WORLD CONFERENCE ON STUDENT - CENTERED LEARNING APPROACHES

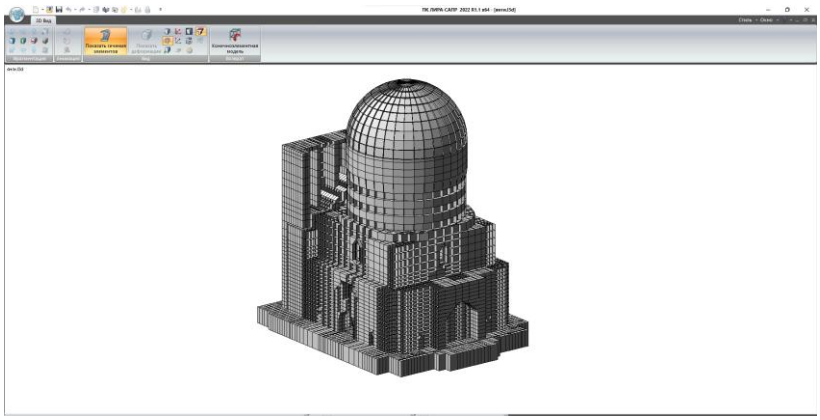
MASJID BINOSINING MAVJUD HOLATINI LIRA DASTURIDA SXEMASINI YASASH VA DEFORMATSIYA HOLATINI ANIQLASH.

Toshkent Arxitektura Qurilish Universiteti

Qurilish Muhandisi 2-bosqich Magistratura talabasi

Suyunov Sohib Normamat o‘g‘li

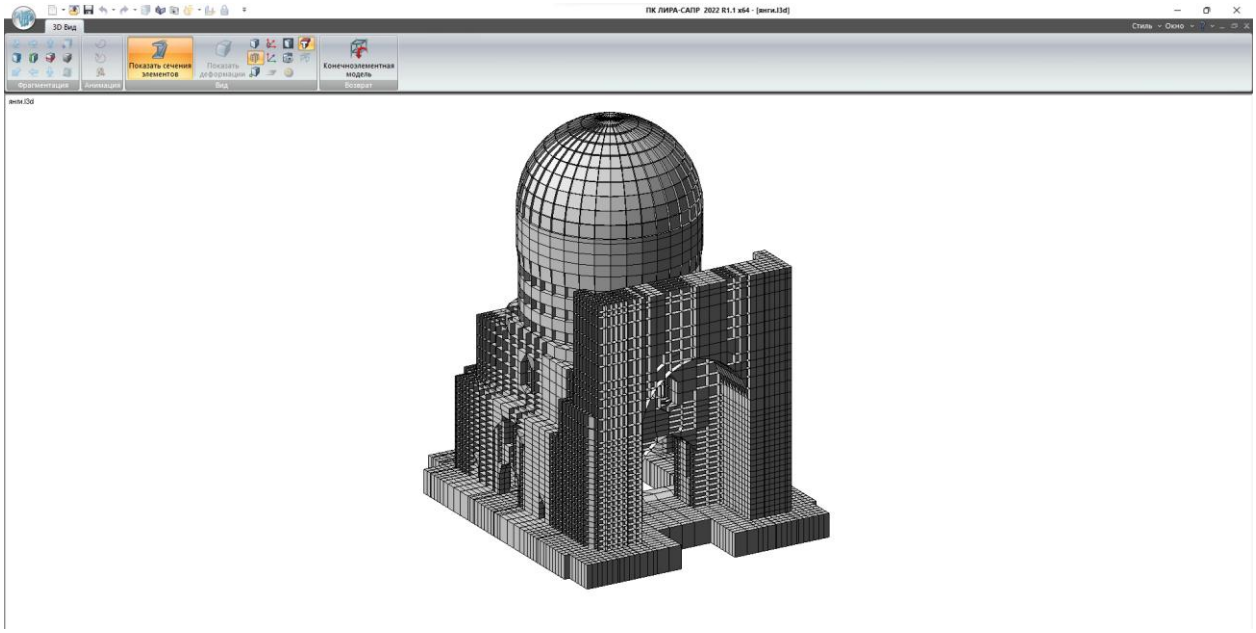
“Ko‘k Gumbaz” masjidi binosining mavjud texnik holatini baholash maqsadida inshootning fazoviy hisobiy modeli LIRA-SAPR dasturiy majmuasida yaratildi. Hisobiy modelni shakllantirishda masjidning real geometrik o‘lchamlari, konstruktiv sxemasi, gumbaz tizimi, qalin yuk ko‘taruvchi devorlari hamda arkali elementlari hisobga olindi. Modelni yaratishda obidaning arxitektura-rejaviy yechimlari, dala kuzatuvlari natijalari va mavjud o‘lchov ma’lumotlaridan foydalanildi. Masjid binosi murakkab fazoviy konstruktiv tizimga ega bo‘lgani sababli hisobiy model uch o‘lchamli fazoviy tizim ko‘rinishida shakllantirildi. Hisoblash jarayonida gumbaz, baraban qismi, arkalar, tashqi devorlar va poydevor elementlari chekli elementlarga ajratilib modellashtirildi. Konstruksiyalarni modellashtirishda qobiqsimon va hajmiy chekli elementlardan foydalanildi. Bu esa konstruksiyaning real ish holatini maksimal darajada aniq ifodalash imkonini berdi.



3.1.1-rasm: *Ko’k gumbaz masjiding 3D holatida orqa tomondan ko’rinishi*

3.1.1-rasmda masjid binosining LIRA-SAPR dasturida yaratilgan uch o‘lchamli fazoviy modeli keltirilgan. Modelda gumbazning geometrik shakli, yuk ko‘taruvchi devorlarning qalinligi hamda arkalar tizimining fazoviy ishlashi aks ettirilgan.

Masjidning ichki gumbazi va tashqi gumbazi o‘zaro bog‘langan holda ishlashi sababli modelda ularning birgalikdagi deformatsion holati hisobga olindi. Gumbazning yuklari baraban qismi orqali devorlarga uzatilishi va devorlar orqali poydevorga taqsimlanishi hisoblash jarayonida alohida e’tiborga olindi. Ayniqsa, arkalar bilan gumbaz tutashgan zonalarda kuchlanishlarning konsentratsiyalanishi ehtimoli mavjudligi sababli ushbu hududlarda mayda chekli elementlar tarmog‘i qo‘llanildi.

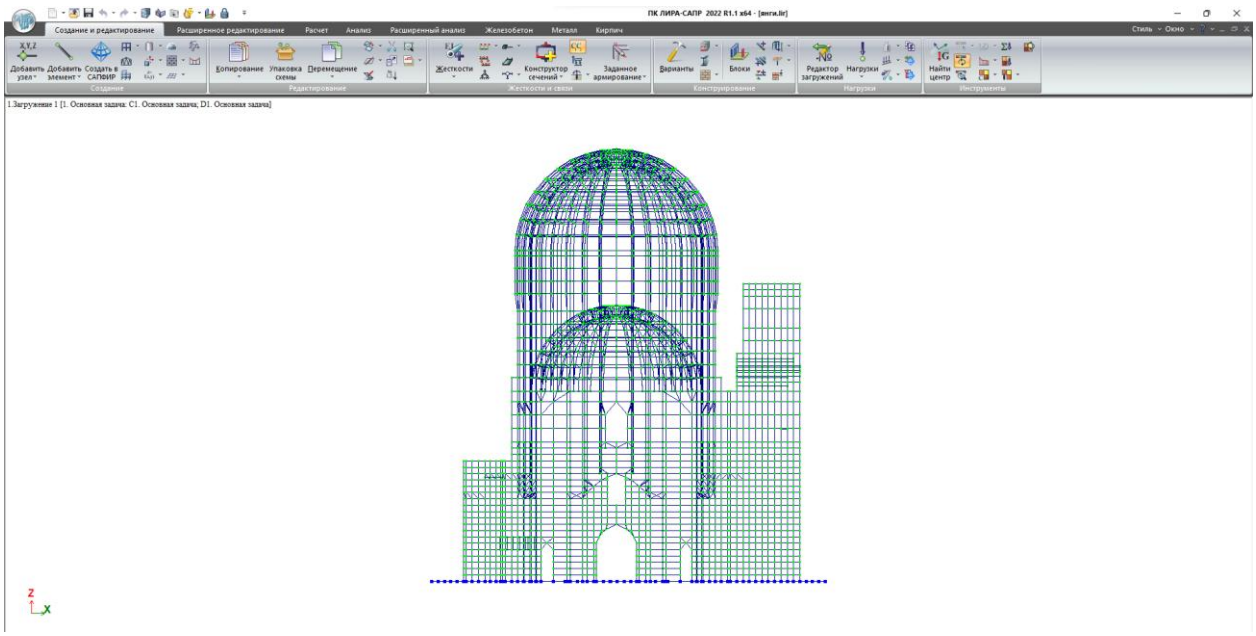


3.1.2-rasm: *Ko’k gumbaz masjiding 3D holatida old tomondan ko’rinishi*

3.1.2-rasmda masjidning boshqa rakursdagi fazoviy modeli ko‘rsatilgan bo‘lib, unda yuk ko‘taruvchi elementlarning o‘zaro bog‘lanishi va konstruktiv tizimning

umumiy ishlash sxemasi aks ettirilgan. Hisobiy modelni yaratishda konstruksiyaning geometrik simmetriyasi, materiallarning fizik-mexanik xossalari va mavjud deformatsiyalar holati inobatga olindi.

Masjid konstruksiyasining asosiy materiali pishiq g‘isht va loy qorishmasidan iborat bo‘lgani sababli hisoblashda materialning elastiklik moduli, zichligi va deformatsion ko‘rsatkichlari me’yoriy hujjatlar asosida qabul qilindi. Hisoblashda tarixiy g‘isht konstruksiyalar uchun tavsiya etilgan fizik-mexanik parametrlar qo‘llanildi.



3.1.3-rasm: *Masjid binoning hisobiy sxemasi*

3.1.3-rasmda masjid binosining umumiy hisobiy sxemasi keltirilgan. Mazkur sxema asosida bino konstruksiyasining deformatsion holati, ichki kuchlanishlari va siljishlari aniqlandi. Hisoblash ishlari chekli elementlar usuli asosida bajarildi. Bunda bino konstruksiyasiga doimiy yuklar, vaqtinchalik yuklar hamda seysmik ta’sirlar qo‘llanildi. Seysmik yuklar QMQ va KMK me’yoriy hujjatlariga muvofiq 8 ballik

hudud uchun qabul qilindi.

Hisoblash natijalari shuni ko‘rsatdiki, masjidning eng katta deformatsiyalari gumbazning baraban qismida, arkalar tutashgan hududlarda va tashqi devorlarning yuqori zonalarida yuzaga kelmoqda. Vertikal cho‘kishlar va gorizontal siljishlarning notekis taqsimlanishi konstruksiyada qo‘shimcha ichki kuchlanishlarni hosil qilmoqda. Ayniqsa, namlik ta’sirida zaiflashgan zonalarda deformatsiyalar miqdorining ortishi kuzatildi.

Olingan natijalar masjid konstruksiyalarining hozirgi texnik holati murakkab ekanligini hamda konstruktiv elementlarni kuchaytirish zarurligini ko‘rsatdi. Shu sababli keyingi bosqichda bino konstruksiyasini kuchaytirish variantlari ishlab chiqilib, ularning samaradorligi LIRA-SAPR dasturida alohida hisoblash orqali tahlil qilinadi.

LIRA-SAPR HISOBLASH PARAMETRLARI VA YUKLANISHLAR TAVSIFI

№	Ko‘rsatkich nomi	Tavsifi
1	Hisoblash dasturi	LIRA-SAPR dasturiy majmuasi
2	Hisoblash usuli	Ko‘chishlar bo‘yicha chekli elementlar usuli
3	Fazoviy model turi	Uch o‘lchamli fazoviy hisobiy model
4	Asosiy noma’lumlar	X, Y, Z chiziqli ko‘chishlar hamda UX, UY, UZ burchak ko‘chishlari
5	Hisoblash me’yorlari	СНиП 2.03.01-84*, СНиП II-23-81*, СНиП II-22-81
6	Seysmik hisob me’yorlari	СНиП 2.01.07-85*
7	Grunt parametrlari me’yori	СНиП 2.02.01-83

8	Dinamik hisob usuli	Nyumark usuli bo‘yicha akselerogramma integrallash
9	Hisoblash turi	Statik va dinamik (seysmik) hisob
10	Hisobda qo‘llangan yuklar	Xususiy yuk, odam yuki, qor yuki va seysmik yuk

HISOBDA QO‘LLANGAN YUKLANISHLAR

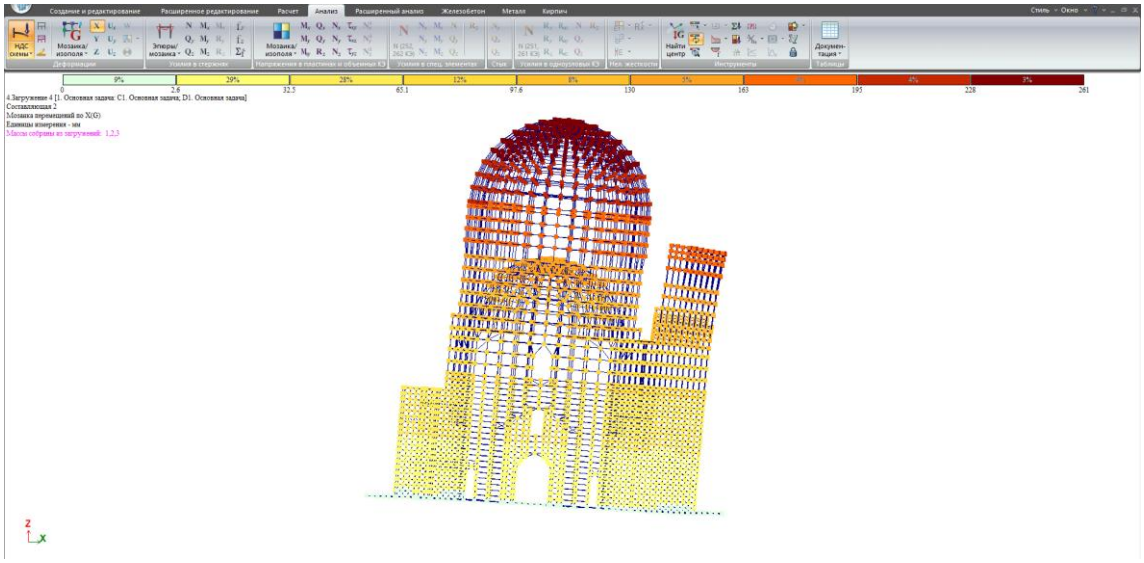
Yuklanish №	Yuk turi	Tavsifi
1	Statik yuk	Inshootning xususiy og‘irligi
2	Statik yuk	Odamlar va ekspluatatsion yuk
3	Statik yuk	Qor yuki
4	Dinamik yuk	X yo‘nalishidagi seysmik ta’sir (akselerogramma)
5	Dinamik yuk	Y yo‘nalishidagi seysmik ta’sir (akselerogramma)
6	Dinamik yuk	Z yo‘nalishidagi seysmik ta’sir (akselerogramma)

HISOBIY CHEKLI ELEMENTLAR TURLARI

Element turi	Element nomi	Qo‘llanish sohasi
KE-32	Tetraedr element	Hajmli elementlar
KE-34	6 tugunli izoparametrik element	Fazoviy konstruksiyalar
KE-36	8 tugunli izoparametrik element	Fazoviy massiv elementlar
KE-41	To‘rtburchak qobiq elementi	Devor va qobiq konstruksiyalar
KE-42	Uchburchak qobiq elementi	Murakkab geometrik yuzalar
KE-44	Universal to‘rtburchak qobiq elementi	Gumbaz va devor elementlari

HISOB NATIJALARIDA ANIQLANGAN ASOSIY PARAMETRLAR

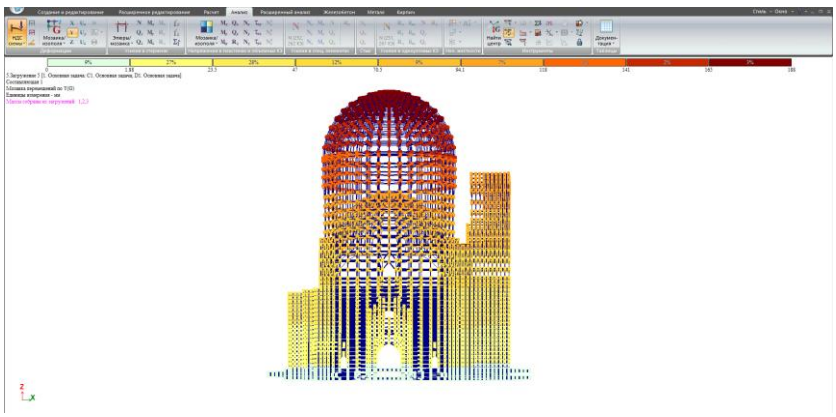
№	Natija turi	Tavsifi
1	Tugun ko‘chishlari	X, Y, Z yo‘nalishlaridagi siljishlar
2	Kuchlanishlar	NX, NY, NZ normal kuchlanishlar
3	Kesuvchi kuchlanishlar	TXY, TXZ, TYZ
4	Eguvchi momentlar	MX, MY
5	Buruvchi moment	MXY
6	Kesuvchi kuchlar	QX, QY
7	Seysmik natijalar	Tebranish shakllari va davrlari
8	RSU natijalari	Hisobiy kuchlar kombinatsiyasi



3.1.4-rasm: *X o'qi ko'chish eng yuqori darajada 261 mm*

ЗАГР	N п/п	Собств...	Рад/с.	Гц.	Периоды	RAD - Коэф. распр.	RAD - Масса	RAD - Сумма масс
4 - (мод. 27)								
4	1	237.719734	15.418162	2.455121	0.407312	-0.003359	0.000278	0.000278
4	2	273.943451	16.551237	2.635547	0.379428	-1.613263	68.910423	68.910701
4	3	989.638183	31.458515	5.009318	0.199628	-0.228476	0.334315	69.245016
4	4	997.958697	31.590484	5.030332	0.198794	0.056442	0.071125	69.316141
4	5	1397.26110	37.379956	5.952222	0.168004	0.001456	0.000006	69.316147
4	6	1693.87491	41.156712	6.553617	0.152588	-0.007698	0.001143	69.317290
4	7	2754.97124	52.487820	8.357933	0.119647	-0.929877	17.437099	86.754389
4	8	2976.67944	54.558954	8.687732	0.115105	-0.034932	0.029718	86.784107
4	9	4094.77140	63.990401	10.189554	0.098140	-0.522153	0.507013	87.291119
4	10	4387.41708	66.237581	10.547385	0.094810	0.000834	0.000012	87.291131
4	11	4739.99256	68.847604	10.962994	0.091216	0.000464	0.000003	87.291134
4	12	4994.83918	70.674176	11.253850	0.088858	-0.001328	0.000047	87.291181
4	13	6951.23104	83.374043	13.276121	0.075323	0.781513	6.477400	93.768581
4	14	7709.46816	87.803577	13.981461	0.071523	-0.093859	0.088230	93.856811
4	15	8550.00153	92.466218	14.723920	0.067917	0.001391	0.000034	93.856845
4	16	8917.58708	94.432977	15.037098	0.066502	-0.011387	0.000636	93.857482
4	17	9325.04980	96.566297	15.376799	0.065033	-0.005749	0.000055	93.857537
4	18	10153.9193	100.766658	16.045646	0.062322	-0.223487	0.269834	94.127371
4	19	11324.1735	106.415100	16.945080	0.059014	0.001115	0.000016	94.127387
4	20	11661.3551	107.987754	17.195502	0.058155	-0.349294	1.141217	95.268604
4	21	12433.0055	111.503388	17.755317	0.056321	0.078470	0.028185	95.296788
4	22	12699.6070	112.692533	17.944671	0.055727	0.001998	0.000035	95.296823
4	23	12823.0691	113.238991	18.031687	0.055458	-0.039122	0.016388	95.313212
4	24	12848.5353	113.351380	18.049583	0.055403	-0.010957	0.003550	95.316762
4	25	13580.0867	116.533629	18.556310	0.053890	-0.087026	0.074620	95.391382
4	26	15059.1382	122.715681	19.540713	0.051175	0.162361	0.061946	95.453328
4	27	15197.9265	123.279871	19.630553	0.050941	0.398330	0.171284	95.624612
4	28	15263.8002	123.546753	19.673050	0.050831	0.044092	0.029135	95.653747
4	29	16502.9544	128.463826	20.456023	0.048885	0.007039	0.000403	95.654150
4	30	17954.3936	133.994006	21.336625	0.046868	0.029448	0.004125	95.658275
4	31	18317.8492	135.343449	21.551505	0.046400	0.002207	0.000023	95.658298
4	32	18700.8069	136.750894	21.775620	0.045923	-0.140137	0.028537	95.686835
4	33	20519.0094	143.244579	22.809646	0.043841	-0.055010	0.021601	95.708436
4	34	22739.9046	150.797562	24.012351	0.041645	0.043668	0.018318	95.726754
4	35	22962.4003	151.533496	24.129538	0.041443	-0.003021	0.000103	95.726857
4	36	23922.8432	154.670111	24.628999	0.040603	0.093763	0.038233	95.765090
4	37	24844.0237	157.619871	25.098706	0.039843	0.001416	0.000041	95.765131
4	38	26560.6709	162.974449	25.951345	0.038534	-0.002159	0.000003	95.765134
4	39	27987.8499	167.295696	26.639442	0.037538	-0.001927	0.000035	95.765168
4	40	28189.4837	167.897242	26.735230	0.037404	0.000060	0.000000	95.765169
4	41	28254.8424	168.091768	26.766205	0.037361	-0.027166	0.003932	95.769101
4	42	28806.0738	169.723522	27.026039	0.037001	-0.268650	0.126553	95.895653
4	43	29202.9878	170.888817	27.211595	0.036749	-0.000389	0.000001	95.895654
4	44	29747.8639	172.475691	27.464282	0.036411	-0.001599	0.000036	95.895690
4	45	30666.5617	175.118708	27.885145	0.035861	-0.009564	0.001142	95.896832
4	46	30743.4752	175.338174	27.920091	0.035817	0.177711	0.197429	96.094261
4	47	32940.3446	181.494751	28.900438	0.034602	0.040164	0.022030	96.116292
4	48	33259.4814	182.371822	29.040099	0.034435	0.043468	0.014549	96.130840
4	49	33317.8645	182.531818	29.065576	0.034405	-0.021780	0.003638	96.134478
4	50	35773.2019	189.138050	30.117524	0.033203	-0.086116	0.066603	96.201080
4	51	35878.2348	189.415508	30.161705	0.033155	0.077398	0.054984	96.256065
4	52	36387.7824	190.755819	30.375130	0.032922	-0.003362	0.000158	96.256223

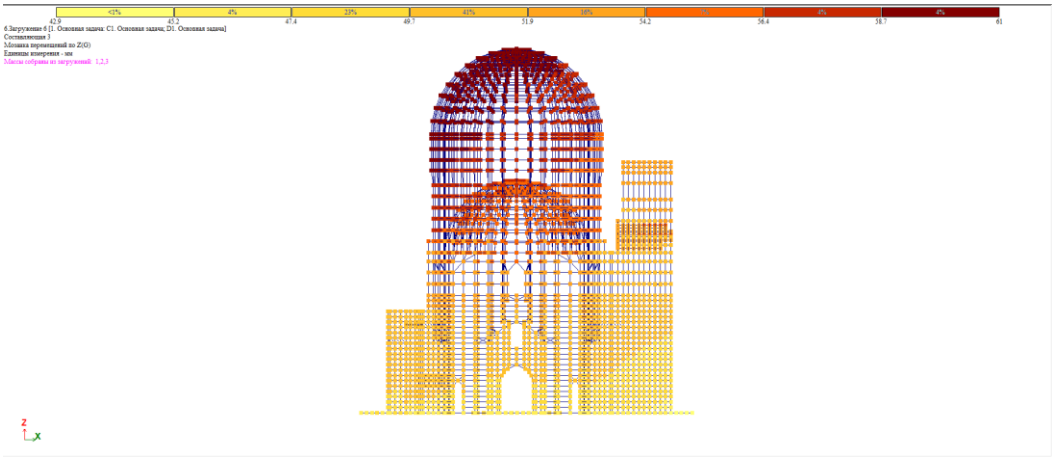
3.1.5-rasm: *X o'qi bo'yicha tebranishlar ko'rsatkichlari*



3.1.6-rasm *Y o'qi ko'chish eng yuqori darajada 188 mm*

5 - (мод. 27)								
5	1	237.719734	15.418162	2.455121	0.407312	1.701041	71.421333	71.421333
5	2	273.943451	16.551237	2.635547	0.379428	-0.003097	0.000254	71.421586
5	3	989.638183	31.458515	5.009318	0.199628	0.000946	0.000006	71.421592
5	4	997.958697	31.590484	5.030332	0.198794	0.000211	0.000001	71.421593
5	5	1397.26110	37.379956	5.952222	0.168004	0.370657	0.369291	71.790884
5	6	1693.87491	41.156712	6.553617	0.152588	0.567058	6.203049	77.993932
5	7	2754.97124	52.487820	8.357933	0.119647	-0.034784	0.024399	78.018332
5	8	2976.67944	54.558954	8.687732	0.115105	0.637922	9.910994	87.929325
5	9	4094.77140	63.990401	10.189554	0.098140	0.003576	0.000024	87.929349
5	10	4387.41708	66.237581	10.547385	0.094810	0.307459	1.628903	89.558252
5	11	4739.99256	68.847604	10.962994	0.091216	-0.379011	1.705229	91.263481
5	12	4994.83918	70.674176	11.253850	0.088858	-0.002987	0.000238	91.263719
5	13	6951.23104	83.374043	13.276121	0.075323	-0.004178	0.000185	91.263904
5	14	7709.46816	87.803577	13.981461	0.071523	-0.000370	0.000001	91.263905
5	15	8550.00153	92.466218	14.723920	0.067917	0.158571	0.444340	91.708246
5	16	8917.58708	94.432977	15.037098	0.066502	-0.416155	0.849674	92.557920
5	17	9325.04980	96.566297	15.376799	0.065033	-0.820498	1.119996	93.677915
5	18	10153.9193	100.766658	16.045646	0.062322	-0.007926	0.000339	93.678255
5	19	11324.1735	106.415100	16.945080	0.059014	-0.205034	0.539260	94.217515
5	20	11661.3551	107.987754	17.195502	0.058155	0.001853	0.000032	94.217547
5	21	12433.0055	111.503388	17.755317	0.056321	-0.001375	0.000009	94.217555
5	22	12699.6070	112.692533	17.944671	0.055727	0.061682	0.033148	94.250703
5	23	12823.0691	113.238991	18.031687	0.055458	-0.061111	0.039987	94.290691
5	24	12848.5353	113.351380	18.049583	0.055403	0.145176	0.623279	94.913970
5	25	13580.0867	116.533629	18.556310	0.053890	0.001449	0.000021	94.913990
5	26	15059.1382	122.715681	19.540713	0.051175	0.078061	0.014319	94.928310
5	27	15197.9265	123.279871	19.630553	0.050941	0.212184	0.048602	94.976912
5	28	15263.8002	123.546753	19.673050	0.050831	-0.184805	0.511823	95.488735
5	29	16502.9544	128.463826	20.456023	0.048885	0.111161	0.100402	95.589137
5	30	17954.3936	133.994006	21.336625	0.046868	-0.001380	0.000009	95.589146
5	31	18317.8492	135.343449	21.551505	0.046400	-0.052872	0.013050	95.602196
5	32	18700.8069	136.750894	21.775620	0.045923	-0.001633	0.000004	95.602200
5	33	20519.0094	143.244579	22.809646	0.043841	-0.001085	0.000008	95.602208
5	34	22739.9046	150.797562	24.012351	0.041645	-0.001574	0.000024	95.602232
5	35	22962.4003	151.533496	24.129538	0.041443	-0.020393	0.004693	95.606925
5	36	23922.8432	154.670111	24.628999	0.040603	-0.002272	0.000022	95.606948
5	37	24844.0237	157.619871	25.098706	0.039843	0.095990	0.188477	95.795425
5	38	26560.6709	162.974449	25.951345	0.038534	-0.254527	0.045582	95.841007
5	39	27987.8499	167.295696	26.639442	0.037538	0.001689	0.000027	95.841033
5	40	28189.4837	167.897242	26.735230	25.951345	-0.007461	0.000345	95.841378
5	41	28254.8424	168.091768	26.766205	0.037361	0.001536	0.000013	95.841391
5	42	28806.0738	169.723522	27.026039	0.037001	-0.008737	0.000134	95.841525
5	43	29202.9878	170.888817	27.211595	0.036749	0.129341	0.131674	95.973199
5	44	29747.8639	172.475691	27.464282	0.036411	0.166837	0.393705	96.366904
5	45	30666.5617	175.118708	27.885145	0.035861	-0.057117	0.040714	96.407618
5	46	30743.4752	175.338174	27.920091	0.035817	-0.003786	0.000090	96.407708
5	47	32940.3446	181.494751	28.900438	0.034602	0.000016	0.000000	96.407708
5	48	33259.4814	182.371822	29.040099	0.034435	-0.000377	0.000001	96.407709
5	49	33317.8645	182.531818	29.065576	0.034405	-0.002853	0.000062	96.407771
5	50	35773.2019	189.138050	30.117524	0.033203	0.002856	0.000073	96.407844
5	51	35878.2348	189.415508	30.161705	0.033155	-0.001996	0.000037	96.407881
5	52	36387.7824	190.755819	30.375130	0.032922	-0.056865	0.045198	96.453079

3.1.7-rasm *Y o'qi bo'yicha tebranishlar ko'rsatkichlari*



3.1.8-rasm *Z o'qi ko'chish eng yuqori darajada 61mm*

6 - (мод. 27)								
6	1	237.719734	15.418162	2.455121	0.407312	0.000105	0.000000	0.000000
6	2	273.943451	16.551237	2.635547	0.379428	0.013009	0.004176	0.004176
6	3	989.638183	31.458515	5.009318	0.199628	-1.950796	22.712282	22.716458
6	4	997.958697	31.590484	5.030332	0.198794	-1.917940	76.533561	99.250019
6	5	1397.26110	37.379956	5.952222	0.168004	-0.001922	0.000009	99.250028
6	6	1693.87491	41.156712	6.553617	0.152588	0.001504	0.000041	99.250069
6	7	2754.97124	52.487820	8.357933	0.119647	-0.003120	0.000183	99.250252
6	8	2976.67944	54.558954	8.687732	0.115105	-0.000128	0.000000	99.250252
6	9	4094.77140	63.990401	10.189554	0.098140	0.008655	0.000130	99.250382
6	10	4387.41708	66.237581	10.547385	0.094810	0.000684	0.000008	99.250390
6	11	4739.99256	68.847604	10.962994	0.091216	0.000173	0.000000	99.250390
6	12	4994.83918	70.674176	11.253850	0.088858	0.002736	0.000186	99.250576
6	13	6951.23104	83.374043	13.276121	0.075323	0.062186	0.038219	99.288795
6	14	7709.46816	87.803577	13.981461	0.071523	-0.001655	0.000026	99.288821
6	15	8550.00153	92.466218	14.723920	0.067917	-0.000487	0.000004	99.288825
6	16	8917.58708	94.432977	15.037098	0.066502	-0.003289	0.000049	99.288874
6	17	9325.04980	96.566297	15.376799	0.065033	-0.003762	0.000022	99.288896
6	18	10153.9193	100.766658	16.045646	0.062322	0.290463	0.424751	99.713647
6	19	11324.1735	106.415100	16.945080	0.059014	-0.000596	0.000004	99.713651
6	20	11661.3551	107.987754	17.195502	0.058155	0.003334	0.000097	99.713748
6	21	12433.0055	111.503388	17.755317	0.056321	0.089747	0.034357	99.748105
6	22	12699.6070	112.692533	17.944671	0.055727	0.001669	0.000023	99.748127
6	23	12823.0691	113.238991	18.031687	0.055458	-0.029588	0.008735	99.756862
6	24	12848.5353	113.351380	18.049583	0.055403	-0.004309	0.000512	99.757374
6	25	13580.0867	116.533629	18.556310	0.053890	0.019643	0.003543	99.760917
6	26	15059.1382	122.715681	19.540713	0.051175	-0.020632	0.000932	99.761849
6	27	15197.9265	123.279871	19.630553	0.050941	-0.037114	0.001386	99.763235
6	28	15263.8002	123.546753	19.673050	0.050831	-0.005422	0.000411	99.763645
6	29	16502.9544	128.463826	20.456023	0.048885	-0.000442	0.000001	99.763647
6	30	17954.3936	133.994006	21.336625	0.046868	0.030001	0.003990	99.767637
6	31	18317.8492	135.343449	21.551505	0.046400	0.000328	0.000000	99.767638
6	32	18700.8069	136.750894	21.775620	0.045923	0.104303	0.014732	99.782369
6	33	20519.0094	143.244579	22.809646	0.043841	0.003145	0.000066	99.782435
6	34	22739.9046	150.797562	24.012351	0.041645	0.057289	0.029381	99.811816
6	35	22962.4003	151.533496	24.129538	0.041443	-0.003594	0.000136	99.811952
6	36	23922.8432	154.670111	24.628999	0.040603	-0.115256	0.053835	99.865787
6	37	24844.0237	157.619871	25.098706	0.039843	-0.000623	0.000007	99.865794
6	38	26560.6709	162.974449	25.951345	0.038534	0.000077	0.000000	99.865794
6	39	27987.8499	167.295696	26.639442	0.037538	-0.000657	0.000004	99.865798
6	40	28189.4837	167.897242	26.735230	0.037404	0.000042	0.000000	99.865798
6	41	28254.8424	168.091768	26.766205	0.037361	0.000331	0.000001	99.865799
6	42	28806.0738	169.723522	27.026039	0.037001	0.047955	0.003758	99.869556
6	43	29202.9878	170.888817	27.211595	0.036749	0.000701	0.000004	99.869560
6	44	29747.8639	172.475691	27.464282	0.036411	0.000152	0.000000	99.869560
6	45	30666.5617	175.118708	27.885145	0.035861	0.000382	0.000002	99.869562
6	46	30743.4752	175.338174	27.920091	0.035817	-0.002090	0.000025	99.869587
6	47	32940.3446	181.494751	28.900438	0.034602	-0.012696	0.002051	99.871639
6	48	33259.4814	182.371822	29.040099	0.034435	0.014167	0.001440	99.873079
6	49	33317.8645	182.531818	29.065576	0.034405	-0.010446	0.000780	99.873859
6	50	35773.2019	189.138050	30.117524	0.033203	0.001576	0.000021	99.873880
6	51	35878.2348	189.415508	30.161705	0.033155	-0.033976	0.009874	99.883754
6	52	36387.7824	190.755819	30.375130	0.032922	0.000853	0.000009	99.883763

3.1.9-rasm *Z o'qi bo'yicha tebranishlar ko'rsatkichlari*