FACULTY OF MECHANICAL ENGINEERING
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Experimental mechanics (REM)

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Assigment name:	**Membrane theory of shells**	
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Assignment

Identify magnitudes of main stresses of pressure loaded can with inner uniformly distributed pressure in area where membrane shell theory should apply. In the end, identify ratio of main stresses.

Experiment

Overview

The experiment was performed on beer can hen relationships for membrane shell theory should apply. There were used two 120 Ω strain gauges and HBM QuantumX MX1615B as Strain Gauge Amplifier.

$$\sigma_t = \frac{p * D}{2 * t}$$

$$\sigma_m = \frac{F_z}{2 * \pi * h * r * \sin \phi_m} = \frac{p * D}{4 * t}$$

Where p is inner pressure, D is diameter of shell and t thickness of shell.

This can be expressed into:

$$\frac{\sigma_t}{\sigma_m} = 2$$

Parameters

Can was made from Aluminium, volume was 500 ml.
Aluminium properties:

$$E = 70\ GPa$$
$$\mu = 0.33$$

Measurement

Two strain gauges were glued to beer can in order to measure tangential and meridian deformation (see fig. 1).

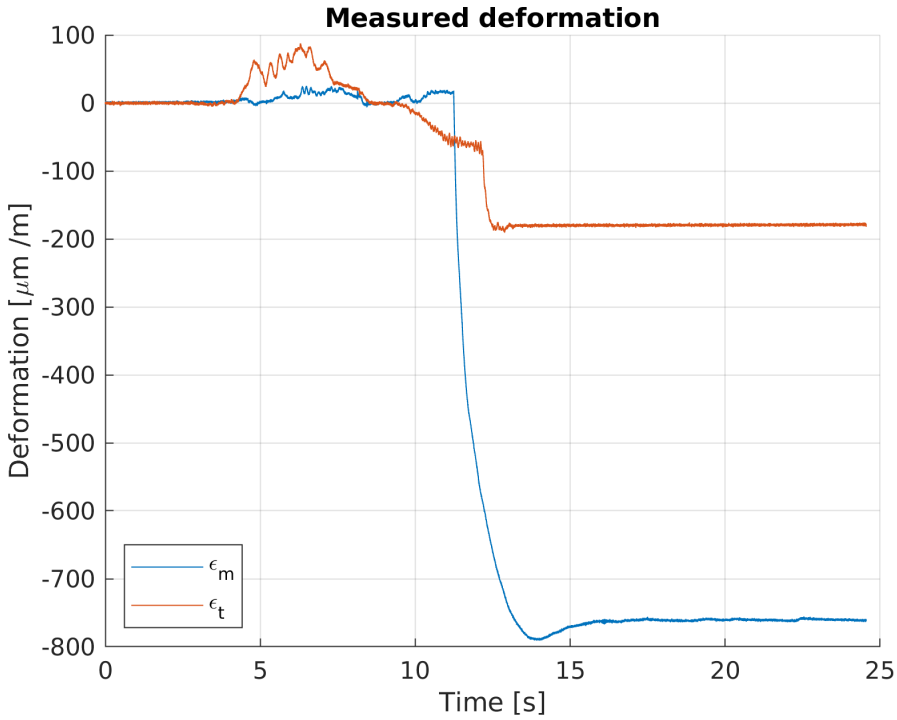

Figure 1: Gathered data

Calculation

To calculate σ_t and σ_m from obtained deformations were used equations 1 and 2.

$$\sigma_t = \frac{E}{1-\mu^2} * (\epsilon_t + \mu * \epsilon_m) \tag{1}$$

$$\sigma_m = \frac{E}{1-\mu^2} * (\epsilon_m + \mu * \epsilon_t) \tag{2}$$

Result is plottet below (fig. 2). Steady value of stresses ($t > 17.5s$) is taken to calculate ratio. Figure 3 shows stresses ratio in steady state, low pass filter was used to highlight ratio.

Mean value of ratio in steady state is 1.91, which is close to 2.

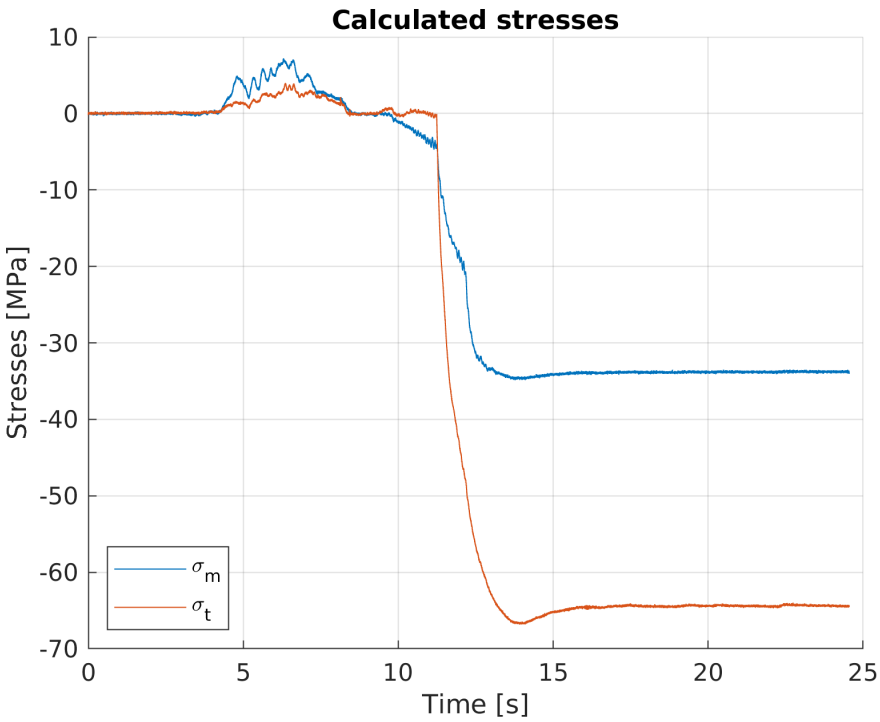

Figure 2: Calculated stresses

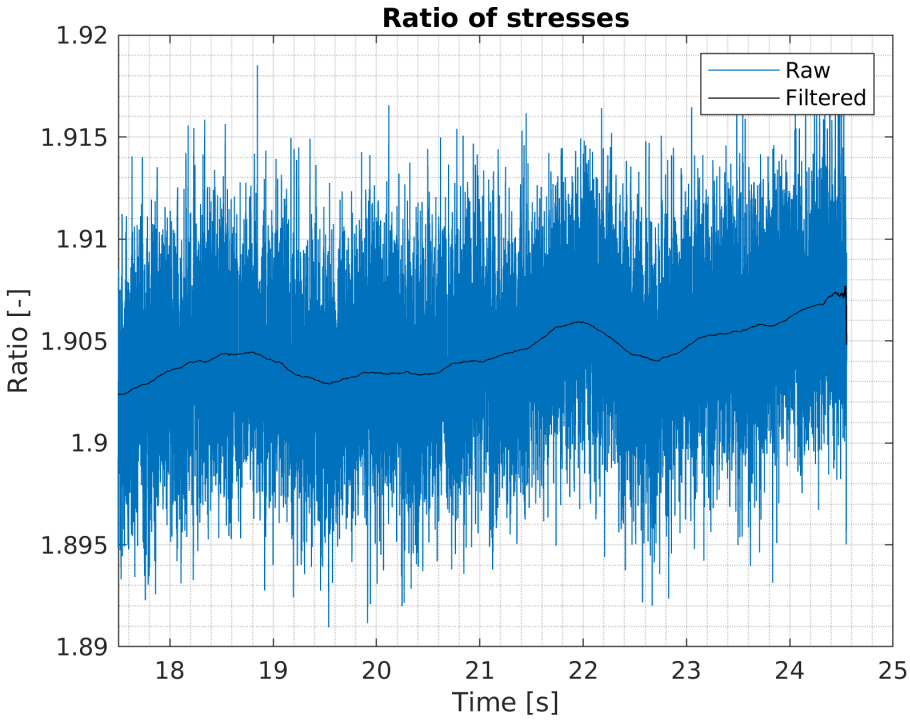

Figure 3: Calculated ratio of stresses

Conclusion

Experiment proved that membrane shell theory can be applied on beer can. Result deviation was 4.78%, which is really good result for experiment on the top of theory.