Quarterly Report

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The results completed to date have shown, amongst other items, the validity of wrinkle model (see Figure 1 below) based upon agreement with full scale test results and have developed some preliminary interaction criteria for wrinkles.

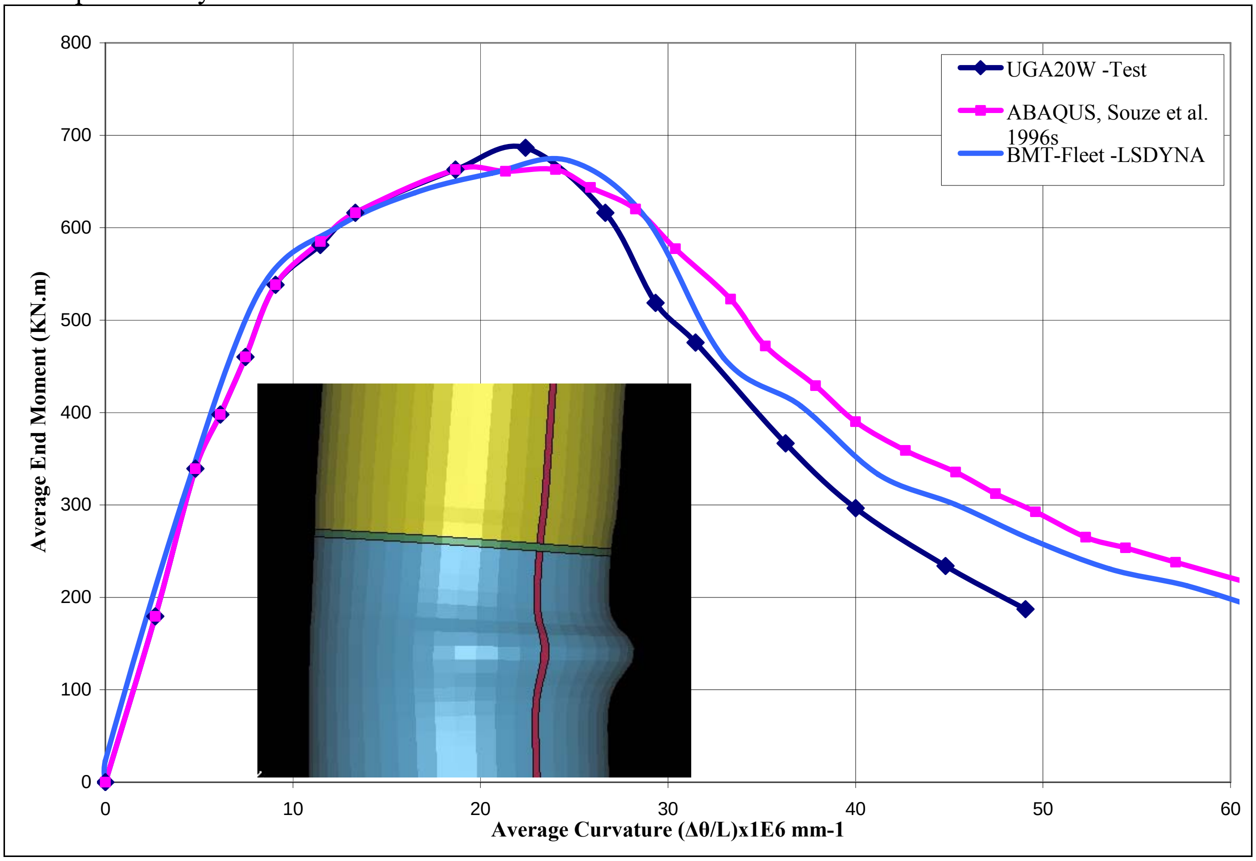

Figure 2: Wrinkle Model

From this model results were developed to identify the safe distance (L) from the crest of the wrinkle for girth welds. These results were plotted as shown in Figure 2 for a range of pipe geometries and critical strain levels.

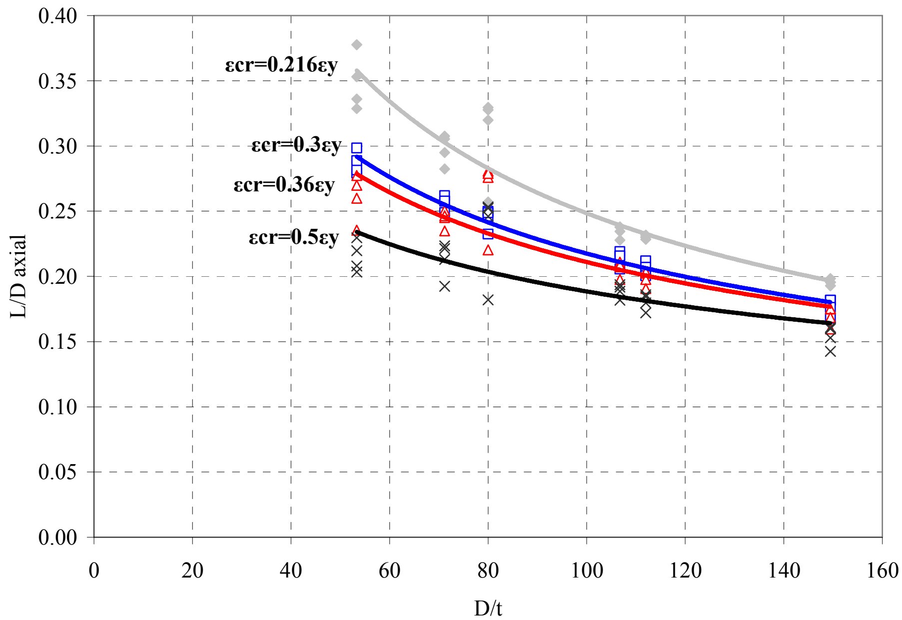

Figure 2: Comparison of Normalized Critical Distance vs D/t – for X52 Pipe

As shown in the sample figure above, the relationship between the normalized critical distance (*L/D*) and the diameter-to-thickness ratio (*D/t*) appears to follow a power law relationship. The normalized critical distance in the axial direction was therefore expressed in convenient dimensionless form as follows:

$$\frac{L}{D} = C\left(\frac{D}{t}\right)^m$$

Where the coefficient *C,* and the exponent *m,* were determined for each of the four possible longitudinal strain criteria, based on the finite element results. Table 1 summarizes the parameters determined based on a data analysis of the results. The results in Table 1 relate the axial distance from the crest of the wrinkle to an acceptable position of a girth weld (Normalized Critical Distance Formula) to the four proposed axial strain criteria (Maximum Axial Strain Change, $\Delta\varepsilon_l$).

Table 1: Normalized Critical Distance Formula for Open-End pipe

Maximum Axial Strain Change, $\Delta\varepsilon_l$	Normalized Critical Distance Formula		
	Parameters		Formula
	C	m	
$\Delta\varepsilon_l=0.216\varepsilon_y$	3.6064	-0.5809	$\frac{L}{D}=3.6064\left(\frac{D}{t}\right)^{-0.5809}$
$\Delta\varepsilon_l=0.3\varepsilon_y$	1.8726	-0.4675	$\frac{L}{D}=1.8726\left(\frac{D}{t}\right)^{-0.4675}$
$\Delta\varepsilon_l=0.36\varepsilon_y$	1.6162	-0.4421	$\frac{L}{D}=1.6162\left(\frac{D}{t}\right)^{-0.4421}$
$\Delta\varepsilon_l=0.5\varepsilon_y$	0.9217	-0.3447	$\frac{L}{D}=0.9217\left(\frac{D}{t}\right)^{-0.3447}$