

Final Exam Equation Sheet

$$\frac{C}{C_0} = e^{-kn} \quad \ln\left(\frac{N}{N_0}\right) = -kt$$

$$Time [min] = \frac{(12,000 + 6,000 n_t) [ml]}{Flowrate [ml/min]}$$

$$Drip rate [ml/min] = \frac{Dosage [mg/l] \times Flowrate [ml/min]}{1,000 mg/l}$$

Bar #	Diameter (in.)	A _s (in ²)
3	0.375	0.110
4	0.500	0.200
5	0.625	0.310
6	0.750	0.440
7	0.875	0.600
8	1.000	0.790
9	1.128	1.000
10	1.270	1.270
11	1.410	1.560

$$T = A_s f_y \quad a = \frac{A_s f_y}{0.85 f'_c b} \quad M = A_s f_y \left(d - \frac{a}{2}\right) \quad M = A_s f_y \left(d - 0.59 \frac{A_s f_y}{f'_c b}\right) \quad V_s = \left(\frac{A_s f_y d}{s} + 2\sqrt{f'_c} b d\right)$$

$$\rho = 0.85 \beta_1 \frac{c f'_c}{d f_y} \quad \beta_1 = 0.85 \geq 0.85 - 0.05 \left(\frac{f'_c - 4000}{1000}\right) \geq 0.65 \quad a = \beta_1 c$$

$$\rho = \frac{A_s}{bd} \quad \frac{c}{d} < 0.375 \text{ beam controlled by tension} \quad \frac{c}{d} > 0.600 \text{ beam controlled by compression}$$

Table 1. Approximate Mixing Water and Air Content.

Slump (in.)	Water (lb./yd ³ of concrete for maximum sizes of aggregate)							
	3/8 in.	1/2 in.	3/4 in.	1 in.	1.5 in.	2 in.	3 in.	6 in.
Non-Air-Entrained Concrete								
1 to 2	350	335	315	300	275	260	220	190
3 to 4	385	365	340	325	300	285	245	210
5 to 6	400	375	350	330	305	290	255	-
6 to 7	410	385	360	340	315	300	270	-
Air (%)	3	2.5	2	1.5	1	0.5	0.3	0.2
Air-Entrained Concrete								
1 to 2	305	295	280	270	250	240	205	180
3 to 4	340	325	305	295	275	265	225	200
5 to 6	355	335	315	300	280	270	240	-
6 to 7	365	345	325	310	290	280	260	-
Air (%)								
Mild exposure	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0
Moderate exposure	6.0	5.5	5.0	4.5	4.5	4.0	3.5	3.0
Extreme exposure	7.5	7.0	6.0	6.0	5.5	5.0	4.5	4.0

Table 2. Relationship between w/c and Compressive Strength.

Compressive strength at 28 days (psi)	w/c, by weight	
	Non-air-entrained concrete	Air-entrained concrete
7,000	0.34	<0.33
6,000	0.41	0.33
5,000	0.48	0.40
4,000	0.57	0.48
3,000	0.68	0.59
2,000	0.82	0.74

Table 3. Volume of Coarse Aggregate per Unit of Volume.

Maximum Size of aggregate (in.)	Fineness Modulus			
	2.40	2.60	2.80	3.00
3/8	0.50	0.48	0.46	0.44
1/2	0.59	0.57	0.55	0.53
3/4	0.66	0.64	0.62	0.60
1	0.71	0.69	0.67	0.65
1.5	0.75	0.73	0.71	0.69
2	0.78	0.76	0.74	0.72
3	0.82	0.80	0.78	0.76
6	0.87	0.85	0.83	0.81