The Project
In this exercise, we will focus on the last remaining major topic in class: design for fatigue. You are to design a punch press mechanism. The press will be used to cut small shapes out of 80-20 brass; these parts will be sold for exorbitant prices to yuppies as garden ornaments. Constraints and goals which your design must meet include the following:

- The parts to be cut out will be at most 5 square inches. The sheet metal is at most 0.050 inches thick.

- The metal punch is designed so that only 0.5 inches of the cut is being sheared at any one instant; this is accomplished by using an angled cutting head.

- A cutting stroke must be at least 0.5 inches long to allow for the completed doodad to be ejected properly. The cutting motion must be approximately linear, though a slight curvature in the movement is acceptable.

- The system is powered by a gearmotor which turns at a speed of 100 rpm and has an output torque capacity of 50 lb-in.

- The gearmotor is an enclosed unit whose diameter is 4 inches and length is 6 inches. The output shaft is 0.375 inches in diameter and extends 0.75 inches from the case. The motor’s base is flat and can be bolted to a baseplate.

- Each part must be chosen or designed for a fatigue life of at least 10,000 cycles.
• The unit should operate as quickly as possible; there are lots of rich yuppie gardeners out there.

• Of course, the system must be as small, lightweight, and simple as possible.

Note that you do not have to design the cutting dies; these will be designed by a specialist in cute little animal and flower shapes. You also do not need to design a feed mechanism for the metal sheet. You must design the power train which converts the rotary motion of the motor into the reciprocating motion of the cutter, and the frame which holds it in place.

The picture shows one possible configuration for such a mechanism; you are welcome to come up with a different mechanism if you prefer.

The Report

• You should submit the usual short report in “Memorandum” or some similar format.

• There should be a table which lists the parts in the system.

• Format change: Your report should contain a set of part specifications. Each part specification will include a design drawing of the part (drafted by hand or with CAD), a free body diagram showing the most serious forces on the part, and the supporting calculations which show that the part will function properly for its design lifetime. These data will be placed together for each part. Nuts and bolts and the like need not be drawn of course, but calculations should be provided to show they won’t break.

• There should be at least one assembly drawing of the system.