University of California at Berkeley
College of Engineering
Mechanical Engineering Department

ME128, Fall 2010 **Liwei Lin**

Project #1

Due Date: Wednesday, 29 September 2010

Interactive Computation and Graphics of Simple Beams

For this project, please design, derive and implement a semi-automated way of performing idealized beam calculations in the Matlab (or other computer tools such as C language, …) environment. Then, apply your new tool to the design of a beam as described below and write a report according to the report template. Starting with the theoretical derivations based on the Roark and Young formulation, in which all beams under similar loading are solved via the exact same equation, formulate a unified solution method for elastic beams under the triple-state, combined loading of a distributed load, a point load and a point moment. In Matlab (or other environment), analyze the shear force, bending moment, rotation angle, neutral axis displacement and bending stress for a fixed/simple supported beam subject to the distributed load and concentrated moment at arbitrary points along the beam. Graph these results against beam length in your report. Tabular data is not necessary for the data presentation section.

Use your program to solve the following problem. A structural engineer proposes a fixed/simple support beam to support the combination of a distributed load, a concentrated load and a concentrated moment. He chooses the configuration described below with low-stress steel.

Variable	Value
Beam type	Wide-flange beam, W6x9
Beam length	120.0 in
Moment of area, I_{xx}	16.4 in^4
Distributed load intensity	180 lb/in
Distributed load begins	45.0 in (from built-in end)
Distributed load ends	100.0 in (from build-in end)
Concentrated moment magnitude	1800 in-lb (CW)
Concentrate moment location	30.0 in (from built-in end)
Concentrated load magnitude	475 lb
Concentrated load location	30.0 in (from build-in end)
Young's modulus	29e+06 psi
Left end	Built-in
Right end	Simple support
Low-strength steel σ_y	36,000 psi (yield)
Low-strength steel cost	$1.25/lb
High-strength steel σ_y	52,000 psi (yield)

High-strength steel cost	$2.85/lb
Safety factor	2

Please use a FEA software to solve the problem and check the results with the analytical/Matlab solutions.

Is this a successful design? What, if necessary, should be done to improve the design? If the design needs to be improved, then please compute the extra cost that your design requires. The beam length must remain 120.0 inches. Please construct a report with the format described in class and posted on the course homepage. Clearly present your derivation in the report under the theory section.