Experiments

- A custom built friction setup is used to measure the friction vs displacement of the strips
- A translational actuator pulls a steel sled (mass 190g, length 100mm, and width 10mm), the nose of which secures the end of the extensible strip
- Different strip materials and substrates were used, e.g. elastomer-coated fabric, braided elastic strip, glass, and tape
- The intrinsic friction force was obtained by rigidly adhering the strips to the sled

Shear Lag Model

\[ f = f_E + f_{ks} \]

Intrinsic friction responses of two contact surfaces

\[ f_E = \begin{cases} \frac{6}{\pi^2} \frac{G}{t} & 0 \leq \Delta \leq \Delta_s \\ \frac{8}{\pi^2} \frac{G}{t} & \Delta_s < \Delta \leq \Delta_a \\ \frac{8}{\pi^2} \frac{G}{t} & \Delta_a < \Delta \leq \Delta_b \\ \end{cases} \]

Comparison of friction force vs displacement response of an elastic strip with two fabric sides in contact with steel on the top and glass on the bottom

\[ \Delta = \frac{\Delta}{L} \]

Displacement of different points and development of slippage zone across the length of a strip. The least-square fits (dash lines) confirm the formation of transition and slip zones

Conclusions

- Effective stiffness has a profound effect on both static and kinetic friction of extensible strips
- There are three distinct regions along the length of the strip, namely no-slip, transition, and slip zones
- The static friction decreases with effective stiffness whereas the kinetic friction increases by decreasing the effective stiffness
- An extended shear lag model is developed to predict the frictional response of extensible strips
- The analysis resembles that obtained when shear lag theory is applied to lap shear joints experiencing adhesive layer plasticity

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