

SSLV324 - Elliptic crack in a 3D body subject to tensile loading

Abstract:

This test case models a planar elliptic crack within a 3D body subject to a tensile loading. The purpose is to study the idealised behaviour of a crack using linear-elastic-fracture mechanics.

1 Reference problem

1.1 Geometry

The specimen configuration is presented in half symmetry, as shown in figure 1. It represents a cube with dimensions ($h=w=t=16$) containing a planar, elliptic crack with dimensions $c=a=1$. The specimen is subjected to a tensile load perpendicular to the plane of the crack and represents pure mode 1 crack opening.

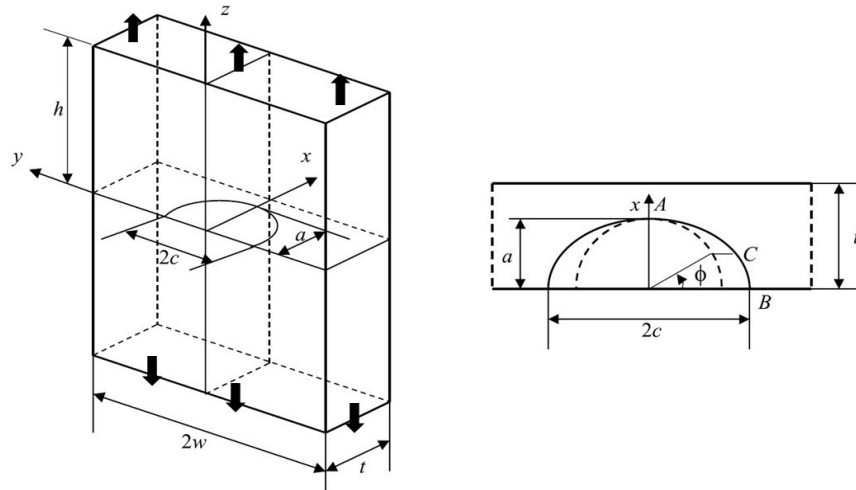


Fig.1 Specimen geometry

1.2 Material properties

The material of the specimen is assumed to be homogeneous isotropic linear elastic with the following parameters:

- Young modulus $E = 200\,000\text{ Mpa}$,
- poisson's ratio $\nu = 0,3$.

1.3 Boundary conditions and loading

The structure is subjected to a tensile stress ($\sigma = 1\text{ MPa}$). Due to symmetry, only one quarter of the elliptical crack is considered and symmetric conditions are implemented on two faces `FACE_LAT` and `FACE_AV` .

2 Reference solution

2.1 Method used for the reference solution

For a circular crack of radius a in an infinite medium, subjected to a uniform tension σ_0 according to the normal to the plane of the crack lips, T-stress is independent of the curvilinear abscisse along the crack front s and is expressed in the following way [1]:

$$T(s) = -\sigma_0$$

2.2 Reference results

By considering the numerical values of the statement, we get: $T = -1 \text{ MPa}$.

2.3 Bibliographical references

- 1 X . Wang , Elastic T_stress solutions for semi-elliptical surface cracks in finite thickness plates Engineering Fracture Mechanics , 70 (2003) 731-756

3 Model A

3.1 Mesh

The quadratic mesh of structure is provided as a MED format . Due to symmetry, only one quarter of the structure is represented, as shown in figure 2.

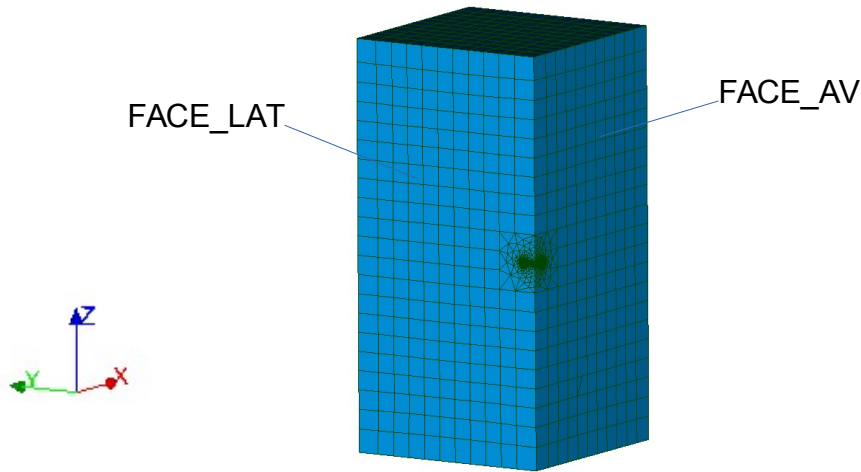
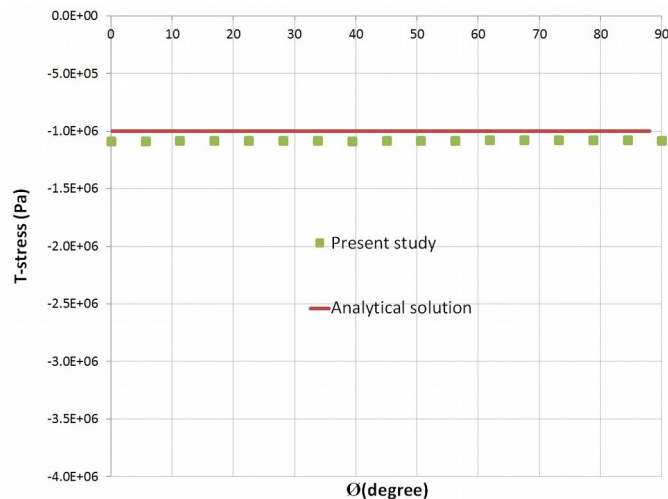


Fig.2 Mesh

3.2 Quantities tested and results

| Identification | Type de Référence | Référence | % tolérance |
|----------------|-------------------|-----------|-------------|
| T - MAX | ANALYTIQUE | -1.E6 | 5.0 |
| T - MIN | ANALYTIQUE | -1.E6 | 5.0 |



4 Conclusion

Results are in good agreement with the theory.