Find Required Footing Size:

Footing ID =	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
DL =	120	130	140	150	120	130	140	150	120	130	140	150	120	130	140	kips
LL =	140	140	140	140	150	150	150	150	160	160	160	160	170	170	170	kips
Q =	260	270	280	290	270	280	290	300	280	290	300	310	290	300	310	kips
q-allow =	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	ksf
B =	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	ft
L =	18.91	19.64	20.36	21.09	19.64	20.36	21.09	21.82	20.36	21.09	21.82	22.55	21.09	21.82	22.55	ft
L =	19	20	20.5	21.5	20	20.5	21.5	22	20.5	21.5	22	23	21.5	22	23	ft

Footing Concrete Data:

f'c =	2000	2500	3000	3500	4000	4500	5000	2000	2500	3000	3500	4000	4500	5000	5500	psi
fy =	40	40	40	40	40	40	40	60	60	60	60	60	60	60	60	ksi

Column Data:

c1 =	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	inches
c2 =	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	inches
f'c =	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	psi

Check Beam Shear:

Vu =	368	380	392	404	384	396	408	420	400	412	424	436	416	428	440	kips
qu =	3.52153	3.45455	3.47672	3.41649	3.49091	3.5122	3.45032	3.47107	3.54767	3.48414	3.50413	3.44664	3.51797	3.53719	3.47826	ksf
(short dir.) d, reqd. =	7.21	6.54	6.13	5.70	5.50	5.27	4.98	7.14	6.68	6.14	5.81	5.44	5.27	5.08	4.82	inches
(long dir) d, reqd. =	28.85	27.63	26.57	25.95	23.20	22.83	22.67	33.31	28.93	27.98	27.12	26.59	24.03	23.69	23.55	inches
try d	29.00	28.00	27.00	26.00	24.00	23.00	23.00	34.00	29.00	28.00	28.00	27.00	25.00	24.00	24.00	inches

Check Punching Shear:

V =	338	352	365	378	360	372	385	386	370	383	396	409	391	403	416	kips
B =	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	feet
L =	19.00	20.00	20.50	21.50	20.00	20.50	21.50	22.00	20.50	21.50	22.00	23.00	21.50	22.00	23.00	feet
α =	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	interior column
β =	3.45	3.64	3.73	3.91	3.64	3.73	3.91	4.00	3.73	3.91	4.00	4.18	3.91	4.00	4.18	
b_o =	139.54	136.64	134.16	132.82	125.83	125.02	124.86	150.18	139.82	137.68	135.69	134.63	128.19	127.49	127.36	inches
ϕ =	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Eq. 11-35 Vc =	451	469	486	504	480	496	513	515	493	511	528	545	521	537	554	kips
Eq. 11-36 Vc =	1222	1285	1333	1397	1267	1318	1384	1510	1375	1439	1489	1555	1423	1475	1542	kips
Eq. 11-37 Vc =	571	606	633	667	619	646	679	686	642	676	704	738	690	717	750	kips
Minimum Value V_c * f =	338	352	365	378	360	372	385	386	370	383	396	409	391	403	416	kips
fVc -V =	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(residual error)
d, reqd. =	22.89	22.16	21.54	21.21	19.46	19.25	19.21	25.54	22.96	22.42	21.92	21.66	20.05	19.87	19.84	inches
try d	23.00	23.00	22.00	22.00	20.00	20.00	20.00	26.00	23.00	23.00	22.00	22.00	21.00	20.00	20.00	inches

Check Flexural Steel Long Direction:

Mu =	142.622	155.886	165.253	179.473	157.527	166.939	181.249	191.343	168.625	183.026	193.165	208.522	184.803	194.988	210.435	ft-kips
d =	29.00	28.00	27.00	26.00	24.00	23.00	23.00	34.00	29.00	28.00	28.00	27.00	25.00	24.00	24.00	inches
a =	3.41551	3.0805	2.81346	2.72039	2.25049	2.21508	2.16184	3.90219	3.219	3.01001	2.70747	2.65434	2.24842	2.22741	2.18323	inches
β_1 =	0.85	0.85	0.85	0.85	0.85	0.825	0.8	0.85	0.85	0.85	0.85	0.85	0.825	0.8	0.775	
c =	4.01825	3.62412	3.30995	3.20046	2.64764	2.68495	2.7023	4.59081	3.78706	3.54118	3.18526	3.12275	2.72536	2.78426	2.81707	inches
ε_s =	0.01865	0.02018	0.02147	0.02137	0.02419	0.0227	0.02253	0.01922	0.01997	0.02072	0.02337	0.02294	0.02452	0.02286	0.02256	
check ε_s >= 0.004 =	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
ϕ =	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
ϕMn =	142.622	126.429	132.968	150.337	129.981	144.063	156.442	143.58	131.687	148.487	149.67	167.91	153.843	160.908	173.691	ft-kips
Mu - ϕMn =	0.00	29.46	32.28	29.14	27.55	22.88	24.81	47.76	36.94	34.54	43.50	40.61	30.96	34.08	36.74	<= 0
Strength As =	1.7419	1.9638	2.1523	2.4279	2.2955	2.5418	2.7563	1.3267	1.3681	1.5351	1.6109	1.8049	1.7200	1.8933	2.0413	in^2/ft width
Strength As total =	33.10	39.28	44.12	52.20	45.91	52.11	59.26	29.19	28.05	33.00	35.44	41.51	36.98	41.65	46.95	in^2

Check rmin for flexural reinforcing:

shrinkage ρ min =	0.00200	0.00200	0.00200	0.00200	0.00200	0.00200	0.00200	0.00180	0.00180	0.00180	0.00180	0.00180	0.00180	0.00180	0.00180	
shrinkage As min =	0.6960	0.6720	0.6480	0.6240	0.5760	0.5520	0.5520	0.7344	0.6264	0.6048	0.6048	0.5832	0.5400	0.5184	0.5184	in^2/ft width
shrinkage As min total =	3.83	3.70	3.56	3.43	3.17	3.04	3.04	4.04	3.45	3.33	3.33	3.21	2.97	2.85	2.85	in^2
ρ min =	0.00335	0.00375	0.00411	0.00444	0.00474	0.00503	0.00530	0.00224	0.00250	0.00274	0.00296	0.00316	0.00335	0.00354	0.00371	
ρ min =	0.00500	0.00500	0.00500	0.00500	0.00500	0.00500	0.00500	0.00333	0.00333	0.00333	0.00333	0.00333	0.00333	0.00333	0.00333	
usemax flexural ρ min =	0.00500	0.00500	0.00500	0.00500	0.00500	0.00503	0.00530	0.00333	0.00333	0.00333	0.00333	0.00333	0.00335	0.00354	0.00371	
As for ρ min =	1.7400	1.6800	1.6200	1.5600	1.4400	1.3886	1.4637	1.3600	1.1600	1.1200	1.1200	1.0800	1.0062	1.0182	1.0679	in^2/ft width
As per ρ min total =	9.57	9.24	8.91	8.58	7.92	7.64	8.05	7.48	6.38	6.16	6.16	5.94	5.53	5.60	5.87	in^2

If strength steel is less than flexural ρ min then provide 1/3x Strength As or shrinkage steel whichever is greater.

Strength As =	1.74191	1.96382	2.15229	2.42795	2.2955	2.5418	2.75634	1.36	1.36808	1.5351	1.61094	1.80495	1.72004	1.8933	2.04132	in^2/ft width
Strength As total =	33.10	39.28	44.12	52.20	45.91	52.11	59.26	29.92	28.05	33.00	35.44	41.51	36.98	41.65	46.95	in^2

Check Flexural Steel Short Direction:

Mu =	8.91388	8.74432	8.80044	8.64799	8.83636	8.89024	8.73362	8.78616	8.98004	8.81924	8.86983	8.72431	8.90486	8.95351	8.80435	ft-kips
d =	29.00	28.00	27.00	26.00	24.00	23.00	23.00	34.00	29.00	28.00	28.00	27.00	25.00	24.00	24.00	inches
a =	0.2016	0.16377	0.1424	0.12452	0.12062	0.11256	0.09949	0.16932	0.16237	0.13758	0.11856	0.1058	0.10368	0.09773	0.08735	inches
β_1 =	0.85	0.85	0.85	0.85	0.85	0.825	0.8	0.85	0.85	0.85	0.85	0.85	0.825	0.8	0.775	
c =	0.23718	0.19267	0.16753	0.1465	0.14191	0.13643	0.12436	0.1992	0.19102	0.16186	0.13949	0.12447	0.12568	0.12216	0.11271	inches
ε_s =	0.36382	0.43297	0.4805	0.52943	0.50436	0.50274	0.55184	0.50904	0.45245	0.51597	0.59921	0.64774	0.59376	0.58637	0.63582	
check ε_s >= 0.004 =	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
ϕ =	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
ϕMn =	8.91388	8.74432	8.80044	8.64799	8.83636	8.89024	8.73362	8.78616	8.98004	8.81924	8.86983	8.72431	8.90486	8.95351	8.80435	ft-kips
Mu - ϕMn =	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	<= 0
Strength As =	0.1028	0.1044	0.1089	0.1111	0.1230	0.1292	0.1268	0.0576	0.0690	0.0702	0.0705	0.0719	0.0793	0.0831	0.0817	in^2/ft width
Strength As total =	1.95	2.09	2.23	2.39	2.46	2.65	2.73	1.27	1.41	1.51	1.55	1.65	1.71	1.83	1.88	in^2

Check rmin for flexural reinforcing:

shrinkage ρ min =	0.00200	0.00200	0.00200	0.00200	0.00200	0.00200	0.00200	0.00180	0.00180	0.00180	0.00180	0.00180	0.00180	0.00180	0.00180	
shrinkage As min =	0.6960	0.6720	0.6480	0.6240	0.5760	0.5520	0.5520	0.7344	0.6264	0.6048	0.6048	0.5832	0.5400	0.5184	0.5184	in^2/ft width
shrinkage As min total =	13.22	13.44	13.28	13.42	11.52	11.32	11.87	16.16	12.84	13.00	13.31	13.41	11.61	11.40	11.92	in^2
ρ min =	0.00335	0.00375	0.00411	0.00444	0.00474	0.00503	0.00530	0.00224	0.00250	0.00274	0.00296	0.00316	0.00335	0.00354	0.00371	
ρ min =	0.00500	0.00500	0.00500	0.00500	0.00500	0.00500	0.00500	0.00333	0.00333	0.00333	0.00333	0.00333	0.00333	0.00333	0.00333	
usemax flexural ρ min =	0.00500	0.00500	0.00500	0.00500	0.00500	0.00503	0.00530	0.00333	0.00333	0.00333	0.00333	0.00333	0.00335	0.00354	0.00371	
As for ρ min =	1.7400	1.6800	1.6200	1.5600	1.4400	1.3886	1.4637	1.3600	1.1600	1.1200	1.1200	1.0800	1.0062	1.0182	1.0679	in^2/ft width
As per ρ min total =	33.06	33.60	33.21	33.54	28.80	28.47	31.47	29.92	23.78	24.08	24.64	24.84	21.63	22.40	24.56	in^2

If strength steel is less than flexural ρ min then provide 1/3x Strength As or shrinkage steel whichever is greater.

Strength As =	0.696	0.672	0.648	0.624	0.576	0.552	0.552	0.7344	0.6264	0.6048	0.6048	0.5832	0.54	0.5184	0.5184	in^2/ft width
Strength As total =	13.22	13.44	13.28	13.42	11.52	11.32	11.87	16.16	12.84	13.00	13.31	13.41	11.61	11.40	11.92	in^2