

# DARWIN 3.5 Release Notes

March 15, 2002  
Southwest Research Institute

## *Enhancements*

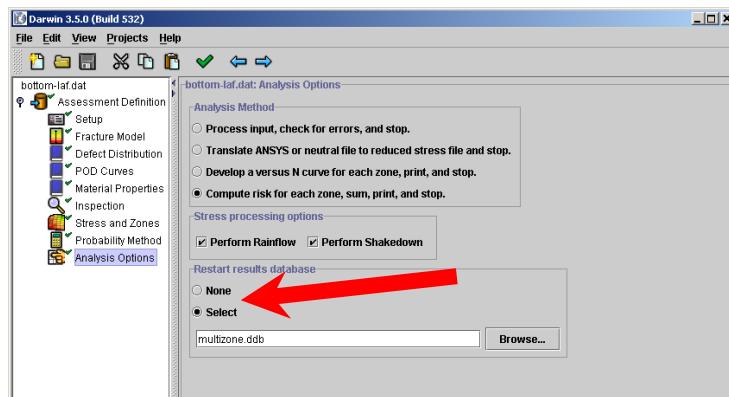
### Risk Assessment Code

#### **Restart Capability**

A results database file, “jobname.ddb”, is created for every analysis. This file may be used as a restart file for subsequent analyses, e.g. when one or more zones are further refined. This leads to substantial timesavings during the zone refinement iterations. The restart capability has three levels of checks in order to allow re-using as much of the previous results as possible:

1. Stress processing
2. Deterministic crack growth
3. Risk assessment

The figure below shows where the restart database file is defined in the Analysis Options screen.



#### Database format:

The database format is industry-standard XML. This format can be viewed directly using a text editor. With an XML editor (such as EXML or Merlot) the tree structure of the database can easily be browsed. All information contained in the output file (\*.out) is also contained in the database. The database can also be used to re-create the input file (\*.dat) in the GUI if it is inadvertently deleted.

#### Retrieval of Zones:

Each of the restart checks is performed on a per-zone basis. For any zone in the input file, DARWIN compares the zone's properties with those in the database. If a match is found, the results are retrieved. Otherwise DARWIN proceeds to compute the results for this specific zone. Note that the zone numbers do not have to match, but the information within the zone must match as described in the next section.

#### Zone Comparison Checks:

For a given zone, the data in the input file (\*.dat) are compared to the input data in the database (\*.ddb). Comparison checks are performed for each of three major sections of the code: stress processing, deterministic crack growth, and risk assessment. The comparison checks associated with each of these major sections is as follows:

### Stress Processing:

- Elements: All element numbers must match exactly
- Crack type, plane, r and z coordinates
- Plate: stress directions and dimensions (xd, hx, yd, hy)

### Deterministic Crack Growth:

- All checks associated with stress processing
- Material number (material number only, not actual data)

### Risk Assessment:

- All checks associated with stress processing
- All checks associated with deterministic crack growth
- Defect (defect number only, not actual data)
- Number of samples
- Volume multiplier
- Life scatter: median and COV
- Inspection schedules: the numbers and type (top, left, etc.)
- Probabilistic method

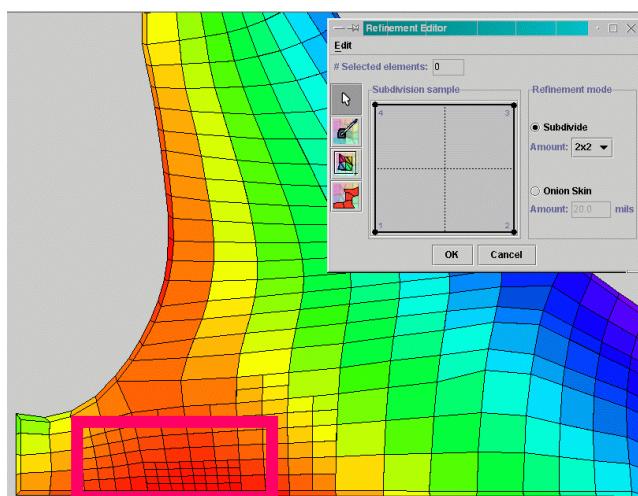
### Convert old RSF format to ddb format

The stress processing was changed to a zone-by-zone computation architecture in the DARWIN 3.5 Release. These results are now also stored in the database (\*.ddb file) and the old Reduced Stress Files (\*.rsf) are no longer used. To ensure backward compatibility with DARWIN 3.4, a translator program was created: rsf2ddb. This program resides in the \$DARWIN/darwin-ra/rsf2ddb directory; it reads the \*.rsf file and creates a \*\_rsf.ddb database file. The format for the reduced stress database file is compatible with the restart and zone refinement features.

## GUI Enhancements

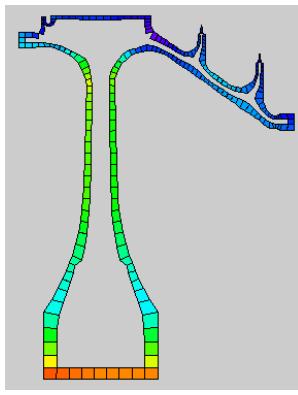
### Element Subdivision

All elements can be subdivided into four smaller elements (2 x 2 sub-division). The surface elements can be onion skinned by an arbitrary amount. Stresses and temperatures are interpolated during the creation of the new zones. The GUI supports one level of undo/redo. Each element can be subdivided repeatedly to provide the desired resolution for zone creation.

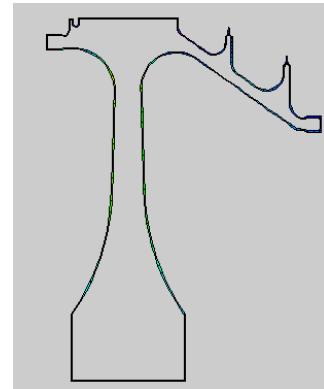


## Onion Skinning

The Advisory Circular 33.14 advises that a thin layer of material 20 mils thick be associated with surface zones. Typically, the FE models typically do not have elements of this thickness at the surface. Therefore an onion skinning capability was added to the GUI to automatically create a layer of user-specified thickness (this thickness is specified in the Refinement Editor).



Before onion skinning



After onion skinning

## UIF/UOF File Writing

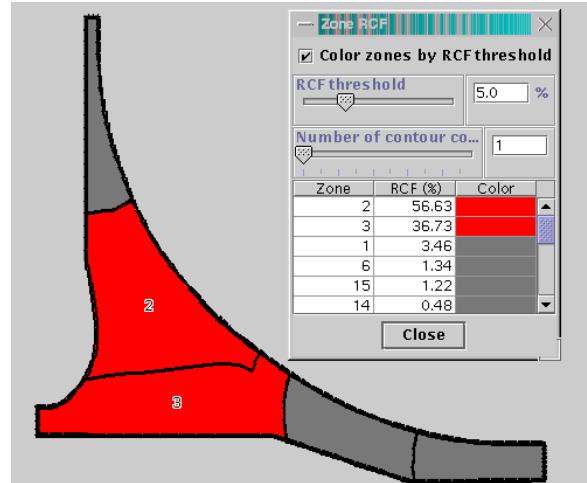
The element refinement and onion skinning results can be saved directly to the UIF/UOF files. This feature was added to the GUI in the Stress and Zones screen. Use of this feature is required if the user wants to use the refined mesh in a risk assessment.



## Zone Refinement Capability

The risk computed by DARWIN is dependent on the zone break-up (but always converges from above, so that a coarse zone mesh provides a conservative result). A zone refinement capability was implemented as follows:

1. Identify zones which contribute significantly to the overall risk are identified based on their Risk Contribution Factor.
2. Sub-divide zones and redefine plates and other properties for each new zone (material, defect distribution, etc.)
3. Perform risk-assessment on new setup (the restart capability will dramatically reduce the required computer time)





### Risk Contribution Factor (RCF):

The user can specify a threshold risk contribution factor in DARWIN. All zones with a RCF greater than the threshold will be color coded by DARWIN. The user can either choose one color code to identify all zones with  $RCF > \text{threshold}$  value, or can select multiple contour values to create a RCF contour plot.



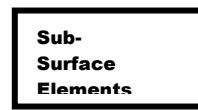
### Sub-zone Creation:

A new “sub-divide” button was added to the zone editor panel, which automatically creates sub-zones from parent zones. Sub-surface zones are divided into 4 (or 3) zones; surface zones are divided into 2 sub-zones. This procedure forces each sub-zone to inherit its properties from the parent zone, adjusts the plate if necessary and places the flaw in the sub-zone which is geometrically closest to the location in the parent zone. Of course, the user has the option to edit each of the newly created sub-zones.

## Visualization Features

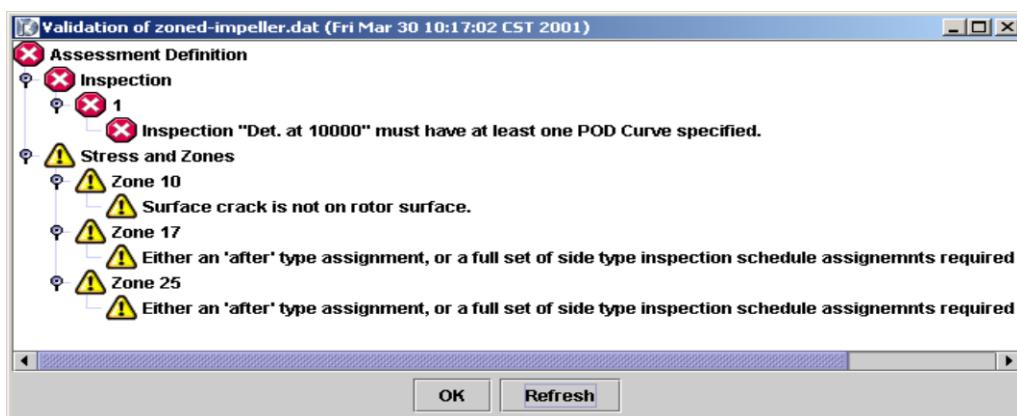
Several filters have been implemented so that users can toggle the display of the following features:

- Filter elements: sub-surface and surface elements may be filtered from the display.
- Filter zoned elements: this may come in handy to identify material not included in any zone
- Show zone numbers and highlight border
- Element and Node numbers are accessible via tool tips in the Stress and Zones display

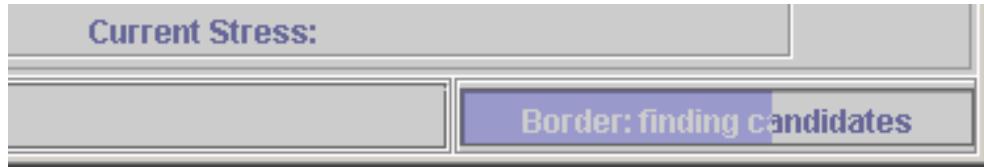


Additional GUI features:

- Improved validation of input: information is organized in tree hierarchy, and clearly differentiates between warnings and errors. It is easily “refreshed” as fixes are made.
- The status log display can now be expanded to show the full contents in a larger window. Its contents can be saved to a file to aid in bug reporting.



- Progress status display: the progress of time consuming operations is reported via a progress monitor next to the log window.



- Expanded Contour capability: The number of contours is no longer limited to 20, it is now unlimited. This allows a finer display of stress gradients.
- Crack animation: A new GUI button provides capability for viewing the crack growth as a function of the number of cycles. The animation shows the location, type and size of the crack.

