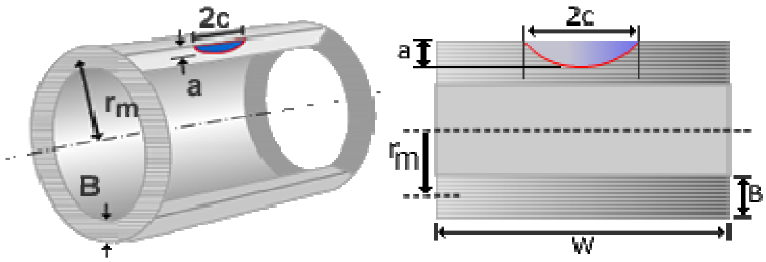
April 2008

CRACKWISE 4.1 RELEASED

CRACKWISE® version 4.0 was released to coincide with the publication of BS7910:2005, and has since been maintained so that it is fully compliant with the amendment published in 2007. TWI is now pleased to announce the release of version 4.1 of the software, which is freely available to all registered users. Several enhancements have been made, one relating to changes in the underlying procedure and the rest to improvements in the functionality of the software.

1. A .pdf copy of the amended version of the underlying procedure, BS7910:2005, is included in the software. Amendment 1 (dated 2007) replaces the original procedure (dated 2005) and consists of the full procedure with tag marks to show where corrections have been made. All such corrections have already been implemented in the software, so the .pdf document is for information only.

2. Many of the sketches showing flaw geometry have been re-drawn in three dimensions. The original 2D sketches have been retained so that users can more easily visualise both the actual component and its idealization in two dimensions.

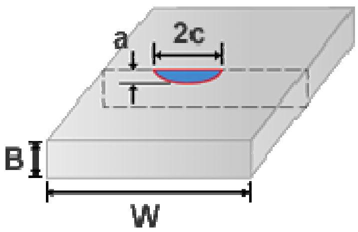


3. Users will now automatically receive an alert (via the opening page) if they are using an out-of-date copy of the software, ie if a newer version is available on the TWI software website. This will save users from having to check the website regularly and will be particularly useful for companies with multiple users, in which the responsibility for downloading the software may lie with a single user. E-mail alerts will continue to be issued to the main contact in each user organisation.

4. The calculation of K-solutions for flaws in flat plates has been greatly enhanced by the incorporation of weight function methods. Users can now describe the stress distribution through the thickness of the plate using a polynomial function rather than a combination of bending and membrane stresses. This allows a much more accurate calculation of both primary and secondary values of stress intensity, K_{Ip} and K_{Is}. An example of the application of weight functions is given below.

Example of the application of weight functions

A component, which can be represented as a flat plate with a surface-breaking flaw, is analysed using the 'known flaw' procedure in CRACKWISE®. The plate contains a finite surface flaw with a height (a) of 20% of the plate thickness (B).



The actual stress distribution for the uncracked body (derived, for example, from Finite Element Analysis) across the whole plate section is shown by the polynomial stress distribution in Figure 1 (green dotted line). In many cases, however, the user will have less information than this and will use a simplified approach based on, say, code maximum stress, represented as a uniform membrane stress of 210N/mm² in Figure 1 (red dashed line). Alternatively, the actual stress distribution could be linearised across the whole cross section, producing a membrane stress of 165N/mm² and a bending stress of 45N/mm² (blue dot-dashed line of Figure 1). This linearisation conservatively describes the actual stress distribution, but is more accurate than the membrane stress assumption. A fourth method of treating the stress distribution, recommended in BS7910, is to linearise the stress distribution across the flaw, for the purposes of calculating applied stress intensity, K_I. [For the calculation of the reference stress, σ_{ref} and the normalised limit load, L_r, this approach could be non-conservative, so the stress distributions used for K_r and L_r need to be separated on this occasion.] Linearisation across the flaw produces still lower values of membrane stress (P_m=110N/mm²) and a higher bending stress (P_b=100N/mm²) as shown in the solid black line.

The consequences of these different treatments of the stress input can be seen in the FAD in Figure 2. All analyses have been carried out using Level 2 assessment, but the analysis point moves away from the Failure Assessment Line, towards the origin of the FAD, as the stress input becomes more accurate, the membrane stress assumption producing the highest values of L_r, K_r and the weight function method the lowest.

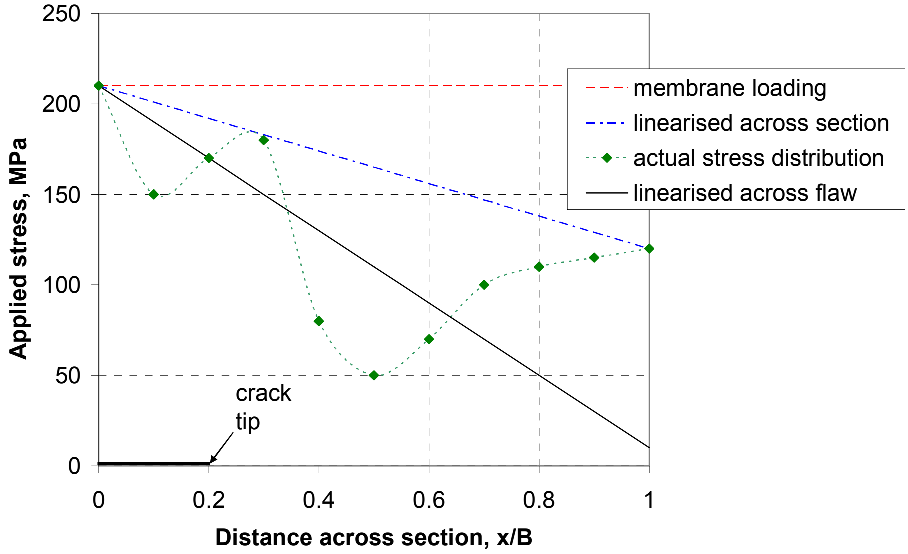


Figure 1. Example of stress distribution across a component, showing how it can be idealised for input into a BS7910 fracture assessment.

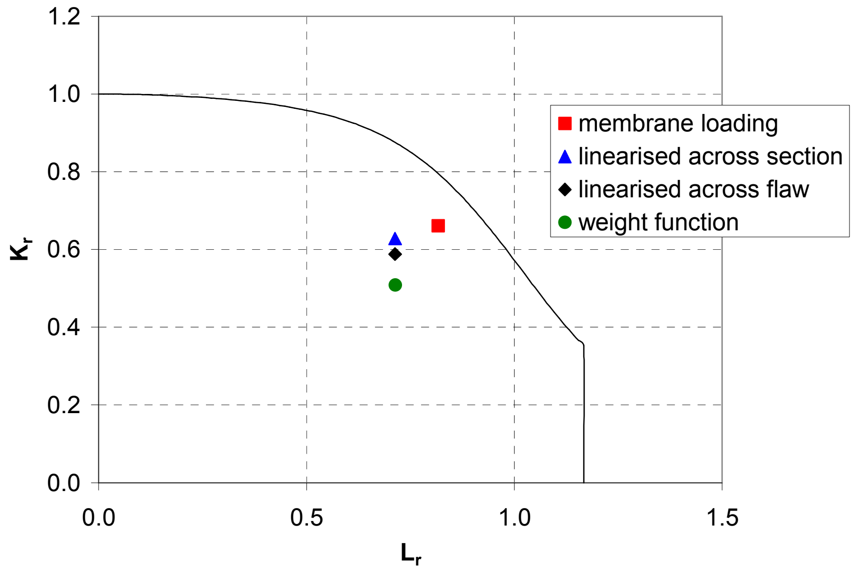
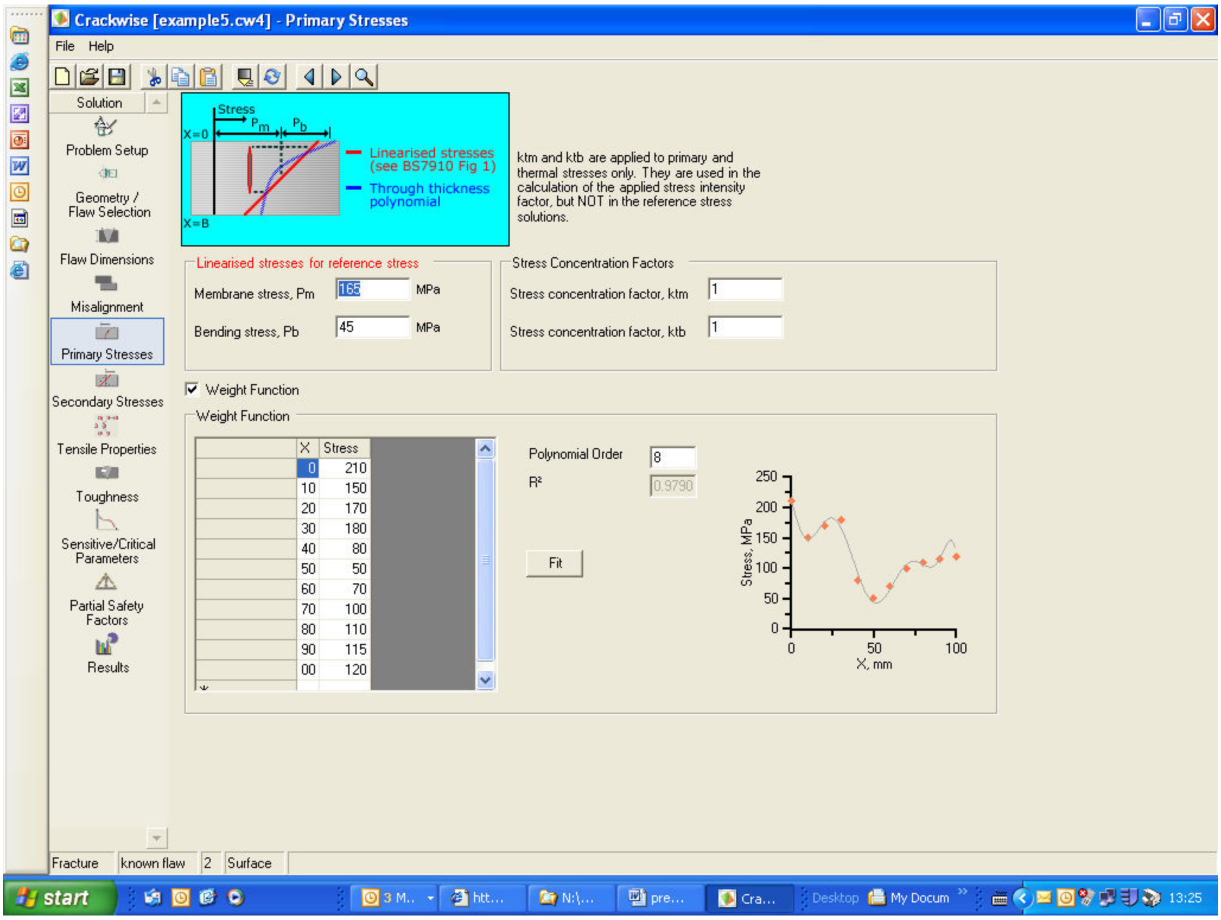


Figure 2 Example of BS7910 fracture analysis (Level 2) using different types of stress input.

How to implement weight functions in CRACKWISE®

Using the weight function method in CRACKWISE® is simple and intuitive; tick the 'weight function' option in the screen for 'primary stresses' and/or 'secondary stresses'. Then input the stresses as a function of thickness in the table, choose an appropriate order of polynomial (up to 8) and select 'fit'. The stress distribution will be shown as a graph along with a 'goodness of fit' parameter (R^2). Double-clicking on the graph will expand it to fill the lower half of the screen; repeating the double-click will return the display to its original condition (table plus graph).

A separate table above the 'weight function' part of the screen displays the 'linearised stresses for reference stress' (shown in red) in place of the usual 'stresses' option. This is because, when weight function methods are switched OFF, CRACKWISE® calculates both K_r and L_r from the same stress information. With weight function ON, the L_r and K_r calculations are decoupled, and a safe and conservative approach is to calculate L_r on the basis of stresses linearised across the section, not across the extent of the flaw.



For further information on CRACKWISE software (purchase, training, technical support) please contact Crackwise@twi.co.uk