

# Adhesive Bonding Strength of Aerospace Composites

## Introduction

Composite materials have shown lots of potential as aircraft component material for the present and the future. They can be used for uni-body designs, thus the need for mechanical bolted joint assembly negligible. Joining methods commonly used for aircraft assembly can be divided into several categories which are: adhesive bonding, mechanical fastening and fusion bonding. Only adhesive bonding will be investigated.

There are also various types of adhesive bonding joints. The main 4 types are single lap, double lap, stepped up and scarf joints (Armstrong, Bevan and Cole, 2005).

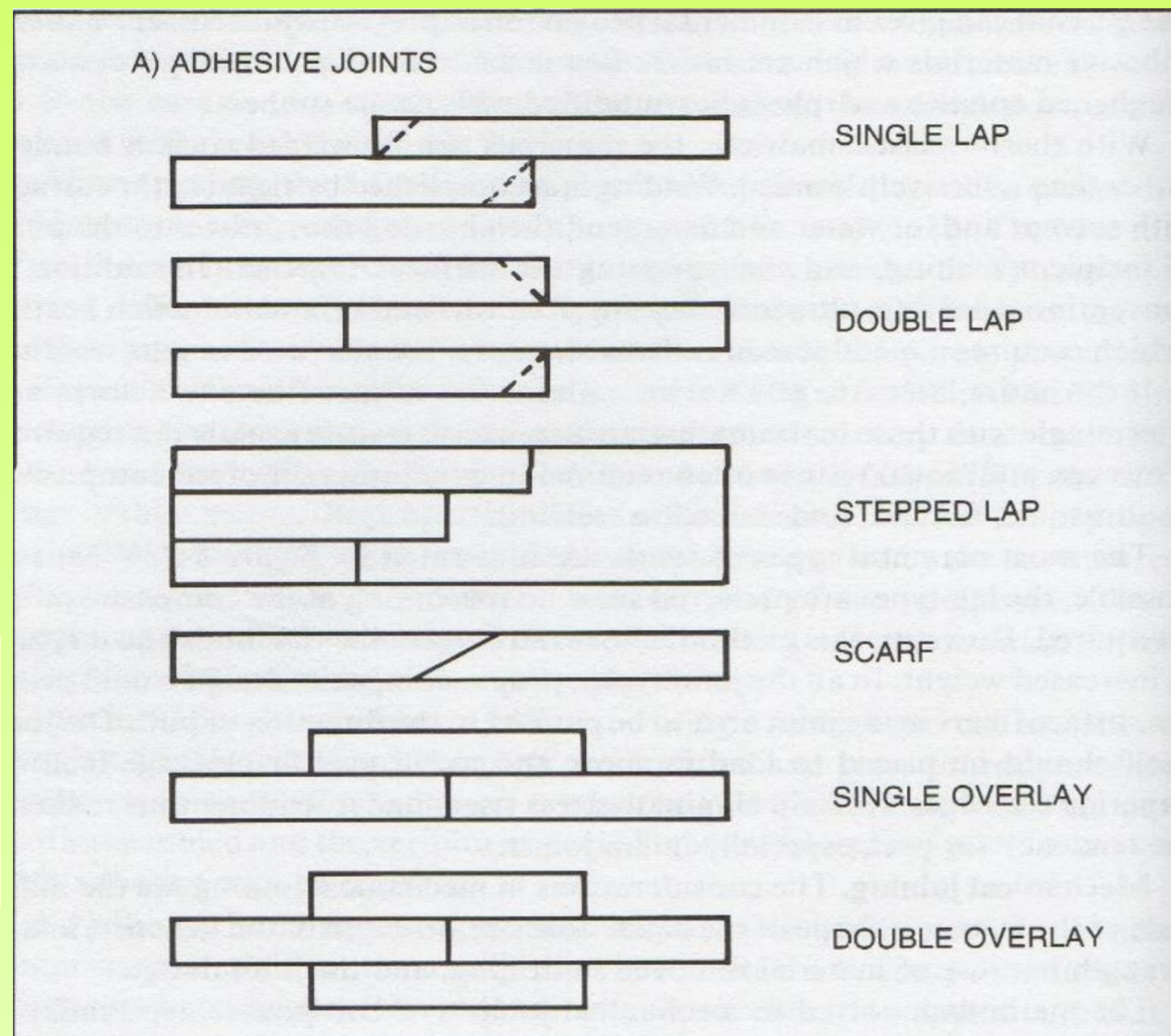


Fig. 1 Illustrations of the different types of joints (Strong and Ploskonka, 1989).

## Objectives

- To successfully bond the composite material using Araldite 2020 by means of a single lap joint.
- To study the shear strength of the single lap joint by conducting a single lap shear test.
- This is done by means of a tensile test using the Instron 5982 universal testing machine.
- Discuss on results obtained and compare with other successful results from other similar studies that have been conducted

## Methodology

- Preparation of surface is carried out. Roughening of surface using 240 grit sand paper
- Material is then cleaned of particles using an alcohol swab and left to dry
- Markings were then made on the material for overlap area and grip area



Fig. 2 Markings made on the specimen.

- Wires of diameter 1mm x 15mm length were cut and glued on overlap area with superglue
- Leave to dry for about 10 seconds
- Velcro is then glued onto grip area to protect specimen and add additional friction for better grip



Fig.3 Velcro glued to grip area adding more friction to grip.

- Araldite 2020 is applied to overlap area of bottom specimen
- Top specimen is carefully laid over it
- Overlap area is taped and clamped using aluminium clips
- Specimen is then left to cure at 25°C overnight
- Two pieces of aluminium packing was also created for the purpose of machine's grip and Velcro was also glued



Fig. 4 Specimen wrapped in tape and aluminum clip to hold in place.

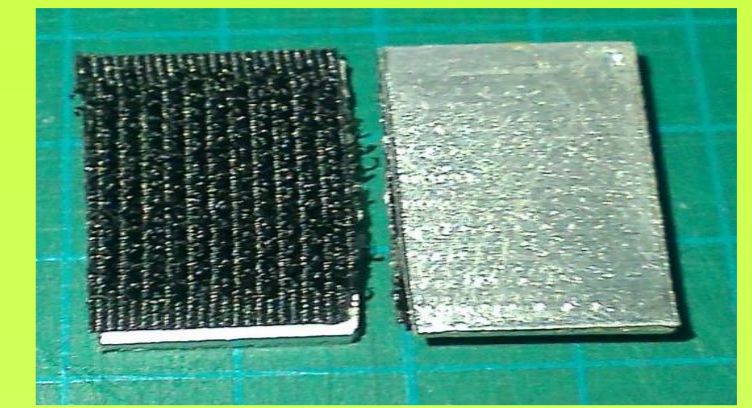


Fig. 5 Aluminum packing with Velcro glued to it.

- Specimen is mounted on the Instron 5982 universal testing machine
- Distance of 40mm is kept between the grips
- Specimen is then pulled until it breaks or fails due to shear stress applied by the tensile force



Fig. 5 Specimen mounted on the Instron 5982 universal testing machine.

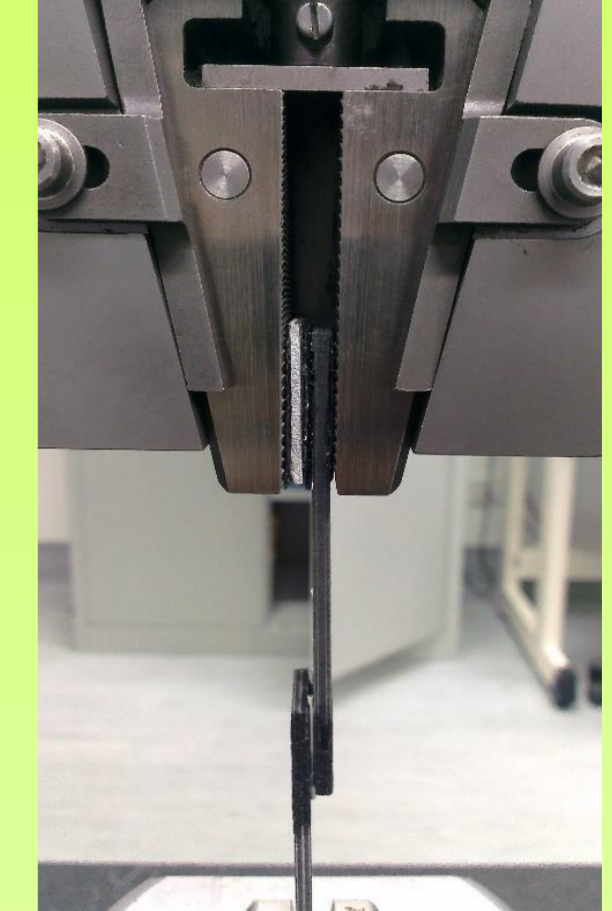


Fig. 6 Aluminum packing plate placed between the grips and the specimen.

## Results and Discussions

- Results were recorded using 'Bluehill' software
- 5 samples were tested
- Results obtained proved to be invalid due to slippage of specimen from the grips
- Velcro glued on the aluminium packing started losing grip strength as more specimens are being tested
- Results of this failed attempted were collected and found that highest force achieved was only 535.288N and lowest was 442.654N



Fig. 7 The Velcro material glued to the composite starts to peel off.

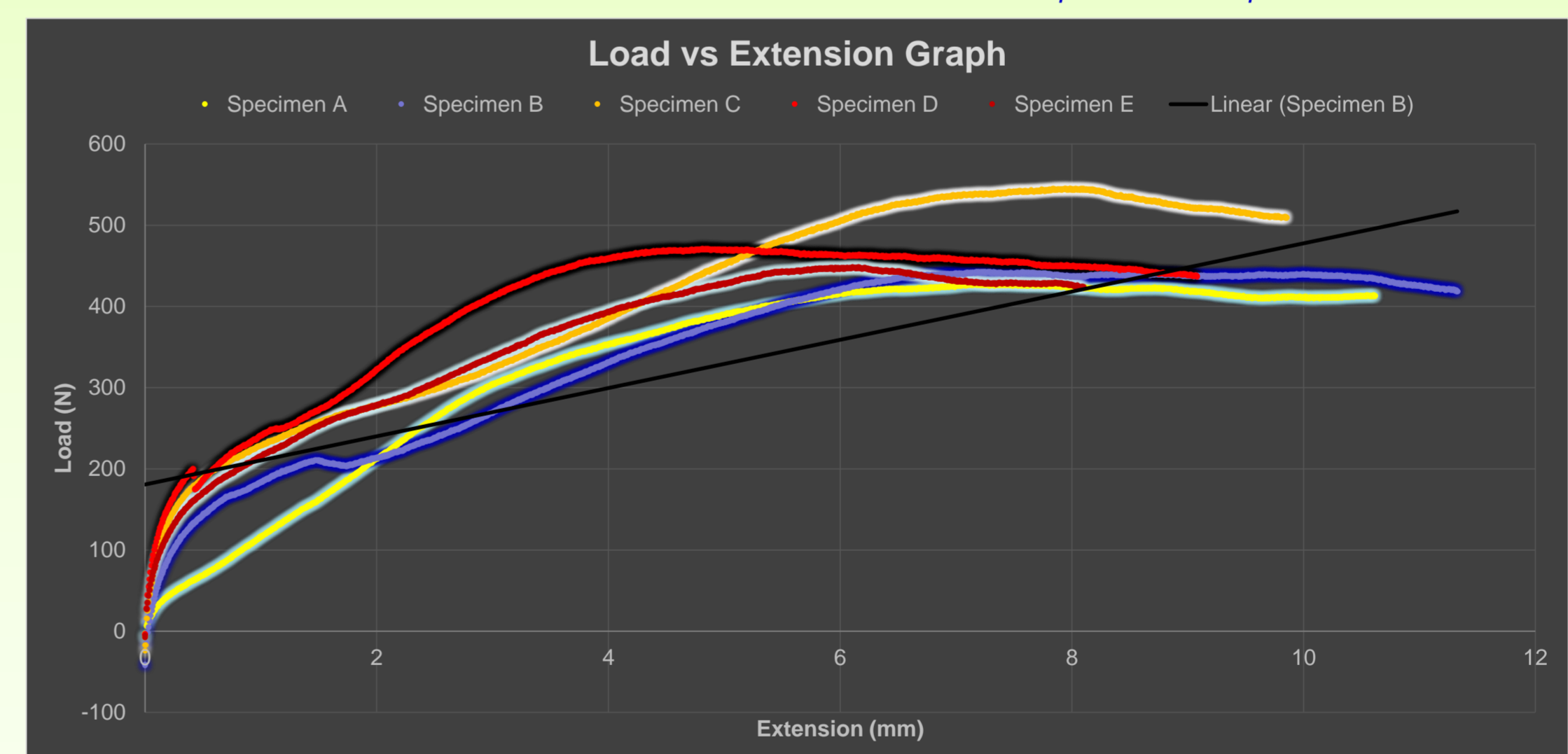


Fig. 8 Load vs Extension graph

## Conclusion

- Results obtained were inconclusive as specimens kept slipping away from grips
- Time and resources were major constraints to conduct study on material being tested, and curing was not controlled well enough. Moisture might be present during curing
- Amount of Araldite applied to all specimen may not be equal for results to be concluded as accurate
- However, Araldite 2020 has successfully bonded the specimens
- More investigation needed how to conduct single-lap shear test successfully, especially with the issue of the slippage of the machine grips

## References

- Armstrong, K., Bevan, L. and Cole, W. (2005). *Care and repair of advanced composites*. 2nd ed. Warrendale, Pa.: SAE International.
- Strong, A. and Ploskonka, C. (1989) *Fundamentals of composites manufacturing*. 1st edn. Dearborn, Mich.: Society of Manufacturing Engineers, Publications Development Dept., Reference Publications Division.