunar missions. For now, NASA remained committed to the Saturn IB as a launch vehicle.

Maintaining launch complex 34 and the pad crews during a multiyear hiatus was a costly venture. Originally an Army project, its design had suffered from inadequate funding. During seven years of use, the complex had undergone major modifications including changes to support manned flights. LC-37 had been designed by NASA engineers in 1961 with a better understanding of Saturn requirements; its service structure, launch umbilical tower, and blockhouse were more appropriately sized to IB operations. But it had not yet been altered for manned launches, and that change would take nearly two years.

As another option, the Advanced Programs Office at the Kennedy Spaceflight Centre wanted to used complex 39 (which was also used for the still ongoing Saturn V launches) to launch AAP missions. It would be a challenge, however. Everything at this newer launch complex was oversized and mismatched for the Saturn IB owing to the Saturn V’s titanic size. It was also a launch complex designed around the mobile launch complex. While the Saturn IB was assembled on the launch pad, the Saturn V was stacked in the controlled environment of the Vehicle Assembly Building on the mobile launch platform that then crawled its way to the launch pad.

The biggest problem in launching the IB from LC-39 was adjusting the launch facilities to the smaller rocket. Since an Apollo stacked atop a Saturn IB was 43 meters shorter than the Apollo-Saturn V, much of the supporting equipment would not be correctly positioned. Boeing proposed to minimize modifications by placing the Saturn IB on a 39-meter pedestal so that the second stage and instrument unit, as well as the Apollo spacecraft, would stand at the same height as the Saturn V configuration. Thus the launch team could use the launcher's upper service arms and the work platforms of the service structure and assembly building.

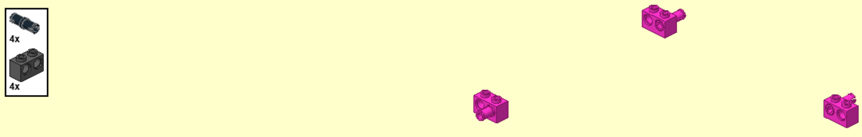
The pedestal (milkstool in local parlance) was Skylab's most distinctive feature at LC-39. A 250-ton steel structure with four legs and a series of horizontal and diagonal pipes supporting the main platform, the milkstool featured a nearly 28-foot diameter exhaust hole and all the support arms, fuel pipes, and electrical lines needed to prepare the Saturn IB for launch. And it was tricky to build. Not only did the milkstool have to be rigid enough to not buckle under the stress of a rocket launching on top of it, it could only weigh as much as the Saturn V’s S-I stage it was taking the pace of. Any heavier and the mobile launch platform wouldn’t be able to support its weight. The modifications worked. The Skylab space station was launched on May 14, 1973 on the last Saturn V ever to leave the Earth. The first Skylab crew followed right on its heels on May 25, 1973. The first Saturn IB to launch from a milkstool -- there were no unmanned tests -- did so without a problem. The two subsequent manned missions and the Apollo half of the Apollo-Soyuz Test Project also used the milkstool on their paths to a successful orbital mission.

The Saturn IB launch vehicle lifting off from Launch Complex 39B at 9:01 a.m. EST. The Skylab 4 astronauts Gerald P. Carr, Dr. Edward G. Gibson, and William R. Pogue, were onboard for the third and final mission to the orbiting space station.
Credit: NASA

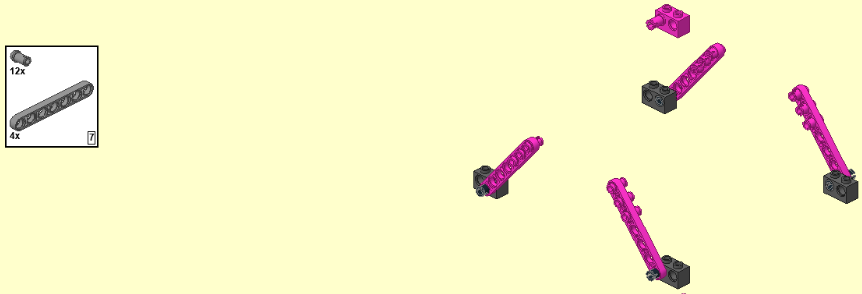
Launchpad 39 „Milkstool“

© David Welling, 2018

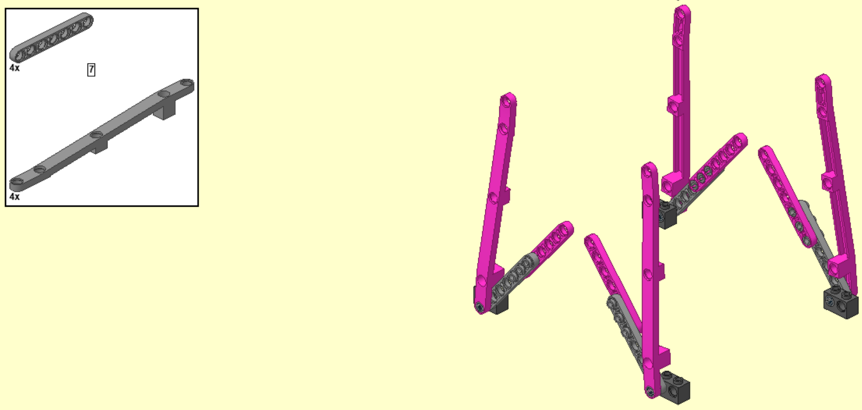
1



2



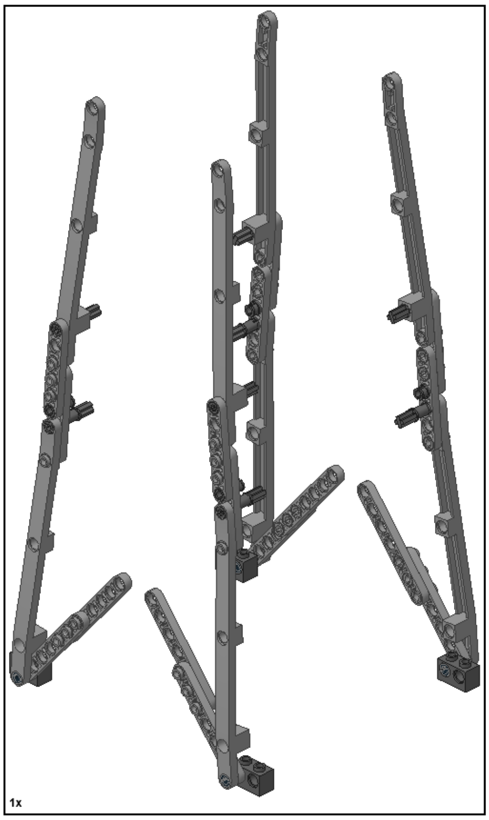
3



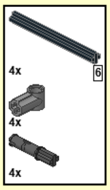
4

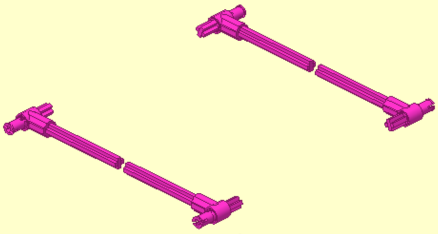
5

1

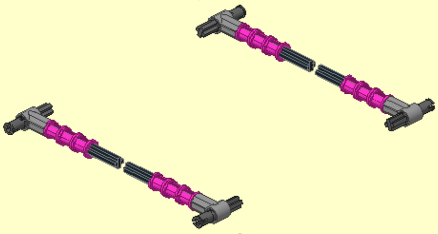


1

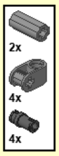


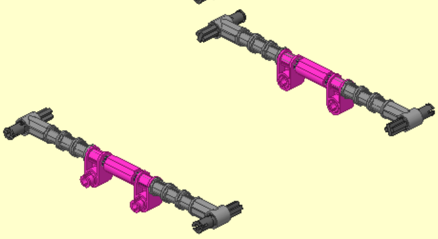


2

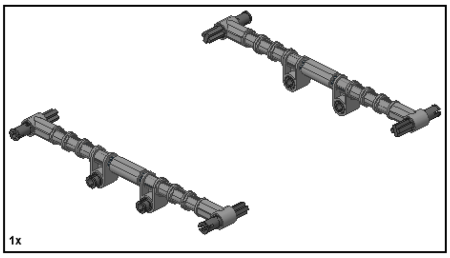


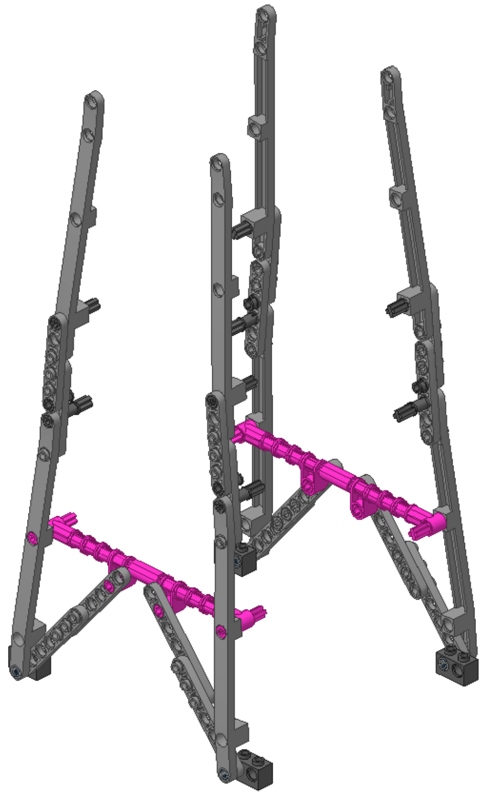
3



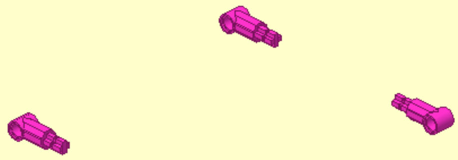


2

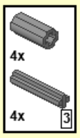


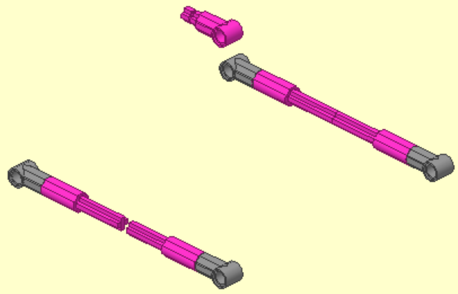


1

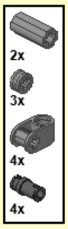


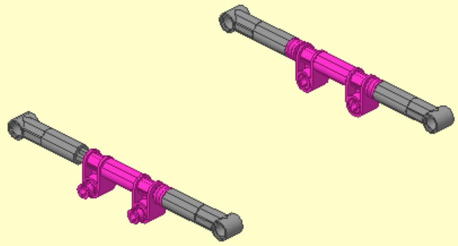
2



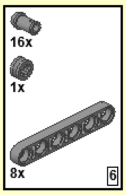


3

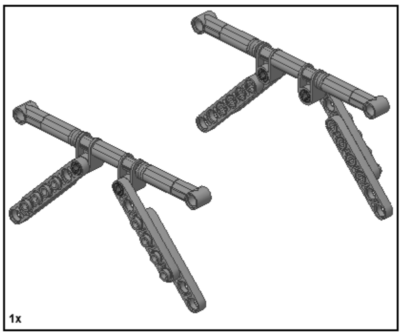


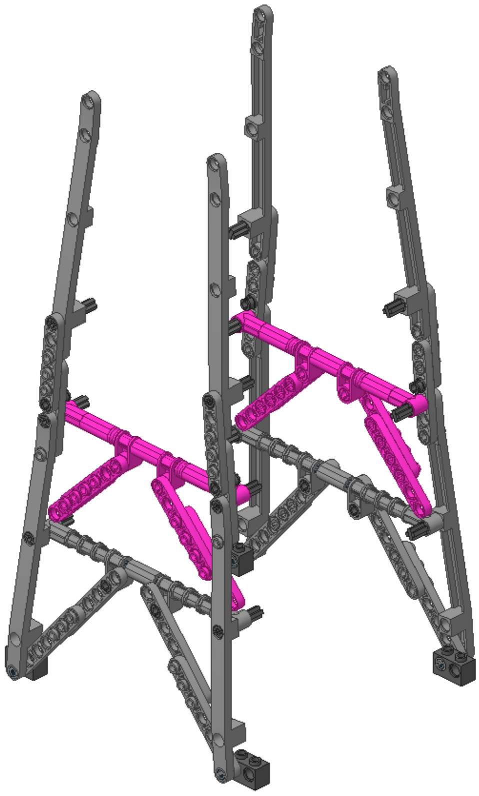


4

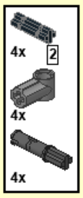


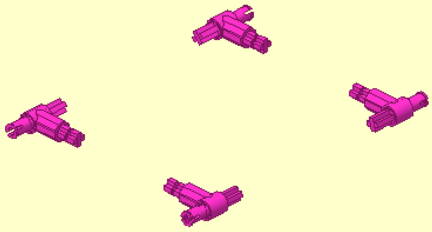
3



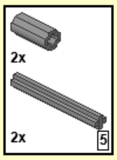


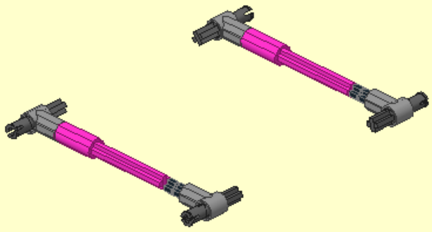
1



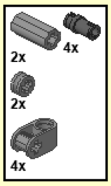


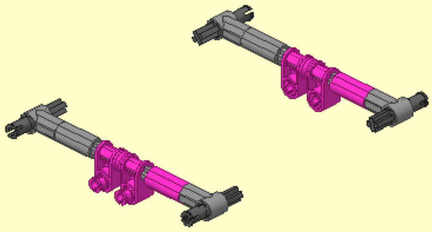
2



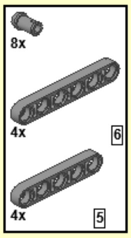


3

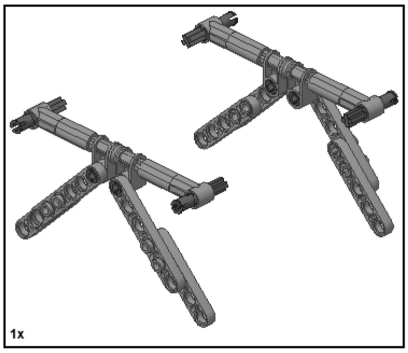


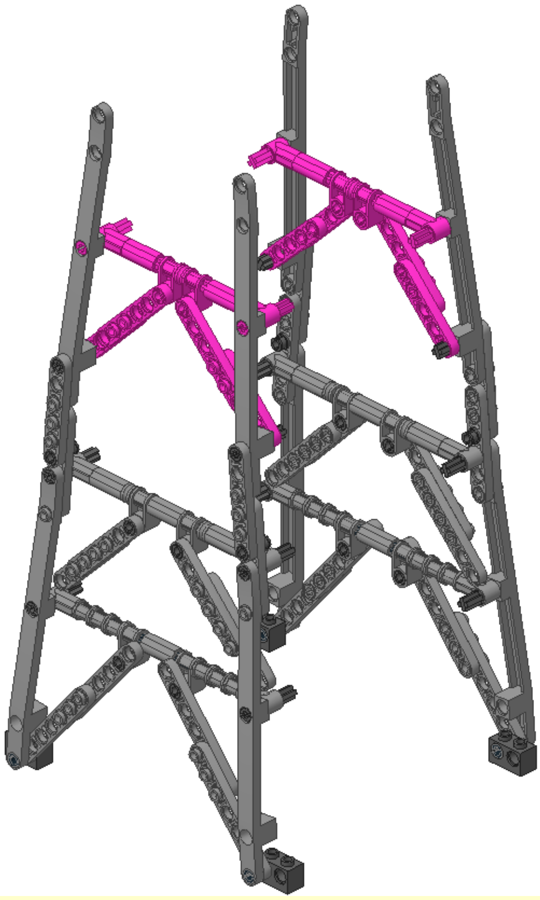


4

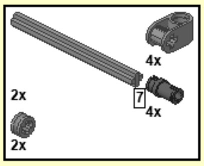


4

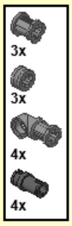




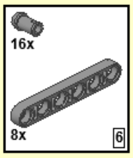
1

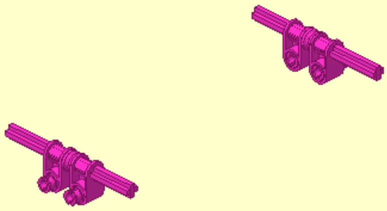


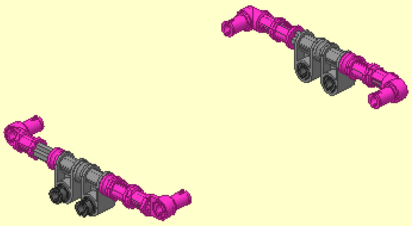
2

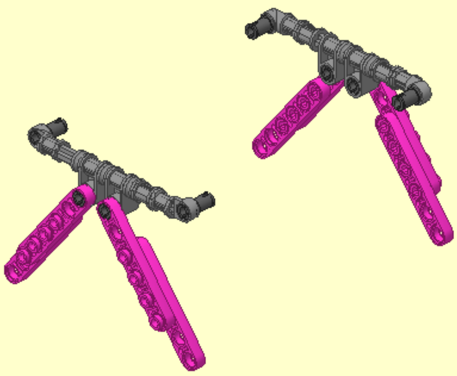


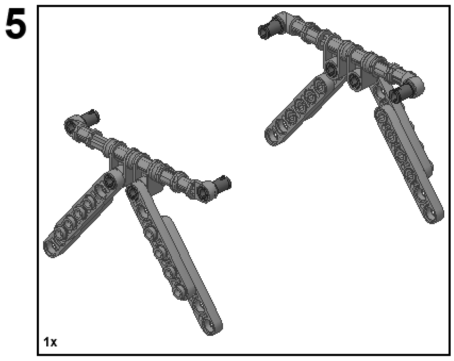
3

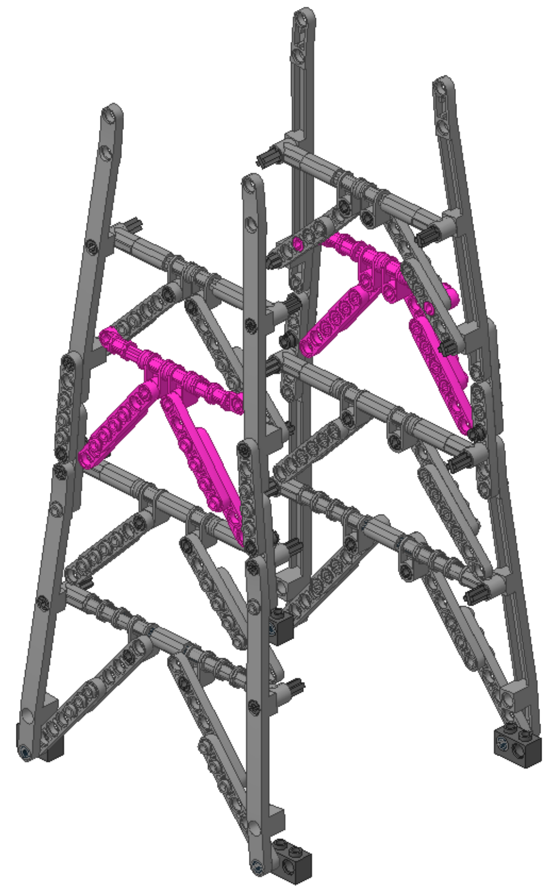


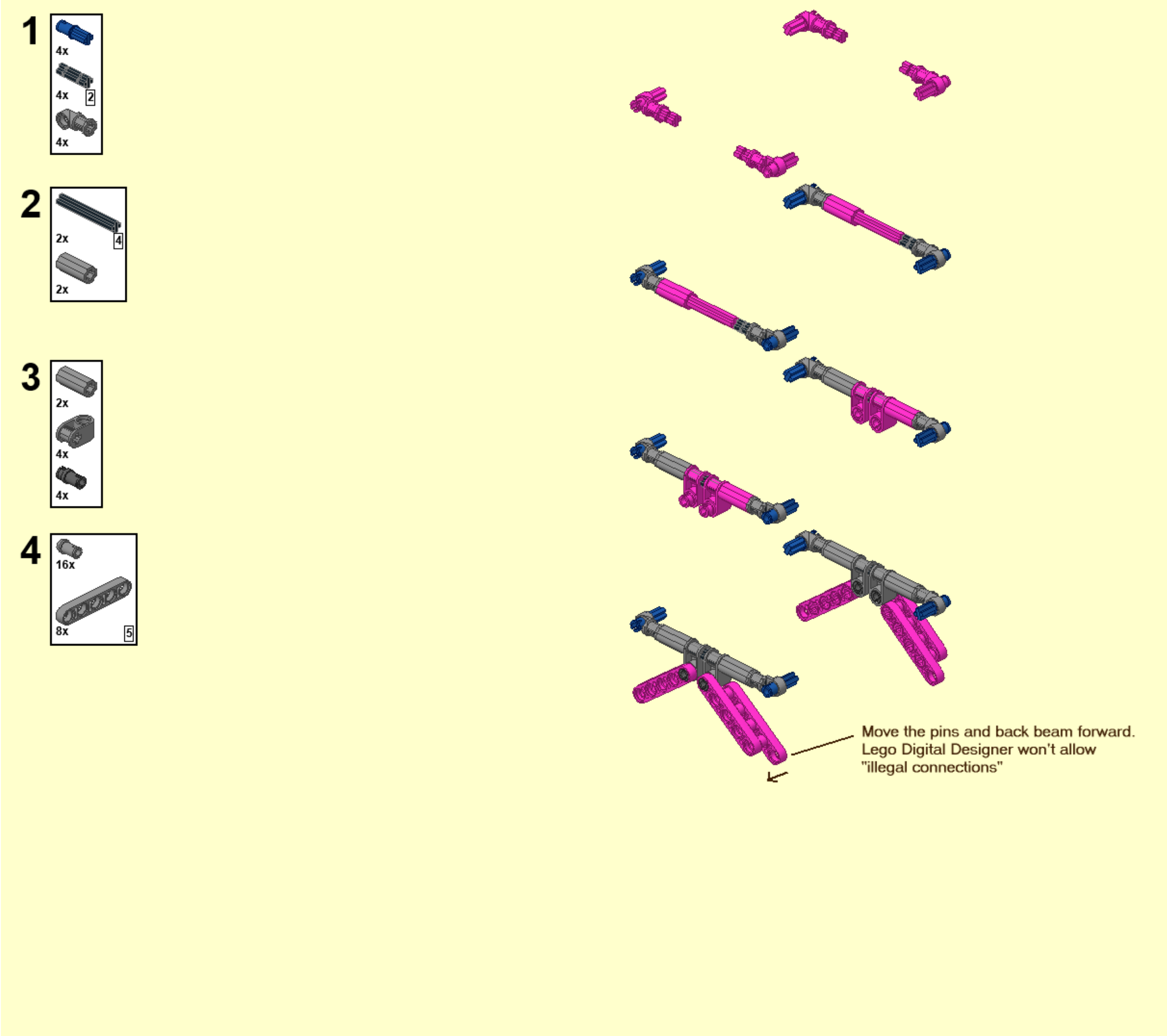




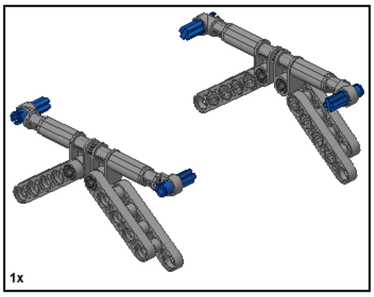


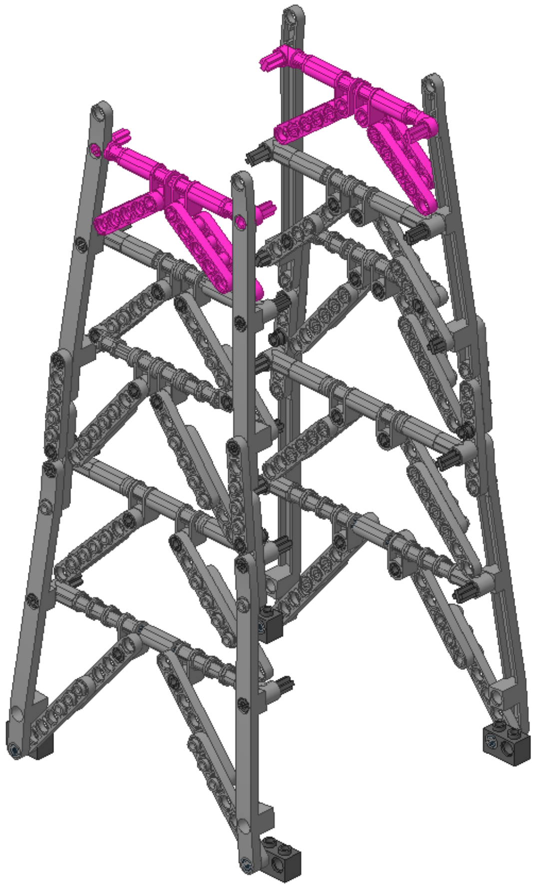

5
1x



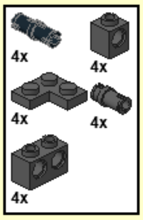

1
4x
4x
2
4x
2
2x
4
2x
3
2x
4x
4x
4
16x
8x
5
Move the pins and back beam forward.
Lego Digital Designer won't allow
"illegal connections"

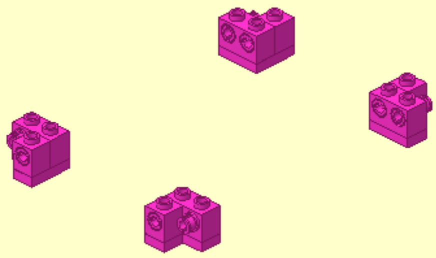
6



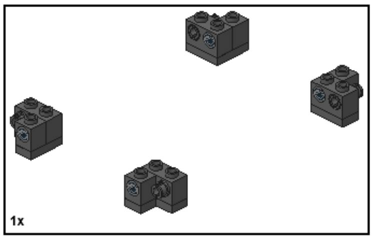


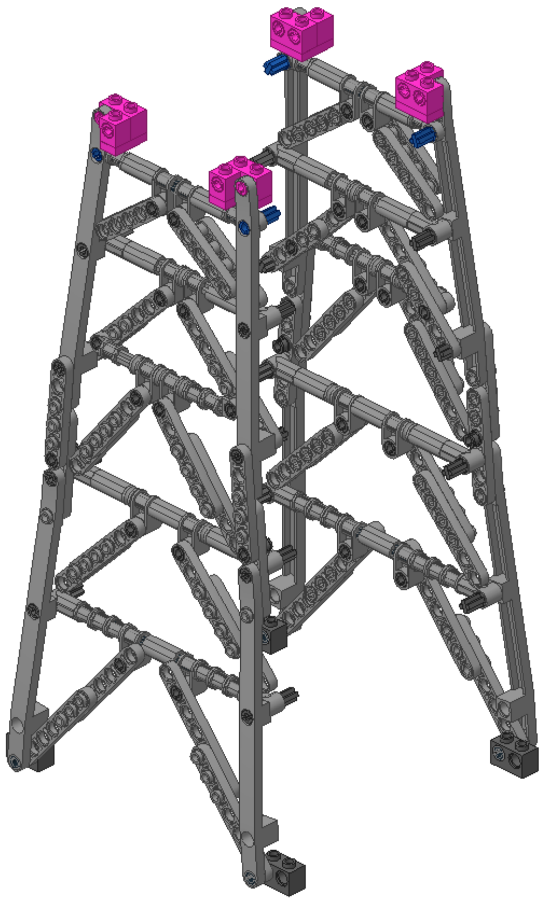
1



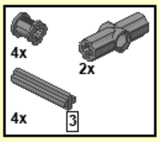


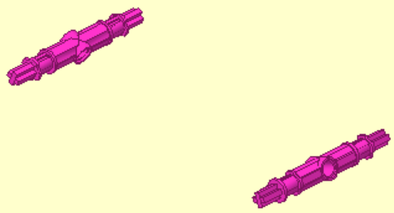
7



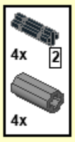


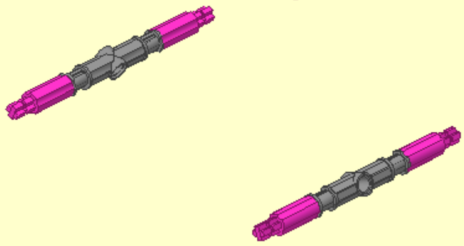
1



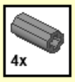


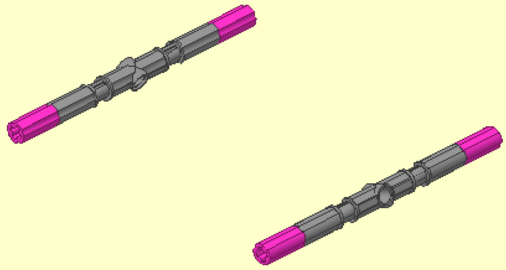
2



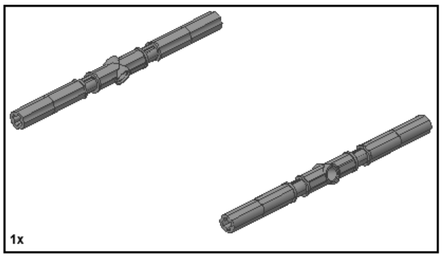


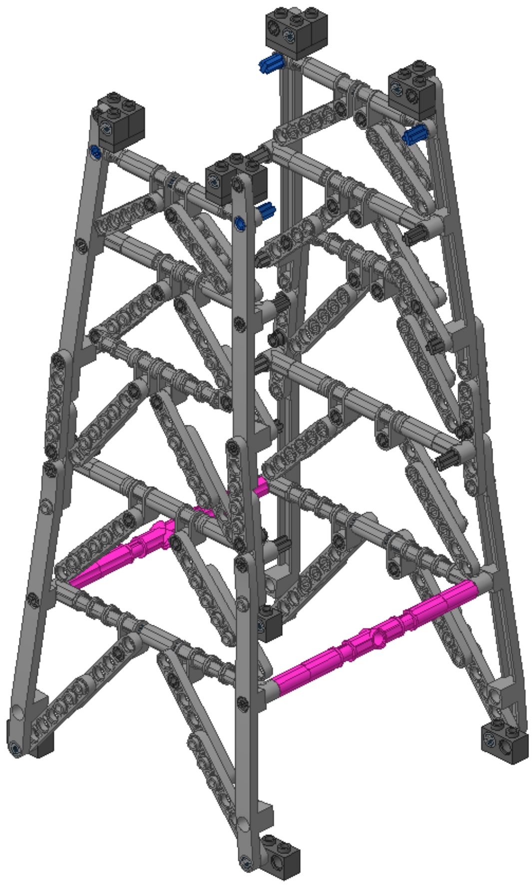
3

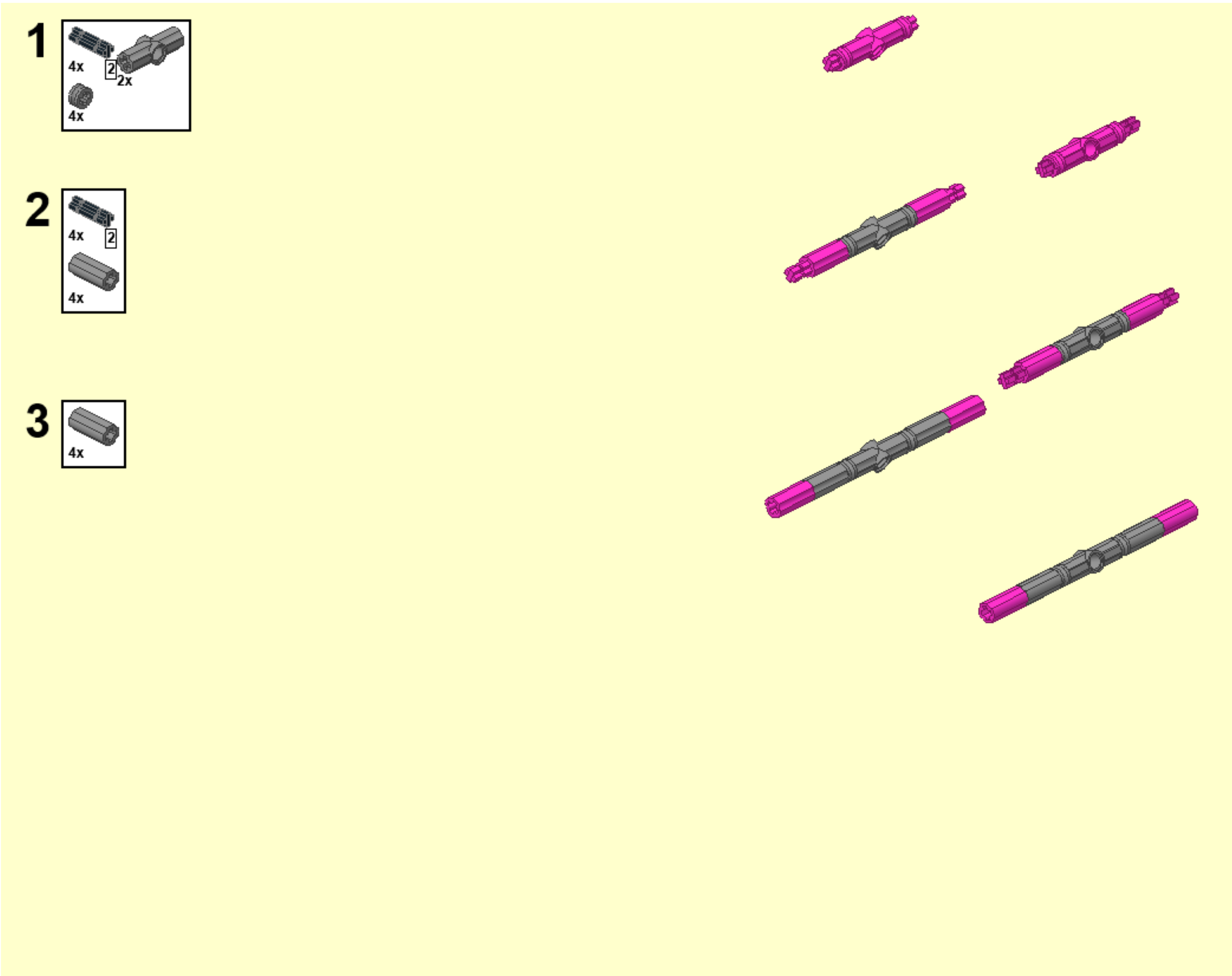




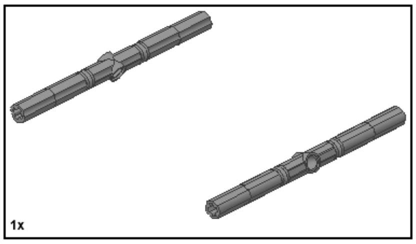
8

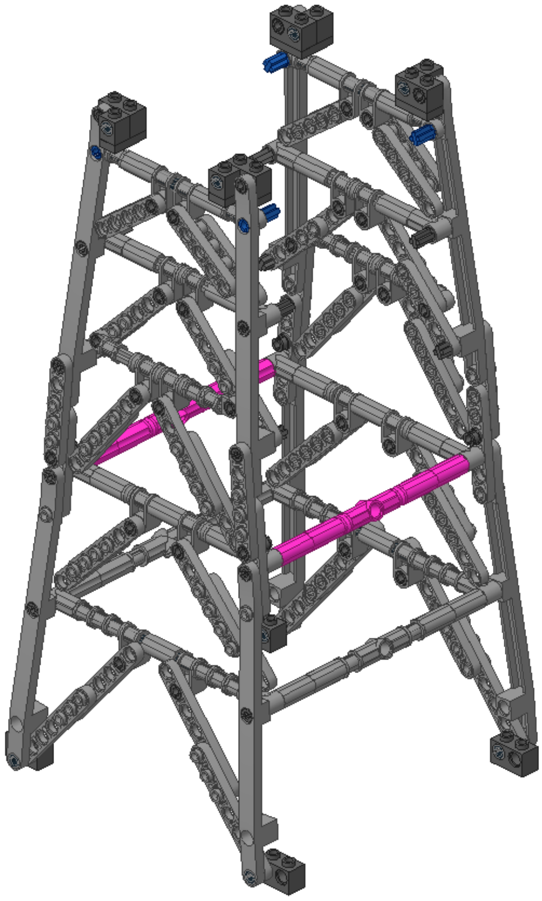




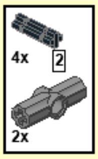


9

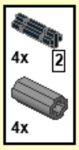




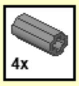
1

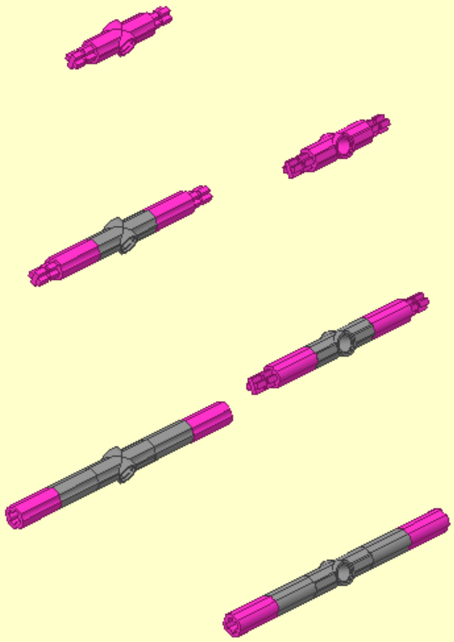


2

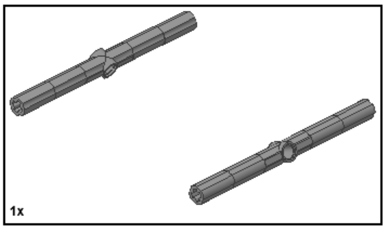


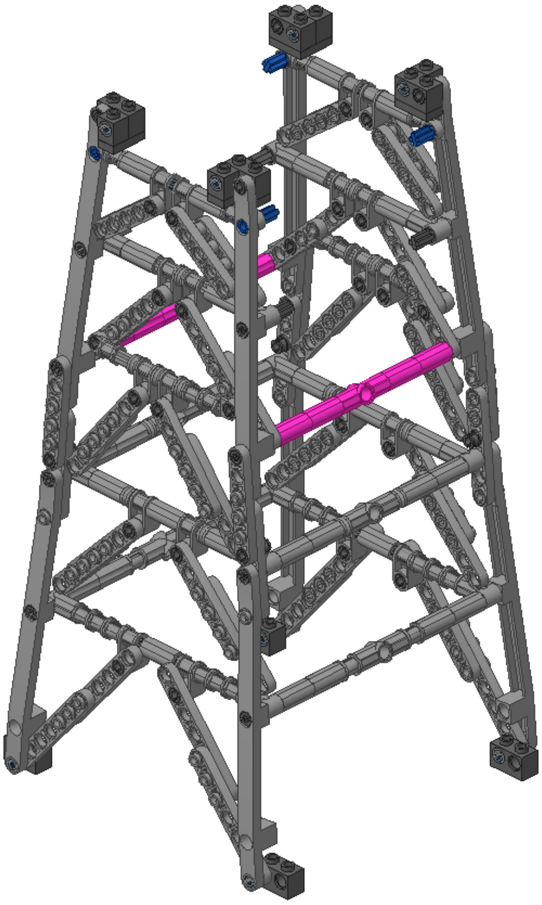
3



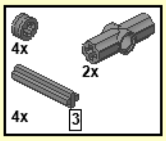


10

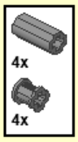


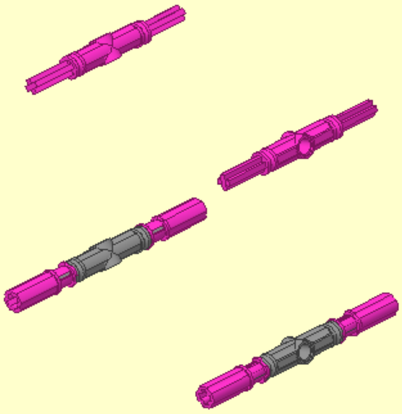


1

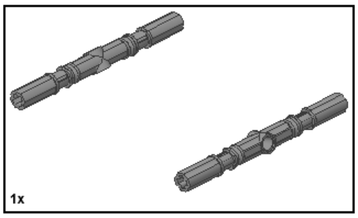


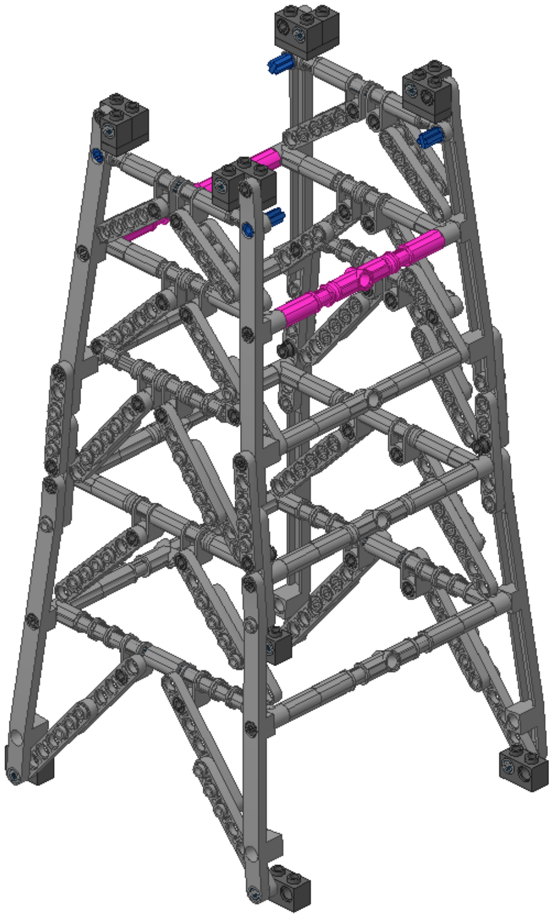
2



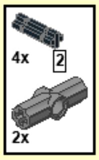


11

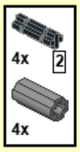




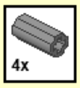
1

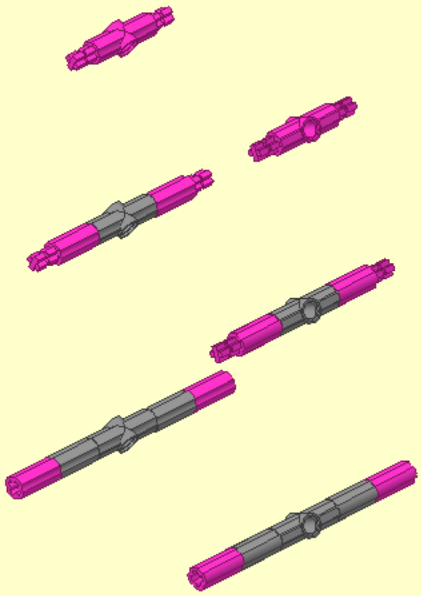


2

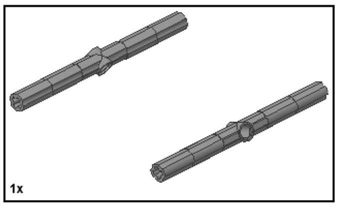


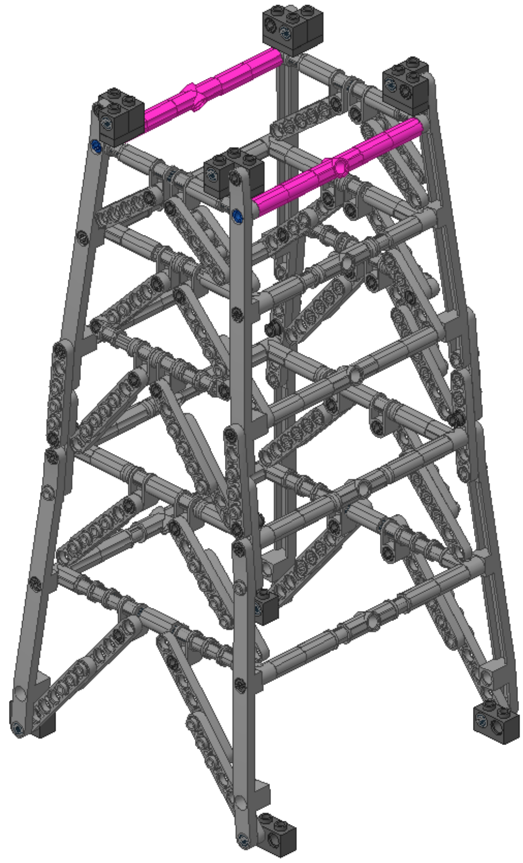
3



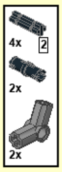


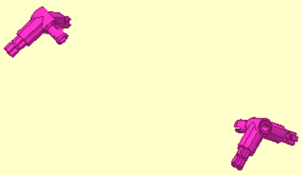
12



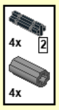


1

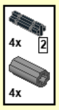


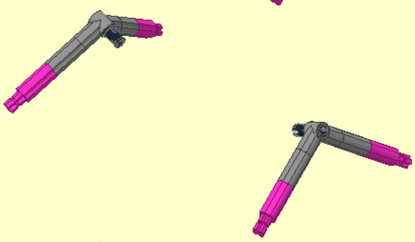


2

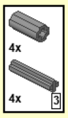


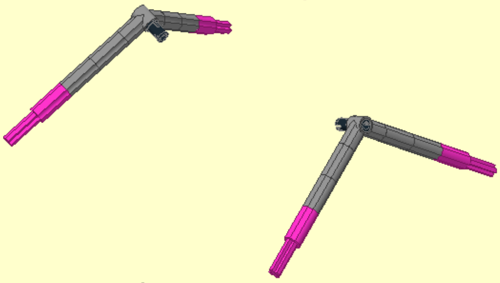
3



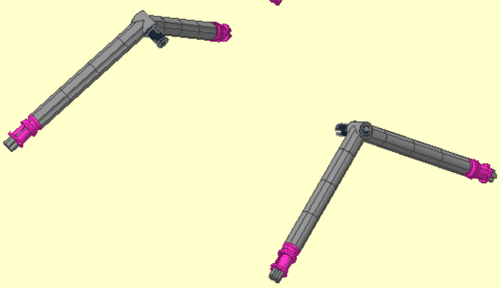


4

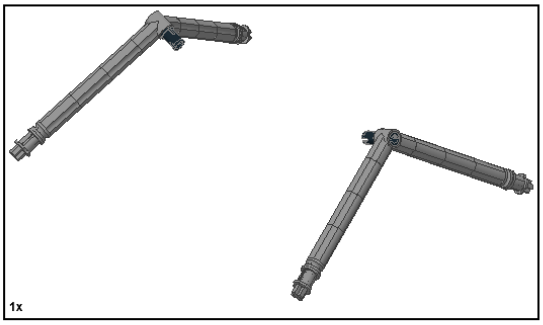


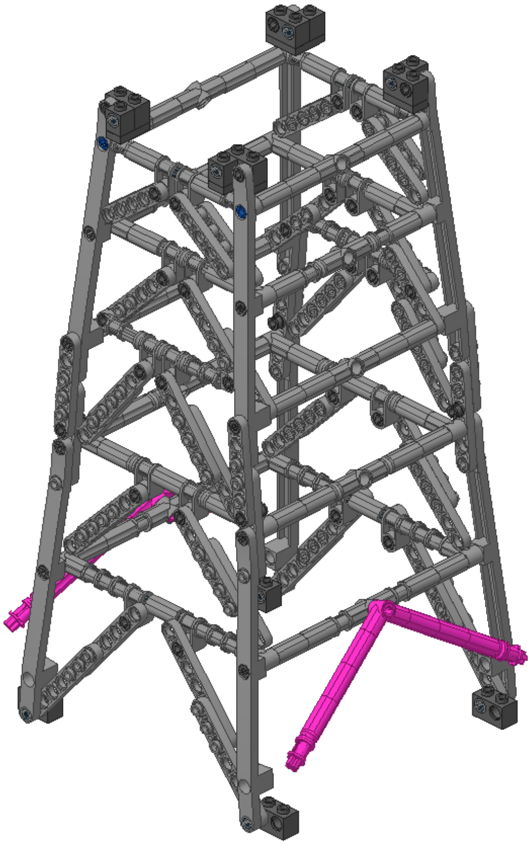


5

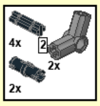


13

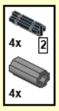




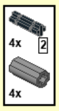
1

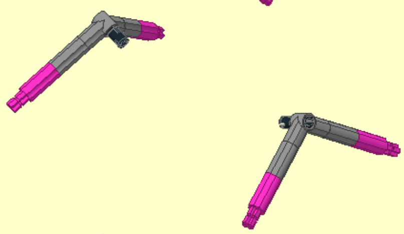


2

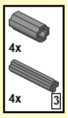


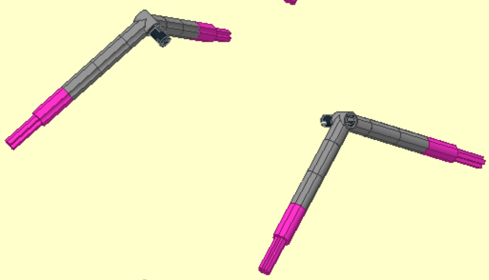
3



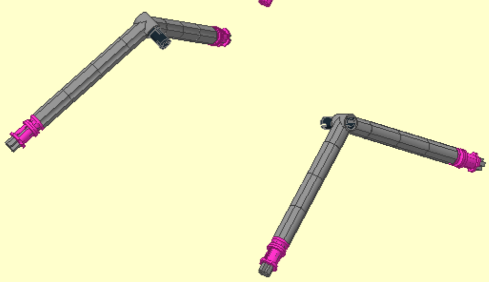


4

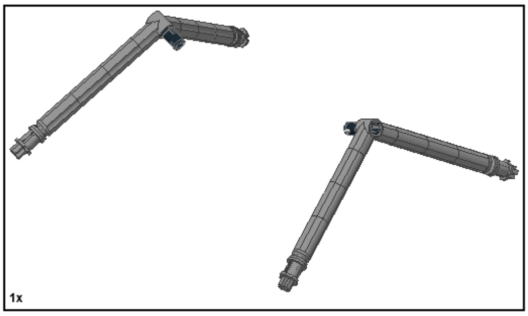


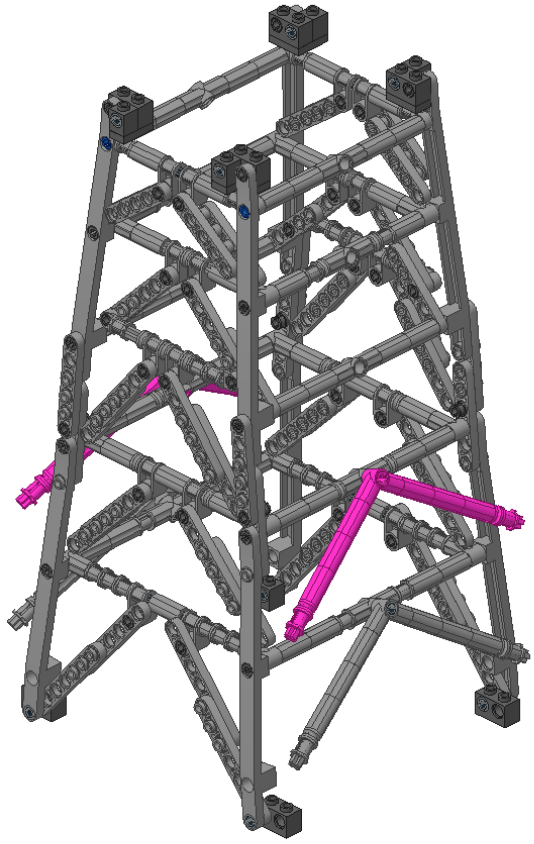


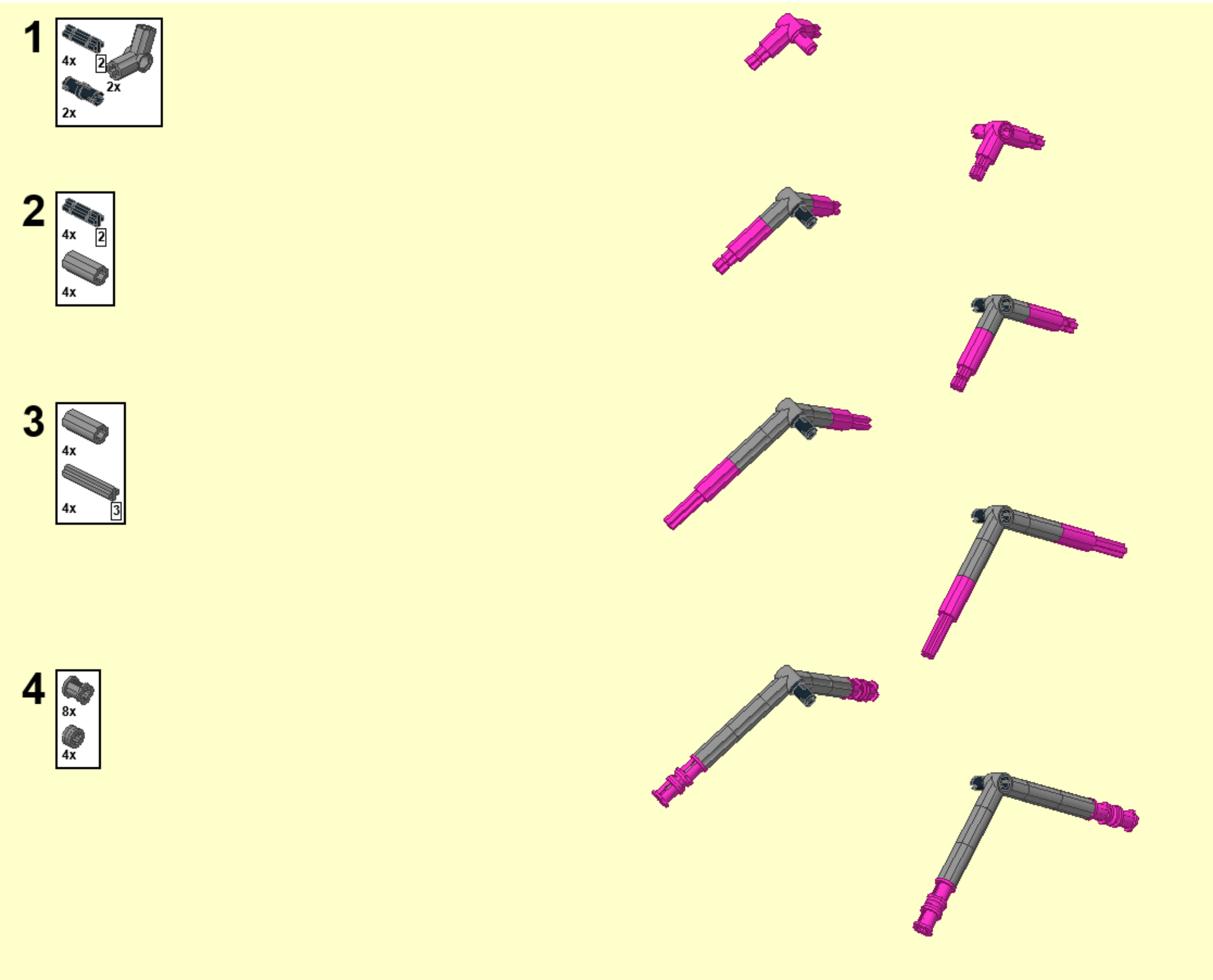
5



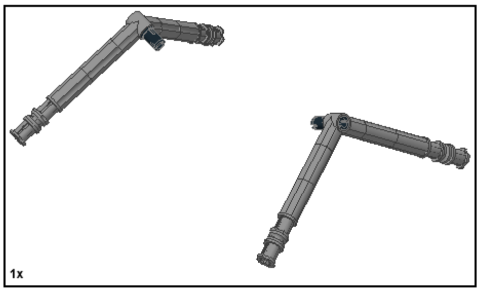
14

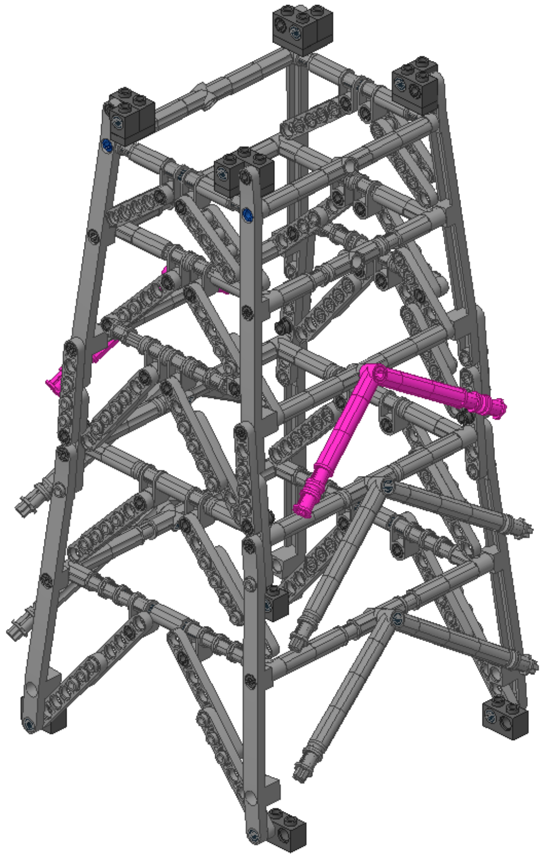




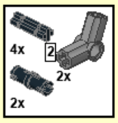


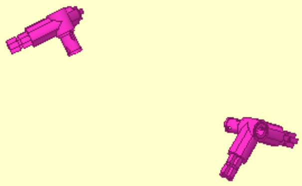
15



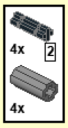


1

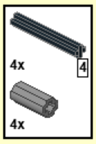




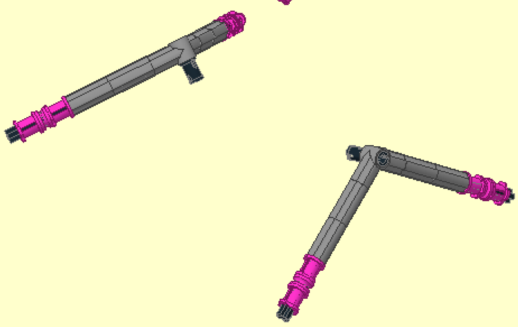
2



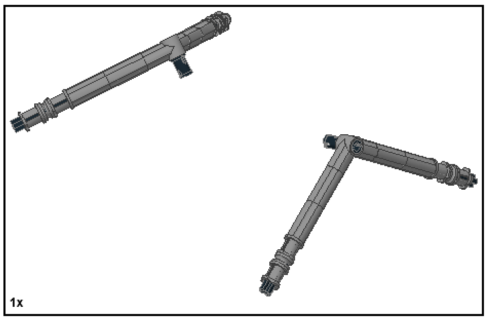
3

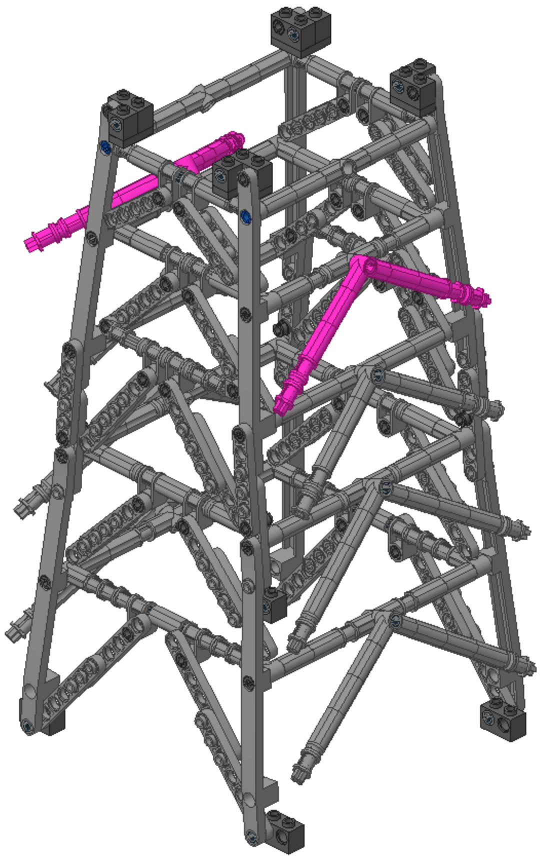


4

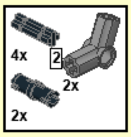


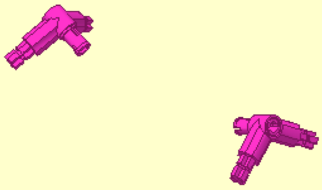
16



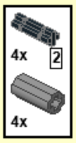


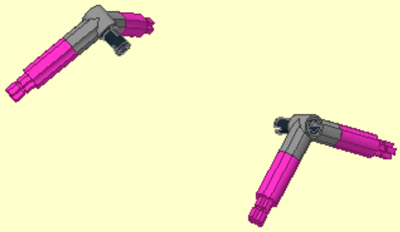
1



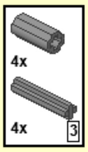


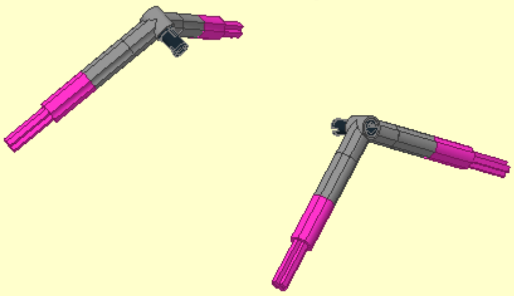
2



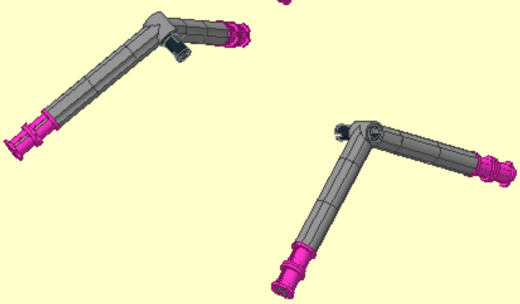


3

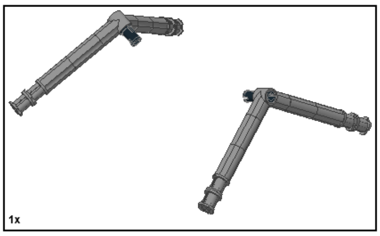


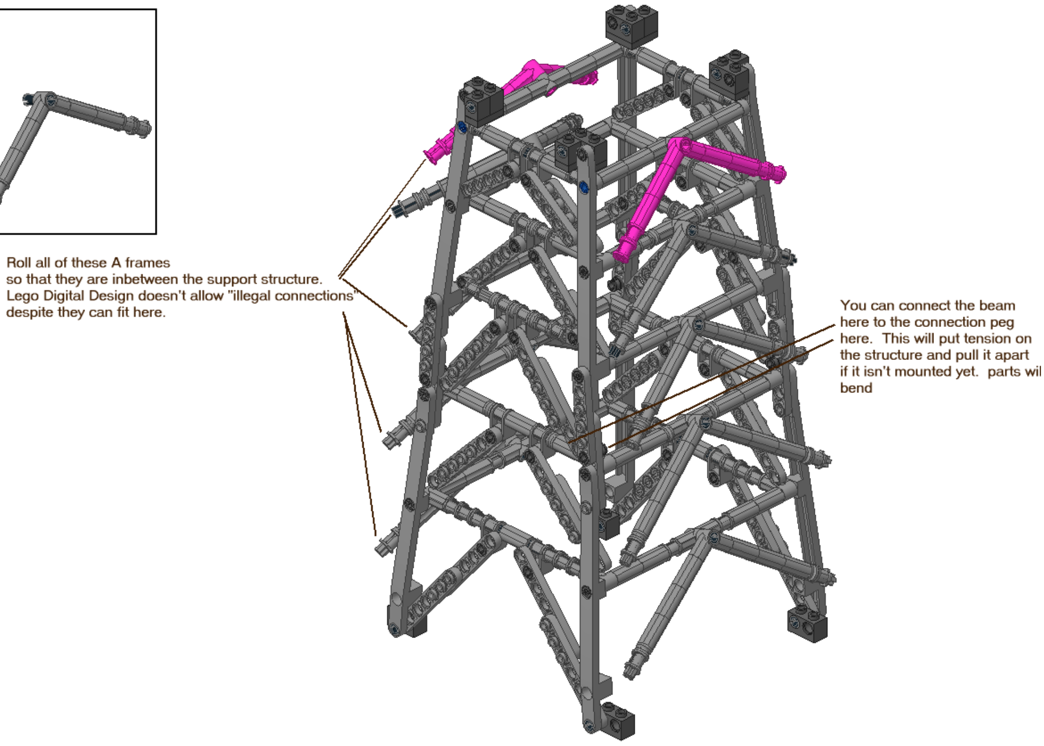


4

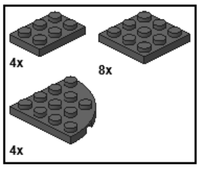


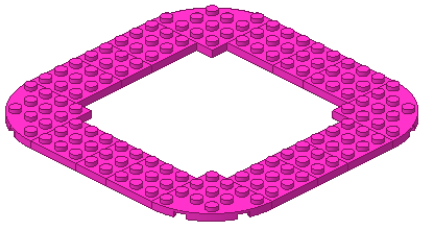
17


1x

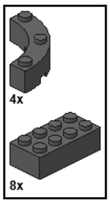

Roll all of these A frames
so that they are inbetween the support structure.
Lego Digital Design doesn't allow "illegal connections"
despite they can fit here.
You can connect the beam
here to the connection peg
here. This will put tension on
the structure and pull it apart
if it isn't mounted yet. parts wil
bend

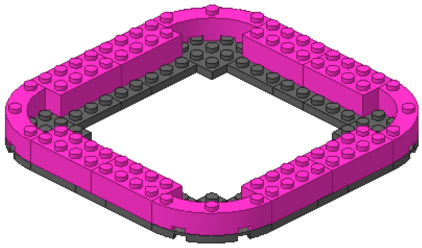
1


4x
8x
4x

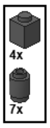


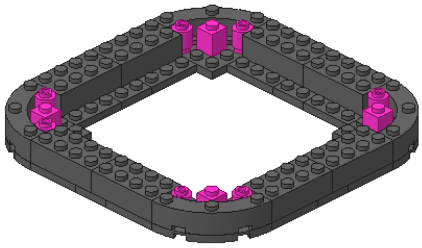
2


4x
8x

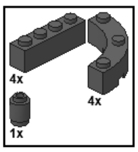


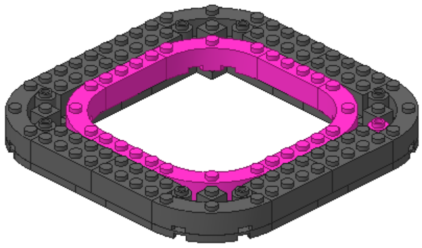
3


4x
7x

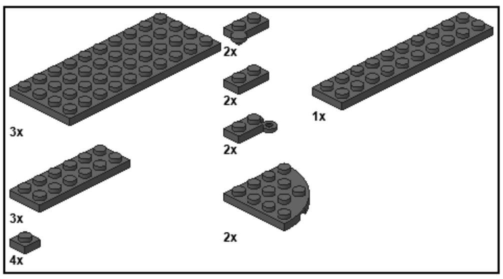


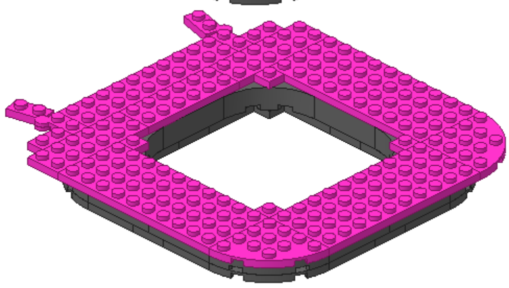
4


4x
4x
1x

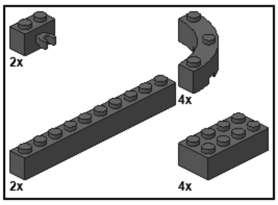


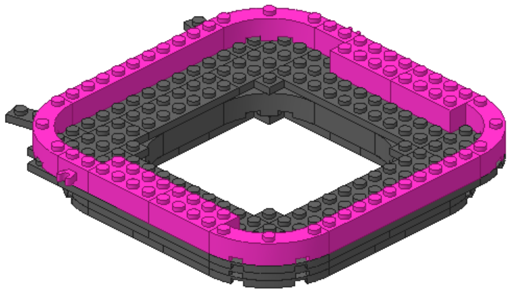
5


2x
2x
1x
3x
2x
3x
2x
4x

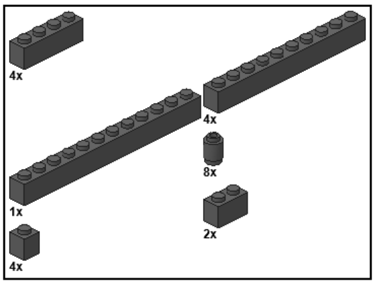


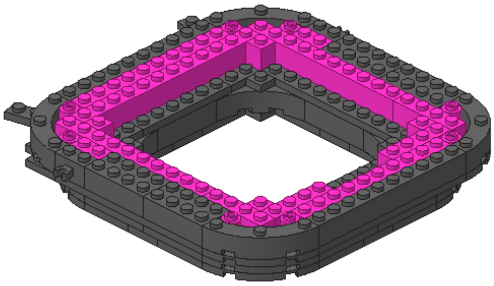
6



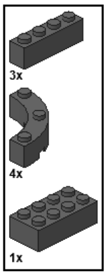


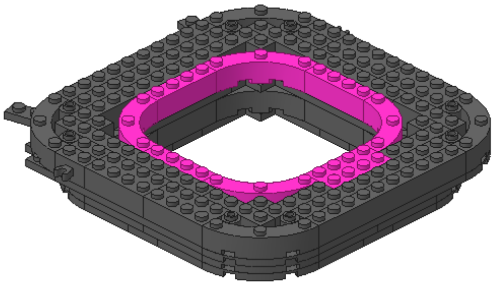
7



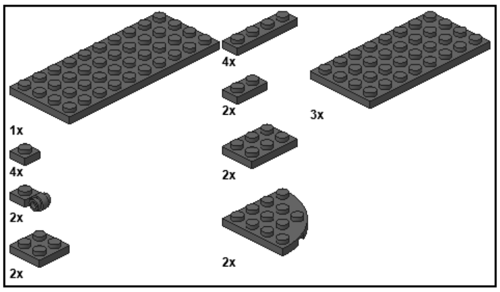


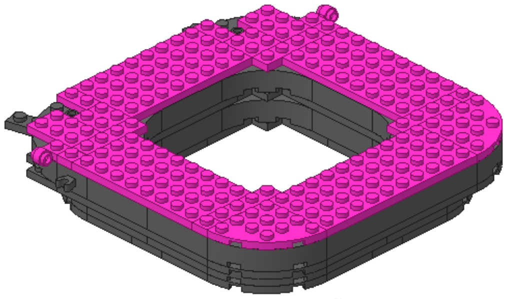
8



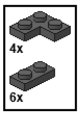


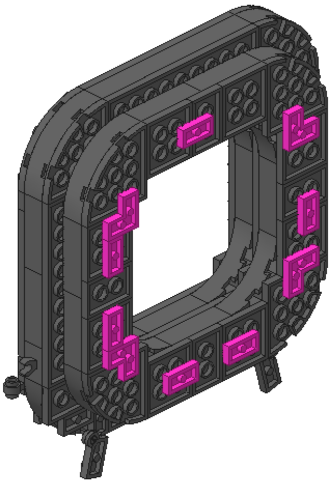
9





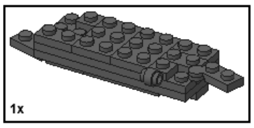
10

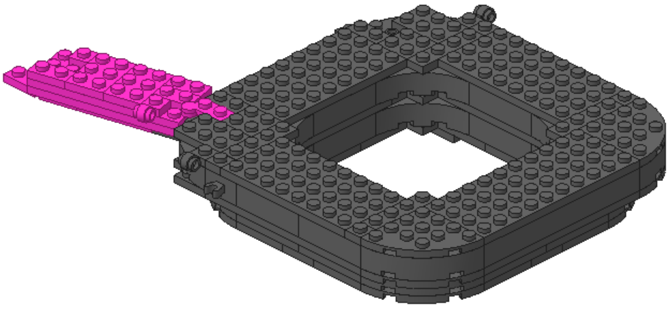


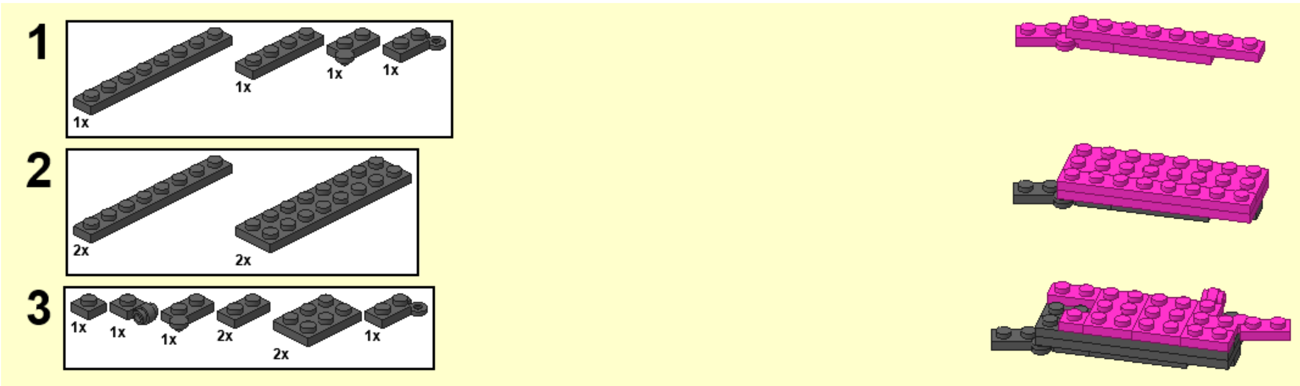



1
1x
1x
1x
1x
2
2x
2x
3
1x
1x
1x
2x
1x
2x

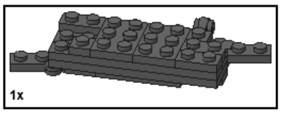
11

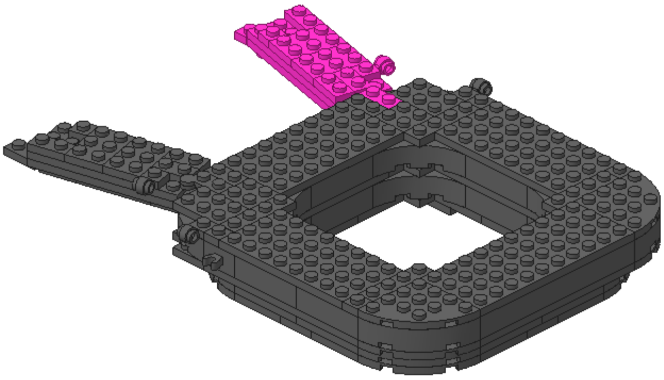

1x

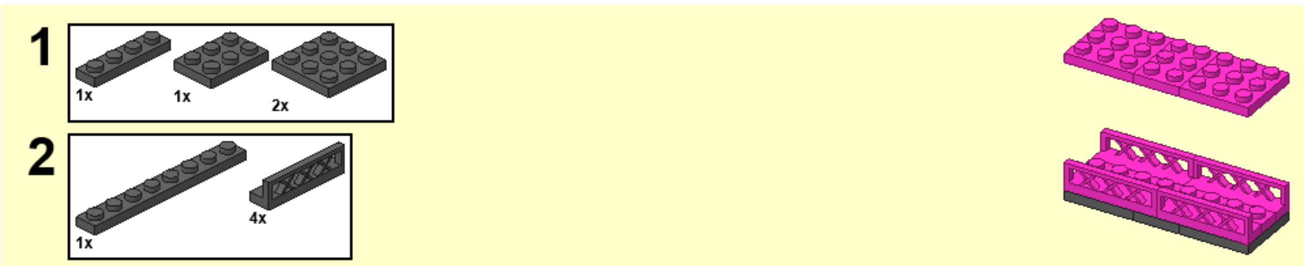



1
1x
1x
1x
1x
2
2x
2x
3
1x
1x
1x
2x
2x
1x

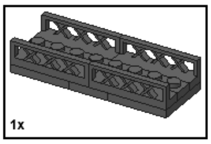
12

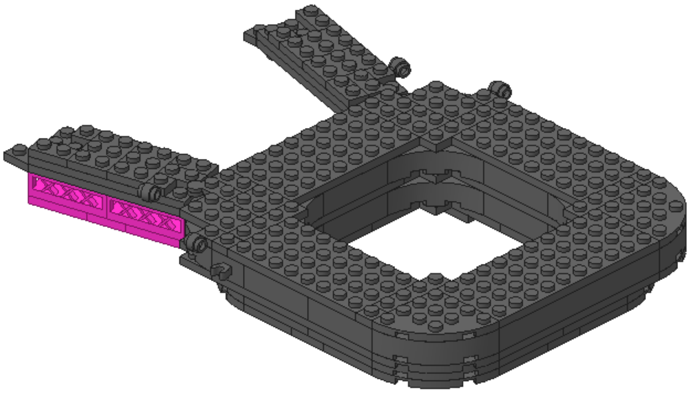

1x



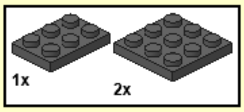

1
1x
1x
2x
2
1x
4x

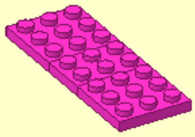
13



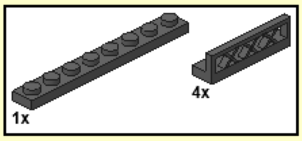


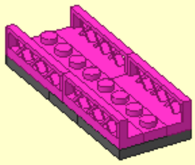
1



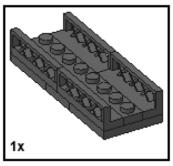


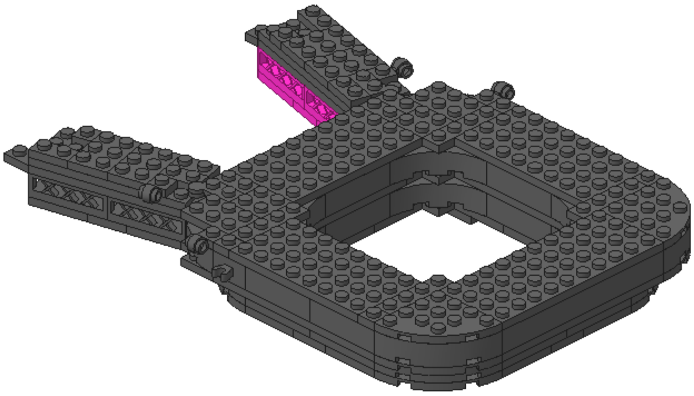
2



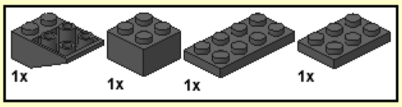


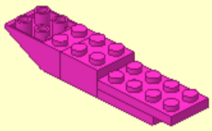
14



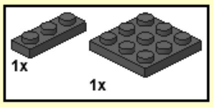


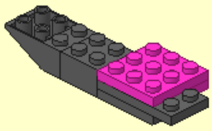
1



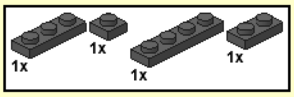


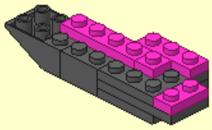
2



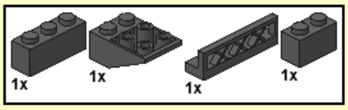


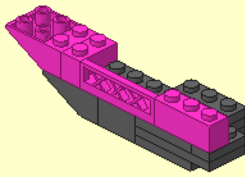
3



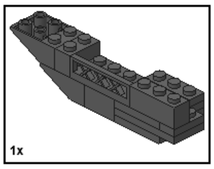


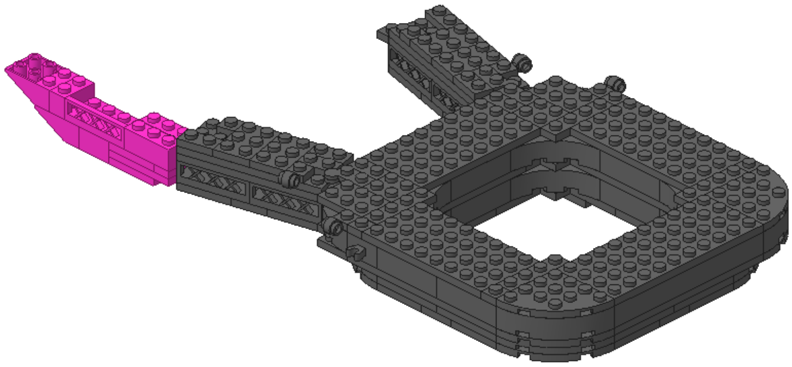
4

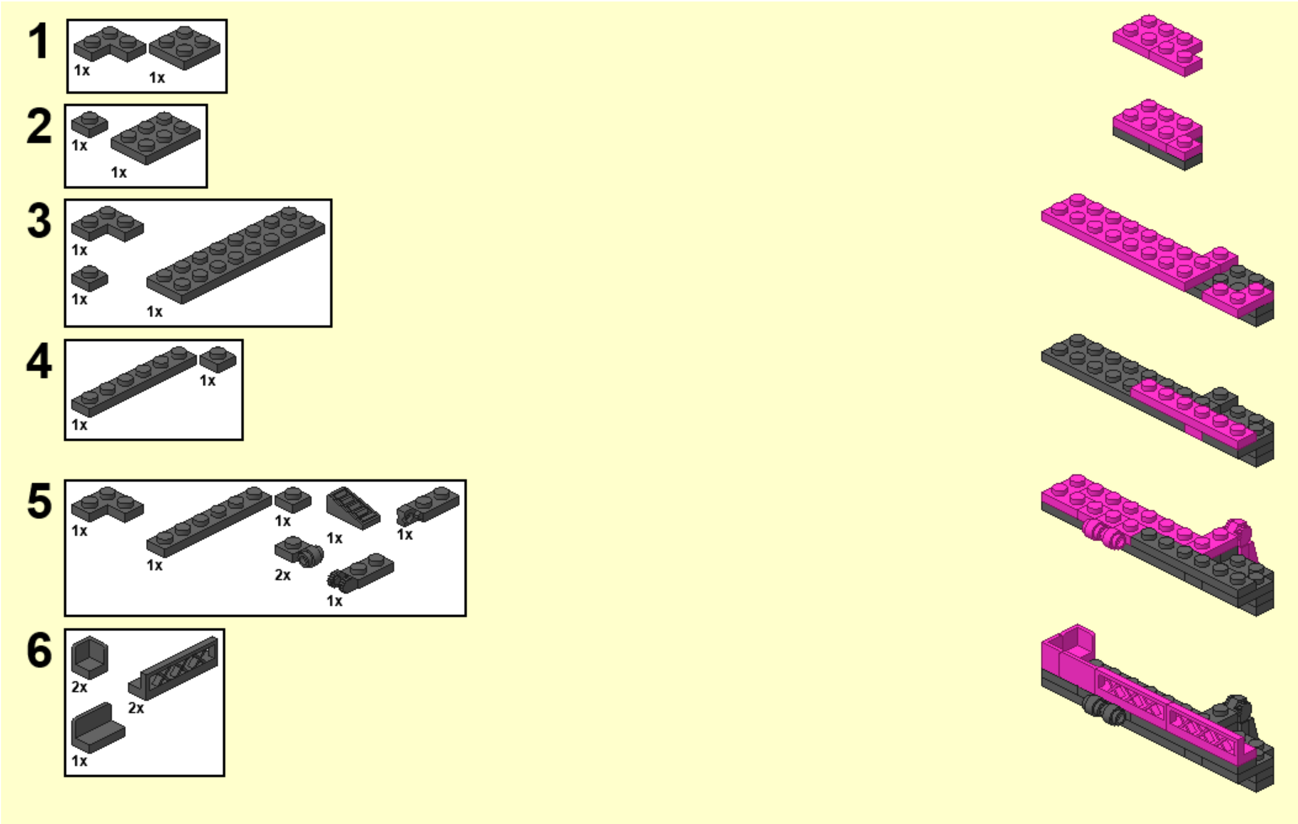




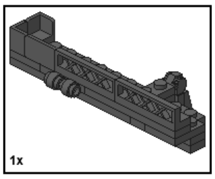
15

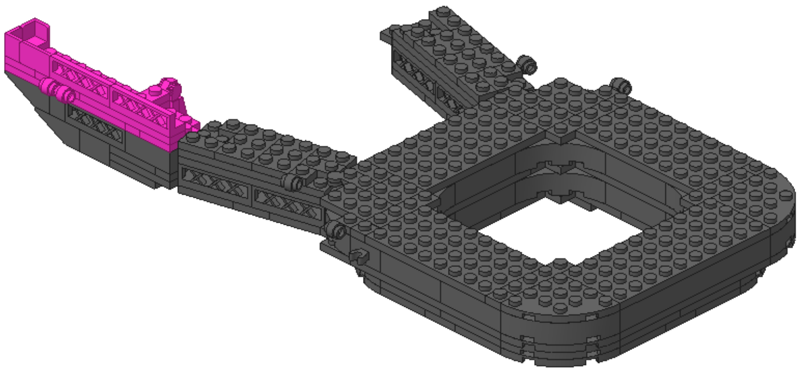

1x

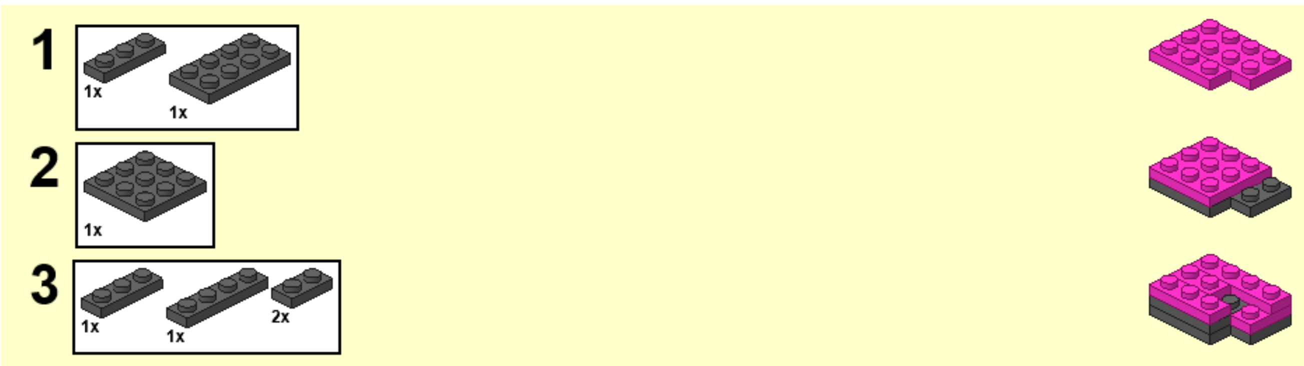


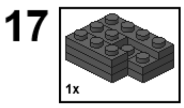

1
1x
1x
2
1x
1x
3
1x
1x
1x
4
1x
1x
5
1x
1x
1x
1x
1x
2x
1x
6
2x
2x
1x

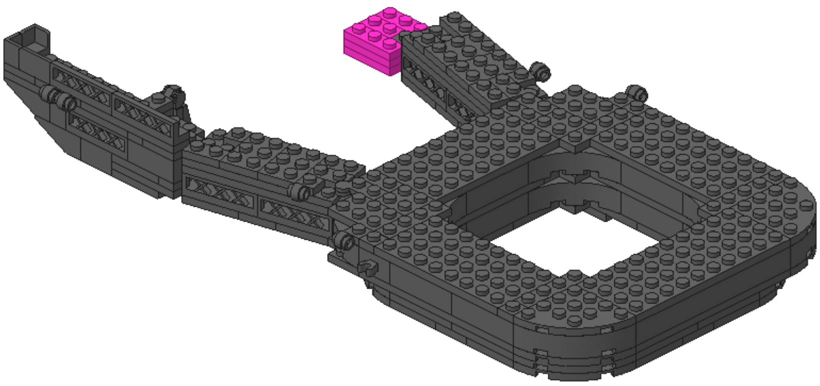
16


1x

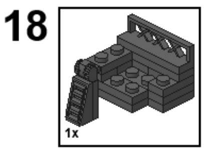


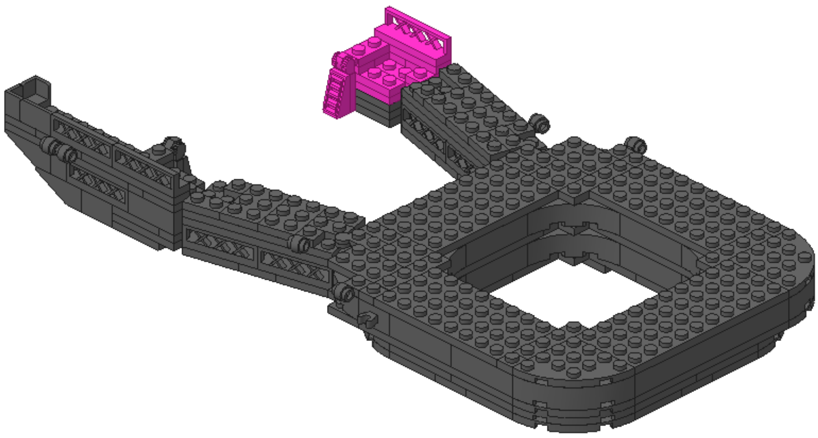

1
1x
1x
2
1x
3
1x
1x
2x

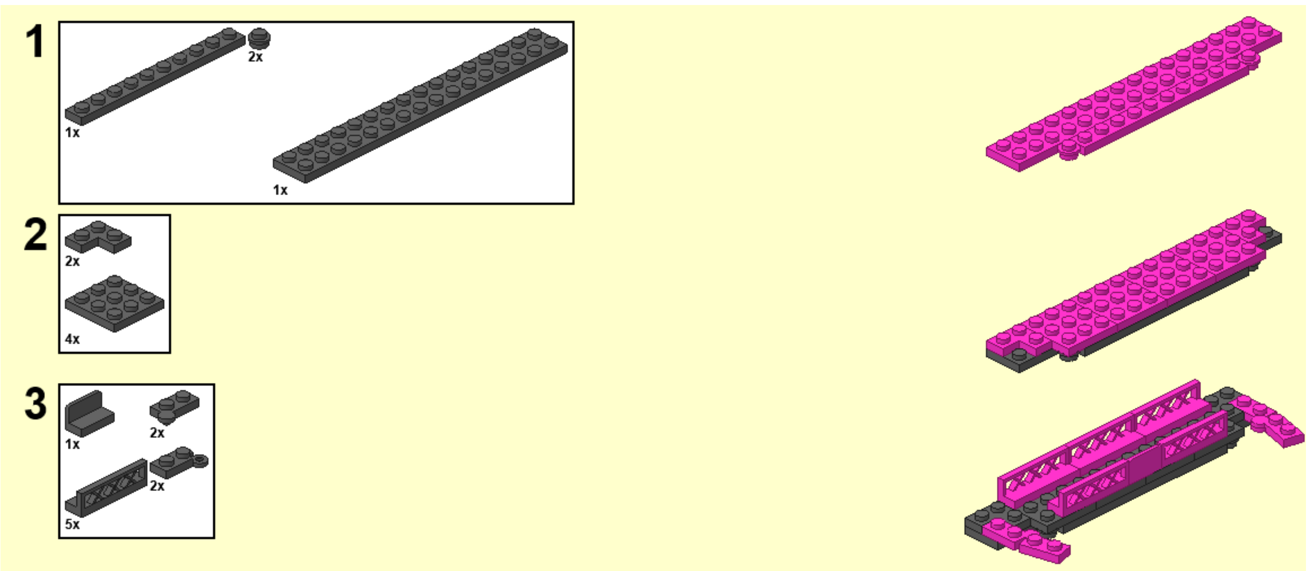

17
1x



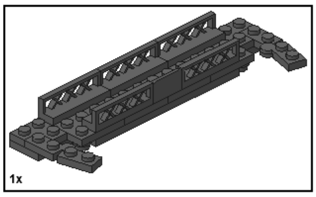

1
1x
1x
2
1x
1x
3
2x
1x
4
1x
1x
1x
1x
5
1x
1x

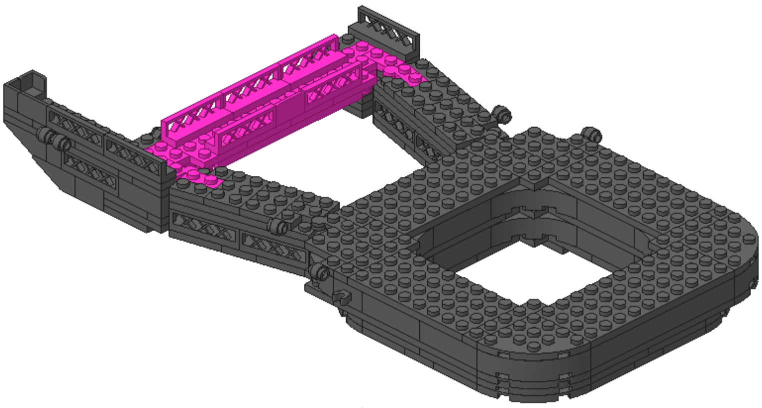

18
1x



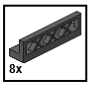

1
2x
1x
1x
2
2x
4x
3
1x
2x
2x
5x

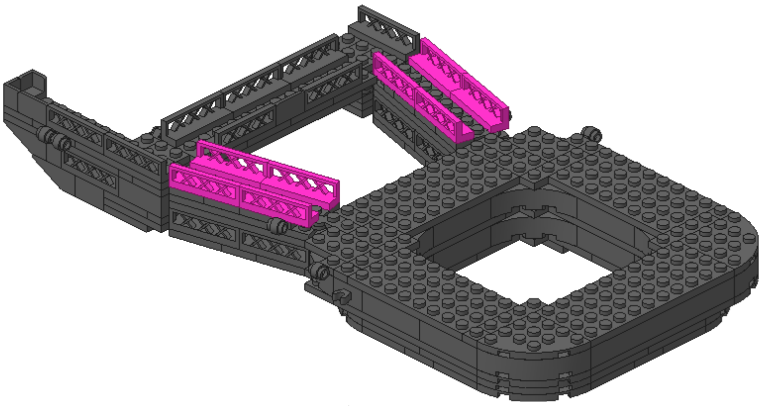
19



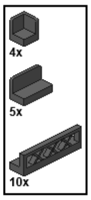


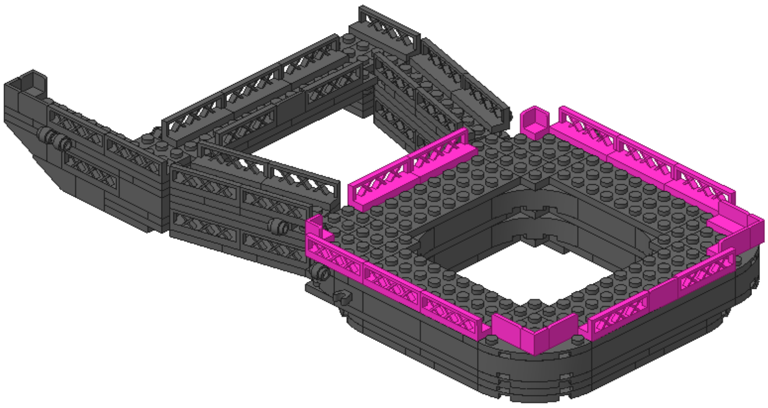
20



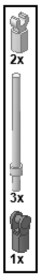


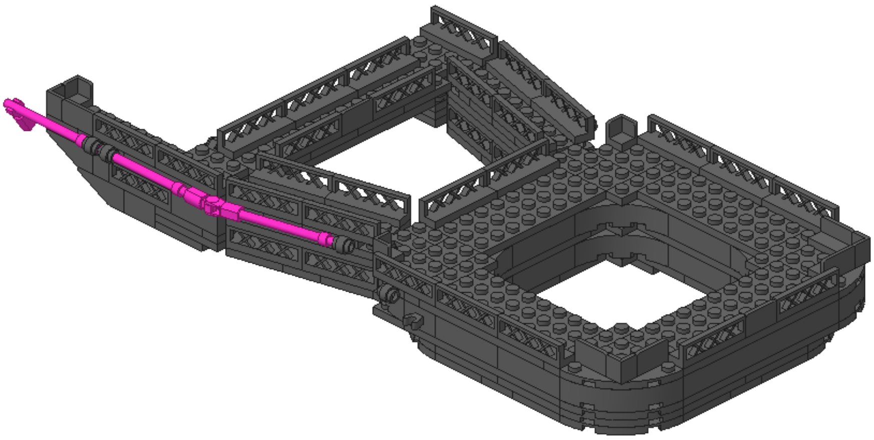
21



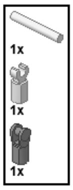


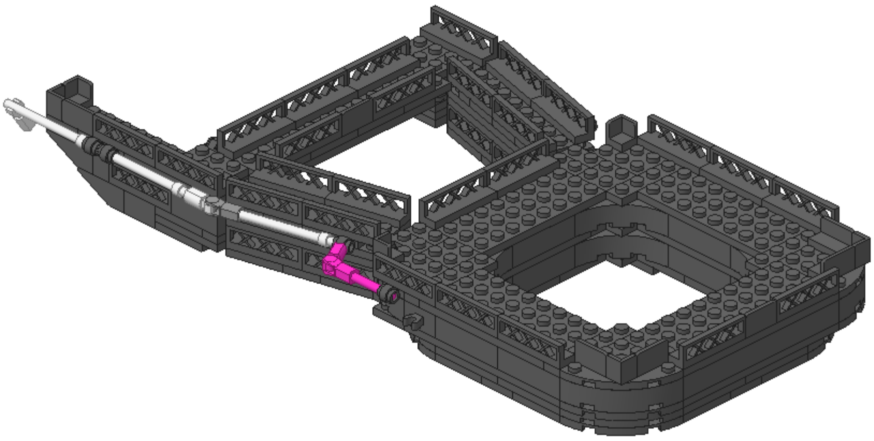
22



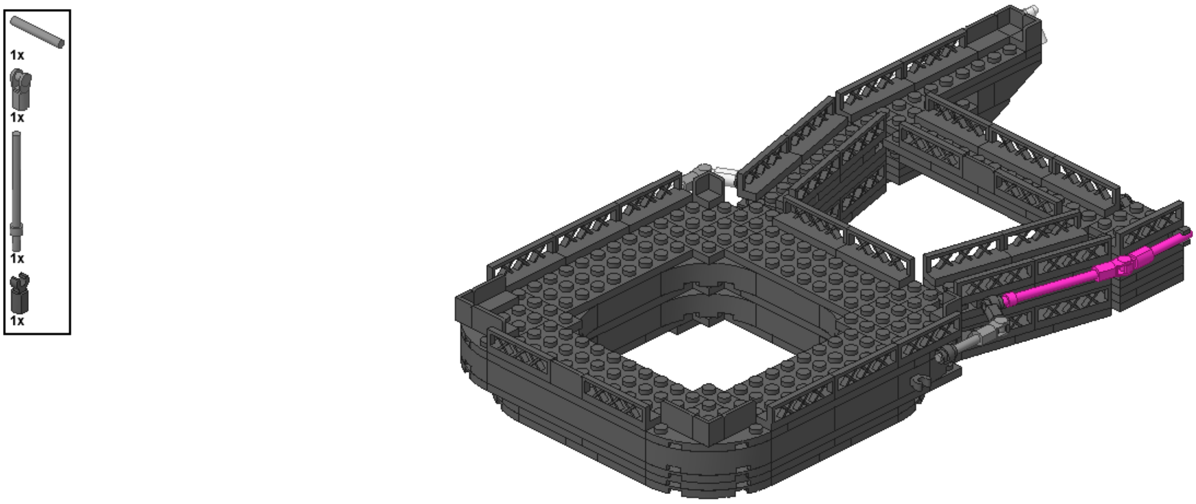


23

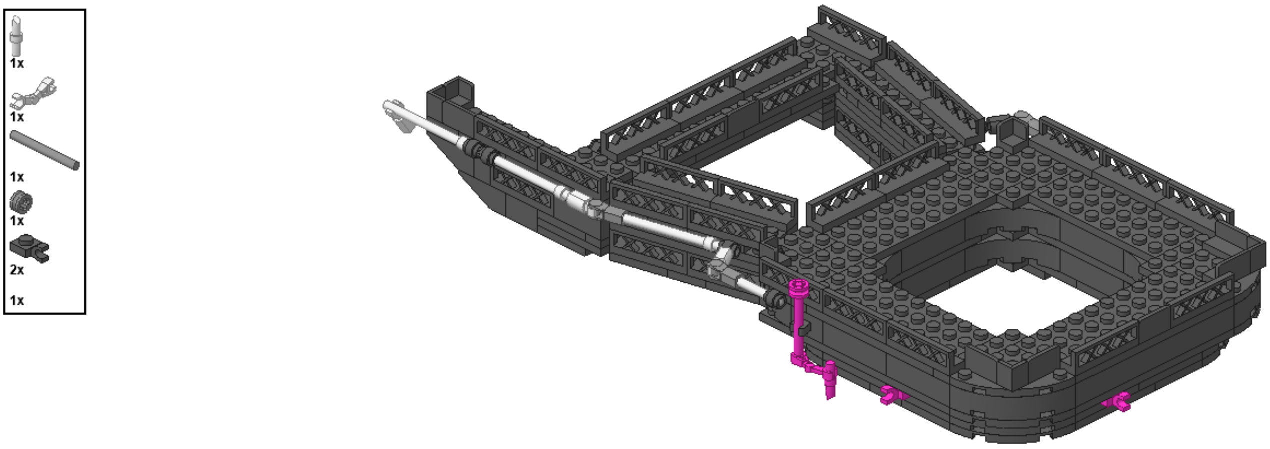




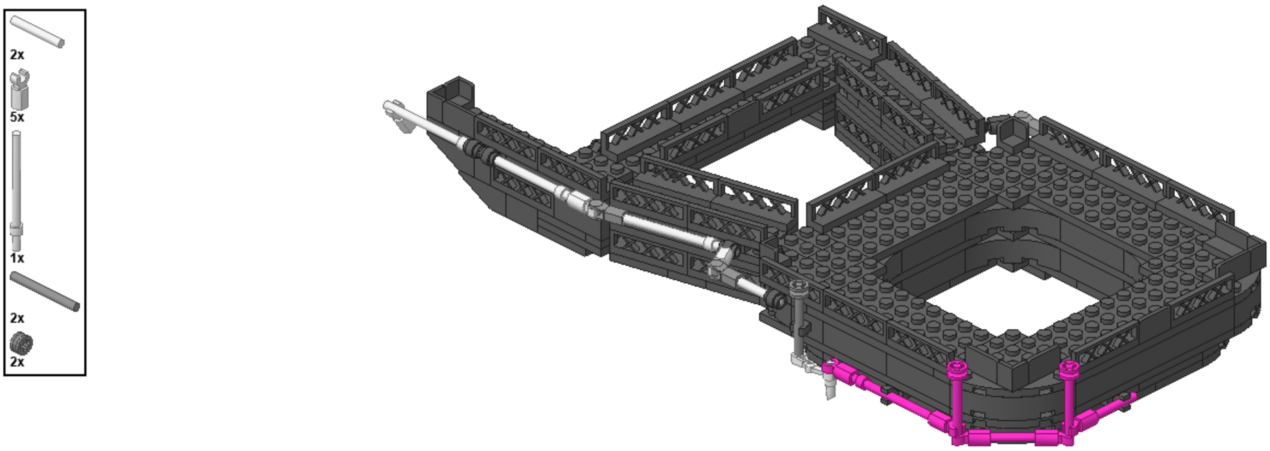
25



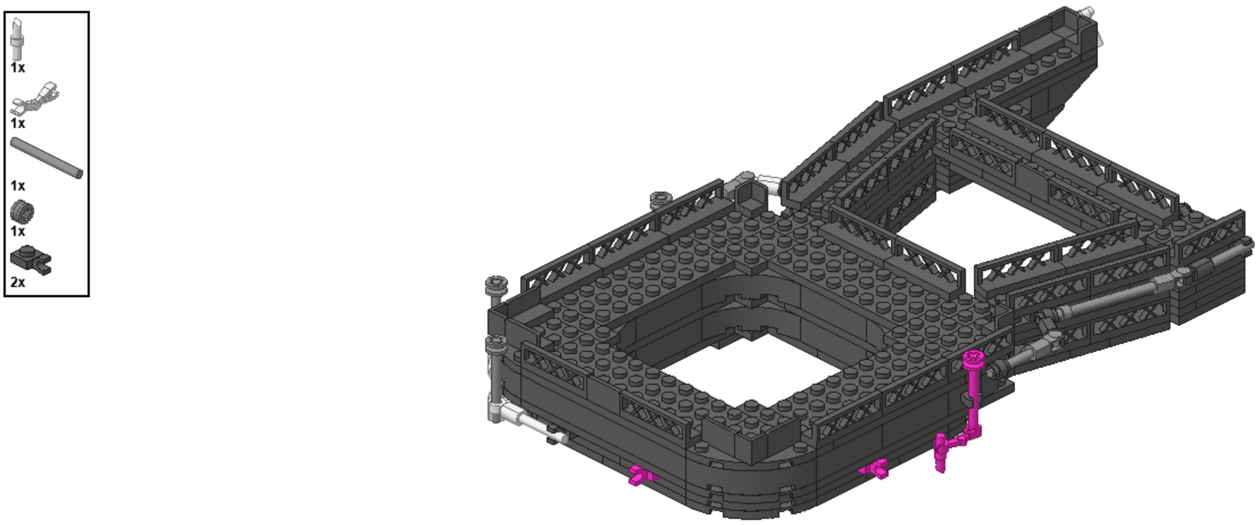
26



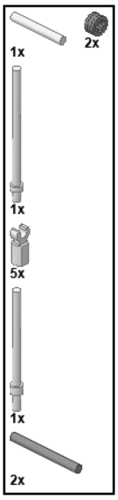
27

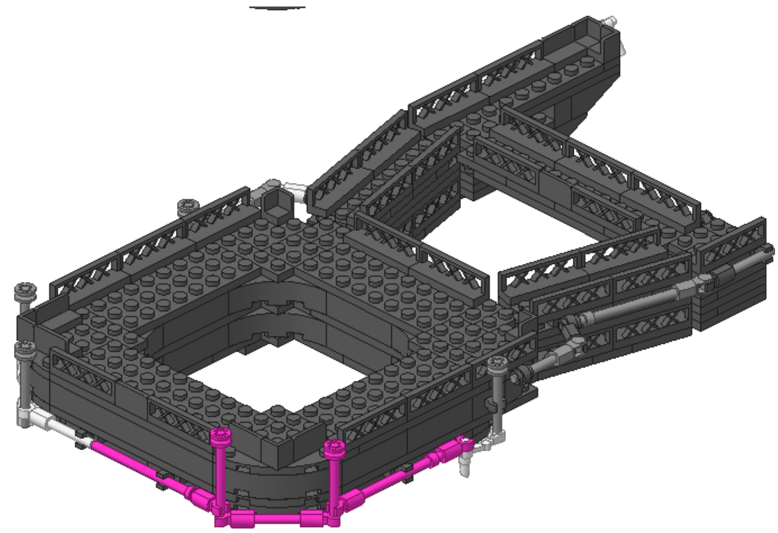


28

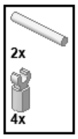


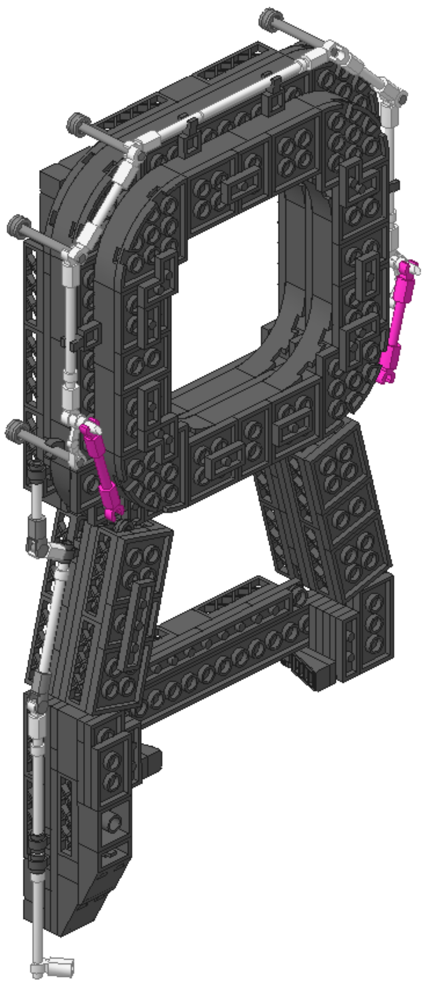
29



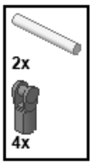


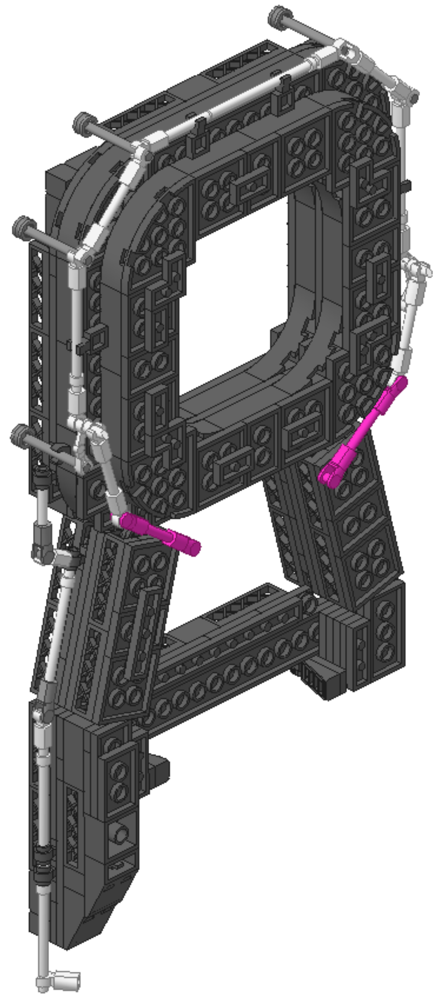
30



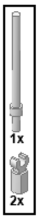


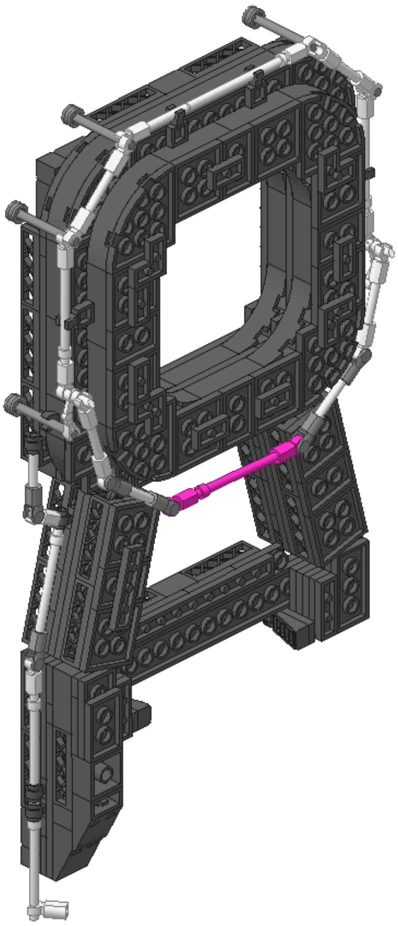
31



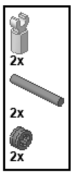


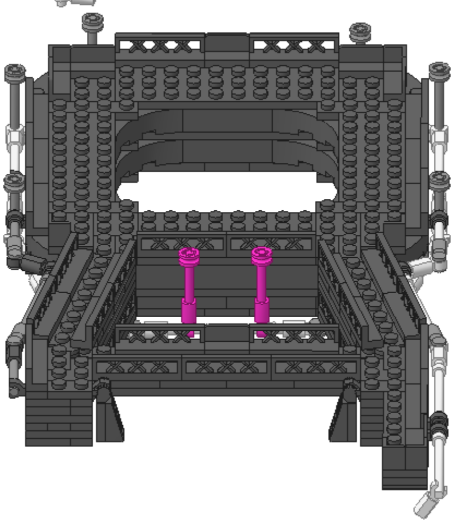
32



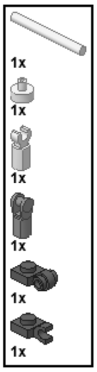


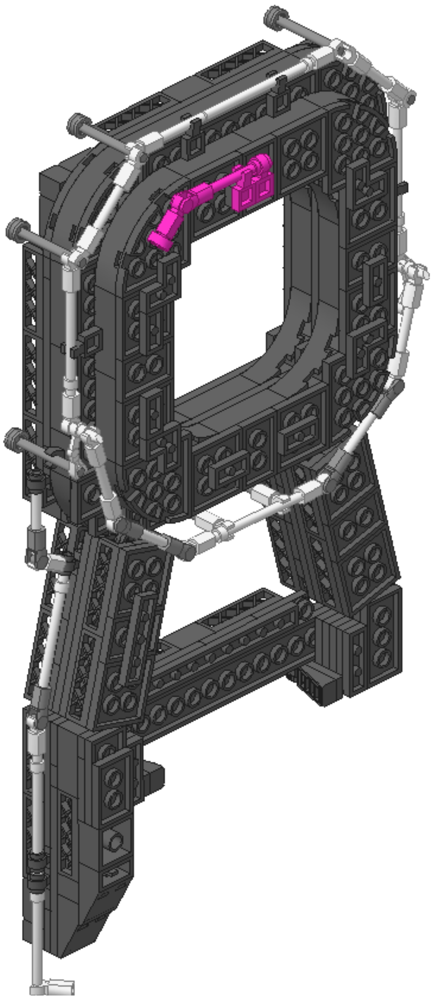
33



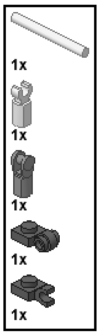


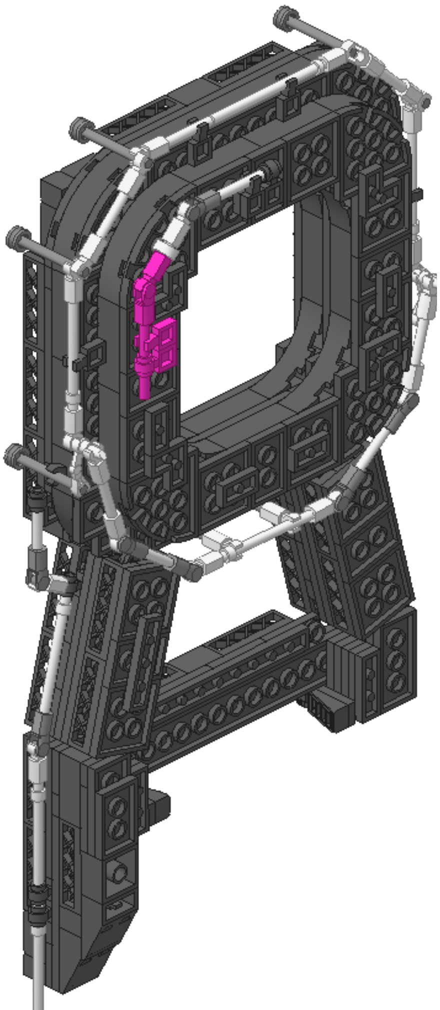
34



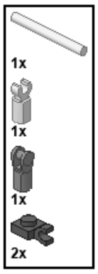


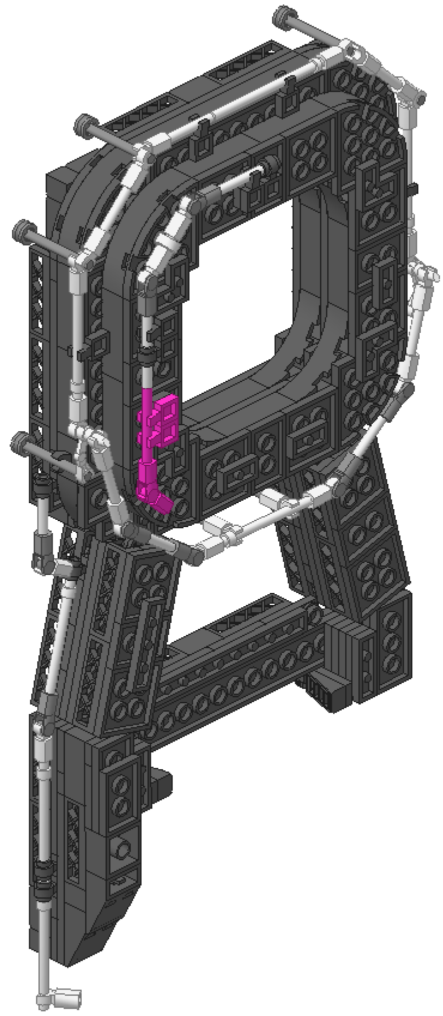
35



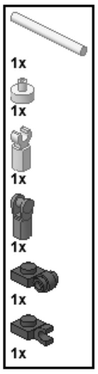


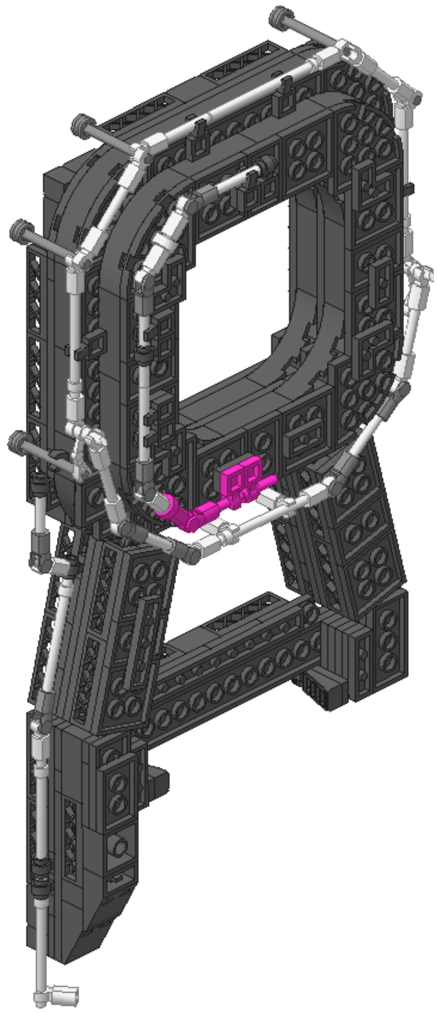
36



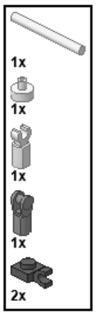


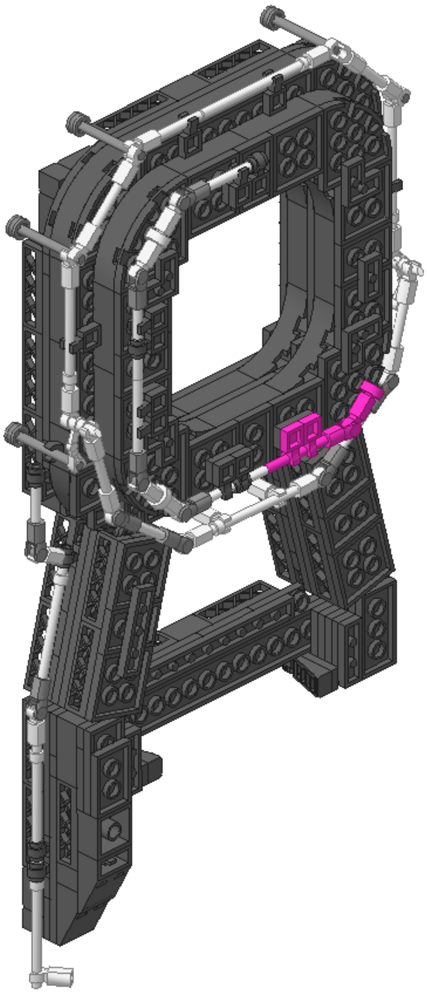
37



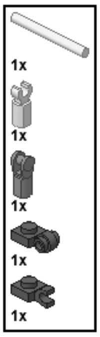


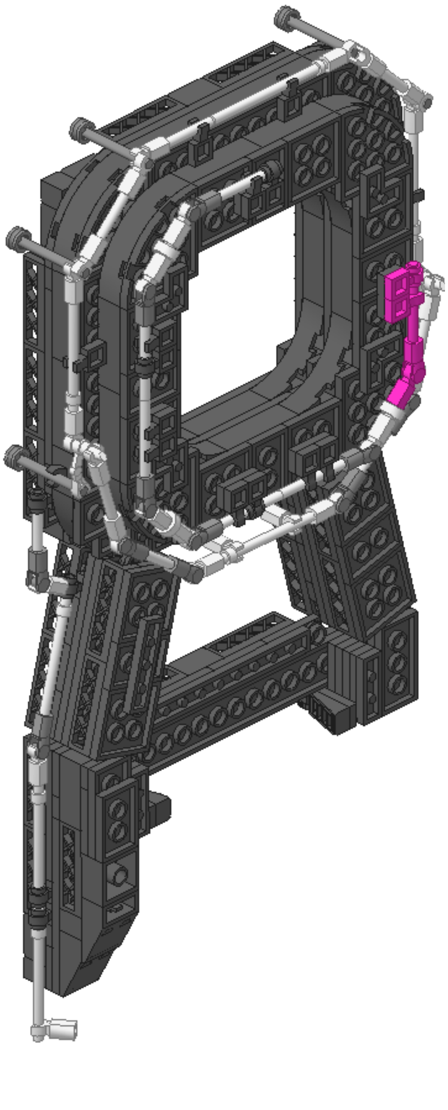
38



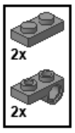


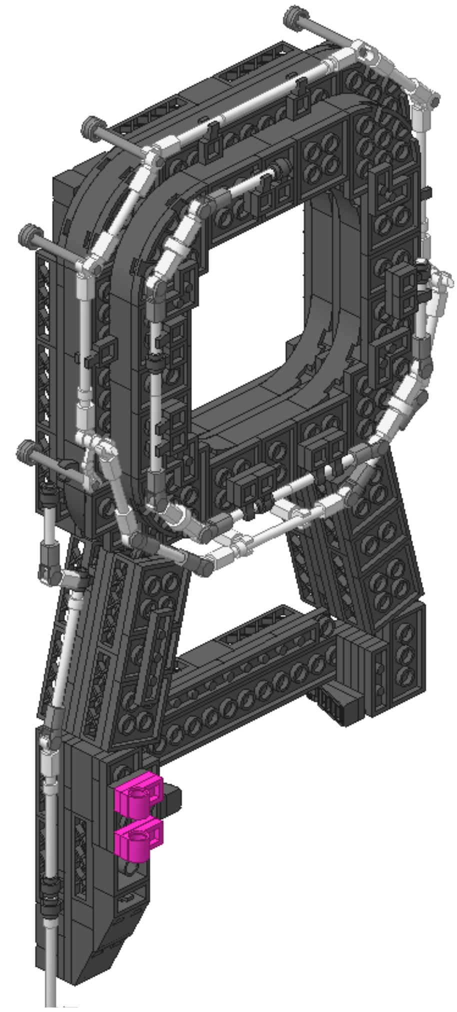
39



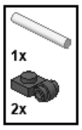


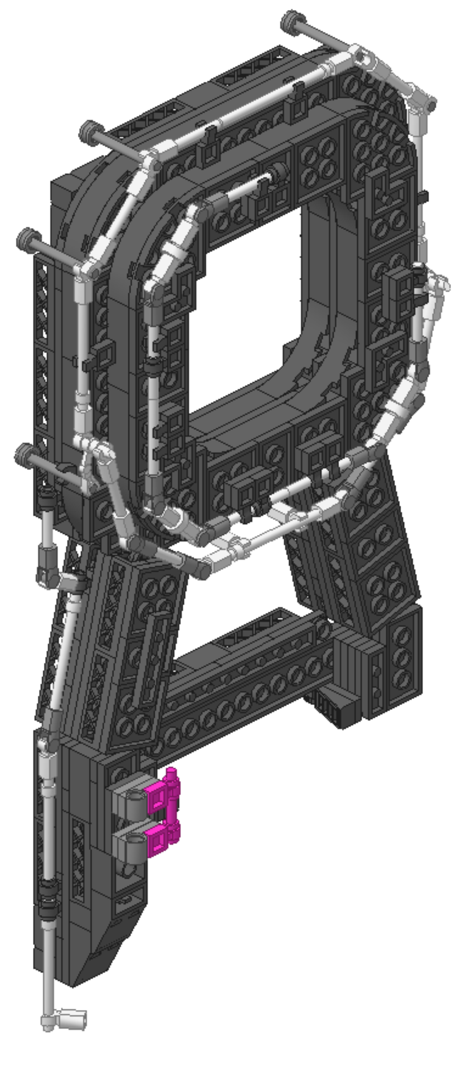
40



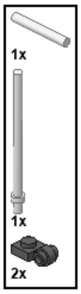


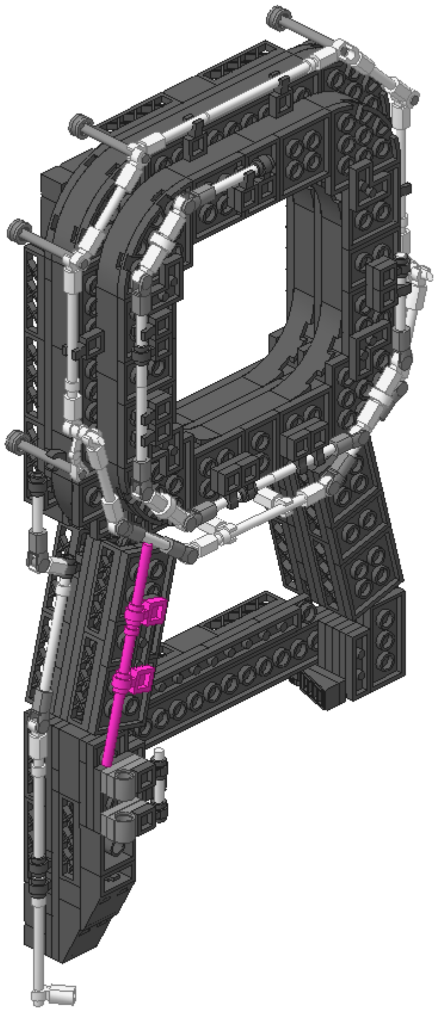
41



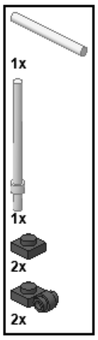


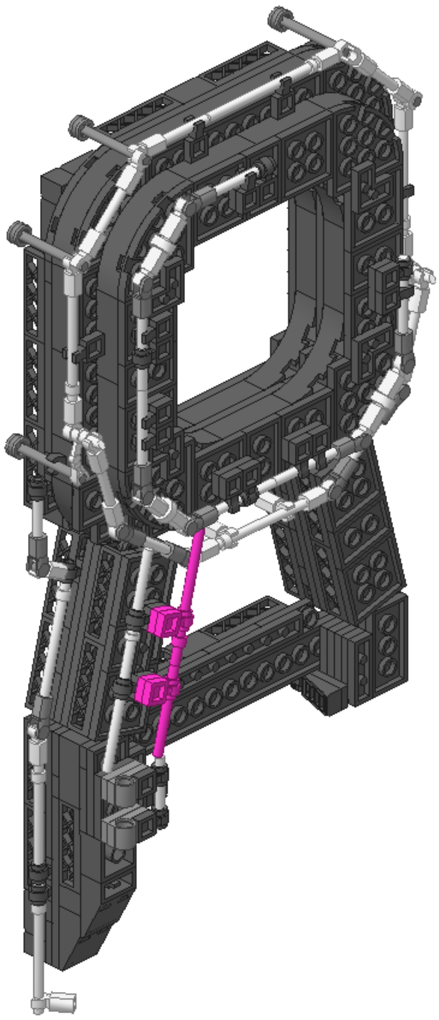
42

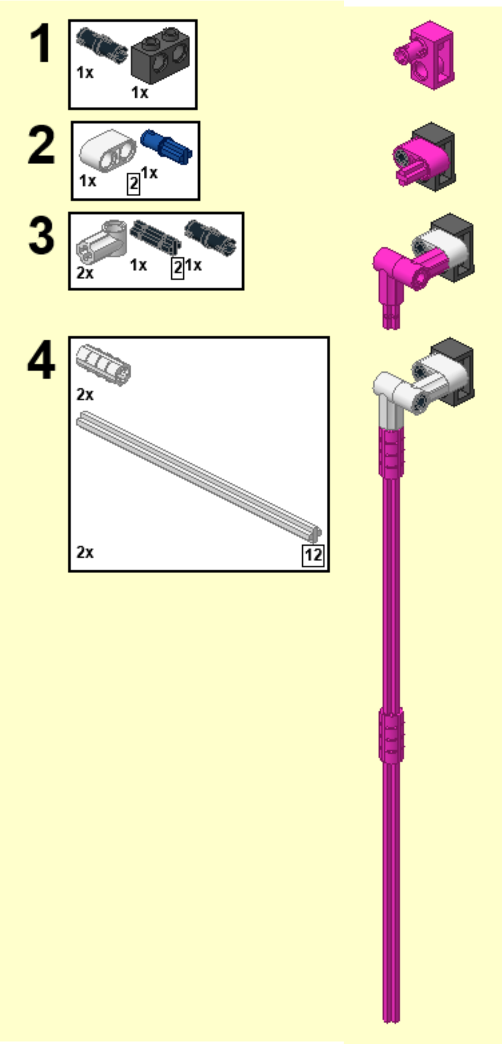




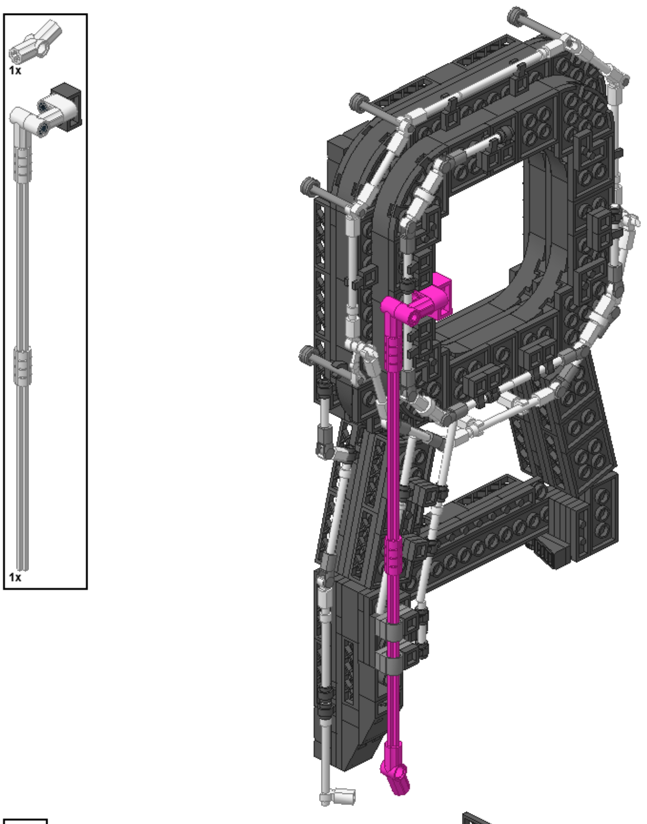
43



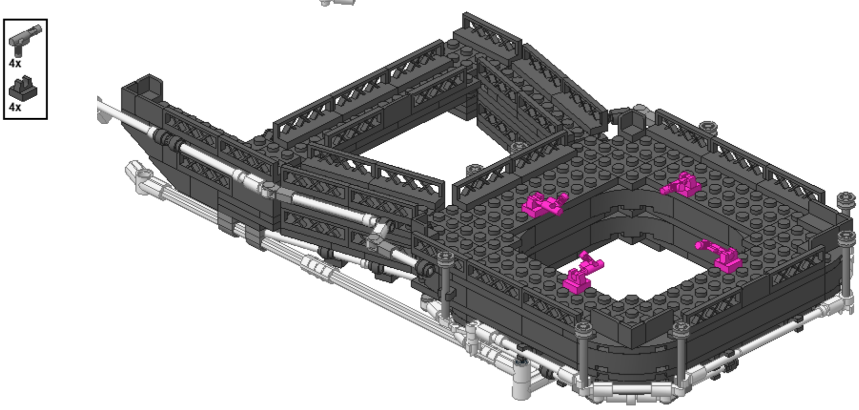


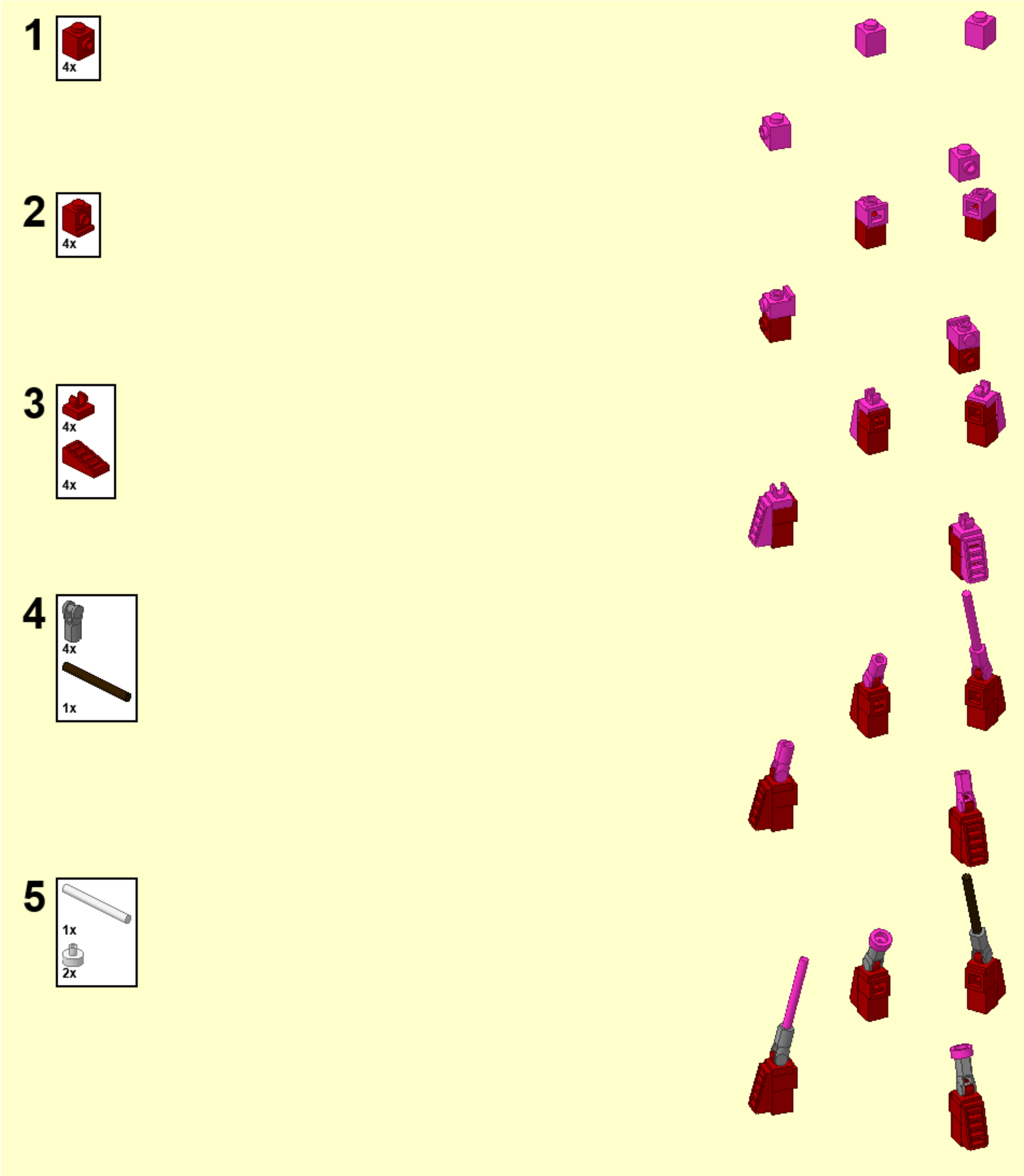


44

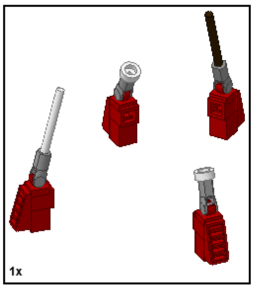


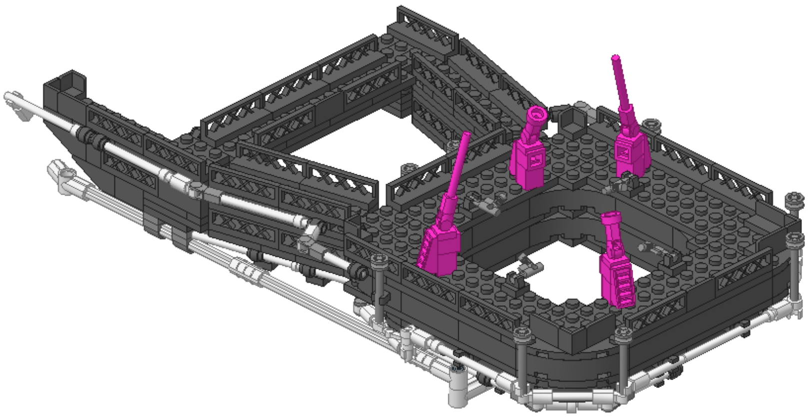
45



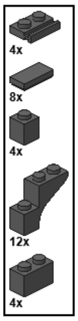

1
4x
2
4x
3
4x
4x
4
4x
1x
5
1x
2x

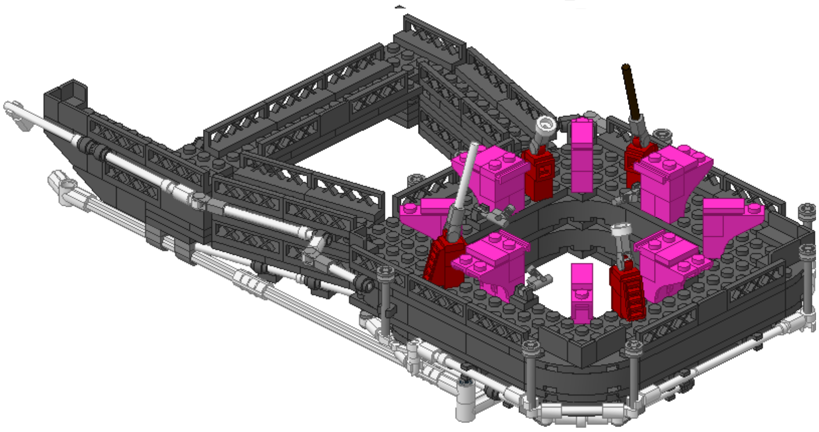
46



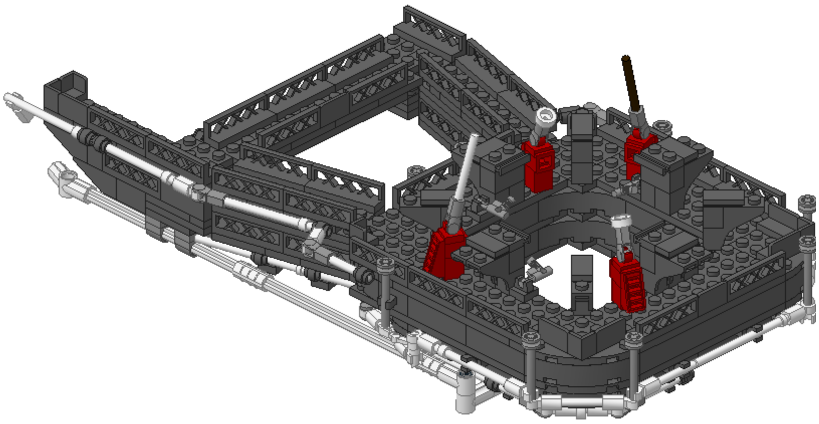


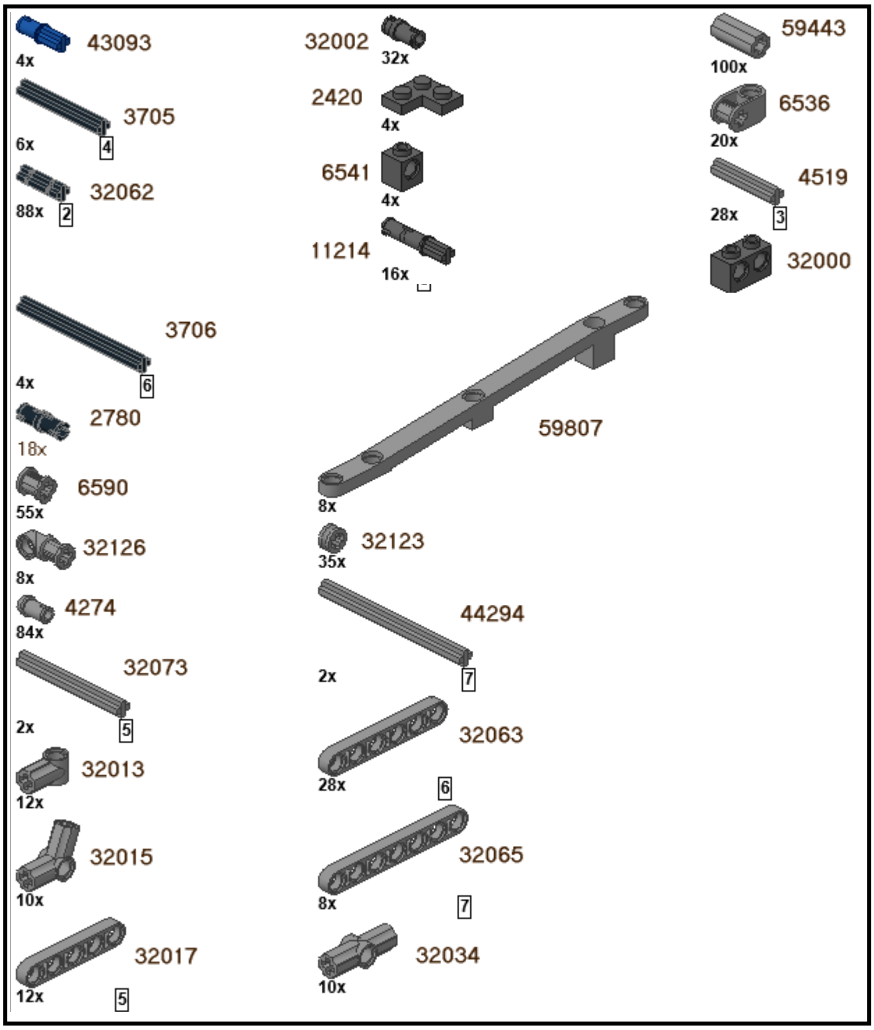
47

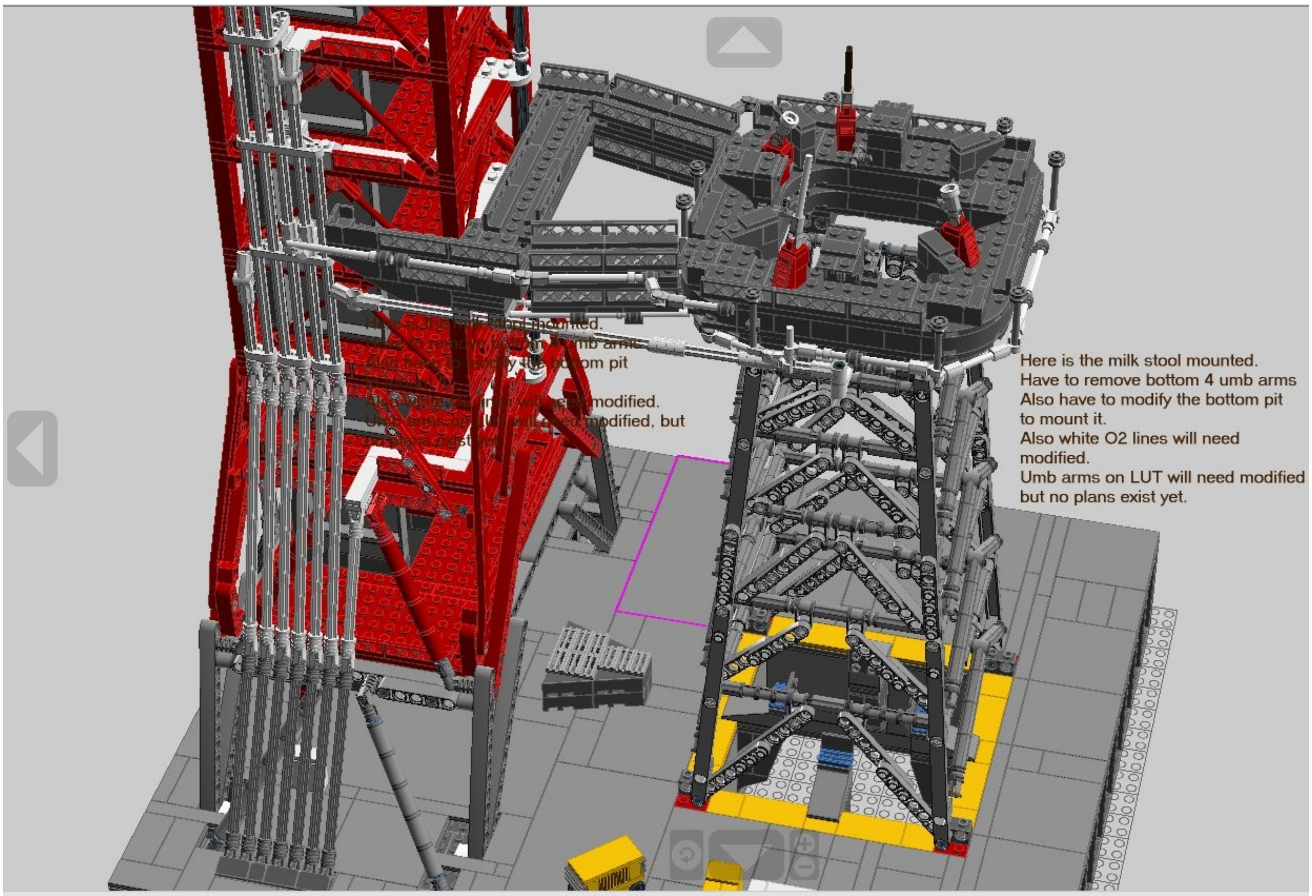


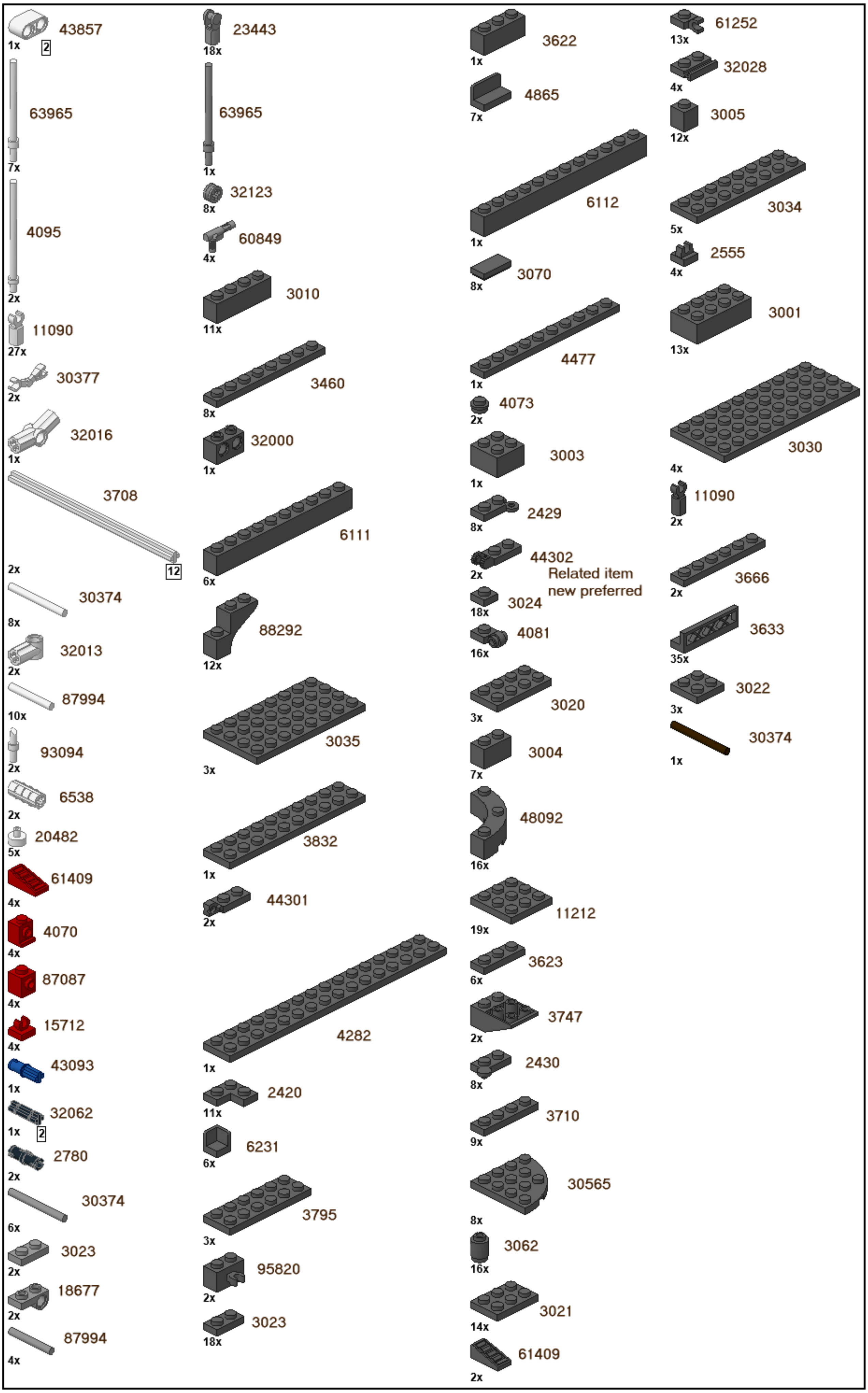


48




43093
4x
3705
6x
4
32062
88x
2
3706
4x
6
2780
18x
6590
55x
32126
8x
4274
84x
32073
2x
5
32013
12x
32015
10x
32017
12x
5
32002
32x
2420
4x
6541
4x
11214
16x
59807
8x
32123
35x
44294
2x
7
32063
28x
6
32065
8x
7
32034
10x
59443
100x
6536
20x
4519
28x
3
32000


Here is the milk stool mounted.
Have to remove bottom 4 umb arms
Also have to modify the bottom pit
to mount it.
Also white O2 lines will need
modified.
Umb arms on LUT will need modified
but no plans exist yet.


43857 1x 2
63965 7x
4095 2x
11090 27x
30377 2x
32016 1x
3708 2x 12
30374 8x
32013 2x
87994 10x
93094 2x
6538 2x
20482 5x
61409 4x
4070 4x
87087 4x
15712 4x
43093 1x
32062 1x 2
2780 2x
30374 6x
3023 2x
18677 2x
87994 4x
23443 18x
63965 1x
32123 8x
60849 4x
3010 11x
3460 8x
32000 1x
6111 6x
88292 12x
3035 3x
3832 1x
44301 2x
4282 1x
2420 11x
6231 6x
3795 3x
95820 2x
3023 18x
3622 1x
4865 7x
6112 1x
3070 8x
4477 1x
4073 2x
3003 1x
2429 8x
44302 2x
Related item
new preferred
3024 18x
4081 16x
3020 3x
3004 7x
48092 16x
11212 19x
3623 6x
3747 2x
2430 8x
3710 9x
30565 8x
3062 16x
3021 14x
61409 2x
61252 13x
32028 4x
3005 12x
3034 5x
2555 4x
3001 13x
3030 4x
11090 2x
3666 2x
3633 35x
3022 3x
30374 1x

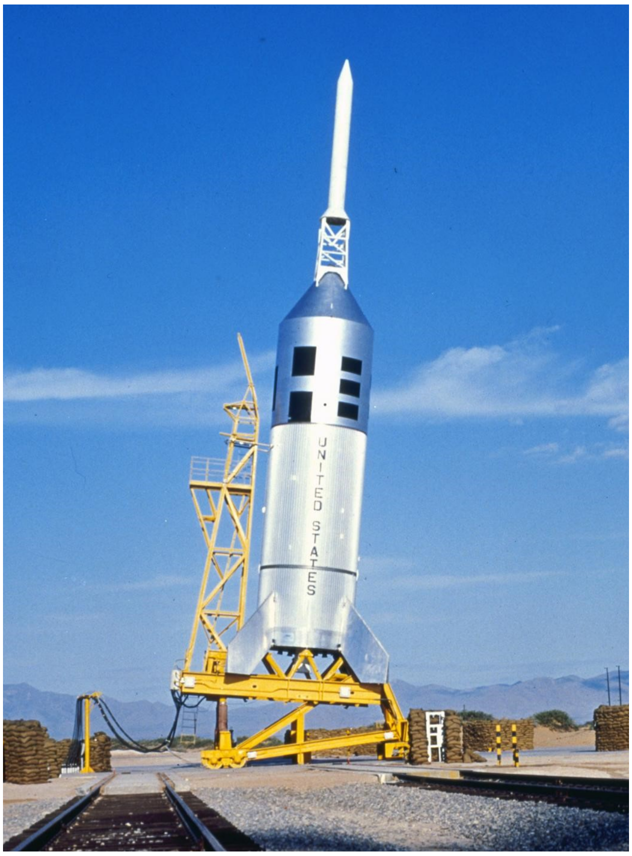
Little Joe II

Little Joe II was as small testbed used in the development of the Apollo Command Module (CSM). Little Joe II could be fitted with varying rocket engines selected according to the mission profile and launched its payload, the CMS, several miles into the air to test reentry procedures, parachutes and the and the Launch Escape System on top of the Apollo Crew Capsule. Little Joe II conducted four successful and one partly successful launches from 1963-66.

One of the most central aspects of Apollo was the development of a space capsule able to house, protect and supply three astronauts in space for several days. Part of the development were extensive tests, some of which had to be conducted in flight. The Little Joe program for Mercury had been used in testing the launch escape system for the Mercury spacecraft from 1959–60 with excellent results, so the Apollo program followed the same approach to develop and construct a specialized launch vehicle for testing purposes.

When NASA awarded the initial Apollo contract to North American Aviation on November 28, 1961, it was still assumed the lunar landing would be achieved by direct ascent rather than by lunar orbit rendezvous. Therefore, design proceeded without a means of docking the command module to a lunar excursion module (LEM). But the change to lunar orbit rendezvous, plus several technical obstacles encountered in some subsystems (such as environmental control), soon made it clear that substantial redesign would be required. 1963, NASA decided the most efficient way to keep the program on track was to proceed with the development in two versions, Block I and Block II, with Block II incorporating lessens learned.

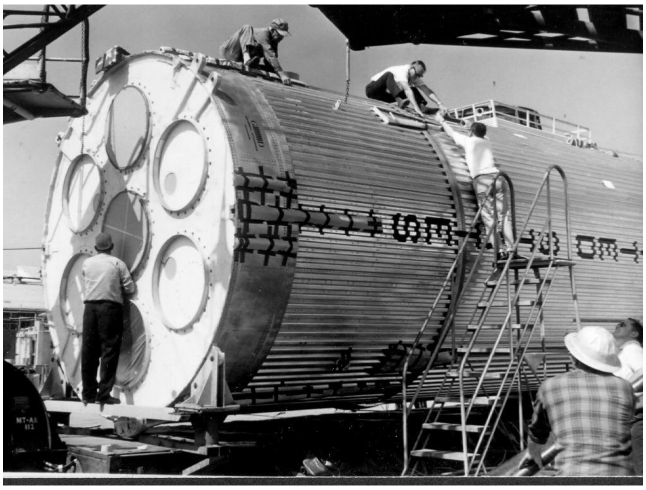
Meanwhile, fabrication of the detail parts for the first Little Joe II rocket started in August 1962, and the final factory systems checkout was completed in July 1963. There was an original fixed-fin configuration and a later version using flight controls. The vehicle was sized to match the diameter



Above: Little Joe on the launch platform, Dezember 1964
Credit: NASA

Overleaf: S65-19755 - White Sands Missile Range Little Joe II/BP-22 (Mission A-003) .
Credit: NASA

of the Apollo spacecraft service module and to suit the length of the Algol rocket motors. Aerodynamic fins were sized to assure that the vehicle was inherently stable. The structural design was based on a gross weight of 100,000 kg, of which 36,000 kg was payload. Little Joe II was also designed for sequential firing with a possible 10-second overlap of four first-stage and three second-stage sustainer motors, this extending range and altitude. Sustainer thrust



Little Joe II being inspected before shipment. The Six openings fot the Algol solid motor rocket engines are clearly visible.
Credit: NASA

was provided by Algol solid-propellant motors. Versatility of performance was achieved by varying the number and firing sequence of the primary motors (capability of up to seven) required to perform the mission. Recruit rocket motors were used for booster motors as required to supplement lift-off thrust.

The Little Joe II launch vehicle proved to be very acceptable for use in this program. Two difficulties were experienced. The qualification test vehicle (QTV) did not destruct when commanded to do so because improperly installed primacord did not propagate the initial detonation to the shaped charges on the Algol motor case. The fourth mission (A-003) launch vehicle became uncontrolled about 2.5 seconds after lift-off when an aerodynamic fin moved to a hard over position as the result of an electronic failure. These problems were corrected and the abort test program was successfully completed.

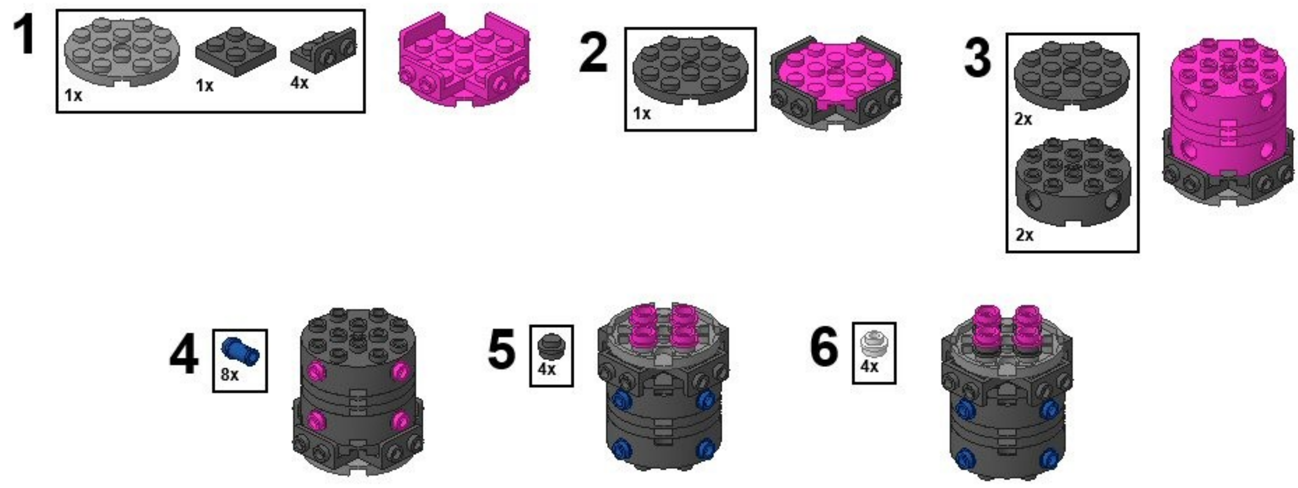
With the results incoming, by January 1964 North American started presenting Block II design details to NASA. Block I spacecraft were used for all unmanned Saturn 1B and Saturn V test flights. However, the Apollo 1 fire on Feb 21st 1967 which killed all three astronauts (Gus Grissom, Ed White and Roger Chaffee) revealed serious design, construction and maintenance shortcomings in Block I, many of which had been carried over into Block II command modules being built at the time.

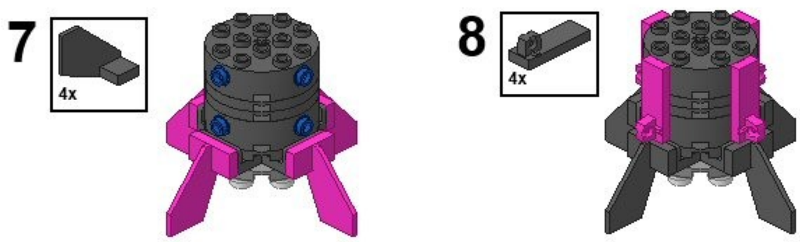
After a thorough investigation Block II incorporated a revised CM heat shield design, which was tested on the unmanned Apollo 4 and Apollo 6 flights, so the first all-up Block II spacecraft flew on the first manned mission, Apollo 7.

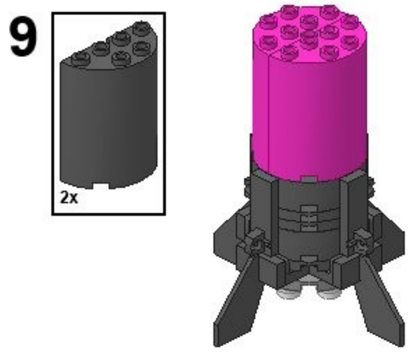
Datasheet Little Joe II

General	
Name	Little Joe II
Function	Apollo launch escape system testing
Manufacturer	General Dynamics/Convair
Country of origin	United States
Cost per Launch	
Family	Saturn
Size	
Height	1,032 inches (26.2 m) with payload
Diameter	154 inches (3.9 m)
Width	341 inches (8.7 m) at fins
Mass	25,900 to 80,300 kg
Stages	1
Capacity	
Payload suborbital	32,445 pounds (14,717 kg)
Payload to LEO	n/a
Launch history	
Status	Retired
Launch sites	Launch complex 36, White Sands Missile Range, New Mexico
Total launches	5
Successes	4
Failures	1
Partial failures	
First flight	August 28, 1963
Last flight	January 20, 1966
Notable payloads	

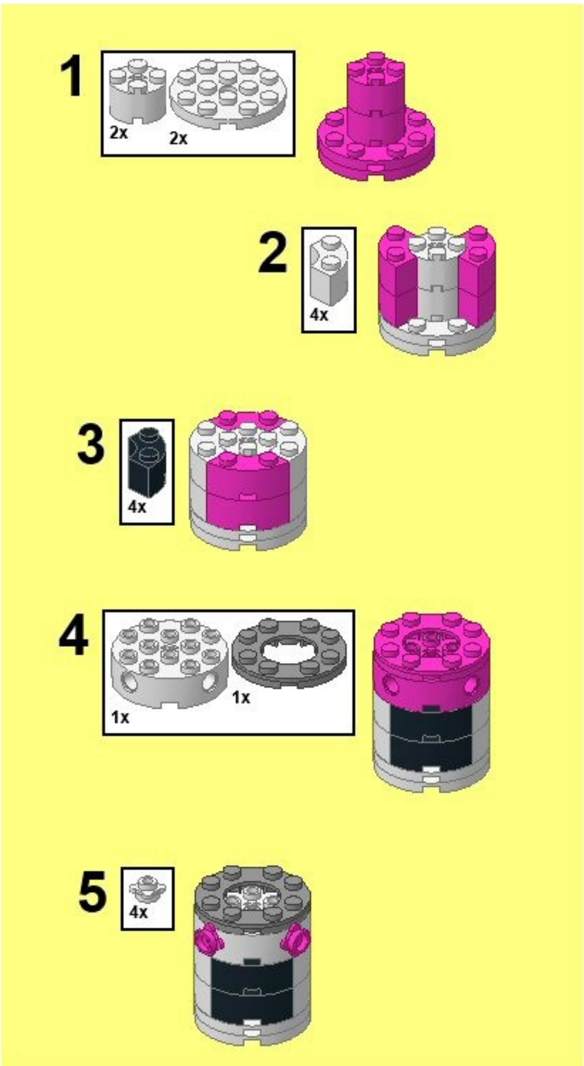
Boosters	
No. Boosters	6
Engines	1 Thiokol 1.5KS35000 Recruit
Thrust	38,000 pounds-force (170 kN)
Isp	228,000 pounds-force (1,010 kN)[1]
Burn time	~1.53 s
Fuel	Solid
Length	
Diameter	
First stage	
Engines	1 Aerojet Algol 1-D sustainer
Thrust	105,100 pounds-force (468,000 N)[2]
Isp	
Burn time	~40 s
Fuel	Solid
Gross mass	
Empty mass	
Length	
Diameter	
Model	
Year Created	2017
Author	Grant Passmore/eiffleman
Parts count	73 (Rocket)
Diameter	
Height	
Weigth	
Link Rocket	https://ideas.lego.com/projects/d061bd70-11e7-4805-b5a7-dcfa21d15030/updates?project_updates_page=2
Link Launcher	https://ideas.lego.com/projects/0f8efc2a-ce0a-4285-9f2b-036bf3eb9f38/updates

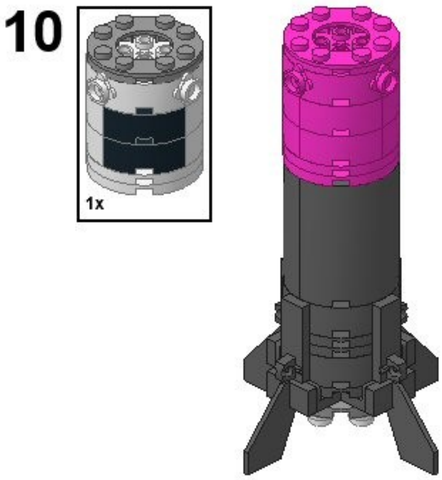


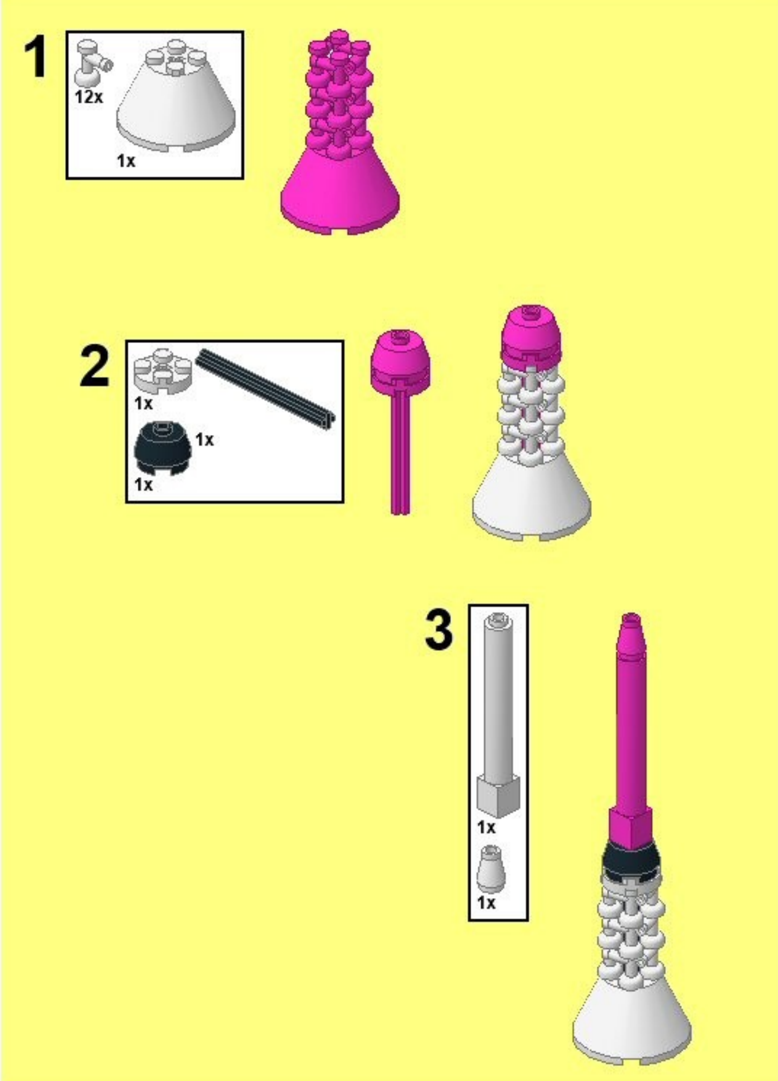


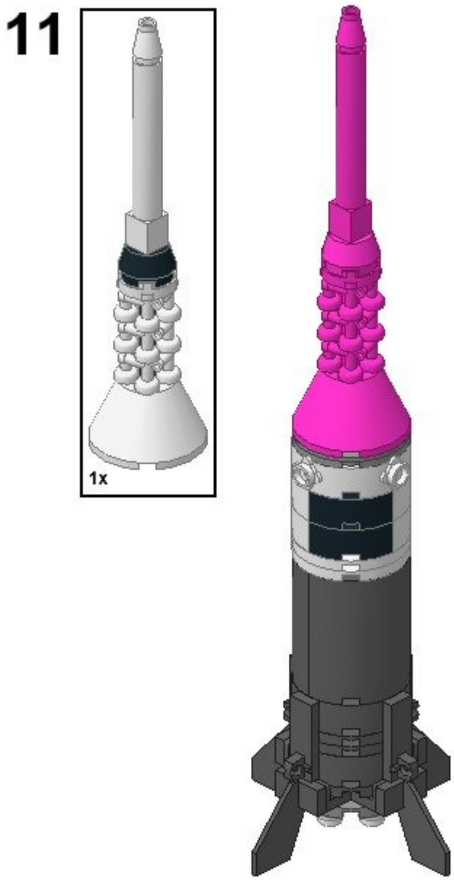


A design by Eiffleman

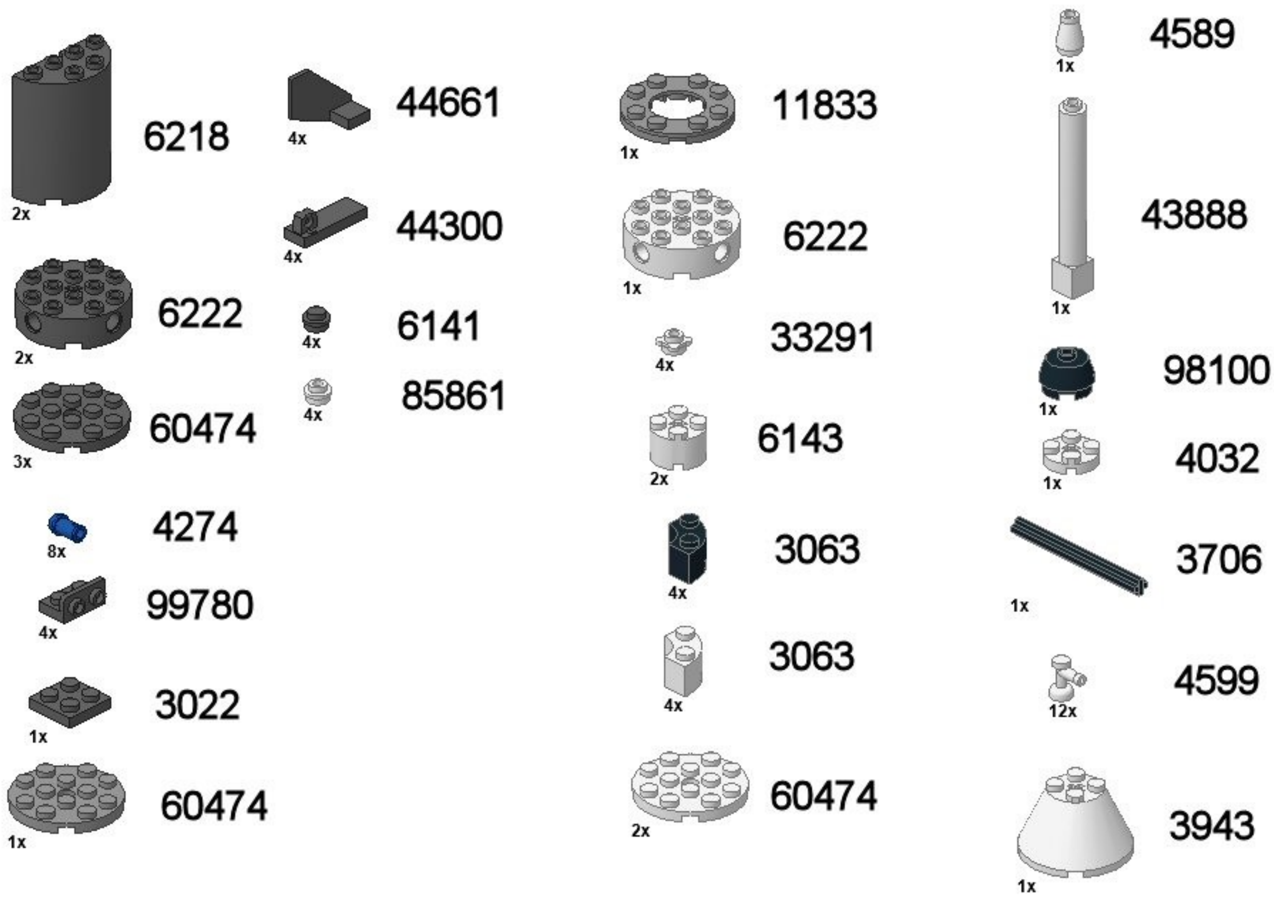


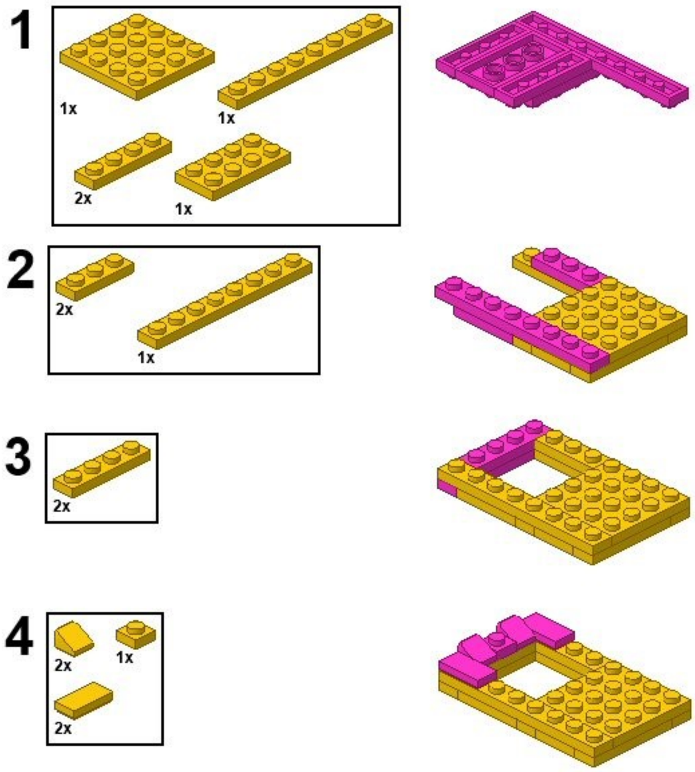




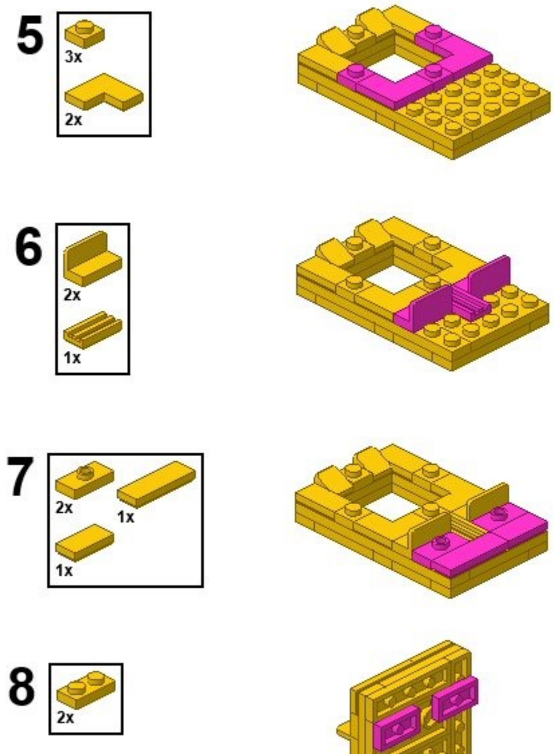


Little Joe II - Parts List

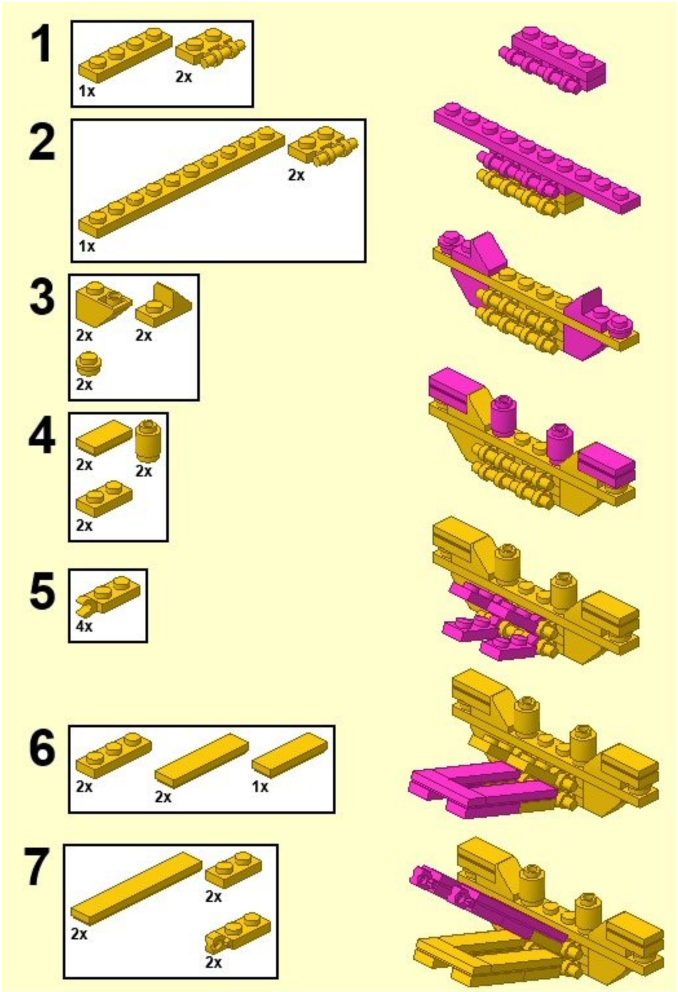


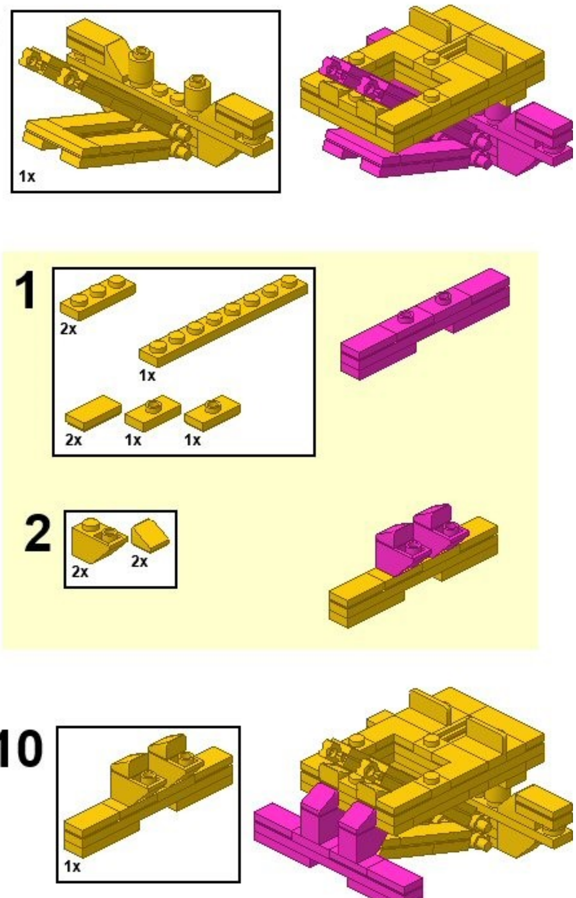


'Little Joe II' Launcher
by Eiffleman



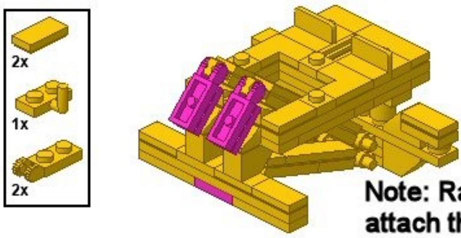
Note: Main step 9's
1x1 round bricks
hollow studs connect
the pins in these two
1x2 plates





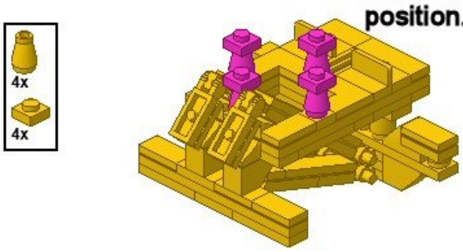
'Little Joe II' Launcher
by Eiffleman

11

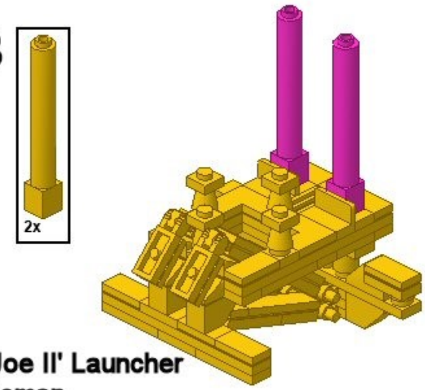


Note: Raise the arm and attach the end pieces. Set at 90º and lower the arm into position. It will click into place

12

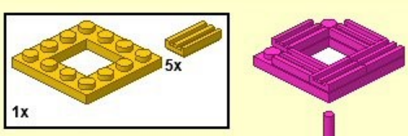


13

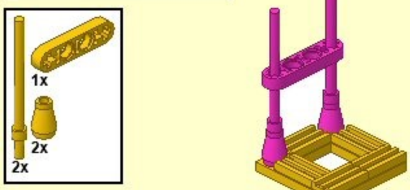


'Little Joe II' Launcher
by Eiffleman

1

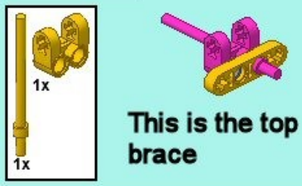


2



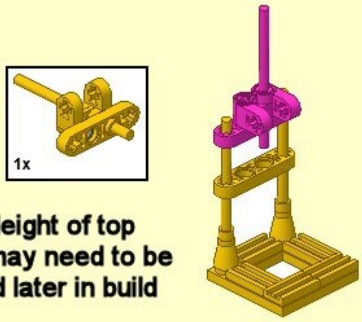
1

2



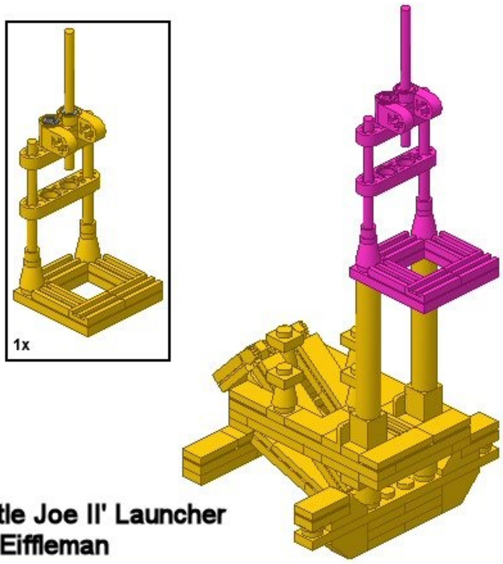
This is the top brace

3



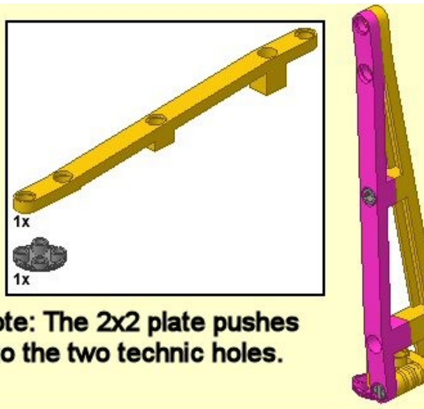
Note: Height of top brace may need to be adusted later in build

14



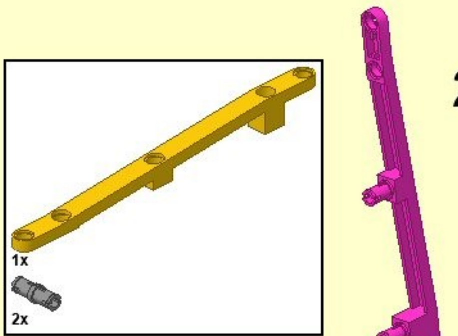
'Little Joe II' Launcher
by Eiffleman

3

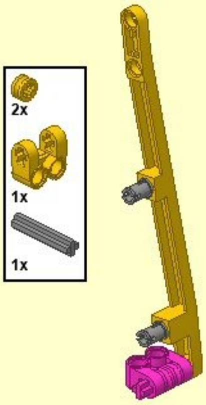


Note: The 2x2 plate pushes into the two technic holes.

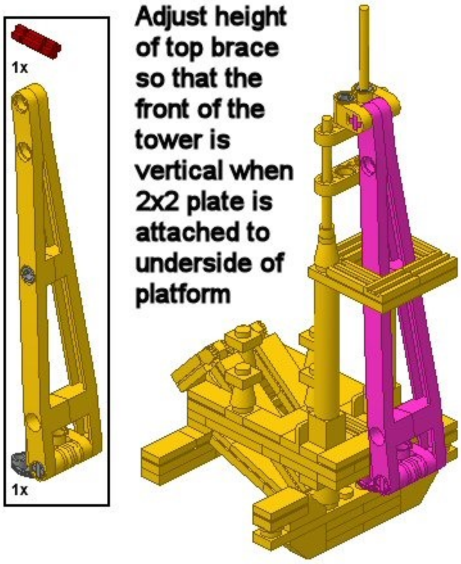
1



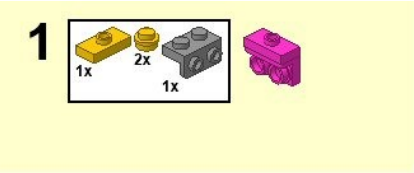
2

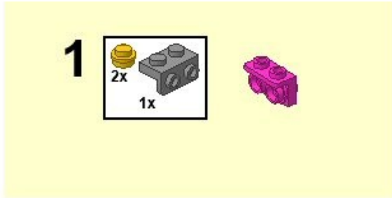


15

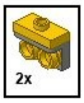


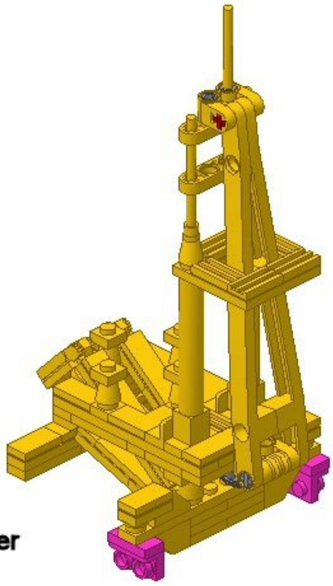
Adjust height of top brace so that the front of the tower is vertical when 2x2 plate is attached to underside of platform





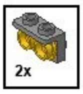
16



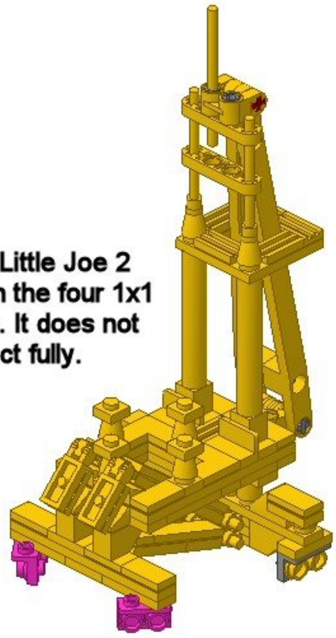


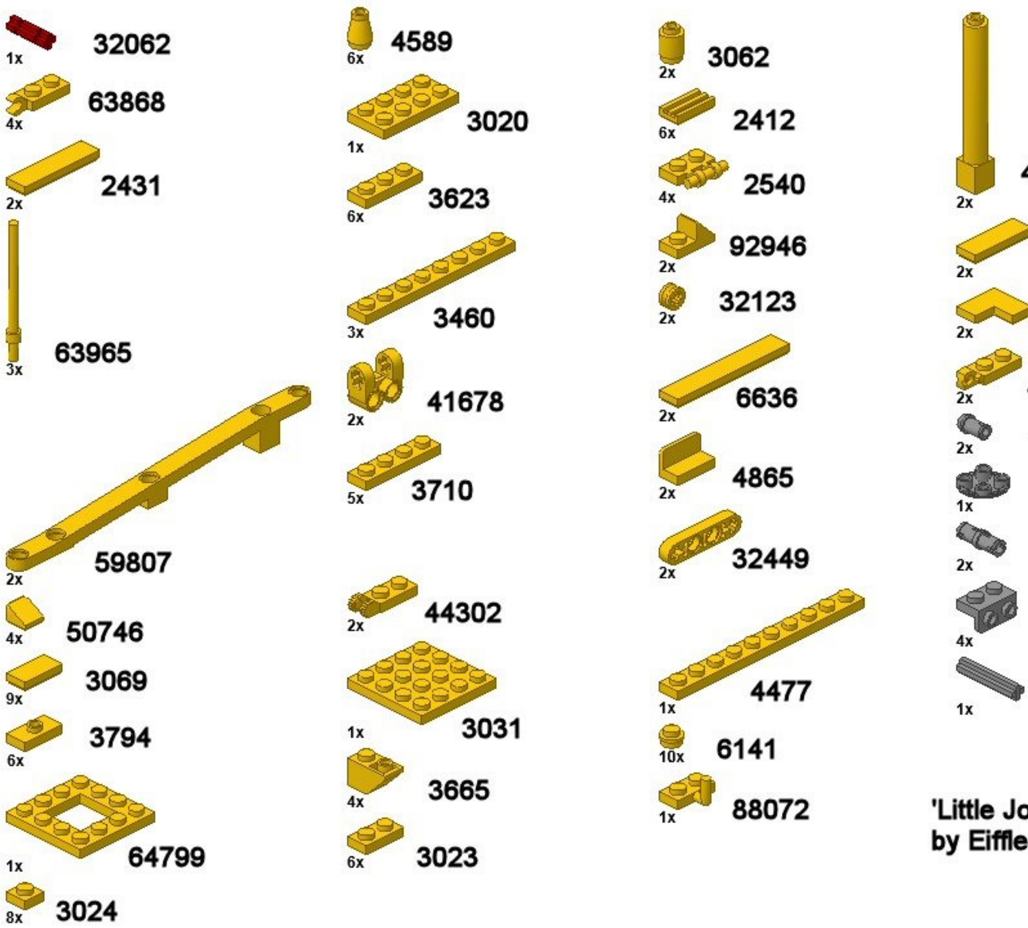
'Little Joe II' Launcher
by Eiffleman

17



Note: Little Joe 2 sits on the four 1x1 plates. It does not connect fully.





'Little Joe II' Launcher
by Eiffleman


UNITED STATES
USA
USA

The Saturn V

The Saturn V is the only official Lego set model in this series. Born on Lego ideas as the brainchild of Valerie Roche and Felix Stiessen in spring 2015, it achived 10.000 supporters in November 2015 and came into the shelves in 2017 as Lego Set 21309. The model, as well as the accompanying booklet, was the inspiration for this little work, and therefore no instructions for the Saturn V are included in here. They can, however, easily be downloaded and printed from Lego. You will find a link to the instructions in the Appendices.

The Saturn V was launched 13 times from the Kennedy Space Center in Florida with no loss of crew or payload. As of 2018, the Saturn V remains the tallest, heaviest, and most powerful (highest total impulse) rocket ever brought to operational status, and holds records for the heaviest payload launched and largest payload capacity to low Earth orbit (LEO) of 140,000 kg (310,000 lb), which included the third stage and unburned propellant needed to send the Apollo Command/Service Module and Lunar Module to the Moon.

The largest production model of the Saturn family of rockets, the Saturn V was designed under the direction of Wernher von Braun and Arthur Rudolph at the Marshall Space Flight Center in Huntsville, Alabama, with Boeing, North American Aviation, Douglas Aircraft Company, and IBM as the lead contractors.

To date, the Saturn V remains the only launch vehicle to carry humans beyond low Earth orbit. A total of 15 flight-capable vehicles were built, but only 13 were flown. An additional three vehicles were built for ground testing purposes. A total of 24 astronauts were launched to the Moon, three of them twice, in the four years spanning December 1968 through December 1972

The Apollo Astrovan

Mercury and Gemini pilots were driven to the launch pads on a modified truck, but in 1968 NASA decided to aquire a dedicated astronaut shuttle. A Cortez Motor Home was modified and extensively tested before being used to take the crews out to the pad.

The Apollo 10 crew leaves the Kennedy Space Center's Manned Spacecraft Operations Building during the Apollo 10 prelaunch countdown. Leading is astronaut John W. Young, command module pilot, followed by astronauts Thomas P. Stafford, commander; and Eugene A. Cernan, lunar module pilot. The transfer van carried them over to Pad B, Launch Complex 39, where their spacecraft awaited them. Liftoff for the lunar orbit mission was at 12:49 p.m. (EDT), May 18, 1969.
Credit: NASA

The Mercury and Gemini pilots were driven to the launch pads on a modified truck, but in 1968 NASA decided to aquire a dedicated astronaut shuttle. A Cortez Motor Home was modified and extensively tested before being used to take the crews out to the pad.

In the 1960s, Mercury astronauts traveled from their crew quarters in Hangar S on Cape Canaveral Air Force Station to the launch pads inside a transfer van pulled by a Reo tractor. Although the tractor had five forward gears, only four were used, and the highest speed reached was 20 mph. Faster speeds along the Cape's less-than-perfect roads would have resulted in a pretty rough ride.

The big van also had a relatively light load. Only the astronaut was seated in the van and the support personnel stood up during the trip to the pad. The driver communicated with the passengers by intercom to tell them when they were approaching a curve or turn.

Gordon Cooper's ride to Launch Complex 14 on May 15, 1963, took 16 minutes. His chauffeur, C. J. LaMar, drove either the primary or backup van for all Mercury launches. Along with driving primate astronauts Ham and Enos to the pad, LaMar piloted the backup van, which would have been used in case of a breakdown of the primary van, for the launches of Alan Shepard, Gus Grissom and John Glenn, and delivered Scott Carpenter, Walter Schirra and Cooper to the pad for their flights.

The Astronaut Van @ the Apollo-Saturn V Museum at the Kennedy Space Center in Florida. This specially oufitted van was used to transport fully suited Apollo crews to the launch pad. The astronauts carried small ventilators that controlled the temperatures of their suits until they connected to the command module's life support system.
Credit: NASA

As for the first dedicated Astrovan, the Clark Forklift Company began making these small motorhomes in 1963 in Battle Creek, Michigan and are commonly referred to as Clark Cortez motorhomes. Class-A motor coaches were built as an integrated unit, including the chassis and engine, whereas Class-B and C motorhomes were constructed on top of an existing truck chassis. Only a little more than 4000 were ever built, and those still operational are very popular with their owners. Nasa refurbished the acquired Clak Cortez motorhome to enable it to transport three Astronauts.

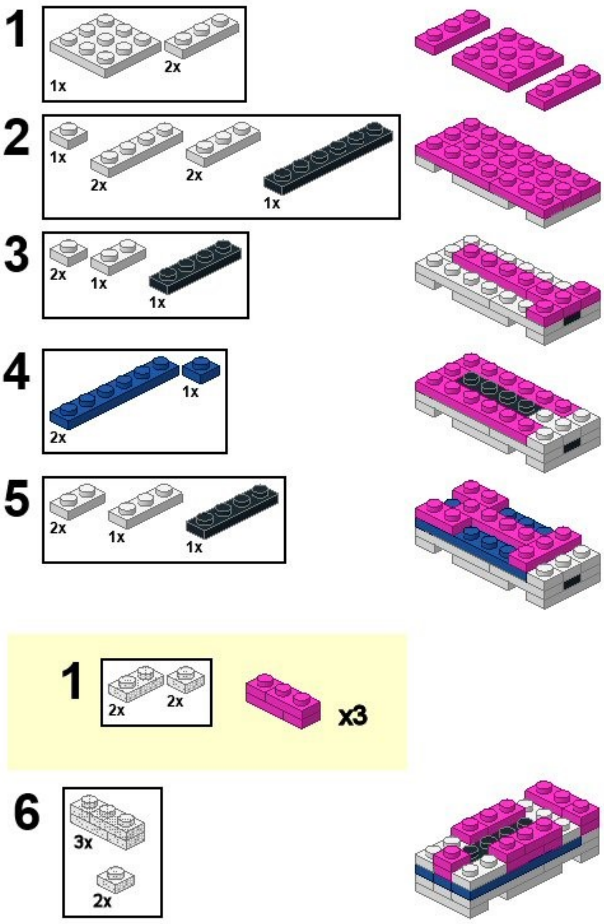
The original Cortez Motorhome from 1964. The Clark Forklift Company began making these small motorhomes in 1963 in Battle Creek, Michigan, and are commonly referred to as Clark Cortez motorhomes. Class-A motor coaches are built as an integrated unit, including the chassis and engine, whereas Class-B and C motorhomes are built on top of an existing truck chassis.

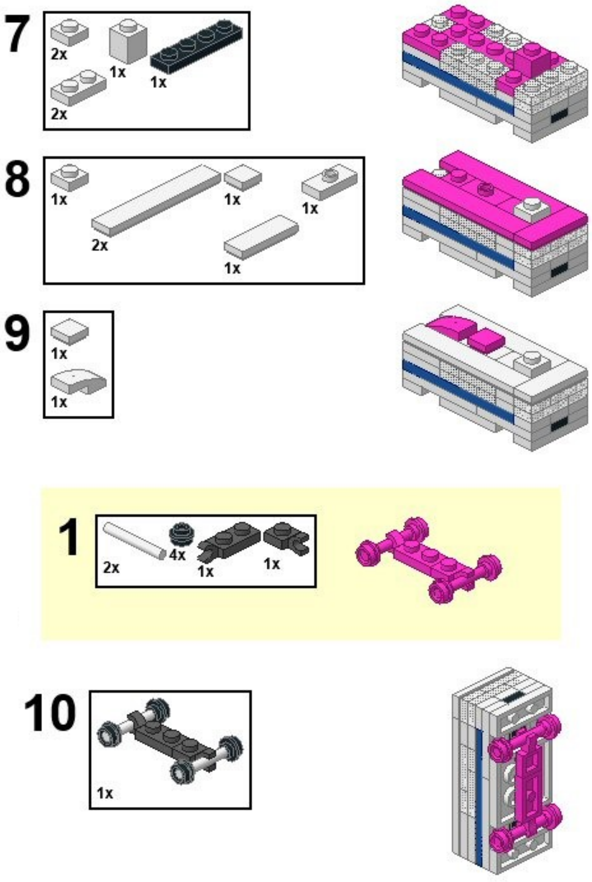
Early units used a Chrysler 225ci industrial slant-6 engine. In 1969 a V-8 engine was introduced, using a Ford 302ci engine but still using the 4-speed manual transaxle. In 1971, the Oldsmobile Toronado front wheel transaxle with a 455ci engine in conjunction with a GM 3-speed automatic was used
Credit: Cortez

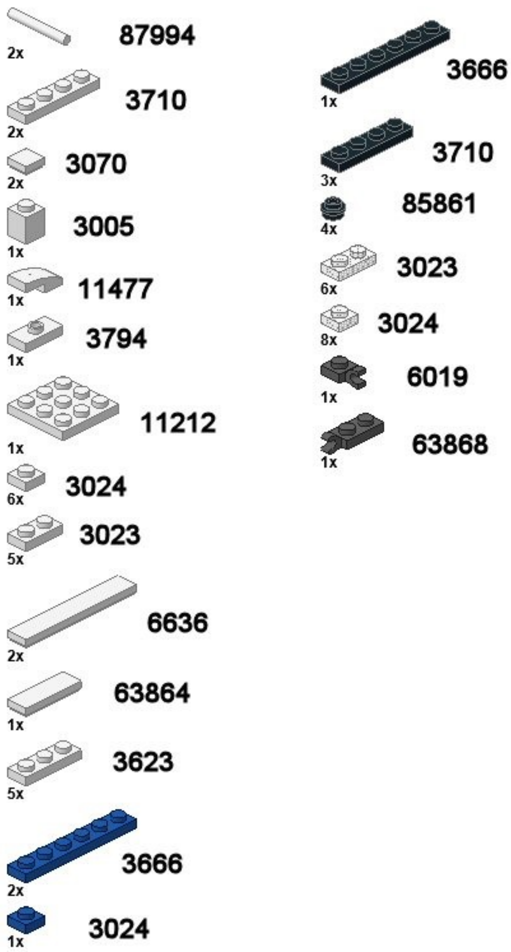
From 1968 onward, the Astrovan was used to shuttle the Apollo crews to the launch pad prior to the liftoff. The astrovan could take up to four astronauts and was used for Apollo, Skylab, Apollo/Soyuz and the early Space Shuttle missions. It was replaced after fifteen years of service in 1983 for STS-8 with a larger vehicle which could carry the larger Space Shuttle crews. It is now on exhibition in the Kenney Space Center Visitors's Centre.

Apollo Era Astrovan

© Grant Passmore, 2018







M-113 Astronaut Rescue Vehicle

For each launch of the Apollo Missions, NASA had a special rescue team standing by in armored personnel carriers, ready to carry astronauts and firefighters safely away from the launch pad should something go wrong. The vehicles are refurbished and adapted M 113 armored personal carrier (APCs).

Rumbling, cramped, heavy and lacking a big field of view, the M113 wouldn't seem to be a good candidate for an ambulance. It doesn't even have a steering wheel. But it has something essential for a NASA rescue mission at the launch pad: armor.

Basically a bunker on tracks, the M113 is a Vietnam-era armored personnel carrier that offers the astronauts a safe vehicle to get out of danger. It also offers firefighters heavy protection in case they have to go into danger to retrieve the flight crew and launch pad personnel.

NASA has a different kind of rescue vehicle because it has to make a different kind of rescue if a rocket crew is in danger. In the unlikely worst-case scenario, neither the astro-

nauts nor emergency crews have to worry about debris raining down on them when they are inside an M113.

NASA began using surplus Army M113s during the Apollo Program in case an emergency developed with the spacecraft or the gigantic Saturn V rocket, and continued to use them throughout the Shuttle Program. Three were on hand on launch day. Two stood by less than a mile from the launch pad, each with a complement of firefighters on board.

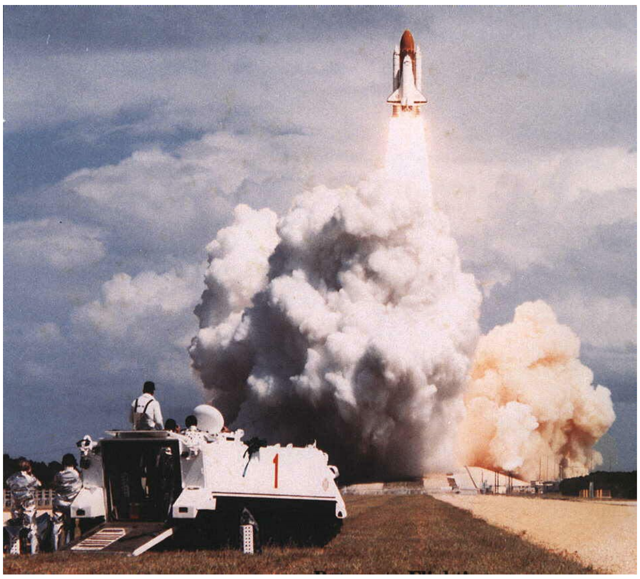
The inside of the M113 is hardly spacious, so the firefighters had to curl their legs up tight. Only the driver was able to see out consistently, looking through four slits facing the pad. The passengers could take turns looking through the slits in another hatch, but that meant awkwardly trying to kneel or stand in the middle of the rest of the crew.

From the vehicle, one could feel the launch more than see it because the thunder thoroughly shook the 10-ton armored personnel carrier.

The astronauts and pad workers have limited air sources, so the rescue teams would have to work to get them to safety in less than 10 minutes from the time a rescue call was recieved. The other M113 sat empty with its back ramp open facing the door of an emergency bunker near the pad. If the astronauts would had to take the slidewire baskets to get away from the pad, they would have exited the baskets and into the bunker. From there they could have gotten into the M113 quickly and be driven to safety.

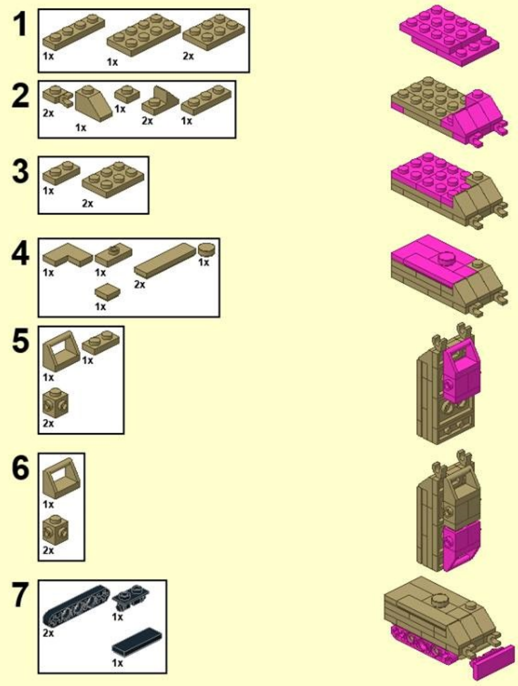
The limited field of view comes from four slits in front of the driver, each one a prism instead of an opening. With the

driver's hatch down, it can be tough to make out everything around the vehicle while it's in motion. That's why the vehicles have gotten wet a couple of times by accident. Still some flight crews embraced the unusual vehicle and had a good time with the training, welcoming it as a distraction.

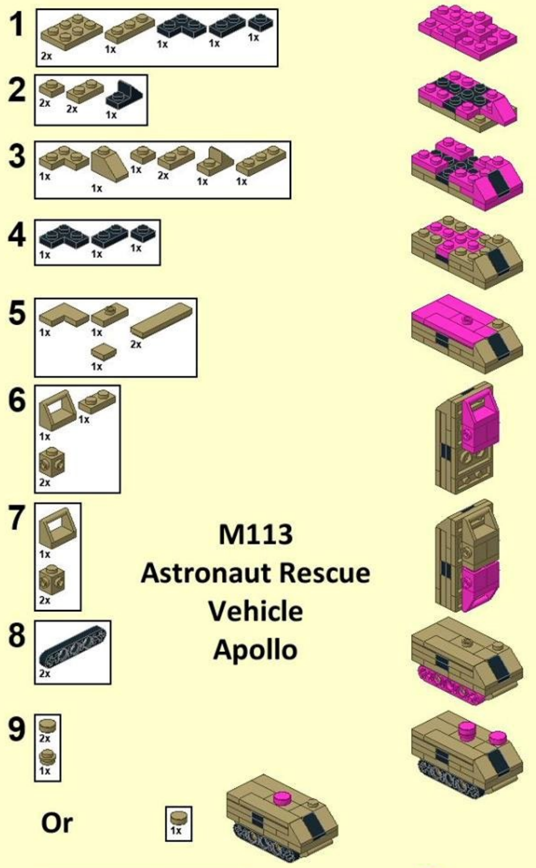


M-113 Astronaut Rescue Vehicle

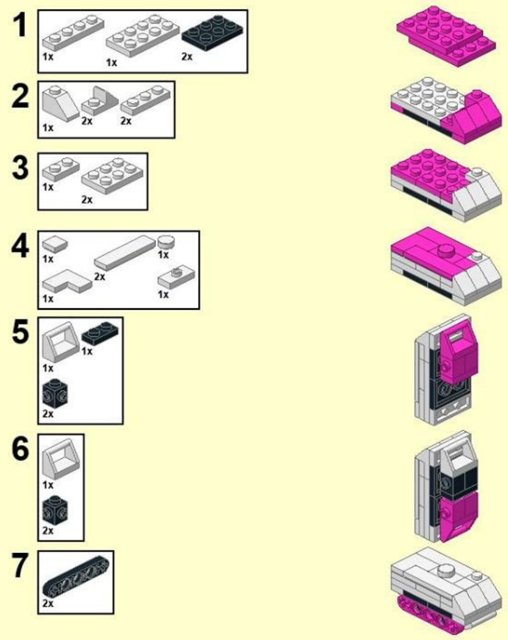
© Grant Passmore, 2019



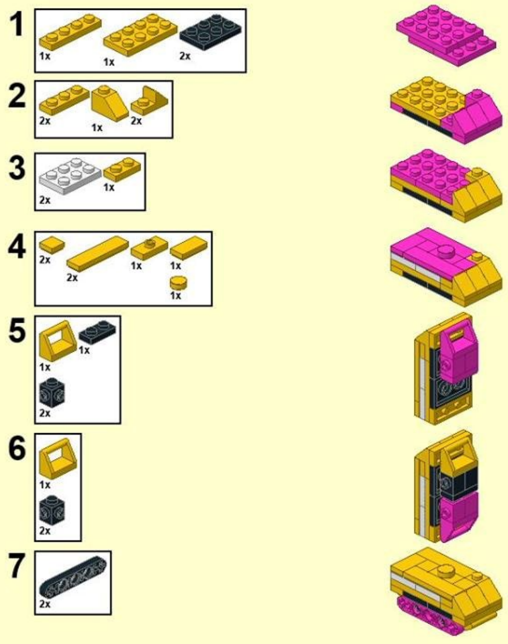
M113 Astronaut Rescue Vehicle
Mercury and Gemini



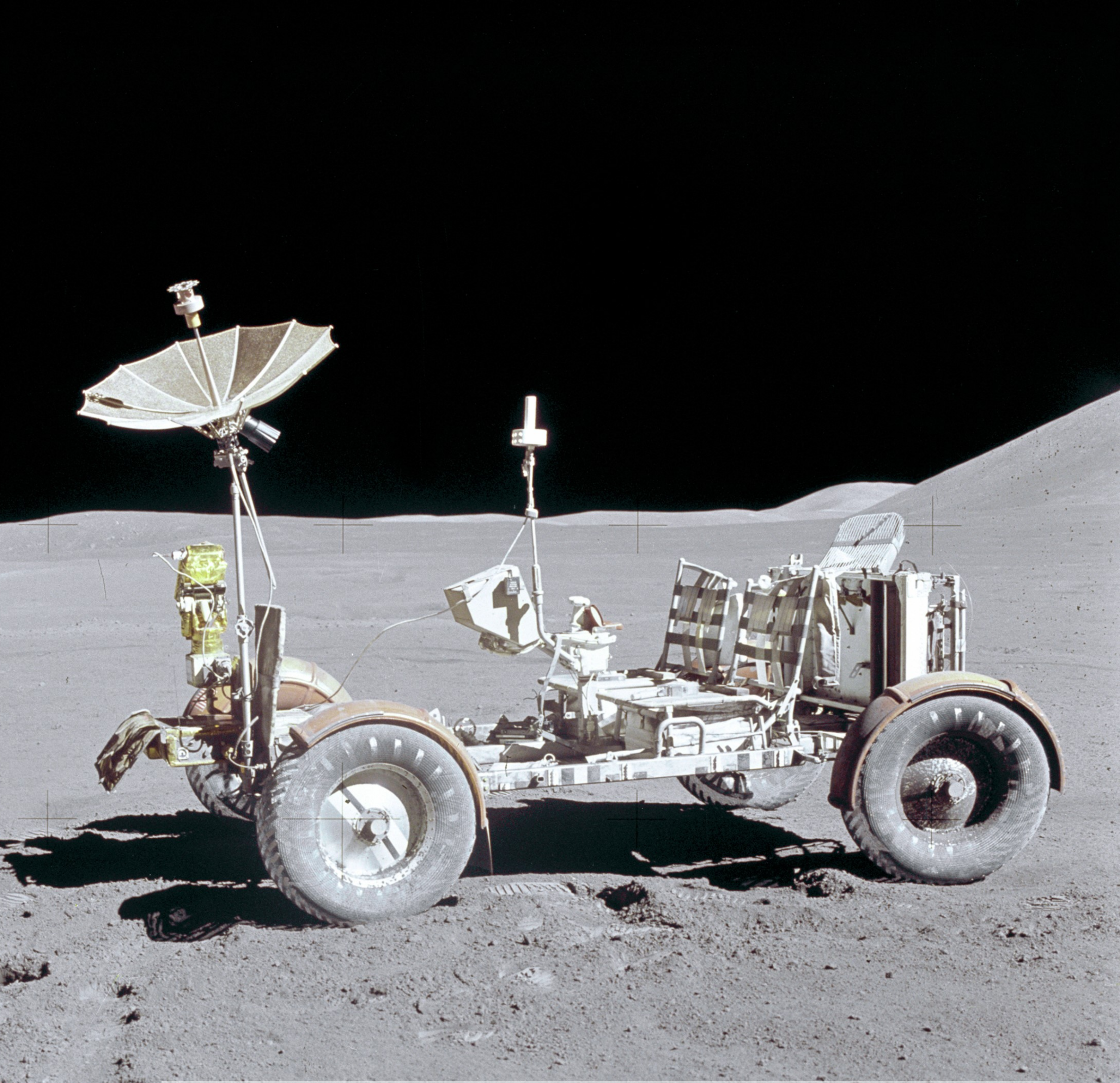
M113
Astronaut Rescue
Vehicle
Apollo



M113 Astronaut Rescue Vehicle
Early Space Shuttle

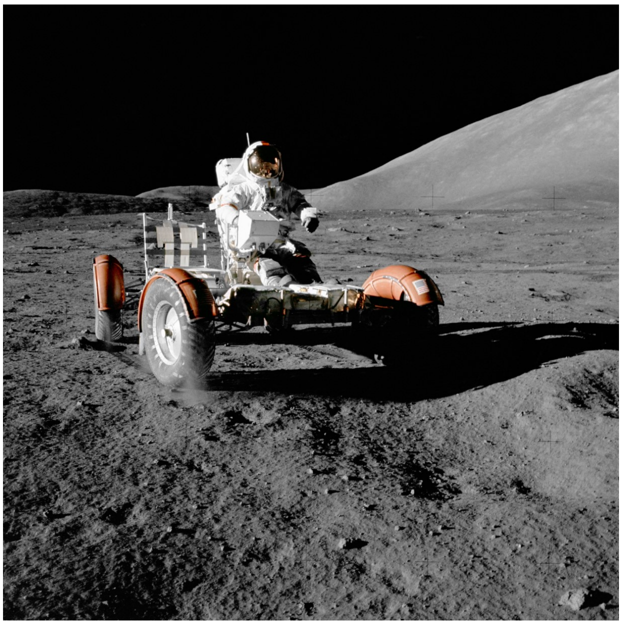


M113 Astronaut Rescue Vehicle
Late Space Shuttle



The Moon Rover

The Lunar Roving Vehicle (LRV) was an electric vehicle designed to operate in the low-gravity vacuum of the Moon and to be capable of traversing the lunar surface, allowing the Apollo astronauts to extend the range of their surface activities. The LRV was used on the Moon in the last three missions of the American Apollo program (15, 16, and 17) during 1971 and 1972. It was popularly known as "moon buggy", a play on the words "dune buggy".



Astronaut Eugene A Carman, commander, makes a short checkout of the Lunar Roving Vehicle (LRV) during the early part of the first Apollo 17 Extravehicular Activity (EVA-1) at the Taurus-Littrow landing site, December 11th 1972.
Credit: NASA

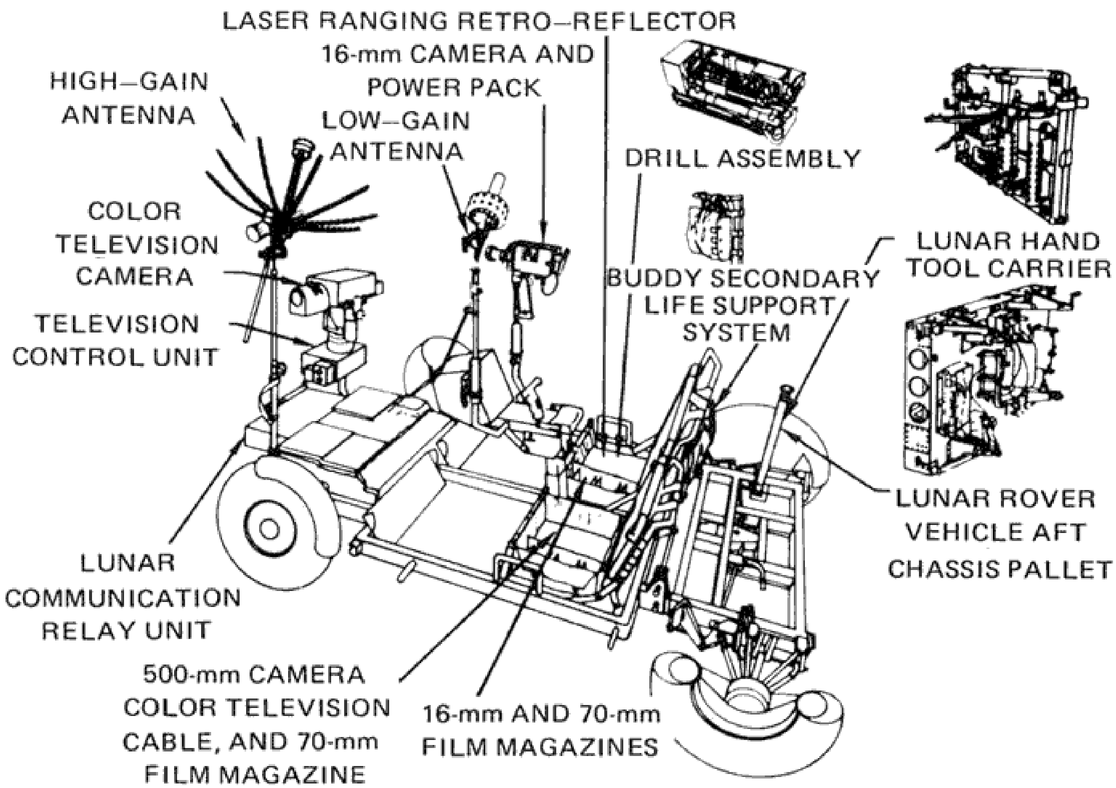
Years before the first satellite was launched, busy minds where already thinking not only how to get to the moon, but, more importantly, what to do once there. From 1952–1954, Collier's Weekly magazine ran a series by Wernher von Braun and others, "Man Will Conquer Space Soon!" In this, von Braun described a six-week stay on the Moon, featuring 10-ton tractor trailers for moving supplies. In 1956, Mieczysław G. Bekker published two books on land locomotion. At the time, Bekker was a University of Michigan professor and a consultant to the U.S. Army Tank-Automotive Command's Land Locomotion Laboratory. The books provided much of the theoretical base for future lunar vehicle development.

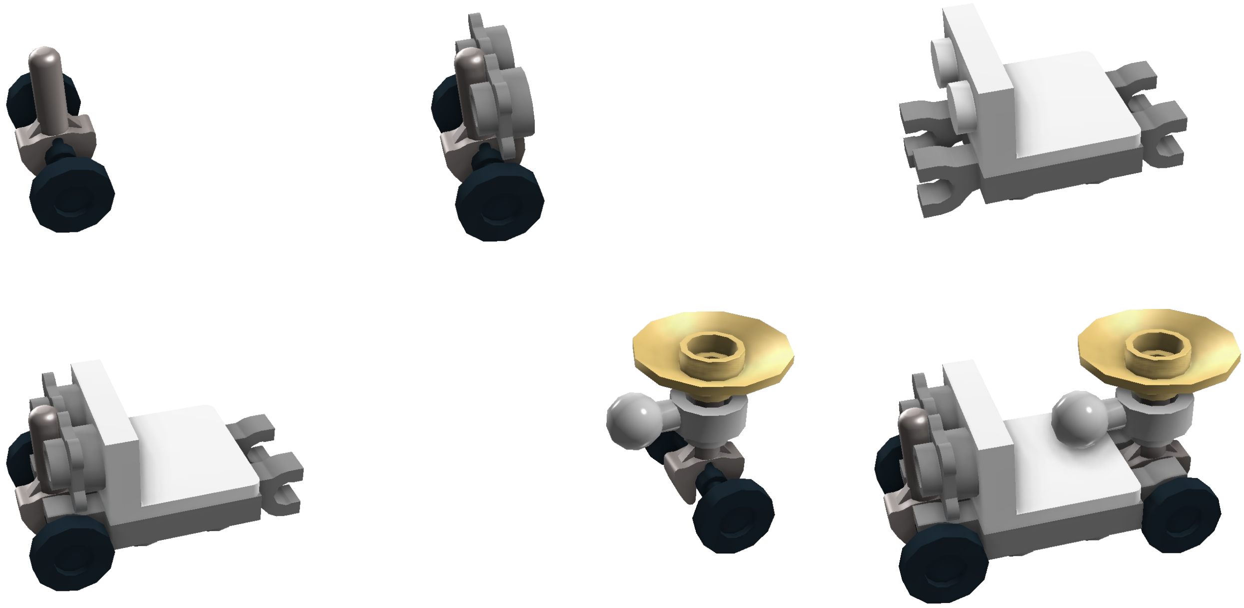
A series of studies beginning in the early Sixties had to contend with the fact that every kilo transported to moon raised launch costs, so the originally envisioned closed vehicles were slimmed down until only a small, two-person buggy remained. And even the result had to be redesigned several times to be able to fit into the storage capacity of the moon lander as it was built.

The Lunar Roving Vehicle had a mass of 210 kg and was designed to hold a payload of an additional 490 kg on the lunar surface. The frame was 3.1 meters long with a wheelbase of 2.3 meters. The maximum height was 1.14 meters. It had two side-by-side foldable seats made of tubular aluminum with nylon webbing and aluminum floor panels. A large mesh dish antenna was mounted on a mast on the front center of the rover.

Moon buggies were used during the missions Apollo 15, Apollo 16, and Apollo 17. The rover was first used on 31 July 1971, during the Apollo 15 mission. This greatly expanded the range of the lunar explorers. Previous teams of astronauts were restricted to short walking distances around the landing site due to the bulky space suit equipment required to sustain life in the lunar environment. The range, however, was operationally restricted to remain within walking distance of the lunar module, in case the rover broke down at any point.The rovers were designed with a top speed of about 8 mph (13 km/h), although Eugene Cernan recorded a maximum speed of 11.2 mph (18.0 km/h), giving him the (unofficial) lunar land-speed record.

The LRV was transported to the Moon on the Apollo Lunar Module (LM) and, once unpacked on the surface, could carry one or two astronauts, their equipment, and lunar samples. The three LRVs remain on the Moon.





Sikorsky H-34 Rescue Helicopter

Helicopter 66 iws a United States Navy Sikorsky Sea King helicopter used during the late 1960s for the water recovery of astronauts during the Apollo program. It has been called "one of the most famous, or at least most iconic, helicopters in history", was the subject of a 1969 song by Manuela and was made into a die-cast model by Dinky Toys. In addition to its work in support of NASA, Helicopter 66 also transported the Shah of Iran during his 1973 visit to the aircraft carrier USS Kitty Hawk.

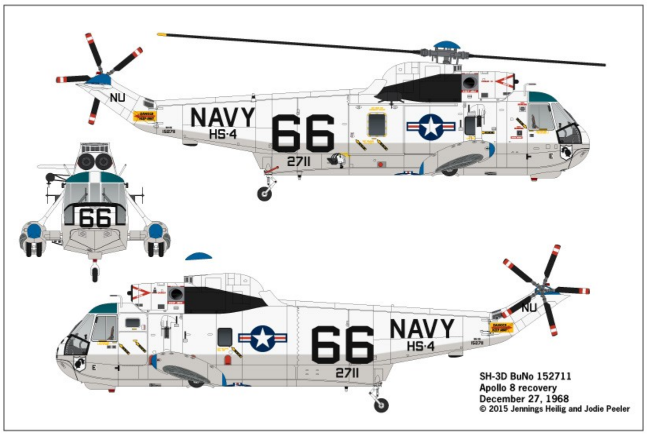
The Apollo 8 crew stands in the doorway of the recovery helicopter after arriving aboard the carrier U.S.S. Yorktown. In left foreground is Commander Borman. Behind him is Lovell and on the right is Anders. Apollo 8 splashed down at 10:51 a.m. EST, Dec. 27, 1968, in the central Pacific Ocean,
Credit: NASA

Helicopter 66 was a Sikorsky Sea King SH-3D. The SH-3D model Sea Kings were designed for anti-submarine warfare (ASW) and were typically configured to carry a crew of four and up to three passengers. Powered by two General Electric T58-GE-10 turboshaft engines producing up to 1,400 horsepower (1,000 kW) each, SH-3Ds had a maximum airspeed of 120 knots (220 km/h; 140 mph) and a mission endurance averaging 4.5 hours. They had a maximum allowable weight of 20,500 pounds (9,300 kg) with the ability to carry an external payload of up to 6,000 pounds (2,700 kg). Helicopter 66 was delivered to the U.S. Navy on March 4, 1967, and, in 1968, was added to the inventory of U.S. Navy Helicopter Anti-Submarine Squadron Four (HS-4) Its original tail number was NT-66/2711.

Activated on June 30, 1952, Squadron Four – "the Black Knights" – was the first anti-submarine warfare helicopter squadron of the U.S. Navy to deploy aboard an aircraft carrier when, in 1953, it operated from USS Rendova. It began using the Sea King SH-3D in 1968, transitioning from the SH-3A model. That year, the squadron was assigned to Carrier Anti-Submarine Air Group 59 and deployed aboard USS Yorktown to the Sea of Japan (East Sea) in response to the capture of USS Pueblo by the Korean People's Navy. Later that year, Yorktown—and Squadron Four—was tasked to support the National Aeronautics and Space Administration (NASA) in the oceanic recovery of returning astronauts.

View of Sikorsky (S-61B) SH-3D Sea King helicopter belonging to the Helicopter Anti-Submarine Squadron FOUR (HS-4) (number 66) about to land on the USS Iwo Jima (LPH-2) during the Apollo 13 recovery mission, April 17, 1970.
Credit: NASA

During the Apollo 8, Apollo 10, and Apollo 11 missions, Helicopter 66 was the primary recovery vehicle which hoisted returning astronauts from the spacecraft command modules. As a result, it was featured prominently in television news coverage and still photography, achieving—in the words of space historian Dwayne A. Day—the status of "one of the most famous, or at least most iconic, helicopters in history". Commander Donald S. Jones, who would later command the United States Third Fleet, piloted Helicopter



66 during its inaugural astronaut recovery mission following Apollo 8, and again during the Apollo 11 recovery.

Following the Apollo 11 mission, the Navy switched to a three-digit designation system and Helicopter 66 was retagged Helicopter 740. Recognizing the fame Helicopter 66 had achieved, the Navy began the practice of repainting Helicopter 740 as Helicopter 66 for the later recovery missions in which it participated, Apollo 12 and Apollo 13, painting it back as Helicopter 740 at the conclusion of each mission. During the period of its use for astronaut recovery, Helicopter 66 bore victory markings on its fuselage showing a space capsule silhouette, with one being added for each recovery in which it participated. For the recovery of the Apollo 11 astronauts, the underside of the fuselage was emblazoned with the words "Hail, Columbia".

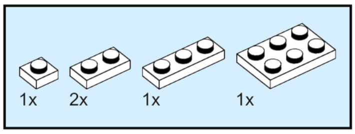
On June 4, 1975, Helicopter 66, renumbered as '740', crashed while, en route to the U.S. Navy's Helo Offshore Training Area to conduct a regularly scheduled, three-hour nighttime anti-submarine training. Though the crew was subsequently rescued by the U.S. Coast Guard, pilot Leo Rolek was critically injured and later died of the wounds he sustained in the crash.

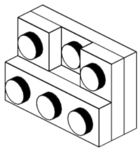
The exact cause of the downing of Helicopter 66 is unknown; as of 2017 the U.S. Navy incident report remains largely classified. The broken fuselage of the helicopter later sank in 800 fathoms (1,500 m) of water. The submerged helicopter remains the property of the U.S. Navy.

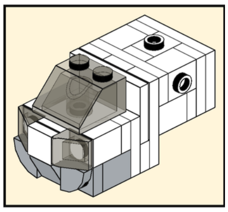
Sikorsky H-34 Rescue Helicopter

© Mark Balderama, Sebastian Schön, 2019

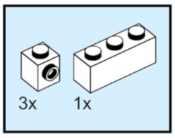
1

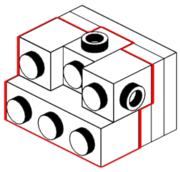




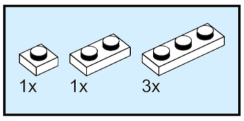


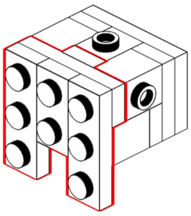
2



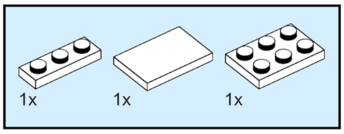


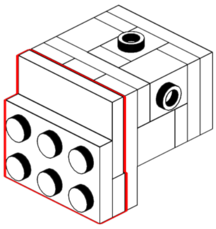
3



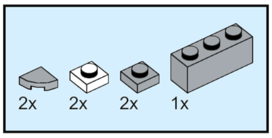


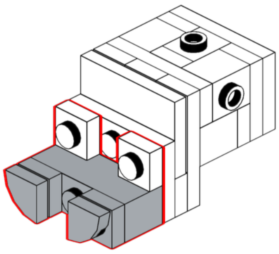
4



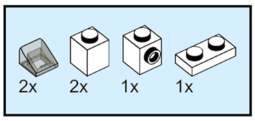


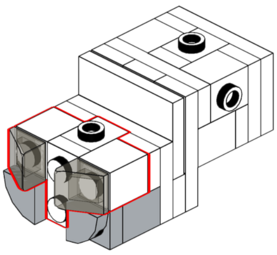
5



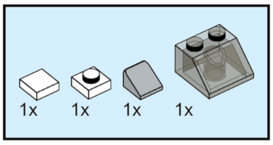


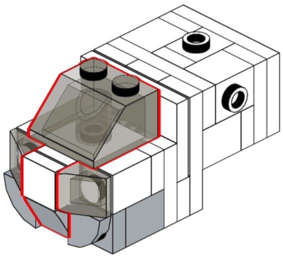
6



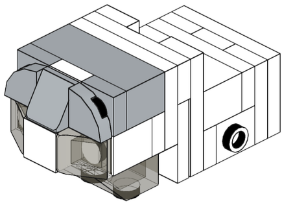


7

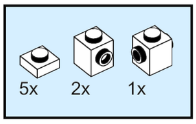


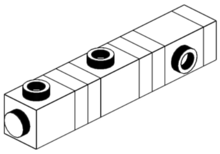


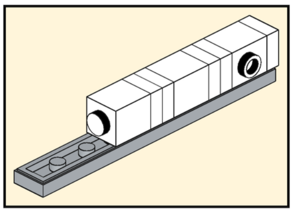
8



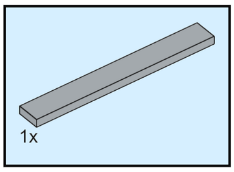
9

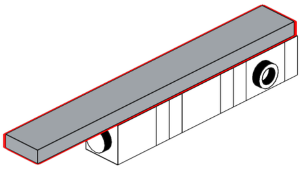




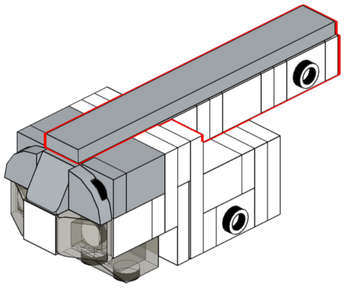


10

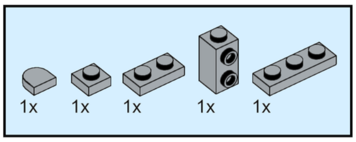


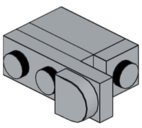


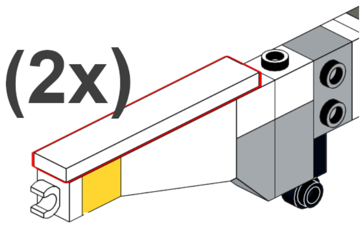
11



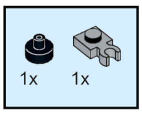
12

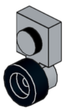






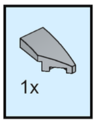
13

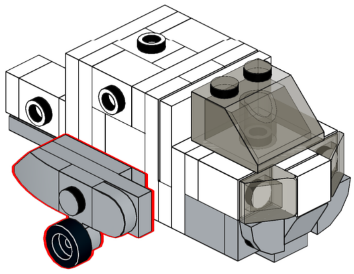




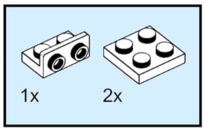
(2x)

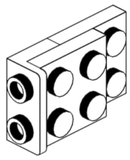
14



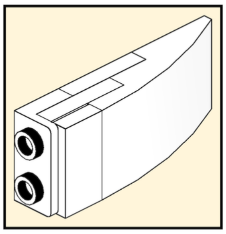


15

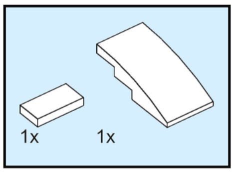


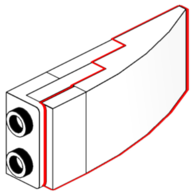


(2x)

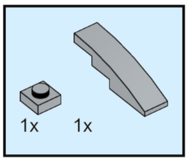


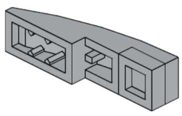
16



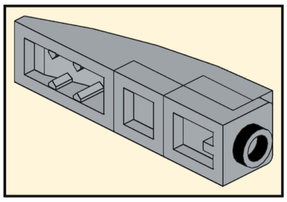


17

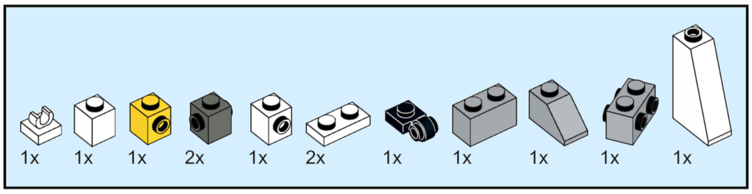


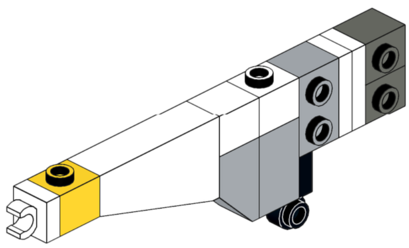


(2x)

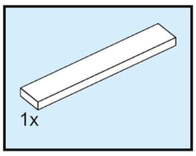


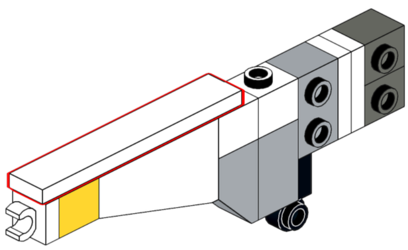
18



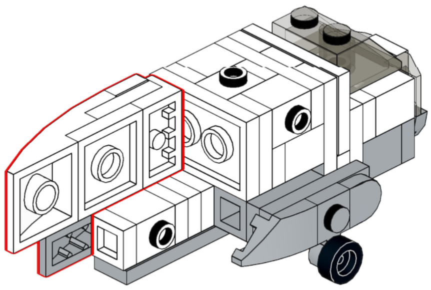


19

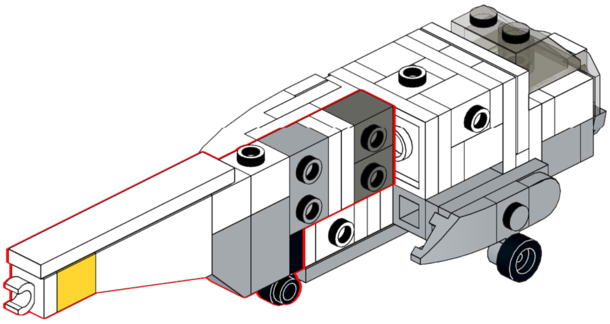




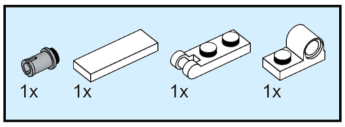
20

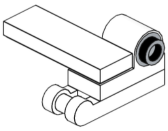


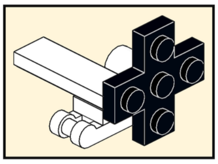
21



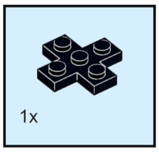
22

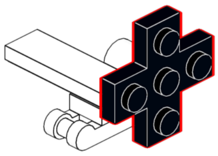




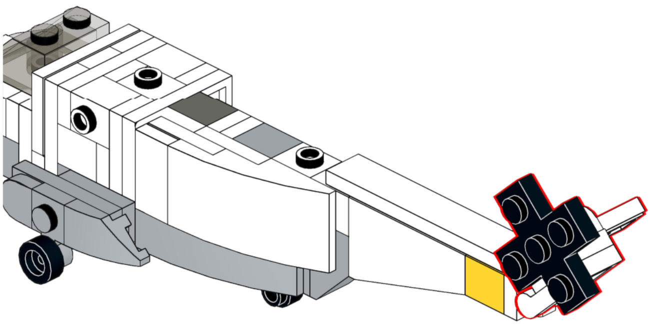


23

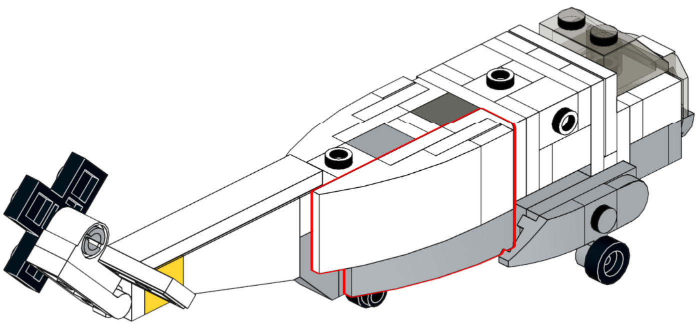




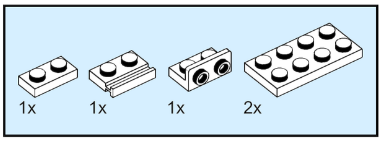
24

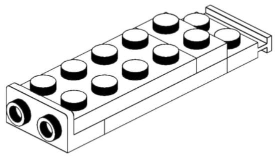


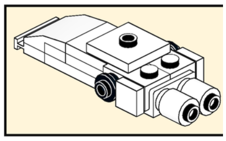
25



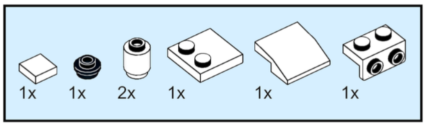
26

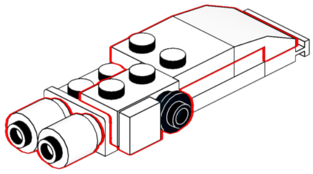




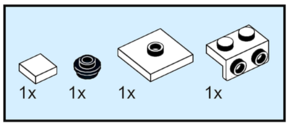


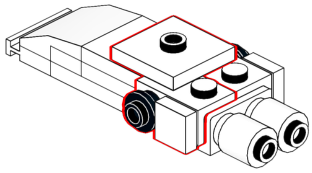
27

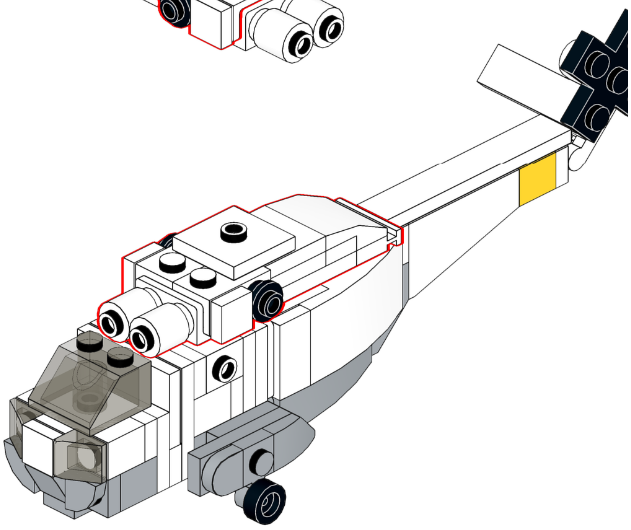




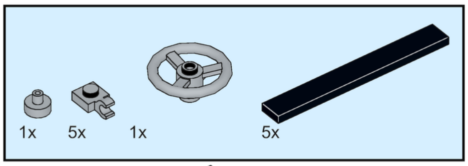
28

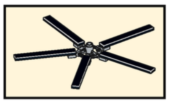


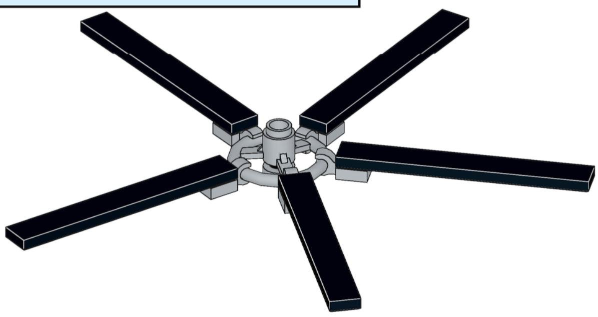


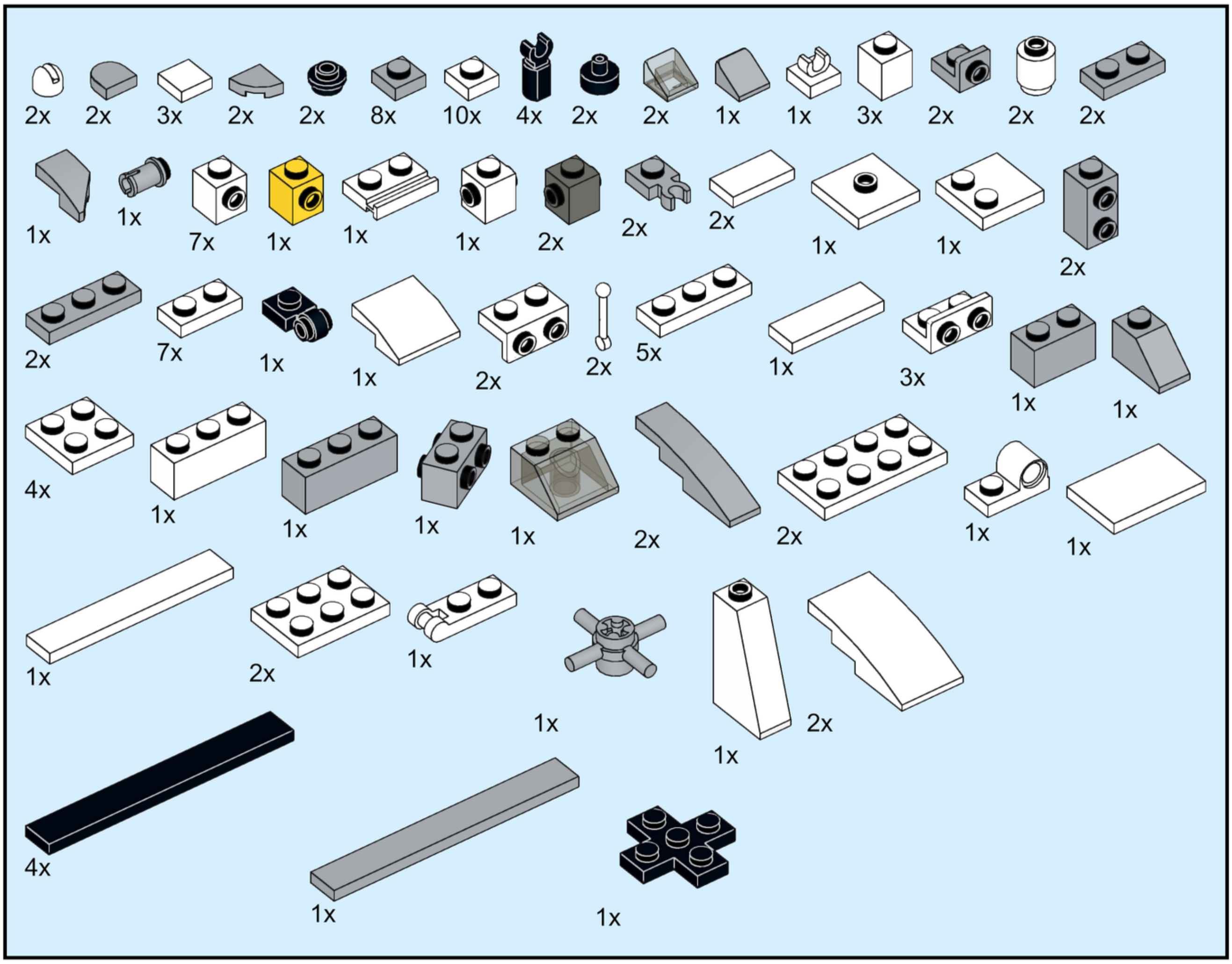


29



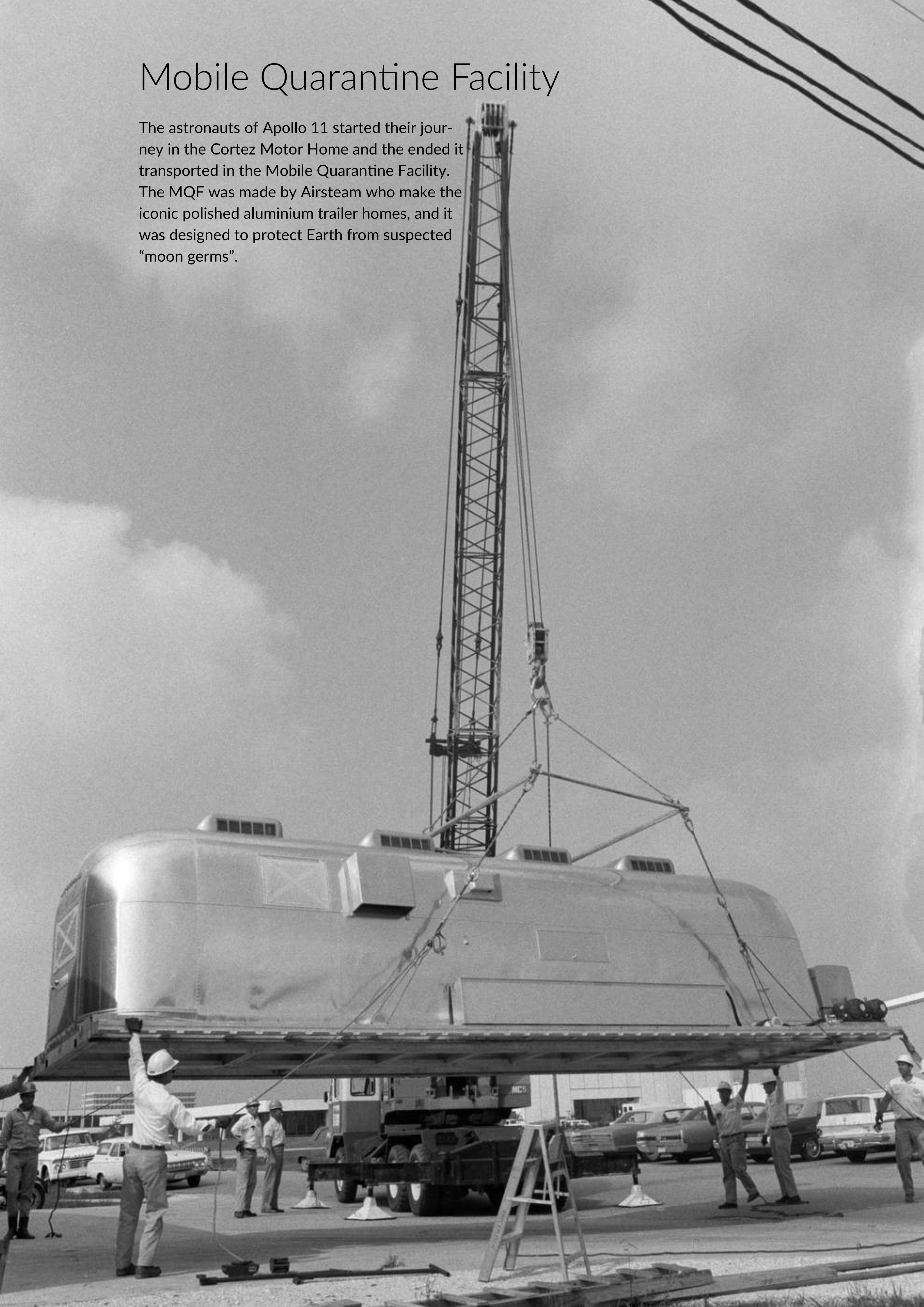





2x
2x
3x
2x
2x
8x
10x
4x
2x
2x
1x
1x
3x
2x
2x
2x
1x
1x
7x
1x
1x
1x
2x
2x
2x
1x
1x
2x
2x
7x
1x
1x
2x
2x
5x
1x
3x
1x
1x
4x
1x
1x
1x
1x
2x
2x
1x
1x
1x
2x
1x
1x
1x
2x
4x
1x
1x

Mobile Quarantine Facility

The astronauts of Apollo 11 started their journey in the Cortez Motor Home and the ended it transported in the Mobile Quarantine Facility. The MQF was made by Airsteam who make the iconic polished aluminium trailer homes, and it was designed to protect Earth from suspected “moon germs”.



President Richard M. Nixon was in the central Pacific recovery area on 24 July 1969 to welcome the Apollo 11 astronauts aboard the USS Hornet, prime recovery ship for the historic Apollo 11 lunar landing mission.
Credit: NASA

In 1963, the National Academy of Sciences, anxious to guard against invisible invaders, called for a way to isolate the Apollo astronauts upon their return from a series of planned Moon landings. Accordingly, NASA developed the Mobile Quarantine Facility (MQF), essentially a highly modified, wheelless, 35-foot vacation trailer equipped with elaborate air ventilation and filtration systems. Under contract to NASA, Melpar, Inc., of Falls Church, Virginia, converted four 35-foot Airstream trailers into MQFs, delivering the first unit in March 1968 and the last three in the spring of 1969.

Plans called for Neil Armstrong, Edwin “Buzz” Aldrin and Michael Collins to be quarantined—for three weeks, under hermetically sealed conditions—from the moment they opened the hatch of their capsule, bobbing in the Pacific. America’s newest heroes had to struggle into biological isolation suits tossed through the hatch after splashdown. (The gear was also donned by recovery helicopter pilot Cmdr. Don Jones and his crew.) When the three astronauts emerged from the helicopter to the cheers from the aircraft carrier USS Hornet, they were quickly transferred to the MQF. Recovery engineer John Hirasaki, who handled the Moon-dust cleanup, and NASA physician William Carpentier joined them in quarantine. Anxiety regarding a possible infection was heightened by the presence on the carrier of President Richard Nixon.

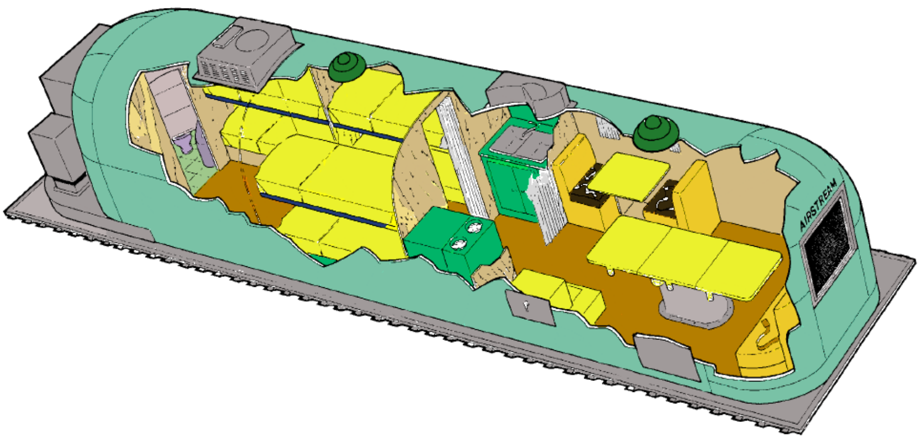
Once in the Airstream, the crew found quarters far more spacious than the Apollo capsule’s: the quarantine trailer contained a living area, sleeping compartment and kitchen, plus airline-type seats for use when the MQF was ferried in the belly of a C-141 transport plane. The astronauts would spend 65 hours in its tightly sealed interior.

In the years to come, the other quarantine facilities would be on hand for the landing of the crews from Apollo 12 later in 1969 and Apollo 14 in 1971. (In 1970, Apollo 13′s Moon landing was famously aborted after an onboard explosion.) By the time the Apollo 15 lunar landing took place in July

Within the Mobile Quarantine Facility, Apollo 11 astronauts (left to right) Michael Collins, Edwin E. Aldrin Jr. and Neil A. Armstrong relax following their successful lunar landing mission.
Credit: NASA

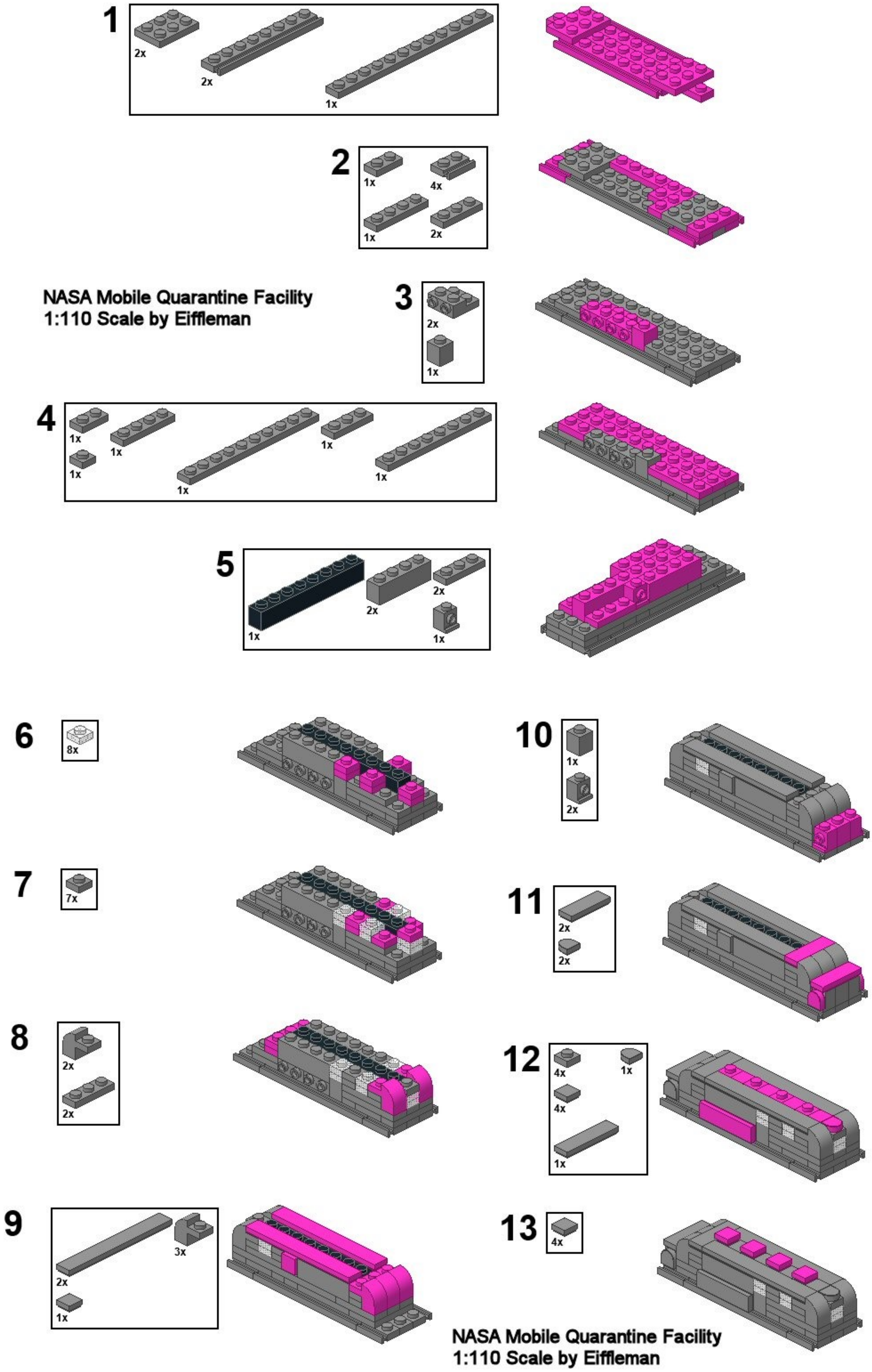
1971, the fear of pathogens had receded and the use of trailers was abandoned.

Of the four Mobile Quarantine Facilities that were built for the Apollo Moon landings, three still survive. The unused unit that was intended for Apollo 13 was borrowed by the US Department of Agriculture for a time (they used it as a test chamber), then was placed into storage and was subsequently lost. The Apollo 14 MQF is on display at the USS Hornet Museum in California, where the carrier has been converted into a floating museum. The Apollo 12 MQF is on display at the US Space and Rocket Center in Alabama. And the Apollo 11 MQF is on display at the Smithsonian's Udvar-Hazy Center.

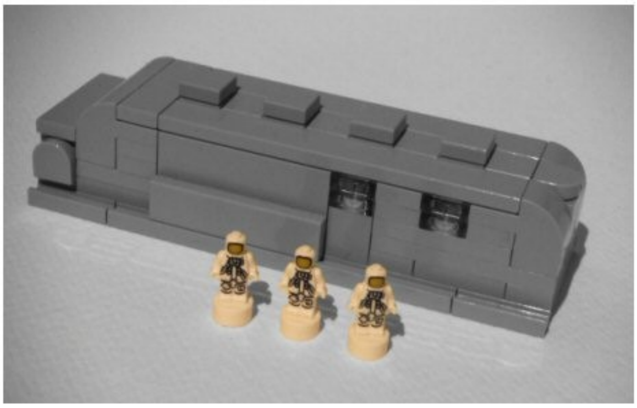


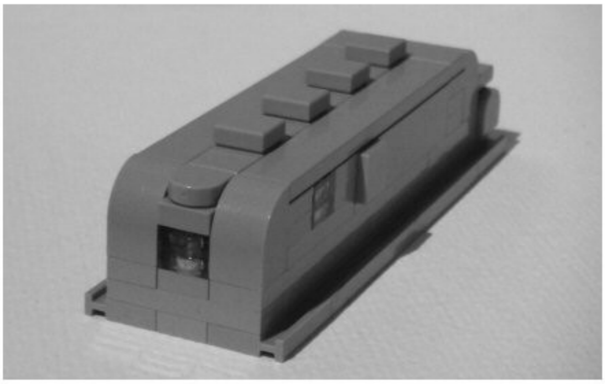
Left Colored schematics of the MQF.
Credit: NASA

Overleaf: MQF no. 3 arrives at the Marshall Space Center.
Credit: NASA

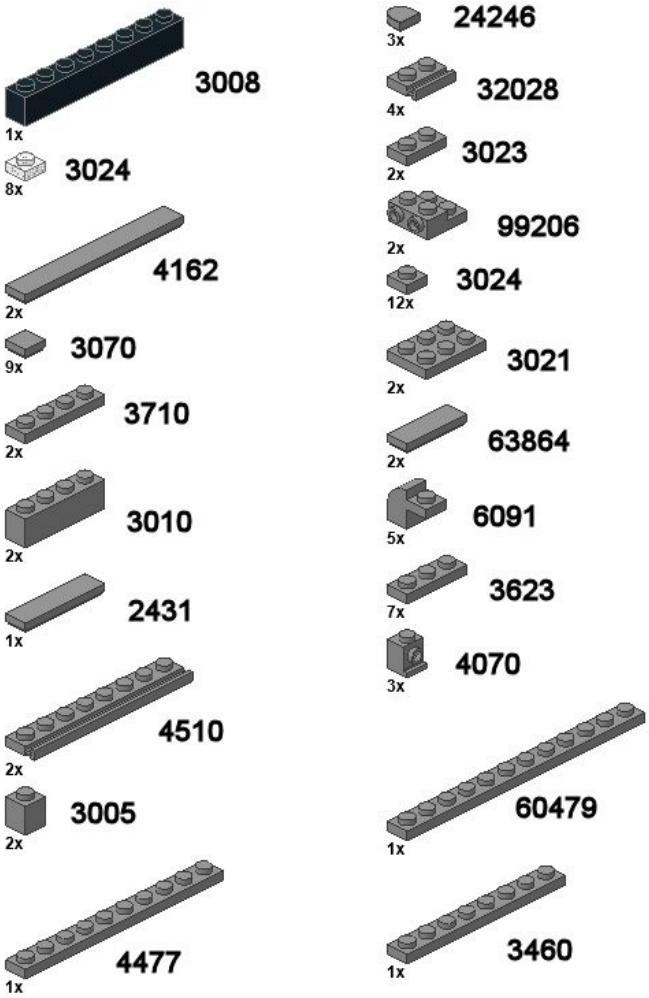


1
2x
2x
1x
2
1x
4x
1x
2x
NASA Mobile Quarantine Facility
1:110 Scale by Eiffleman
3
2x
1x
4
1x
1x
1x
1x
1x
1x
5
1x
2x
2x
1x
6
8x
10
1x
2x
7
7x
11
2x
2x
8
2x
2x
12
4x
1x
4x
1x
9
3x
2x
1x
13
4x
NASA Mobile Quarantine Facility
1:110 Scale by Eiffleman



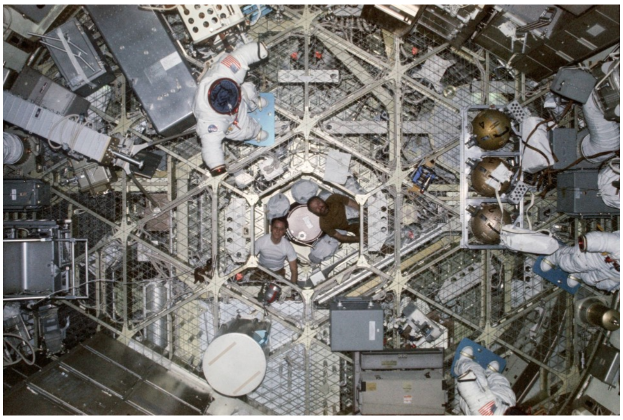


NASA Mobile Quarantine Facility
1:110 Scale by Eiffleman



Skylab

Skylab was the first and only US space station, based on the S-IVB upper stage of the Saturn V rocket. Despite its massive size, it was manned by only three astronauts. Skylab was occupied for about 24 weeks between May 1973 and February 1974 by three different missions before funding cuts precluded further visits. Five years after the last visit, Skylab reentered the atmosphere on July 11, 1979, with fragments crashing in Western Australia.

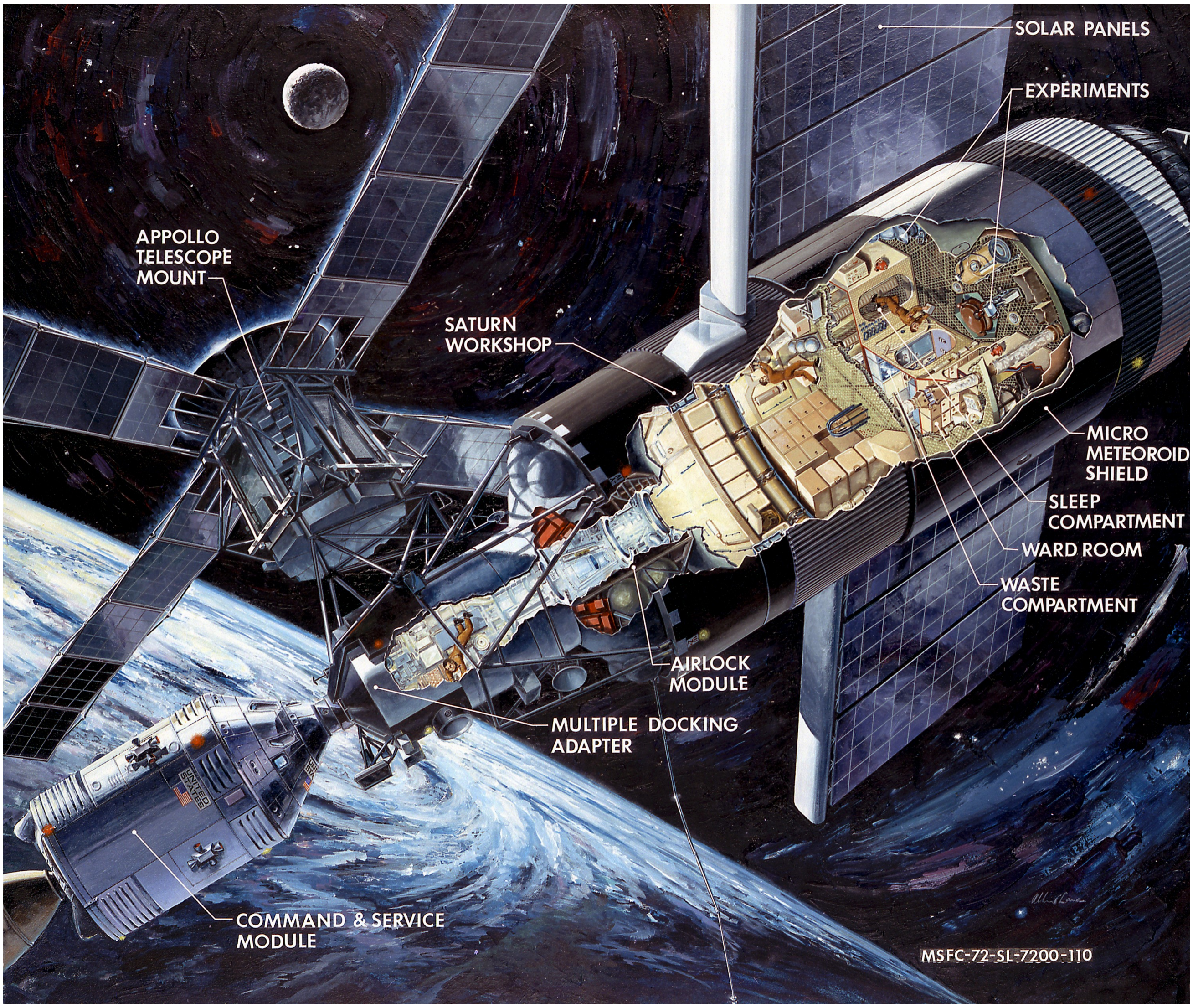


The inside of Skalyb as seen by the Astronauts during the Skylab-4 Mission
Credit: NASA

The scaling back from the massive splurge of funds the NASA enjoyed in the early Sixties led to a scramble for plans on how to best use the existing resources, creating the Apollo Applications project. Apart from the political vastly successful Apollo Soyuz Test Project, the APPs most spectacular result was to put America's first space station into orbit.

Early concepts for a US space station go back to the very origins of the space age. From 1952 to 54, Werner von Braun contributed to a series of articles in Collier's magazine titled "Man Will Conquer Space Soon!". He envisioned a large, circular station 250 feet (75m) in diameter that would rotate to generate artificial gravity and require a fleet of 7,000-ton (6,500-metric ton) space shuttles for construction in orbit. Studies continued throughout the Fifties and early Sixties. In 1964 von Braun, already weary for the future of his employees after the end of Apollo, set up the Apollo Logistic Support System Office, originally intended to study various ways to modify the Apollo hardware for scientific missions. The office initially proposed a number of projects for direct scientific study, including an extended-stay lunar mission which required two Saturn V launchers, a "lunar truck" based on the Lunar Module (LEM), a large crewed solar telescope using a LEM as its crew quarters, and small space stations using a variety of LEM or CSM-based hardware. Although it did not look at the space station specifically, over the next two years the office would become increasingly dedicated to this role. In August 1965, the office was renamed, becoming the Apollo Applications Program (AAP).

Design work continued over the next two years, in an era of shrinking budgets. In August 1967, the agency announced that the lunar mapping and base construction missions examined by the AAP were being canceled. Only the Earth-orbiting missions remained, namely the Orbital Workshop and Apollo Telescope Mount solar observatory.



Launch of the unmanned Skylab Space Station atop a Saturn V, May 14th, 1973
Credit: NASA

Many advocates of manned space travel expected until the 1960s that a space station would be an important early step in space exploration. The development of the transistor, the solar cell, and telemetry, led to unmanned satellites that could take photographs of weather patterns or enemy nuclear weapons and send them to Earth, meaning the requirement for human presence in space was vastly reduced.

Establishing a manned outpost in space for longer periods of time posed a lot of challenges apart from keeping the astronauts fed and healthy. Astronauts were uninterested in watching movies on a proposed entertainment center or in playing games, but they did want books and individual music choices. Food was also important; early Apollo crews complained about its quality, and a NASA volunteer found it intolerable to live on the Apollo food for four days on Earth. Skylab food significantly improved on its predecessors by prioritizing edibility over scientific needs.

In Skylab each astronaut had a private sleeping area the size of a small walk-in closet, with a curtain, sleeping bag, and locker. Designers also added a shower and a toilet for comfort and to obtain precise urine and feces samples for examination on Earth.

Scientist-astronaut Owen K. Garriott, Skylab 3 science pilot, is seen performing an extravehicular activity at the Apollo Telescope Mount (ATM) of the Skylab space station cluster in Earth orbit, 6. August 1973
Credit: NASA

Skylab included the Apollo Telescope Mount (a multi-spectral solar observatory), Multiple Docking Adapter (with two docking ports), Airlock Module with extravehicular activity (EVA) hatches, and the Orbital Workshop (the main habitable space inside Skylab). Electrical power came from solar arrays, as well as fuel cells in the docked Apollo CSM. The rear of the station included a large waste tank, propellant tanks for maneuvering jets, and a heat radiator. Numerous experiments were conducted aboard Skylab during its operational life. Solar science was significantly advanced by the telescope, and observation of the Sun was unprecedented. Thousands of photographs of Earth were taken, and the Earth Resources Experiment Package (EREP) viewed Earth with sensors that recorded data in the visible, infrared, and microwave spectral regions.

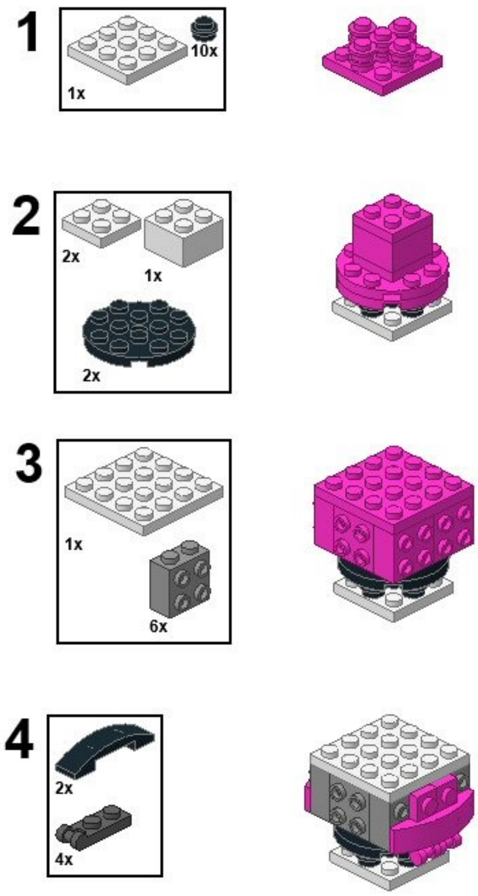
Skylab was launched on May 14, 1973 by the modified Saturn V. The first two crews had to overcome some unexpected challenges. During the station's launch, airflow caused a meteoroid shield to come off, tearing off one of two solar panels and preventing the other from deploying. The damage resulted in reduced power for the station. When the first crew arrived 11 days later, their first task was to repair the damage. Once repairs were complete, full power was restored.

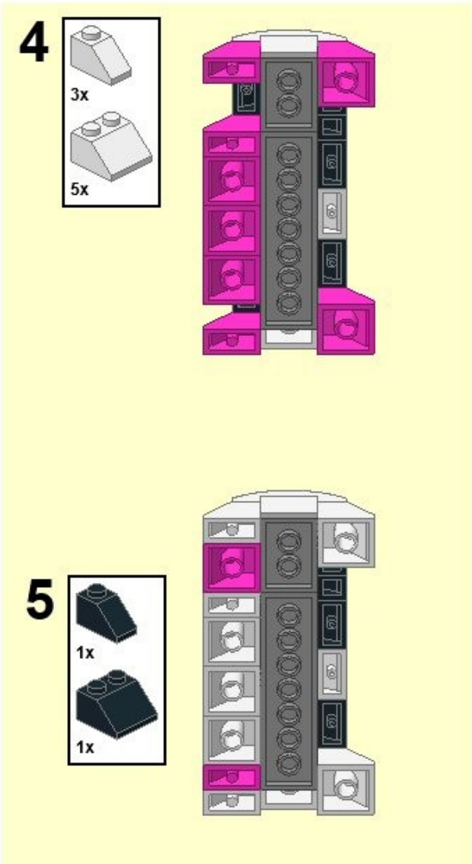
Original plans called for the station to remain in space after the final Skylab mission, for another 8 to 10 years, possibly to be visited by the Shuttle fleet. But unexpectedly high solar activity as well as delays in the Shuttle program foiled the plan, and on July 11, 1979, Skylab re-entered the Earth's atmosphere and disintegrated, dispersing debris across a sparsely populated section of western Australia and the southeastern Indian Ocean.

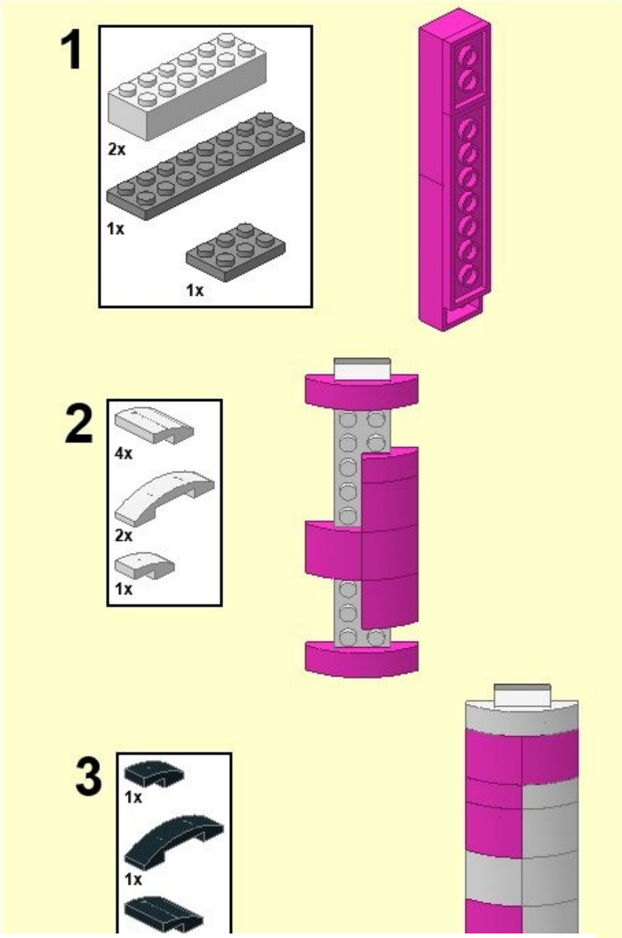
The model comes in three different configurations: “As flown” – fitting atop of a Saturn V, “As deployed” – complete with missing solar panel and installed solar protection “As planned” in full flight configuration.

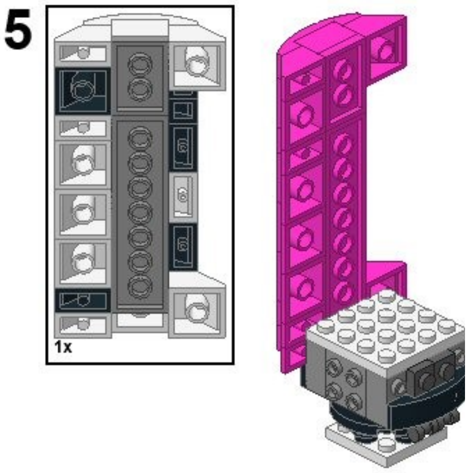
Skylab

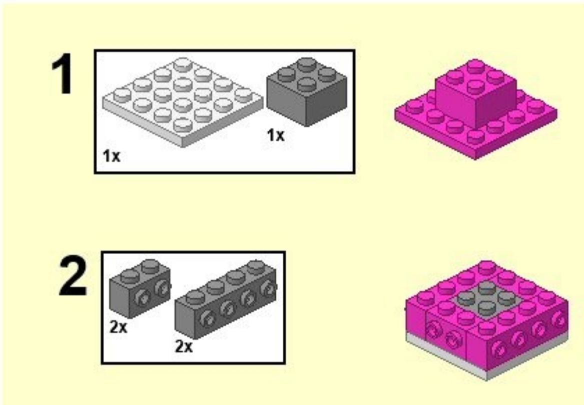
© Grant Passmore 2019

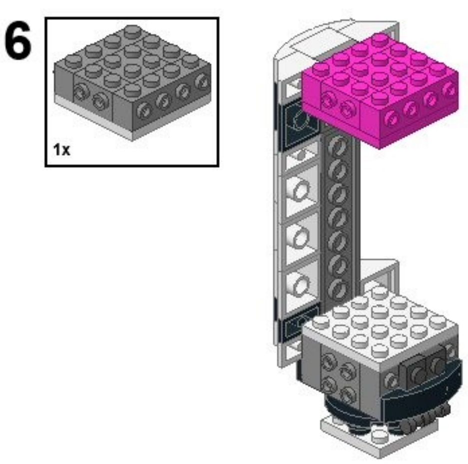


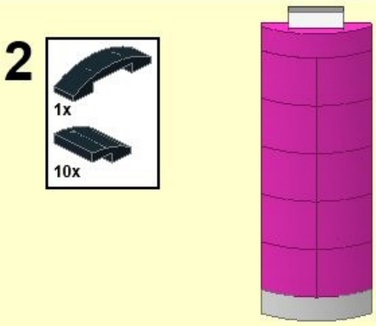




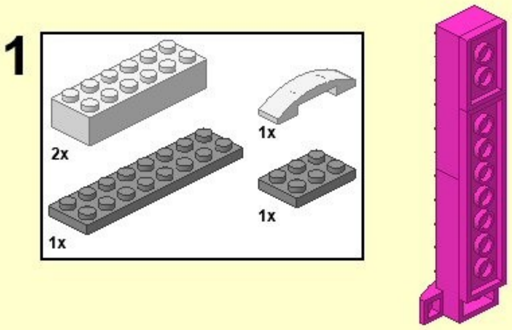


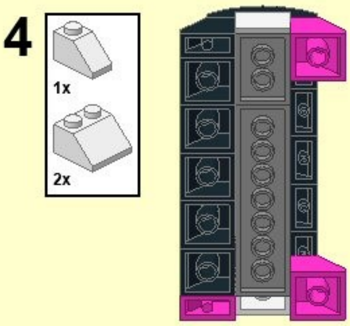


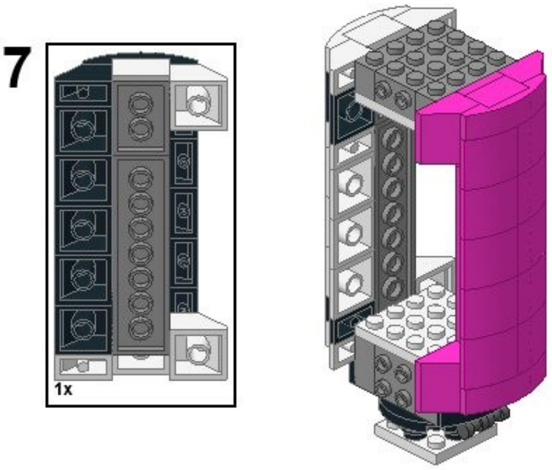

6
1x

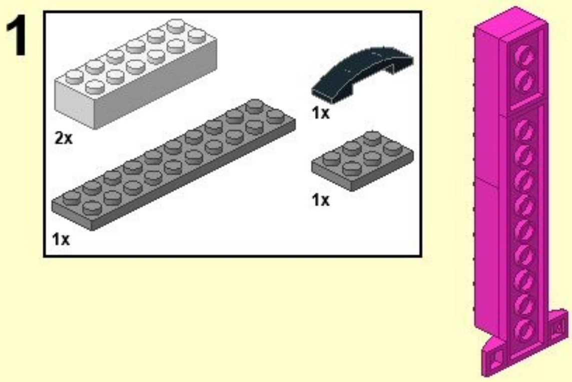

2
1x
10x

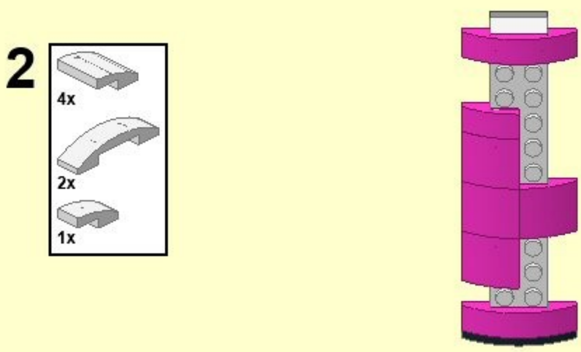

3
1x
5x

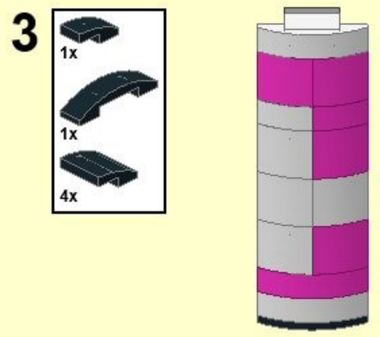

1
2x
1x
1x
1x

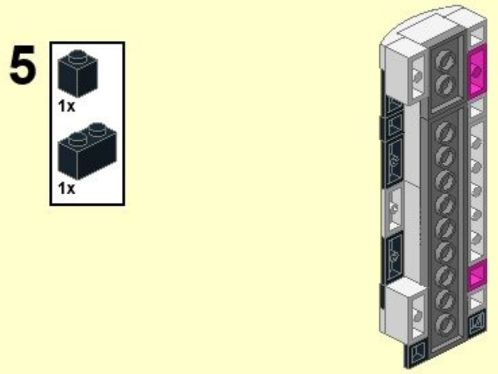

4
1x
2x

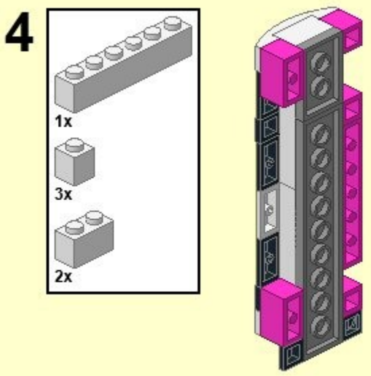

7
1x

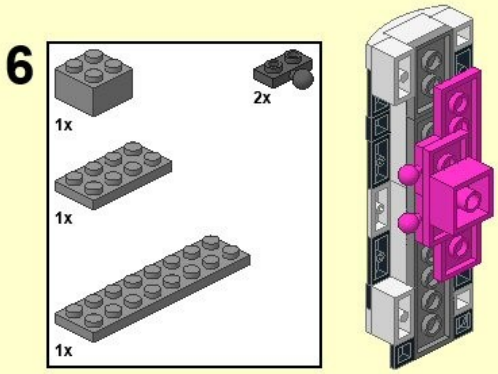

1
2x
1x
1x
1x

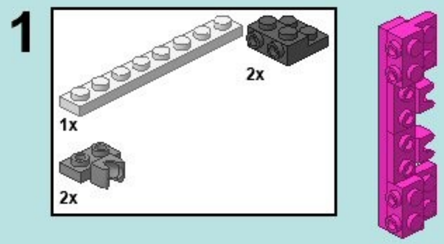

2
4x
2x
1x

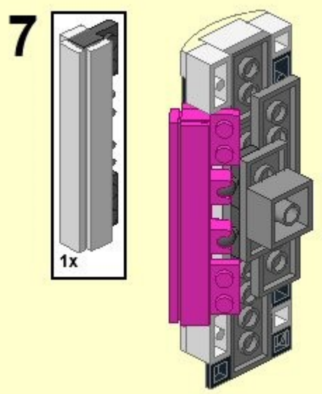

3
1x
1x
4x

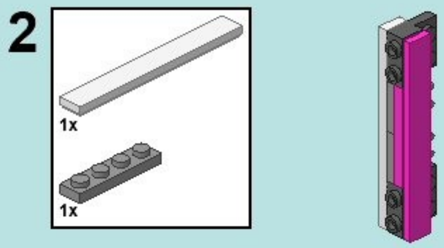

5
1x
1x

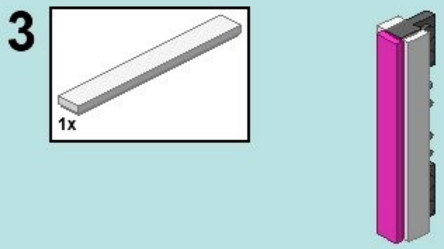

4
1x
3x
2x

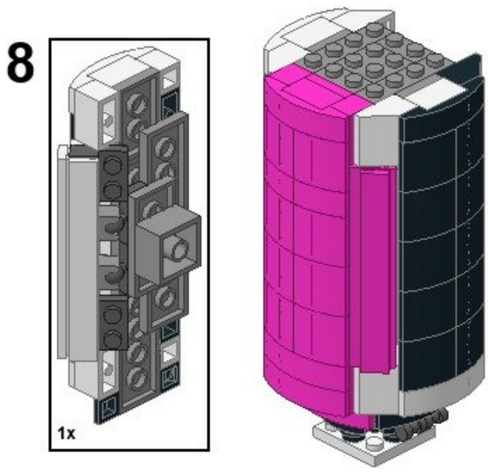

6
1x
2x
1x
1x

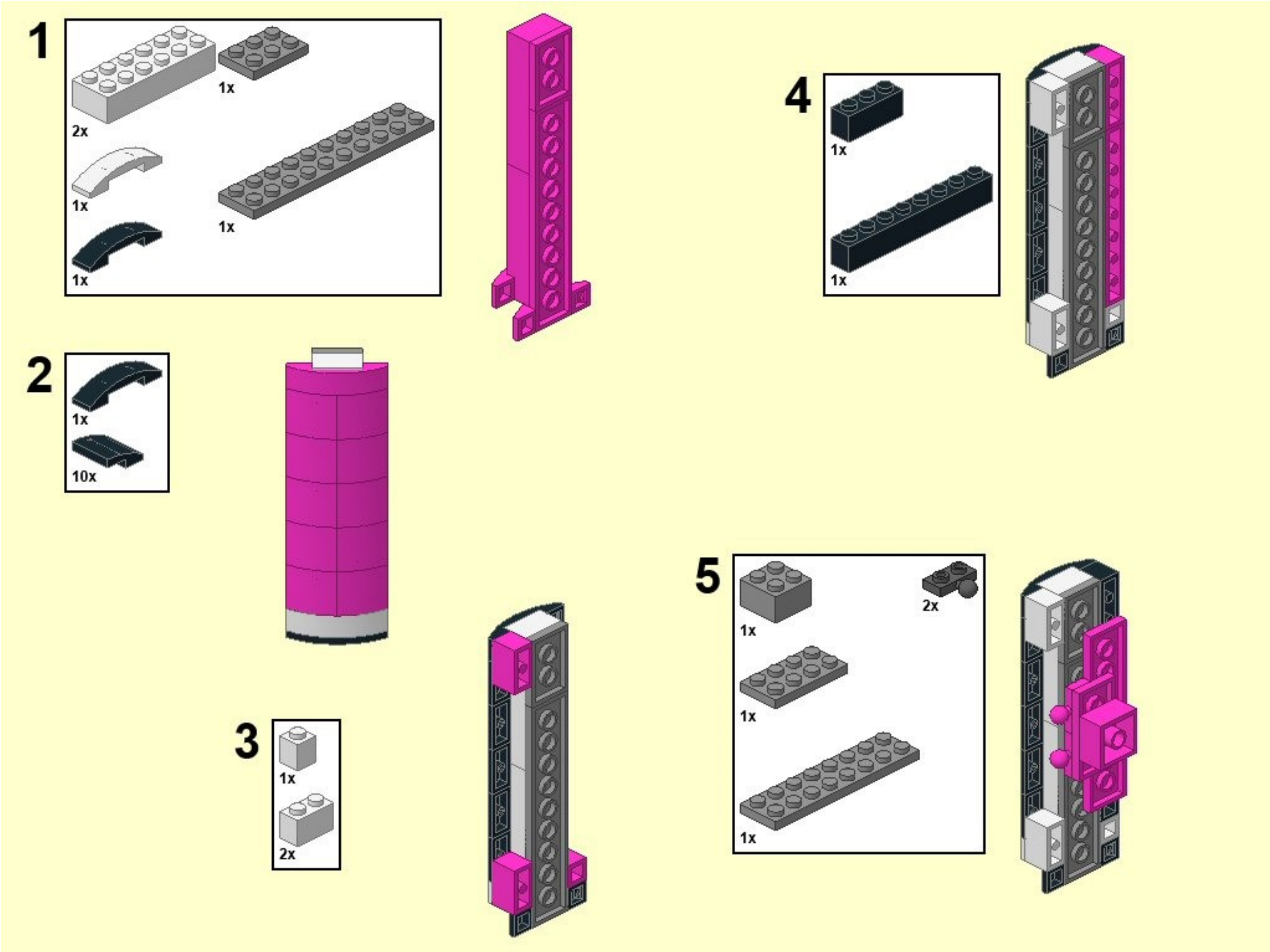

1
2x
1x
2x

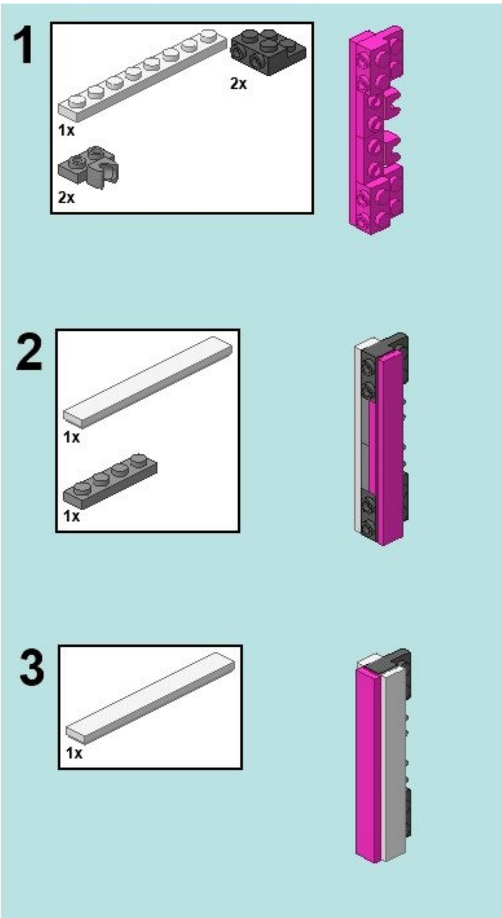

7
1x

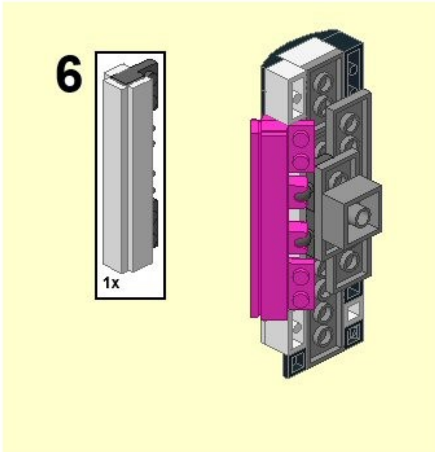

2
1x
1x

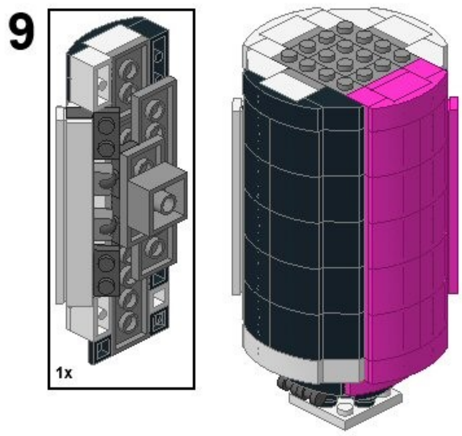

3
1x

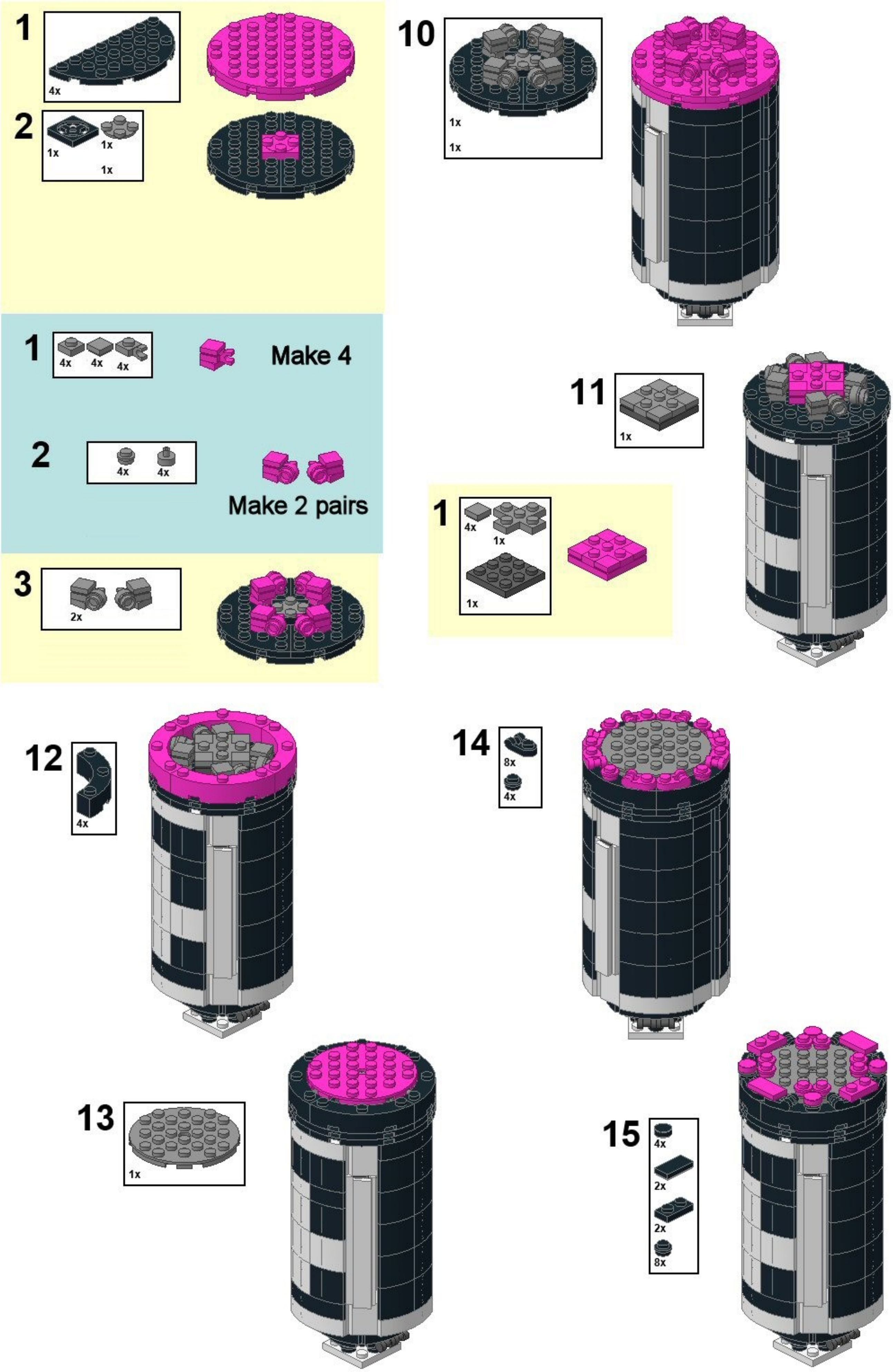

8
1x


1
2x
1x
1x
1x
1x
2
1x
10x
3
1x
2x
4
1x
1x
5
1x
2x
1x
1x


1
1x
2x
2x
2
1x
1x
3
1x

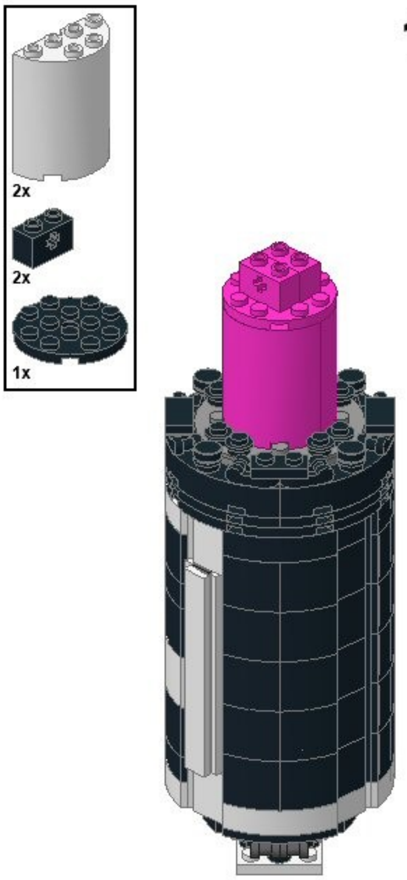

6
1x


9
1x

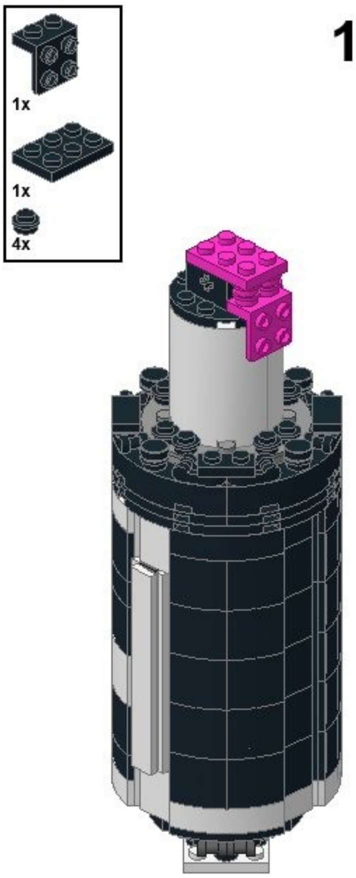


1
4x
2
1x
1x
1x
1
4x
4x
4x
Make 4
2
4x
4x
Make 2 pairs
3
2x
10
1x
1x
11
1x
1
4x
1x
1x
12
4x
13
1x
14
8x
4x
15
4x
2x
2x
8x

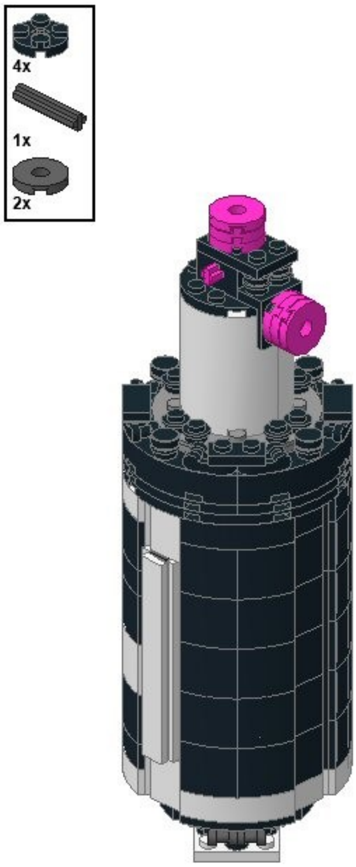
16



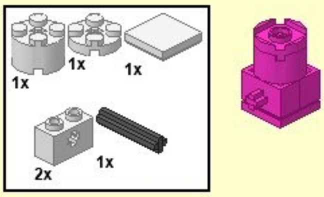
17



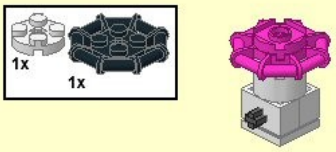
18



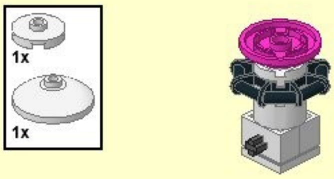
1



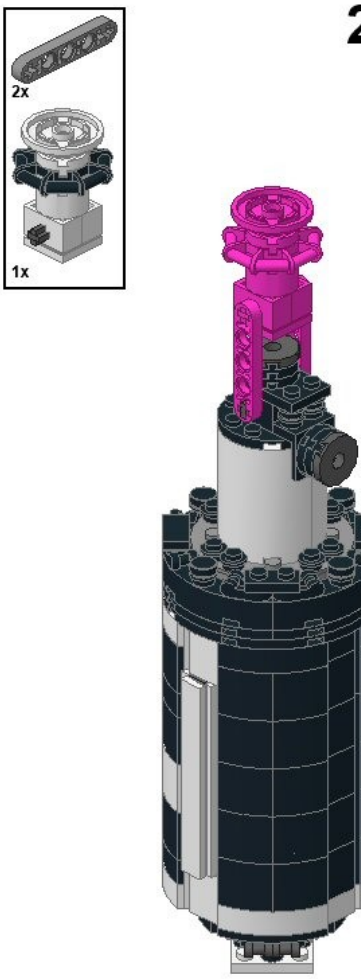
2



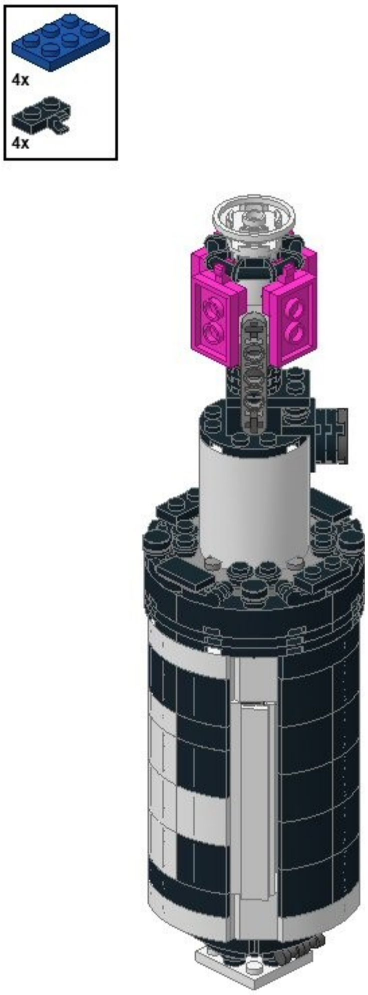
3

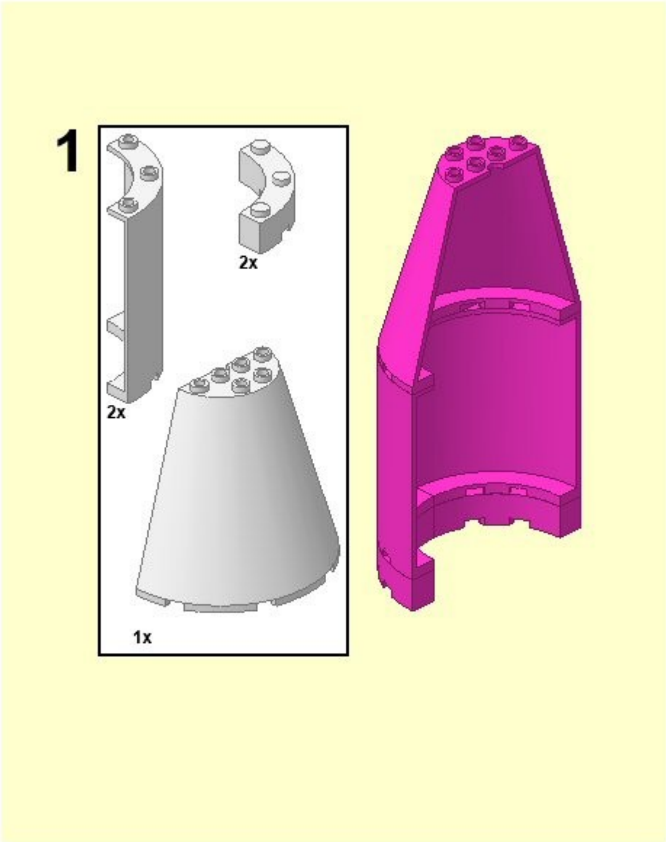


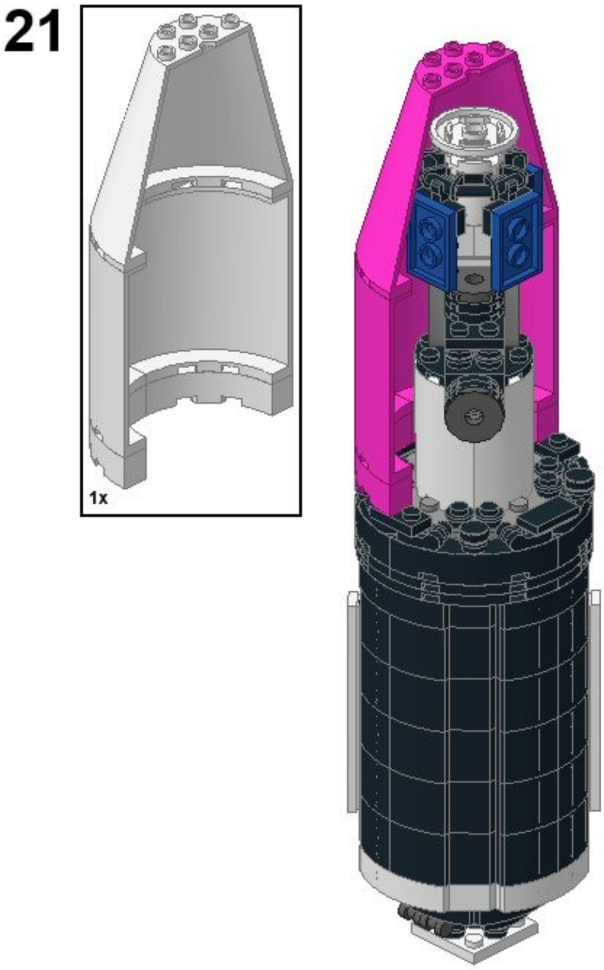
19

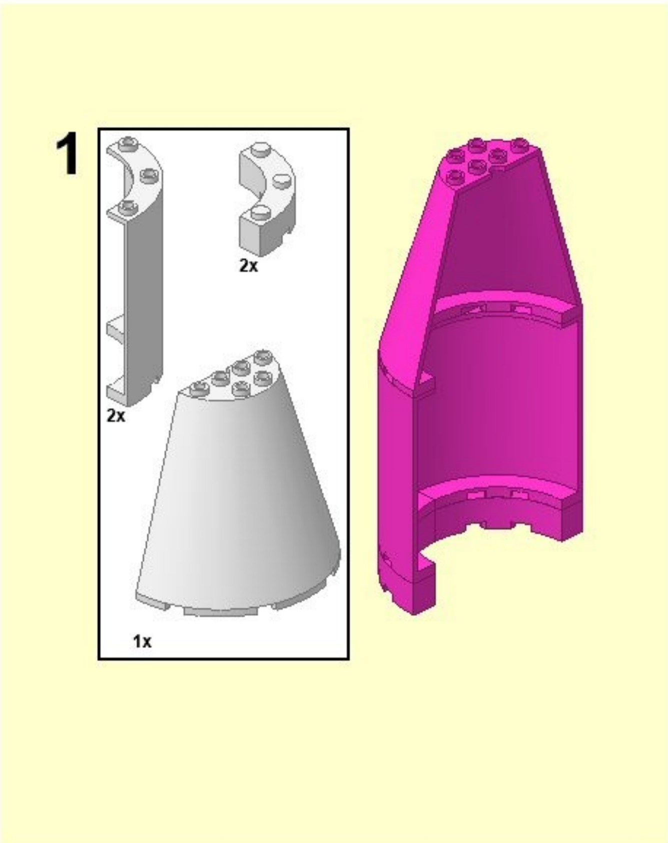


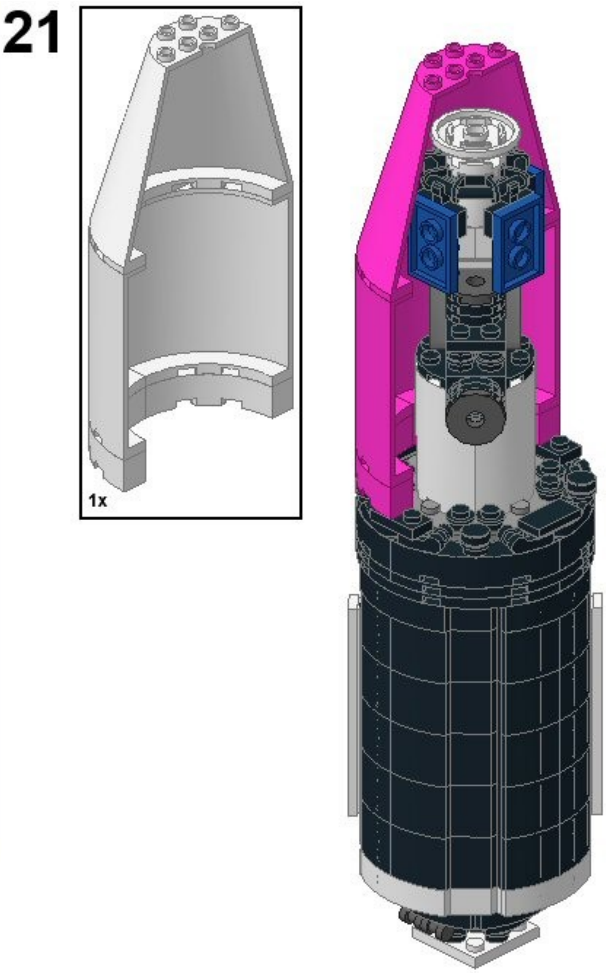
20

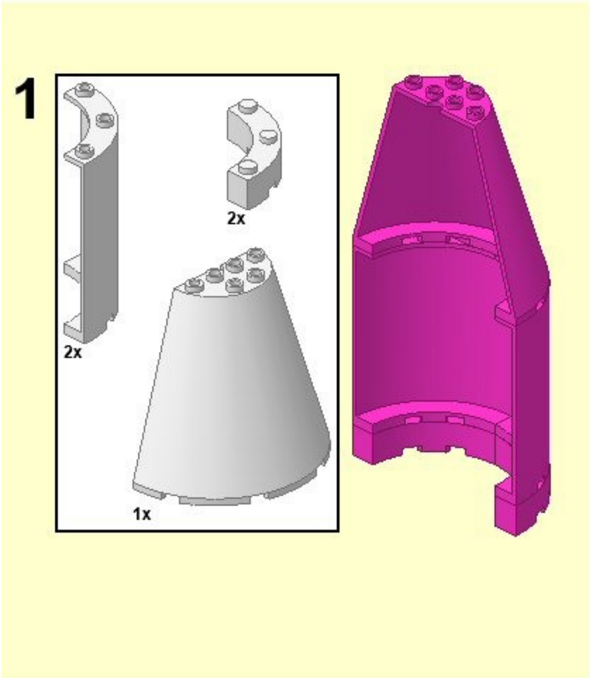



1
2x
2x
1x

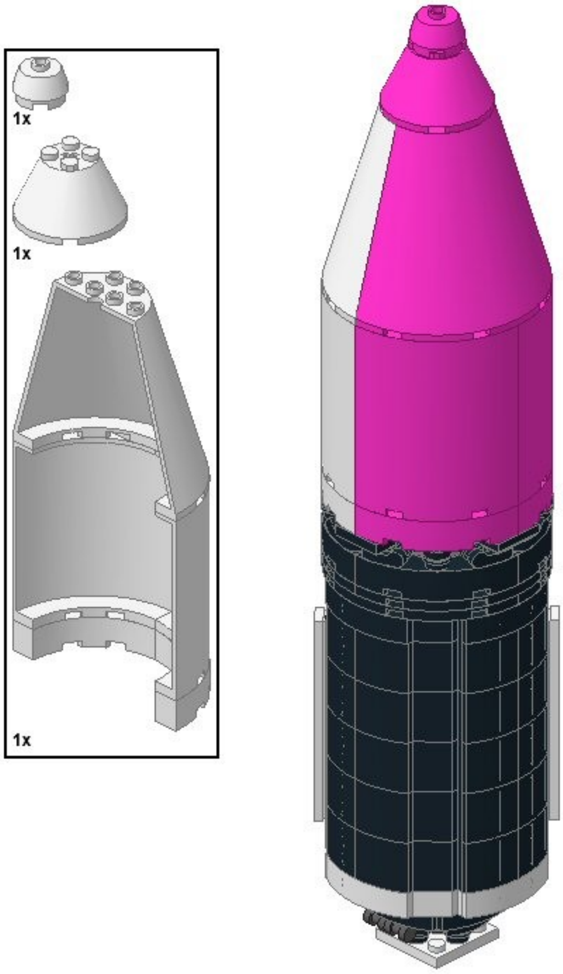

21
1x


1
2x
2x
1x


21
1x



22



SKYLAB DEPLOYED CONVERSION
by Eiffleman

1

2

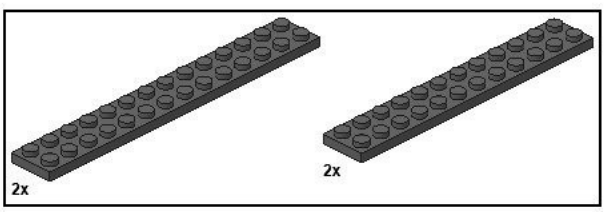
3

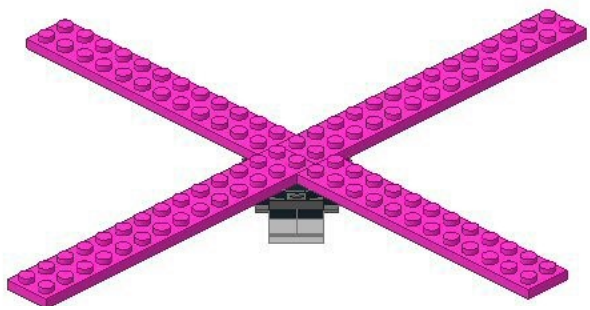
Line up the turntable with the 1x2 single stud tiles.

4

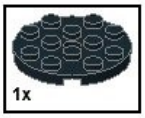
The 4x4 round tile is turned 45 degrees

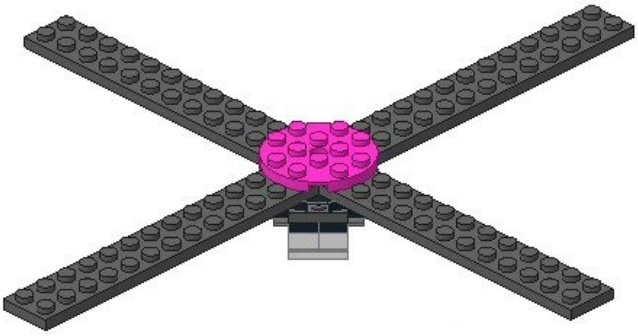
5





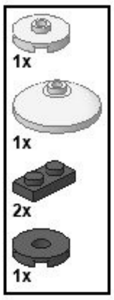
6



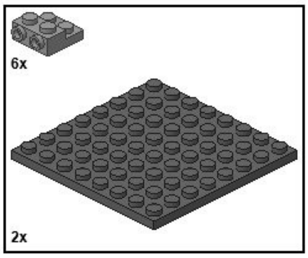


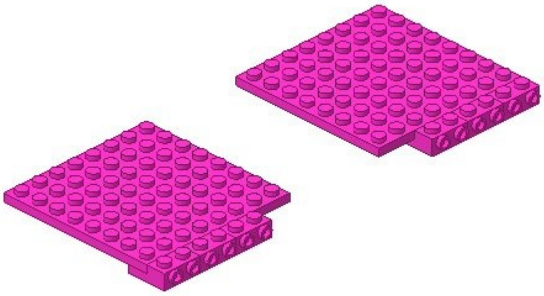
7

8

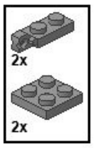


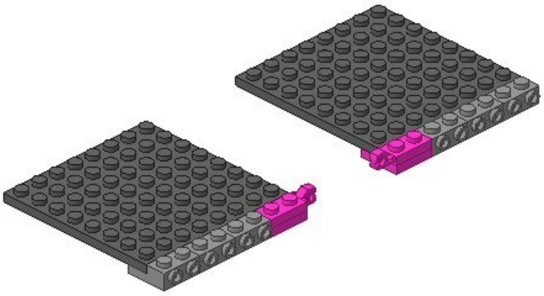
1



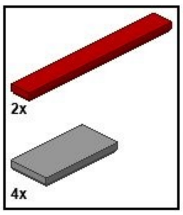


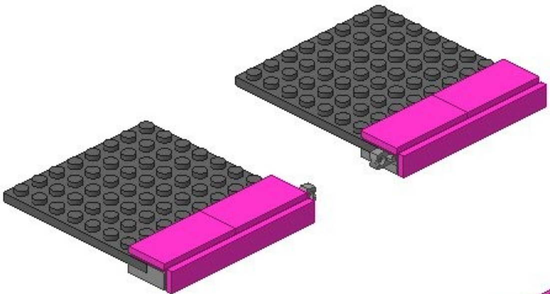
2





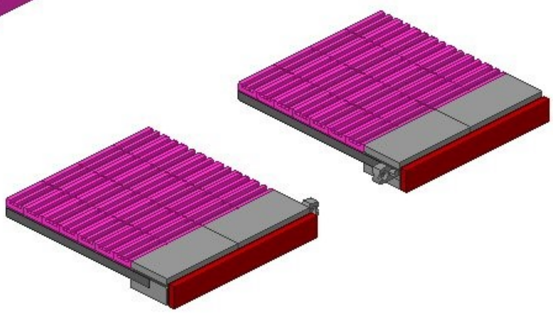
3



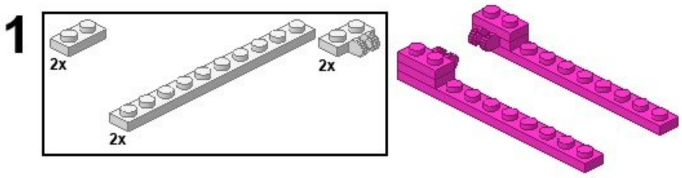


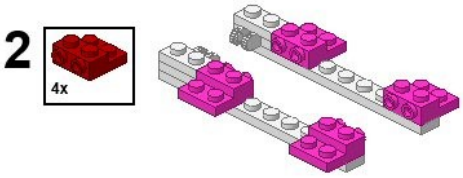
Note: Red Tiles are from the
sides of the 'Payload' version

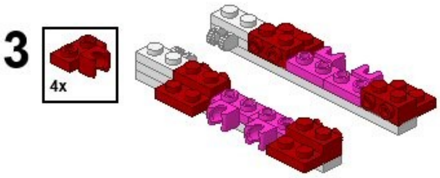
4



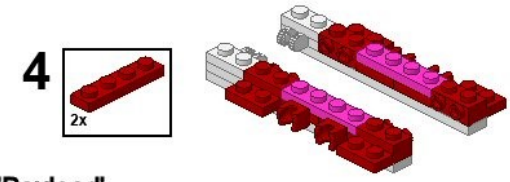
SKYLAB DEPLOYED CONVERSION
by Elffleman



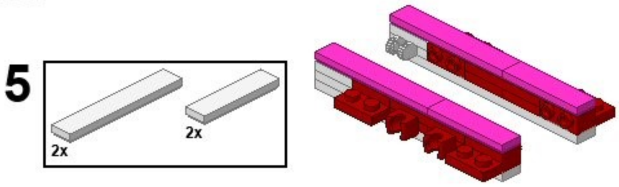




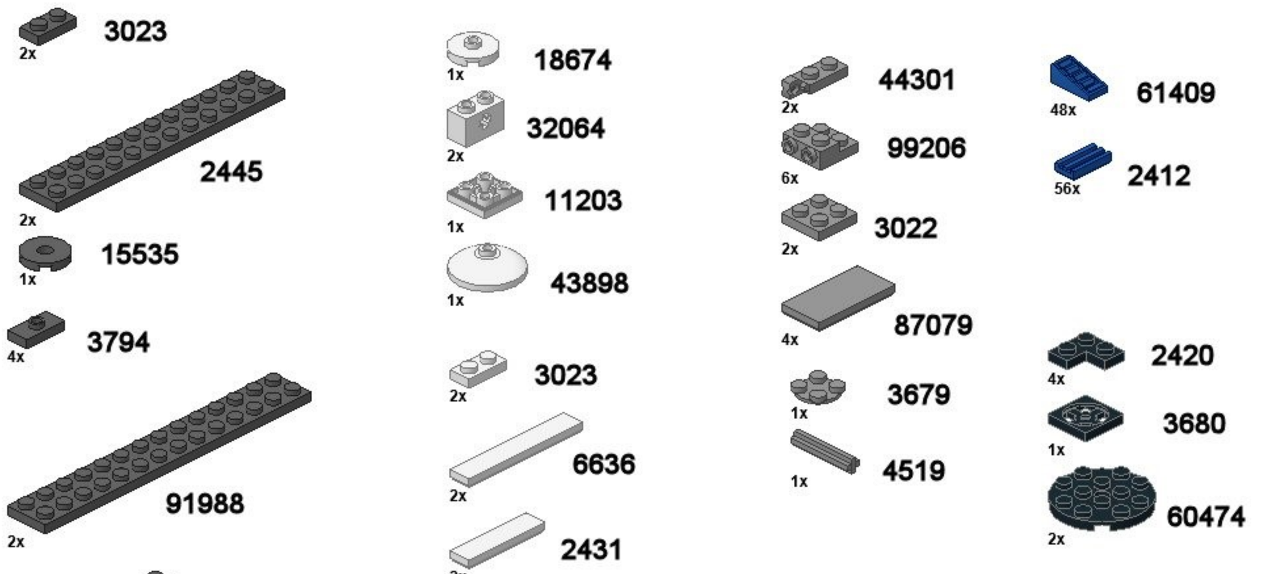
Note: Red parts are taken from the sides of the 'Payload' version.

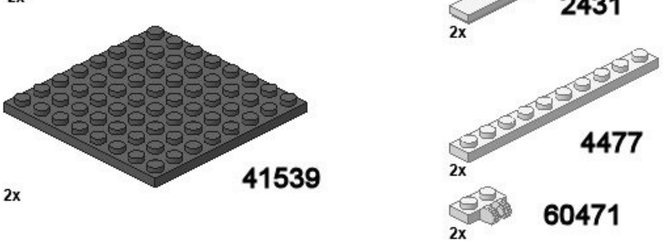


The side assemblies are 2 studs longer and a 2x2 slope and 1x2 brick must be taken out of the 'Payload' version to allow for the increased length of the sides.



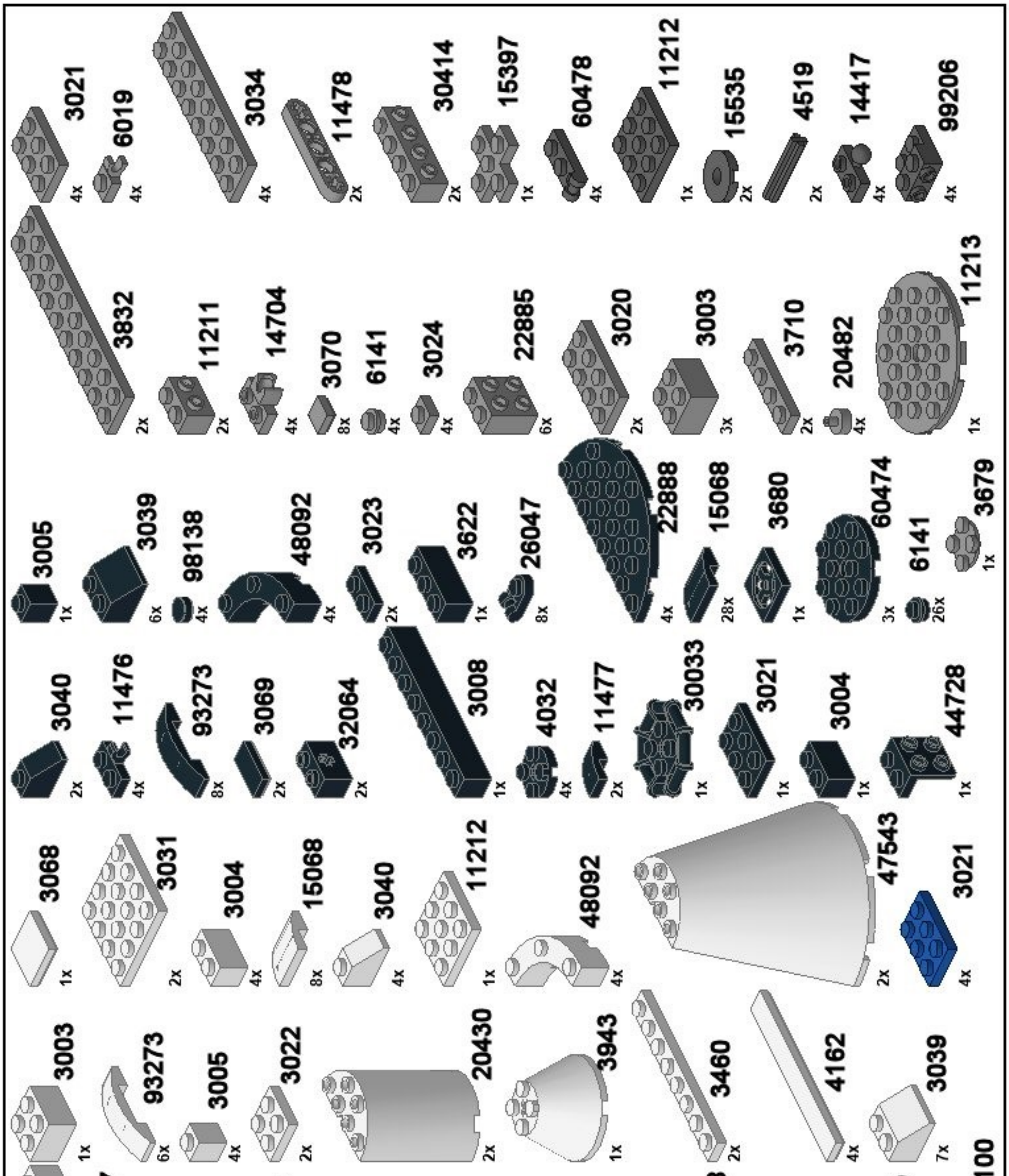
SKYLAB DEPLOYED CONVERSION
by Eiffleman

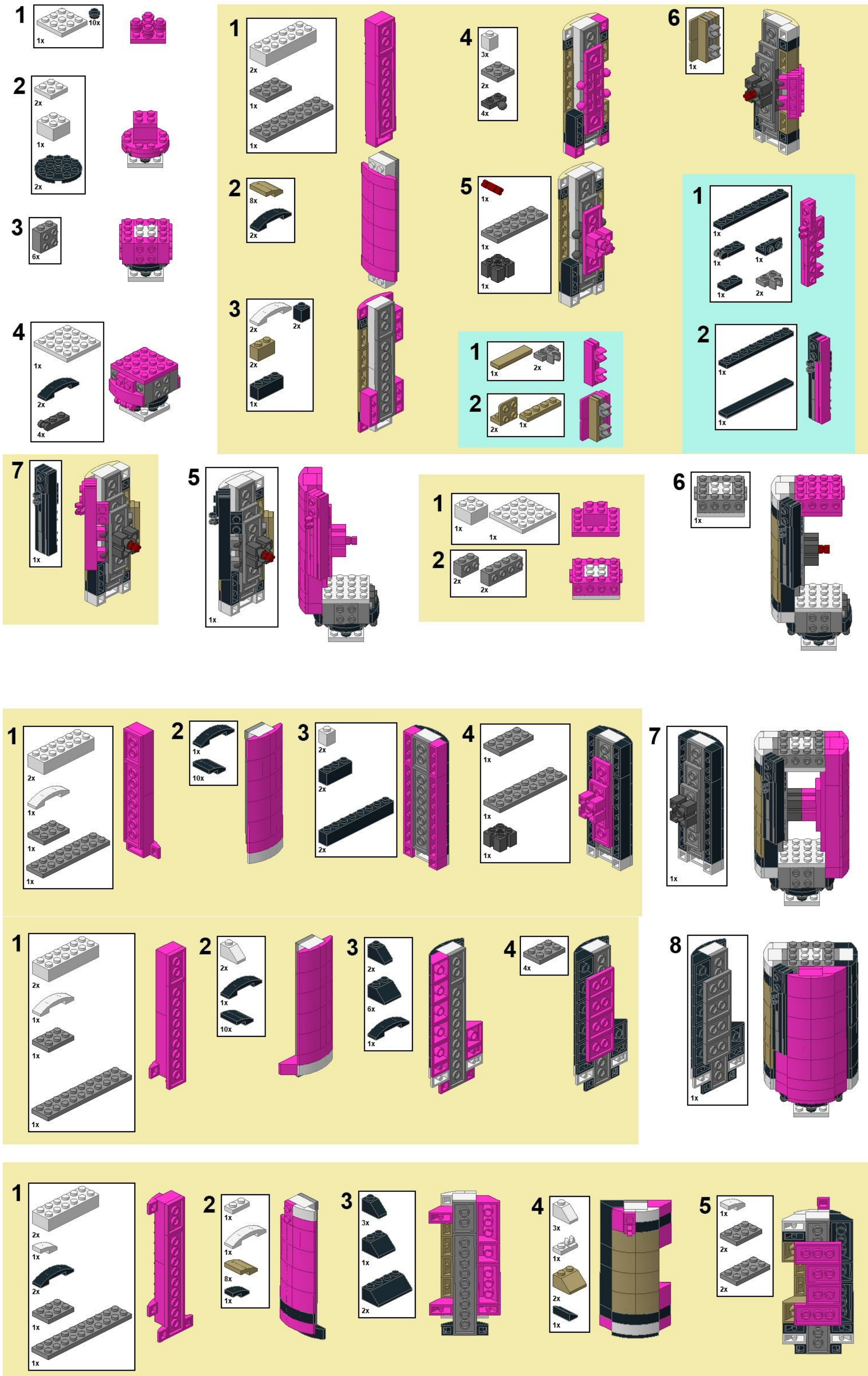


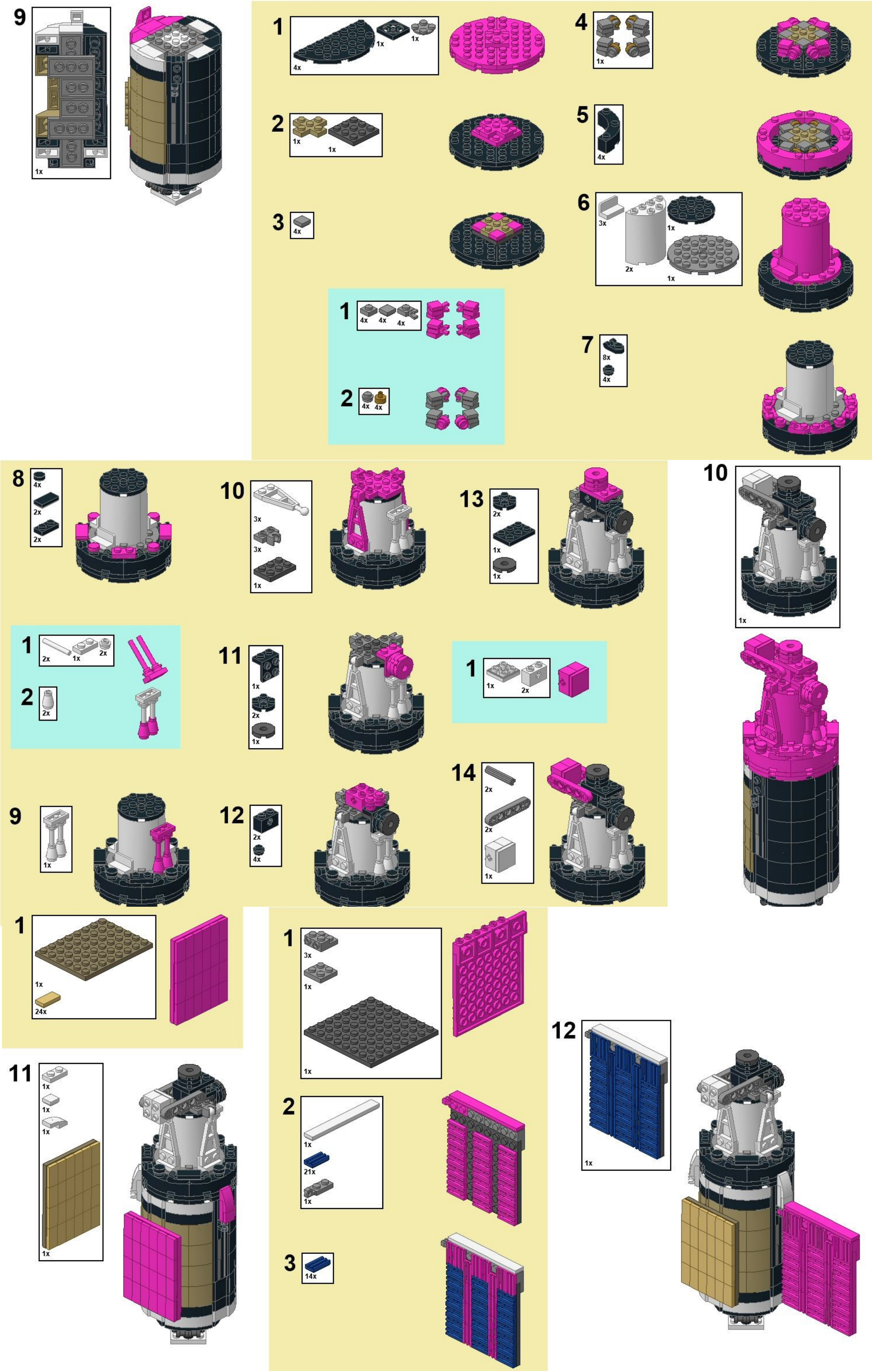


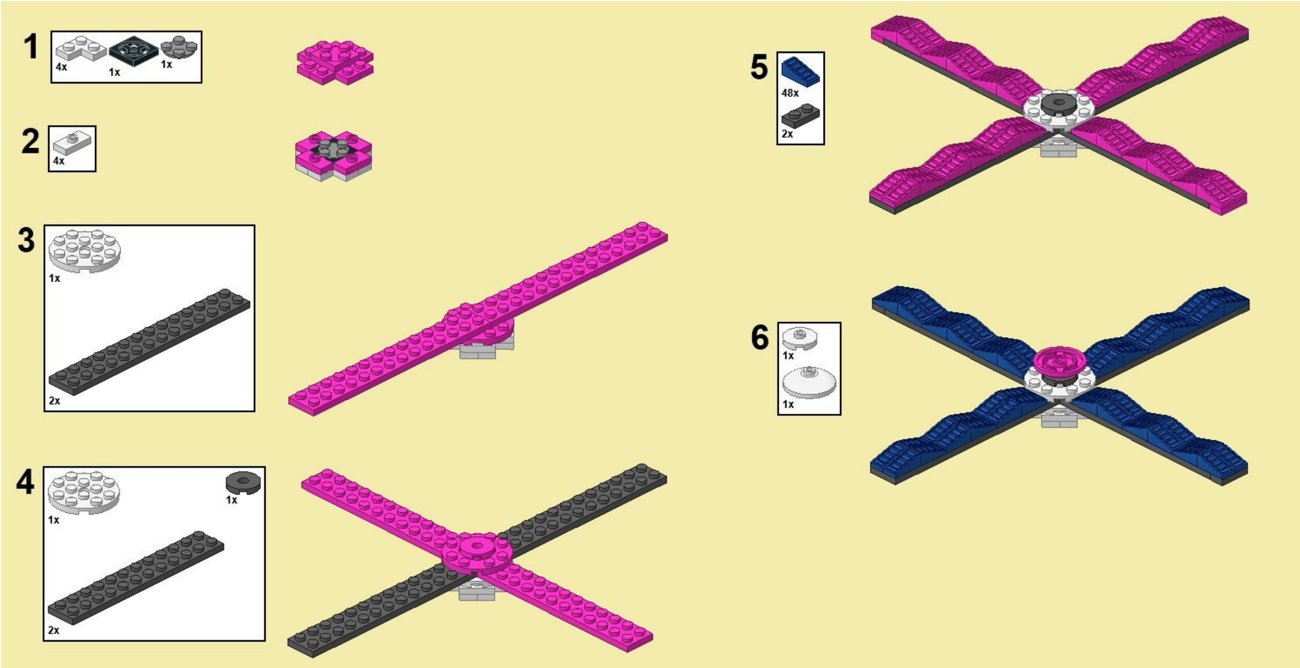
Red parts not shown as these are reused parts from the 'Payload' version of Skylab

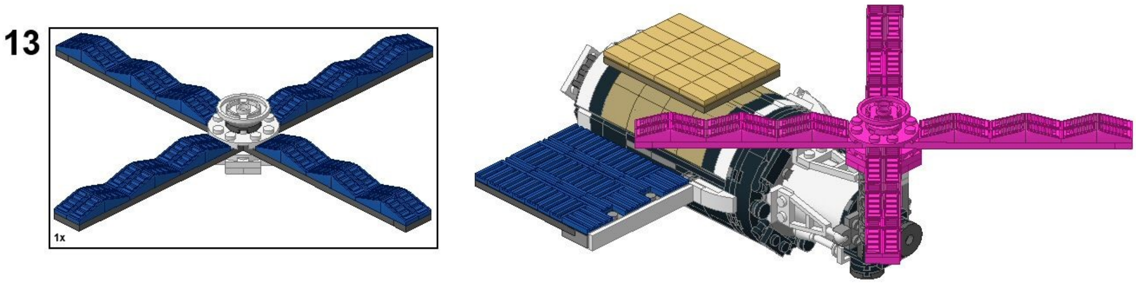
SKYLAB DEPLOYED CONVERSION
by Eiffleman

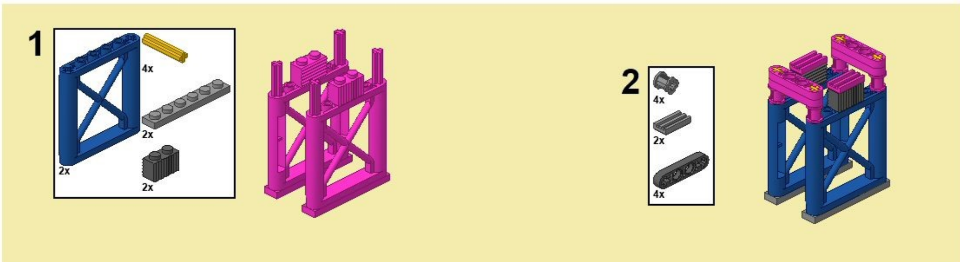

3021 4x
6019 4x
3034 4x
11478 2x
30414 2x
15397 1x
60478 4x
11212 1x
15535 2x
4519 2x
14417 4x
99206 4x
3832 2x
11211 2x
14704 4x
3070 8x
6141 4x
3024 4x
22885 6x
3020 2x
3003 3x
3710 2x
20482 4x
11213 1x
3005 1x
3039 6x
98138 4x
48092 4x
3023 2x
3622 1x
26047 8x
22888 4x
15068 28x
3680 1x
60474 3x
6141 26x
3679 1x
3040 2x
11476 4x
93273 8x
3069 2x
32064 2x
3008 1x
4032 4x
11477 2x
30033 1x
3021 1x
3004 1x
44728 1x
3068 1x
3031 2x
3004 4x
15068 8x
3040 4x
11212 1x
48092 4x
47543 2x
3021 4x
3003 1x
93273 6x
3005 4x
3022 2x
20430 2x
3943 1x
3460 2x
4162 4x
3039 7x
44237 8x
4032 2x
18674 1x
11477 2x
32064 2x
30562 4x
43898 1x
6143 1x
3009 1x
98100 1x

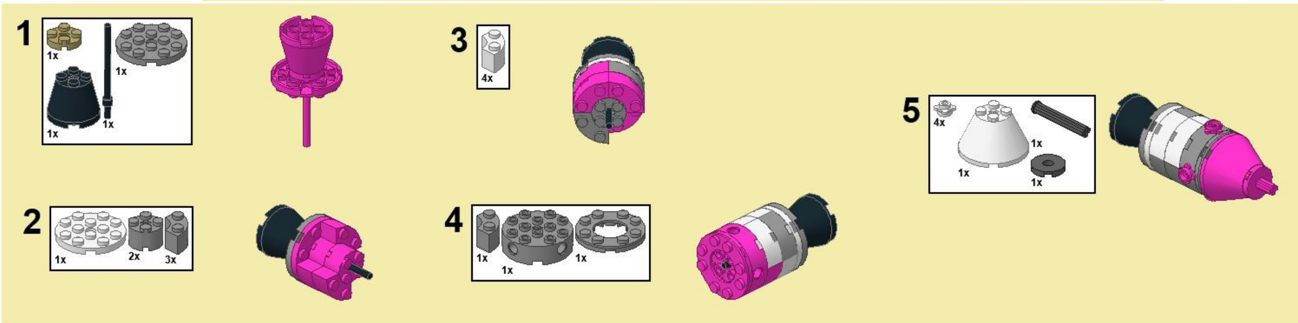


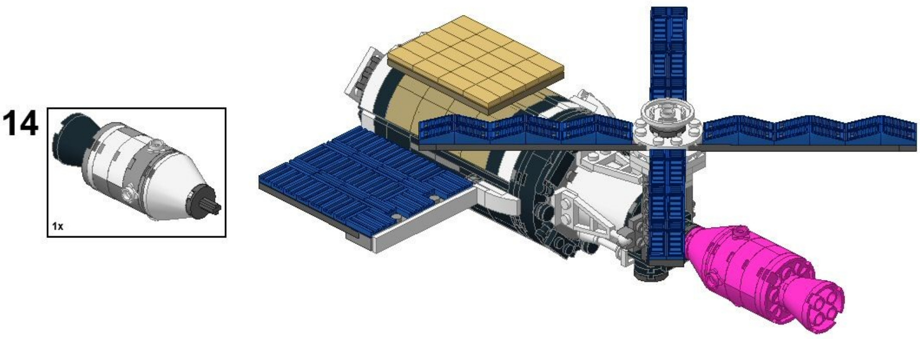

9 1x
1 4x 1x 1x
2 1x 1x
3 4x
1 4x 4x 4x
2 4x 4x
4 1x
5 4x
6 3x 1x 2x 1x
7 8x 4x
8 4x 2x 2x
10 3x 3x 1x
13 2x 1x 1x
10 1x
1 2x 1x 2x
2 2x
11 1x 2x 1x
1 1x 2x
9 1x
12 2x 4x
14 2x 2x 1x
1 1x 24x
1 3x 1x 1x
11 1x 1x 1x 1x
2 1x 21x 1x
12 1x
3 14x

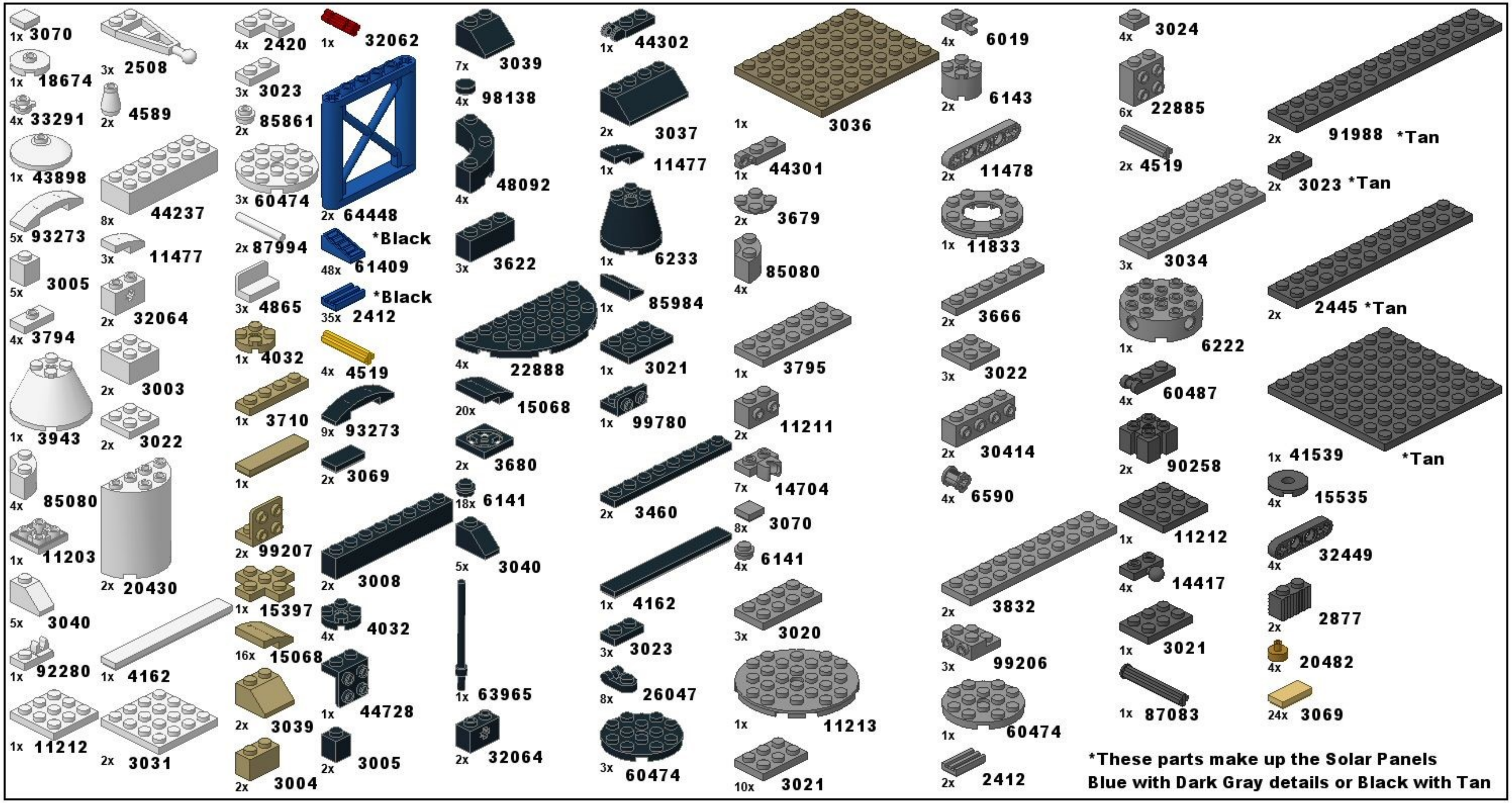

1
4x
1x
1x
2
4x
3
1x
2x
4
1x
1x
2x
5
48x
2x
6
1x
1x


13
1x


1
4x
2x
2x
2x
2
4x
2x
4x


1
1x
1x
1x
1x
2
1x
2x
3x
3
4x
4
1x
1x
1x
5
4x
1x
1x
1x

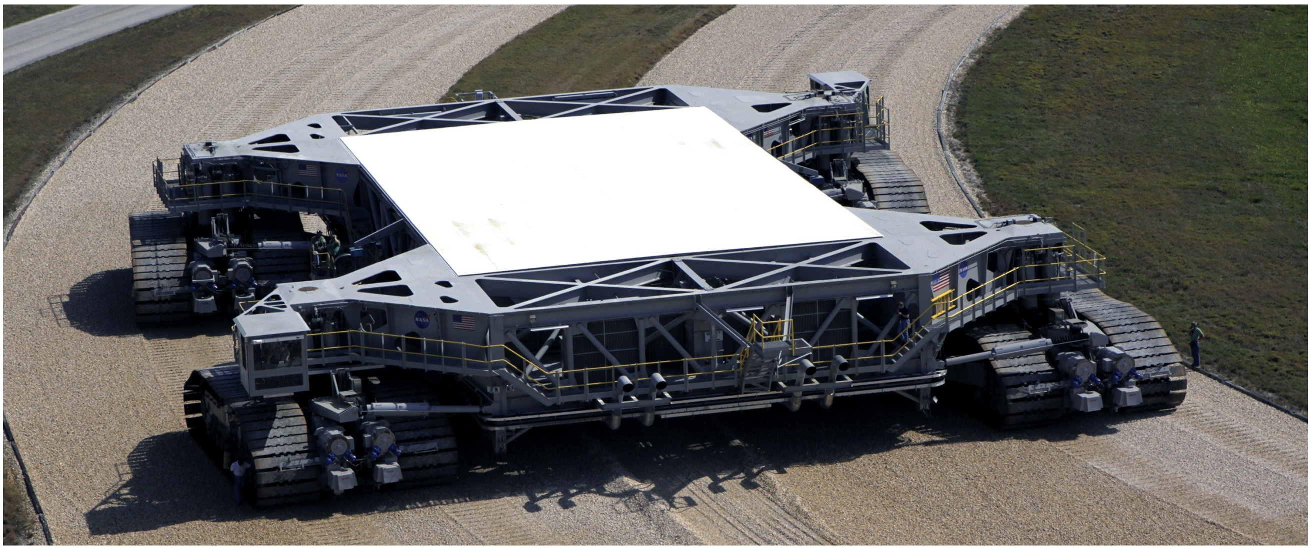

14
1x



1x 3070
1x 18674
4x 33291
1x 43898
5x 93273
5x 3005
4x 3794
1x 3943
4x 85080
1x 11203
5x 3040
1x 92280
1x 11212
3x 2508
2x 4589
8x 44237
3x 11477
2x 32064
2x 3003
2x 3022
2x 20430
1x 4162
2x 3031
4x 2420
3x 3023
2x 85861
3x 60474
2x 87994
3x 4865
1x 4032
1x 3710
1x
2x 99207
1x 15397
16x 15068
2x 3039
2x 3004
1x 32062
2x 64448
*Black
48x 61409
*Black
35x 2412
4x 4519
9x 93273
2x 3069
2x 3008
4x 4032
1x 44728
2x 3005
7x 3039
4x 98138
4x 48092
3x 3622
4x 22888
20x 15068
2x 3680
18x 6141
5x 3040
1x 63965
2x 32064
1x 44302
2x 3037
1x 11477
1x 6233
1x 85984
1x 3021
1x 99780
2x 3460
1x 4162
3x 3023
8x 26047
3x 60474
1x 3036
1x 44301
2x 3679
4x 85080
1x 3795
2x 11211
7x 14704
8x 3070
4x 6141
3x 3020
1x 11213
10x 3021
4x 6019
2x 6143
2x 11478
1x 11833
2x 3666
3x 3022
2x 30414
4x 6590
2x 3832
3x 99206
1x 60474
2x 2412
4x 3024
6x 22885
2x 4519
3x 3034
1x 6222
4x 60487
2x 90258
1x 11212
4x 14417
1x 3021
1x 87083
2x 91988 *Tan
2x 3023 *Tan
2x 2445 *Tan
*Tan
1x 41539
4x 15535
4x 32449
2x 2877
4x 20482
24x 3069
*These parts make up the Solar Panels
Blue with Dark Gray details or Black with Tan

The Crawler

The crawler-transporters, formally known as the "Missile Crawler Transporter Facilities", are a pair of giant tracked transport vehicles. They were used on all Saturn V launches as well as all the Space Shuttle launches to transport the Mobile Launcher Platform into the Vehicle Assembly Building and then to the Launch Pad with an assembled space vehicle.



Crawler-transporter-2 (CT-2) is on its way from the Vehicle Assembly Building to the Park Site west of the building.
Credits: NASA/Jim Grossmann

The two crawler-transporters were designed and built by Marion Power Shovel Company in 1964-65 using components designed and built by Rockwell International at a cost of US$14 million each. Upon its construction, the crawler-transporter became the largest self-powered land vehicle in the world. The name-giving maximum speed of a crawler is 1.6km (one mile) per hour loaded, about 3.2 km (2 miles) per hour unloaded. Launch Pad to VAB trip time with the Mobile Launch Platform is about 5 hours. The crawler burns 568 liters of diesel oil per mile.

Each crawler-transporter has a mass of 2,721 tonnes (6,000,000 lb) and has eight tracks, two on each corner. It is driven by 16 electric motors that are powered by two generators. Each track has 57 shoes, and each shoe weighs 900 kg (1,984 lb). The vehicle measures 40 by 35 metres (131 by 114 ft). The height from ground level to the platform is adjustable from 6.1 to 7.9 m (20 to 26 ft), and each side can be raised and lowered independently of the other. The crawler uses a laser guidance system and a leveling system to keep the Mobile Launcher Platform level within 10 minutes of arc (0.16 degrees; about 30 cm (1 ft) at the top of the Saturn V), while moving up the 5 percent grade to the launch site. A separate laser docking system provides pinpoint accuracy when the crawler-transporter and Mobile Launch Platform are positioned in the VAB or at the launch pad. A team of nearly 30 engineers, technicians and drivers operates the vehicle from an internal control room.

Above: Space Shuttle Discovery climbs the five percent grade to the top of the hardstand at Launch Pad 39A. Rollout is a milestone for the STS-120 mission to the International Space Station.
Credit: NASA

Overleaf: Crawler-Transporter No.2, carrying the Shuttle's Mobile Launch Platform.
Credit: NASA

These massive machines have performed well for more than 40 years. So far, KSC's two crawler-transporters have accumulated 1,243 miles since 1977. Including the Apollo years, the transporters have racked up 2,526 miles, about the same distance as a one-way trip from KSC to Los Angeles by interstate highway or a round trip between KSC and New York City. Responsibility for the ongoing maintenance work for these monstrous vehicles fall to United Space Alliance's Transporter Operations team

Crawler No. 2 was upgraded in 2012-14 from its a lifting capacity of 12 million pounds -- the combined weight of the shuttle and mobile launcher -- to 18 million pounds, for NASA's new heavy lift rocket. They will serve NASA into the 21st century.

Designers Notes

1. The Crawler-Transporter model is strong enough to support the Saturn V (but has not been tested with a launch pad and Tower).

2. Exhaust stacks use click hinge connectors to set the angle, I sometimes knock them and have to reposition them. The hinges look better than the alternate fixed pieces which have holes through them.

3.Picking up the model sometimes moves the side hinged access gangways It is best to pick up the model from the side as the bottom row of the front and back structure have bricks which are only held on by their studs

4. The top deck is a tight fit - I had to add the two levers to pop the lid open and one edge is only one plate thick as it was impossible to fit when it was two plates thick. The thin edge goes to the rear of the Crawler.

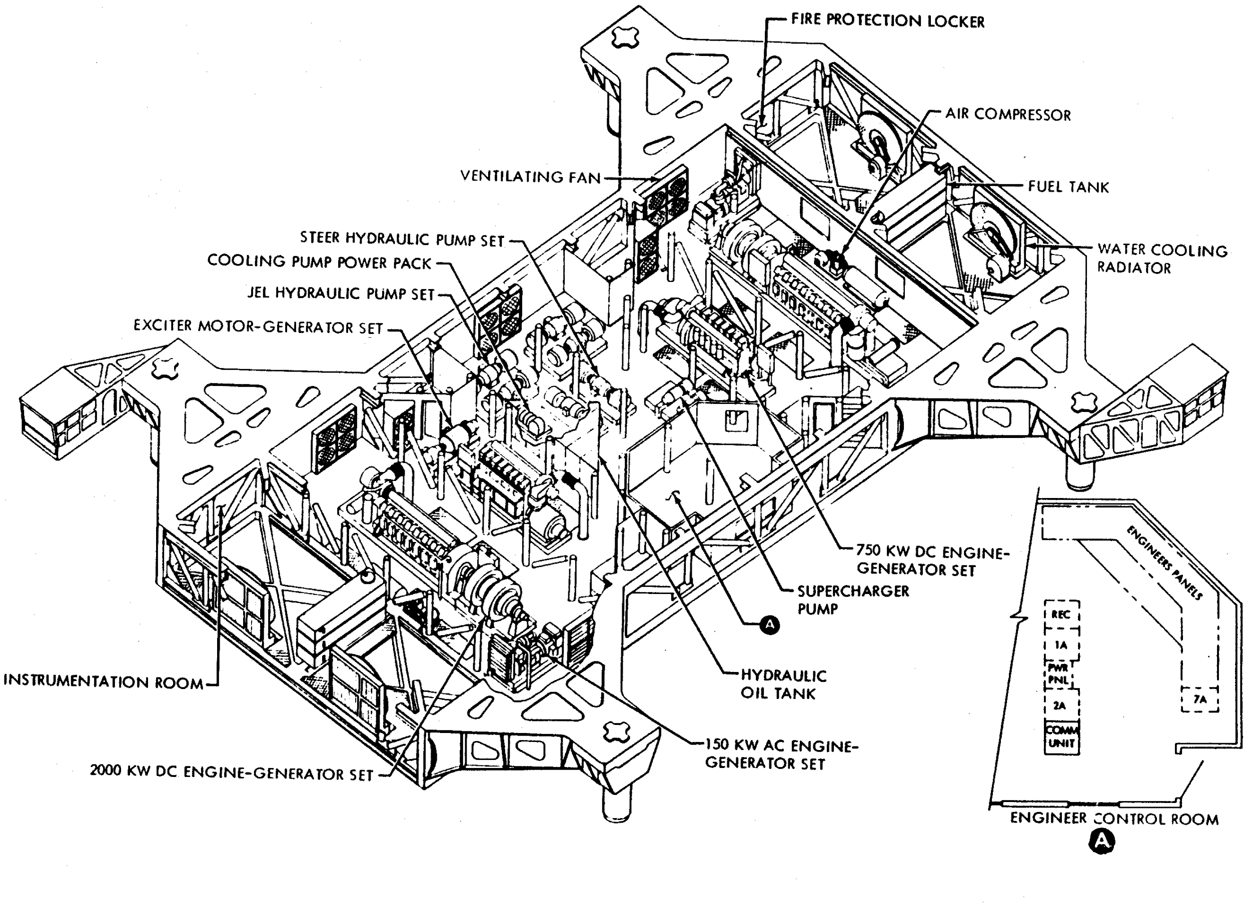
The „Missile Crawler Transporter Facilities“ Or Crawler Transporter carrying the Umbilical Launch Tower in 1966
Credit: NASA

5. First time fitting the tracks it can take a few attempts to adjust the length of the hydraulic rams so that the tracks are parallel to the Crawler body. Setting them means fitting and removing the track units a few times (once set there is no issue). Its easier to take off the two 2x2 plates with the ball socket and leave the two side rams attached to the body than try and separate the ball socket connection.

6. The large hydraulic fluid tank in the middle of the interior is only held by one stud (the second stud just keeps it aligned so that it cannot turn), this has not proven to be an issue as I have inverted the model and it doesn't fall out (when the top deck is fitted the tank is sandwiched between the floor and top deck and cannot move)

7. The track are loosely fitted - not to the point where it can come off, but they do sag when the model is picked up. This was done to let the top of the tracks move in a wave and look like they have a lot of weight.

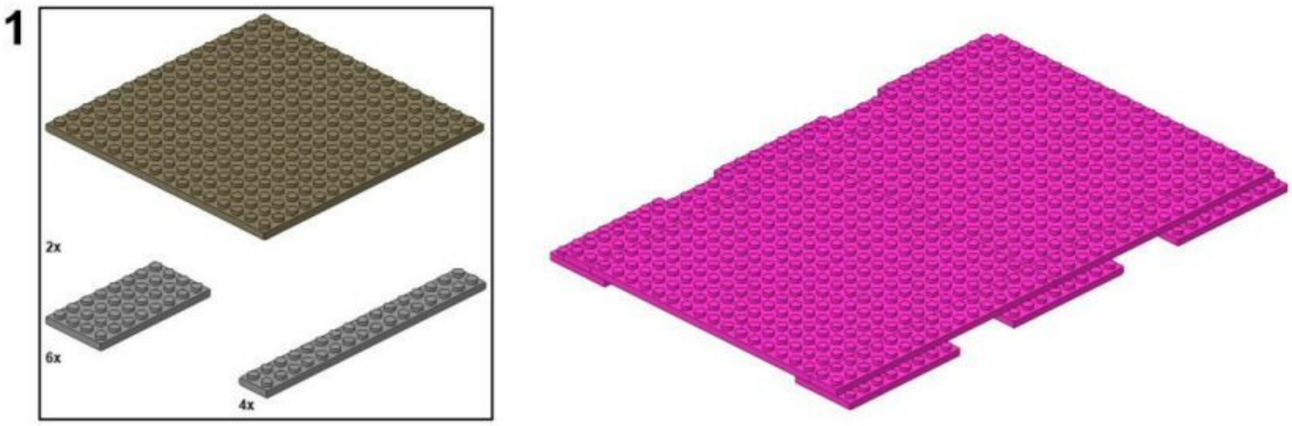
8. The cross axle's main purpose is not structural, it connects the track unit to the main body. The load is passed through the flat plates on the top of the unit. Directional stability comes from the four 'hydraulic rams' which attach the track unit to the main body of the crawler.

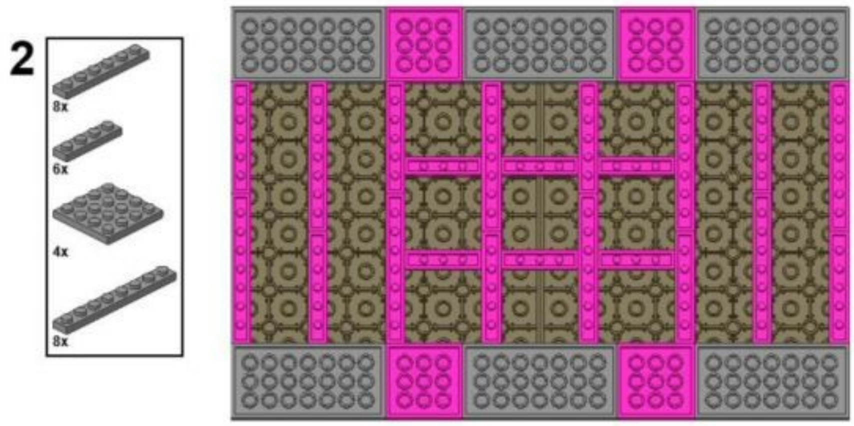


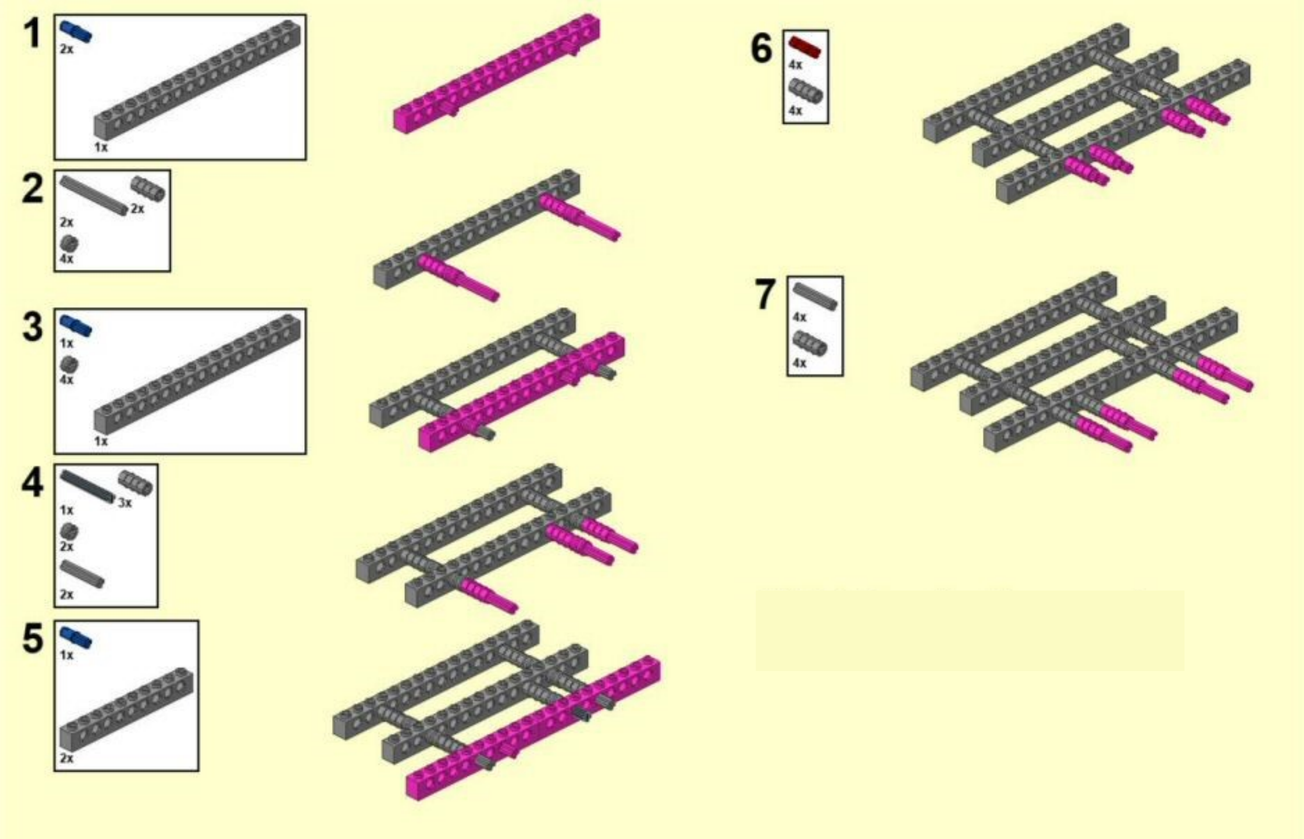
CT Equipment Location

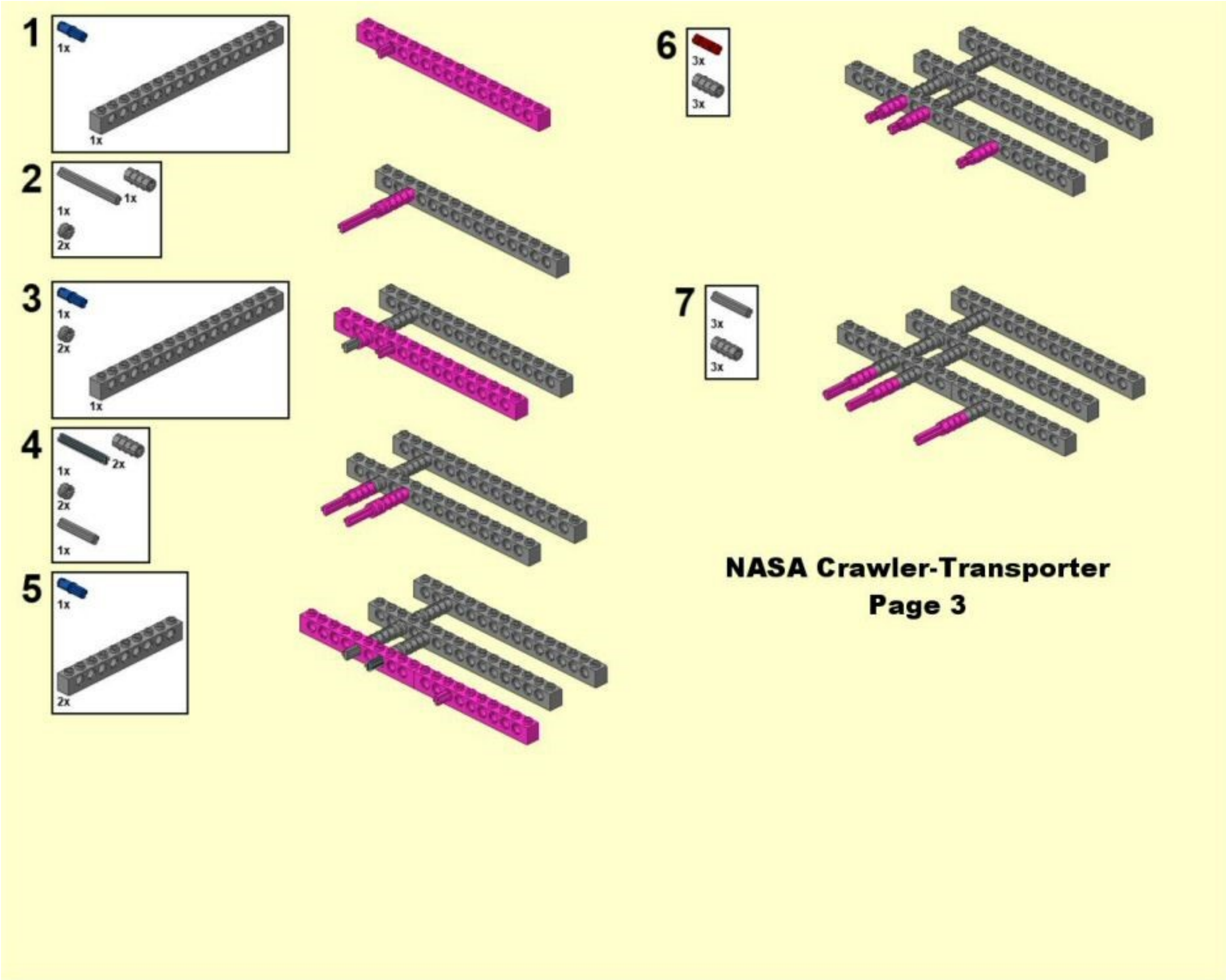
NASA Crawler

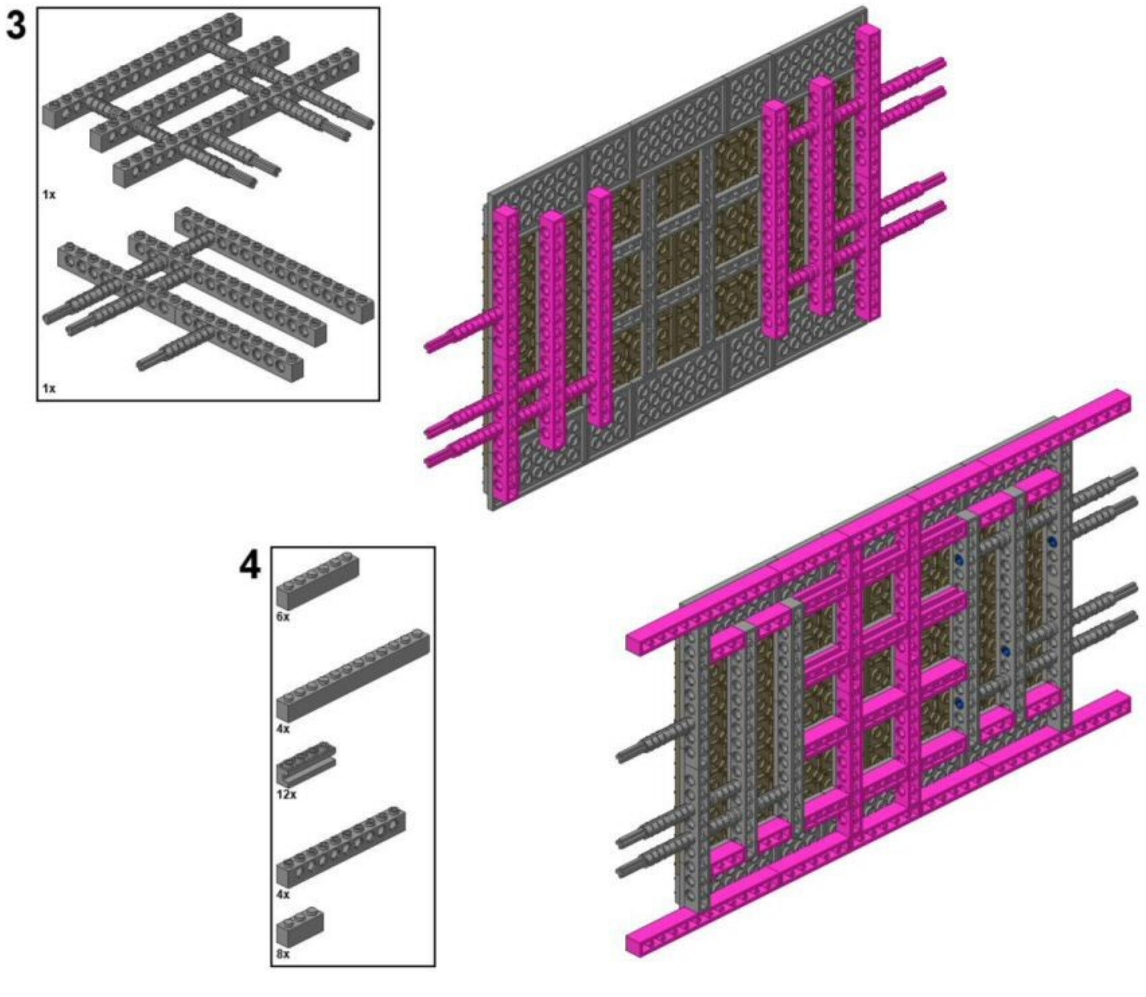
© Grant Passmore 2018



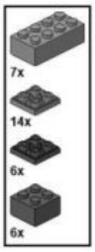


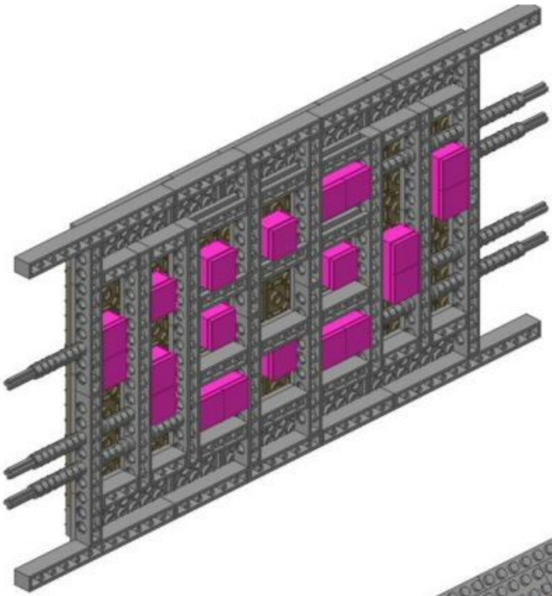



1
1x
1x
2
1x
1x
2x
3
1x
2x
1x
4
1x
2x
2x
1x
5
1x
2x
6
3x
3x
7
3x
3x
NASA Crawler-Transporter
Page 3

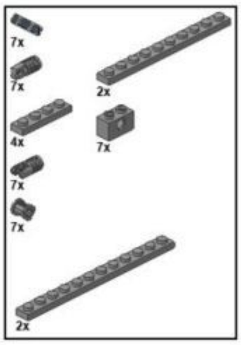

3
1x
1x
4
6x
4x
12x
4x
8x

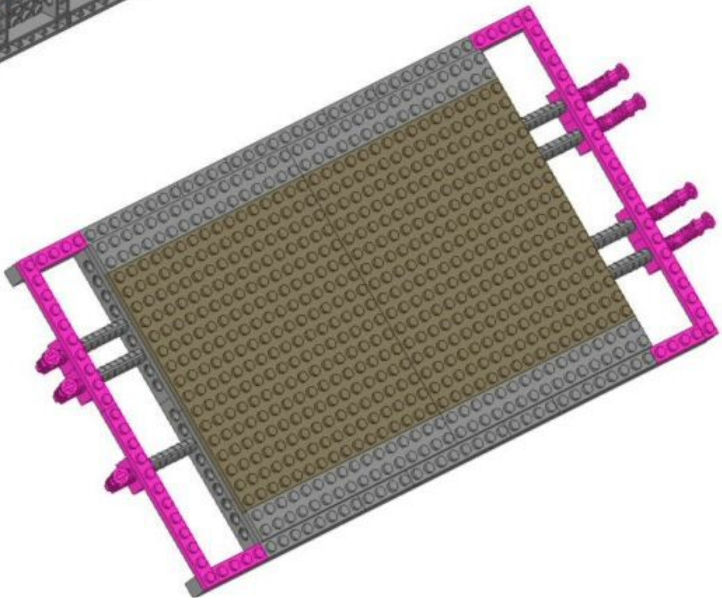
5


7x
14x
6x
6x

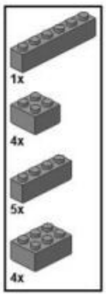


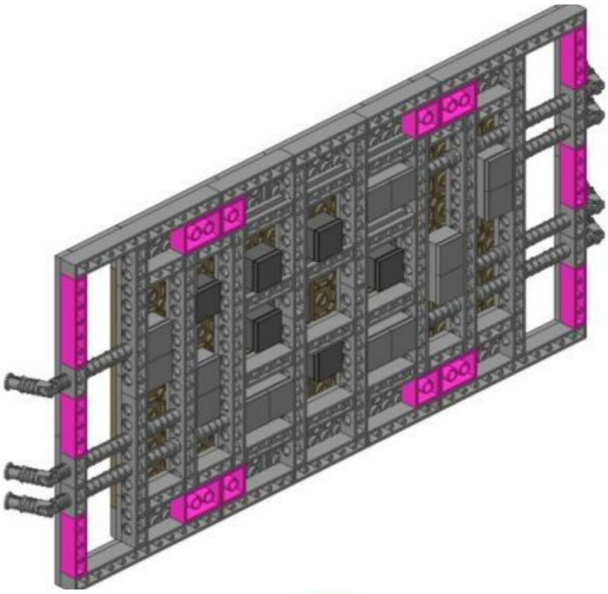
6


7x
7x
2x
4x
7x
7x
7x
2x

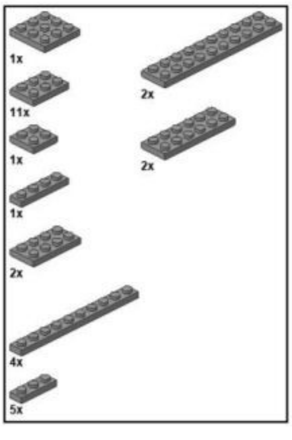


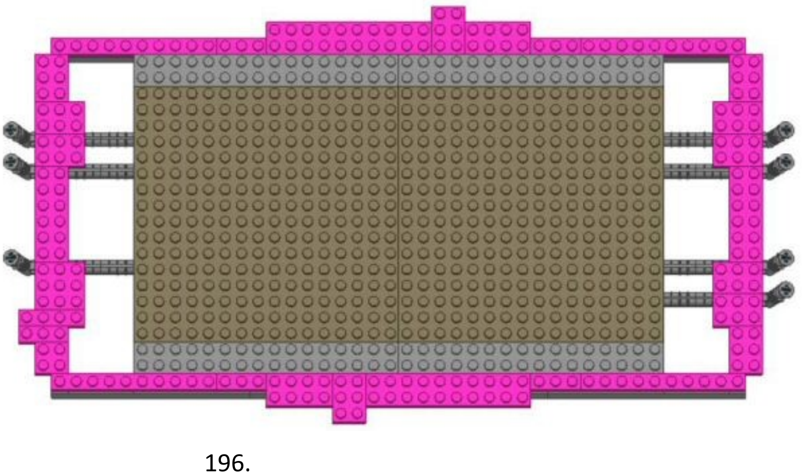
7


1x
4x
5x
4x

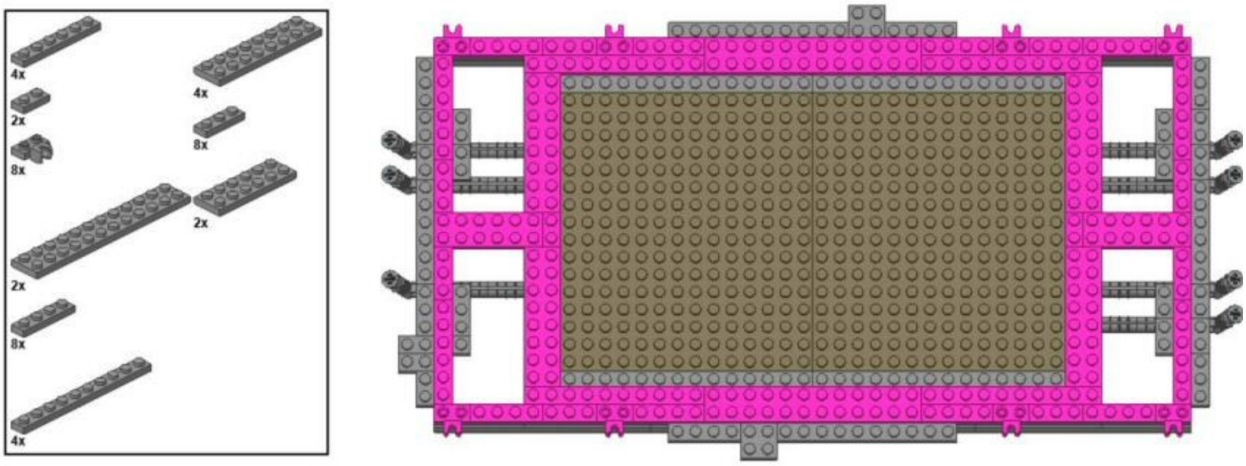


8

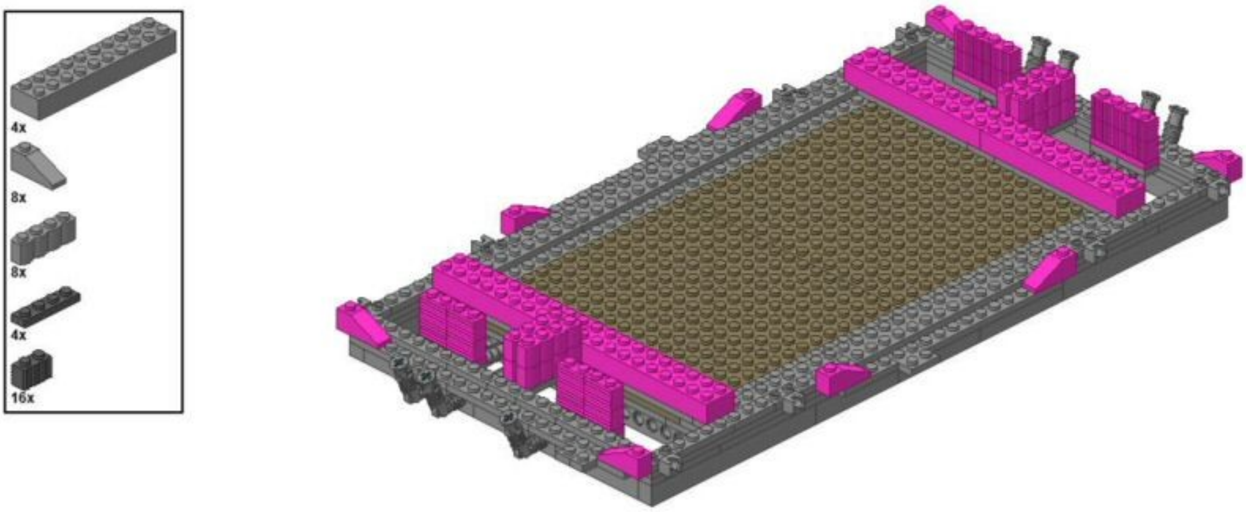

1x
2x
11x
1x
2x
1x
2x
4x
5x



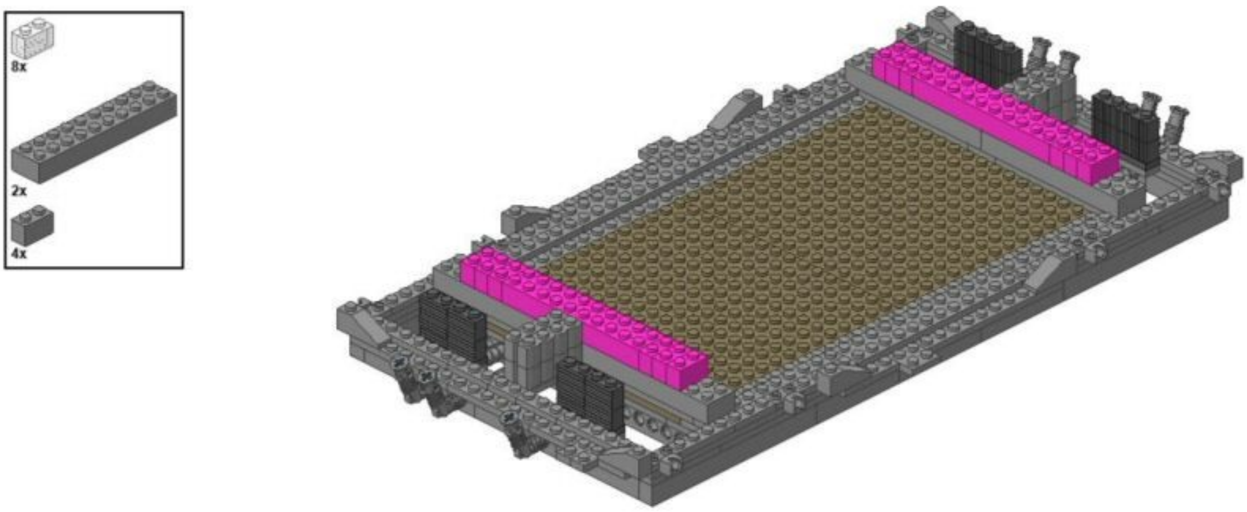
9



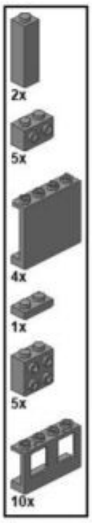
10

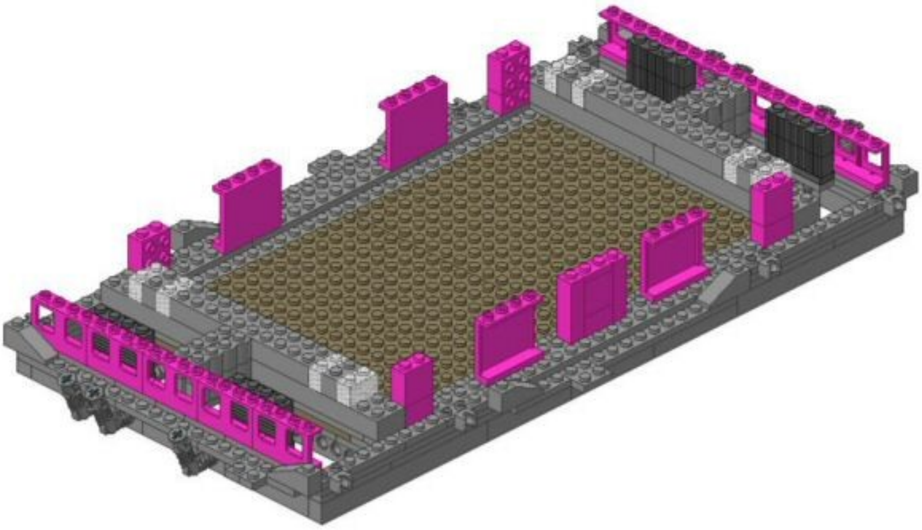


11

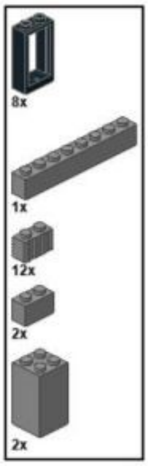


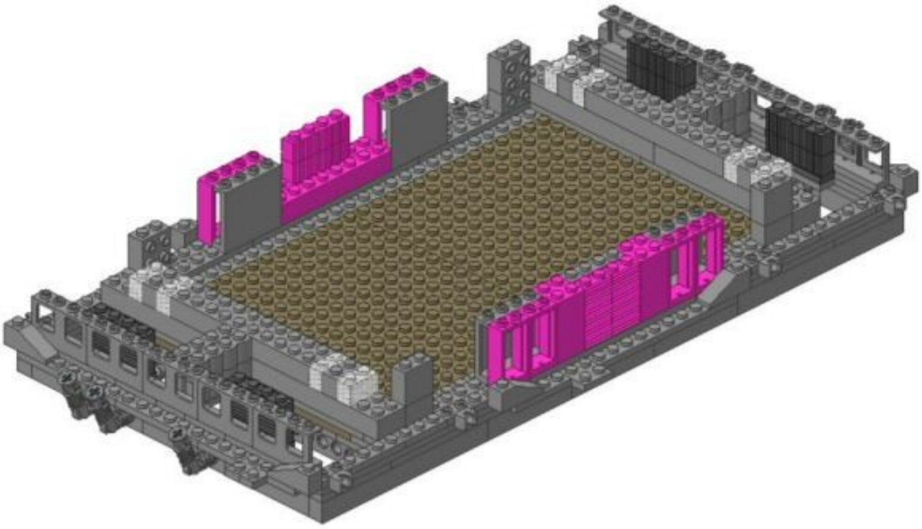
12



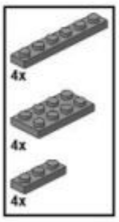


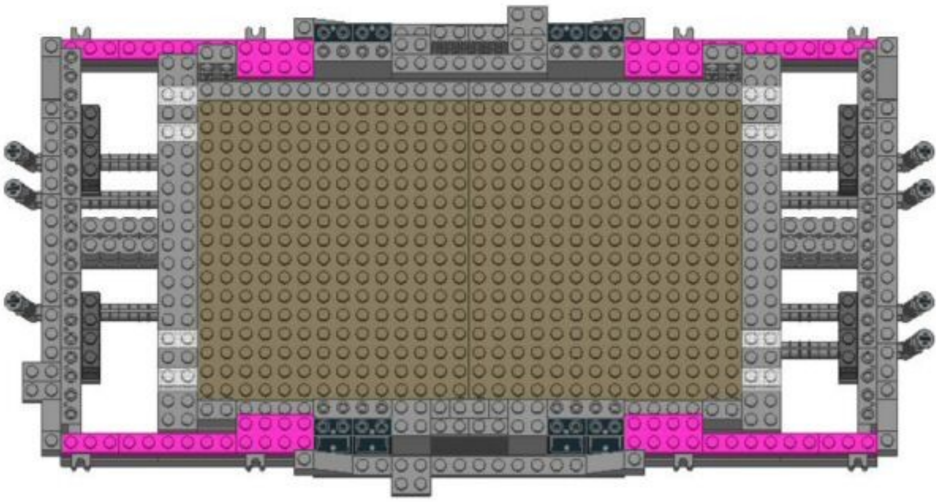
13



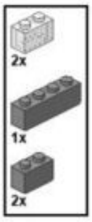


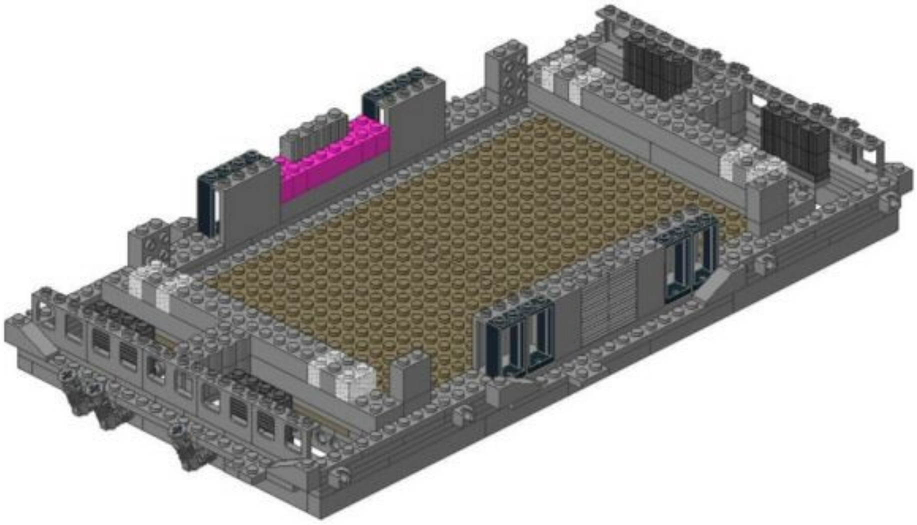
14



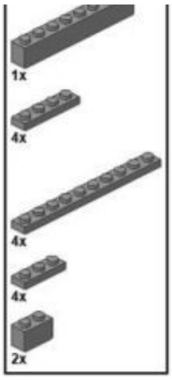


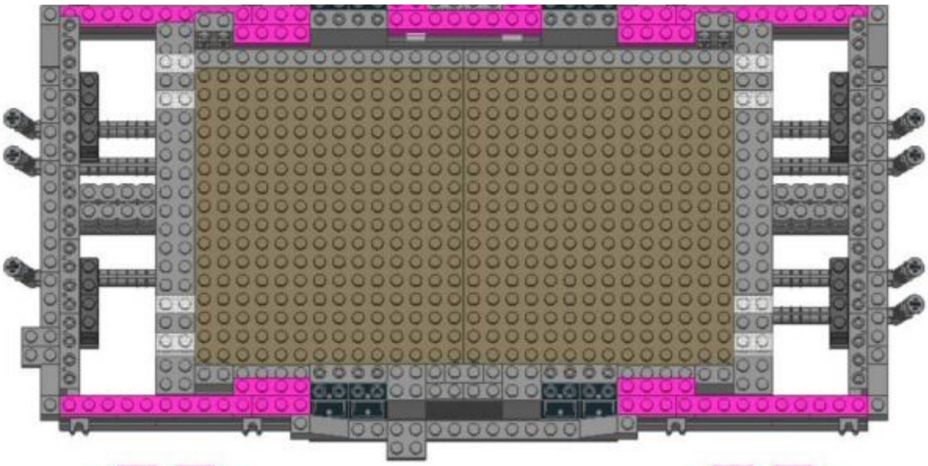
15



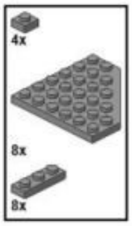


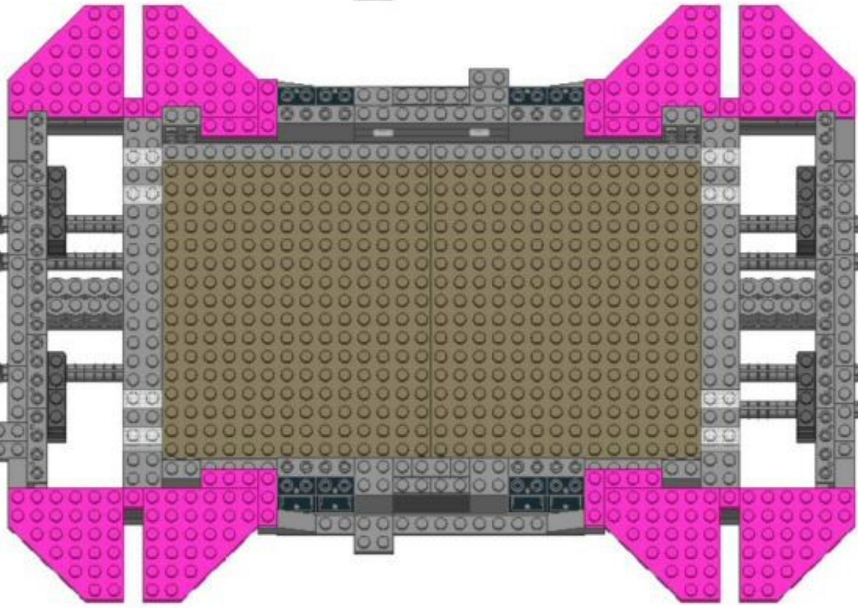
16



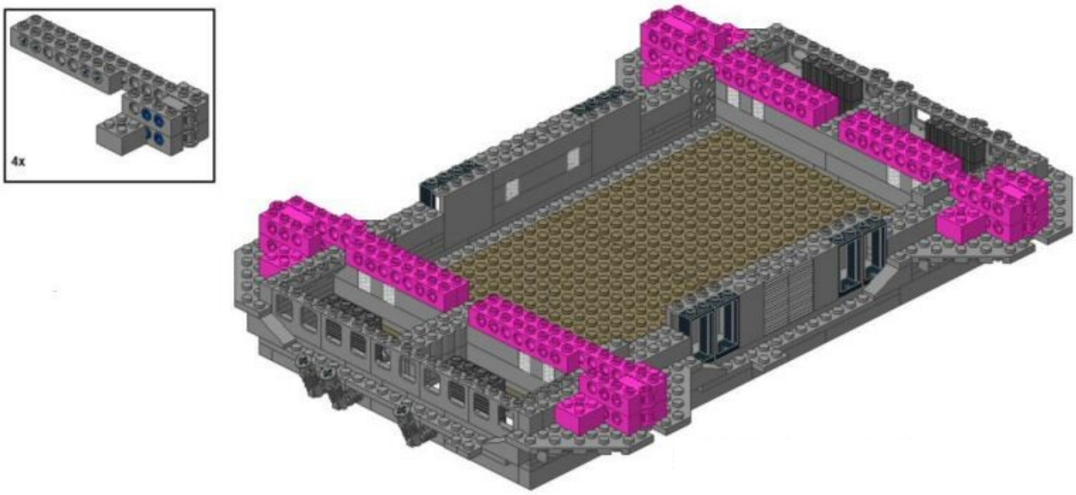


17

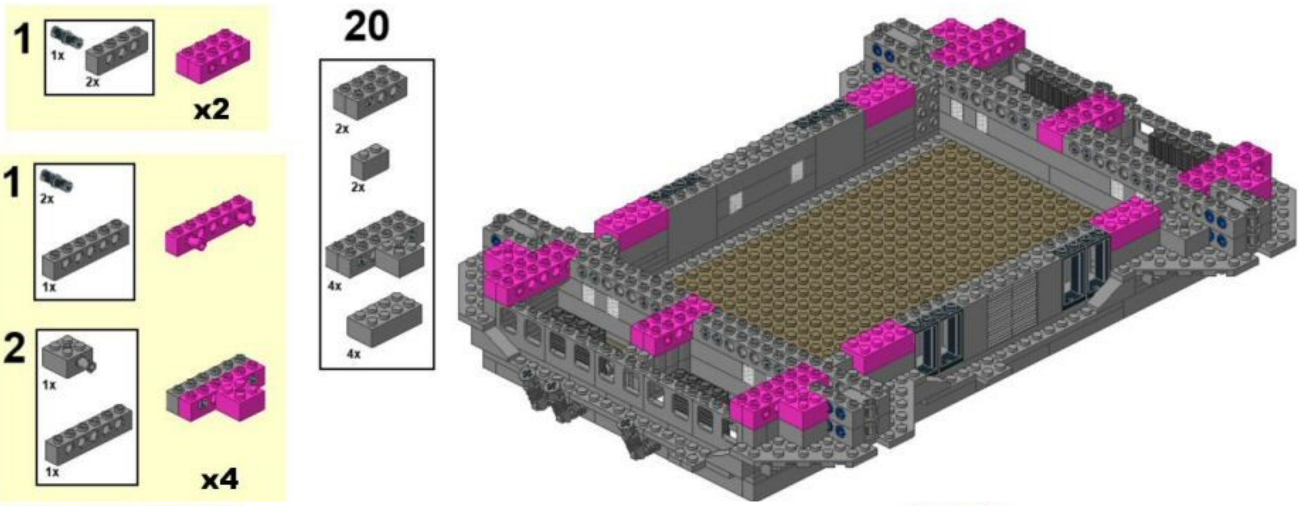




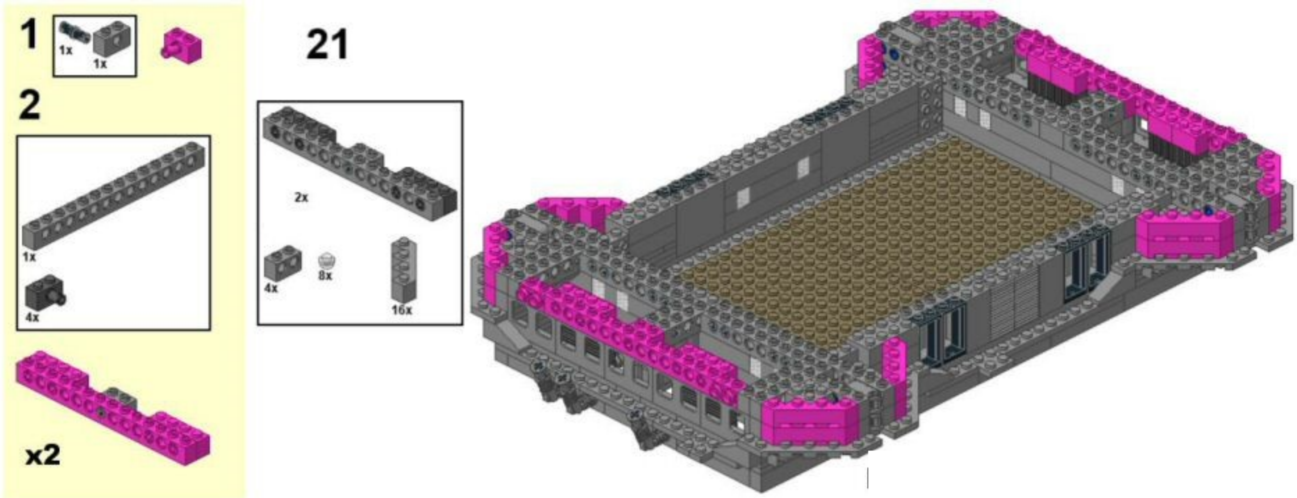
19


4x

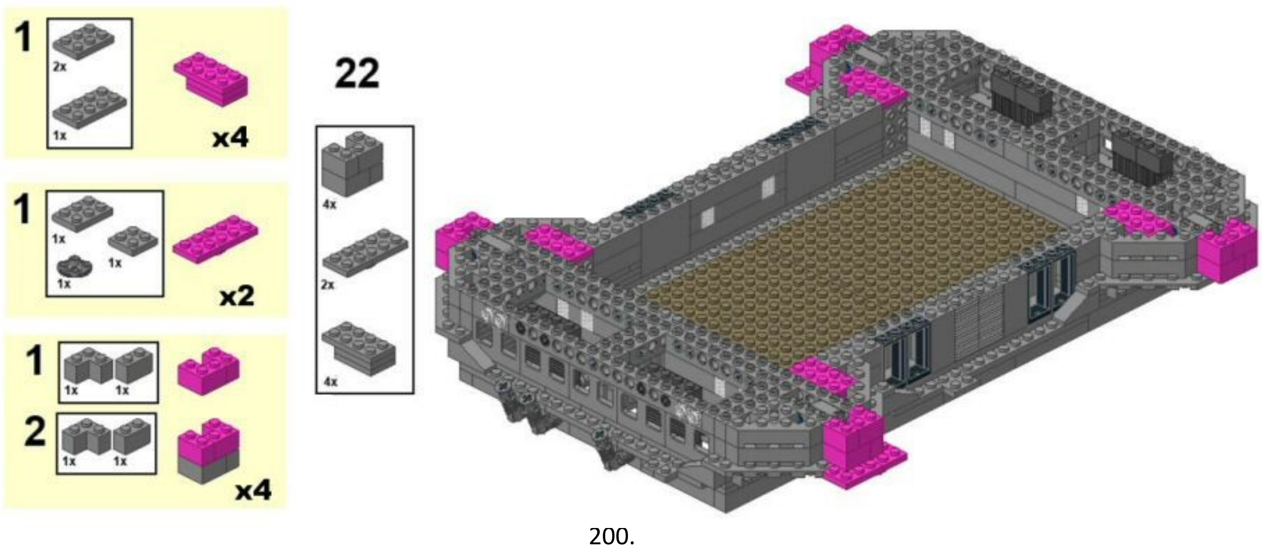
20

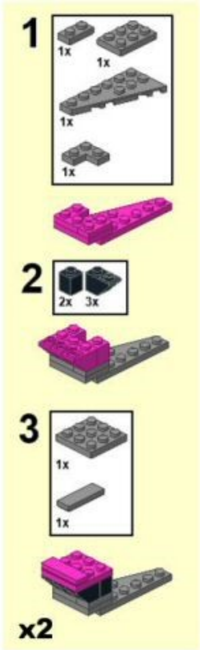

1
1x
2x
x2
1
2x
1x
2
1x
1x
x4
2x
2x
4x
4x

21

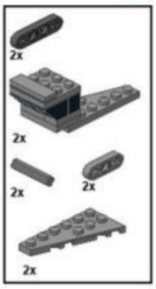

1
1x
1x
2
1x
4x
x2
2x
4x
8x
16x

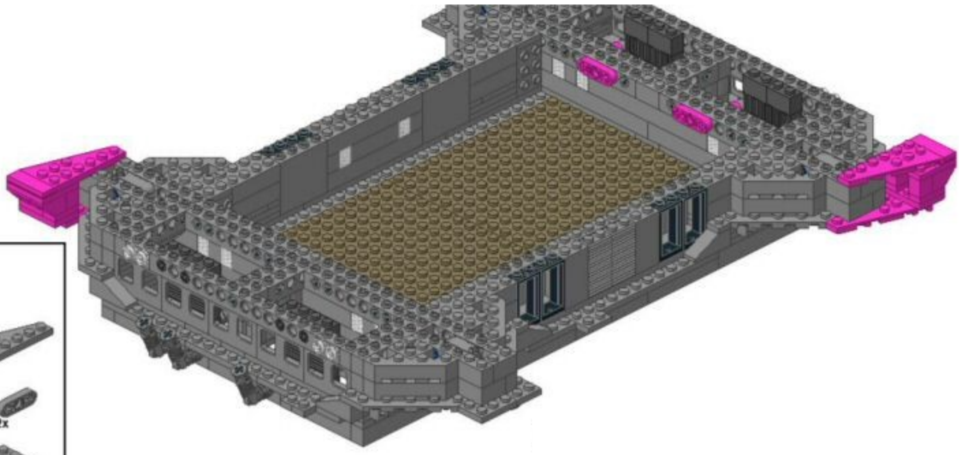
22


1
2x
1x
x4
1
1x
1x
1x
x2
1
1x
1x
2
1x
1x
x4
4x
2x
4x

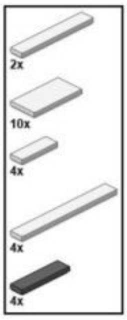

1
1x
1x
1x
1x
2
2x
3x
3
1x
1x
x2

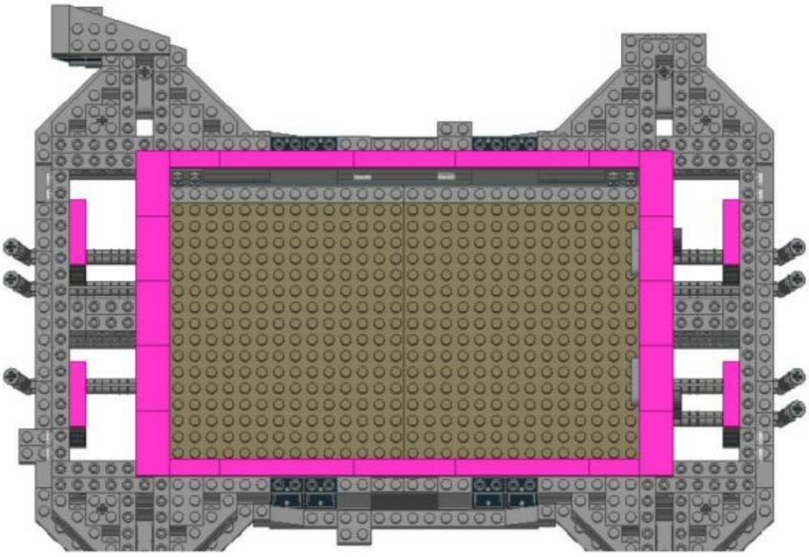
23


2x
2x
2x
2x
2x

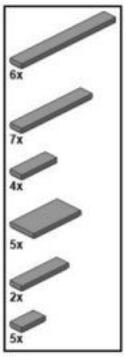


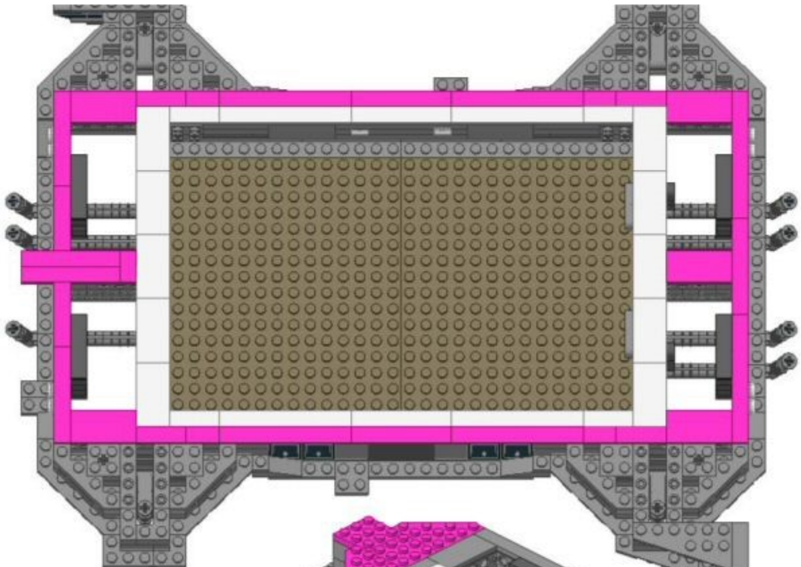
24


2x
10x
4x
4x
4x

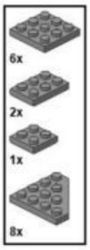


25

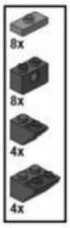

6x
7x
4x
5x
2x
5x

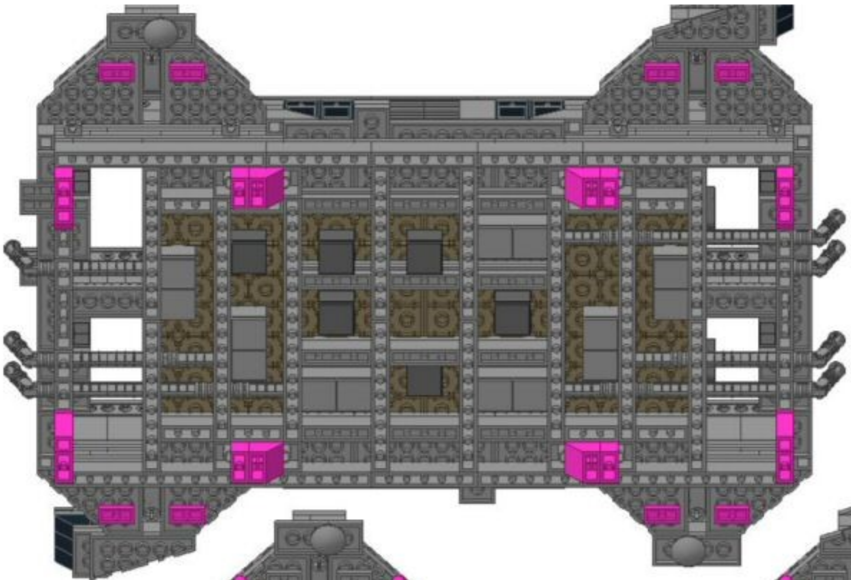


26


6x
2x
1x
8x

27

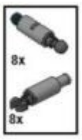

8x
8x
4x
4x

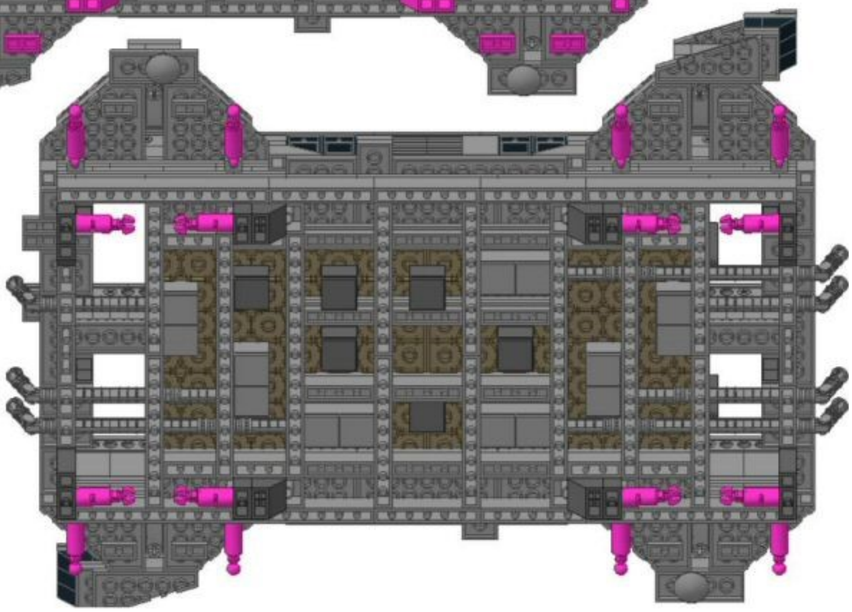


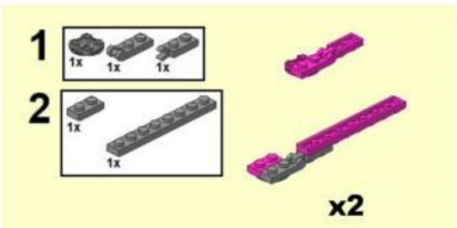

1
1x
1x
1x
1x
x8


1
1x
1x
1x
1x
1x
x8

28

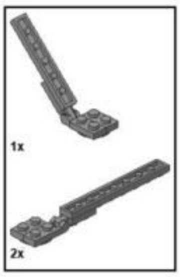

8x
8x

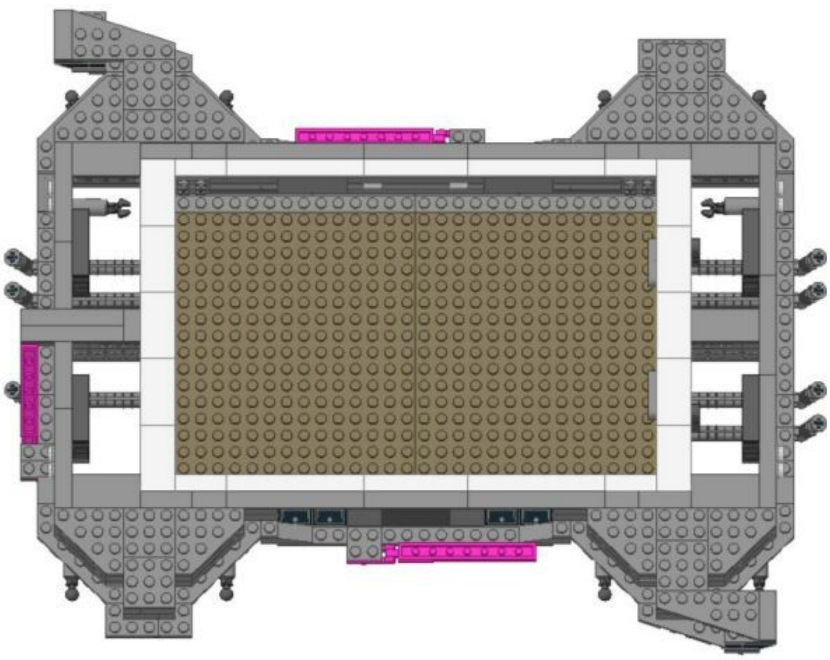


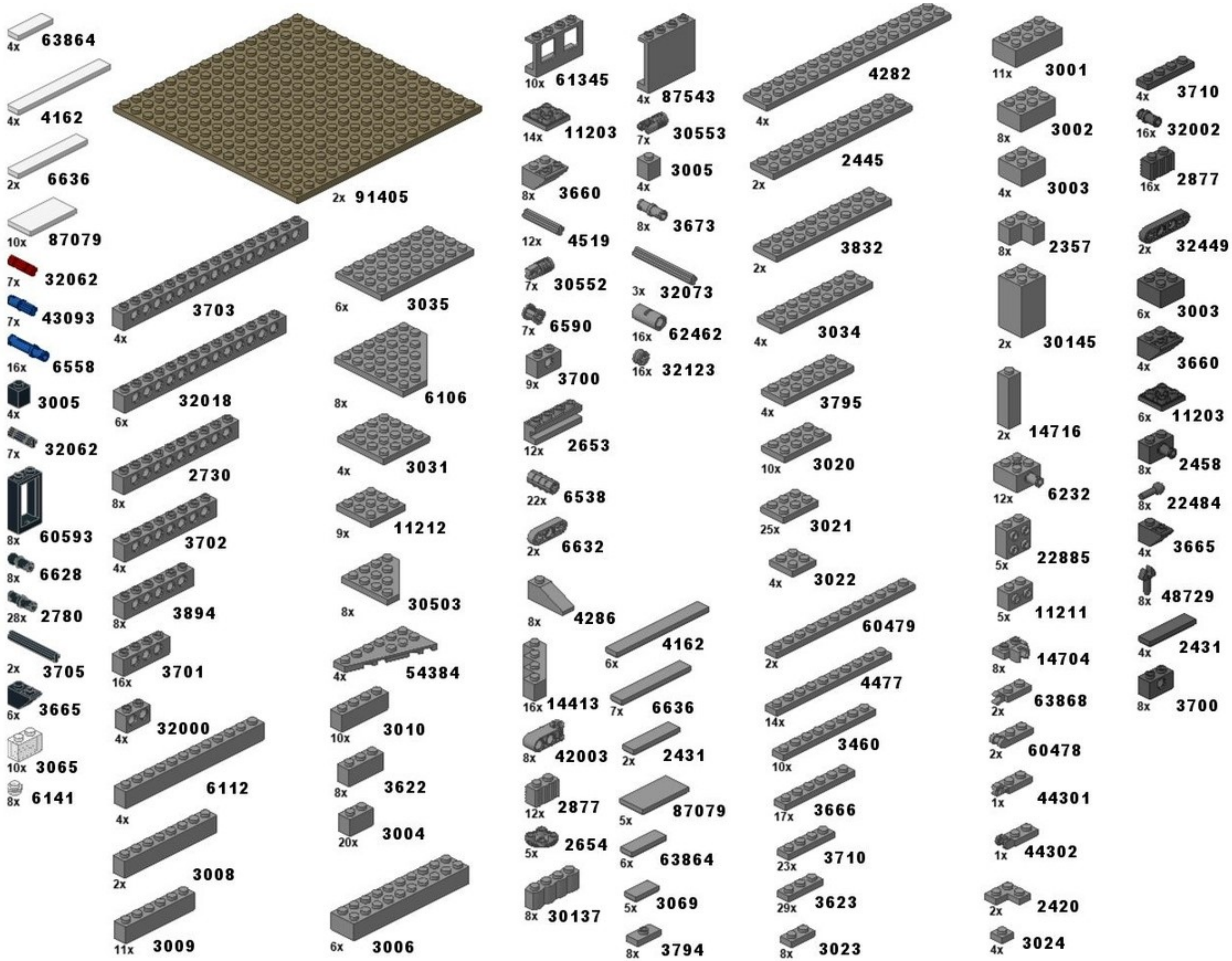

1
1x
1x
1x
2
1x
1x
x2


1
1x
1x
1x
2
1x
1x

29

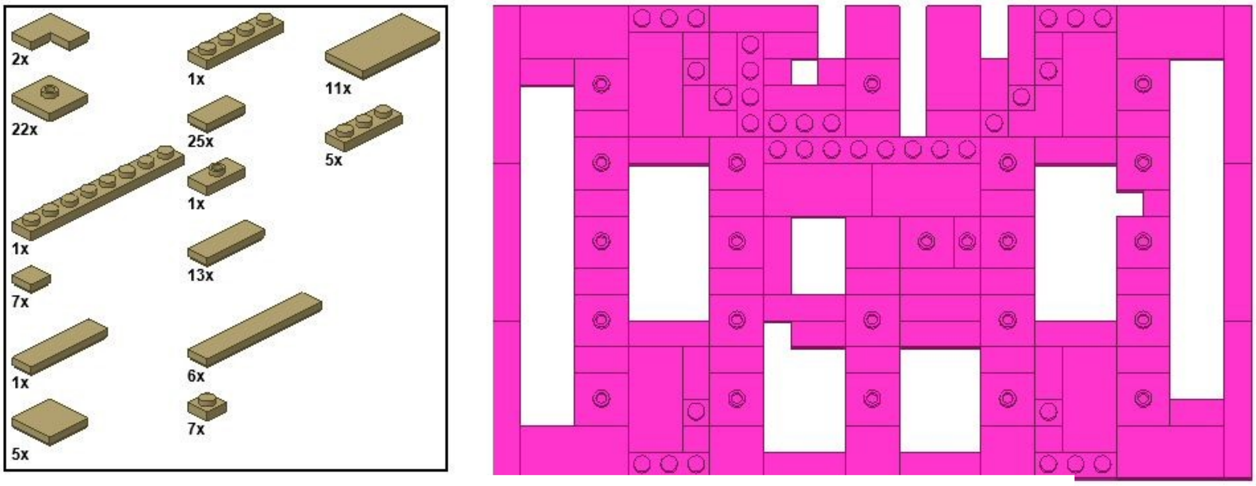

1x
2x



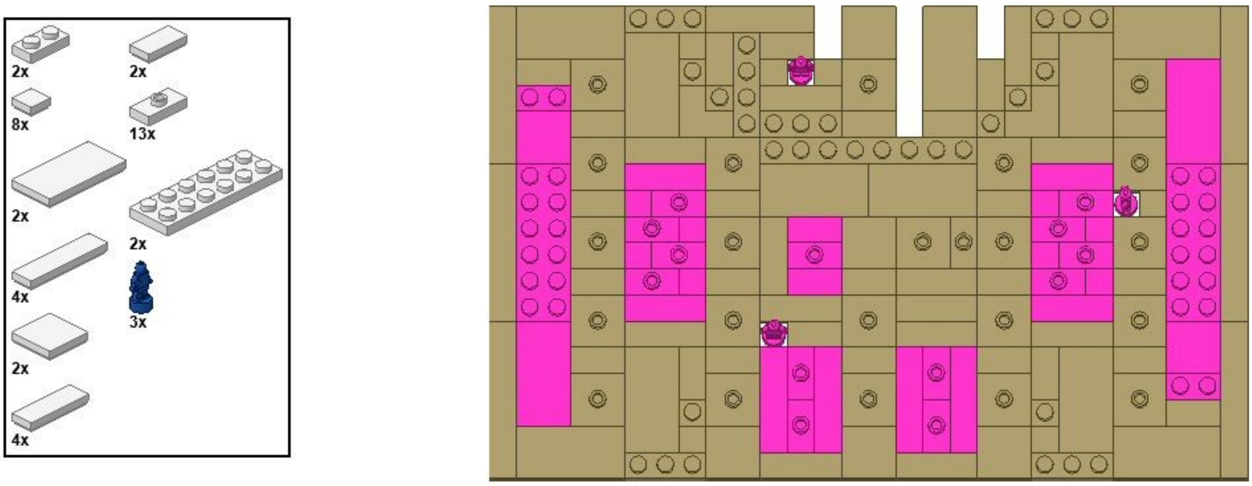


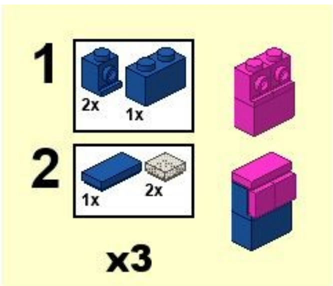
NASA Crawler-Transporter Body - Parts List

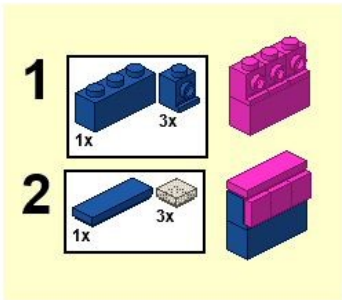
1


2x
1x
11x
22x
25x
5x
1x
1x
13x
7x
1x
6x
7x
5x

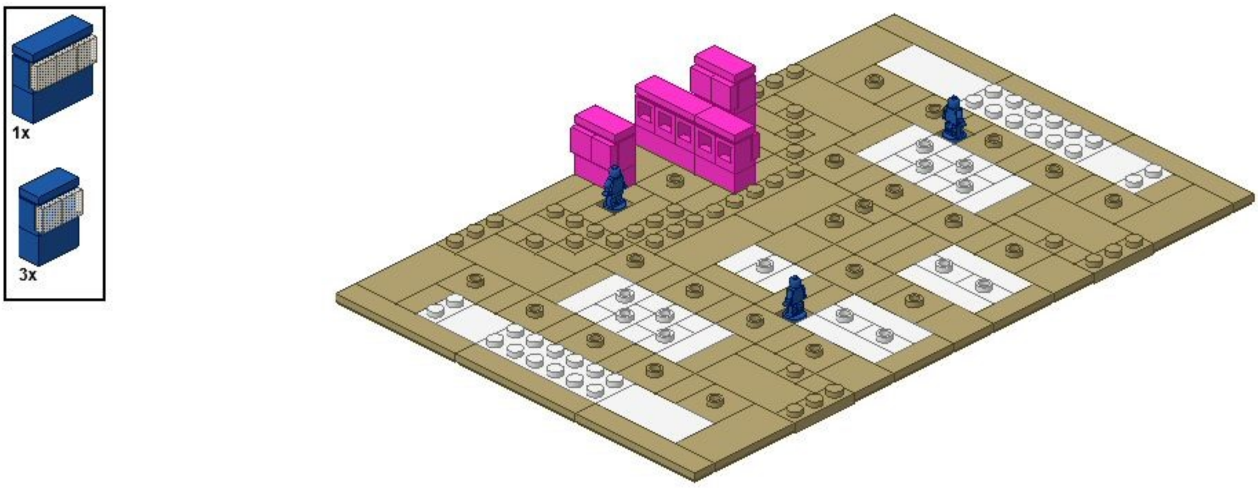
2


2x
2x
8x
13x
2x
2x
4x
3x
2x
4x

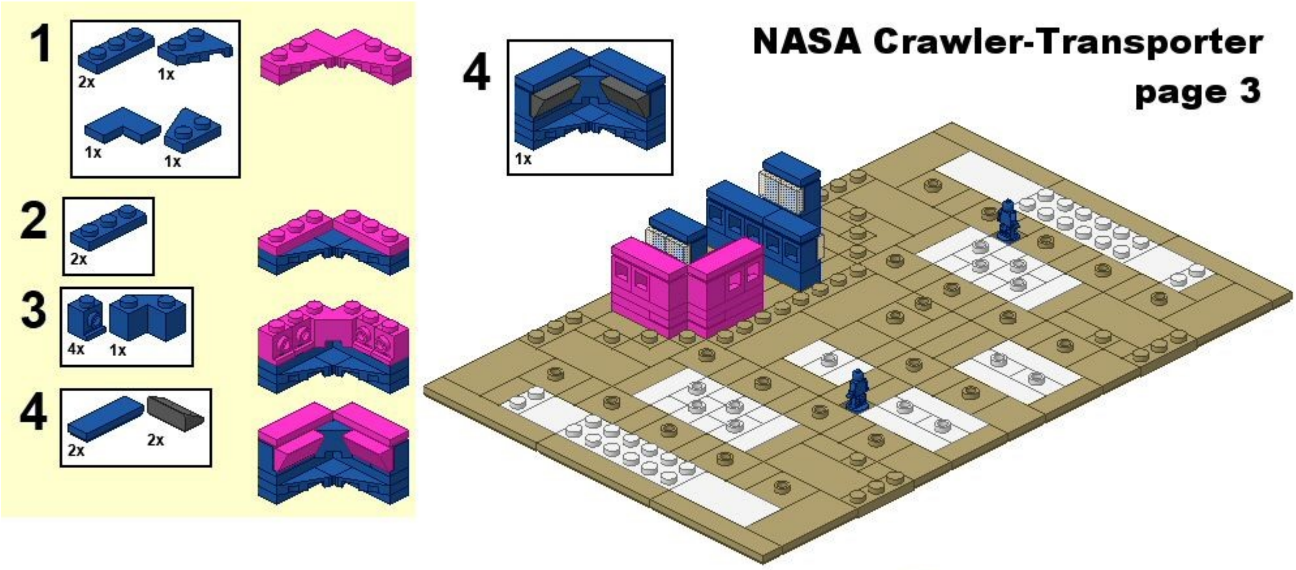

1
2x
1x
2
1x
2x
x3

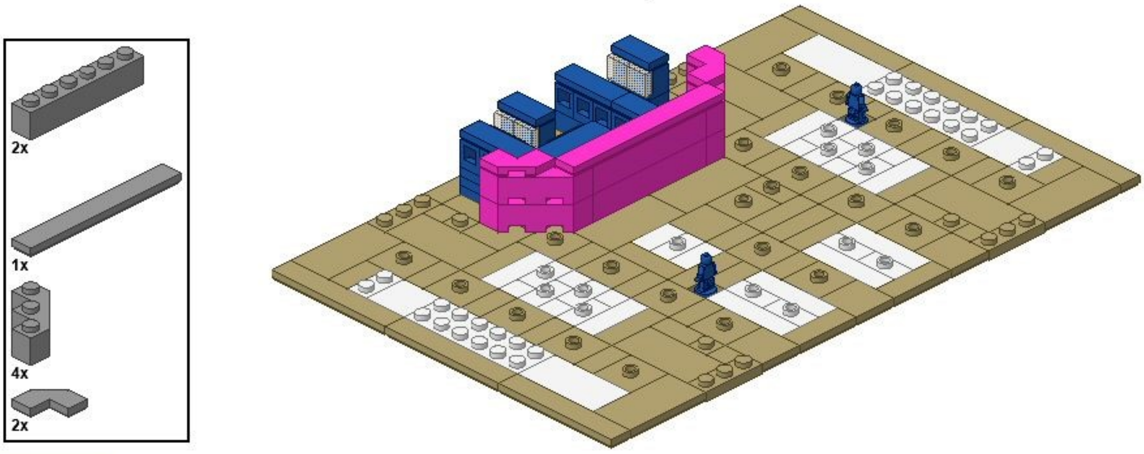

1
1x
3x
2
1x
3x

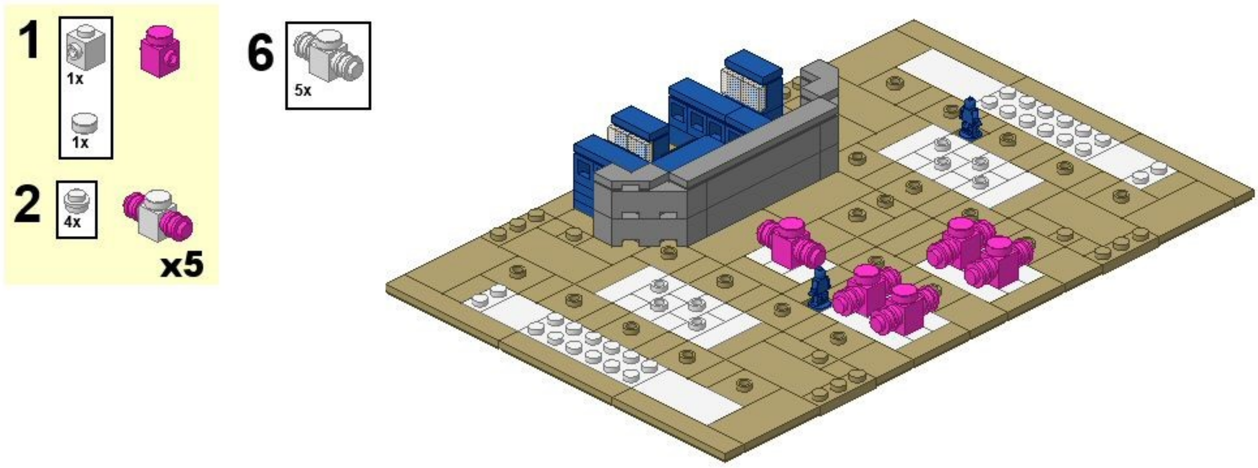
3

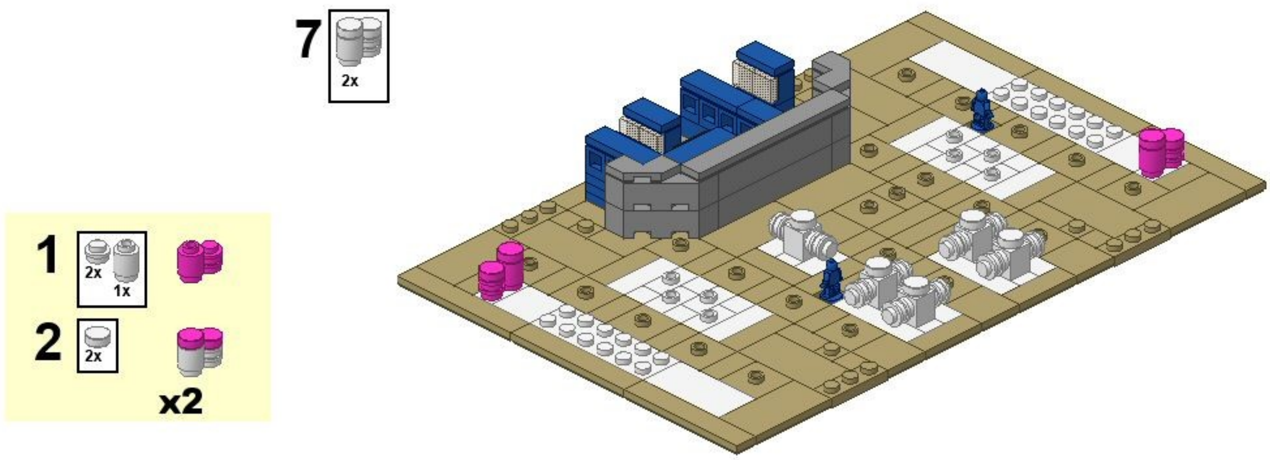

1x
3x

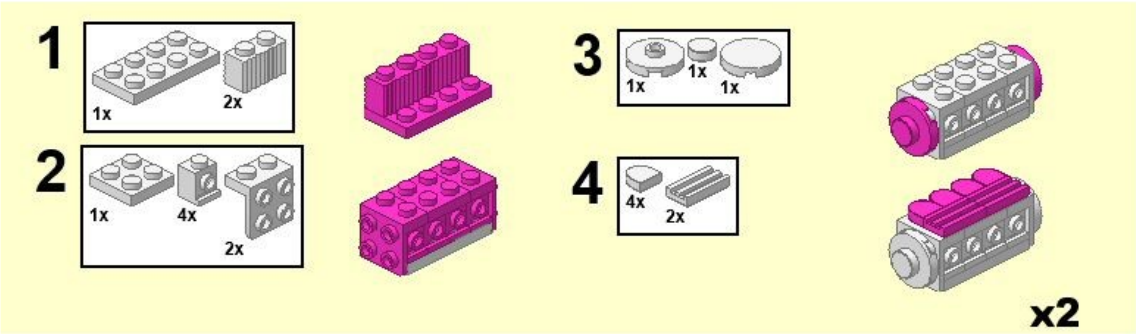
NASA Crawler-Transporter
page 3

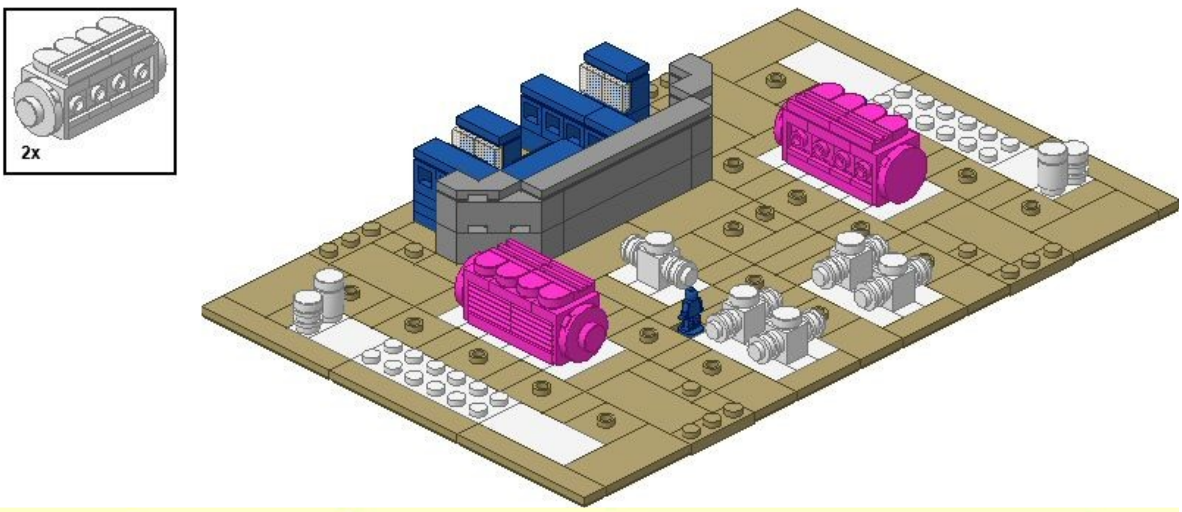




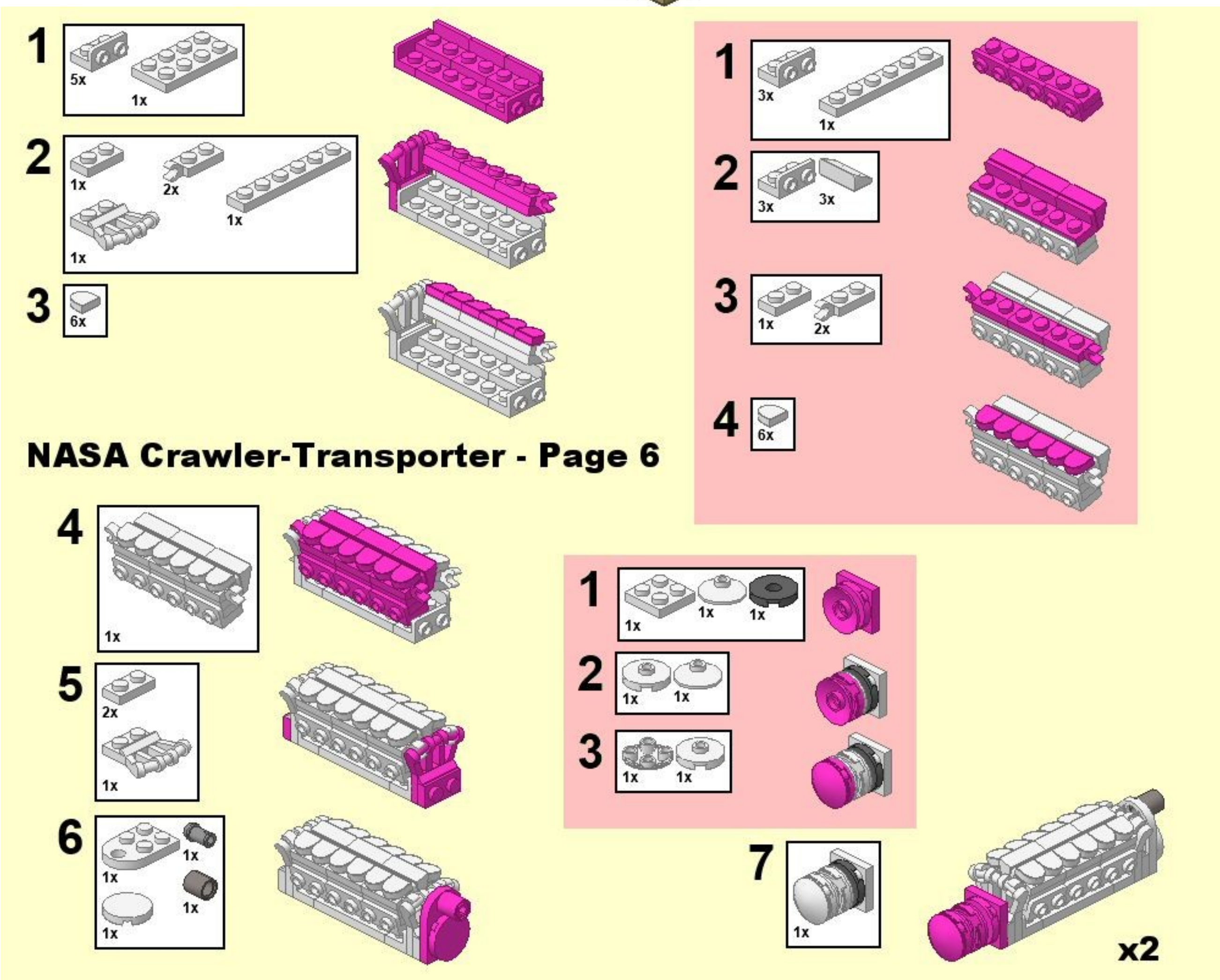




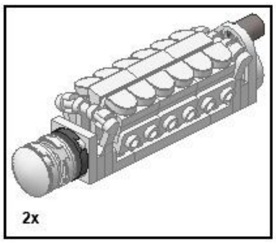


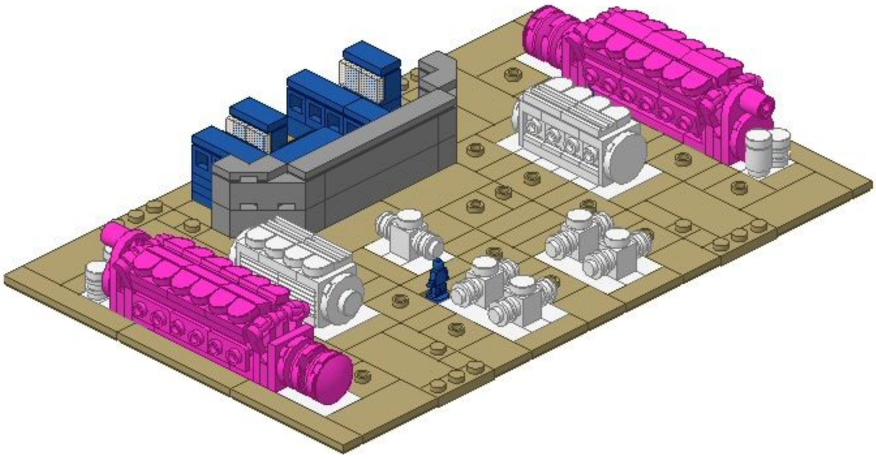


NASA Crawler-Transporter - Page 6

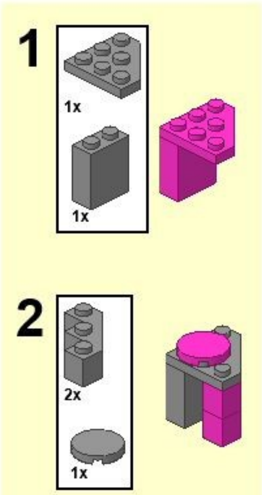


9

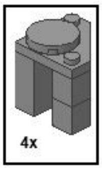


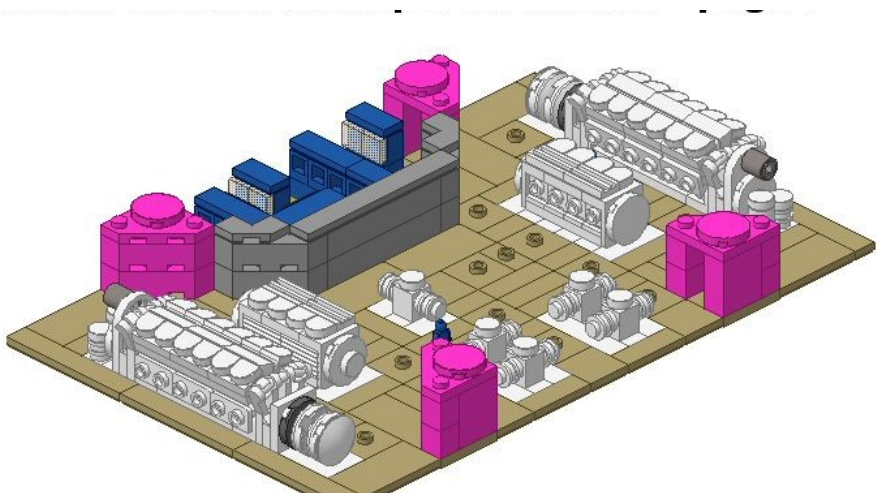


x4 Build 2 as mirror image

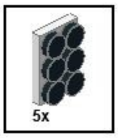


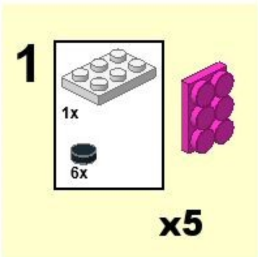
10

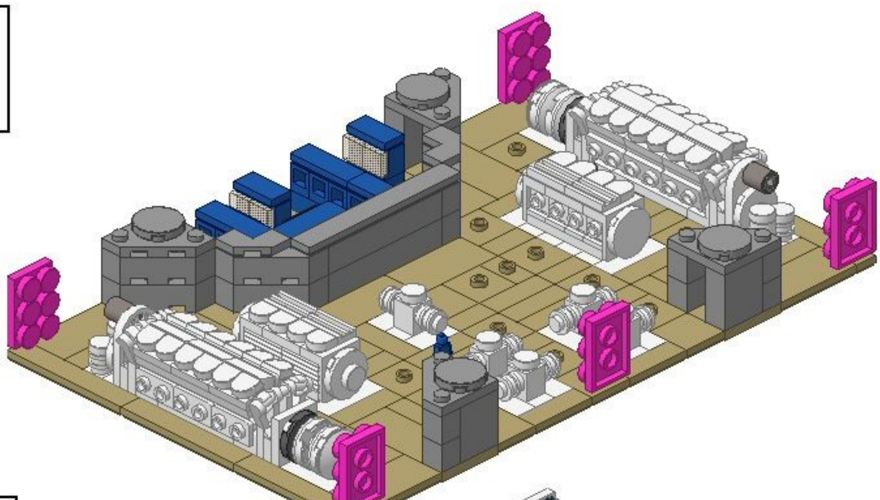




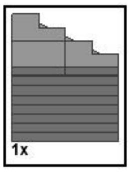
11

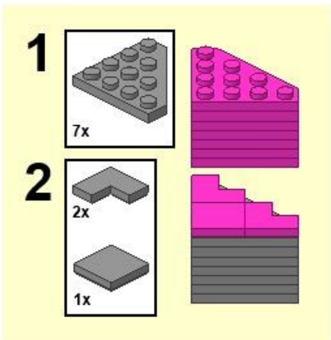


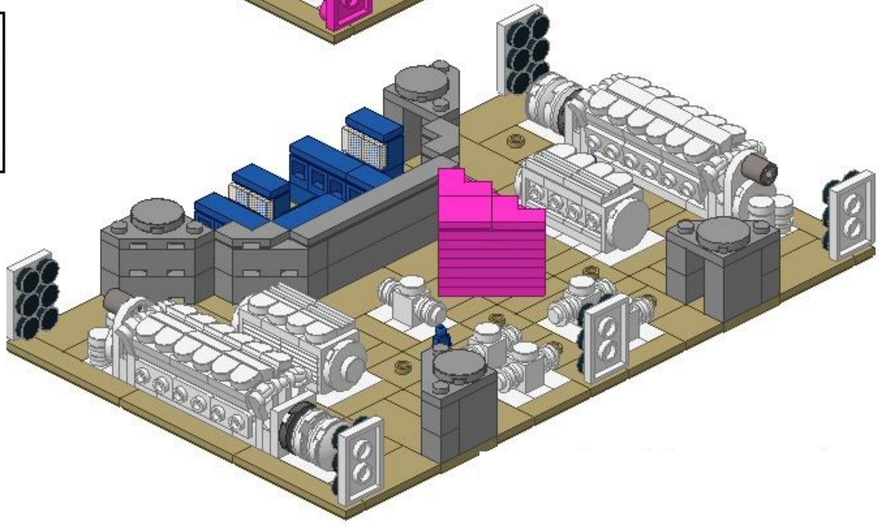


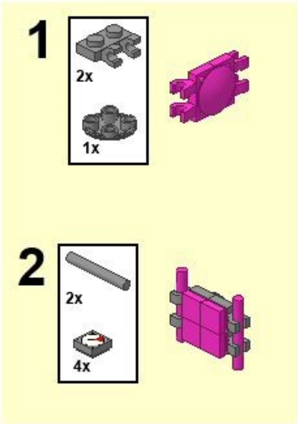


12

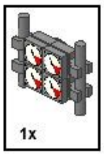


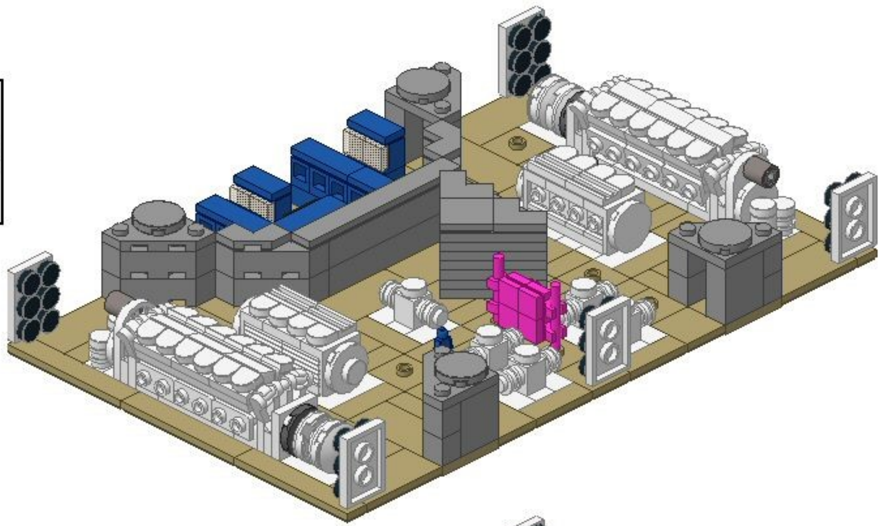


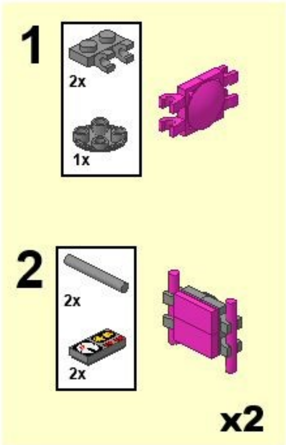




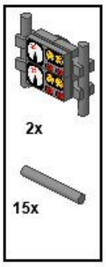
13

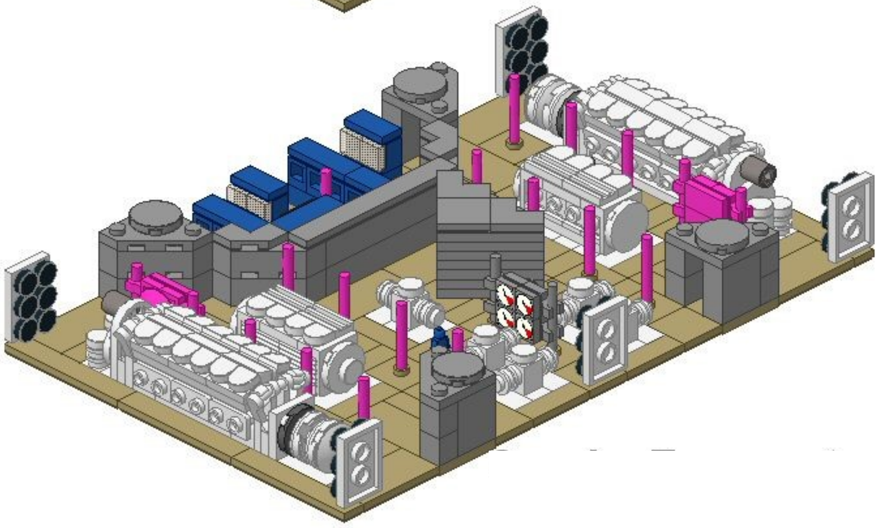


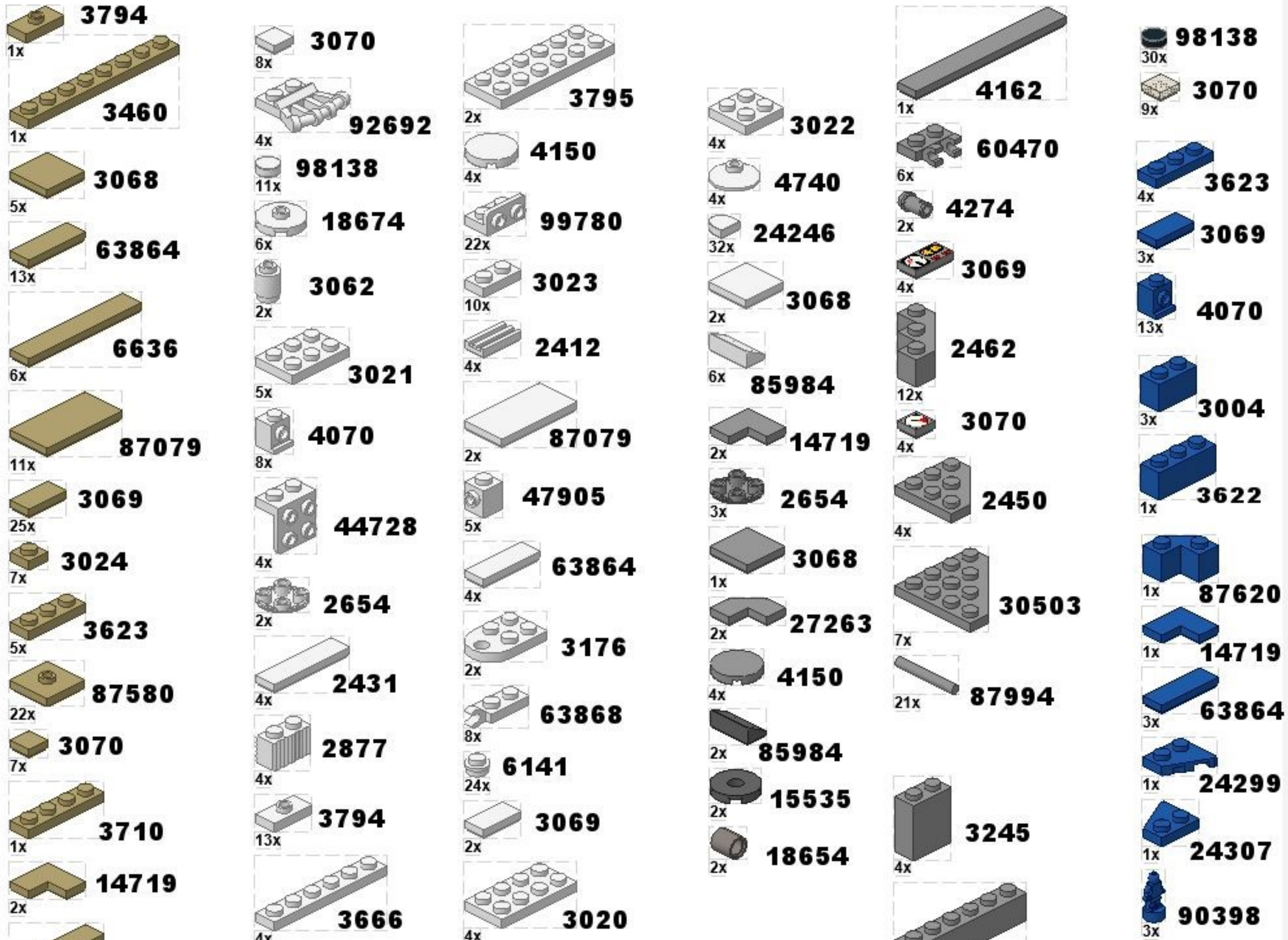




14

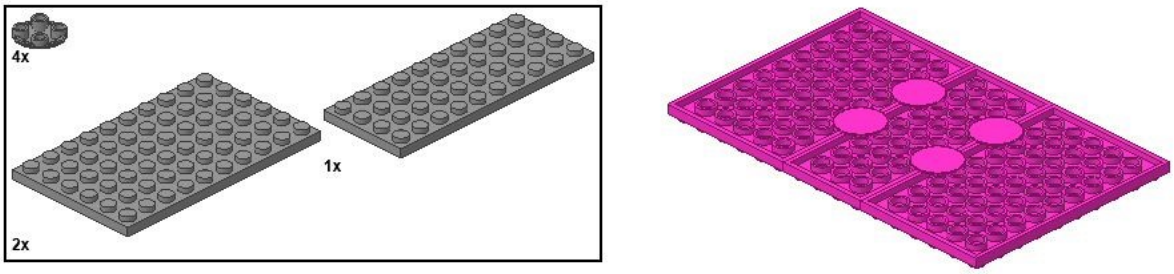




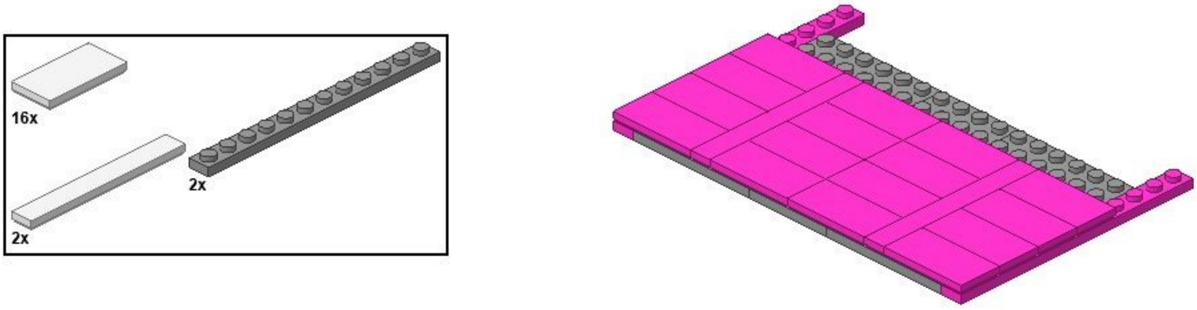


NASA Crawler-Transporter Interior
Parts List

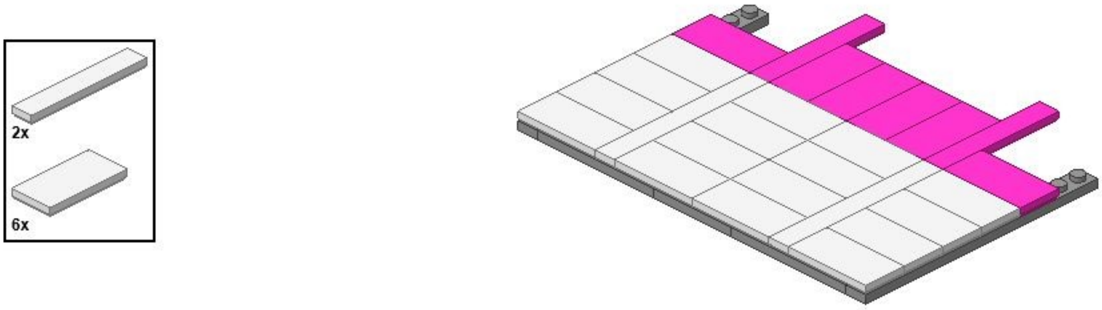
1



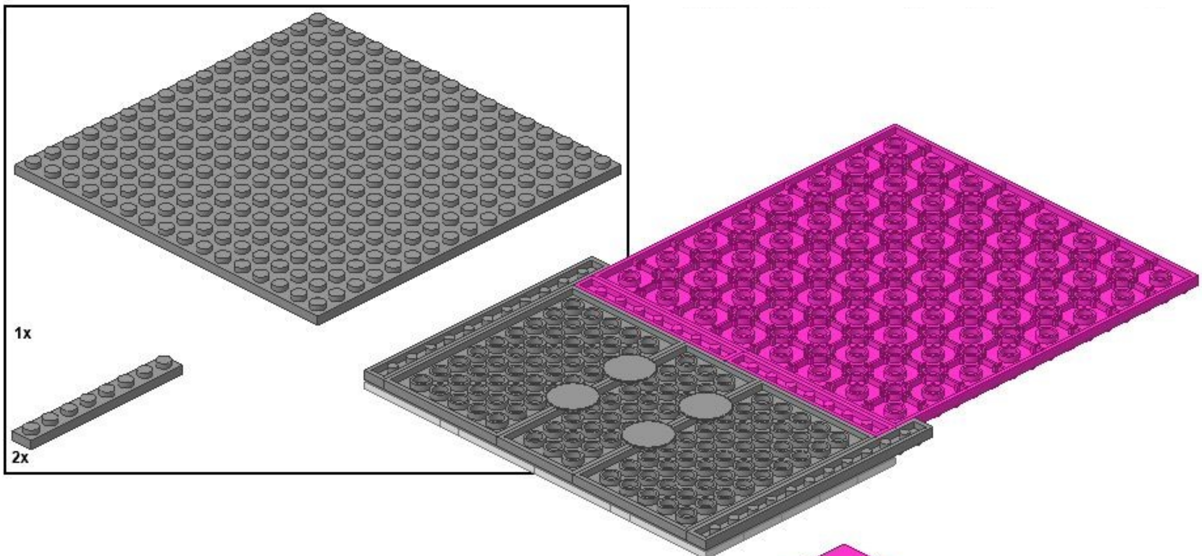
2



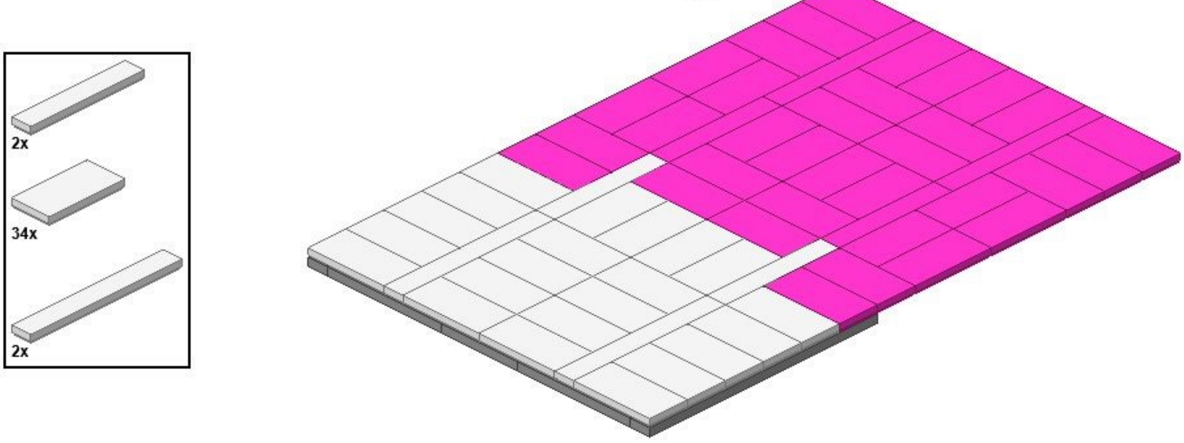
3



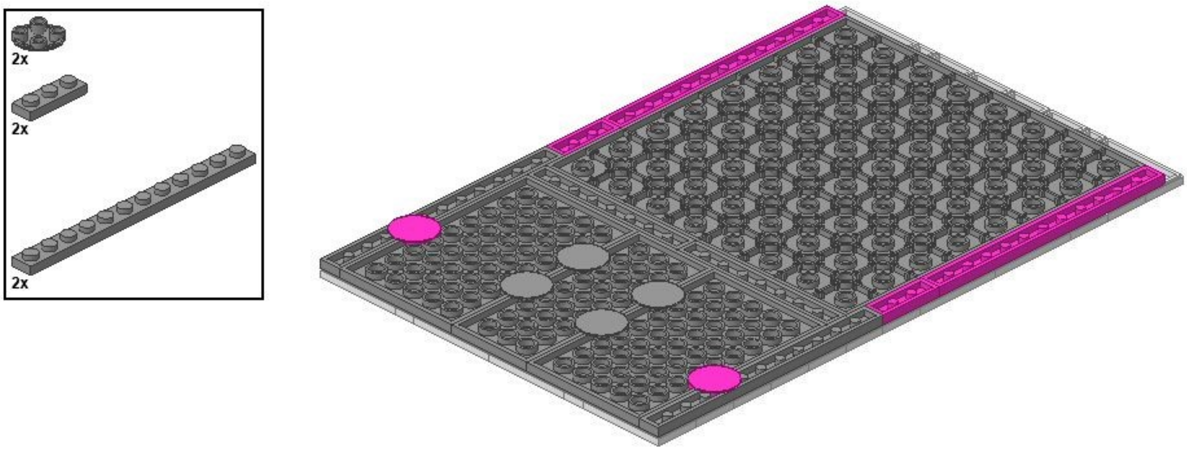
4

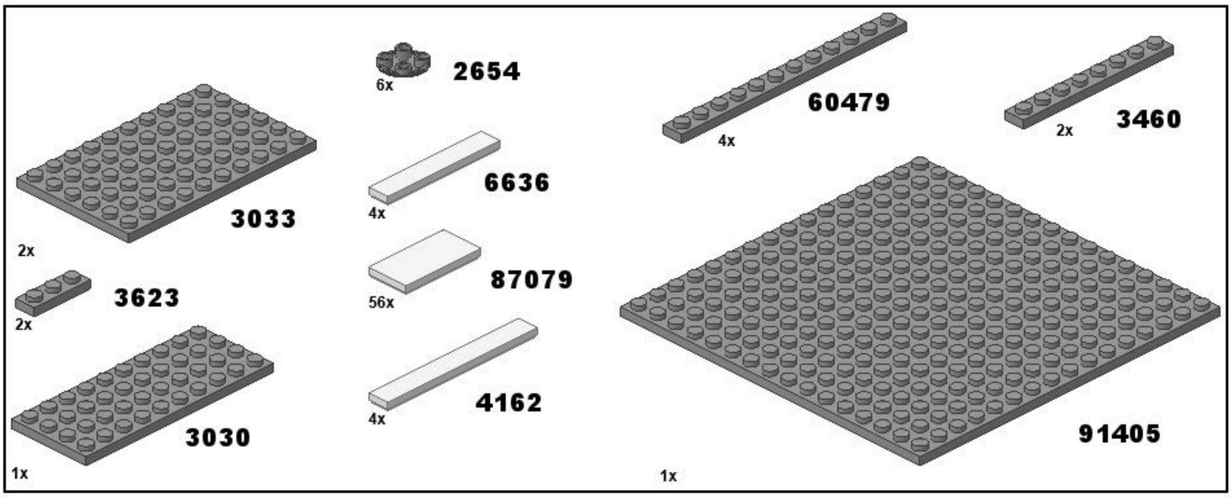


5

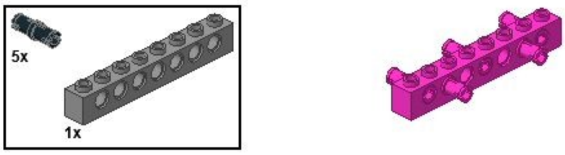


6

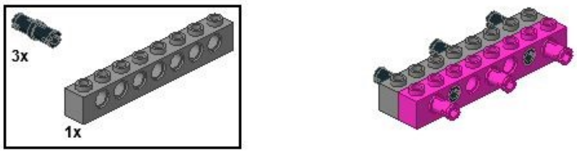

2x
2x
2x


2654
6x
60479
4x
3460
2x
3033
2x
6636
4x
3623
2x
87079
56x
3030
1x
4162
4x
91405
1x

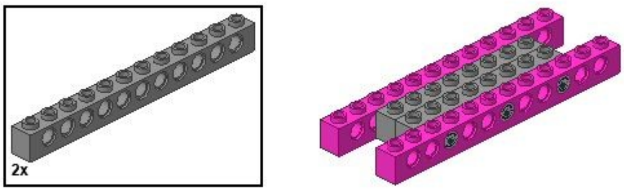
1


5x
1x

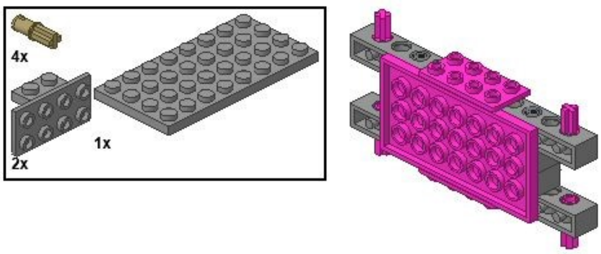
2

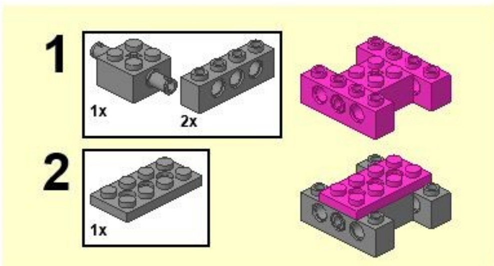

3x
1x

3

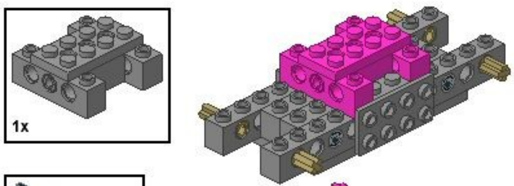

2x

4

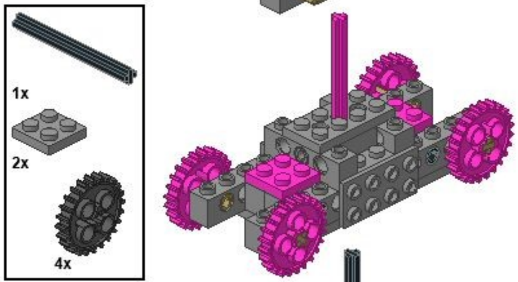

4x
2x
1x


1
1x
2x
2
1x

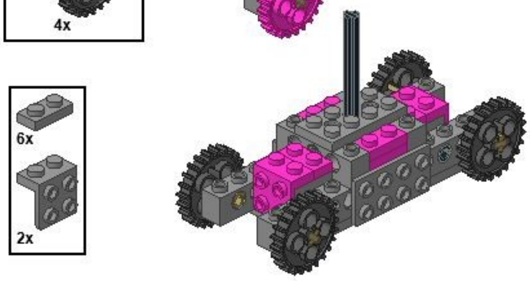
5


1x

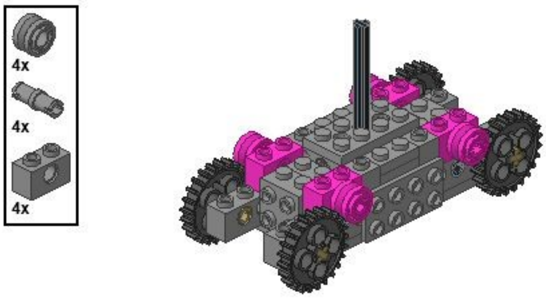
6


1x
2x
4x

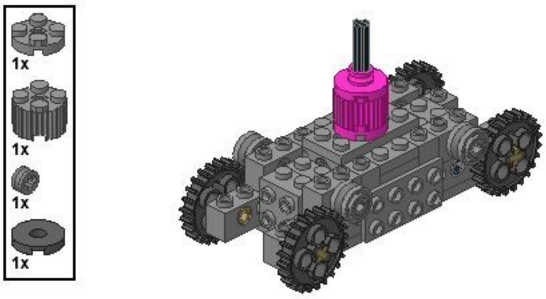
7


6x
2x

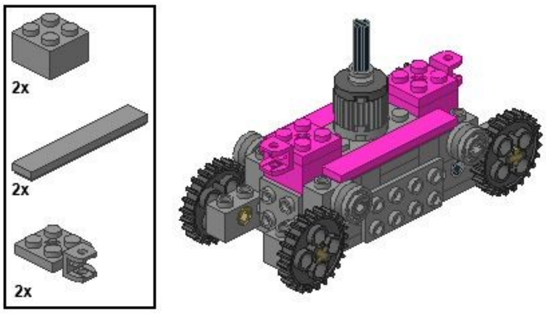
8



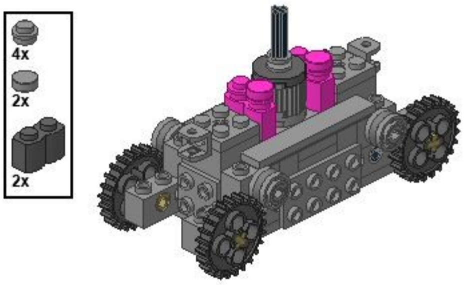
9



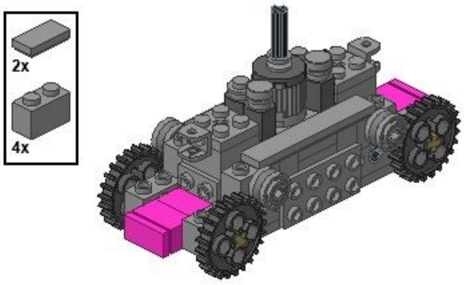
10



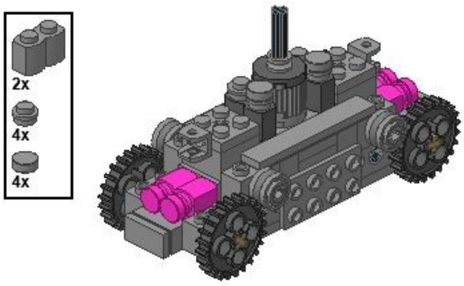
11

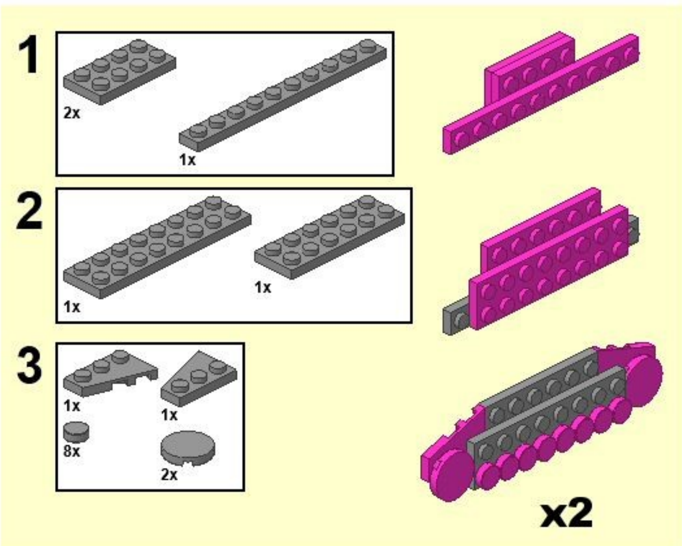


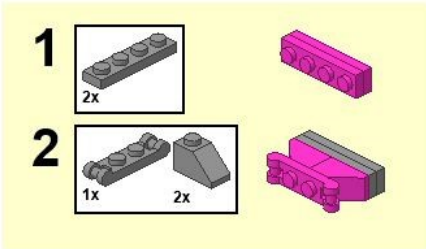
12



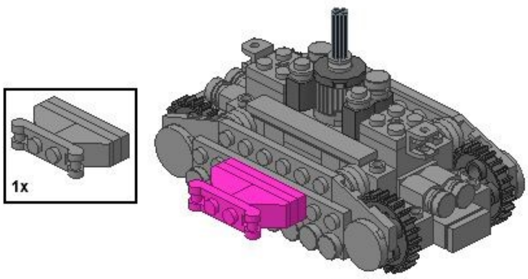
13



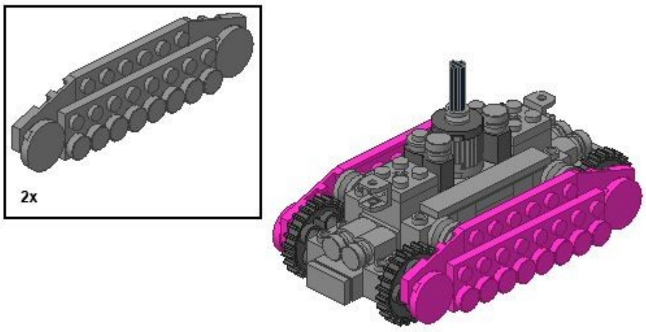




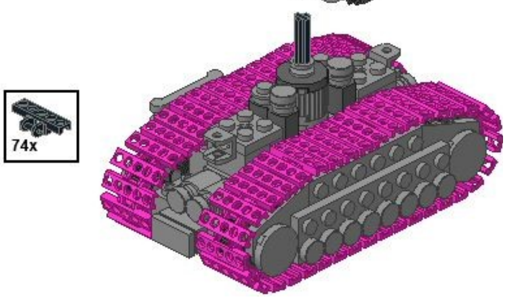
15

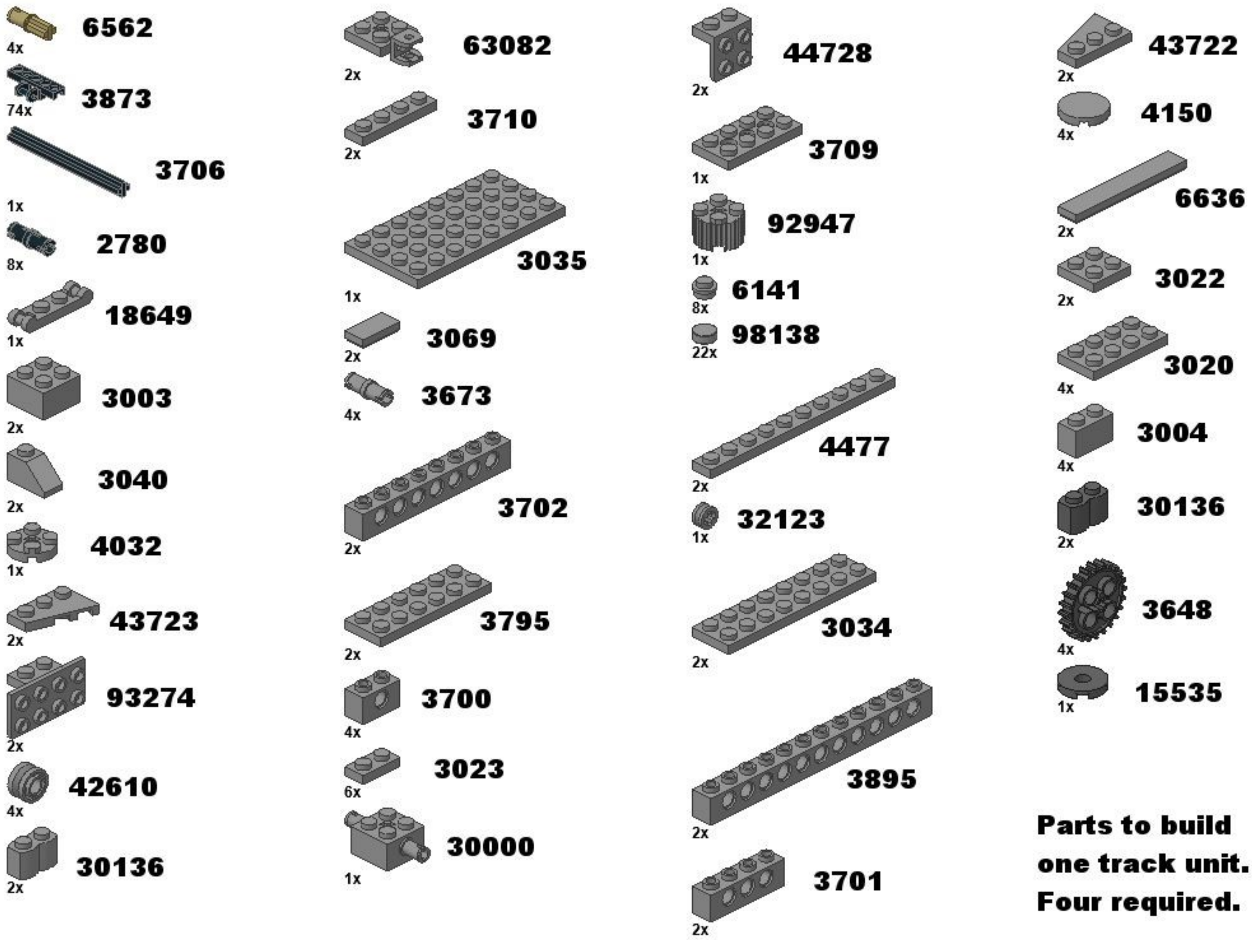


14



16





Parts to build one track unit. Four required.

References

Akens, David S.: Saturn illustrated chronology: Saturn's first eleven years, April 1957 – April 1968. NASA – Marshall Space Flight Center, 1971

Belew, Leland. F., ed. (1977). Skylab, Our First Space Station. Washington, DC: National Aeronautics and Space Administration Scientific and Technical Information Office. OCLC 2644423. SP-400.

Benson, Charles Dunlap & Compton, William: Living and Working in Space: A History of Skylab. National Aeronautics and Space Administration Scientific and Technical Information Office. SP-4208., Washington, DC, 1983

Benson, Charles Dunlap and William Barnaby Faherty. Moonport: A history of Apollo launch facilities and operations. NASA. Published by University Press of Florida in two volumes: Gateway to the Moon: Building the Kennedy Space Center Launch Complex, 1978

Bilstein, Roger E.: Stages to Saturn: A Technological History of the Apollo/Saturn Launch Vehicle. NASA SP-4206, 1996

Brooks, Courtney G.; Grimwood, James M.; Swenson, Loyd S., Jr.: Chariots for Apollo: A History of Manned Lunar Spacecraft. The NASA History Series. Foreword by Samuel C. Phillips. Washington, D.C., 1979

Burrows, William E.: This New Ocean: The Story of the First Space Age. New York: Modern Library, 1999

Cadbury, Deborah: Space Race: The Epic Battle Between America and The Soviet Union for Dominion of Space. New York: Harper Collins Publishers. 2006

Chaikin, Andrew.: A Man on the Moon. New York: Penguin Books, 1994

Compton, William David: Where No Man Has Gone Before: A History of Apollo Lunar Exploration Missions. The NASA History Series, National Aeronautics and Space Administration, SP-4214, Washington DC, 1989

Ertel, Ivan D.; Newkirk, Roland W.; et al.: The Apollo Spacecraft: A Chronology (PDF). IV. Foreword by Kenneth S. Kleinknecht. Washington, D.C.: Scientific and Technical Information Office, NASA, 1978

Gray, Mike: Angle of Attack: Harrison Storms and the Race to the Moon. W. W. Norton & Company, 1992

Gruntman, Mike: Blazing the Trail. Reston, Virginia: American Institute of Aeronautics and Astronautics, 2004

Harland, David M.: Exploring the Moon: the Apollo Expeditions. Springer-Praxis books in space exploration. Chichester, England: Springer, 2008

Heppenheimer,, T. A.: Countdown: A History of Spacecraft and Rocketry. New York: John Wiley & Sons, 1997

Johnston, Dietlein and Berry (ed.): Biomedical Results of Apollo. Scientific and Technical Information Office, National Aeronautics and Space Administration SP-368, Washington, D.C., 1975

Launius, Roger D.; McCurdy, Howard E., eds.: Spaceflight and the Myth of Presidential Leadership. Champaign, IL: University of Illinois Press, 2007

Launius, Roger: To Reach the Higher Frontier: A History of U.S. Launch Vehicles. University of Kentucky, 2002

Longsdon, J: John F. Kennedy and the Race to the Moon, Palgrave McMillan, 2010

Martin Marietta & Bendix: Skylab Reuse Study. Washington, DC: National Aeronautics and Space Administration, September 1978

Mindell, David A.: Digital Apollo: Human and Machine in Spaceflight. Cambridge, Massachusetts: The MIT Press, 2008

Murray, Charles; Cox, Catherine Bly: Apollo: The Race to the Moon. New York: Simon & Schuster. 1998

Newkirk, Roland W.; Ertel, Ivan D.; Brooks, Courtney G.: Skylab: A Chronology. National Aeronautics and Space Administration. SP-4011, 1977

Orloff, Richard W.: Apollo By The Numbers: A Statistical Reference. NASA. Published by Government Reprints Press, 2001

Webb, James E. et al: Apollo Expeditions to the Moon, NASA SP-350

Wells, Helen T.; Whiteley, Susan H.; Karegeannes, Carrie E. Origin of NASA Names. NASA Science and Technical Information Office

Wilford, John Noble: We Reach the Moon: The New York Times Story of Man's Greatest Adventure. New York: Bantam Paperbacks, 1969

Winter, Frank: Rockets Into Space, 1990

More Bricks in Space!

Download all books as PDF from ametria.org/lego—for free!

Vol I: Race to Space (published Nov 2018)

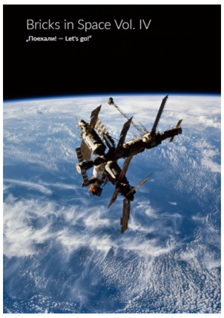
The first volume of the series describes the US Space program during the “Space Race”, when Air Force, Navy and Army all vied to bring the first human into space—before the Russians did it. Contains instructions for twelve models scaled at 1:110, depicting famous rockets such as the Juno I and II, the Thor Delta, the Redstone Mercury, Atlas Agena and many more!.

Vol II: Moonshot! (2 volumes, published November 2019)

The second volume to the series and perfect companion to your Saturn V LEGO model: A history of mankind’s first flight to the moon, complete with instructions for models for all relevant rockets and spaceships at the 1:110 scale. Including: Little Joe II, Saturn I, Saturn Ib, The Launch Umbilical Tower, the Crawler, and more.

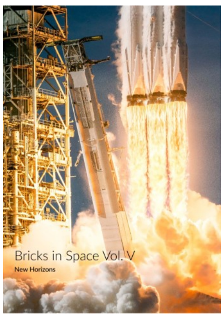
Vol III: Meeting the Pantheon (in preparation)

The third volume of the series covers the exploration of the solar system in the past forty years, as well as the work of the Space Shuttle. Included are instructions to create models of Launch Complex 41, the Titan III and IV , Dyna Soar, the Gemini Manned Orbital Laboratory, The Space Shuttle and its launch platform, and many more.



Vol IV: Let’s Go! (in preparation)

The fourth volume of the series shows how the Soviets won the Race to Space: First satellite, First man in Space, first women in space, first Space Station, and many more. Included are descriptions and instructions for the R7, the worlds first intercontinental ballistic missile, the Vostok and Soyuz launchers, The launch vehicles Proton and Energiya, space station Mir, and the famous N1 moon rocket.



Vol V: New Horizons (planned)

With the new century and the retirement of the Space Shuttle new players have entered the arena. SpaceX “Falcon Heavy” and the Chinese “Long march” are only one of several challengers to the venerable Russian Proton rocket or the new NASA “Ares” system. Watch history unfold!

About the Author

Wolf Broszies was born in 1972 in Kaiserslautern, Germany. His father is a reverend, his mother a high school teacher. He graduated in 1991 and, after compulsory military service, studied history and philosophy in various European cities for much longer than necessary. Wolf works as a product owner in an IT company and is married with two kids.

Having kids allowed him to return to his childhood toys and his fascination with space exploration and science fiction. Enjoying catalogues and compilations, this is his first work for the Lego community.

Bricks in Space Vol II

Part 1 - Moonshot!

The successful launch of Yuri Gagarin to space was publicly perceived as a challenge to America's technical prowess. As a response, the incoming Kennedy administration vowed to put a man on the Moon by the end of the 60ies. The US government consolidated space exploration under a newly founded civil agency, NASA, and unleashed the biggest and most costly engineering effort undertaken in peacetime, designing, building and launching rockets of unprecedented power. On July 20, 1969, at 20:17 UTC. Neil Armstrong became the first person to step onto the lunar surface.

Volume II of "Bricks in Space" presents 13 LEGO-builds of US rockets that helped to put NASA—and humankind—on the Moon for the first time. All scaled at 1:110, these models match the Lego Saturn V rocket (21309). From "clusters last stand", the Saturn I, to the massive Nasa crawler to America's first space station Skylab , you can now recreate the complete Apollo program—with Lego!