# S-N behavior of adhesive joints: A review

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## Introduction

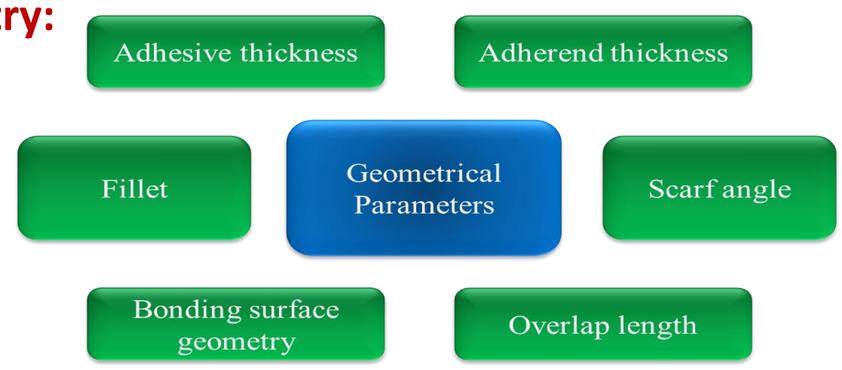
Adhesive joints in engineering structures undergo varied loading conditions, necessitating knowledge of S-N behavior, fatigue life prediction, and improvement methods. This research reviews fatigue behavior literature, emphasizing crucial parameters and design approaches.

## Experimental Studies

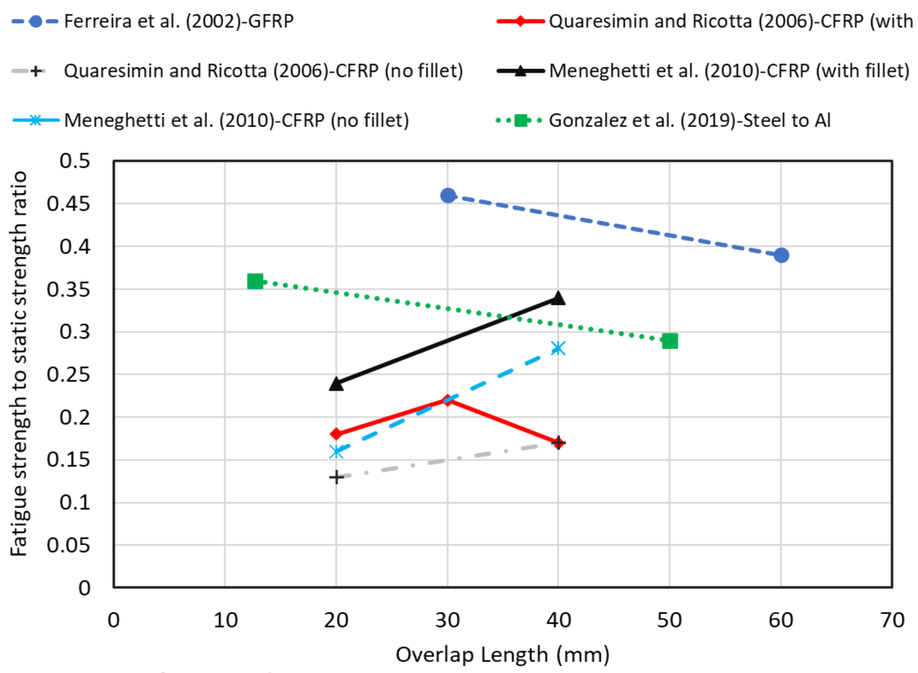
### Materials:

Literature have studied bonded joints with diverse substrates and adhesives. Factors like substrate materials, adhesive types, and surface treatments affect fatigue behavior. Improved fatigue strength has been seen with interface layer insertion, high yield stress substrates, and suitable adhesives.

### Geometry:

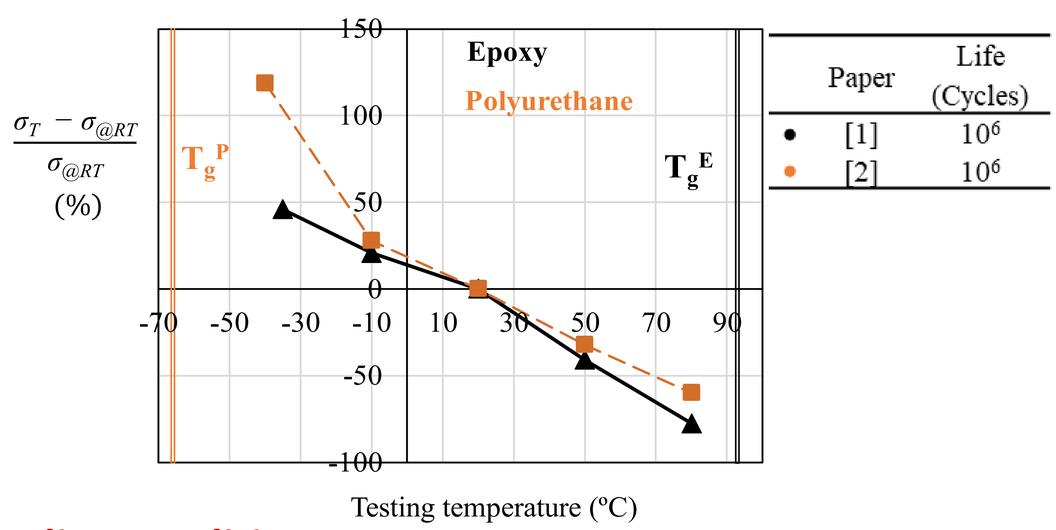



Increasing overlap length generally reduces the fatigue strength in bonded joints for the same fatigue load ratio. Strategies like fillet creation, groove patterns, and sinusoidal/zig-zag geometries on overlap surfaces enhance fatigue strength.



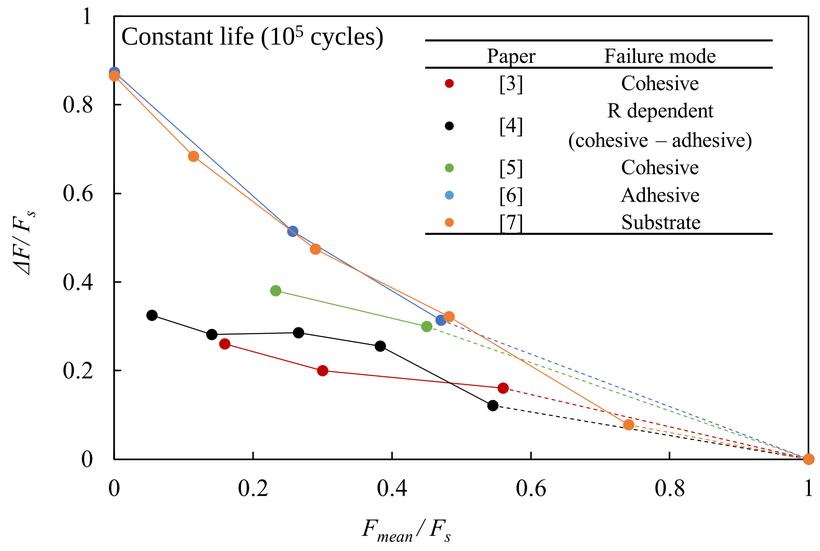

### Environmental conditions:

Temperature and humidity significantly impact adhesive joint fatigue behavior. Elevated temperatures, near the glass transition temperature, decrease fatigue life. Similarly, humidity accelerates fatigue degradation and interfacial property deterioration, partially reversible after drying.

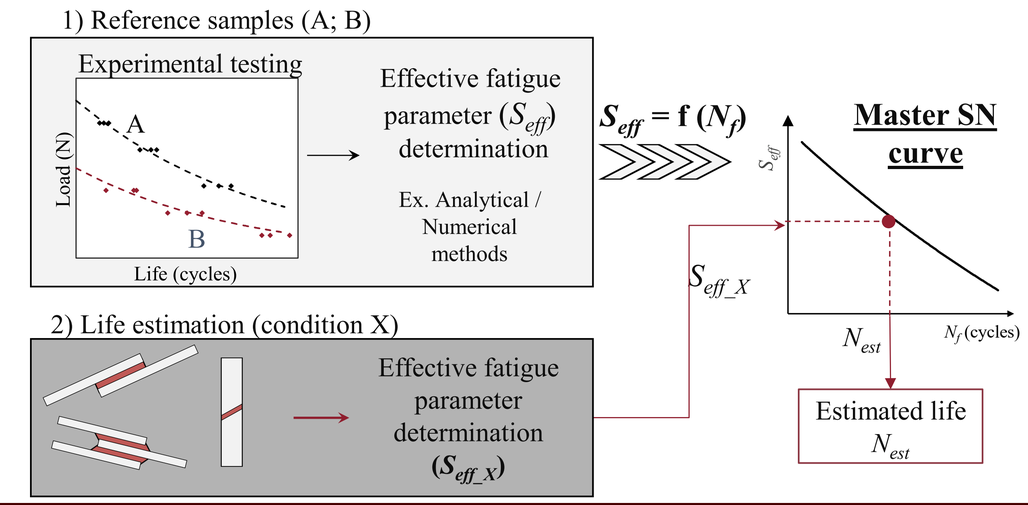



### Loading conditions:

Loading angle affects adhesive joint performance, with geometry-dependent results. Increased load ratio enhances fatigue life, but variable amplitude loading, can cause premature failure due to load interaction effects.



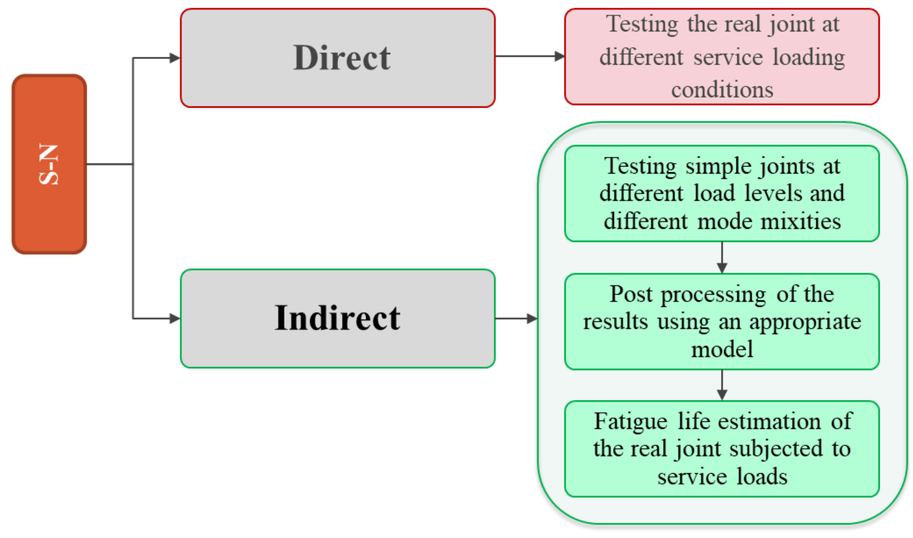

## Fatigue Life Prediction Techniques




## Fatigue Life Improvement Techniques

Enhancing adhesives' fatigue behavior involves increasing adherend/adhesive interface adhesion and employing methods like surface treatment and particle reinforcement. Surface treatment methods (mechanical, chemical, laser) can improve interface adhesion and mechanical interlocking, while particle reinforcement enhances fatigue properties. Addition of nanoparticles has shown improved fatigue strength in bonded joints.

## S-N Methodology in Real Applications




## Conclusions

This review analyzes the effects of influencing parameters on the S-N response of adhesive joints. Developing a universal fatigue life prediction model is challenging due to complex factors. Experimental studies show increasing overlap length in single lap joints reduces fatigue life. Temperature and humidity impact fatigue behavior, accelerating degradation, but some effects can be reversed after drying of hygrothermally aged samples.

## References

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