FE Civil Exam Checklist

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Mathematics and Statistics

- ❑ Know how and when to use the Pythagorean theorem
- ❑ Know how to use soh-cah-toa
- ❑ Know law of sines
- ❑ Know how to find the intersection point between two lines
- ❑ Know how to find the intersection point between a line and a circle
- ❑ Know how to use L'Hospital's rule to find the limit
- ❑ Know how to find the derivative of an equation quickly by using the FE Reference Handbook list of typical derivatives
- ❑ Know that the derivative of an equation at a point gives you the slope of the curve at that point
- ❑ Know how to solve integrals quickly by using the FE Reference Handbook list of typical integrals
- ❑ Know that the integral of a function between two points gives you the area under a curve between those two points.
- ❑ Know how to take the dot product and cross product of two vectors

- ❑ Know how to add and subtract vectors
- ❑ Know the difference between a unit vector and a vector
- ❑ Know how to find the magnitude of a vector that is currently in i,j,k form
- ❑ Know how to solve any vector problem with a TI-36x Pro calculator
- ❑ Know that the mathematical definition of the result of the dot product
- ❑ Know that the mathematical definition of the result of the cross product
- ❑ Know how to calculate the mean, mode, median, and standard deviation from a list of unordered numbers
- ❑ Know how to use confidence interval tables
- ❑ Know how to do probability distributions

Ethics and Professional Practice

- ❑ Know when a professional engineer may or may not sign/stamp an engineering document
- ❑ Know an engineer's obligations to the client and the public
- ❑ Know the steps to engineering licensure in the US
- ❑ Know different kinds of typical contracts and legal agreements engineers might get involved in

Engineering Economics

- ❑ Know how to find future worth given a repeated series of payments with interest
- ❑ Know how to find future worth given present worth with interest, and vice-versa
- ❑ Know what to do when given compounded monthly interest as opposed to compounded yearly interest
- ❑ Know the difference-when to use straight line depreciation vs. MACRS depreciation
- ❑ Know how to use interest rate tables

- ❏ Know how to combine a time value of money equation with a break-even equation

Statics

- ❏ Know how to find the x and y components of a force vector
- ❏ Know how to find the resultant vector given two force vectors
- ❏ Know how to sum the moments about a point
- ❏ Know the reactions of pin, roller, and fixed supports
- ❏ Know how to calculate the resultant force off a distributed uniform load and a triangular distributed load
- ❏ Know what an equivalent force system is
- ❏ Know how to draw a free-body-diagram on a flat surface and on an inclined surface
- ❏ Know how to tilt a coordinate system to solve for the free-body-diagram forces when on an inclined surface
- ❏ Know how to visually spot a zero-force member in a truss
- ❏ Know the reaction forces of a member connected with hinges in a frame
- ❏ Know how to use the Parallel Axis Theorem to find the centroid of a compound shape
- ❏ Know where to find the centroid equations of common shapes
- ❏ Know how to use the Parallel Axis Theorem to find the area moment of inertia of a compound shapes in the FE Reference Handbook
- ❏ Know where to find the area moment equations of common shapes in the FE Reference Handbook
- ❏ Know static friction's role in a free-body-diagram

Dynamics

- ❏ Know how to calculate linear velocity off circular motion
- ❏ Know projectile-impact calculations

- ❏ Know mathematical relationships between acceleration, velocity, and distance
- ❏ Know how to use the Parallel Axis Theorem to find the mass moment of inertia of a compound shapes in the FE Reference Handbook
- ❏ Know where to find the mass moment equations of common shapes in the FE Reference Handbook
- ❏ Know how to solve pulleys
- ❏ Know how to use spring problems with Hooke's law
- ❏ Know how to draw a free-body-diagram of an object in motion
- ❏ Know how to do an energy balance with kinetic and potential energy

Mechanics of Materials

- ❏ Know how to draw a beam's shear-moment diagram
- ❏ Know the mathematical relationships between beam loading, shear, and moment
- ❏ Know the graphical relationships between shear diagrams and moment diagrams
- ❏ Know what part of a stress-strain curve is the elastic deformation region, yield point, Young's modulus, plastic deformation region, ultimate strength point, and fracture point
- ❏ Be able to differentiate elastic, brittle, and ductile materials by looking at the stress-strain curve
- ❏ Know how to use deformation equations with the right units
- ❏ Know how to use the method of sections to calculate internal stress in a member that is subject to axial loading
- ❏ Know how to calculate max principal stress off a Mohr's circle
- ❏ Know how to calculate max principal stress off a stress element
- ❏ Know how to calculate max in-plane shear stress off a stress element
- ❏ Know how to draw a Mohr's circle when given a stress element

Materials

- ❑ Know the basics behind making concrete and asphalt
- ❑ Know the typical quality control tests for steel and concrete
- ❑ Know the difference between ferrous and nonferrous metals

Fluid Mechanics

- ❑ Know how to solve manometer problems
- ❑ Know the difference between a suppressed weir and a contracted weir and their corresponding equations
- ❑ Know what weirs are
- ❑ Know what viscosity is
- ❑ Know how to calculate a fluid's unit weight when given its specific gravity
- ❑ Know how to draw a free-body-diagram for an object floating on water and under water
- ❑ Know how buoyancy calculations work
- ❑ Know the difference between absolute pressure and gage pressure
- ❑ Know how to use the energy equation
- ❑ Know that flow rate equals velocity times cross-sectional area

Surveying

- ❑ Know how to convert from azimuth angle to bearing and vice-versa
- ❑ Know how to properly use the Trapezoidal Rule and Simpson's 1/3 Rule formulas to calculate areas
- ❑ Know the difference between cut and fill
- ❑ Know how and when to use average end-area, pyramid, and prismoidal volume equations
- ❑ Know how to convert cubic feet to cubic yards

- ❏ Know how to calculate departure and latitude
- ❏ Know how to do leveling circuit calculations given fore sight, back sight, or instrument height

Water Resources and Environmental Engineering

- ❏ Know how to interpret a hydrograph
- ❏ Know how to calculate a weighted curve number
- ❏ Know the basics of the water cycle
- ❏ Know how to calculate runoff given precipitation and the NRCS curve number
- ❏ Know the basics behind a NRCS curve number
- ❏ Know open channel flow calculations and Manning's equation
- ❏ Know closed conduit flow calculations and Hazen-Williams equation
- ❏ Know the energy equation, accounting for pipe friction and other head losses
- ❏ Know how to use the Moody Diagram to determine the friction factor
- ❏ Know the basics behind Reynold's number
- ❏ Know how to interpret pump performance curves
- ❏ Know how to account for pumps in the energy equation
- ❏ Know how to calculate seepage through soil
- ❏ Know how to size a detention pond given the expected runoff volume
- ❏ Know the difference between stormwater and wastewater
- ❏ Know the calculations associated with wells
- ❏ Know basic water chemistry
- ❏ Know what BOD is and the BOD 5-day jar test
- ❏ Know the typical potable water and wastewater treatment processes, including basic treatment calculations

Structural Engineering

- ❏ Know how to calculate the maximum moment in a determinant beam given different beam support-loading scenarios
- ❏ Know how to use the method of joints and sections to find truss members' internal forces
- ❏ Know how to use the equilibrium equations to calculate reaction forces off statically determinate beams, trusses, and frames
- ❏ Know how to calculate deflection of a simple beam via the tabulated beam deflection equations
- ❏ Know how to use the unit load (virtual work) method to calculate deflection in frame
- ❏ Know how to calculate buckling vs. material yield failure in a column
- ❏ Know how to calculate the critical axial load in a column
- ❏ Know how to classify a beam as statically determinate or statically indeterminate
- ❏ Know how to classify a truss as stable and statically indeterminate, stable and statically determinate, or unstable
- ❏ Know how to classify a frame as stable and statically indeterminate, stable and statically determinate, or unstable
- ❏ Know how to calculate reactions and forces when a basic truss, frame, or beam is statically indeterminate
- ❏ Know tributary areas for a given loading positioning and support
- ❏ Know what to do when there are multiple dead or weather loads in LRFD design
- ❏ Know design criteria failure modes for steel members in tension
- ❏ Know the difference between design moment and nominal moment in steel design
- ❏ Know which steel design moment equation to use given different lateral bracings
- ❏ Know how to use moment strength tables for different W-sections
- ❏ Know how to select the lightest W-section given a load and its factored moment
- ❏ Know design criteria failure modes for steel members in compression
- ❏ Know how to use the KL/r table for steel W-section columns

- ❏ Know how to calculate nominal and design compressive strength of a steel column without the KL/r table
- ❏ Know how to calculate the nominal and design moment strength of concrete beam
- ❏ Know the different phi values for different tensional strain in concrete design
- ❏ Know how to calculate factored shear in a concrete beam
- ❏ Know how to calculate the design strength of a concrete column
- ❏ Know how to pick rebar to meet a desired reinforcement ratio or area of steel

Geotechnical Engineering

- ❏ Know how to classify soil using USCS and AASHTO
- ❏ Know how to use the plasticity index - liquid limit chart to classify soil
- ❏ Know phase relation equations and diagram
- ❏ Know that sand has zero cohesion
- ❏ Know how to interpret a Mohr's circle to calculate soil's shear strength
- ❏ Know that coarse-grained soils use the constant head test while fine-grained soils use the falling head test to determine hydraulic conductivity
- ❏ Know what are the basic geotechnical tests done in the field
- ❏ Know the difference between effective stress and total stress and which parameters go with each
- ❏ Know how to calculate effective stress at the mid point of a soil layer
- ❏ Know how to account for ground water when calculating effective stress of a soil layer
- ❏ Know how to calculate active pressure from a partially saturated soil profile
- ❏ Know the difference between drained and undrained soil conditions and which parameters to use for shear strength calculations when drained or undrained

- ❏ Know the important assumption about a footing when using Terzaghi bearing capacity equation
- ❏ Know how to use Terzaghi bearing capacity equation after being given the bearing capacity factors
- ❏ Know how to use Terzaghi bearing capacity equation when the ground water level is above the footing and below the footing
- ❏ Know the different types of shallow and deep foundations
- ❏ Know the difference between normally consolidated and overconsolidated soil
- ❏ Know what calculations need to be done to determine the appropriate consolidation equation to use
- ❏ Know the relationship between seepage and slope failure
- ❏ Know how to calculate mobilized shear along a slope slip surface
- ❏ Know the purpose of geotextile geogrids in geotechnical engineering

Transportation Engineering

- ❏ Know how to calculate the different components of horizontal and vertical curves
- ❏ Know the average AASHTO reaction time value of 2.5 seconds
- ❏ Know how to solve curve length equations
- ❏ Know the typical value for object height in stopping sight distance
- ❏ Know how to calculate algebraic difference in grades (A) in length of curve equations
- ❏ Understand traffic flow relationships
- ❏ Know how to use traffic safety equations
- ❏ Know how to calculate the structural number for pavement when given layer thicknesses and their coefficients

Construction Engineering

- ❏ Know the different parties involved in a construction project
- ❏ Know the differences between design-build, construction manager agency, and design-bid-build project delivery methods
- ❏ Know what project procurement is
- ❏ Know what OSHA is
- ❏ Know the different types of temporary erosion control devices
- ❏ Know how to fill out early start, late start, duration, early finish, and late finish for all the nodes in a construction activity schedule
- ❏ Know how to determine the critical path in a construction activity schedule
- ❏ Know how to interpret typical features in engineering drawings
- ❏ Know what it means when the cost performance index (CPI) is below 1 or above 1
- ❏ Know what it means when the schedule performance index (SPI) is below 1 or above 1