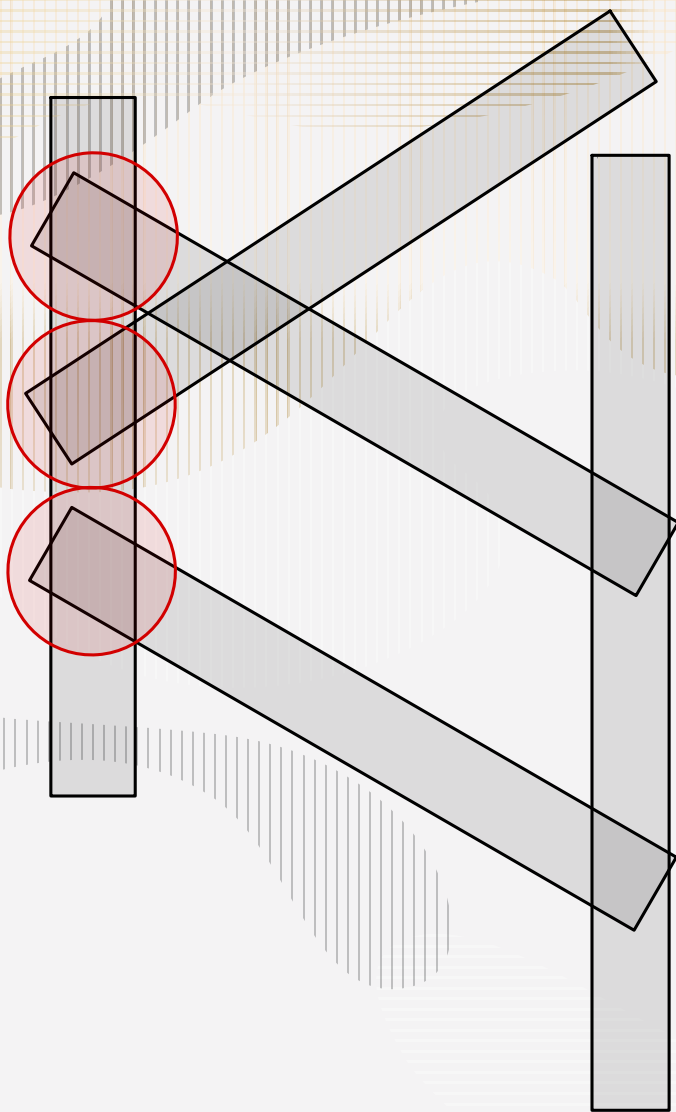




EFFICIENT LIFT MECHANISM

REVERSE 4 BAR LIFT

+ 2 BAR LIFT

MECHANISM

BUILD GUIDE

TEAM #: 4253U

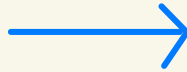
**CREATORS: BRENDON L,
LUCAS K, & KARSON K.**

LOCATION: CHINESE TAIPEI

PRE-BUILD

PREPARATIONS:

1. PARTS NEEDED (MECHANISM):



2. PARTS NEEDED (BASE FRAME):

(ONLY NECESSARY IF
STANDALONE I.E.
WITHOUT A DRIVETRAIN
TO ATTACH ETC.)



Part	Size	Amount
C-channels	1x2x1x35	4
Screws	0.375"	4
Nuts	Nylock	4

Part	Size	Amount
11W Motors	N/A	2
	Green Gearbox	2
C-Channel	1x2x1x20	1
	1x2x1x25	10
	1x2x1x35	4
Bearings	N/A	30
Gears	60T High Strength	6
Screws	0.375"	2
	0.5"	20
	0.75"	6
	1"	12
	1.25"	2
	1.5"	6
	1.75"	4
	2.5"	4
Shafts	~3"	2
Shaft Adapter	HS #8 Square Bore	2
Collars	Drive Shaft	2
Spacers	0.25"	2
	0.375"	6
	0.5"	4
Washers	Nylon	8
Rubber Bands	Any Type	6-8

3. TOOLS:

- SCREWDRIVER
- WRENCH

(PERHAPS A POWER SCREWDRIVER IF LAZY AT
BUILDING)

**GENERAL BUILDING RULE:
SCREWS FACES THE INSIDE OF C-CHANNEL
ALWAYS**

1. CREATE THE RAISING STRUCTURE

PARTS NEEDED:

6X BEARINGS

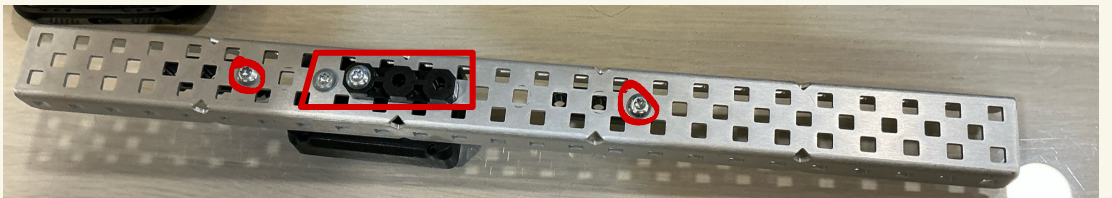
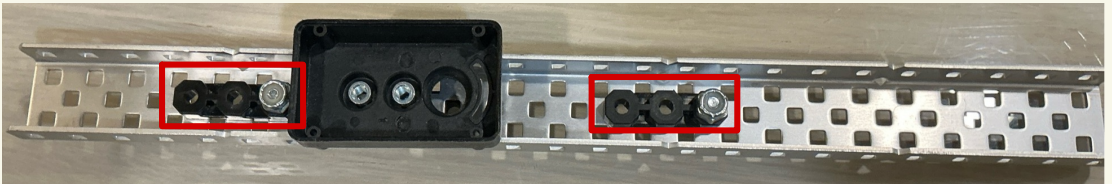
6X .5" SCREWS

2X .375" SCREWS

A. ATTACH BEARINGS TO C-CHANNELS ON THE ROW OF CENTER HOLES

ONE ON 4TH TO 6TH HOLE & 14-16TH HOLES - INSIDE C-CHANNEL

B. PLACE BEARING ON 9-11TH HOLES OUTSIDE THE C-CHANNEL ACROSS FROM MOTOR CAP WHICH SHOULD SCREWED IN ON 8TH & 9TH HOLES INSIDE C-CHANNEL

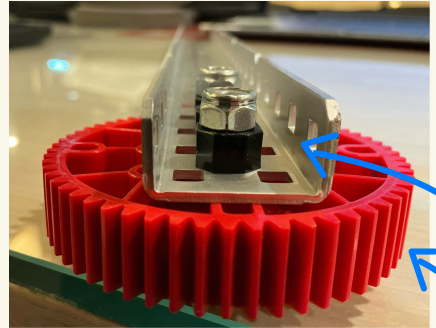


REPEAT A-B 2X

2. CREATE THE “ARMS”

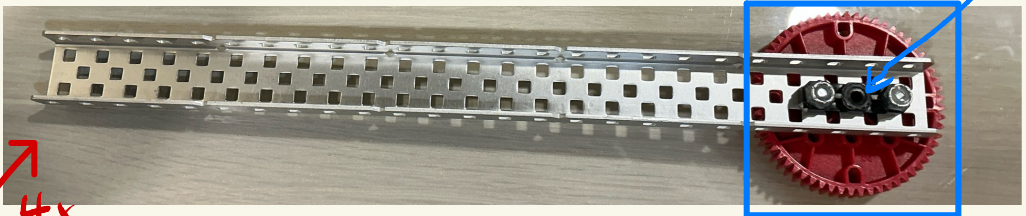
PARTS NEEDED TOTAL:

6X 60T GEAR
6X 1X2X1X25 C-CHANNELS
6X BEARINGS
12X 1” SCREWS
12X NYLOCK NUTS

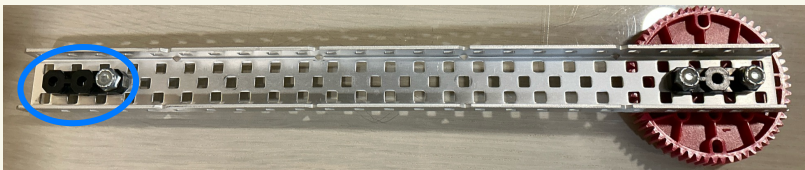


A. CENTER BEARING 2ND CENTER HOLE INSIDE
C-CHANNEL & GEAR ON SAME HOLE OUTSIDE C-
CHANNEL

B. PLACE 1” SCREWS THROUGH ALL 3 PARTS,
SCREW ON WITH NYLOCKS



C. PLACE ONE BEARING CENTERED ON 2ND HOLE
OF OTHER END INSIDE, SCREW IN ON 3RD HOLE
WITH .5” SCREW AND NYLOCK NUT



REPEAT A-C 4x
KEEP THE 4 ARMS
REPEAT A-B 2x
SET ASIDE THESE 2 ARMS

3. ATTACH THE 4-BAR'S ARMS

PARTS NEEDED:

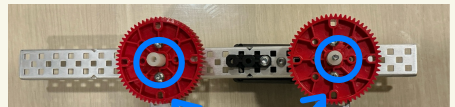
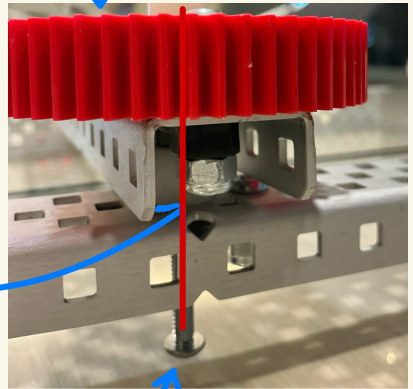
**BOTH RAISING STRUCTURE BUILT IN PART A
ARMS WITH SECOND BEARING FROM PART B
4x 2.5" SCREWS**

**A. PLACE RAISING STRUCTURE
WITH ARM'S GEAR'S BEARING
FACING THE OUTSIDE OF THE
RAISING STRUCTURE'S C-
CHANNEL WITH 0.5" SPACER
BETWEEN**

**B. PLACE 2.5" SCREWS
THROUGH PART A'S TWO
OUTER BEARINGS, WITH ONE
0.5" SPACER WITHIN THE TWO
INSIDES OF THE C-CHANNEL**

**C. PLACE ON ANOTHER 0.5"
SPACER AT THE END OF THE
SCREW**

**REPEAT A-C FOR BOTH OUTER
BEARINGS ON RAISING
STRUCTURES 2X**



4. CREATE THE 2ND SIDE OF RAISING STRUCTURE

PARTS NEEDED TOTAL:

6X BEARINGS

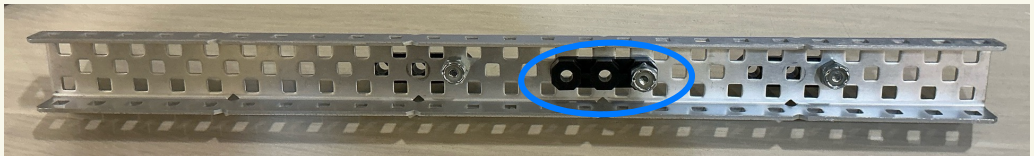
6X .5" SCREWS

6X NYLOCK NUTS

SIMILAR TO STEP 1, BUT WITHOUT MOTOR CAP AND REVERSE PLACEMENTS OF BEARINGS

A. FOLLOW STEP 1 INSTRUCTIONS EXCLUDING MOTOR CAP WHILE REVERSING PLACEMENTS OF BEARINGS

REMINDER: SCREWS ALWAYS FACE INSIDE OF C-CHANNELS



REPEAT 2X

5. ALIGNING THE 2-BAR ARMS WITH 4-BAR'S GEARS

PARTS NEEDED TOTAL:

ARMS WITHOUT 2ND
BEARINGS FROM STEP 2
2X 0.25" SPACERS
2X 0.375" SPACERS
2X DRIVE SHAFT COLLARS

A. PLACE 3" SHAFT INTO CENTER BEARING

- ADD ONTO SHAFT:

1. 0.25" SPACER
2. SHAFT COLLAR
3. ARM WITH GEAR
FACING COLLAR

FACING COLLAR

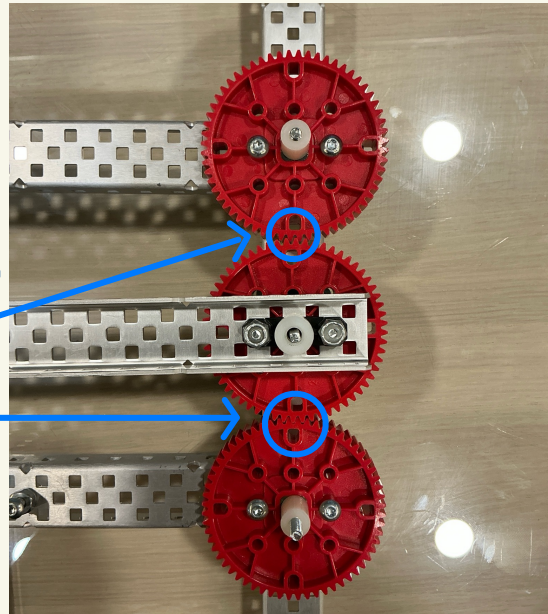
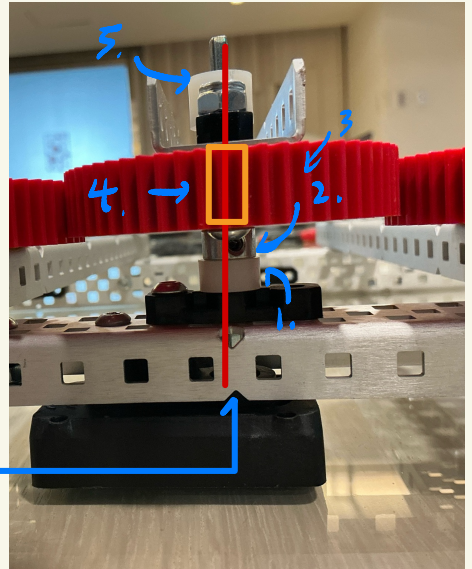
4. HIGH STRENGTH SHAFT ADAPTER (INTO GEAR)

5. 0.5" SPACER

B. ADJUST ARM'S SO THAT IT IS IN FOLLOWING POSITION:

(PERPENDICULAR TO
RAISING STRUCTURE)

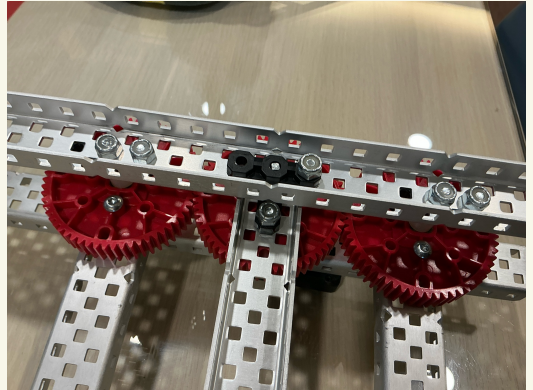
COMPLETE ON ONE SIDE,
THEN MIRROR ON OTHER



6. ATTACH THE 2ND SIDE OF RAISING STRUCTURE

PARTS NEEDED:

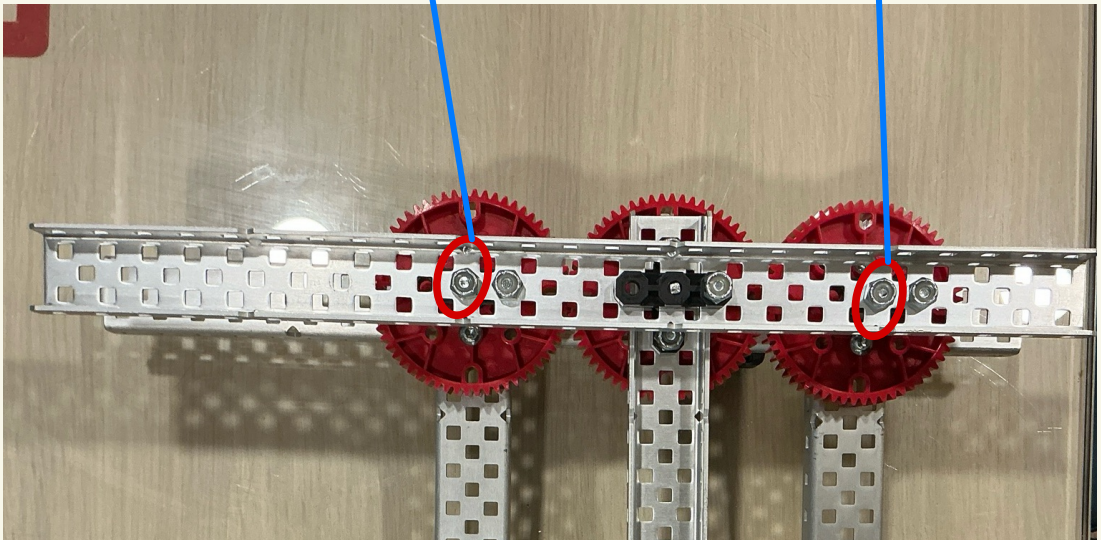
PARTS FROM STEP 4
ASSEMBLY FROM STEP 5
2x NYLOCK NUTS



A. PLACE OUTSIDE OF C-CHANNEL PART FROM STEP 4 ON TO STEP 5'S DOWN, WITH SCREW JOINTS AND SHAFTS GOING THROUGH THE CENTER.

B. NYLOCK ON THE SCREWS AND SCREW IN LOOSELY (JUST SO THAT THE 2.5" SCREW END IS FLUSH WITH NYLOCK)

REPEAT 2X



7. CREATE THE C-CHANNEL FOR 4-BAR TO ATTACH TO AND LIFT ITSELF FROM (LIFT STRUCTURE)

PARTS NEEDED:

4x 1x2x1x35 C-CHANNEL

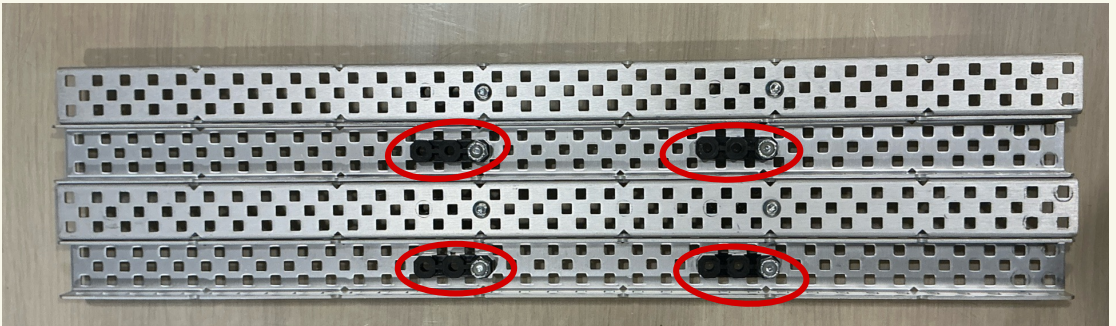
8x BEARINGS

2x 0.5" SCREWS

2x NYLOCK NUTS

A. SCREW IN THE CENTER ROW ON 10TH & 20TH HOLES

REPEAT 4x



8. ATTACH TO LIFT STRUCTURE

PARTS NEEDED:

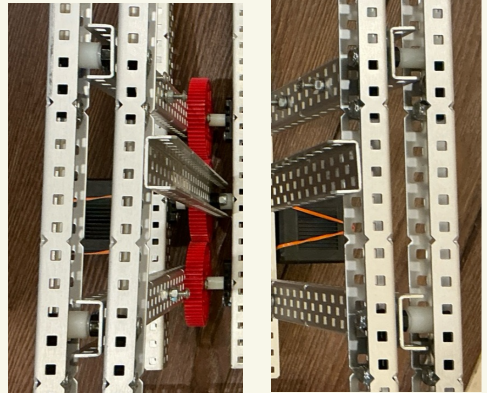
ASSEMBLY FROM STEP 6&7

4x 1.75" SCREWS

4x .5" SPACERS

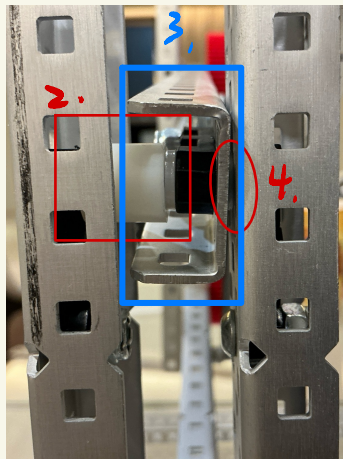
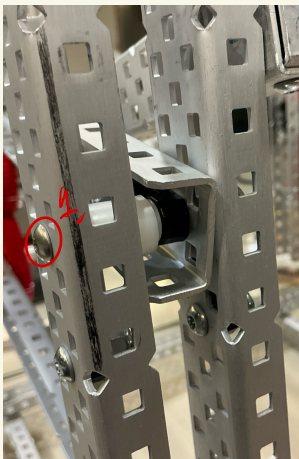
8x NYLON WASHERS

4x NYLOCK NUTS



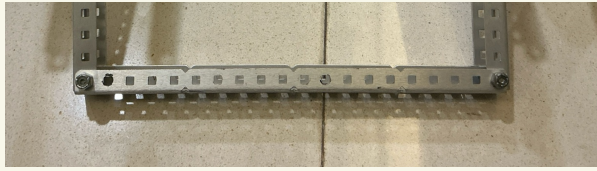
A. USE ONE LIFT STRUCTURE FROM PART 7

1. PLACE 1.75" SCREW THROUGH BEARING ON 12TH & 22ND HOLES
2. ADD 0.5" SPACER AND NYLON WASHER'
3. PLACE ON ONE ARM THROUGH BEARING
4. ADD WASHER AGAIN
5. PLACE ON SECOND LIFT STRUCTURE
6. ADD NYLOCK NUT AND SCREW UNTIL SCREW IS FLUSH WITH WHITE PART OF NUT.



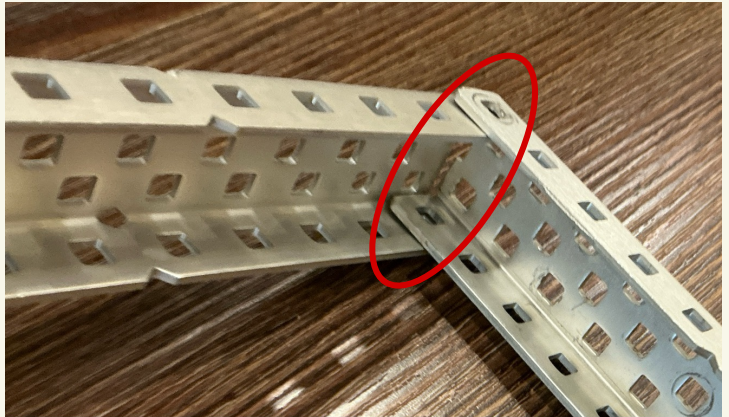
REPEAT FOR ALL 4 SCREW JOINTS OF MECHANISM
(OTHER SIDE SHOULD BE MIRRORED)

9. CONNECTING BOTH SIDES

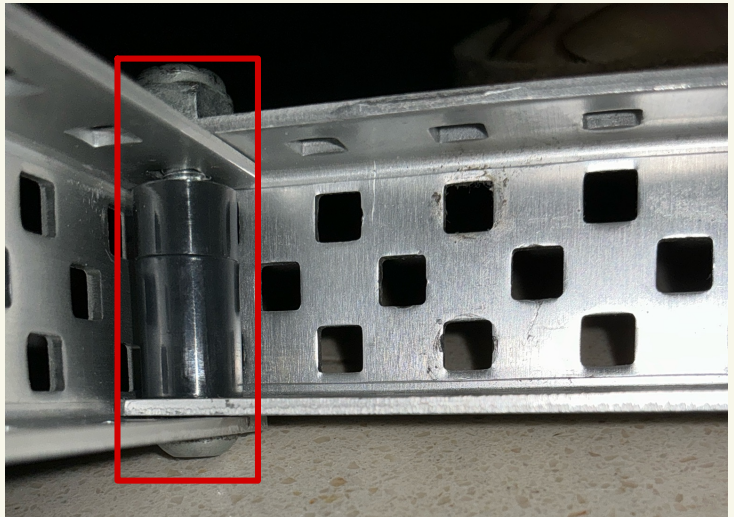


PARTS NEEDED: 1x 1x2x1x20 C-CHANNEL
2 x 1.25" SCREWS
2x NYLOCK NUTS
2x 0.5" SPACERS
2x 0.25" SPACERS

A. PLACE C-CHANNEL END TO END WITH 2-BAR'S ARMS, WITH SIDES OVERLAPPING



B. PLACE SPACERS INSIDE BOTH C-CHANNEL, THEN SHOVE SCREW THROUGH ALL 4 OBJECTS



C. NYLOCK ON SCREW AND SCREW IN

10. DECREASING MOTOR LOAD

PARTS NEEDED:

6x 0.75"

12x NYLOCK NUTS

6 TO 8 RUBBER BANDS (TEST DEPENDENT)

A. SCREW A NYLOCK JUST PAST HALFWAY ON TO THE SCREW X6



B. POSITIONING SHOULD BE LIKE THIS (OR CLOSE TO):
(TOP BAR: 9TH & 14TH HOLE FROM GEAR)
(BOTTOM BAR: 6TH HOLE FROM GEAR)



C. SCREW ON NYLOCK ONCE SCREW HAS BEEN INSERTED, THEN PLACE ON RUBBERBANDS (TEST UNTIL STRUCTURE CAN BE VERY LIGHTLY PUSHED UP)

MECHANISM IS COMPLETE

EXPLANATION!

- + **QUICK NOTE:** ALL 1x2x1x25 LENGTH C-CHANNELS ARE ADJUSTABLE FOR ADAPTATION, AS LONG AS ALL PARALLEL SETS ARE THE SAME LENGTH, AND LARGE ENOUGH FOR THE GEARS
- + **QUICK NOTE 2:** THERE WAS NO BRACING ON THE RAISING STRUCTURE SINCE THIS WAS A DEMO, NOT A FINAL PRODUCT
- + **STRUCTURAL:** PARALLELOGRAMS ARE CONGRUENT AND PARALLEL ON OPPOSITE SIDES, THUS MAKING THE REVERSE 4 BAR'S MOVEMENT POSSIBLE WITH JUST THE ROTATION OF A GEAR
- + **STRUCTURAL:** THE DISTANCE BETWEEN THE PARALLEL 4-BAR DOES NOT CHANGE AND THUS IF A RUBBERBAND'S CONNECTING POINTS ARE CONNECTED ONLY AT TWO POINTS THEY DON'T HELP THE LOAD BEARING THAT THE MOTOR TAKES ON, AND MAY POSSIBLE INCREASE IT INSTEAD
- + **STRUCTURAL:** THE # OF RUBBER BANDS ARE DEPENDENT ON WHAT IS PLACED ON THE TWO BAR.
- + **E.G.** A CLAW WOULD NEED MORE RUBBERBANDS IN ORDER TO OFFSET THAT WEIGHT LOAD ON THE MOTORS.

EXPLANATION! (CONT'D)

- + **STRUCTURAL:** WHEN THE LIFT IS EXTENDED, THE STRUCTURE ACTUALLY DOES NOT EXPAND IN ANY DIRECTION BUT UPWARDS, SINCE THE TWO BAR'S C-CHANNELS AND THE 4-BAR'S ARE ALL THE SAME LENGTH AND ANGLES ARE ALL CHANGING AT THE SAME RATE, THUS NOT MOVING FORWARD OR BACKWARD, ONLY UPWARDS
- + **MOTION:** ON THE NON-DRIVEN ARMS (NOT BEING MOVED DIRECTLY BY A MOTOR), SCREW JOINTS ARE USED IN PLACE OF SHAFTS BECAUSE THEY ARE ROUND AND THUS REDUCES FRICTION WHEN SPINNING IN OR HAVING OBJECTS SPINNING ON IT
- + **STRUCTURE:** SCREW JOINTS ARE ALSO STRONGER THAN SHAFTS AND REDUCES THE ODDS OF BEING WARPED BY USAGE

**NEXT PG:
INSTRUCTIONS FOR
ATTACHMENT TO
THE FRAME**

10. ATTACHMENT TO FRAME

PARTS NEEDED TOTAL:

4x 1x2x1x35 C-CHANNELS

4x 1.75" SCREWS

4x 0.375" SCREWS

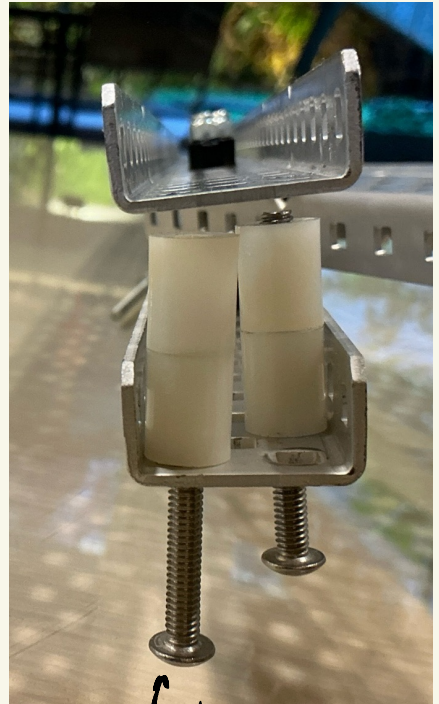
A. PLACE TWO 1.75" SCREWS THROUGH OUTSIDE OF LIFT STRUCTURE, AND ADD TWO 0.5" SPACERS ON EACH

B. ADD A C-CHANNEL THROUGH WITH ABOVE SPACERS SLOTTED INSIDE, AND PUSH THE SCREWS ALL THE WAY THROUGH.

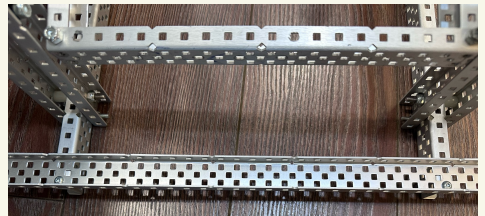
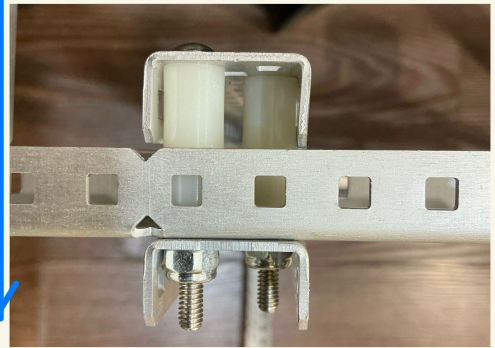
C. ADD NYLOCKS TO THE ENDS AND SCREW ON

D. ADD SOME CROSS BRACING WITH THE OTHER TWO C-CHANNELS WITH A WIDTH OF 30 HOLES

REPEAT FOR A-D FOR BOTH SIDES



about to fall out.





**THANKS FOR
USING OUR
GUIDE!**

**REVERSE 4 BAR
LIFT + 2 BAR
LIFT MECHANISM
COMPLETE**