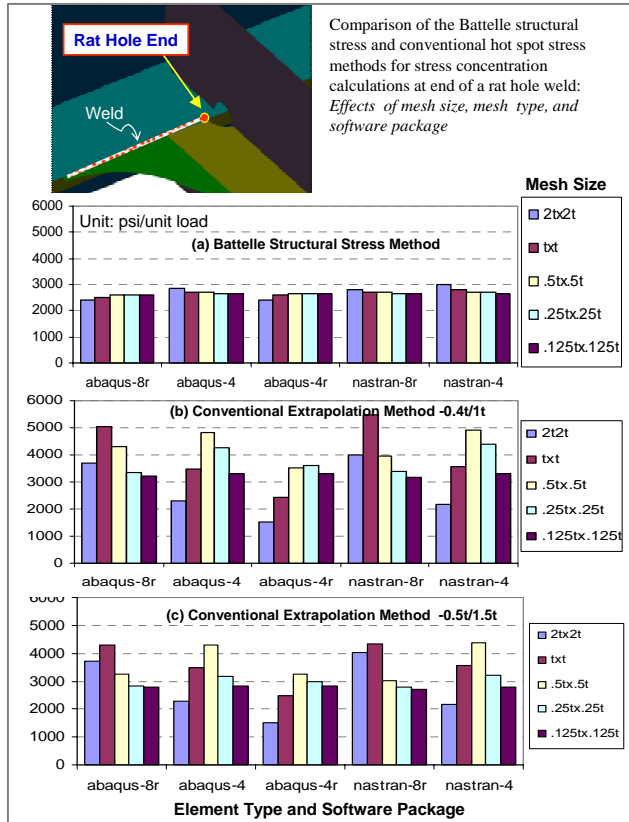


Battelle Structural Stress JIP on

Mesh-Insensitive Structural Stress Method for Fatigue Evaluation of Welded Structures*



Background

A Battelle Joint Industry Project (JIP) was launched in 2001 to further refine and validate Battelle's patented mesh-insensitive structural stress method for various industrial applications. As a result of the JIP sponsorship, rapid progress has been made in validating the effectiveness of the structural stress method by effectively correlating large

amount of S-N data from drastically different joint types, loading modes, and plate thicknesses. Some of major accomplishments from this JIP are summarized below:

- Demonstrated the robustness of the nodal force based structural stress procedure for all joint types from applications in aerospace, civil structures, ground vehicle, offshore/marine, petrochemical, nuclear utilities, etc.
- Automated the structural stress calculation procedures in the form of post-processors for ABAQUS, ANSYS, and NASTRAN for day-to-day fatigue design and evaluations
- Formulated a structural stress based master S-N curve approach by consolidating all well-documented historical fatigue data from various industries without using any empirical parameters
- Established a comprehensive weld S-N data base containing about 5000 fatigue tests from literature spanning from 1950s' to present

The Needs for Structural Stress JIP II

Some JIP I sponsors have expressed the needs for a User Group for the JIP to provide continued the technical support for using the JIP structural stress method. This includes:

- Technical support and enhancement for the automated structural stress post-processors as they are being implemented for company-specific applications
- Technical support and enhancement of the comprehensive JIP S-N database
- Training of design and analysis engineers on both the structural stress method and its use in day to day application

In addition, with pooled resources, further technical developments and new applications of the structural stress method can be carried out as they are being identified by JIP sponsors, such as:

- Development of general 3D solid model capabilities for automated structural stress calculations
- Treatment of weld root/throat cracking
- Treatment of multi-axial fatigue under general and random loading conditions, etc.
- Furthermore, for Code-regulated industries, such as pressure vessel and piping systems governed by ASME Codes and Standards and offshore/marine structures governed by Guidance from Class Societies, a

coordinated effort is needed for the structural stress method to gain the acceptance by these Code bodies.

JIP II Scope of Work

Based on JIP long range plan approved by JIP II sponsors, near-term working items (e.g., a period of six-months) will be proposed by surveying the needs from current JIP II sponsors and approved (one vote per participating company) by JIP II Industrial Steering Committee (ISC) on a semi-annual basis at JIP II review meetings. The current working items approved by JIP II ISC for the period from Nov. 1, 2004 to May 1, 2005 include:

- Conduct entry-level training course for the JIP structural stress method
- Add 3D solid element capabilities to the current structural stress post-processor (3D shell/plate element models only during JIP I)
- Design a user-friendly database for thousands of S-N data analyzed thus far
- Preliminary investigation of generalized structural stress procedures for multi-axial fatigue loading conditions and additional data collection, etc.

JIP II Deliverables

The deliverables of the JIP II within the proposed two- year effort include the following:

- JIP S-N database containing all S-N data analyzed (up to 3000 fatigue tests)
- Enhanced structural stress analysis procedures in the form of FEA post-processors with 3D solid capabilities
- Semi-annual project progress summary and comprehensive annual project reports documenting above and validation case study details
- Two comprehensive workshops per year (one entry-level on the structural stress method and one advanced level on new developments (For the entry-level training course, JIP II participants can send up to five persons free of charge; non-JIP II participants will be charged at \$2,000/person)

JIP II Participation Fee

To participate in the JIP, an annual fee of \$15,000/company is required for the current JIP participants. An annual fee of \$35,000/company is required for new participants for the first year and \$15,000/company for subsequent years.

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