DARWIN® 5.2 Release Notes

August 2005

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Summary of New Capabilities

The DARWIN 5.2 release includes the following new features:

- New Bivariant Stress Intensity Factor Solution for Corner Crack in Plate (CC09)
- New Bivariant Stress 3D Visualization Capability
- Improved Shop Visit Model
- Keyword Support for DARWIN Library Files

Bivariant Stress Intensity Factor Solution for Corner Crack in Plate (CC09)

A new bivariant weight function formulation was developed for a corner crack in a rectangular plate of finite width and thickness. It is based on an existing solution for an elliptical crack in an infinite body modified to account for the free boundary conditions associated with a quarter-elliptical corner crack in a quarter-infinite body (and additional correction terms to account for finite width and thickness effects). The stress intensity factor (K) is evaluated by performing surface integration across the crack area and includes parameters that account for the finite boundary effects at the crack tips. Reference stress solutions associated with these parameters were numerically generated using FADD3D fracture mechanics software (a general boundary element code for three-dimensional linear elastic fracture analysis) at 150 different combinations of geometrical aspect ratios.

The CC09 bivariant K solution provides improved accuracy for cracks growing in bivariant stress fields (i.e., significant stress gradients in orthogonal directions). The errors associated with use of a univariant solution for a highly bivariant stress field can be substantial. For example, for the bivariant stress field shown in Fig. 1, the univariant stress intensity factor solution dramatically overestimates the actual SIF by a factor of three at the a-tip and nearly a factor of ten at the c-tip.

A capability is also provided to exercise CC09 using univariant or bivariant stress models for both polynomial and weight function solutions. Since the univariant and polynomial solutions are significantly faster than the bivariant and weight function solutions, respectively, use of this feature can provide improved computation speed without a substantial decrease in accuracy for linear stress fields that are not strongly bivariant.

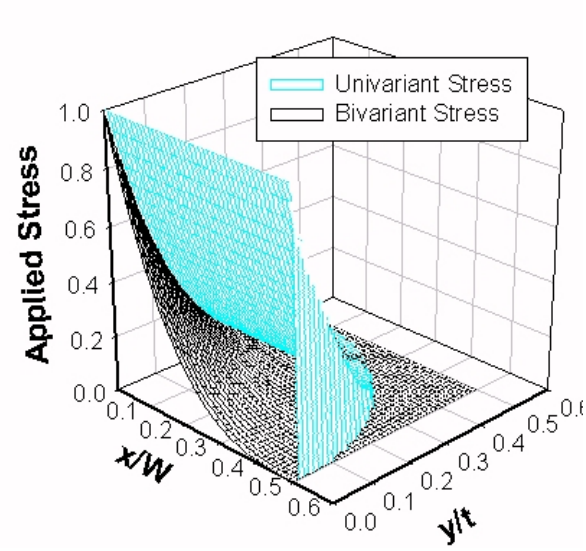

Figure 1. The new bivariant K solution provides improved accuracy for bivariant stress fields.

New Bivariant Stress 3D Visualization Capability

The new bivariant K solution described in the previous section allows the user to select a univariant or bivariant solution based on the character of the stress field. Therefore, a new capability was developed to provide visualization of the stress field in three-dimensional space (Fig. 2). This new feature appears in the plate editor screen when the bivariant corner crack (CC09) is selected.

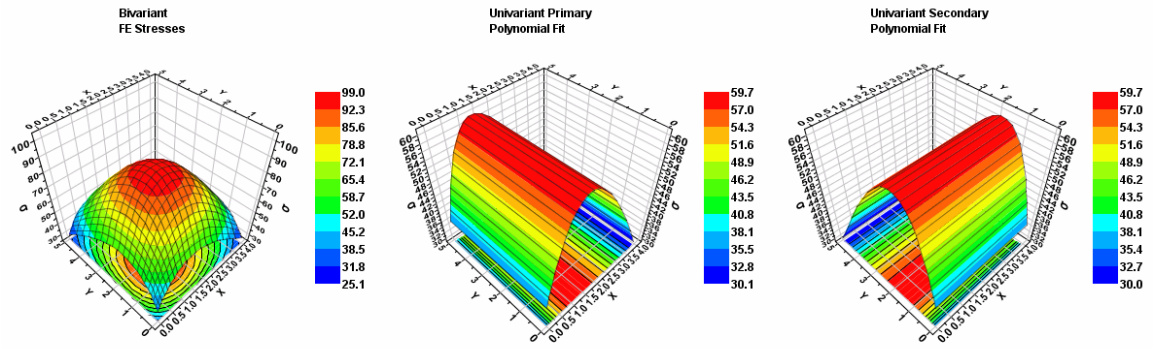

Figure 2. New 3D stress visualization capability assists the user in selecting the most efficient stress intensity factor solution for a corner crack in a plate (CC09).

Improved Shop Visit Model

In previous releases, shop visit inspection times were specified as independent random variables. This model did not take into account the relationship among inspection times (i.e., the dependency of future inspections on the timing of previous inspections).

A new capability was added to allow the user to specify the time of inspection in terms of a previous inspection. As shown in Fig. 3, the user can specify links between two inspections using a new "link" feature. This capability was implemented for both tabular and normally distributed inspections. The GUI provides several options for viewing linked inspections (see 5.2 help system for details).

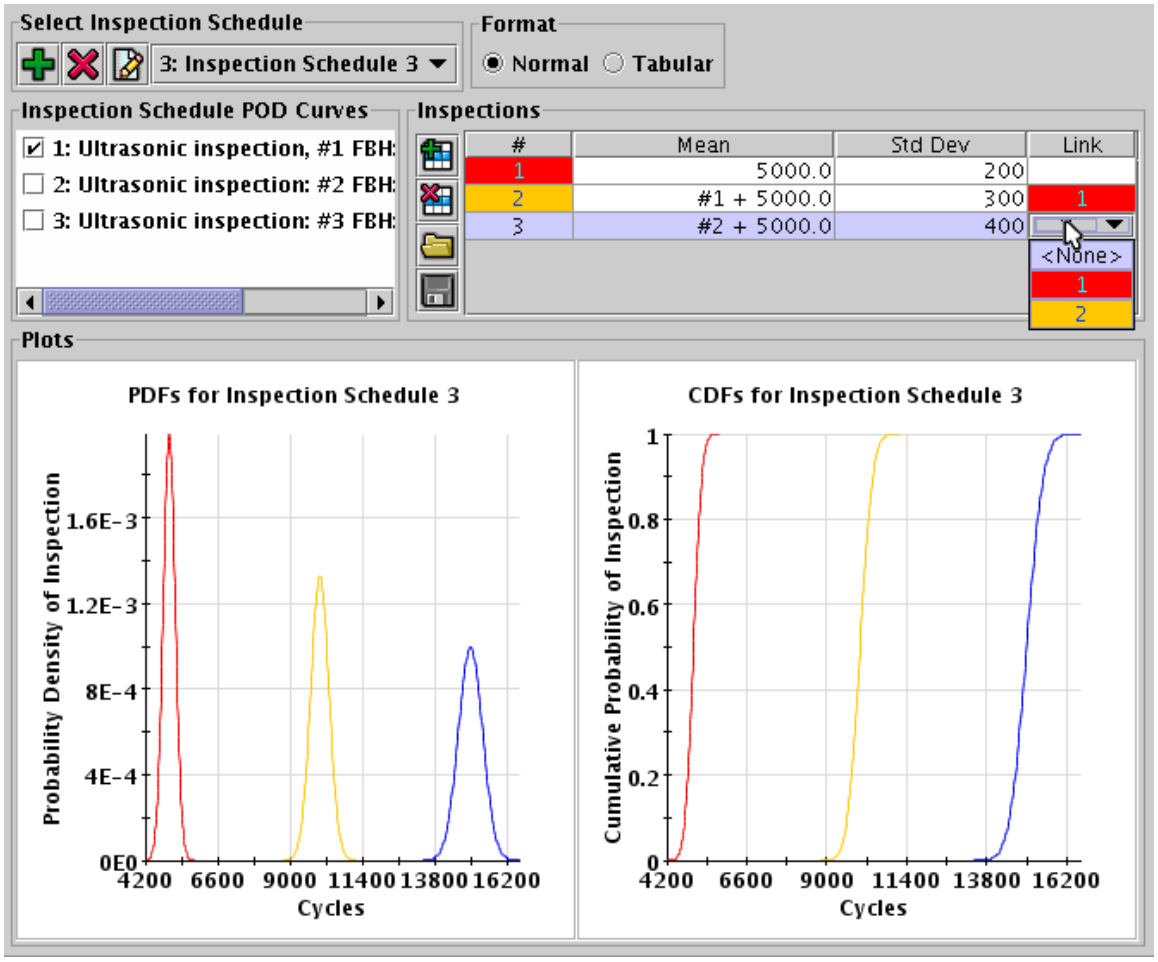

Figure 3. Improved shop visit model allows user to specify inspection times in terms of previous inspections (i.e., inspections are linked).

Keyword Support for DARWIN Library Files

DARWIN provides the capability to perform risk assessment of components with both material-related (inherent) and manufacturing-related (surface damage) anomalies using either US or SI units. A number of input parameters are specified in ASCII text –based

library files (i.e., defect distribution, probability of detection, and material properties) that do not include a specification of units or initial anomaly type.

A capability has been included in DARWIN 5.2 to support additional keywords in the library files associated with analysis mode (inherent/surface damage), units (US/Metric), crack units (area/length/depth), and reference units (volume/weight/area). The GUI has been enhanced to include validation checking of library files containing keywords as follows:

Analysis Mode: For surface damage mode, GUI allows only anomaly distributions with analysis mode keywords “area”. For inherent analysis mode, GUI allows only anomaly distributions with analysis mode keywords “volume” or “weight”.

Units: GUI allows only library files with units keyword (e.g., US, METRIC) that matches the user specified project units (e.g., US, METRIC).

Anomaly aspect ratio (existing keyword): GUI issues a warning if the aspect ratio keyword in the anomaly distribution does not equal the aspect ratio set in the deterministic fracture mechanics section of the project file.

GUI keyword validation checking is performed only if keywords are present in a library file (and is therefore backwards compatible to library files associated with previous DARWIN releases).