

CEE 431
Guidelines for Estimating Project

Do's

1. Give a reference for every number that you have obtained from somewhere.
2. Go through project Specs and Means carefully to avoid unnecessary work.
3. State all your assumptions clearly with every assignment.
4. Pick a percent for using as waste factor for a particular task and use it consistently (say 5 %).
5. Divide the task evenly in your team members.
6. Correct your mistakes so that you may get back half the points deducted (all project assignments, corrected or not, will be submitted as part of your project proposal at the end of the course).

Don'ts

1. Do not call the vendors in town for prices.
2. Do not give a page number of Means as a reference. The correct method to give a reference for example is "Means 1990, 073-103-0300".
3. Do not add any waste in material quantity, add it in the cost calculation.

EXAMPLE CONCRETE FLATWORK ESTIMATE

Annotated with links to sources of information. Click on colored rectangles to follow links.

Project: <u>Baker School</u>	Number	Length	Width	Depth	Extension	Extension	Total Quantity	Matl/Equip Cost / Unit	Total Matl/Equip Cost (\$)	Labor Cost / Unit	Total Labor Cost (\$)	Labor Hrs/Unit	Total Labor Hours
Page: <u>7</u>													
By, Date: <u>RIC 1/17/94</u>													
<u>Concrete slabs</u>	#	ft	ft	ft	SF	CF	CY						
Class Area	1	180-054-6	0-6		9,810	4,905							
thickened slab E-W	5	54-01-9	0-9		-	354							
" " NS	2	179-0	"	"	-	470							
thickened edge	2	53-01-9	1-6		-	278							
" "	2	179-0	"	"	-	940							
<out for planters>	2	6-03-6	0-6		<42>	<21>							
condenser pad	1	30-023-3	0-8		698	465							
Σ					10,466	7,391							
<u>Concrete Placement Cost</u>							274 CY	5202	14,253	13.44	3,669	0.471	129
[est] max placement = 10 CY/hr = 80 CY/day (274 CY) / (10 CY/hr) = 27.4 hr > 3 days $\Rightarrow$ use 4 placements = 32 crew hr prod = (274 CY) / (32 crew hr) = 8.6 CY/crew-hr Use medium size crew = 3 laborers + 1 labor foreman to place by direct chute from ready-mix truck Crew: 3 laborers @ \$28.57 = 85.71 1 foreman @ 29.90 = 29.90 \$115.61 / crew-hr / (8.6 CY/crew-hr) = \$13.44 / CY (4 man-hr / crew-hr) / (8.6 CY/crew-hr) = 0.471 man-hr / CY Ready-mix concrete: 3000 psi = \$51.00 / CY [M-R033-060-Detroit] material cost = (\$51.00 / CY) (1.02 waste) = \$52.02 / CY in place													
<u>Concrete Placement Plan</u>													
place in checkerboard													
placement 1 = (13)(5.3) = 69 CY													
2 " " 69													
3 " " 69													
4 (9)(5.3) = 48 CY													
" cond pad = 17													
272 CY $\approx$ 274 CY OK													
each square $\approx \frac{9900 CF}{(9)(12)(27 CY)} = 5.3 CY$													
condenser pad $\approx \frac{465}{27} = 17 CY$													

Project: Baker School
 Page: 8
 By, Date: RK 1/18/94

Number	Length	Width	Depth	Extension	Extension	Total Quantity	Matl/Equip Cost / Unit	Total Matl/Equip Cost (\$)	Labor Cost / Unit	Total Labor Cost (\$)	Labor Hrs/Unit	Total Labor Hours
Concrete finish: (from p. 7)						10,466 ^{SF}	.057	597.49	4,385	0.012	126	
Use steel trowel finish per specs, with cement masons & gas finishing machines												
[est] 1 cement mason can trowel 700 SF/day												
# masons = $\frac{10,466 \text{ SF}}{4 \text{ days} \times 700 \text{ SF/day}} = 3.7 \text{ masons} \Rightarrow \text{Use 4 cement masons}$												
day & 4 machines												
productivity = $\frac{10,466 \text{ SF}}{(4 \text{ days})(8 \text{ hr/day and } 4 \text{ mtr/c-hr})} = 327 \text{ SF/c-hr}$												
labor: 4 masons @ \$34.23/hr = \$136.92/c-hr												
unit cost = $(\$136.92/\text{c-hr}) / (327 \text{ SF/c-hr}) = \$0.419/\text{SF}$												
equipment: 4 machines @ \$37.20/day [Mcnew C-9] = \$18.60/c-hr												
8 c-hr/day												
unit cost = $(\$18.60/\text{c-hr}) / (327 \text{ SF/c-hr}) = \$0.057/\text{SF}$												
Curing:						10,466 ^{SF}	.053	555	—	—	—	—
Use waterproof paper @ (\$0.0525/SF [M-134-0200 (assume includes laps)])												
(labor is included in placement/finishing)												

Project: Baker School		Number	Length	Width	Depth	Extension	Extension	Total Quantity	Matt/Equip Cost / Unit	Total Matt/Equip Cost (\$)	Labor Cost / Unit	Total Labor Cost (\$)	Labor Hrs/Unit	Total Labor Hours
Reinforcing Steel:		ft				number	lap	#4(ft)	#6(ft)	6x6 W5.5x5.5				
class area #4@10'o.c. +		(9,810 ^{sf})	(12" / 10")	(2 way)		1.05		24,721						[4 - each way]
thickened slab E-W 2-#6		5 54	-	-	2	1.03			556					
" " NS "		2 179	-	-	2	1.05			752					
thickened edge E-W 4-#6		2 53	-	-	4	1.05			445					
" " N-S 4-#6		2 179	-	-	4	1.05			1,504					
< planters > #4@10'o.c. +		(42 ^{sf})	(12" / 10")	(2 way)		-	< 101 >							
condenser pad T & B		(698 ^{sf})	(2 [T & B])			1.08			1,508					
Totals								24,620	3,257	1,508				
lb/unit								0.688	1,502	0.80				
lb								16,940	4,880	1,210				
T = lb/2000								8.47	2.45	0.60				[M 207-1020]
\$/T delivered to site (incl accessories)								500	500	700				[M 107-0600]
ironworker T/crow day for 4 rodmen								2.30	2.30	2.00				(5000 SF/day) (0.8 / SF) = 2,000 T/#
[Means ref]								[M 107-0600]	[M 207-1000]					
ironworker \$/crew hr for 4 rodmen + 1 foreman (non working):														
4 reinf ironworkers @ 29.24 = \$116.96/c hr														
1 foreman @ 32.37														
														\$149.33/c hr
labor \$/T = (\$149.33/c hr) (8 hr/day) / (T/c-day)								519	519	597				
man hr/T = (5 man/c hr) (8 hr/day) / (T/c-day)								17.4	17.4	20.0				
									\$/T	\$		\$/T	\$	mh/T
Resteel Cost #4								8.47 ^T	500	4,235	519	4,396	17.4	147
#6								2.45 ^T	500	1,225	519	1,272	17.4	43
6X6 W5.5X5.5								0.60 ^T	700	420	597	358	20.0	12
										5,880		6,026		202
<u>Concrete Flatwork Cost Summary</u>														
Concrete placement (p7)										14,253		3,669		129
finish (p8)										597		4,385		126
curing (p8)										555		-		-
reinforcing (p9)										5,880		6,026		202
										21,285		14,080		457

Project: Broadway Bank
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By Date: RIC 2/1/95

	Number	Length	Width	Depth	Extension	Extension	Total Quantity	Matl/Equip Cost / Unit Total	Matl/Equip Cost (\$)	Labor Cost / Unit Total	Labor Cost (\$)	Hr / Unit Total	Labor Hours
Concrete walls													
S wall, sec. A	1	87'-6"	9'-2"	8"	1604	538	802						
<out for windows>	6	4-8	6-0	8	<336>	<113>	<168>						
E wall	1	48'-5	9'-2	6	888	222	444						
N wall, sec. D	1	41'-6	9'-10	6	934	233	467						
					5833	1587	2917						
						= 59 CY							
Formwork materials - Cost a 4'-0" module @ 9'-2" high													
3/4" plywood 4'x9'-4" = 37.3 SF @ .45 = \$16.79 / 4'-0"													
2-2x4 @ 4'-0" = 8'													
3-2x4 studs @ 10'-0" = 30' 38' = 25.4 FBM													
8-2x6 wales @ 4'-0" = 32' = 32 57.4 FBM @ 0.60 = \$34.44													
lumber for 2 uses = \$51.23 = \$25.62 / ALF													
4-5000# ties, single use @ 0.56 / 2 sides = 1.12													
12'-2x4 shores @ 8' O.C., 2 uses = 0.60													
8 FBM (0.60) / (8'/4') (2 sides) (2 uses) = \$27.34 / ALF													
unit cost = \$27.34 / (4'-0" x 9'-2") = \$27.34 / 36.7 SF = \$0.74 / SFCA													
labor - carpenter													
fabricate @ 1 hr / 8 LF / 2 men = 0.5 hr / 8 LF													
erect @ 1 hr / 16 LF = 0.5													
strip @ 1 hr / 32 LF = 0.25													
1.25 hr / 8 LF @ \$34.20 = \$42.75 / 8 LF													
laborer clean = (1 hr) (1 cleaning) / ((32 LF) (2 men)) = 0.125 hr @ \$28.60 = 3.58													
1.375 hr / 8 x 9'-2" = \$46.33 / 8 x 9'-2" = \$0.63 / SFCA													
= 0.019 hr / SFCA													
SFCA													
Formwork = 5833 0.74 4316 0.63 3,675 0.019 111													

The diagram illustrates the formwork setup for concrete walls. It shows two vertical sections labeled 'S wall, sec. A' and 'N wall, sec. D'. The height of each section is indicated as 9'-2". The width of the modules is shown as 4'-0". The diagram also depicts the internal bracing system, including horizontal walers (2x6), vertical studs (2x4), and diagonal braces (2x4). Dimensions for the bracing are given as 10'-0" between walers and 8'-0" between studs.

033 | Cast-In-Place Concrete

033 100 Structural Concrete		CREW	DAILY OUTPUT	MAN- HOURS	UNIT	1993 BARE COSTS				TOTAL INCL O&P		
						MAT.	LABOR	EQUIP.	TOTAL			
118	0700	Curing compound,(200 to 400 S.F. per gallon), 55 gal. lots				Gal.	6.85			6.85	7.55	118
	0720	5 gallon lots					7.65			7.65	8.40	
	0800	Premium grade,(450 S.F. per gallon), 55 gallon lots					13.25			13.25	14.60	
	0820	5 gallon lots					14.10			14.10	15.50	
	0900	Dustproofing compound,(200-600 S.F./gal.), 55 gallon lots					7			7	7.70	
	0920	5 gallon lots				↓	8			8	8.80	
	1000	Epoxy dustproof coating, colors,(300-400 S.F. per coat),										
	1010	or transparent,(400-600 S.F. per coat)				Gal.	50			50	55	
	1100	Hardeners, metallic, 55 lb. bags, natural (grey)				Lb.	.41			.41	.45	
	1200	Colors, average				↓	.67			.67	.74	
	1300	Non-metallic, 55 lb. bags, natural (grey), minimum					.34			.34	.37	
	1310	Maximum					.58			.58	.64	
	1320	Non-metallic, colors, minimum					.38			.38	.42	
	1340	Maximum					.62			.62	.68	
	1400	Non-metallic, non-slip, 100 lb. bags, minimum					.38			.38	.42	
	1420	Maximum				↓	.75			.75	.83	
	1500	Solution type,(300 to 400 S.F. per gallon)				Gal.	5.25			5.25	5.80	
	1510											
	1550	Release agent, for tilt slabs				Gal.	7.25			7.25	8	
	1570	For forms, average				↓	4.75			4.75	5.20	
	1600	Sealer, hardener and dustproofer, clear, 450 S.F., minimum					7			7	7.70	
	1620	Maximum					19.25			19.25	21	
	1700	Colors (300-400 S.F. per gallon)				↓	17			17	18.70	
	1710											
	1800	Set accelerator for below freezing, 1 to 1-1/2 gal. per C.Y.				Gal.	4.30			4.30	4.73	
	1900	Set retarder, 2 to 4 fl. oz. per bag of cement				*	13.60			13.60	14.95	
	2000	Waterproofing, integral 1 lb. per bag of cement				Lb.	.83			.83	.91	
	2100	Powdered metallic, 40 lbs. per 100 S.F., minimum				↓	.83			.83	.91	
	2120	Maximum				↓	1.75			1.75	1.93	
	2200	Water reducing admixture, average				Gal.	7.75			7.75	8.55	
122	0010	CONCRETE, FIELD MIX FOB forms 2250 psi				C.Y.	51			51	56	122
	0020	2000 psi				*	53.50			53.50	59	
126	0010	CONCRETE, READY MIX Regular weight, 2000 psi				C.Y.	45.50			45.50	50	126
	0100	2500 psi				↓	47			47	51.50	
	0150	3000 psi					48			48	53	
	0200	3500 psi					49.50			49.50	54.50	
	0250	3750 psi					50			50	55	
	0300	4000 psi					50.50			50.50	55.50	
	0350	4500 psi					52			52	57	
	0400	5000 psi					53			53	58.50	
	0411	6000 psi					60.50			60.50	66.50	
	0412	8000 psi					98.50			98.50	108	
	0413	10000 psi					140			140	154	
	0414	12000 psi					169			169	186	
	1000	For high early strength cement, add					10%					
	1010	For structural lightweight with regular sand, add					25%					
	2000	For all lightweight aggregate, add				↓	45%					
	3000	For integral colors, 2500 psi, 5 bag mix										
3100	Red, yellow or brown, 1.8 lb. per bag, add				C.Y.	11.50			11.50	12.65		
3200	9.4 lb. per bag, add				↓	61			61	67		
3400	Black, 1.8 lb. per bag, add					13.50			13.50	14.85		
3500	7.5 lb. per bag, add					56			56	61.50		
3700	Green, 1.8 lb. per bag, add					26.50			26.50	29		
3800	7.5 lb. per bag, add				↓	111			111	122		
130	0010	CONCRETE IN PLACE Including forms (4 uses), reinforcing										130
	0050	steel, including finishing unless otherwise indicated										

3
CONCRETE

Concrete

R033

Cast-In-Place Concrete

R033-060 Concrete Material Net Prices

Costs below are C.Y. of concrete delivered, per ton of bulk cement; per bag cement delivered T.L.L.; per ton for stone and sand

aggregates loaded at plant (no trucking included) and per 4 C.F. bag for perlite or vermiculite aggregate delivered T.L.L.

City	Ready Mix Concrete		Cement T.L. Lots		Aggregates per Ton			Vermiculite or Perlite 4 C.F. Bag
	Regular Weight		Bulk per Ton	Bags per Bag	Crushed Stone		Sand	
	3000 psi	5000 psi			1-1/2"	3/4"		
Atlanta	\$41.30	\$48.85	\$63.95	\$5.75	\$ 9.75	\$ 9.95	\$ 8.25	\$6.85
Baltimore	54.80	53.65	63.65	6.35	8.50	9.05	6.55	6.05
Boston	59.25	58.35	65.25	6.55	11.55	12.75	7.40	6.70
Buffalo	57.00	60.05	68.20	6.45	8.85	9.30	7.90	7.00
Chicago	47.50	51.95	66.55	6.10	9.60	9.85	6.40	6.00
Cincinnati	40.00	50.30	62.65	6.15	9.65	10.30	4.70	7.10
Cleveland	51.00	49.10	64.30	6.45	10.10	10.65	7.70	7.05
Columbus	50.60	52.25	68.55	6.40	8.50	8.75	6.20	7.00
Dallas	46.15	47.50	60.25	5.10	10.65	10.90	6.55	6.60
Denver	47.50	62.80	72.30	6.75	9.80	9.95	5.80	6.95
Detroit	51.00	61.30	63.30	5.90	9.30	9.45	5.65	6.95
Houston	40.00	47.25	62.70	5.60	10.45	10.10	7.30	6.20
Indianapolis	47.25	51.60	64.25	6.65	8.75	9.30	6.70	6.95
Kansas City	45.00	49.80	72.20	6.75	10.00	10.30	6.40	7.10
Los Angeles	56.00	54.35	72.55	7.05	10.90	11.50	7.90	7.25
Memphis	44.25	49.95	64.60	6.80	9.25	9.60	6.85	6.65
Milwaukee	46.50	48.10	67.60	6.50	9.35	9.75	6.10	6.55
Minneapolis	51.25	52.05	72.80	5.80	12.55	12.80	6.75	6.75
Nashville	34.75	52.20	65.35	6.35	9.65	9.75	7.95	6.35
New Orleans	47.30	43.90	61.00	5.95	11.20	11.80	8.05	6.85
New York City	62.50	70.10	68.35	7.10	15.10	16.70	11.25	7.10
Philadelphia	45.50	50.70	65.90	6.20	11.15	11.75	6.85	6.35
Phoenix	42.00	51.25	65.25	5.85	8.50	9.00	7.65	6.70
Pittsburgh	50.00	51.35	65.65	6.30	14.00	14.00	8.35	6.60
St. Louis	44.05	49.25	59.80	5.80	9.85	10.75	7.95	6.85
San Antonio	42.00	42.45	60.00	5.70	8.15	7.45	5.35	6.10
San Diego	52.05	56.85	67.60	6.55	9.95	10.05	8.05	6.20
San Francisco	53.15	56.70	69.70	6.75	11.20	13.25	10.75	6.45
Seattle	49.20	50.15	65.85	6.50	11.05	11.50	7.15	6.85
Washington, D.C.	48.75	57.85	64.85	6.30	12.35	13.35	8.55	7.10
Average	\$48.25	\$52.75	\$65.85	\$6.30	\$10.30	\$10.80	\$ 7.30	\$6.70

R033-070 Ready Mix Material Prices

Table below lists national average prices per C.Y. of concrete. Prices in the key cities for different strengths can be closely estimated by factoring against the 3000 psi or 5000 psi price from

R033-060 above or from the City Cost Indexes, cast-in-place concrete material factor.

Strength in psi	Design Mix	Bags per C.Y.	Heavy Weight		Light Weight		Admixtures and Special Items	
	Nominal Mix		Regular	High Early	110# per C.F.	All Light Weight	Add to Each C.Y. of Concrete for the Following Items:	
2,000	1:3:5	4.5	\$45.65	\$49.36	\$57.96	\$70.33	Calcium chloride, 1%	\$1.30 per C.Y.
2,500	1:2-1/2:4-1/2	5	46.85	51.01	59.20	71.58	" 2%	2.60 per C.Y.
3,000	1:2:4	5.5	48.25	52.67	60.44	72.82	Water reducing agent	.15 per bag
3,500	1:2:3-1/2	6	49.40	54.33	61.69	74.06	Set retarder	.50 per bag
3,750	1:2:3-1/4	6.3	50.00	55.20	62.33	74.70	High early cement	.90 per bag
4,000	1:2:3	6.5	50.78	56.03	62.97	75.35	White cement	8.20 per bag
4,500	1:2:2-1/2	7	51.90	57.68	64.22	76.59	Pump aid	1.80 per C.Y.
5,000	1:1-1/2:2-1/2	7.5	52.75	59.34	65.46	77.83	Winter concrete	4.00 per C.Y.
	1:1:2	8	55.66	62.28	-	Perlite	Synthetic Fiber Reinforcing	7.75 per C.Y.
	1:4 topping	7.5	53.77	59.98	-	1:6 =		
	1:3 topping	8.5	55.89	62.93	-	\$70.75		
	1:2 topping	11	60.03	69.14	-			

REFERENCE TABLES

CREWS

Crew No.	Bare Costs		Incl. Subs O & P		Cost Per Man-Hour	
	Hr.	Daily	Hr.	Daily	Bare Costs	Incl. O&P
Crew B-94D						
1 Building Laborer	\$18.55	\$148.40	\$29.10	\$232.80	\$18.55	\$29.10
1 Centr. Water Pump, 6"		156.80		172.50		
1-20 Ft. Suction Hose, 6"		19.40		21.35		
2-50 Ft. Disch. Hoses, 6"		30.80		33.90	25.88	28.46
8 M.H., Daily Totals	\$355.40		\$460.55		\$44.43	\$57.56
Crew B-95						
1 Equip. Oper. (crane)	\$24.95	\$199.60	\$38.05	\$304.40	\$21.75	\$33.58
1 Building Laborer	18.55	148.40	29.10	232.80		
16 M.H., Daily Totals	\$348.00		\$537.20		\$21.75	\$33.58
Crew B-95A						
1 Equip. Oper. (crane)	\$24.95	\$199.60	\$38.05	\$304.40	\$21.75	\$33.58
1 Building Laborer	18.55	148.40	29.10	232.80		
1 Hyd. Excavator, 5/8 C.Y.		372.40		409.65	23.28	25.60
16 M.H., Daily Totals	\$720.40		\$946.85		\$45.03	\$59.18
Crew B-95B						
1 Equip. Oper. (crane)	\$24.95	\$199.60	\$38.05	\$304.40	\$21.75	\$33.58
1 Building Laborer	18.55	148.40	29.10	232.80		
1 Hyd. Excavator, 1.5 C.Y.		724.60		797.05	45.29	49.82
16 M.H., Daily Totals	\$1072.60		\$1334.25		\$67.04	\$83.40
Crew B-95C						
1 Equip. Oper. (crane)	\$24.95	\$199.60	\$38.05	\$304.40	\$21.75	\$33.58
1 Building Laborer	18.55	148.40	29.10	232.80		
1 Hyd. Excavator, 2.5 C.Y.		1732.00		1905.20	108.25	119.08
16 M.H., Daily Totals	\$2080.00		\$2442.40		\$130.00	\$152.66
Crew C-1						
3 Carpenters	\$23.35	\$560.40	\$36.65	\$879.60	\$22.15	\$34.76
1 Building Laborer	18.55	148.40	29.10	232.80		
3 Power Tools		24.60		27.05	.77	.85
32 M.H., Daily Totals	\$733.40		\$1139.45		\$22.92	\$35.61
Crew C-1A						
1 Carpenter	\$23.35	\$186.80	\$36.65	\$293.20	\$23.35	\$36.65
1 Circular Saw, 7"		8.20		9.00	1.03	1.13
8 M.H., Daily Totals	\$195.00		\$302.20		\$24.38	\$37.78
Crew C-2						
1 Carpenter Foreman (out)	\$25.35	\$202.80	\$39.80	\$318.40	\$22.88	\$35.92
4 Carpenters	23.35	747.20	36.65	1172.80		
1 Building Laborer	18.55	148.40	29.10	232.80		
4 Power Tools		32.80		36.10	.68	.75
48 M.H., Daily Totals	\$1131.20		\$1760.10		\$23.56	\$36.67
Crew C-3						
1 Rodman Foreman	\$27.85	\$222.80	\$48.80	\$390.40	\$23.93	\$40.43
4 Rodmen (reinf.)	25.85	827.20	45.30	1449.60		
1 Equip. Oper. (light)	23.10	184.80	35.25	282.00		
2 Building Laborers	18.55	296.80	29.10	465.60		
3 Stressing Equipment		36.60		40.25		
5 Grouting Equipment		121.40		133.55	2.47	2.72
64 M.H., Daily Totals	\$1689.60		\$2761.40		\$26.40	\$43.15

Crew No.	Bare Costs		Incl. Subs O & P		Cost Per Man-Hour	
	Hr.	Daily	Hr.	Daily	Bare Costs	Incl. O&P
Crew C-4						
1 Rodman Foreman	\$27.85	\$222.80	\$48.80	\$390.40	\$26.35	\$46.17
3 Rodmen (reinf.)	25.85	620.40	45.30	1087.20		
3 Stressing Equipment		36.60		40.25	1.14	1.26
32 M.H., Daily Totals	\$879.80		\$1517.85		\$27.49	\$47.43
Crew C-5						
1 Rodman Foreman	\$27.85	\$222.80	\$48.80	\$390.40	\$25.21	\$42.71
4 Rodmen (reinf.)	25.85	827.20	45.30	1449.60		
1 Equip. Oper. (crane)	24.95	199.60	38.05	304.40		
1 Equip. Oper. Oiler	20.25	162.00	30.90	247.20		
1 Hyd. Crane, 25 Ton		508.20		559.00	9.08	9.98
56 M.H., Daily Totals	\$1919.80		\$2950.60		\$34.29	\$52.69
Crew C-6						
1 Labor Foreman (outside)	\$20.55	\$164.40	\$32.25	\$258.00	\$19.63	\$30.51
4 Building Laborers	18.55	593.60	29.10	931.20		
1 Cement Finisher	23.05	184.40	34.40	275.20		
2 Gas Engine Vibrators		64.80		71.30	1.35	1.49
48 M.H., Daily Totals	\$1007.20		\$1535.70		\$20.98	\$32.00
Crew C-7						
1 Labor Foreman (outside)	\$20.55	\$164.40	\$32.25	\$258.00	\$20.06	\$31.11
5 Building Laborers	18.55	742.00	29.10	1164.00		
1 Cement Finisher	23.05	184.40	34.40	275.20		
1 Equip. Oper. (med.)	24.10	192.80	36.75	294.00		
2 Gas Engine Vibrators		64.80		71.30		
1 Concrete Bucket, 1 C.Y.		19.20		21.10		
1 Hyd. Crane, 55 Ton		710.00		781.00	12.41	13.65
64 M.H., Daily Totals	\$2077.60		\$2864.60		\$32.47	\$44.76
Crew C-8						
1 Labor Foreman (outside)	\$20.55	\$164.40	\$32.25	\$258.00	\$20.91	\$32.16
3 Building Laborers	18.55	445.20	29.10	698.40		
2 Cement Finishers	23.05	368.80	34.40	550.40		
1 Equip. Oper. (med.)	24.10	192.80	36.75	294.00		
1 Concrete Pump (small)		542.60		596.85	9.69	10.66
56 M.H., Daily Totals	\$1713.80		\$2397.65		\$30.60	\$42.82
Crew C-8A						
1 Labor Foreman (outside)	\$20.55	\$164.40	\$32.25	\$258.00	\$20.38	\$31.39
3 Building Laborers	18.55	445.20	29.10	698.40		
2 Cement Finishers	23.05	368.80	34.40	550.40		
48 M.H., Daily Totals	\$978.40		\$1506.80		\$20.38	\$31.39
Crew C-9						
1 Cement Finisher	\$23.05	\$184.40	\$34.40	\$275.20	\$23.05	\$34.40
1 Gas Finishing Mach.		\$37.20		40.90	4.65	5.12
8 M.H., Daily Totals	\$221.60		\$316.10		\$27.70	\$39.52
Crew C-10						
1 Building Laborer	\$18.55	\$148.40	\$29.10	\$232.80	\$21.55	\$32.63
2 Cement Finishers	23.05	368.80	34.40	550.40		
2 Gas Finishing Mach.		74.40		81.85	3.10	3.41
24 M.H., Daily Totals	\$591.60		\$865.05		\$24.65	\$36.04

(P.8)

CREWS

033 | Cast-In-Place Concrete

3
CONCRETE

033 100 Structural Concrete			CREW	DAILY OUTPUT	MAN-HOURS	UNIT	1993 BARE COSTS				TOTAL INCL O&P
							MAT.	LABOR	EQUIP.	TOTAL	
130	3800	Footings, spread under 1 C.Y.	C-17B	31.82	2.577	C.Y.	68	63	7.90	138.90	183
	3850	Over 5 C.Y.	C-17C	70.45	1.178		64	29	5.35	98.35	122
	3900	Footings, strip, 18" x 9", plain	C-17B	34.22	2.396		59	58.50	7.35	124.85	166
	3950	36" x 12", reinforced		49.07	1.671		63	41	5.15	109.15	140
	4000	Foundation mat, under 10 C.Y.		32.32	2.537		107	62	7.80	176.80	225
	4050	Over 20 C.Y.		47.37	1.731		103	42.50	5.30	150.80	186
	4200	Grade walls, 8" thick, 8' high	C-15	10.16	7.087		109	157	5.25	271.25	375
	4250	14' high	C-20	7.30	8.767		175	176	83	434	560
	4260	12" thick, 8' high	C-17A	13.50	6		138	147	9.35	294.35	395
	4270	14' high	C-20	11.60	5.517		130	111	52.50	293.50	375
	4300	15" thick, 8' high	C-17B	20.01	4.098		84	100	12.60	196.60	264
	4350	12' high	C-20	14.80	4.324		110	87	41	238	300
	4500	18' high	"	12	5.333		130	107	50.50	287.50	365
	4510										
	4650	Slab on grade, not including finish, 4" thick	C-17C	75.28	1.103	C.Y.	56	27	5	88	110
	4700	6" thick	"	113.47	.731	"	54	17.95	3.33	75.28	91
	4750	Slab on grade, incl. troweled finish, not incl. forms									
	4760	or reinforcing, over 10,000 S.F., 4" thick slab	C-8	3,520	.016	S.F.	.67	.33	.15	1.15	1.42
	4820	6" thick slab		3,610	.016		1.04	.32	.15	1.51	1.81
	4840	8" thick slab		3,275	.017		1.30	.36	.17	1.83	2.16
	4900	12" thick slab		2,875	.019		1.94	.41	.19	2.54	2.97
	4950	15" thick slab		2,560	.022		2.42	.46	.21	3.09	3.59
	5000	Slab on grade, incl. textured finish, not incl. forms									
	5001	or reinforcing, 4" thick slab	C-8A	2,200	.022	S.F.	1.14	.44		1.58	1.93
	5010	6" thick		2,000	.024		1.44	.49		1.93	2.33
	5020	8" thick		1,800	.027		1.79	.54		2.33	2.81
	5200	Lift slab in place above the foundation, incl. forms,									
	5210	reinforcing, concrete and columns, minimum	C-17E	745	.107	S.F.	2.50	2.63	.08	5.21	6.95
	5250	Average		675	.119		4.10	2.90	.09	7.09	9.15
	5300	Maximum		430	.186		4.45	4.56	.13	9.14	12.25
	5500	Lightweight, ready mix, including screed finish only,									
	5510	not including forms or reinforcing									
	5550	1:4 for structural roof decks	C-8	80	.700	C.Y.	76	14.65	6.80	97.45	113
	5600	1:6 for ground slab with radiant heat		90	.622		73	13	6.05	92.05	107
	5650	1:3:2 with sand aggregate, roof deck		80	.700		77	14.65	6.80	98.45	114
	5700	Ground slab		105	.533		77	11.15	5.15	93.30	107
	5900	Pile caps, incl. forms and reinf., sq. or rect., under 5 C.Y.	C-17C	47.26	1.756		70	43	8	121	153
	5950	Over 10 C.Y.		76.47	1.085		64	26.50	4.94	95.44	118
	6000	Triangular or hexagonal, under 5 C.Y.		47.95	1.731		72	42.50	7.90	122.40	155
	6050	Over 10 C.Y.		77.85	1.066		69	26	4.85	99.85	122
	6200	Retaining walls, gravity, 4' high see division 022-708	C-17B	19.10	4.293		66	105	13.20	184.20	253
	6250	10' high		27.10	3.026		68	74	9.30	151.30	202
	6300	Cantilever, level backfill loading, 8' high		16.30	5.031		125	123	15.45	263.45	350
	6350	16' high		17	4.824		113	118	14.80	245.80	325
	6800	Stairs, not including safety treads, free standing	C-15	120	.600	LF Nose	5	13.30	.44	18.74	27
	6850	Cast on ground		180	.400	"	3.77	8.85	.30	12.92	18.50
	7000	Stair landings, free standing		285	.253	S.F.	2.10	5.60	.19	7.89	11.35
	7050	Cast on ground		685	.105	"	1.22	2.33	.08	3.63	5.10
134	0010	CURING With burlap, 4 uses assumed, 7.5 oz.	2 Clab	55	.291	C.S.F.	2.70	5.40		8.10	11.40
	0100	12 oz.		55	.291		3.90	5.40		9.30	12.75
	0200	With waterproof curing paper, 2 ply, reinforced		70	.229		\$ 5.25 / CSF	4.24		9.49	12.45
	0300	With sprayed membrane curing compound		95	.168		2.05	3.12		5.17	7.15
	0400	Curing blankets, 1" to 2" thick, buy, minimum				S.F.	.80			.80	.88
	0450	Maximum					2.50			2.50	2.75
	0500	Electrically heated pads, 110 volts, 15 watts per S.F., buy					4.20			4.20	4.62
	0600	20 watts per S.F., buy					5.60		5.60	6.15	

[EN134-0200]

$$\frac{\$5.25}{100\text{SF}} = \$0.0525/\text{SF} \rightarrow (\text{P.8})$$

R032-010 Reinforcing Steel Weights and Measures

Bar Designation No.**	Nominal Weight Lb./Ft.	U.S. Customary Units			SI Units			
		Nominal Dimensions*			Nominal Dimensions*			
		Diameter in.	Cross Sectional Area, in. ²	Perimeter in.	Nominal Weight kg/m	Diameter mm	Cross Sectional Area, cm ²	Perimeter mm
3	.376	.375	.11	1.178	.560	9.52	.71	29.9
4	.688	.500 $\approx \frac{4}{8}$	.20	1.571	.994	12.70	1.29	39.9
5	1.043	.625 $\approx \frac{5}{8}$	.31	1.963	1.552	15.88	2.00	49.9
6	1.502	.750 $\approx \frac{6}{8}$	.44	2.356	2.235	19.05	2.84	59.8
7	2.044	.875	.60	2.749	3.042	22.22	3.87	69.8
8	2.670	1.000	.79	3.142	3.973	25.40	5.10	79.8
9	3.400	1.128 $\approx \frac{9}{8}$	1.00	3.544	5.059	28.65	6.45	90.0
10	4.303	1.270	1.27	3.990	6.403	32.26	8.19	101.4
11	5.313	1.410	1.56	4.430	7.906	35.81	10.06	112.5
14	7.650	1.693	2.25	5.320	11.384	43.00	14.52	135.1
18	13.600	2.257	4.00	7.090	20.238	57.33	25.81	180.1

* The nominal dimensions of a deformed bar are equivalent to those of a plain round bar having the same weight per foot as the deformed bar.

** Bar numbers are based on the number of eighths of an inch included in the nominal diameter of the bars.

R032-020 Metric Rebar Specification - ASTM A615-81

Grade 300 (300 MPa* = 43,560 psi; +8.7% vs. Grade 40)				
Grade 400 (400 MPa* = 58,000 psi; -3.4% vs. Grade 60)				
Bar No.	Diameter mm	Area mm ²	Equivalent in. ²	Comparison with U.S. Customary Bars
10	11.3	100	.16	Between #3 & #4
15	16.0	200	.31	#5 (.31 in. ²)
20	19.5	300	.47	#6 (.44 in. ²)
25	25.2	500	.78	#8 (.79 in. ²)
30	29.9	700	1.09	#9 (1.00 in. ²)
35	35.7	1000	1.55	#11 (1.56 in. ²)
45	43.7	1500	2.33	#14 (2.25 in. ²)
55	56.4	2500	3.88	#18 (4.00 in. ²)

* MPa = megapascals

R032-030 Common Stock Styles of Welded Wire Fabric

This table provides some of the basic specifications, sizes, and weights of welded wire fabric used for reinforcing concrete.

New Designation		Old Designation		Steel Area per Foot				Approximate Weight per 100 S.F.	
Spacing - Cross Sectional Area (in.) - (Sq. in. 100)		Spacing - Wire Gauge (in.) - (AS & W)		Longitudinal		Transverse		lbs	kg
				in. ²	cm ²	in. ²	cm ²		
Rolls	6 x 6 - W1.4 x W1.4	6 x 6 - 10 x 10	1	.028	.071	.028	.071	21	9.53
	6 x 6 - W2.0 x W2.0	6 x 6 - 8 x 8		.040	.102	.040	.102	29	13.15
	6 x 6 - W2.9 x W2.9	6 x 6 - 6 x 6		.058	.147	.058	.147	42	19.05
	6 x 6 - W4.0 x W4.0	6 x 6 - 4 x 4		.080	.203	.080	.203	58	26.91
	4 x 4 - W1.4 x W1.4	4 x 4 - 10 x 10	1	.042	.107	.042	.107	31	14.06
	4 x 4 - W2.0 x W2.0	4 x 4 - 8 x 8		.060	.152	.060	.152	43	19.50
	4 x 4 - W2.9 x W2.9	4 x 4 - 6 x 6		.087	.227	.087	.227	62	28.12
	4 x 4 - W4.0 x W4.0	4 x 4 - 4 x 4		.120	.305	.120	.305	85	38.56
Sheets	6 x 6 - W2.9 x W2.9	6 x 6 - 6 x 6	2	.058	.147	.058	.147	42	19.05
	6 x 6 - W4.0 x W4.0	6 x 6 - 4 x 4		.080	.203	.080	.203	58	26.31
	6 x 6 - W5.5 x W5.5	6 x 6 - 2 x 2		.110	.279	.110	.279	80	36.29
	4 x 4 - W1.4 x W1.4	4 x 4 - 4 x 4		.120	.305	.120	.305	85	38.56

NOTES: 1. Exact W—number size for 8 gauge is W2.1
2. Exact W—number size for 2 gauge is W5.4

$$\rightarrow 80 \frac{\text{lbs}}{\text{CSF}} = \frac{80 \text{ lbs}}{100 \text{ SF}} = 0.8 \frac{\text{lbs}}{\text{SF}}$$

$$\text{Cross sectional area} = \frac{5.5}{100} \text{ in}^2 = 0.055 \text{ in}^2$$

$$0.110 \frac{\text{in}^2}{\text{ft}} = 0.055 \text{ in}^2 \times \frac{2 \text{ rods}}{\text{ft}}$$

(P.9)

032 | Concrete Reinforcement

032 100 Reinforcing Steel		CREW	DAILY OUTPUT	MAN-HOURS	UNIT	1993 BARE COSTS				TOTAL INCL O&P	
						MAT.	LABOR	EQUIP.	TOTAL		
102	3600	Spacers, plastic for 1" bar clearance, average			M	44.50			44.50	49	
	3620	For 2" bar clearance, average			↓	54.50			54.50	60	
	3800	Subgrade chairs, (SCSGC) 1/2" diameter, 3-1/2" high			C	261			261	287	
	3850	12" high			↓	750			750	825	
	3900	3/4" diameter, 3-1/2" high			↓	345			345	380	
	3950	12" high			↓	790			790	865	
	4200	Subgrade stakes (SCSGS) 1/2" diameter, 16" long			↓	210			210	231	
	4250	24" long			↓	305			305	335	
	4300	3/4" diameter, 16" long			↓	229			229	252	
	4350	28" long			↓	355			355	390	
	4500	Tie wire, 16 ga. annealed steel, under 500 lbs.			Cwt.	74.50			74.50	82	
	4520	2,000 to 4,000 lbs.			"	68.50			68.50	75.50	
	4550	Tie wire holder, plastic case			Ea.	32			32	35	
	4600	Aluminum case			"	34			34	37.50	
104	0010	COATED REINFORCING Add to material									
	0100	Epoxy coated			Cwt.	16.30			16.30	17.95	
	0150	Galvanized, #3				26.50			26.50	29	
	0200	#4				26			26	28.50	
	0250	#5				22.50			22.50	25	
	0300	#6 or over				21			21	23.50	
	1000	For over 20 tons, #6 or larger, minimum				18.50			18.50	20.50	
	1500	Maximum			↓	22			22	24	
107	0010	REINFORCING IN PLACE A615 Grade 60									
	0100	Beams & Girders, #3 to #7	R032-010	4 Rodm	1.60	20	Ton	500	515	1,015	1,450
	0150	#8 to #18	R032-020		2.70	11.852		490	305	795	1,075
	0200	Columns, #3 to #7	R032-020		1.50	21.333		500	550	1,050	1,525
	0250	#8 to #18	R032-040		2.30	13.913		490	360	850	1,175
	0300	Spirals, hot rolled, 8" to 15" diameter	R032-040		2.20	14.545		1,050	375	1,425	1,800
	0320	15" to 24" diameter	R032-050		2.20	14.545		1,000	375	1,375	1,750
	0330	24" to 36" diameter	R032-050		2.30	13.913		980	360	1,340	1,700
	0340	36" to 48" diameter	R032-060		2.40	13.333		1,000	345	1,345	1,700
	0360	48" to 64" diameter	R032-060		2.50	12.800		1,050	330	1,380	1,725
	0380	64" to 84" diameter	R032-080		2.60	12.308		1,125	320	1,445	1,800
	0390	84" to 96" diameter	R032-080		2.70	11.852		1,125	305	1,430	1,775
	0400	Elevated slabs, #4 to #7			2.90	11.034		510	285	795	1,050
	0500	Footings, #4 to #7			2.10	15.238		490	395	885	1,225
	0550	#8 to #18			3.60	8.889		485	230	715	940
	0600	Slab on grade, #3 to #7			2.30	13.913		500	360	860	1,175
	0700	Walls, #3 to #7			3	10.667		500	276	776	1,025
	0750	#8 to #18			4	8		485	207	692	895
	1000	Typical in place, 10 ton lots, average			1.70	18.824		510	485	995	1,425
	1100	Over 50 ton lots, average			2.30	13.913		485	360	845	1,175
	1200	High strength steel, Grade 75, #14 bars only, add						50		50	55
	2000	Unloading & sorting, add to above									
	2200	Crane cost for handling, add to above, minimum			135	.415		10.45	3.77	14.22	22
	2210	Average			92	.609		15.35	5.55	20.90	32
	2220	Maximum			35	1.600		40.50	14.55	55.05	84.50
	2400	Dowels, 2 feet long, deformed, #3 bar			140	.114		.85	2.95	3.80	6.15
	2410	#4 bar			125	.128		.99	3.31	4.30	6.90
	2420	#5 bar			110	.145		1.20	3.76	4.96	7.90
	2430	#6 bar			105	.152		1.61	3.94	5.55	8.65
	2450	Longer and heavier dowels			450	.036		.40	.92	1.32	2.05
	2500	Smooth dowels, 12" long, 1/4" or 3/8" diameter			140	.114		.61	2.95	3.56	5.85
	2520	5/8" diameter			125	.128		1.07	3.31	4.38	7
	2530	3/4" diameter			110	.145		1.32	3.76	5.08	8.05
	2550										

CONCRETE 3

[M107-0600]

(P.9) ←
T
C-DAY
M-HRS
T
2.30
13.913
500/T
\$

$$\frac{1}{2.30} \frac{C-DAY}{T} \times \frac{4 \text{ MEN}}{C} \times \frac{8 \text{ HRS}}{\text{DAY}} = 13.913 \frac{M-HRS}{T}$$

032 | Concrete Reinforcement

032 200 | Welded Wire Fabric

			CREW	DAILY OUTPUT	MAN- HOURS	UNIT	1993 BARE COSTS				TOTAL INCL O&P
							MAT.	LABOR	EQUIP.	TOTAL	
207	0300	6 x 6 - W2.9 x W2.9 (6 x 6) 42 lb. per C.S.F.	2 Rodm	29	.552	C.S.F.	13.10	14.25		27.35	39.50
	0400	6 x 6 - W4 x W4 (4 x 4) 58 lb. per C.S.F.		27	.593		17.65	15.30		32.95	46.50
	0500	4 x 4 - W1.4 x W1.4 (10 x 10) 31 lb. per C.S.F.		31	.516		10.40	13.35		23.75	35
	0600	4 x 4 - W2.1 x W2.1 (8 x 8) 44 lb. per C.S.F.		29	.552		12.50	14.25		26.75	39
	0650	4 x 4 - W2.9 x W2.9 (6 x 6) 61 lb. per C.S.F.		27	.593		17.75	15.30		33.05	46.50
	0700	4 x 4 - W4 x W4 (4 x 4) 85 lb. per C.S.F.		25	.640		26.50	16.55		43.05	58.50
	0800	2 x 2 - #14 galv. @ 21 lb., beam & column wrap		6.50	2.462		12.70	63.50		76.20	126
	0900	2 x 2 - #12 galv. for gunite reinforcing		6.50	2.462		16.75	63.50		80.25	130
	0950	Material prices for above include 10% lap									
	1000	Material prices for above include 10% lap									
	1010	Specially fabricated heavier gauges in sheets	4 Rodm	50	.640	C.S.F.		16.55		16.55	29
	1020	Material only, minimum				Ton				550	605
	1030	Average								700	770
		Maximum								855	940

240	0010	FIBROUS REINFORCING									240
	0100	Synthetic fibers				Lb.	4.50			4.50	4.95
	0110	Synthetic fibers, 1-1/2 lb. per C.Y., add to concrete				C.Y.	6.75			6.75	7.45
	0150	Steel fibers				Lb.	.50			.50	.55
	0160	Steel fibers, 50 lb. per C.Y., add to concrete				C.Y.	25			25	27.50
	0170	Steel fibers, 75 lb. per C.Y., add to concrete					37.50			37.50	41.50
	0180	Steel fibers, 100 lb. per C.Y., add to concrete					50			50	55

032 300 | Stressing Tendons

307	0010	PRESTRESSING STEEL Post-tensioned in field									307
	0020										
	0100	Grouted strand, 50' span, 100 kip	C-3	1,200	.053	Lb.	1.72	1.28	.13	3.13	4.20
	0150	300 kip		2,700	.024		1.39	.57	.06	2.02	2.55
	0300	100' span, grouted, 100 kip		1,700	.038		1.14	.90	.09	2.13	2.87
	0350	300 kip		3,200	.020		1.01	.48	.05	1.54	1.97
	0500	200' span, grouted, 100 kip		2,700	.024		1.06	.57	.06	1.69	2.19
	0550	300 kip		3,500	.018		.98	.44	.05	1.47	1.87
	0800	Grouted bars, 50' span, 42 kip		2,600	.025		1.14	.59	.06	1.79	2.32
	0850	143 kip		3,200	.020		1	.48	.05	1.53	1.96
	1000	75' span, grouted, 42 kip		3,200	.020		.93	.48	.05	1.46	1.88
	1050	143 kip		4,200	.015		.88	.36	.04	1.28	1.63
	1200	Ungouted strand, 50' span, 100 kip	C-4	1,275	.025		1.11	.66	.03	1.80	2.41
	1250	200 kip		1,475	.022		1.12	.57	.02	1.71	2.26
	1400	100' span, ungouted, 100 kip		1,500	.021		.94	.56	.02	1.52	2.04
	1450	200 kip		1,650	.019		.96	.51	.02	1.49	1.98
	1600	200' span, ungouted, 100 kip		1,500	.021		.88	.56	.02	1.46	1.98
	1650	200 kip		1,700	.019		.89	.50	.02	1.41	1.87
	1800	Ungouted bars, 50' span, 42 kip		1,400	.023		1.01	.60	.03	1.64	2.20
	1850	143 kip		1,700	.019		.94	.50	.02	1.46	1.92
	2000	75' span, ungouted, 42 kip		1,800	.018		.95	.47	.02	1.44	1.89
	2050	143 kip		2,200	.015		.87	.38	.02	1.27	1.65
	2220	Ungouted single strand, 100' slab, 25 kip		1,200	.027		1.01	.70	.03	1.74	2.37
	2250	35 kip		1,475	.022		.94	.57	.02	1.53	2.06

CONCRETE 3