

## Tractor Spindle Simulation

Spindles are a common component in agricultural equipment. The simple round shaft is used as a front axle in the tractor shown in Fig. 1.



**Figure 1. Farm tractor**

In the 1980's, The Society of Automotive Engineers (SAE) Fatigue Design & Evaluation Committee conducted an extensive testing program to develop improved evaluation techniques for determining the life of parts subjected to multiaxial stress and strain. A stepped shaft, Fig. 2, that could be subjected to various combinations of bending and torsion was selected for the experiments. This geometry and size is similar to the wheel spindle in a ground vehicle and contains a typical stress concentration found in many industrial components.



**Figure 2. Spindle and shaft specimen**

A short summary of this test program and all of the test data can be found at [https://www.efatigue.com/benchmarks/SAE\\_shaft/SAE\\_shaft.html](https://www.efatigue.com/benchmarks/SAE_shaft/SAE_shaft.html).

**Calculation Exercises / Discussion Questions:**

1. Download the results spreadsheet from the eFatigue website. Choose several of the test conditions and see how well the multiaxial fatigue analysis match the experiments.
2. From your analysis results, can you draw any conclusions about the best method? Do strain based approaches work better than stress based approaches?
3. What conclusions would you draw about the importance of crack growth in this type of spindle?