



U N I V E R S I T Y O F
SOUTH CAROLINA

LAMSS
Laboratory for Active Materials
and Smart Structures

A novel Helmholtz potential approach to predicting acoustic guided waves generated by fatigue crack

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Overview

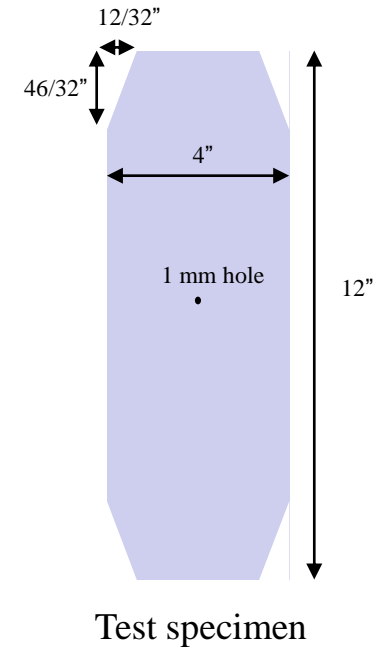
- The objectives of this research can be subdivided into four major categories:
 - (1) Record AE guided wave from fatigue crack experiments
 - (2) Develop an inverse algorithm to calculate source potentials
 - (3) Characterize the crack based on the released energy information
 - (4) Solve a forward problem to simulate the AE signal using the source obtained experimentally

- I am emphasizing task 1 in this presentation

TASK 1: ACOUSTIC EMISSION (AE) FATIGUE TEST OF STEEL PLATE

304 stainless steel for fabrication of specimens

We bought 2' X 1' -1 mm thick stainless steel plate



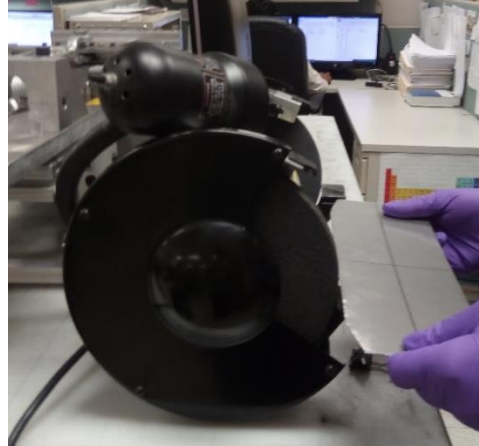
Tensile Strength, Ultimate: 505 Mpa
Tensile strength, Yield: 215 MPa

- 12" X 4" coupons are fabricated
- 1 mm hole is provided at the geometric center for crack initiation

Specimen fabrication



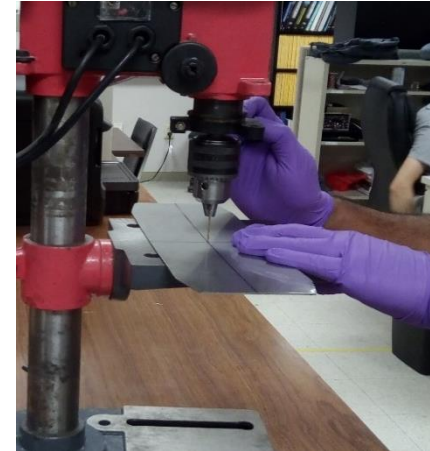
Cutting the specimen using horizontal band saw



Shaping the edges using grinder



Specimen for AE fatigue test



Drilling 1 mm hole at center

Fatigue crack generation in steel specimen

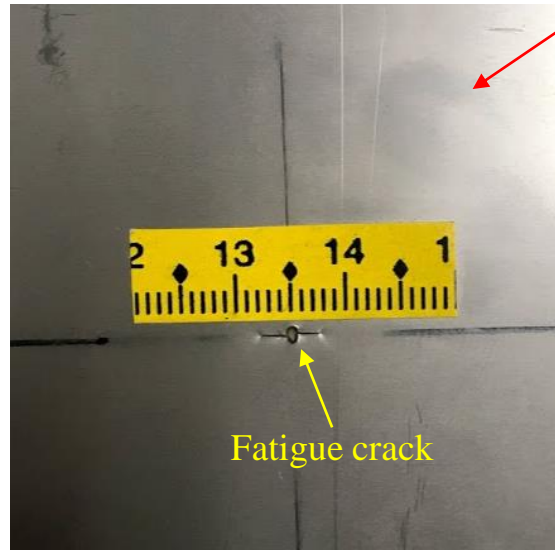
- Before capturing the AE fatigue signal we need to know the required load and no of cycles for crack to grow
- Fatigue loading is applied with a minimum load of 2.5 and maximum load of 25 kN at 4 Hz
- 50,000 fatigue cycles are performed
- Crack does not appear at this load level and number of cycles



Fatigue test for crack generation

Fatigue crack generation in steel specimen (cont.)

- Next step: increased the load range to 3 kN - 30 kN and repeat the experiment
- After increasing the load range crack was initiated after 20000 cycles
- After 35,000 fatigue cycles we observed 6 mm crack



Fatigue test for crack generation

Future work

- AE transducer will be installed on the top surface of the plate
- The experiment will be continued to grow the crack 6 mm to 10 mm
- During the crack growth AE signal will be captured
- Once the AE signal is obtained an inverse algorithm will be developed to characterize the AE source

Thanks