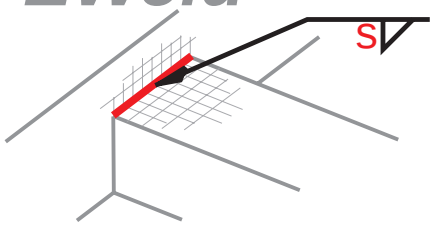
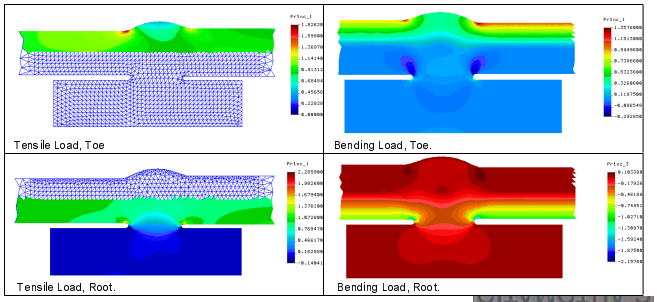
FEWeld



Weld Calculations from FEA

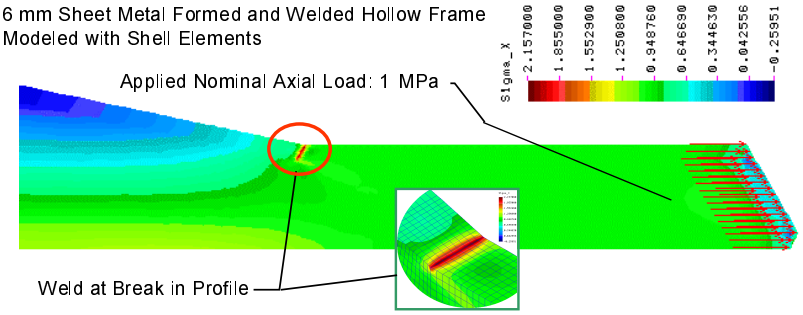
Notch Stress Example

The following example demonstrates combination of geometric weld joint loads with effective notch stress concentration factors to predict the effective notch stress in the structure from the FEA shell element results. The example also illustrates the ease with which new weld formulations are incorporated into the FEWeld environment.



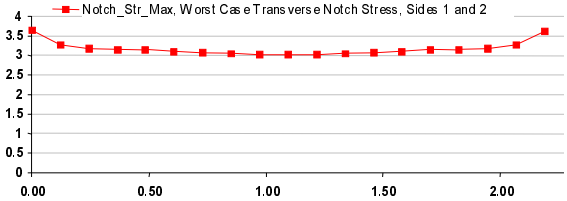
	$K_{TENSION}$	$K_{BENDING}$
TOE	1.59	1.36
ROOT	2.45	-2.16

6 mm Sheet Metal Formed and Welded Hollow Frame
Modeled with Shell Elements

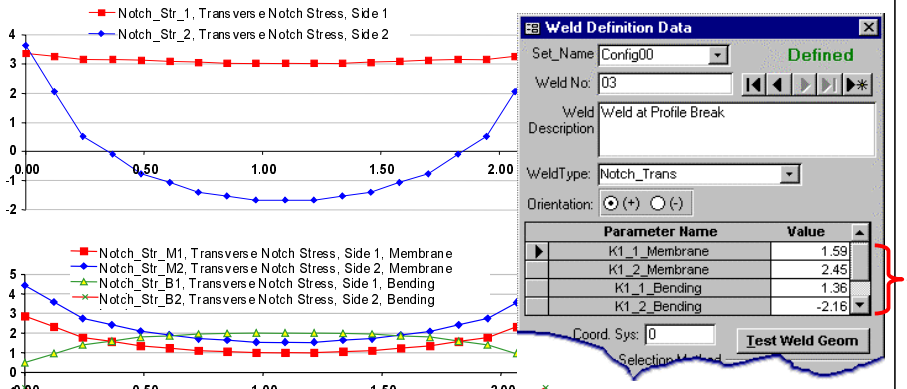


Above is a FEA shell element model of a welded sheet metal structure with applied loading such that the nominal stress is 1.0 Mpa. The predicted structural (geometric effects, not counting the weld notch effect.) stress is 2.16 Mpa at the weld on the outside surface

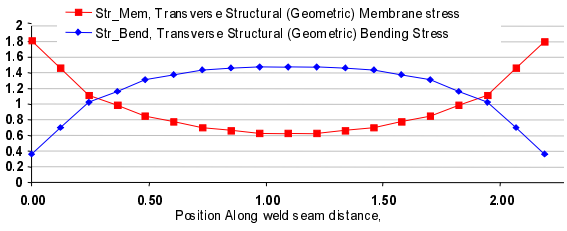
Left is a plane strain FEA model used to estimate the effective notch stress concentration factors on each side of the joint for both Membrane and Bending Loading. The loading applied was such that the nominal stress in the material without the notch would be 1 MPa.



The combined notch and geometric stresses are shown to the left. To the right is the formulation used for the calculation.



Above shows the match-up between the weld formulation input parameters and weld definitions.




```
/******** COMMENT BLOCK ****
    Name:  Notch_Trans
    Weld Side 1 and 2 Stress Concentration Factors for Membrane
    and Bending Applied to Transverse Geometric Stresses and Added.
    Criteria:
        None, Stress Result with Notch Factors Applied and Returned.
    User Inputs:
        K1_1_Membrane:  Transverse Notch Stress Concentration
                        Factor for Membrane Stresses on Joint Side 1
        K1_2_Membrane:  Transverse Notch Stress Concentration
                        Factor for Membrane Stresses on Joint Side 2
        K1_1_Bending:   Transverse Notch Stress Concentration
                        Factor for Bending Stresses on Joint Side 1
        K1_2_Bending:   Transverse Notch Stress Concentration
                        Factor for Bending Stresses on Joint Side 2
    Calculated Variables:
        Notch_Str_1         - The total Notch Stress on Side 1 due to
                              Transverse Membrane and Bending Loads
        Notch_Str_2         - The total Notch Stress on Side 2 due to
                              Transverse Membrane and Bending Loads
        Notch_Str_Max       - The Maximum of Snotch_1 and Snotch_2
        Notch_Str_M1        - The Notch Stress Due to Transverse
                              Membrane Stresses on Side 1
        Notch_Str_M2        - The Notch Stress Due to Transverse
                              Membrane Stresses on Side 2
        Notch_Str_B1        - The Notch Stress Due to Transverse
                              Bending Stresses on Side 1
        Notch_Str_B2        - The Notch Stress Due to Transverse
                              Bending Stresses on Side 2
        Str_Mem             - The Transverse Membrane Stress
        Str_Bend            - The Transverse Stress Due to Bending
    Joint Types: Any
******** END COMMENT BLOCK *********/
@INPUT{
    K1_1_Membrane
    K1_2_Membrane
    K1_1_Bending
    K1_2_Bending
}
Str_Mem = (Sjj_1 + Sjj_2)/2
Str_Bend = Sjj_1 - Str_Mem
Notch_Str_M1 = Str_Mem*K1_1_Membrane
Notch_Str_M2 = Str_Mem*K1_2_Membrane
Notch_Str_B1 =  Str_Bend*K1_1_Bending
Notch_Str_B2 =  Str_Bend*K1_2_Bending
Notch_Str_1 = Notch_Str_M1 + Notch_Str_B1
Notch_Str_2 = Notch_Str_M2 + Notch_Str_B2
@IF(Notch_Str_1 >= Notch_Str_2){
    Notch_Str_Max = Notch_Str_1
}@ELSE{
    Notch_Str_Max = Notch_Str_2
}
@STORE{
    Notch_Str_Max{
      description = "Worst Case Transverse Notch Stress, Sides 1 and 2"
      plot
      summarize max unsigned
    }
    Notch_Str_1{
        description = "Transverse Notch Stress, Side 1"
        summarize max unsigned
    }
    Notch_Str_2{
        description = "Transverse Notch Stress, Side 2"
        summarize max unsigned
    }
    Notch_Str_M1{ "Transverse Notch Stress, Side 1, Membrane Load" }
    Notch_Str_M2{ "Transverse Notch Stress, Side 2, Membrane Load" }
    Notch_Str_B1{ "Transverse Notch Stress, Side 1, Bending Load" }
    Notch_Str_B2{ "Transverse Notch Stress, Side 2, Bending Load" }
    Str_Mem{ "Transverse Structural (Geometric) Membrane Stress" }
    Str_Bend{ "Transverse Structural (Geometric) Bending Stress" }
}
```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