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Introduction & Objective

Stark Industries and Groot Engineering are looking for an efficient column design for the replacement section on the drawbridge that spans across the Gulf Outlet Canal. On The Fly, Inc. have been contacted to design and fabricate a scaled model of the proposed design. The model must undergo a structural performance test and motions operations test in order to prove its ability to interface with the existing bridge structure.

The column must be able to withstand a 400 kip axial load in compression as well as a 64-94 kip lateral earthquake load at the top of the column. In addition, the column must also withstand at least a 10% lateral drift while maintaining at least 75% lateral strength during seismic testing. These forces will be scaled down to 1/40th for the column performance test of the model. The objective of the column design is to create the most cost effective design that balances both strength and ductility.

For the motions operation test, the purpose is to design a mechanical operation to stimulate the real life performance of the drawbridge. In this motion test, a car will be waiting at the gate in order to let a ship pass. After the ship passes, the drawbridge will lower and the car will be released and must smoothly exit the bridge. The speed of the car will be factored into the performance index as an indicator of how well the column interfaces with the bridge and drawbridge.

Column Design

Preliminary Designs

In order to create the most effective design while still meeting the given structural performance criteria, multiple design cases were analyzed on SAP2000 before the final design was chosen. A cylindrical column design was chosen from the beginning because of constructibility and economical purposes. The diameter of the column had to be greater than 60” to meet the load testing constraints. Multiple designs were made by varying diameters from 65”-75” and varying number of longitudinal bars from 10-18. Several designs were analyzed on SAP200 with these different variables, where displacement and moment curvature were considered. The challenge was finding the design that was able to meet both the ultimate displacement criteria as well as the moment curvature and P-M interaction criteria. A balance had to be found between using the right amount of longitudinal bars in order to get the ultimate displacement greater than 60” without sacrificing strength to meet the P-M interaction diagram constraints. After trying all possible cases, the ultimate displacement criteria could not be met with only changing the diameter and longitudinal bars; the spacing for the transverse bars had to be changed as well. When the spacing was halved from 8” to 4”, all given design criteria were met with the chosen final design.

Final Design

The final design for the reinforced concrete column consisted of a cylindrical column with a cross-sectional diameter of 70 inches and a length of 50 feet. The cross-sectional view of the column design is illustrated in **Figure 1**. The reinforcement will consist of 14 #14 longitudinal rebars and 8 feet of #8 rebars will be spiralled throughout the elastic hinge region length of the column with 16” spacing. The plastic hinge length was calculated to be 64” at the base of the column and 4” spacing was the determined spacing needed to meet the design criteria. But because the model would be scaled down to 1/40th, the spacing for the transverse rebar was increased to 8” to make it easier to construct and provide less room for error. Because the spacing was increased, the transverse rebar for the plastic hinge region would be doubled in order to maintain the steel to concrete ratio from the original design. The rebars will be designed to have a 1.5 in concrete cover to provide adequate protection from external elements. The reinforcement details are summarized in **Table 1**. **Figure 2** depicts a three dimensional rendering of the team's overall final column design and the final rebar design.

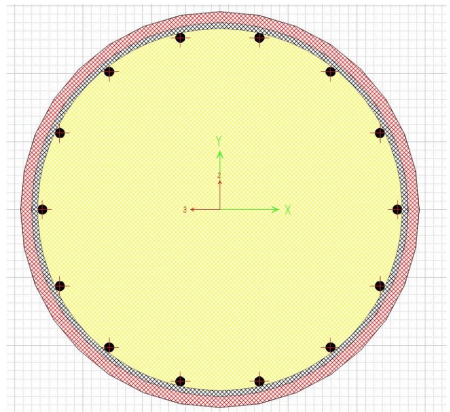


Figure 1: Cross-sectional view of the column design

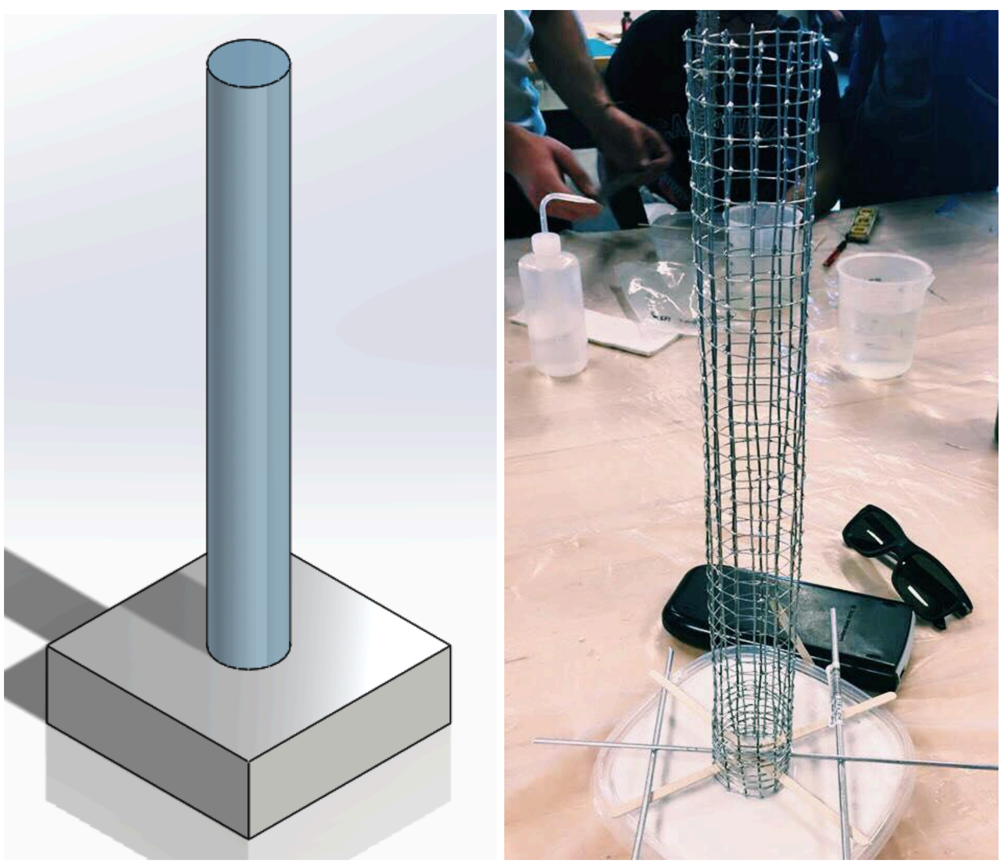


Figure 2: 3-D rendition of final column design (left) & final rebar design

Table 1: Final Design Summary

column diameter (in)	70
concrete cover (in)	1.5
# of longitudinal bars	14
size of longitudinal bars	#14
plastic hinge region length (in)	64
size of transverse bars	#8
# of transverse bars in the plastic hinge region	16
spacing of the transverse bars in the plastic hinge region (in)	8 (doubled bars)
# of transverse bars in the elastic region	34
spacing of the transverse bars in the elastic region (in)	16

The column was designed to withstand a 400 kip axial load in compression. The P-M Interaction diagram was used to verify that enough reinforcement was used in order to resist the moment associated with the loading. This is illustrated in **Figure 3**. The design requirement (orange dot) was calculated from the following equation:

$$F = \frac{M}{L} - \frac{P\Delta}{L} \quad (1)$$

The force, F, was calculated from the moment, M, and the displacement, Δ, at a particular instance. This force was then plotted in relation with the moment to determine the design requirement needed. The design requirement originally laid outside the P-M interaction envelope, which meant that the steel to concrete ratio needed to be increased. The team took this into account during construction and did not scale down on the number of rebars used and only scaled the length. The design was re-analyzed to provide the following figure and allowed the team to uphold their design.

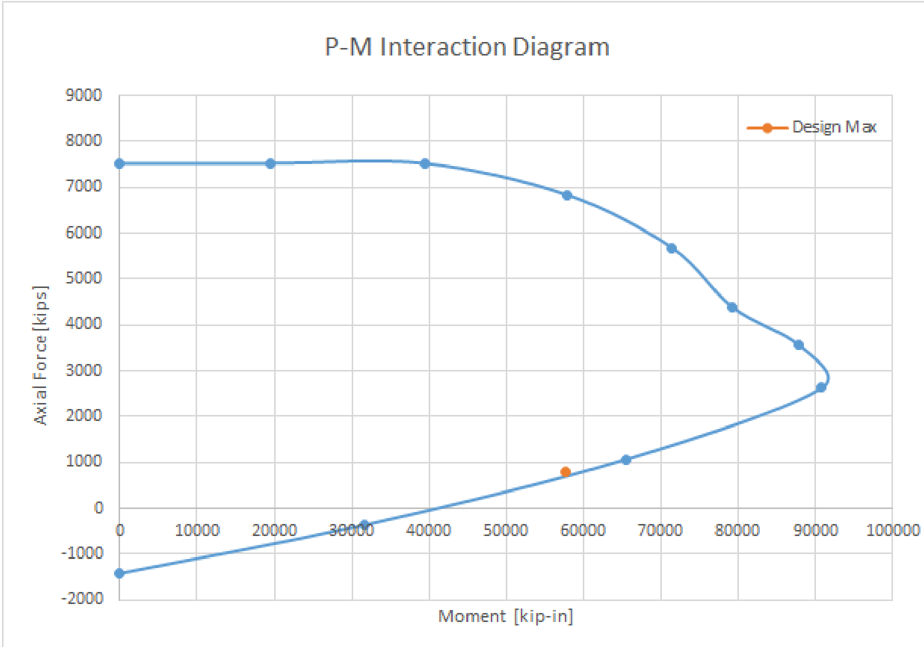


Figure 3: P-M Interaction Diagram

The force-displacement diagram, **Figure 4**, was used to ensure that the design was also flexible, allowing 10% lateral drift without having a 25% reduction from the max lateral force at max displacement. As mentioned earlier, one of the challenges faced was meeting the ultimate deflection constraint. The ultimate deflection can be defined from the following equation:

$$\Delta_u = \Delta_y + \Delta_p > \Delta_a \quad (2)$$

The subscript y and p represent the yield and plastic deflection respectively. Δ_a is the ultimate drift of the column and was calculated to be 10% of the column length. The final design was analyzed to have a ultimate deflection of about 67 in, which is more than 10% of the column's height (60 in). From the force vs displacement diagram, **Figure 4**, the column behavior can be predicted to reach its maximum force at around 81 kips. It's expected for the failure to occur in the plastic hinge section of the column because the moment is the largest in that section. The transverse rebars in that section become critical in how well the connections were made. The connection between the footing and the base of the column is also crucial to how well the column will perform.

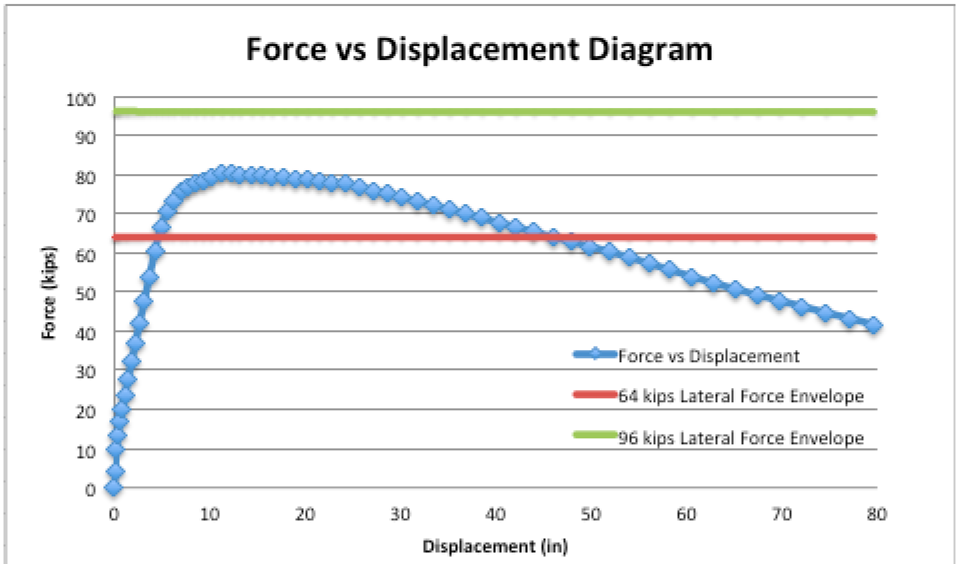
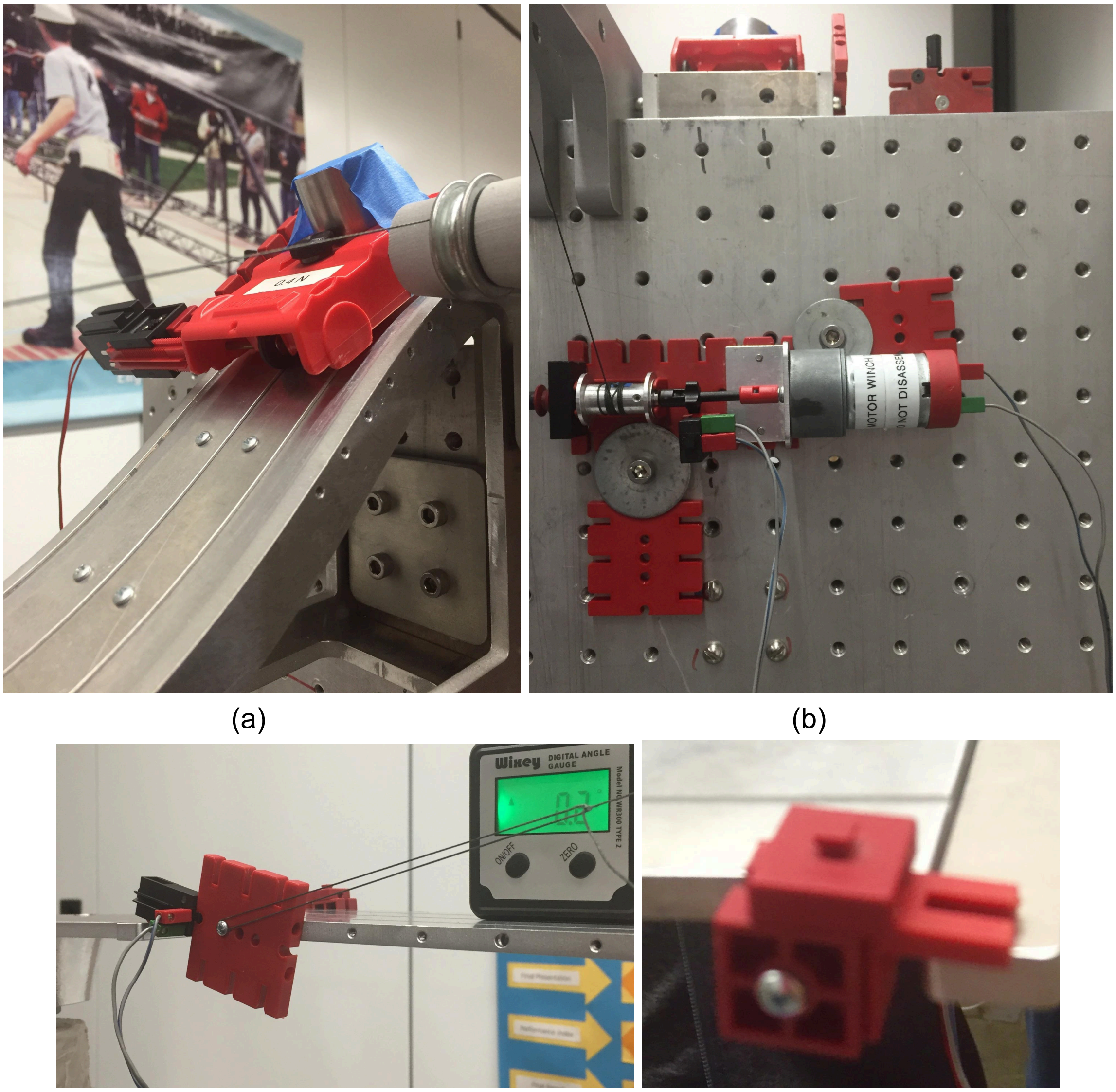


Figure 4: Force vs Displacement Diagram

The total cost for the construction of the column, including the construction and assembly of the mechanical aspect of the project, was calculated to be $71,843.55. Miscellaneous penalties and charges, however, brought up the total cost to $133,843.85.

Motion Operations

The car will be mounted in the peak of the bridge using a base plate. The same base plate will be attached to a gate assembly consisting of a motor rack with a rack pinion (**Figure 5.a)**. This motor will be used to retract the pinion allowing for the release of the car. The drawbridge will be raised to 65-70 degrees from the horizontal with the use of a pulley system, allowing the boat to pass. The pulley system will consist of a motor winch on the back of the bridge (**Figure 5.b**) which is connected to a balanced fixture, attached to the base plate(**Figure 5.c**), mounted to the raising end of the bridge. The motor on the winch assembly will be programed to rotate the pulley by counting the number of clicks it takes for the bridge to lift to 65-70 degrees. The bridge will then be released to go back to horizontal. As soon as the switch (**Figure 5.d**) attached on the raising end of the bridge hits the other end of the deck, the motor winch will stop. This sends a signal to then release the car. Refer to **Figure 6** and **7**, for a better visual of the mechanical configuration. The chosen setup will be further explained in the next section.



(a) (b)

(c) (d)

Figure 5: (a) car mounted with gate assembly, (b) pulley motor winch setup, (c) pulley connection to the bridge, (d) mini switch bridge stopper.

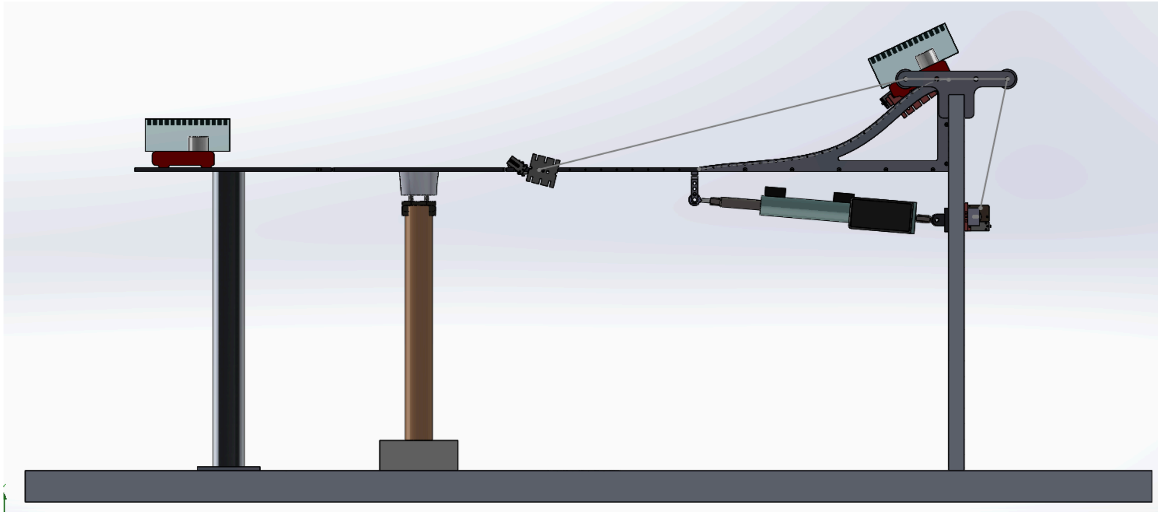


Figure 6: 2-D rendition of ramp and bridge mechanical configuration

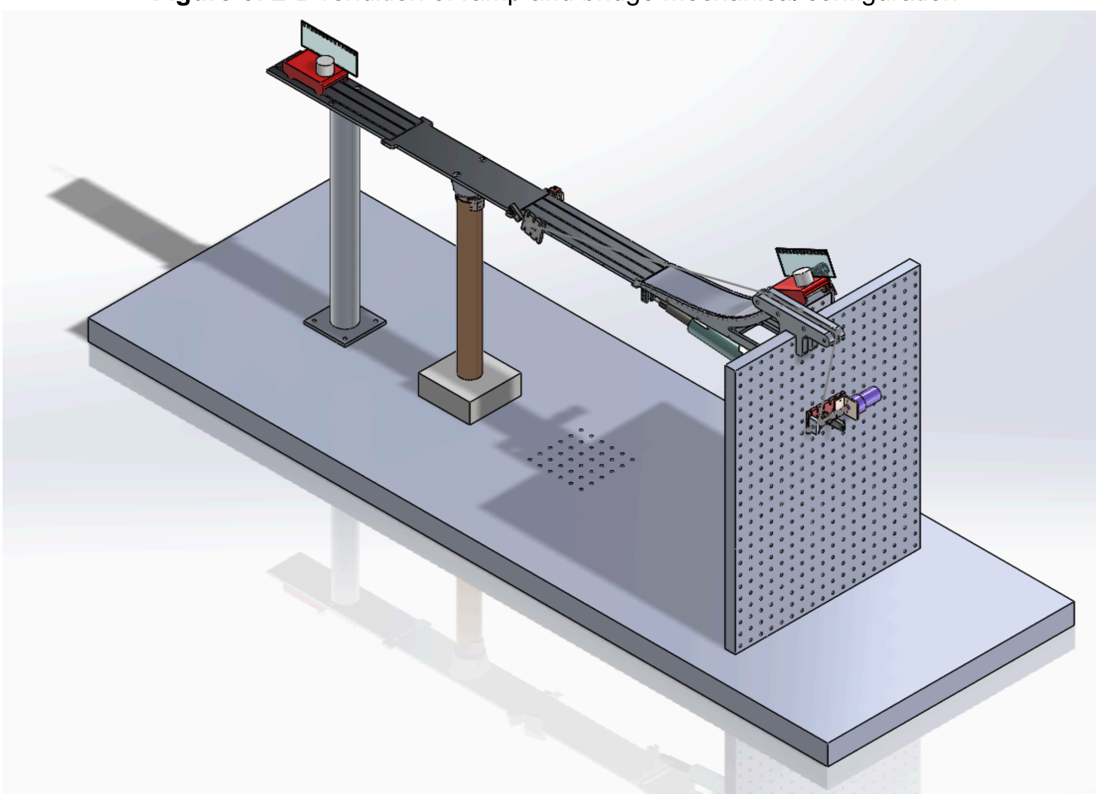


Figure 7: 3-D SolidWorks rendition of ramp and bridge mechanical configuration

RoboPro Program

RoboPro is a programing software that converts computing commands to control signals for motors and sensors. It's a graphic programming language that uses flowcharts to represent the step to step to process of the execution needed. RoboPro will be used for the motion operations of the project, where it'll program the drawbridge and signal the release of the car. The team's goal with the RoboPro program was to keep the logic as simple as possible while performing the test. The program had only two main steps. These were to raise and lower the drawbridge, and to control the car gate.

The first step engaged the pulley motor first. After a set of pulses that was determined during practice testing, the motor would then stop. These pulses were used to accurately raise the drawbridge to the required angle. This was determined to be a better method than using a wait time step. A wait time step was, however, used to allow the boat to pass safely underneath the bridge. Once the boat had passed, the motor would then engage in the opposite direction to lower the drawbridge. As the drawbridge approached horizontal again the mini switch would be engaged, simultaneously stopping the pulley motor and starting the car gate motor. This is the beginning of the second step. The car gate would then run for 1 second, stop, reverse for one second, then stop again. The program then terminated. By running the gate in the opposite direction the setup would be ready for further testing without having to reset anything. These commands can be seen below (**Figure 8).**

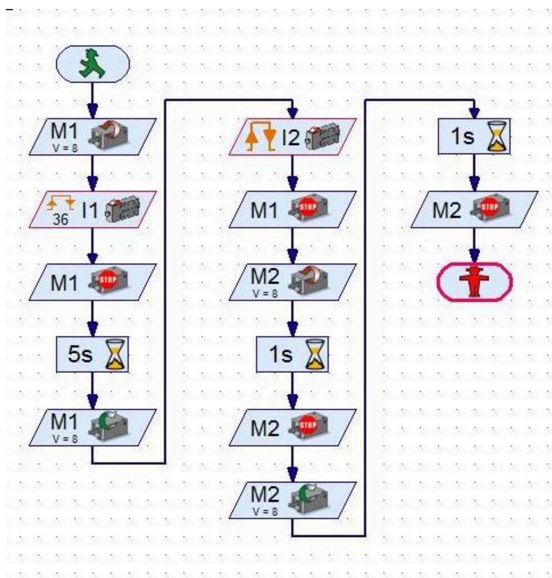


Figure 8:Motion Operations testing RoboPro program

Structural Performance

<u>Motion Operations Test</u>

After the team adjusted the RoboPro pulse count for the angle of the drawbridge during practice testing the program ran perfectly and the test was executed without problem for every iteration. Since the practice tests ran so well, no complications were expected during final testing.

On the day of final testing, the program ran as designed and the drawbridge was raised to the correct angle. However, most warm up runs were failures with the car crashing. This was likely caused by two issues. For the final testing the team set the bridge up in the exact same manner it had been practice tested under. One problem lay in the drawbridge and bridge interface. In retrospect they should both have been at the same angle to begin with, however they weren't for the practice testing and this was replicated during the final testing. Adjusting this helped the test execute successfully approximately 60-80% of the time. Had this been the case to start, it is possible the success rate could have been higher. This first issue would not have been a problem if not for the second issue, which could not be controlled for. That is that week and a half of testing by various teams on the same setup created small misalignments that, when summed together, caused the car to crash more often.

Two improvements that could have been made would be to start with the drawbridge and bridge at the same angle, and to devise a way to open the car gate as the drawbridge was nearly horizontal, so as to save time.

For the final performance, the car crashed twice before a successful run was made. The wait time for the car was 36.5 seconds and the final wait time was 276.5 seconds. The velocity of the car was 7.59 seconds. Refer to the Appendix for full results.

Column Test

For the column test, the peak force reached was at 79.24 lbs when the displacement was -1.5 inches. As shown from **Figure 9** below, the critical section as predicted was in the plastic hinge region. From the load being applied, the base of the column began suffering from brittle failure modes and the rebars became exposed. As the testing went on, the longitudinal bars in the column yielded and necking occurred. This was caused from not bending the transverse rebar ends outward so that the connection between the footing and column was stronger. As the lateral load was applied the longitudinal rebars began pulling out of the foundation and led to the disconnection between the column and footing.

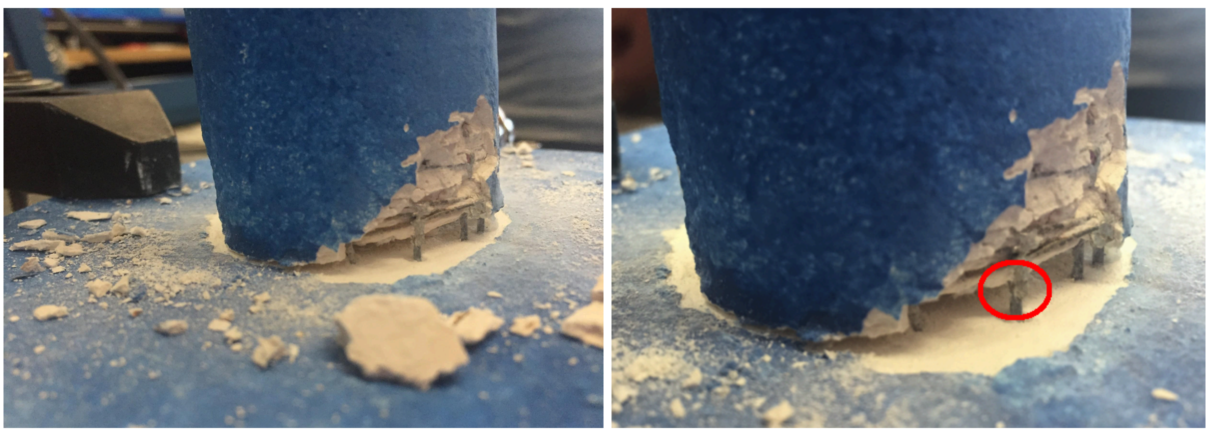


Figure 9: Column testing results, exposed rebar and necking shown in longitudinal rebar

The force vs displacement hysteretic data is shown in **Figure 10**. The maximum load the column reached ranged from 70-80 lbs, which was overly strong compared to the 60 lb maximum design constraint. As compared to the moment curvature from the design analysis, the maximum force was around 81 kips which which when scaled down to the model, is 50.6 kips. The calculated results as compared to the actual results were quite different, resulting in a percent error of 56.5%. This large error was mainly caused from the scaling down of the actual design. In scaling the actual column to the model, more considerations should have been taken into account. Scaling down the length of all reinforcement bars but not scaling down the amount of bars used ultimately caused the overdesign of the model column.

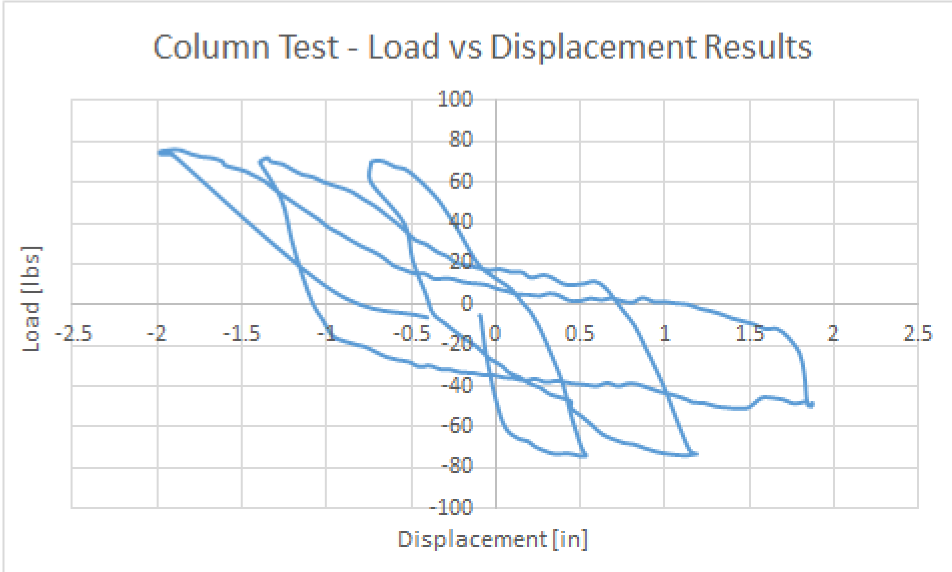


Figure 10: Force vs displacement hysteresis data

Performance Index

The performance index equation involved six values. The velocity of the car after crossing the bridge, the cost of the build, the traffic wait time, any performance penalties, and the aesthetics and magnification factors. This can be seen below.

$$PI = \frac{V \times A \times M}{C \times W \times P} \quad (3)$$

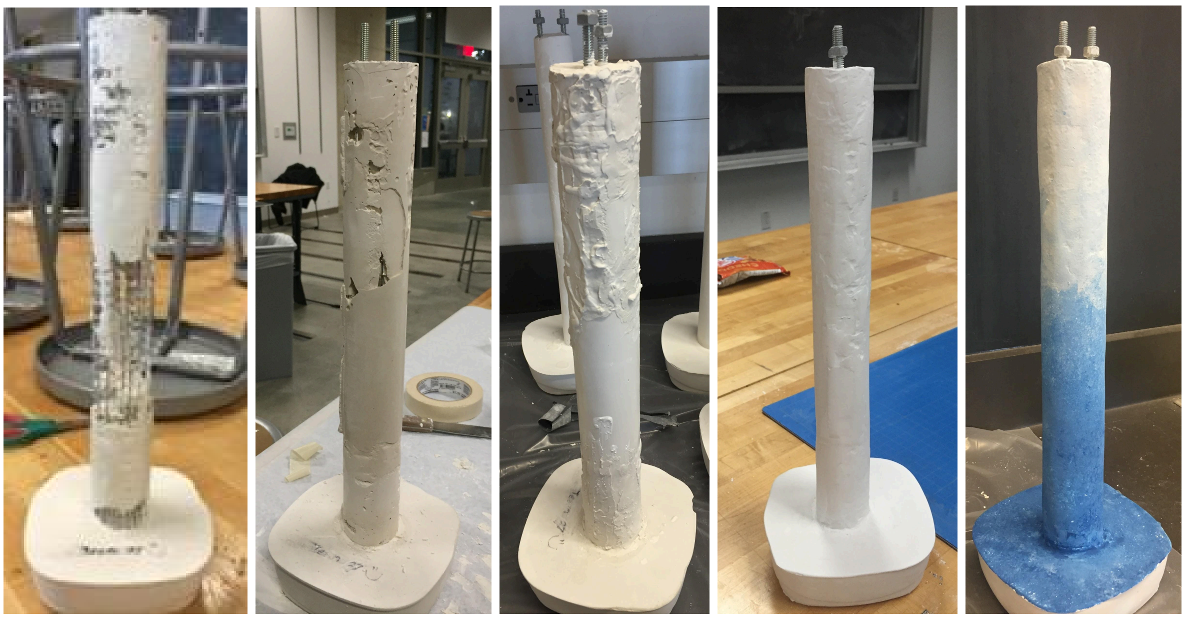
From the practice tests the velocities were approximately 7.5 m/s. Assuming three runs during final testing, with 15 seconds for setting up between the runs, traffic wait time would be 126 s. Accounting for one failure to be conservative puts the W factor at 246 s. The cost before testing was calculated at $131,843.85. Including one crash adds an additional $1000 to the cost. The chosen design was a standard design so the aesthetics factor is 1.0. Assuming overdesign, given an increased cross-section from repouring and patching, The P factor would be at least 1.2. Given 6 loadings this generates a final P of 2.986.

The magnification factor was not detailed anywhere so calculating from known values provided in the Final Project PI Results resulted in a M factor of 3.936×10^{9}.

With these values and using equation XX the expected PI was found to be 302.6. This is significantly close to the experienced PI of 286.6.

Challenges

One of the main challenges that the team faced was the construction. The water content for the initial pour was only about 33%, and since plaster of Paris sets quickly, the team ended up with a column that was not completely filled. The whole middle section did not have concrete. Unfortunately, the formwork that the team used in the pour was opaque, preventing the team to see what was going on inside the formwork. The team resolved this issue by performing an additional pour and a patching session. These were done completely different since they were performed horizontally and with 50% more water content to the same amount of plaster.The second pour filled the middle section of the column. Before the final patching began, the team used a chisel to create easier access to large voids embedded in the structure. The final pour filled these voids and smoothed the outer surface. Construction issues resulted in extra expenses in materials and time. Refer to **Figure 11** for the column construction overview.



(a) (b) (c) (d) (e)

Figure 11: (a) column after the 1st pour, (b) column after the second pour, (c) column after the third pour, (d) column after sanding, (e) final column facade

Another challenge that the team faced was the limited mechanical testing times. Since the team signed up for testing on the first day of practice, the first teams to sign up scheduled the maximum possible times and filled all the spots. Once more times were added, two consecutive mega-charged testing times were purchased in haste. The concern was ensuring any practice time, but since this did not conform to the rules in one of the many documents the team lost those times and was charged for them. Fortunately, practice times opened on Friday and those were purchased correctly. This greatly affected the team's total budget. However, the team felt it necessary to purchase the expensive testing times ensuring safety over budget.

In the final testing, the team faced further adversity. Due to bridge deformations following a week and a half of testing, as well as not ideal bridge to drawbridge angles, two of the three final runs resulted in the car crashing and the driver dying.

Team Responsibilities

All team members assisted in the design and construction process. Due to their experience in SE151A team members Angela Ramirez and Jenny Chen primarily worked on the P-M diagram and Moment Curvature Analysis for the column design. Jason Lee and Xander Schwarz worked on the various other calculations for the design.

All team members participated in soldering the column reinforcement. Due to a much less than ideal soldering iron this took an extended period of time.

Angela and Jason poured the footing. Xander, Jenny and Angela performed the initial pour for the column. The hollow middle section required a second pour that Jason and Angela fulfilled.
Angela and Xander worked together on the final pour to patch the column. This included chiseling the column to provide better access to visible voids. The column was finished off by sanding from Xander and Jason and painting by Jenny and Angela.

Xander was responsible for generating and executing the RoboPro program. This included adjusting the program during testing to ensure fulfilling all requirements of the Motions Operations Test.

For an overview of time the distribute work and time spent, refer to **Table 2** below.

Table 2: Distributed team responsibilities with total hours calculated

	Jenny Chen	**Jason Lee**	**Angela Ramirez**	**Alexander Schwarz**
Analysis/Design	9	7	9	8
Soldering	8.5	9	5	6
Footing Pour		1.5	1.5	
Column Pour 1	1.5		1.5	1.5
Column Pour 2		1.5	1.5	
Column Pour 3			1.5	1.5
Sanding 1		1	1	1
Sanding 2			1	
Aesthetics	1		1	
RoboPro				2
Total	**20**	**20**	**23**	**20**

Conclusion

Team 27 learned a great deal in this project. It enhanced everyone's knowledge in iterative column design, construction, as well as mechanical simulation using RoboPro. The team's final design incorporated longitudinal steel reinforcement. The team found this necessary in order for the column to resist tension forces that concrete is weak with. Transverse reinforcement was also enforced for confinement and to resist shear failure. The team also incorporated a plastic hinge region in the bottom of the column. This was designed to promote enough movement on the column where the moment is at its peak, in order for the column to dissipate energy and allow damage to happen where it is controlled. Redundancy was another concept that the team enforced. Conservative spacing was observed for the transverse and longitudinal reinforcements.This is to ensure that alternate load path is provided so that the structure does not completely fail if one part of the structure gets damaged.

P-M Interaction Diagram and Force-Displacement Diagram were also helpful tools in the iterative design process. P-M Interaction Diagram helped verify that the column is able to resist the applied force and the moment generated by the force applied. This was also useful in determining if enough steel reinforcement was incorporated in the design. Force-Displacement Diagram was used in predicting the column behavior under loading, and making sure that the column will be designed both for strength and ductility.

Soldering took longer than expected for the team since they soldered outside of class. The foundation pour went well, but the construction of the column did not go as well as planned. However, the team was able to pull through and construct the column they have designed. The team learned a lot in this particular experience, specially in finding creative ways to deliver the work despite the adversities.

This project was also helpful in incorporating basic structural engineering knowledge learned from previous classes and apply it to design and build a reinforced concrete column. The team also learned how to use RoboPro that is a well-used program in the industry.

Overall, the column tested was over designed for strength. It carried a peak force of 44.33 lbs in the +1.5” displacement, and 79.24 lb in the -1.5” displacement. The maximum velocity recorded for the mechanical simulation turned out to be 7.59 m/s with a wait time of 36.5 s. However, due to mechanical malfunctions, the first two test runs were unsuccessful, increasing the final wait time to 276.5 s. The total cost of the column was calculated to be $133,843.85, corresponding to a PI of 286.8.

Appendix

Design Equations (from “Column Design Notes and Procedure”)

<u>Minimum cross sectional area needed</u>

$\frac{P}{f'cA_g} \leq 10\%$

$A_g \geq \frac{0.1P}{f'c} = 1000\ in^2$

P - axial load

f’c - compressive strength of concrete

Ag - gross cross sectional area

<u># of longitudinal bars needed</u>

$A_s = 0.01 \times A_g$

$n = \frac{A_s}{A_b}$

As - total area of longitudinal bars

Ab - area of a single longitudinal bar

n - total # of longitudinal bar

<u>Transverse spacing needed for plastic hinge</u>

$\rho_s = \frac{4A_s h}{D_c s_h} > 1\%$

$s_h \leq the\ lowest\ value\ of \rightarrow \frac{1}{s} \times smallest\ column\ dimension$

$\rightarrow 6 \times diameter\ of\ longitudinal\ bar$

$\rightarrow 8"$

Transverse spacing needed for outside the plastic hinge

$s_h \leq the\ lowest\ value\ of \rightarrow 2s_h \times inside\ plastic\ hinge\ region$

$\rightarrow 0.5 \times smallest\ column\ diameter$

$\rightarrow 24"$

Transverse spacing chosen as 8” for plastic hinge, and 16” for outside the plastic hinge

From these equations the following excel was made:

P (kips)	f'c (ksi)	Ab (long)	d (long)	fy (ksi)	Ab (tran)	Cover	L (in)	Lp (in)
400	4	2.25	1.693	50	0.79	10	600	60.6975

Legend
Square
Circle
Rectangle
bad

h	b	d	Ag (sq)	< 10% (sq)	n (sq)	sh (sq)	hxy (sq)	Ps (sq) > 2.5%	sh2 (sq)
40	25	31.5	992.25	10.07810	4.41	6.3	9.807	5.114584497	12.6
39.95	25.05	31.55	995.4025	10.04618	4.424011	6.31	9.857	5.080576169	12.62
39.9	25.1	31.6	998.56	10.01442	4.438044	6.32	9.907	5.04693651	12.64
39.85	25.15	31.65	1001.7225	9.982804	4.4521	6.33	9.957	5.013659843	12.66
39.8	25.2	31.7	1004.89	9.951337	4.466177	6.34	10.007	4.980740611	12.68
39.75	25.25	31.75	1008.0625	9.920019	4.480277	6.35	10.057	4.948173365	12.7
39.7	25.3	31.8	1011.24	9.888849	4.4944	6.36	10.107	4.915952765	12.72
39.65	25.35	31.85	1014.4225	9.857825	4.508544	6.37	10.157	4.884073577	12.74
39.6	25.4	31.9	1017.61	9.826947	4.522711	6.38	10.207	4.852530672	12.76
39.55	25.45	31.95	1020.8025	9.796214	4.5369	6.39	10.257	4.821319018	12.78
39.5	25.5	32	1024	9.765625	4.551111	6.4	10.307	4.790433686	12.8
39.45	25.55	32.05	1027.2025	9.735178	4.565344	6.41	10.357	4.759869839	12.82
39.4	25.6	32.1	1030.41	9.704874	4.5796	6.42	10.407	4.729622735	12.84
39.35	25.65	32.15	1033.6225	9.674711	4.593877	6.43	10.457	4.699687724	12.86
39.3	25.7	32.2	1036.84	9.644689	4.608177	6.44	10.507	4.670060244	12.88
39.25	25.75	32.25	1040.0625	9.614806	4.6225	6.45	10.557	4.640735821	12.9
39.2	25.8	32.3	1043.29	9.585062	4.636844	6.46	10.607	4.611710066	12.92
39.15	25.85	32.35	1046.5225	9.555456	4.651211	6.47	10.657	4.582978672	12.94
39.1	25.9	32.4	1049.76	9.525986	4.6656	6.48	10.707	4.554537415	12.96
39.05	25.95	32.45	1053.0025	9.496653	4.680011	6.49	10.757	4.526382147	12.98
39	26	32.5	1056.25	9.467455	4.694444	6.5	10.807	4.498508801	13
38.95	26.05	32.55	1059.5025	9.438392	4.7089	6.51	10.857	4.470913384	13.02
38.9	26.1	32.6	1062.76	9.409462	4.723377	6.52	10.907	4.443591975	13.04
38.85	26.15	32.65	1066.0225	9.380665	4.737877	6.53	10.957	4.416540728	13.06
38.8	26.2	32.7	1069.29	9.351999	4.7524	6.54	11.007	4.389755866	13.08
38.75	26.25	32.75	1072.5625	9.323465	4.766944	6.55	11.057	4.363233681	13.1
38.7	26.3	32.8	1075.84	9.295062	4.781511	6.56	11.107	4.336970533	13.12
38.65	26.35	32.85	1079.1225	9.266788	4.7961	6.57	11.157	4.310962847	13.14
38.6	26.4	32.9	1082.41	9.238643	4.810711	6.58	11.207	4.285207112	13.16
38.55	26.45	32.95	1085.7025	9.210626	4.825344	6.59	11.257	4.259699883	13.18
38.5	26.5	33	1089	9.182736	4.84	6.6	11.307	4.234437771	13.2
38.45	26.55	33.05	1092.3025	9.154973	4.854677	6.61	11.357	4.209417453	13.22
38.4	26.6	33.1	1095.61	9.127335	4.869377	6.62	11.407	4.18463566	13.24
38.35	26.65	33.15	1098.9225	9.099822	4.8841	6.63	11.457	4.160089184	13.26
38.3	26.7	33.2	1102.24	9.072434	4.898844	6.64	11.507	4.135774871	13.28
38.25	26.75	33.25	1105.5625	9.045169	4.913611	6.65	11.557	4.111689625	13.3
38.2	26.8	33.3	1108.89	9.018027	4.9284	6.66	11.607	4.0878304	13.32
38.15	26.85	33.35	1112.2225	8.991006	4.943211	6.67	11.657	4.064194205	13.34
38.1	26.9	33.4	1115.56	8.964107	4.958044	6.68	11.707	4.0407781	13.36
38.05	26.95	33.45	1118.9025	8.937329	4.9729	6.69	11.757	4.017579197	13.38
38	27	33.5	1122.25	8.910670	4.987777	6.7	11.807	3.994594656	13.4
37.95	27.05	33.55	1125.6025	8.884130	5.002677	6.71	11.857	3.971821685	13.42
37.9	27.1	33.6	1128.96	8.857709	5.0176	6.72	11.907	3.94925754	13.44
37.85	27.15	33.65	1132.3225	8.831406	5.032544	6.73	11.957	3.926899523	13.46
37.8	27.2	33.7	1135.69	8.805219	5.047511	6.74	12.007	3.904744982	13.48
37.75	27.25	33.75	1139.0625	8.779149	5.0625	6.75	12.057	3.882791309	13.5
37.7	27.3	33.8	1142.44	8.753194	5.077511	6.76	12.107	3.86103594	13.52
37.65	27.35	33.85	1145.8225	8.727355	5.092544	6.77	12.157	3.839476354	13.54
37.6	27.4	33.9	1149.21	8.701629	5.1076	6.78	12.207	3.818110069	13.56
37.55	27.45	33.95	1152.6025	8.676017	5.122677	6.79	12.257	3.796934648	13.58
37.5	27.5	34	1156	8.650519	5.137777	6.8	12.307	3.775947691	13.6
37.45	27.55	34.05	1159.4025	8.625132	5.1529	6.81	12.357	3.755146839	13.62
37.4	27.6	34.1	1162.81	8.599857	5.168044	6.82	12.407	3.73452977	13.64
37.35	27.65	34.15	1166.2225	8.574693	5.183211	6.83	12.457	3.7140942	13.66
37.3	27.7	34.2	1169.64	8.549639	5.1984	6.84	12.507	3.693837884	13.68
37.25	27.75	34.25	1173.0625	8.524694	5.213611	6.85	12.557	3.67375861	13.7
37.2	27.8	34.3	1176.49	8.499859	5.228844	6.86	12.607	3.653854203	13.72
37.15	27.85	34.35	1179.9225	8.475132	5.2441	6.87	12.657	3.634122524	13.74
37.1	27.9	34.4	1183.36	8.450513	5.259377	6.88	12.707	3.614561467	13.76
37.05	27.95	34.45	1186.8025	8.426001	5.274677	6.89	12.757	3.595168958	13.78
37	28	34.5	1190.25	8.401596	5.29	6.9	12.807	3.575942957	13.8
36.95	28.05	34.55	1193.7025	8.377296	5.305344	6.91	12.857	3.556881457	13.82
36.9	28.1	34.6	1197.16	8.353102	5.320711	6.92	12.907	3.537982481	13.84
36.85	28.15	34.65	1200.6225	8.329012	5.3361	6.93	12.957	3.519244084	13.86
36.8	28.2	34.7	1204.09	8.305027	5.351511	6.94	13.007	3.500664351	13.88
36.75	28.25	34.75	1207.5625	8.281144	5.366944	6.95	13.057	3.482241395	13.9
36.7	28.3	34.8	1211.04	8.257365	5.3824	6.96	13.107	3.463973362	13.92
36.65	28.35	34.85	1214.5225	8.233688	5.397877	6.97	13.157	3.445858422	13.94
36.6	28.4	34.9	1218.01	8.210113	5.413377	6.98	13.207	3.427894776	13.96
36.55	28.45	34.95	1221.5025	8.186638	5.4289	6.99	13.257	3.410080652	13.98
36.5	28.5	35	1225	8.163265	5.444444	7	13.307	3.392414304	14
36.45	28.55	35.05	1228.5025	8.139991	5.460011	7.01	13.357	3.374894014	14.02
36.4	28.6	35.1	1232.01	8.116817	5.4756	7.02	13.407	3.357518089	14.04
36.35	28.65	35.15	1235.5225	8.093741	5.491211	7.03	13.457	3.340284861	14.06
36.3	28.7	35.2	1239.04	8.070764	5.506844	7.04	13.507	3.323192688	14.08
36.25	28.75	35.25	1242.5625	8.047884	5.5225	7.05	13.557	3.306239952	14.1
36.2	28.8	35.3	1246.09	8.025102	5.538177	7.06	13.607	3.289425061	14.12
36.15	28.85	35.35	1249.6225	8.002416	5.553877	7.07	13.657	3.272746442	14.14
36.1	28.9	35.4	1253.16	7.979826	5.5696	7.08	13.707	3.256202551	14.16
36.05	28.95	35.45	1256.7025	7.957332	5.585344	7.09	13.757	3.239791862	14.18
36	29	35.5	1260.25	7.934933	5.601111	7.1	13.807	3.223512874	14.2
35.95	29.05	35.55	1263.8025	7.912628	5.6169	7.11	13.857	3.207364108	14.22
35.9	29.1	35.6	1267.36	7.890417	5.632711	7.12	13.907	3.191344105	14.24
35.85	29.15	35.65	1270.9225	7.868300	5.648544	7.13	13.957	3.175451429	14.26

h	Ag (cir)	< 10% (cir)	n (cir)	sh (cir)	Dc (cir)	Ps (cir) > 1%	sh2 (cir)	Ag (rec)	< 10% (rec)	n (rec)	sh (rec)	hx (rec)	hy (rec)	Ps (rec) > 2.5 %	sh2 (rec)
40	779.3113	12.8318422	3.463605901	6.3	9.807	10.22916899	12.6	1000	10	4.4444444	5	3.307	18.307	11.28160405	10
39.95	781.7872	12.791203	3.474610202	6.31	9.857	10.16115234	12.62	1000.74	9.9925305	4.4477666	5.01	3.357	18.257	11.12176595	10.02
39.9	784.2671	12.7507565	3.485631956	6.32	9.907	10.09387302	12.64	1001.49	9.9851221	4.4510666	5.02	3.407	18.207	10.96675121	10.04
39.85	786.7510	12.7105016	3.496671163	6.33	9.957	10.02731969	12.66	1002.22	9.9777745	4.4543444	5.03	3.457	18.157	10.8163511	10.06
39.8	789.2387	12.6704370	3.507727824	6.34	10.007	9.961481222	12.68	1002.96	9.9704873	4.4576	5.04	3.507	18.107	10.6703688	10.08
39.75	791.7304	12.6305615	3.518801938	6.35	10.057	9.896346729	12.7	1003.68	9.9632604	4.4608333	5.05	3.557	18.057	10.52861858	10.1
39.7	794.2260	12.5908740	3.529893506	6.36	10.107	9.831905529	12.72	1004.41	9.9560936	4.4640444	5.06	3.607	18.007	10.390925	10.12
39.65	796.7255	12.5513732	3.541002526	6.37	10.157	9.768147154	12.74	1005.12	9.9489865	4.4672333	5.07	3.657	17.957	10.25712225	10.14
39.6	799.2290	12.5120581	3.552129	6.38	10.207	9.705061343	12.76	1005.84	9.9419390	4.4704	5.08	3.707	17.907	10.12705345	10.16
39.55	801.7364	12.4729273	3.563272928	6.39	10.257	9.642638037	12.78	1006.54	9.9349509	4.4735444	5.09	3.757	17.857	10.00057009	10.18
39.5	804.2477	12.4339799	3.574434308	6.4	10.307	9.580867372	12.8	1007.25	9.9280218	4.4766666	5.1	3.807	17.807	9.87753148	10.2
39.45	806.7629	12.3952146	3.585613142	6.41	10.357	9.519739677	12.82	1007.94	9.9211516	4.4797666	5.11	3.857	17.757	9.757804224	10.22
39.4	809.2821	12.3566303	3.596809429	6.42	10.407	9.45924547	12.84	1008.64	9.9143401	4.4828444	5.12	3.907	17.707	9.641261771	10.24
39.35	811.8052	12.3182259	3.60802317	6.43	10.457	9.399375447	12.86	1009.32	9.9075869	4.4859	5.13	3.957	17.657	9.527783974	10.26
39.3	814.3322	12.2800002	3.619254363	6.44	10.507	9.340120488	12.88	1010.01	9.9008920	4.4889333	5.14	4.007	17.607	9.417256692	10.28
39.25	816.8631	12.2419522	3.63050301	6.45	10.557	9.281471642	12.9	1010.68	9.8942551	4.4919444	5.15	4.057	17.557	9.309571423	10.3
39.2	819.3980	12.2040807	3.641769111	6.46	10.607	9.223420132	12.92	1011.36	9.8876760	4.4949333	5.16	4.107	17.507	9.204624957	10.32
39.15	821.9368	12.1663848	3.653052664	6.47	10.657	9.165957344	12.94	1012.02	9.8811544	4.4979	5.17	4.157	17.457	9.10231906	10.34
39.1	824.4795	12.1288632	3.664353671	6.48	10.707	9.109074829	12.96	1012.69	9.8746901	4.5008444	5.18	4.207	17.407	9.002560176	10.36
39.05	827.0262	12.0915149	3.675672131	6.49	10.757	9.052764295	12.98	1013.34	9.8682830	4.5037666	5.19	4.257	17.357	8.905259156	10.38
39	829.5768	12.0543388	3.687008045	6.5	10.807	8.997017603	13	1014	9.8619329	4.5066666	5.2	4.307	17.307	8.810331001	10.4
38.95	832.1313	12.0173340	3.698361412	6.51	10.857	8.941826767	13.02	1014.64	9.8556395	4.5095444	5.21	4.357	17.257	8.717694622	10.42
38.9	834.6897	11.9804993	3.709732232	6.52	10.907	8.88718395	13.04	1015.29	9.8494026	4.5124	5.22	4.407	17.207	8.62727262	10.44
38.85	837.2521	11.9438336	3.721120505	6.53	10.957	8.833081455	13.06	1015.92	9.8432220	4.5152333	5.23	4.457	17.157	8.53899108	10.46
38.8	839.8184	11.9073361	3.732526232	6.54	11.007	8.779511731	13.08	1016.56	9.8370976	4.5180444	5.24	4.507	17.107	8.452779375	10.48
38.75	842.3886	11.8710056	3.743949412	6.55	11.057	8.726467362	13.1	1017.18	9.8310291	4.5208333	5.25	4.557	17.057	8.368569989	10.5
38.7	844.9627	11.8348411	3.755390045	6.56	11.107	8.673941066	13.12	1017.81	9.8250164	4.5236	5.26	4.607	17.007	8.286298347	10.52
38.65	847.5408	11.7988416	3.766848131	6.57	11.157	8.621925693	13.14	1018.42	9.8190592	4.5263444	5.27	4.657	16.957	8.205902656	10.54
38.6	850.1228	11.7630061	3.778323671	6.58	11.207	8.570414225	13.16	1019.04	9.8131574	4.5290666	5.28	4.707	16.907	8.127323759	10.56
38.55	852.7087	11.7273336	3.789816664	6.59	11.257	8.519399765	13.18	1019.64	9.8073108	4.5317666	5.29	4.757	16.857	8.050504995	10.58
38.5	855.2985	11.6918231	3.801327111	6.6	11.307	8.468875542	13.2	1020.25	9.8015192	4.5344444	5.3	4.807	16.807	7.975392072	10.6
38.45	857.8923	11.6564737	3.812855011	6.61	11.357	8.418834905	13.22	1020.84	9.7957824	4.5371	5.31	4.857	16.757	7.901932943	10.62
38.4	860.4900	11.6212844	3.824400364	6.62	11.407	8.36927132	13.24	1021.44	9.7901002	4.5397333	5.32	4.907	16.707	7.830077691	10.64
38.35	863.0917	11.5862542	3.83596317	6.63	11.457	8.320178368	13.26	1022.02	9.7844725	4.5423444	5.33	4.957	16.657	7.759778424	10.66
38.3	865.6972	11.5513821	3.847543429	6.64	11.507	8.271549743	13.28	1022.61	9.7788990	4.5449333	5.34	5.007	16.607	7.690989173	10.68
38.25	868.3067	11.5166672	3.859141142	6.65	11.557	8.223379249	13.3	1023.18	9.7733797	4.5475	5.35	5.057	16.557	7.623665797	10.7
38.2	870.9201	11.4821086	3.870756308	6.66	11.607	8.175660799	13.32	1023.76	9.7679143	4.5500444	5.36	5.107	16.507	7.557765894	10.72
38.15	873.5375	11.4477053	3.882388928	6.67	11.657	8.128388409	13.34	1024.32	9.7625027	4.5525666	5.37	5.157	16.457	7.493248714	10.74
38.1	876.1587	11.4134564	3.894039001	6.68	11.707	8.081556201	13.36	1024.89	9.7571446	4.5550666	5.38	5.207	16.407	7.430075086	10.76
38.05	878.7839	11.3793609	3.905706527	6.69	11.757	8.035158395	13.38	1025.44	9.7518400	4.5575444	5.39	5.257	16.357	7.368207338	10.78
38	881.4130	11.3454180	3.917391506	6.7	11.807	7.989189312	13.4	1026	9.7465886	4.56	5.4	5.307	16.307	7.307609226	10.8
37.95	884.0461	11.3116268	3.929093939	6.71	11.857	7.94364337	13.42	1026.54	9.7413904	4.5624333	5.41	5.357	16.257	7.248245872	10.82
37.9	886.6831	11.2779863	3.940813825	6.72	11.907	7.898515079	13.44	1027.09	9.7362451	4.5648444	5.42	5.407	16.207	7.190083697	10.84
37.85	889.3240	11.2444956	3.952551164	6.73	11.957	7.853799045	13.46	1027.62	9.7311525	4.5672333	5.43	5.457	16.157	7.133090363	10.86
37.8	891.9688	11.2111539	3.964305956	6.74	12.007	7.809489964	13.48	1028.16	9.7261126	4.5696	5.44	5.507	16.107	7.077234717	10.88
37.75	894.6175	11.1779603	3.976078202	6.75	12.057	7.765582618	13.5	1028.68	9.7211252	4.5719444	5.45	5.557	16.057	7.022486737	10.9
37.7	897.2702	11.1449139	3.987867901	6.76	12.107	7.722071881	13.52	1029.21	9.7161900	4.5742666	5.46	5.607	16.007	6.968817484	10.92
37.65	899.9268	11.1120138	3.999675054	6.77	12.157	7.678952707	13.54	1029.72	9.7113071	4.5765666	5.47	5.657	15.957	6.916199051	10.94
37.6	902.5874	11.0792591	4.011499659	6.78	12.207	7.636220139	13.56	1030.24	9.7064761	4.5788444	5.48	5.707	15.907	6.864604521	10.96
37.55	905.2518	11.0466491	4.023341718	6.79	12.257	7.593869296	13.58	1030.74	9.7016970	4.5811	5.49	5.757	15.857	6.81400792	10.98
37.5	907.9202	11.0141829	4.035201231	6.8	12.307	7.551895382	13.6	1031.25	9.6969696	4.5833333	5.5	5.807	15.807	6.764384181	11
37.45	910.5925	10.9818595	4.047078196	6.81	12.357	7.510293677	13.62	1031.74	9.6922938	4.5855444	5.51	5.857	15.757	6.715709106	11.02
37.4	913.2688	10.9496783	4.058972615	6.82	12.407	7.469059539	13.64	1032.24	9.6876695	4.5877333	5.52	5.907	15.707	6.667959322	11.04
37.35	915.9490	10.9176383	4.070884487	6.83	12.457	7.4281884	13.66	1032.72	9.6830964	4.5899	5.53	5.957	15.657	6.621112256	11.06
37.3	918.6331	10.8857387	4.082813813	6.84	12.507	7.387675767	13.68	1033.21	9.6785745	4.5920444	5.54	6.007	15.607	6.575146096	11.08
37.25	921.3211	10.8539787	4.094760591	6.85	12.557	7.347517219	13.7	1033.68	9.6741036	4.5941666	5.55	6.057	15.557	6.53003976	11.1
37.2	924.0130	10.8223575	4.106724823	6.86	12.607	7.307708407	13.72	1034.16	9.6696836	4.5962666	5.56	6.107	15.507	6.485772868	11.12
37.15	926.7089	10.7908743	4.118706509	6.87	12.657	7.268245049	13.74	1034.62	9.6653143	4.5983444	5.57	6.157	15.457	6.442325715	11.14
37.1	929.4087	10.7595283	4.130705647	6.88	12.707	7.229122934	13.76	1035.09	9.6609956	4.6004	5.58	6.207	15.407	6.399679241	11.16
37.05	932.1125	10.7283186	4.142722239	6.89	12.757	7.190337915	13.78	1035.54	9.6567274	4.6024333	5.59	6.257	15.357	6.357815005	11.18
37	934.8201	10.6972446	4.154756284	6.9	12.807	7.151885914	13.8	1036	9.6525096	4.6044444	5.6	6.307	15.307	6.316715163	11.2
36.95	937.5317	10.6663054	4.166807783	6.91	12.857	7.113762914	13.82	1036.44	9.6483420	4.6064333	5.61	6.357	15.257	6.276362446	11.22
36.9	940.2472	10.6355002	4.178876735	6.92	12.907	7.075964962	13.84	1036.89	9.6442245	4.6084	5.62	6.407	15.207	6.236740132	11.24
36.85	942.9667	10.6048282	4.19096314	6.93	12.957	7.038488168	13.86	1037.32	9.6401570	4.6103444	5.63	6.457	15.157	6.197832032	11.26
36.8	945.6900	10.5742888	4.203066998	6.94	13.007	7.001328702	13.88	1037.76	9.6361393	4.6122666	5.64	6.507	15.107	6.159622464	11.28
36.75	948.4173	10.5438811	4.21518831	6.95	13.057	6.964482791	13.9	1038.18	9.6321714	4.6141666	5.65	6.557	15.057	6.122096236	11.3
36.7	951.1485	10.5136043	4.227327075	6.96	13.107	6.927946723	13.92	1038.61	9.6282531	4.6160444	5.66	6.607	15.007	6.08523863	11.32
36.65	953.8837	10.4834578	4.239483293	6.97	13.157	6.891716843	13.94	1039.02	9.6243843	4.6179	5.67	6.657	14.957	6.049035379	11.34
36.6	956.6228	10.4534408	4.251656964	6.98	13.207	6.855789552	13.96	1039.44	9.6205649	4.6197333	5.68	6.707	14.907	6.013472657	11.36
36.55	959.3658	10.4235525	4.263848089	6.99	13.257	6.820161303	13.98	1039.84	9.6167947	4.6215444	5.69	6.757	14.857	5.978537056	11.38
36.5	962.1127	10.3937922	4.276056667	7	13.307	6.784828608	14	1040.25	9.6130737	4.6233333	5.7	6.807	14.807	5.944215577	11.4
36.45	964.8636	10.3641591	4.288282699	7.01	13.357	6.749788028	14.02	1040.64	9.6094018	4.6251	5.71	6.857	14.757	5.91049561	11.42
36.4	967.6183	10.3346526	4.300526183	7.02	13.407	6.715036177	14.04	1041.04	9.6057788	4.6268444	5.72	6.907	14.707	5.877364925	11.44
36.35	970.3771	10.3052720	4.312787121	7.03	13.457	6.680569722	14.06	1041.42	9.6022046	4.6285666	5.73	6.957	14.657	5.844811655	11.46
36.3	973.1397	10.2760164	4.325065513	7.04	13.507	6.646385376	14.08	1041.81	9.5986792	4.6302666	5.74	7.007	14.607	5.812824285	11.48
36.25	975.9063	10.2468853	4.337361357	7.05	13.557	6.612479905	14.1	1042.18	9.5952023	4.6319444	5.75	7.057	14.557	5.781391638	11.5
36.2	978.6767	10.2178778	4.349674655	7.06	13.607	6.578850121	14.12	1042.56	9.5917740	4.6336	5.76	7.107	14.507	5.750502865	11.52
36.15	981.4512	10.1889934	4.362005406	7.07	13.657	6.545492884	14.14	1042.92	9.5883942	4.6352333	5.77	7.157	14.457	5.720147434	11.54
36.1	984.2295	10.1602312	4.374353611	7.08	13.707	6.512405101	14.16	1043.29	9.5850626	4.6368444	5.78	7.207	14.407	5.690315118	11.56
36.05	987.0118	10.1315907	4.386719269	7.09	13.757	6.479583724	14.18	1043.64	9.5817792	4.6384333	5.79	7.257	14.357	5.660995985	11.58
36	989.7980	10.1030711	4.39910238	7.1	13.807	6.447025748	14.2	1044	9.5785440	4.64	5.8	7.307	14.307	5.632180389	11.6
35.95	992.5881	10.0746718	4.411502944	7.11	13.857	6.414728216	14.22	1044.34	9.5753568	4.6415444	5.81	7.357	14.257	5.603858957	11.62
35.9	995.3822	10.0463920	4.423920962	7.12	13.907	6.382688211	14.24	1044.69	9.5722175	4.6430666	5.82	7.407	14.207	5.576022587	11.64
35.85	998.1801	10.0182312	4.436356433	7.13	13.957	6.350902858	14.26	1045.02	9.5691261	4.6445666	5.83	7.457	14.157	5.548662433	11.66

										6.05	58.95	65.45	4283.7025	2.334429	19.03867	8	43.757	0.9027127088	16	3364.412	2.97228751	14.95294256	8	43.757	1.805425418	16	356.647	28.038889	1.5851	1.21	37.257	-15.643	-4.84260378	2.42
										6	59	65.5	4290.25	2.330866	19.06777	8	43.807	0.9016823795	16	3369.554	2.96775140	14.97579765	8	43.807	1.803364759	16	354	28.248587	1.5733333	1.2	37.307	-15.693	-4.860877608	2.4
										5.95	59.05	65.55	4296.8025	2.327311	19.0969	8	43.857	0.9006543995	16	3374.700	2.96322566	14.99867019	8	43.857	1.801308799	16	351.347	28.461850	1.5615444	1.19	37.357	-15.743	-4.879617552	2.38
										5.9	59.1	65.6	4303.36	2.323765	19.12604	8	43.907	0.8996287608	16	3379.851	2.95871027	15.02156018	8	43.907	1.799257522	16	348.69	28.678769	1.5497333	1.18	37.407	-15.793	-4.898833869	2.36
										5.85	59.15	65.65	4309.9225	2.320227	19.15521	8	43.957	0.8986054553	16	3385.005	2.95420519	15.04446763	8	43.957	1.797210911	16	346.027	28.899437	1.5379	1.17	37.457	-15.843	-4.918537186	2.34
										5.8	59.2	65.7	4316.49	2.316697	19.1844	8	44.007	0.8975844752	16	3390.163	2.94971040	15.06739253	8	44.007	1.79516895	16	343.36	29.123951	1.5260444	1.16	37.507	-15.893	-4.938738518	2.32
										5.75	59.25	65.75	4323.0625	2.313174	19.21361	8	44.057	0.8965658125	16	3395.325	2.94522585	15.09033488	8	44.057	1.793131625	16	340.687	29.352412	1.5141666	1.15	37.557	-15.943	-4.959449284	2.3
										5.7	59.3	65.8	4329.64	2.309660	19.24284	8	44.107	0.8955494593	16	3400.491	2.94075152	15.11329469	8	44.107	1.791098919	16	338.01	29.584923	1.5022666	1.14	37.607	-15.993	-4.980681324	2.28
										5.65	59.35	65.85	4336.2225	2.306154	19.2721	8	44.157	0.8945354077	16	3405.661	2.93628739	15.13627194	8	44.157	1.789070815	16	335.327	29.821592	1.4903444	1.13	37.657	-16.043	-5.002446916	2.26
										5.6	59.4	65.9	4342.81	2.302656	19.30137	8	44.207	0.8935236501	16	3410.834	2.93183340	15.15926666	8	44.207	1.7870473	16	332.64	30.062530	1.4784	1.12	37.707	-16.093	-5.024758797	2.24
										5.55	59.45	65.95	4349.4025	2.299166	19.33067	8	44.257	0.8925141785	16	3416.012	2.92738955	15.18227882	8	44.257	1.785028357	16	329.947	30.307852	1.4664333	1.11	37.757	-16.143	-5.047630183	2.22
										5.5	59.5	66	4356	2.295684	19.36	8	44.307	0.8915069854	16	3421.194	2.92295579	15.20530844	8	44.307	1.783013971	16	327.25	30.557677	1.4544444	1.1	37.807	-16.193	-5.07107479	2.2
										5.45	59.55	66.05	4362.6025	2.292209	19.38934	8	44.357	0.8905020628	16	3426.379	2.91853210	15.22835552	8	44.357	1.781004126	16	324.547	30.812130	1.4424333	1.09	37.857	-16.243	-5.095106858	2.18
										5.4	59.6	66.1	4369.21	2.288743	19.41871	8	44.407	0.8894994032	16	3431.569	2.91411844	15.25142004	8	44.407	1.778998806	16	321.84	31.071339	1.4304	1.08	37.907	-16.293	-5.119741172	2.16
										5.35	59.65	66.15	4375.8225	2.285284	19.4481	8	44.457	0.888498999	16	3436.762	2.90971479	15.27450202	8	44.457	1.776997998	16	319.127	31.335438	1.4183444	1.07	37.957	-16.343	-5.14499309	2.14
										5.3	59.7	66.2	4382.44	2.281833	19.47751	8	44.507	0.8875008426	16	3441.960	2.90532111	15.29760145	8	44.507	1.775001685	16	316.41	31.604563	1.4062666	1.06	38.007	-16.393	-5.170878569	2.12
										5.25	59.75	66.25	4389.0625	2.278390	19.50694	8	44.557	0.8865049263	16	3447.161	2.90093737	15.32071834	8	44.557	1.773009853	16	313.687	31.878860	1.3941666	1.05	38.057	-16.443	-5.197414192	2.1
										5.2	59.8	66.3	4395.69	2.274955	19.5364	8	44.607	0.8855112426	16	3452.366	2.89656355	15.34385268	8	44.607	1.771022485	16	310.96	32.158476	1.3820444	1.04	38.107	-16.493	-5.2246172	2.08
										5.15	59.85	66.35	4402.3225	2.271528	19.56587	8	44.657	0.8845197841	16	3457.576	2.89219961	15.36700447	8	44.657	1.769039568	16	308.227	32.443568	1.3699	1.03	38.157	-16.543	-5.252505521	2.06
										5.1	59.9	66.4	4408.96	2.268108	19.59537	8	44.707	0.8835305433	16	3462.789	2.88784553	15.39017372	8	44.707	1.767061087	16	305.49	32.734295	1.3577333	1.02	38.207	-16.593	-5.281097807	2.04
										5.05	59.95	66.45	4415.6025	2.264696	19.6249	8	44.757	0.8825435127	16	3468.006	2.88350127	15.41336042	8	44.757	1.765087025	16	302.747	33.030826	1.3455444	1.01	38.257	-16.643	-5.310413464	2.02
										5	60	66.5	4422.25	2.261292	19.65444	8	44.807	0.881558685	16	3473.227	2.87916681	15.43656457	8	44.807	1.76311737	16	300	33.333333	1.3333333	1	38.307	-16.693	-5.340472696	2
										4.95	60.05	66.55	4428.9025	2.257895	19.68401	8	44.857	0.8805760528	16	3478.451	2.87484211	15.45978617	8	44.857	1.761152106	16	297.247	33.641998	1.3211	0.99	38.357	-16.743	-5.37129654	1.98
										4.9	60.1	66.6	4435.56	2.254506	19.7136	8	44.907	0.8795956087	16	3483.680	2.87052715	15.48302523	8	44.907	1.759191217	16	294.49	33.957010	1.3088444	0.98	38.407	-16.793	-5.402906911	1.96
										4.85	60.15	66.65	4442.2225	2.251125	19.74321	8	44.957	0.8786173455	16	3488.913	2.86622190	15.50628175	8	44.957	1.757234691	16	291.727	34.278564	1.2965666	0.97	38.457	-16.843	-5.435326646	1.94
										4.8	60.2	66.7	4448.89	2.247751	19.77284	8	45.007	0.8776412558	16	3494.150	2.86192633	15.52955571	8	45.007	1.755282512	16	288.96	34.606866	1.2842666	0.96	38.507	-16.893	-5.468579549	1.92
										4.75	60.25	66.75	4455.5625	2.244385	19.8025	8	45.057	0.8766673325	16	3499.390	2.85764041	15.55284713	8	45.057	1.753334665	16	286.187	34.942127	1.2719444	0.95	38.557	-16.943	-5.502690449	1.9
										4.7	60.3	66.8	4462.24	2.241026	19.83217	8	45.107	0.8756955683	16	3504.635	2.85336410	15.576156	8	45.107	1.751391137	16	283.41	35.284570	1.2596	0.94	38.607	-16.993	-5.537685246	1.88
										4.65	60.35	66.85	4468.9225	2.237675	19.86187	8	45.157	0.8747259561	16	3509.883	2.84909739	15.59948233	8	45.157	1.749451912	16	280.627	35.634426	1.2472333	0.93	38.657	-17.043	-5.573590974	1.86
										4.6	60.4	66.9	4475.61	2.234332	19.8916	8	45.207	0.8737584887	16	3515.135	2.84484024	15.62282611	8	45.207	1.747516977	16	277.84	35.991937	1.2348444	0.92	38.707	-17.093	-5.610435858	1.84
										4.55	60.45	66.95	4482.3025	2.230996	19.92134	8	45.257	0.8727931591	16	3520.392	2.84059263	15.64618734	8	45.257	1.745586318	16	275.047	36.357356	1.2224333	0.91	38.757	-17.143	-5.648249385	1.82
										4.5	60.5	67	4489	2.227667	19.95111	8	45.307	0.8718299601	16	3525.652	2.83635452	15.66956602	8	45.307	1.74365992	16	272.25	36.730945	1.21	0.9	38.807	-17.193	-5.687062366	1.8
										4.45	60.55	67.05	4495.7025	2.224346	19.9809	8	45.357	0.8708688846	16	3530.916	2.83212589	15.69296216	8	45.357	1.741737769	16	269.447	37.112981	1.1975444	0.89	38.857	-17.243	-5.726907017	1.78
										4.4	60.6	67.1	4502.41	2.221032	20.01071	8	45.407	0.8699099258	16	3536.184	2.82790670	15.71637575	8	45.407	1.739819852	16	266.64	37.503750	1.1850666	0.88	38.907	-17.293	-5.767817037	1.76
										4.35	60.65	67.15	4509.1225	2.217726	20.04054	8	45.457	0.8689530765	16	3541.456	2.82369694	15.7398068	8	45.457	1.737906153	16	263.827	37.903554	1.1725666	0.87	38.957	-17.343	-5.809827689	1.74
										4.3	60.7	67.2	4515.84	2.214427	20.0704	8	45.507	0.8679983299	16	3546.732	2.81949658	15.7632553	8	45.507	1.73599666	16	261.05	38.312708	1.1600444	0.86	39.007	-17.393	-5.852975896	1.72
										4.25	60.75	67.25	4522.5625	2.211135	20.10027	8	45.557	0.867045679	16	3552.012	2.81530558	15.78672125	8	45.557	1.734091358	16	258.187	38.731542	1.1475	0.85	39.057	-17.443	-5.897300335	1.7
										4.2	60.8	67.3	4529.29	2.207851	20.13017	8	45.607	0.866095117	16	3557.296	2.81112391	15.81020466	8	45.607	1.732190234	16	255.36	39.160401	1.1349333	0.84	39.107	-17.493	-5.942841542	1.68
										4.15	60.85	67.35	4536.0225	2.204574	20.1601	8	45.657	0.8651466369	16	3562.583	2.80695156	15.83370551	8	45.657	1.730293274	16	252.527	39.599647	1.1223444	0.83	39.157	-17.543	-5.989642025	1.66
										4.1	60.9	67.4	4542.76	2.201304	20.19004	8	45.707	0.8642002319	16	3567.875	2.80278849	15.85722383	8	45.707	1.728400464	16	249.69	40.049661	1.1097333	0.82	39.207	-17.593	-6.037746382	1.64
										4.05	60.95	67.45	4549.5025	2.198042	20.22001	8	45.757	0.8632558953	16	3573.170	2.79863467	15.88075959	8	45.757	1.726511791	16	246.847	40.510841	1.0971	0.81	39.257	-17.643	-6.08720143	1.62
										4	61	67.5	4556.25	2.194787	20.25	8	45.807	0.8623136202	16	3578.470	2.79449008	15.90431281	8	45.807	1.72462724	16	244	40.983606	1.0844444	0.8	39.307	-17.693	-6.138056346	1.6
										3.95	61.05	67.55	4563.0025	2.191539	20.28001	8	45.857	0.8613733999	16	3583.773	2.79035469	15.92788348	8	45.857	1.7227468	16	241.147	41.468395	1.0717666	0.79	39.357	-17.743	-6.190362813	1.58
										3.9	61.1	67.6	4569.76	2.188298	20.31004	8	45.907	0.8604352277	16	3589.081	2.78622847	15.95147161	8	45.907	1.720870455	16	238.29	41.965672	1.0590666	0.78	39.407	-17.793	-6.244175181	1.56
										3.85	61.15	67.65	4576.5225	2.185065	20.3401	8	45.957	0.859499097	16	3594.392	2.78211140	15.97507718	8	45.957	1.718998194	16	235.427	42.475921	1.0463444	0.77	39.457	-17.843	-6.299550642	1.54
										3.8	61.2	67.7	4583.29	2.181838	20.37017	8	46.007	0.858565001	16	3599.707	2.77800345	15.99870021	8	46.007	1.717130002	16	232.56	42.999656	1.0336	0.76	39.507	-17.893	-6.356549415	1.52
										3.75	61.25	67.75	4590.0625	2.178619	20.40027	8	46.057	0.8576329331	16	3605.026	2.77390459	16.0223407	8	46.057	1.715265866	16	229.687	43.537414	1.0208333	0.75	39.557	-17.943	-6.415234946	1.5
										3.7	61.3	67.8	4596.84	2.175407	20.4304	8	46.107	0.8567028868	16	3610.349	2.76981479	16.04599864	8	46.107	1.713405774	16	226.81	44.089766	1.0080444	0.74	39.607	-17.993	-6.475674131	1.48
										3.65	61.35	67.85	4603.6225	2.172202	20.46054	8	46.157	0.8557748554	16	3615.676	2.76573403	16.06967403	8	46.157	1.711549711	16	223.927	44.657310	0.9952333	0.73	39.657	-18.043	-6.537937544	1.46
										3.6	61.4	67.9	4610.41	2.169004	20.49071	8	46.207	0.8548488324	16	3621.007	2.76166229	16.09336687	8	46.207	1.709697665	16	221.04	45.240680	0.9824	0.72	39.707	-18.093	-6.602099702	1.44
										3.55	61.45	67.95	4617.2025	2.165813	20.5209	8	46.257	0.8539248114	16	3626.342	2.75759953	16.11707717	8	46.257	1.707849623	16	218.147	45.840543	0.9695444	0.71	39.757	-18.143	-6.668239334	1.42
										3.5	61.5	68	4624	2.162629	20.55111	8	46.307	0.8530027858	16	3631.681	2.75354572	16.14080492	8	46.307	1.706005572	16	215.25	46.457607	0.9566666	0.7	39.807	-18.193	-6.736439686	1.4
										3.45	61.55	68.05	4630.8025	2.159452	20.58134	8	46.357	0.8520827491	16	3637.023	2.74950085	16.16455013	8	46.357	1.704165498	16	212.347	47.092619	0.9437666	0.69	39.857	-18.243	-6.806788847	1.38
										3.4	61.6	68.1	4637.61	2.156283	20.6116	8	46.407	0.851164695	16	3642.370	2.74546489	16.18831278	8	46.407	1.70232939	16	209.44	47.746371	0.9308444	0.68	39.907	-18.293	-6.879380103	1.36
										3.35	61.65	68.15	4644.4225	2.153120	20.64187	8	46.457	0.850248617	16	3647.720	2.74143781	16.2120929	8	46.457	1.700497234	16	206.527	48.419701	0.9179	0.67	39.957	-18.343	-6.95431233	1.34
										3.3	61.7	68.2	4651.24	2.149964	20.67217	8	46.507	0.8493345018	16	3653.075	2.73741958	16.23589046	8	46.507	1.698669018	16	203.61	49.113501	0.9049333	0.66	40.007	-18.393	-7.031690411	1.32
										3.25	61.75	68.25	4658.0625	2.146815	20.7025	8	46.557	0.848422364	16	3658.433	2.73341017	16.25970548	8	46.557	1.696844728	16	200.687	49.828713	0.8919444	0.65	40.057	-18.443	-7.1116257	1.3
										3.2	61.8	68.3	4664.89	2.143673	20.73284	8	46.607	0.8475121763	16	3663.796	2.72940957	16.28353795	8	46.607	1.695024353	16	197.76	50.566343	0.8789333	0.64	40.107	-18.493	-7.194236532	1.28
										3.15	61.85	68.35	4671.7225	2.140538	20.76321	8	46.657	0.8466039394	16	3669.162	2.72541775	16.30738787	8	46.657	1.693207879	16	194.827	51.327456	0.8659	0.63	40.157	-18.543	-7.279648767	1.26
										3.1	61.9	68.4	4678.56	2.137409	20.7936	8	46.707	0.845697647	16	3674.532	2.72143468	16.33125525	8	46.707	1.691395294	16	191.89	52.113189	0.8528444	0.62	40.207	-18.593	-7.367996406	1.24
										3.05	61.95	68.45	4685.4025	2.134288	20.82401	8	46.757	0.844793293	16	3679.906	2.71746033	16.35514008	8	46.757	1.689586586	16	188.947	52.924754	0.8397666	0.61	40.257	-18.643	-7.459422254	1.22
										3	62	68.5	4692.25	2.131173	20.85444	8	46.807	0.843890871	16	3685.284	2.71349468	16.37904237	8	46.807	1.687781742	16	186	53.763440	0.8266666	0.6	40.307	-18.693	-7.554078653	1.2
										2.95	62.05	68.55	4699.1025	2.128065	20.8849	8	46.857	0.842990375	16	3690.666	2.70953771	16.4029621	8	46.857	1.68598075	16	183.047	54.630628	0.8135444	0.59	40.357	-18.743	-7.652128289	1.18
										2.9	62.1	68.6	4705.96	2.124964	20.91537	8	46.907	0.8420917987	16	3696.052	2.70558939	16.42689929	8	46.907	1.684183597	16	180.09	55.527791	0.8004	0.58	40.407	-18.793	-7.753745089	1.16
										2.85	62.15	68.65	4712.8225	2.121870	20.94587	8	46.957	0.841195136	16	3701.442	2.70164969	16.45085394	8	46.957	1.682390272	16	177.127	56.456507	0.7872333	0.57	40.457	-18.843	-7.859115201	1.14
										2.8	62.2	68.7	4719.69	2.118783	20.9764	8	47.007	0.8403003808	16	3706.835	2.69771858	16.47482603	8	47.007	1.680600762	16	174.16	57.418465	0.7740444	0.56	40.507	-18.893	-7.968438086	1.12
										2.75	62.25	68.75	4726.5625	2.115702	21.00694	8	47.057	0.839407527	16	3712.233	2.69379606	16.49881559	8	47.057	1.678815054	16	171.187	58.415480	0.7608333	0.55	40.557	-18.943	-8.08192773	1.1
										2.7	62.3	68.8	4733.44	2.112628	21.03751	8	47.107	0.8385165687	16	3717.635	2.68988208	16.52282259	8	47.107	1.677033137	16	168.21	59.449497	0.7476	0.54	40.607	-18.993	-8.199813987	1.08
										2.65	62.35	68.85	4740.3225	2.109561	21.0681	8	47.157	0.8376274996	16	3723.040	2.68597662	16.54684705	8	47.157	1.675254999	16	165.227	60.522612	0.7343444	0.53	40.657	-19.043	-8.322344079	1.06
										2.6	62.4	68.9	4747.21	2.106500	21.09871	8	47.207	0.8367403139	16	3728.450	2.68207967	16.57088896	8	47.207	1.673480628	16	162.24	61.637080	0.7210666	0.52	40.707	-19.093	-8.449784261	1.04
										2.55	62.45	68.95	4754.1025	2.103446	21.12934	8	47.257	0.8358550056	16	3733.863	2.67819119	16.59494832	8	47.257	1.671710011	16	159.247	62.795334	0.7077666	0.51	40.757	-19.143	-8.582421687	1.02
										2.5	62.5	69	4761	2.100399	21.16	8	47.307	0.8349715687	16	3739.280	2.67431116	16.61902514	8	47.307	1.669943137	16	156.25	64	0.6944444	0.5	40.807	-19.193	-8.720566504	1
										2.45	62.55	69.05	4767.9025	2.097358	21.19067	8	47.357	0.8340899973	16	3744.701	2.67043955	16.64311941	8	47.357	1.668179995	16	153.247	65.253919	0.6811	0.49	40.857	-19.243	-8.864554197	0.98
										2.4	62.6	69.1	4774.81	2.094324	21.22137	8	47.407	0.8332102854	16	3750.127	2.66657635	16.66723113	8	47.407	1.666420571	16	150.24	66.560170	0.6677333	0.48	40.907	-19.293	-9.014748223	0.96
										2.35	62.65	69.15	4781.7225	2.091296	21.2521	8	47.457	0.8323324272	16	3755.556	2.66272152	16.69136031	8	47.457	1.664664854	16	147.227	67.922093	0.6543444	0.47	40.957	-19.343	-9.171542993	0.94
										2.3	62.7	69.2	4788.64	2.088275	21.28284	8	47.507	0.8314564169	16	3760.989	2.65887505	16.71550694	8	47.507	1.662912834	16	144.21	69.343318	0.6409333	0.46	41.007	-19.393	-9.335367231	0.92
										2.25	62.75	69.25	4795.5625	2.085261	21.31361	8	47.557	0.8305822487	16	3766.425	2.65503691	16.73967102	8	47.557	1.661164497	16	141.187	70.827799	0.6275	0.45	41.057	-19.443	-9.506687791	0.9
										2.2	62.8	69.3	4802.49	2.082253	21.3444	8	47.607	0.8297099166	16	3771.866	2.65120707	16.76385256	8	47.607	1.659419833	16	138.16	72.379849	0.6140444	0.44	41.107	-19.493	-9.686013986	0.88
										2.15	62.85	69.35	4809.4225	2.079251	21.37521	8	47.657	0.828839415	16	3777.311	2.64738551	16.78805156	8	47.657	1.65767883	16	135.127	74.004181	0.6005666	0.43	41.157	-19.543	-9.873902527	0.86
										2.1	62.9	69.4	4816.36	2.076256	21.40604	8	47.707	0.827970738	16	3782.760	2.64357221	16.81226799	8	47.707	1.655941476	16	132.09	75.705958	0.5870666	0.42	41.207	-19.593	-10.07096317	0.84
										2.05	62.95	69.45	4823.3025	2.073268	21.4369	8	47.757	0.8271038801	16	3788.212	2.63976714	16.83650189	8	47.757	1.65420776	16	129.047	77.490846	0.5735444	0.41	41.257	-19.643	-10.27786516	0.82
										2	63	69.5	4830.25	2.070286	21.46777	8	47.807	0.8262388353	16	3793.669	2.63597028	16.86075324	8	47.807	1.652477671	16	126	79.365079	0.56	0.4	41.307	-19.693	-10.49534471	0.8
										1.95	63.05	69.55	4837.2025	2.067310	21.49867	8	47.857	0.8253755981	16	3799.129	2.63218160	16.88502204	8	47.857	1.650751196	16	122.947	81.335529	0.5464333	0.39	41.357	-19.743	-10.72421355	0.78
										1.9	63.1	69.6	4844.16	2.064341	21.5296	8	47.907	0.8245141629	16	3804.594	2.62840109	16.9093083	8	47.907	1.649028326	16	119.89	83.409792	0.5328444	0.38	41.407	-19.793	-10.96536889	0.76
										1.85	63.15	69.65	4851.1225	2.061378	21.56054	8	47.957	0.8236545238	16	3810.062	2.62462872	16.93361201	8	47.957	1.647309048	16	116.827	85.596285	0.5192333	0.37	41.457	-19.843	-11.21980493	0.74

1.8	63.2	69.7	4858.09	2.058422	21.59151	8	48.007	0.8227966755	16	3815.534	2.62086446	16.95793317	8	48.007	1.645593351	16	113.76	87.904360	0.5056	0.36	41.507	-19.893	-11.48862637	0.72
1.75	63.25	69.75	4865.0625	2.055472	21.6225	8	48.057	0.8219406122	16	3821.011	2.6171083	16.98227179	8	48.057	1.643881224	16	110.687	90.344438	0.4919444	0.35	41.557	-19.943	-11.7730642	0.7
1.7	63.3	69.8	4872.04	2.052528	21.65351	8	48.107	0.8210863284	16	3826.491	2.61336020	17.00662786	8	48.107	1.642172657	16	107.61	92.928166	0.4782666	0.34	41.607	-19.993	-12.07449423	0.68
1.65	63.35	69.85	4879.0225	2.049590	21.68454	8	48.157	0.8202338186	16	3831.975	2.60962015	17.03100138	8	48.157	1.640467637	16	104.527	95.668603	0.4645666	0.33	41.657	-20.043	-12.39445906	0.66
1.6	63.4	69.9	4886.01	2.046659	21.7156	8	48.207	0.8193830771	16	3837.463	2.60588812	17.05539236	8	48.207	1.638766154	16	101.44	98.580441	0.4508444	0.32	41.707	-20.093	-12.73469417	0.64
1.55	63.45	69.95	4893.0025	2.043734	21.74667	8	48.257	0.8185340987	16	3842.955	2.6021641	17.07980079	8	48.257	1.637068197	16	98.3475	101.68026	0.4371	0.31	41.757	-20.143	-13.09715894	0.62
1.5	63.5	70	4900	2.040816	21.77777	8	48.307	0.8176868777	16	3848.451	2.59844805	17.10422667	8	48.307	1.635373755	16	95.25	104.98687	0.4233333	0.3	41.807	-20.193	-13.48407408	0.6
1.45	63.55	70.05	4907.0025	2.037903	21.8089	8	48.357	0.8168414087	16	3853.950	2.59473995	17.12867001	8	48.357	1.633682817	16	92.1475	108.52166	0.4095444	0.29	41.857	-20.243	-13.89796658	0.58
1.4	63.6	70.1	4914.01	2.034997	21.84004	8	48.407	0.8159976863	16	3859.454	2.59103979	17.1531308	8	48.407	1.631995373	16	89.04	112.30907	0.3957333	0.28	41.907	-20.293	-14.34172449	0.56
1.35	63.65	70.15	4921.0225	2.032098	21.87121	8	48.457	0.8151557051	16	3864.962	2.58734753	17.17760904	8	48.457	1.63031141	16	85.9275	116.37717	0.3819	0.27	41.957	-20.343	-14.81866373	0.54
1.3	63.7	70.2	4928.04	2.029204	21.9024	8	48.507	0.8143154596	16	3870.473	2.58366317	17.20210473	8	48.507	1.628630919	16	82.81	120.75836	0.3680444	0.26	42.007	-20.393	-15.33261039	0.52
1.25	63.75	70.25	4935.0625	2.026316	21.93361	8	48.557	0.8134769446	16	3875.989	2.57998666	17.22661788	8	48.557	1.626953889	16	79.6875	125.49019	0.3541666	0.25	42.057	-20.443	-15.88800275	0.5
1.2	63.8	70.3	4942.09	2.023435	21.96484	8	48.607	0.8126401547	16	3881.508	2.57631800	17.25114849	8	48.607	1.625280309	16	76.56	130.61650	0.3402666	0.24	42.107	-20.493	-16.49001885	0.48
1.15	63.85	70.35	4949.1225	2.020560	21.9961	8	48.657	0.8118050846	16	3887.031	2.57265716	17.27569654	8	48.657	1.623610169	16	73.4275	136.18875	0.3263444	0.23	42.157	-20.543	-17.14473726	0.46
1.1	63.9	70.4	4956.16	2.017691	22.02737	8	48.707	0.8109717289	16	3892.558	2.56900411	17.30026205	8	48.707	1.621943458	16	70.29	142.26774	0.3124	0.22	42.207	-20.593	-17.85934181	0.44
1.05	63.95	70.45	4963.2025	2.014828	22.05867	8	48.757	0.8101400824	16	3898.090	2.56535884	17.32484501	8	48.757	1.620280165	16	67.1475	148.92587	0.2984333	0.21	42.257	-20.643	-18.64238468	0.42
1	64	70.5	4970.25	2.011971	22.09	8	48.807	0.8093101399	16	3903.625	2.56172133	17.34944543	8	48.807	1.61862028	16	64	156.25	0.2844444	0.2	42.307	-20.693	-19.50412853	0.4
0.95	64.05	70.55	4977.3025	2.009120	22.12134	8	48.857	0.8084818961	16	3909.164	2.55809154	17.3740633	8	48.857	1.616963792	16	60.8475	164.34528	0.2704333	0.19	42.357	-20.743	-20.45699659	0.38
0.9	64.1	70.6	4984.36	2.006275	22.15271	8	48.907	0.8076553459	16	3914.707	2.55446947	17.39869862	8	48.907	1.615310692	16	57.69	173.34026	0.2564	0.18	42.407	-20.793	-21.51617288	0.36
0.85	64.15	70.65	4991.4225	2.003436	22.1841	8	48.957	0.8068304839	16	3920.254	2.55085508	17.4233514	8	48.957	1.613660968	16	54.5275	183.39370	0.2423444	0.17	42.457	-20.843	-22.70041414	0.34
0.8	64.2	70.7	4998.49	2.000604	22.21551	8	49.007	0.8060073051	16	3925.804	2.54724835	17.44802163	8	49.007	1.61201461	16	51.36	194.70404	0.2282666	0.16	42.507	-20.893	-24.03316633	0.32
0.75	64.25	70.75	5005.5625	1.997777	22.24694	8	49.057	0.8051858043	16	3931.359	2.54364928	17.47270931	8	49.057	1.610371609	16	48.1875	207.52269	0.2141666	0.15	42.557	-20.943	-25.54412772	0.3
0.7	64.3	70.8	5012.64	1.994956	22.2784	8	49.107	0.8043659763	16	3936.918	2.54005782	17.49741444	8	49.107	1.608731953	16	45.01	222.17285	0.2000444	0.14	42.607	-20.993	-27.27148183	0.28
0.65	64.35	70.85	5019.7225	1.992141	22.30987	8	49.157	0.8035478162	16	3942.480	2.53647396	17.52213703	8	49.157	1.607095632	16	41.8275	239.07716	0.1859	0.13	42.657	-21.043	-29.265161	0.26
0.6	64.4	70.9	5026.81	1.989333	22.34137	8	49.207	0.8027313187	16	3948.047	2.53289769	17.54687707	8	49.207	1.605462637	16	38.64	258.79917	0.1717333	0.12	42.707	-21.093	-31.59174174	0.24
0.55	64.45	70.95	5033.9025	1.986530	22.3729	8	49.257	0.8019164789	16	3953.617	2.52932897	17.57163457	8	49.257	1.603832958	16	35.4475	282.10734	0.1575444	0.11	42.757	-21.143	-34.34201024	0.22
0.5	64.5	71	5041	1.983733	22.40444	8	49.307	0.8011032916	16	3959.192	2.52576779	17.59640952	8	49.307	1.602206583	16	32.25	310.07751	0.1433333	0.1	42.807	-21.193	-37.64306722	0.2
0.45	64.55	71.05	5048.1025	1.980942	22.43601	8	49.357	0.8002917519	16	3964.770	2.52221412	17.62120192	8	49.357	1.600583504	16	29.0475	344.26370	0.1291	0.09	42.857	-21.243	-41.67850269	0.18
0.4	64.6	71.1	5055.21	1.978157	22.4676	8	49.407	0.7994818548	16	3970.352	2.51866795	17.64601178	8	49.407	1.59896371	16	25.84	386.99690	0.1148444	0.08	42.907	-21.293	-46.72370171	0.16
0.35	64.65	71.15	5062.3225	1.975377	22.49921	8	49.457	0.7986735952	16	3975.938	2.51512926	17.67083908	8	49.457	1.59734719	16	22.6275	441.94011	0.1005666	0.07	42.957	-21.343	-53.21141231	0.14
0.3	64.7	71.2	5069.44	1.972604	22.53084	8	49.507	0.7978669683	16	3981.528	2.51159801	17.69568385	8	49.507	1.595733937	16	19.41	515.19835	0.0862666	0.06	43.007	-21.393	-61.86288129	0.12
0.25	64.75	71.25	5076.5625	1.969836	22.5625	8	49.557	0.797061969	16	3987.122	2.50807420	17.72054606	8	49.557	1.594123938	16	16.1875	617.76061	0.0719444	0.05	43.057	-21.443	-73.97635302	0.1
0.2	64.8	71.3	5083.69	1.967075	22.59417	8	49.607	0.7962585925	16	3992.720	2.50455780	17.74542573	8	49.607	1.592517185	16	12.96	771.60493	0.0576	0.04	43.107	-21.493	-92.14831634	0.08
0.15	64.85	71.35	5090.8225	1.964319	22.62587	8	49.657	0.7954568339	16	3998.322	2.50104878	17.77032285	8	49.657	1.590913668	16	9.7275	1028.0133	0.0432333	0.03	43.157	-21.543	-122.4372454	0.06
0.1	64.9	71.4	5097.96	1.961568	22.6576	8	49.707	0.7946566882	16	4003.928	2.49754714	17.79523743	8	49.707	1.589313376	16	6.49	1540.8320	0.0288444	0.02	43.207	-21.593	-183.0185629	0.04
0.05	64.95	71.45	5105.1025	1.958824	22.68934	8	49.757	0.7938581506	16	4009.538	2.49405285	17.82016946	8	49.757	1.587716301	16	3.2475	3079.2917	0.0144333	0.01	43.257	-21.643	-364.7693826	0.02
0	65	71.5	5112.25	1.956085	22.72111	8	49.807	0.7930612163	16	4015.151	2.49056588	17.84511894	8	49.807	1.586122433	16	0.00000	444597973	0	0	43.307	-21.693	-525249148723	0
-0.05	65.05	71.55	5119.4025	1.953352	22.7529	8	49.857	0.7922658804	16	4020.769	2.48708622	17.87008587	8	49.857	1.584531761	16	-3.2525	-3074.5580	-0.0144555	-0.00999	43.357	-21.743	362.2542954	-0.025
-0.1	65.1	71.6	5126.56	1.950625	22.78471	8	49.907	0.7914721382	16	4026.390	2.48361385	17.89507026	8	49.907	1.582944276	16	-6.51	-1536.0983	-0.0289333	-0.02	43.407	-21.793	180.5034255	-0.05
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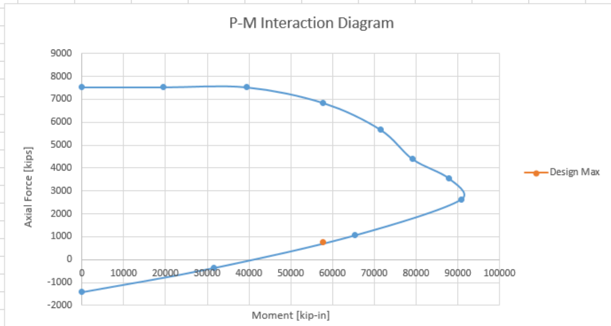
-3.35	68.35	74.85	5602.5225	1.784910	24.9001	8	53.157	0.7430818142	16	4400.210	2.27261835	19.55649281	8	53.157	1.486163628	16	-228.97	-43.673366	-1.0176555	-0.67	46.657	-25.043	4.362287325	-1.675
-3.4	68.4	74.9	5610.01	1.782528	24.93337	8	53.207	0.742383521	16	4406.091	2.26958516	19.58262911	8	53.207	1.484767042	16	-232.56	-42.999656	-1.0336	-0.68	46.707	-25.093	4.284979627	-1.7
-3.45	68.45	74.95	5617.5025	1.780150	24.96667	8	53.257	0.7416865389	16	4411.976	2.26655803	19.60878287	8	53.257	1.483373078	16	-236.15	-42.345518	-1.0495666	-0.69	46.757	-25.143	4.20997396	-1.725
-3.5	68.5	75	5625	1.777777	25	8	53.307	0.7409908642	16	4417.864	2.26353696	19.63495408	8	53.307	1.481981728	16	-239.75	-41.710114	-1.0655555	-0.7	46.807	-25.193	4.137171275	-1.75
-3.55	68.55	75.05	5632.5025	1.775409	25.03334	8	53.357	0.7402964934	16	4423.757	2.26052193	19.66114275	8	53.357	1.480592987	16	-243.35	-41.092653	-1.0815666	-0.71	46.857	-25.243	4.066478107	-1.775
-3.6	68.6	75.1	5640.01	1.773046	25.06671	8	53.407	0.7396034228	16	4429.653	2.25751292	19.68734887	8	53.407	1.479206846	16	-246.96	-40.492387	-1.0976	-0.72	46.907	-25.293	3.997806186	-1.8
-3.65	68.65	75.15	5647.5225	1.770687	25.1001	8	53.457	0.7389116486	16	4435.553	2.25450991	19.71357244	8	53.457	1.477823297	16	-250.57	-39.908609	-1.1136555	-0.73	46.957	-25.343	3.931072084	-1.825
-3.7	68.7	75.2	5655.04	1.768334	25.13351	8	53.507	0.7382211673	16	4441.458	2.25151288	19.73981347	8	53.507	1.476442335	16	-254.19	-39.340650	-1.1297333	-0.74	47.007	-25.393	3.866196883	-1.85
-3.75	68.75	75.25	5662.5625	1.765984	25.16694	8	53.557	0.7375319753	16	4447.366	2.24852183	19.76607194	8	53.557	1.475063951	16	-257.81	-38.787878	-1.1458333	-0.75	47.057	-25.443	3.803105879	-1.875
-3.8	68.8	75.3	5670.09	1.763640	25.2004	8	53.607	0.7368440689	16	4453.278	2.24553674	19.79234788	8	53.607	1.473688138	16	-261.44	-38.249694	-1.1619555	-0.76	47.107	-25.493	3.7417283	-1.9
-3.85	68.85	75.35	5677.6225	1.761300	25.23387	8	53.657	0.7361574445	16	4459.194	2.24255759	19.81864126	8	53.657	1.472314889	16	-265.07	-37.725527	-1.1781	-0.77	47.157	-25.543	3.681997056	-1.925
-3.9	68.9	75.4	5685.16	1.758965	25.26737	8	53.707	0.7354720986	16	4465.114	2.23958436	19.8449521	8	53.707	1.470944197	16	-268.71	-37.214841	-1.1942666	-0.78	47.207	-25.593	3.623848497	-1.95
-3.95	68.95	75.45	5692.7025	1.756634	25.3009	8	53.757	0.7347880276	16	4471.038	2.23661704	19.87128039	8	53.757	1.469576055	16	-272.35	-36.717122	-1.2104555	-0.79	47.257	-25.643	3.567222203	-1.975
-4	69	75.5	5700.25	1.754309	25.33444	8	53.807	0.7341052279	16	4476.965	2.23365562	19.89762614	8	53.807	1.468210456	16	-276	-36.231884	-1.2266666	-0.8	47.307	-25.693	3.512060773	-2
-4.05	69.05	75.55	5707.8025	1.751987	25.36801	8	53.857	0.7334236961	16	4482.897	2.23070007	19.92398934	8	53.857	1.466847392	16	-279.65	-35.758664	-1.2429	-0.81	47.357	-25.743	3.458309645	-2.025
-4.1	69.1	75.6	5715.36	1.749671	25.4016	8	53.907	0.7327434285	16	4488.833	2.22775038	19.95036999	8	53.907	1.465486857	16	-283.31	-35.297024	-1.2591555	-0.82	47.407	-25.793	3.405916922	-2.05
-4.15	69.15	75.65	5722.9225	1.747358	25.43521	8	53.957	0.7320644217	16	4494.772	2.22480654	19.97676809	8	53.957	1.464128843	16	-286.97	-34.846544	-1.2754333	-0.83	47.457	-25.843	3.354833209	-2.075
-4.2	69.2	75.7	5730.49	1.745051	25.46884	8	54.007	0.7313866721	16	4500.716	2.22186854	20.00318365	8	54.007	1.462773344	16	-290.64	-34.406826	-1.2917333	-0.84	47.507	-25.893	3.305011466	-2.1
-4.25	69.25	75.75	5738.0625	1.742748	25.5025	8	54.057	0.7307101763	16	4506.663	2.21893634	20.02961666	8	54.057	1.461420353	16	-294.31	-33.977489	-1.3080555	-0.85	47.557	-25.943	3.256406869	-2.125
-4.3	69.3	75.8	5745.64	1.740450	25.53617	8	54.107	0.7300349308	16	4512.615	2.21600995	20.05606713	8	54.107	1.460069862	16	-297.99	-33.558173	-1.3244	-0.86	47.607	-25.993	3.208976681	-2.15
-4.35	69.35	75.85	5753.2225	1.738156	25.56987	8	54.157	0.7293609321	16	4518.570	2.21308935	20.08253504	8	54.157	1.458721864	16	-301.67	-33.148530	-1.3407666	-0.87	47.657	-26.043	3.162680133	-2.175

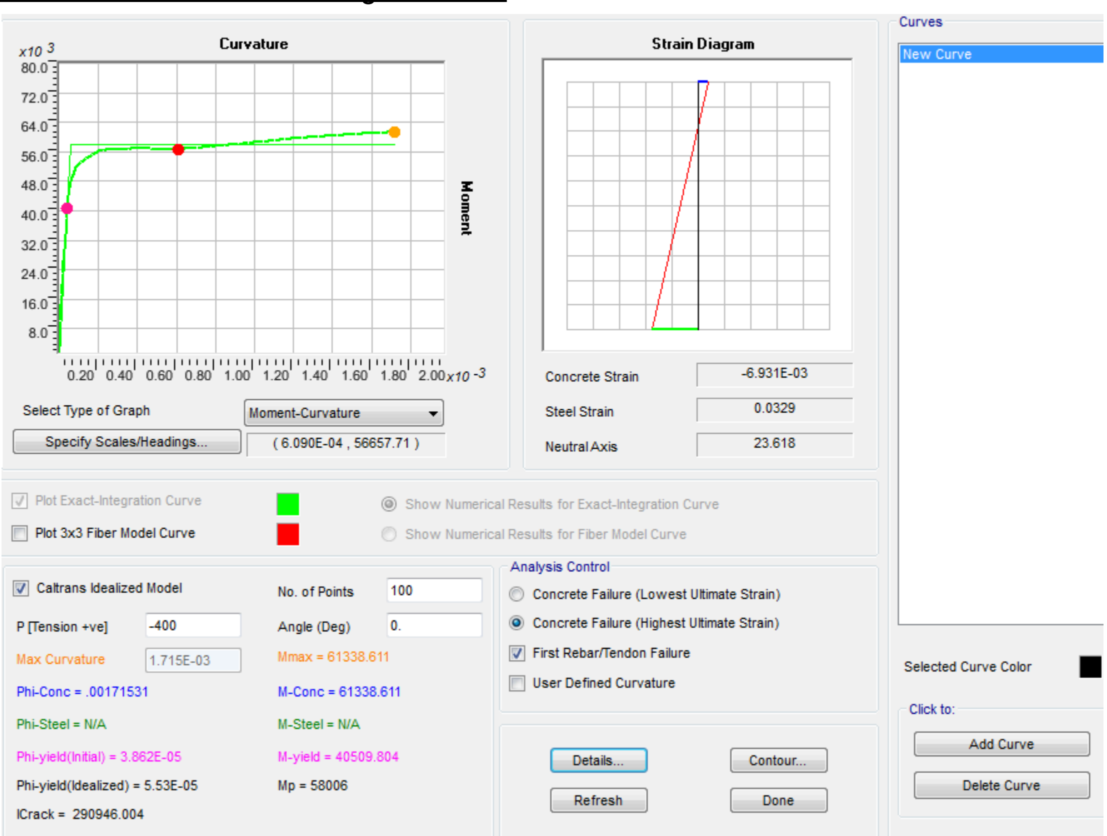
P-M interaction data collected from SAP2000 on Excel

	M	P
-7524	0	7524
-7524	19475	7524
-7524	39379	7524
-6840	57779	6840
-5681	71420	5681
-4386	79227	4386
-3549	87895	3549
-2623	90834	2623
-1062	65411	1062
364.4123	31589	-364.412
1417.5	0	-1417.5
	750	57600



	Curve 1	0. degrees		Curve 2	15. degrees		Curve 3	30. degrees		Curve 4	45. degrees		Curve 5	60. degrees		Curve 6	75. degrees		Curve 7	90. degrees	
	P	M2	M3	P	M2	M3	P	M2	M3	P	M2	M3	P	M2	M3	P	M2	M3	P	M2	M3
1	-7524	0	0	-7524	0	0	-7524	0	0	-7524	0	0	-7524	0	0	-7524	0	0	-7524	0	0
2	-7524	0	19475	-7524	4939.608	18766	-7524	9817.451	16832	-7524	13570	13747	-7524	16872	9617.535	-7524	18861	5099.635	-7524	19407	0
3	-7524	0	39379	-7524	10138	37816	-7524	19650	33939	-7524	27552	27647	-7524	33918	19614	-7524	37988	10200	-7524	39051	0
4	-6840	0	57779	-6883	14849	55164	-6866	28556	49801	-6877	40612	40361	-6880	49469	28695	-6856	55635	14755	-6886	57072	0
5	-5681	0	71420	-5733	18214	68428	-5712	35575	61529	-5720	50119	50225	-5729	61420	35340	-5699	68795	18477	-5728	70837	0
6	-4386	0	79227	-4478	20424	76273	-4444	39496	68499	-4455	55871	55899	-4472	68439	39456	-4422	76462	20397	-4475	78953	0
7	-3549	0	87895	-3625	22768	85577	-3596	44182	76333	-3601	62324	62527	-3619	76717	44078	-3578	85051	22858	-3613	88463	0
8	-2623	0	90834	-2663	23537	88268	-2651	45569	78917	-2644	64301	64489	-2657	79204	45441	-2642	87944	23482	-2653	91208	0
9	-1062	0	65411	-1108	16994	64578	-1093	33290	57135	-1084	46423	46969	-1099	57811	32801	-1085	63634	17195	-1100	66622	0
10	364.4123	0	31589	343.7306	8077.676	31318	347.0639	16379	27642	365.058	22022	22821	348.8548	28130	15667	346.8422	30949	8478.479	361.2209	31851	0
11	1417.5	0	0	1417.5	0	0	1417.5	0	0	1417.5	0	0	1417.5	0	0	1417.5	0	0	1417.5	0	0

Results from SAP2000 Design Process



Testing Results

SE 120 Final Project - Drawbridge Motion & Structural Column Performance

TEAM	Virtual Costs					Motions Operations Test							
	Vlab Cost	Misc Bonuses	Misc Penalties or Charges	Motion Testing Penalties	Total Cost C	Car Stuck, Person is OK	Car Stuck, Person Dies	Never makes it across bridge	Bridge Angle Incorrect	Wait Time (s)	Final Wait Time (s) W	Velocity (m/s)	Final Velocity (in/s) V
1	$ 54,701.18	$ -	$ 3,000.00	$ -	$ 57,701.18	0	0	0	0	38.8	38.8	7.710	303.54
2	$ 66,824.94	$ -	$ 15,000.00	$ -	$ 81,824.94	0	0	0	0	37.1	37.1	7.700	303.15
3	$ 59,970.15	$ 10,000.00	$ 12,000.00	$ 2,000.00	$ 63,970.15	0	1	0	1	41.0	401.0	6.800	267.72
4	$ 62,624.17	$ 10,000.00	$ -	$ -	$ 52,624.17	0	0	0	0	38.3	38.3	8.040	316.54
5	$ 58,239.36	$ -	$ 15,000.00	$ -	$ 73,239.36	0	0	0	0	36.7	36.7	7.380	290.55
6	$ 87,661.17	$ -	$ 115,500.00	$ 2,000.00	$ 205,161.17	0	0	0	2	35.5	155.5	8.530	335.83
7	$ 65,346.76	$ 2,500.00	$ 12,500.00	$ -	$ 75,346.76	0	0	0	0	37.5	37.5	7.040	277.17
8	$ 83,965.26	$ 10,000.00	$ -	$ -	$ 73,965.26	0	0	0	0	55.3	55.3	7.680	302.36
9	$ 77,508.98	$ -	$ 65,000.00	$ -	$ 142,508.98	0	0	0	0	56.0	56.0	7.340	288.98
10	$ 68,134.81	$ -	$ 12,500.00	$ -	$ 80,634.81	0	0	0	0	55.1	55.1	7.560	297.64
11	$ 61,884.00	$ -	$ 20,000.00	$ -	$ 81,884.00	0	0	0	0	36.8	36.8	7.460	293.70
12	$ 56,556.42	$ -	$ 8,000.00	$ 5,000.00	$ 69,556.42	2	2	0	1	1.0	481.0	3.400	133.86
13	$ 65,209.51	$ -	$ 30,000.00	$ -	$ 95,209.51	0	0	0	0	37.0	37.0	7.410	291.73
14	$ 67,774.14	$ 10,000.00	$ 12,000.00	$ -	$ 69,774.14	0	0	0	0	37.7	37.7	7.190	283.07
15	$ 45,749.58	$ -	$ 23,000.00	$ -	$ 68,749.58	0	0	0	0	37.0	37.0	7.560	297.64
16	$ 61,823.14	$ -	$ 15,000.00	$ -	$ 76,823.14	0	0	0	0	35.4	35.4	8.900	350.39
17	$ 58,491.40	$ -	$ 27,500.00	$ -	$ 85,991.40	0	0	0	0	37.8	37.8	7.700	303.15
18	$ 47,479.73	$ -	$ 20,000.00	$ -	$ 67,479.73	0	0	0	0	37.0	37.0	7.590	298.82
20	$ 63,526.41	$ 10,000.00	$ -	$ -	$ 53,526.41	0	0	0	0	36.3	36.3	7.870	309.84
21	$ 72,709.70	$ -	$ 15,000.00	$ 1,000.00	$ 88,709.70	1	0	0	0	56.1	176.1	8.490	334.25
22	$ 60,431.20	$ -	$ 15,500.00	$ -	$ 75,931.20	0	0	0	0	55.8	55.8	7.730	304.33
23	$ 71,430.50	$ -	$ 17,500.00	$ -	$ 88,930.50	0	0	0	0	54.4	54.4	7.290	287.01
24	$ 102,777.06	$ -	$ 35,500.00	$ -	$ 138,277.06	0	0	0	0	56.6	56.6	7.060	277.95
25	$ 71,509.50	$ -	$ 17,500.00	$ -	$ 89,009.50	0	0	0	0	55.6	55.6	7.490	294.88
26	$ 62,076.91	$ -	$ 20,000.00	$ 1,000.00	$ 83,076.91	1	0	0	0	36.3	156.3	8.220	323.62
27	$ 71,843.85	$ -	$ 60,000.00	$ 2,000.00	$ 133,843.85	0	2	0	0	36.5	276.5	7.590	298.82
28	$ 55,498.11	$ -	$ 27,000.00	$ -	$ 82,498.11	0	0	0	0	38.9	38.9	7.600	299.21
29	$ 67,349.04	$ 10,000.00	$ 11,500.00	$ -	$ 68,849.04	0	0	0	0	39.3	39.3	7.140	281.10
30	$ 61,264.83	$ 10,000.00	$ 5,000.00	$ 1,000.00	$ 57,264.83	0	1	0	0	38.8	278.8	6.960	274.02
31	$ 65,812.90	$ -	$ -	$ -	$ 65,812.90	0	0	0	0	55.2	55.2	7.430	292.52
32	$ 77,495.98	$ -	$ 3,000.00	$ 1,000.00	$ 81,495.98	1	0	0	0	54.8	174.8	7.740	304.72
33	$ 82,312.98	$ -	$ -	$ 2,000.00	$ 84,312.98	2	0	0	0	55.9	175.9	6.900	271.65
34	$ 69,021.73	$ -	$ -	$ -	$ 69,021.73	0	0	0	0	55.7	55.7	7.540	296.85
35	$ 74,900.65	$ -	$ 12,500.00	$ -	$ 87,400.65	0	0	0	0	56.1	56.1	7.770	305.91
36	$ 68,170.43	$ -	$ 17,500.00	$ 1,000.00	$ 86,670.43	1	0	0	0	55.2	175.2	7.470	294.09

TEAM	Column Structural Test															PI	Rank
	Aesthetics Factor A	Peak Force @ 0.5" Disp (lbs)	Performance Factor P	Peak Force @ -0.5" Disp (lbs)	Performance Factor P	Peak Force @ 1.0" Disp (lbs)	Performance Factor P	Peak Force @ -1.0" Disp (lbs)	Performance Factor P	Peak Force @ 1.5" Disp (lbs)	Performance Factor P	Peak Force @ -1.5" Disp (lbs)	Performance Factor P	Ultimate Displacement (inches)	Performance Factor P		
1	1.00	57.47	1.00	54.85	1.00	62.32	1.21	49.87	1.00	48.85	1.00	46.51	1.00	1.50	1.00	11,205.2	2
2	1.00	66.27	1.22	61.38	1.21	64.97	1.21	61.41	1.21	57.35	1.00	49.99	1.00	1.50	1.00	4,626.7	7
3	1.00	98.00	1.28	78.52	1.24	79.51	1.24	81.02	1.25	60.72	1.21	64.86	1.21	1.50	1.00	289.7	30
4	1.00	64.63	1.21	54.78	1.00	59.56	1.00	47.39	1.00	58.51	1.00	56.27	1.00	1.50	1.00	12,979.4	1
5	1.00	67.35	1.22	79.06	1.24	64.99	1.21	70.53	1.23	60.11	1.21	64.27	1.21	1.50	1.00	3,279.2	10
6	1.00	83.97	1.25	79.97	1.24	83.33	1.25	81.45	1.25	26.15	1.53	16.37	1.55	1.50	1.00	183.3	33
7	1.00	51.08	1.00	48.85	1.00	45.83	1.00	35.11	1.51	28.75	1.53	23.01	1.54	1.50	1.00	2,757.1	14
8	1.00	85.70	1.26	74.10	1.23	84.53	1.25	67.52	1.22	73.85	1.23	59.52	1.00	1.50	1.00	2,542.4	15
9	1.00	38.95	1.51	44.67	1.00	35.39	1.51	38.88	1.51	16.54	1.55	26.39	1.53	1.50	1.00	443.9	27
10	1.00	84.96	1.25	78.78	1.24	77.21	1.24	74.23	1.23	70.16	1.23	60.41	1.21	1.50	1.00	1,905.0	20
11	1.00	101.97	1.29	93.00	1.27	98.81	1.28	99.38	1.28	76.51	1.24	87.33	1.26	1.50	1.00	2,327.3	16
12	1.00	100.53	1.29	83.78	1.25	102.30	1.29	86.78	1.26	76.05	1.24	73.24	1.23	1.50	1.00	100.1	35
13	1.00	69.38	1.22	70.69	1.23	73.79	1.23	62.35	1.21	61.28	1.21	53.29	1.00	1.50	1.00	3,063.7	12
14	1.00	141.00	1.37	129.51	1.34	141.25	1.37	121.07	1.33	121.50	1.33	82.65	1.25	1.50	1.00	1,933.0	19
15	1.00	95.32	1.28	70.00	1.22	87.42	1.26	65.64	1.22	87.41	1.26	62.93	1.21	1.50	1.00	3,199.7	11
16	1.00	89.19	1.26	85.49	1.26	87.35	1.26	78.15	1.24	77.90	1.24	74.34	1.23	1.50	1.00	3,405.7	9
17	1.00	75.91	1.24	57.12	1.00	76.38	1.24	59.98	1.00	68.60	1.22	57.21	1.00	1.50	1.00	4,971.7	6
18	1.00	63.27	1.21	58.93	1.00	54.40	1.00	62.81	1.21	53.25	1.00	48.34	1.00	1.50	1.00	8,181.2	3
20	1.00	77.07	1.24	77.72	1.24	72.48	1.23	80.86	1.25	35.85	1.51	63.93	1.21	1.50	1.00	3,697.0	8
21	1.20	69.60	1.22	75.35	1.24	72.97	1.23	75.78	1.24	56.60	1.00	51.41	1.00	1.50	1.00	1,112.8	23
22	1.00	42.34	1.00	64.56	1.21	28.25	1.53	36.32	1.51	24.18	1.54	24.10	1.54	1.50	1.00	1,083.4	24
23	1.00	66.43	1.22	73.06	1.23	70.97	1.23	70.45	1.23	48.95	1.00	60.06	1.21	1.50	1.00	2,158.5	18
24	1.00	86.22	1.26	171.62	1.43	0.00	1.58	0.00	1.58	0.00	1.58	0.00	1.58	0.50	3.00	105.4	34
25	1.00	92.70	1.27	101.20	1.29	80.75	1.25	83.59	1.25	80.79	1.25	66.25	1.22	1.50	1.00	1,527.2	22
26	1.20	64.65	1.21	73.84	1.23	69.17	1.22	79.17	1.24	64.14	1.21	60.20	1.21	1.50	1.00	907.3	25
27	1.00	68.81	1.22	75.22	1.24	68.00	1.22	74.99	1.23	44.33	1.00	79.24	1.24	1.50	1.00	286.8	31
28	1.00	46.99	1.00	39.77	1.51	55.99	1.00	47.08	1.00	56.48	1.00	45.17	1.00	1.50	1.00	6,169.9	5
29	1.00	71.71	1.23	79.75	1.24	73.35	1.23	85.12	1.26	66.95	1.22	67.98	1.22	1.50	1.00	2,952.2	13
30	1.00	65.45	1.22	66.82	1.22	61.41	1.21	60.51	1.21	50.19	1.00	49.96	1.00	1.50	1.00	787.5	26
31	1.00	56.31	1.00	53.79	1.00	49.53	1.00	50.30	1.00	49.73	1.00	41.47	1.00	1.50	1.00	8,052.0	4
32	1.00	42.03	1.00	36.09	1.51	31.20	1.52	27.08	1.53	34.28	1.52	25.81	1.53	1.50	1.00	262.0	32
33	1.00	103.12	1.29	100.40	1.29	107.16	1.30	99.53	1.28	41.71	1.00	19.08	1.55	1.50	1.00	426.7	28
34	1.00	46.35	1.00	42.73	1.00	41.43	1.00	35.20	1.51	30.03	1.52	22.80	1.54	1.50	1.00	2,185.3	17
35	1.00	89.89	1.26	80.06	1.25	97.33	1.28	90.15	1.27	90.14	1.27	83.99	1.25	1.50	1.00	1,535.0	21
36	1.00	36.32	1.51	64.69	1.21	33.02	1.52	46.23	1.00	22.55	1.54	36.84	1.51	1.50	1.00	300.0	29