Planar Delamination of CFRP Panels under Quasi-static Out-of-plane Indentation

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Introduction

The uploaded dataset collects test data related to experiments of planar delamination under quasi-static out-of-plane indentation. It includes essential components such as force-displacement data obtained from the MTS machine, as well as information on compliance/stiffness variations. A set of images used for 3D digital image correlation (DIC) analysis, facilitating the extraction of out-of-plane deflection, surface strains, and curvatures, is provided. Moreover, ultrasound scanning images is also provided for measurement of projected delamination area. Additionally, an acoustic emission dataset is provided for the purpose of monitoring delamination initiation, and for potential identification of damage modes and damage states.

This comprehensive dataset has been made accessible to the research community, serving as a resource for researchers to incorporate into their own research endeavours.

The material used in this research is M30SC-150-DT120-34F, unidirectional carbon fibre prepreg provided by Delta Tech Italy. The specimen configurations are shown in the following table:

Specimen label	Stacking sequence	Test procedure
PCLO(0//0)	$[(0/90/45/-45)_s//(0/90/45/-45)_s]$	SSL[b], MSL
PCLO(0//90)	$[(90/0/45/-45)_s//(0/90/45/-45)_s]$	SSL, MSL
PCLS-R[a](0//0)	$[(0/90/45/-45)_s//(0/90/45/-45)_s]$	SSL
PCLS-R(0//90)	$[(90/0/45/-45)_s//(0/90/45/-45)_s]$	SSL

a: R indicates specimen with rubber mat protection. b: Single step loading (SSL), multi-step loading (MSL).

The specimen configurations are shown in Figure 1.

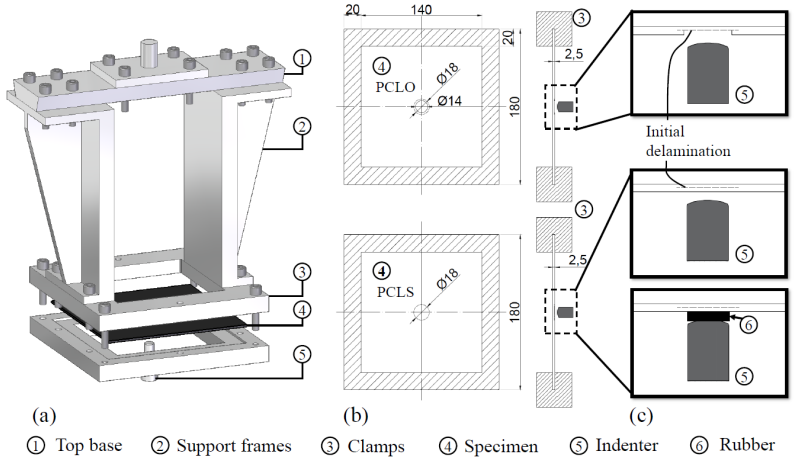


Figure 1 Specimen configurations

Experiment setup

The experimental setup is shown in Figure 2. The cameras employed for 3D Digital Image Correlation (DIC) have a focal length of 23mm, capturing speckle images at a rate of one frame every 5 seconds. The angle between two cameras is 30º. Two ultrasound scanning systems are used to capture the delamination area: Dolphicam (provided by Dolphitech) for time-of-fight visualization and ultrasound C-scanning (provided by Delft Aerospace Structures and Materials Laboratory (DASML)) for amplitude visualization. 4 acoustic emission (AE) sensors are used to detect delamination growth. The configurations of AE sensors are shown in Figure 3.

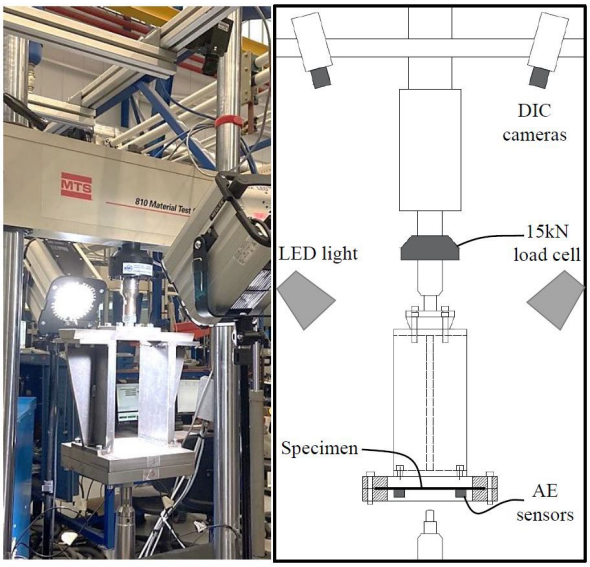
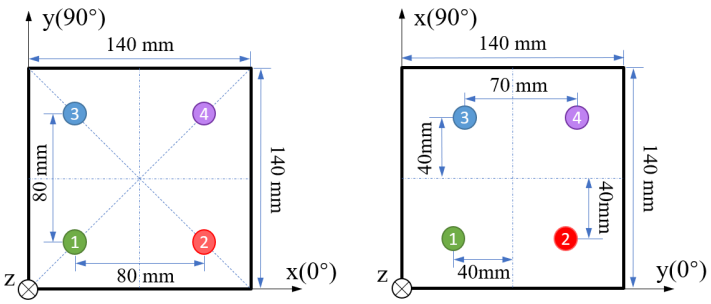


Figure 2 Experiment setup



(a) PCLS-R(0//0) (b) PCLO and PCLS-R(0//90)

Figure 3 AE sensor distribution.

Dataset description

1. The AE dataset collects two types of data, transient signal waves of AE hits (tradb.) and primary database (pridb.) which contains main AE features of all AE hits. An open source python package is provided for loading the database: https://pyvallenae.readthedocs.io/en/stable.

2. The C-scan dataset collects the ultrasound scanning images captured by two distinct systems.

3. The DIC dataset collects calibration and speckle images of 4 specimens. Due to size limitations, only half of the speckle images are provided, which is sufficient for DIC analysis. The number (00xxx) in the name of the image files indicates the frame of DIC images, the interval between each frame is 5

second. The number (0 or 1) at the end of the names indicates camera 1 or 2. The rest of the naming can be ignored as the images of various specimens are organized into separate documents.

4. The Growth dataset collects the measurement of delamination growth by both DIC and C-scan. The measurement error and difference between DIC and C-scan are discussed in the research paper. Here only the average values are provided.

5. The MTS dataset collects force-displacement acquisitions of all specimens from SSL and MSL tests. The deflection in the dataset was measured from DIC analysis. In the MSL data, the description of the force-displacement columns (Exp'x.x'mm) indicates the end load (displacement) level of each loading step. Very small fluctuations can be identified in the force displacement data, primarily attributed to the negligible measurement errors stemming from the MTS load cell.

Nomenclature

- PCLO Planar centre loaded opening
- PCLS Planar centre loaded split
- SSL Single step loading
- MSL Multi-step loading