Introduction

• Dyneema® HB210 is a new material with ballistic armor applications
• HB210 has high tensile strength with low weight
• Damage mechanisms are clear at cross section of impact site for tests such as QSI and QS-PS
• Difficult to investigate cross sections without damaging fiber architecture due to high tensile strength

Objectives

• Test samples for failure response under QSI and QS-PS
• Obtain detailed images of specimen cross sections at site of impact and outside of annulus region
• Identify damage mechanisms in specimens to classify failure modes for Dyneema® HB210 for modeling

Theory

• A parameter a/Hc serves as a boundary to define failure modes for Dyneema® HB210 where a is annulus width (Dp – Ds)
• Fibers fail in shear when a/Hc < and fail in tension when a/Hc > 1

X-ray CT Process

• Objects are scanned with X-rays on a rotating stage to capture 360 degrees of 2D images which are reconstructed into slices to form 3D model

QS-PS Damage Evolution

• X-ray CT provides 3D virtual volumes of specimens with which cross sections can easily be investigated at any position in the sample

QS-PS X-ray CT

• X-ray CT provides detailed 3D virtual volumes of specimens to identify failure

QS-PS X-ray CT

• X-ray CT provides detailed 3D virtual volumes of specimens to identify failure

Future Work

• Perform Nano X-ray CT to photograph undamaged fiber cross sections to more accurately model fiber architecture
• Develop methodology to capture live X-ray Images during testing to record video of internal damage mechanisms
• Export mesh of scans as finite element model to directly compare experimental results to FEM simulations
• Use results of X-ray CT imaging to model interfibrillar damage interactions in LS-DYNA

References

B. Z. Haque and J.W. Gillespie, “Punch Shear based penetration model of thick section composites”