Civil Engineering Cheatsheet

A comprehensive cheat sheet covering essential concepts, formulas, and tables in civil engineering. Designed for quick reference for students and professionals.

Structural Analysis & Design

Material Properties

Steel (A36)	`Fy = 36 ksi`
	`Fu = 58 ksi`
	`E = 29,000 ksi`

Concrete (f'c)	`f'c = Concrete compressive strength (ksi)` `E = 57000 * sqrt(f'c) (psi)`
Wood	Properties vary widely; refer to specific wood species tables.

Load Combinations (ASCE 7)

LRFD (Load and Resistance Factor Design) Load Combinations:

```
1.4D
1.2D + 1.6L + 0.5(Lr or S or R)
1.2D + 1.6(Lr or S or R) + (L or 0.5W)
1.2D + 1.0W + L + 0.5(Lr or S or R)
1.2D + 1.0E + L + 0.2S
0.9D + 1.0W + 0.9H
0.9D + 1.0E + 0.9H
```

Where:
D = Dead Load, L = Live Load, Lr = Roof Live Load, S = Snow Load, R = Rain Load, W = Wind Load, E = Earthquake Load, H = Soil Load

Beam Deflection Formulas

Cantilever Beam, End Load	`delta = (P*L^3) / (3*E*I)`
Cantilever Beam, Uniform Load	`delta = (w*L^4) / (8*E*I)`
Simply Supported Beam, Center Load	`delta = (P*L^3) / (48*E*I)`
Simply Supported Beam, Uniform Load	`delta = (5*w*L^4) / (384*E*I)`

Geotechnical Engineering

Soil Properties

Unit Weight (γ)	`γ = W / V`
Dry Unit Weight (γd)	`γd = Ws / V`
Void Ratio (e)	`e = Vv / Vs`
Porosity (n)	`n = Vv / V`
Degree of Saturation (S)	`S = Vw / Vv`
Water Content (w)	`w = Ww / Ws`

Effective Stress

```
σ' = σ - u
```

Where:
σ′ = Effective stress
σ = Total stress
u = Pore water pressure

Bearing Capacity (Terzaghi)

Strip Footing	`q_ult = cNc + γDfNq + 0.5γBNγ`
Square Footing	`q_ult = 1.3cNc + γDfNq + 0.4γBNγ`
Circular Footing	`q_ult = 1.3cNc + γDfNq + 0.3γBNγ`

Where	`c = Cohesion`
	`γ = Unit weight of soil`
	`Df = Depth of footing`
	`B = Width or diameter of footing`
	`Nc, Nq, Nγ = Bearing capacity factors`

Transportation Engineering

Highway Capacity

Density (D)	`D = v / s` where v = flow rate, s = space mean speed
Flow Rate (v)	`v = D * s`
Space Mean Speed (s)	`s = v / D`

Traffic Flow Relationships

Fundamental equation of traffic flow:

```
v = k * u
```

Where:
v = flow (vehicles/hour)
k = density (vehicles/mile)
u = speed (miles/hour)

Stopping Sight Distance (SSD)

SSD Formula	`SSD = 1.47*v*t + (v^2) / (30*(f +- g))`

Where:
v = speed (mph)
t = perception-reaction time (sec, typically 2.5 sec)
f = coefficient of friction
g = grade (+ for uphill, - for downhill)

Environmental Engineering

Water Quality Parameters

BOD (Biochemical Oxygen Demand)	`BOD = (DOi - DOf) / P` Where: DOi = Initial dissolved oxygen DOf = Final dissolved oxygen P = Dilution factor
COD (Chemical Oxygen Demand)	Measure of the oxygen equivalent of the organic matter in a water sample that is susceptible to oxidation by a strong chemical oxidant.
pH	Measure of acidity or alkalinity. pH = -log[H+]
Turbidity	Measure of the cloudiness of water. Caused by suspended solids.

Activated Sludge Process

Sludge Volume Index (SVI):

```
SVI = (Settled Sludge Volume (mL/L) * 1000) / MLSS (mg/L)
```

Where:
MLSS = Mixed Liquor Suspended Solids

Air Quality

PM10 & PM2.5	Particulate matter with aerodynamic diameter less than 10 µm and 2.5 µm, respectively.
Ozone (O3)	Formed by photochemical reactions involving nitrogen oxides (NOx) and volatile organic compounds (VOCs).
Carbon Monoxide (CO)	A colorless, odorless toxic gas produced by incomplete combustion.