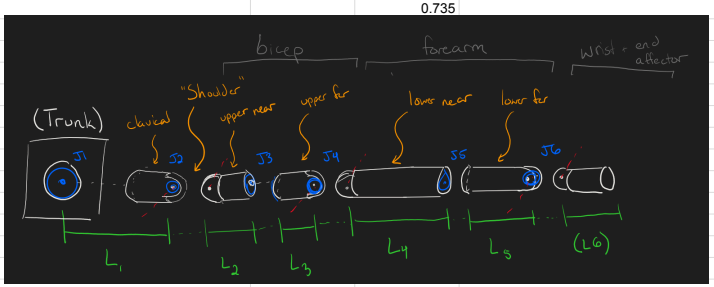
Component Type	Mass (kg)	Length [m]	Notes	Required Rated Torque [Nm]	Spec'd Motors	Rated Torque	Cost	Mass [Kg]
Joint 1	1.42	0		26.14123746	Robstride 04	40	280	1.42
Link 1	0.2019843687	0.0762						4.161
Joint 2	1.42	0	Sum Mass of components below for Torque	36.78683086	Robstride 04	40	280	1.42
Link 2	0.4039687374	0.2024						4.476
Joint 3	0.88	0		15.19523786	Robstride 03	20	250	0.88
Link 3	0.3366406145	0.127						
Joint 4	0.88	0	Sum Mass of	19.53629652	Robstride 03	20	250	0.88
Link 4	0.5386249832	0.2532						2
Joint 5	0.88	0	Matching to Joint 3 spec	15.19523786	Robstride 03	20	250	0.88
Link 5	0.2	0.0762	End Effector					
Point mass	5	0	Payload mass dictates torque requirements					
		0.735		Numbers increase from Proximal to Distal		Cost per Arm:	1310	
						Total Upper Body	2620	



Assumptions
Mass of links are based on tube diameter
Joint masses based on Stompy

Joint 4 Torque Calculation (Shoulder)	Qty	Units	Notes
Mass: Link 5 and Link 4	0.7386249832	Kilograms	
Length: Link 5 and Link 4	0.3294	Meter	
Center of Mass Sum Link 4 and 5	0.1647	Meter	Assume Cylindrical Tube uniform geometry
Weight of Beam	7.245911085	N	
Weight of Payload	49.05	N	Treated as point mass
Length: Joint 4 to Payload	0.3294	Meter	
Weight of Joint 5	8.6328	N	Treated as point mass
Length: Joint 4 to Joint 5 (link 4)	0.2532	Meter	
Moment: Beam (link 4 and 5)	1.193401556	Nm	Force * distance
Moment: Payload	16.15707	Nm	
Moment: Joint 5	2.18582496	Nm	
Moment on Joint 4: (Sum of Moments)	19.53629652	Nm	Rated Torque Spec

APPROACH: SUM ALL Moments together
Assume links prior to joint 4 is a static fixed point
Note: Motor Lengths are treated as negligible

Joint 2 Torque Calculation (Elbow)	Qty	Units	Notes
Mass: Link 5, 4, 3, 2	1.479234335	Kg	
Length: Link 5, 4, 3, 2	0.6588	Meter	
Center of Mass Sum Links 5,4,3,2	0.3294	Meter	
Weight of Beam	14.51128883	N	
Weight of Payload	49.05	N	
Length: Joint 2 to Payload	0.4564	Meter	
Weight of Joint 5	8.6328	N	
Length: Joint 2 to Joint 5	0.5826	Meter	
Weight: Joint 4	8.6328	N	
Length: Joint 2 to Joint 4	0.3294	Meter	
Weight: Joint 3	8.6328	N	
Length: Joint 2 to Joint 3	0.2024	Meter	
Moment: Beam (Link 5,4,3,2)	4.78001854	Nm	
Moment: Payload	22.38642	Nm	
Moment: Joint 5	5.02946928	Nm	
Moment: Joint 4	2.84364432	Nm	
Moment: Joint 3	1.74727872	Nm	
Moment on Joint 2: (Sum of Moments)	36.78683086	Nm	Rated Torque Spec

NOTE: Motor lengths are treated as negligible

Joint 1 Torque Calculation (Elbow)	Qty	Units	Notes
Mass: Link 5, 4, 3, 2	1.479234335	Kg	
Length: Link 5, 4, 3, 2	0.5588	Meter	
Center of Mass Sum Links 5, 4, 3, 2	0.2794	Meter	
Weight of Beam	14.51128883	N	
Weight of Payload	49.05	N	
Length: Joint 2 to Payload	0.4064	Meter	
Weight of Joint 5	2.3544	N	
Length: Joint 2 to Joint 5	0.4826	Meter	
Weight: Joint 4	2.3544	N	
Length: Joint 2 to Joint 4	0.2794	Meter	
Weight: Joint 3	2.3544	N	
Length: Joint 2 to Joint 3	0.1524	Meter	
Moment: Beam (Link 5,4,3,2)	4.054454098	Nm	
Moment: Payload	19.93392	Nm	
Moment: Joint 5	1.13623344	Nm	
Moment: Joint 4	0.65781936	Nm	
Moment: Joint 3	0.35881056	Nm	
Moment on Joint 2: (Sum of Moments)	26.14123746	Nm	Rated Torque Spec

Note: Motor Lengths are treated as negligible

This is effectievly the same torque as on Joint 2. Assume joint 2 bent 90 degrees applying moment on 1. Mass and moments from joint 2 and 1 negated a

Joint 3 Torque Calculation	Qty	Units	Notes
Mass: Link 5 and 4	0.7386249832	Kilograms	
Length: Link 5 and 4	0.2794	Meter	
Center of Mass Sum Links 5 and 4	0.1397	Meter	Assume Cylindrical Tube uniform geometry
Weight of Beam	7.245911085	N	
Weight of Payload	49.05	N	Treated as point mass
Length: Joint 4 to Payload	0.2794	Meter	
Weight of Joint 5	2.3544	N	Treated as point mass
Length: Joint 4 to Joint 5 (link 4)	0.2032	Meter	
Moment: Beam (link 4 and 5)	1.012253779	Nm	Force * distance
Moment: Payload	13.70457	Nm	
Moment: Joint 5	0.47841408	Nm	
Moment on Joint 4: (Sum of Moments)	15.19523786	Nm	Rated Torque Spec