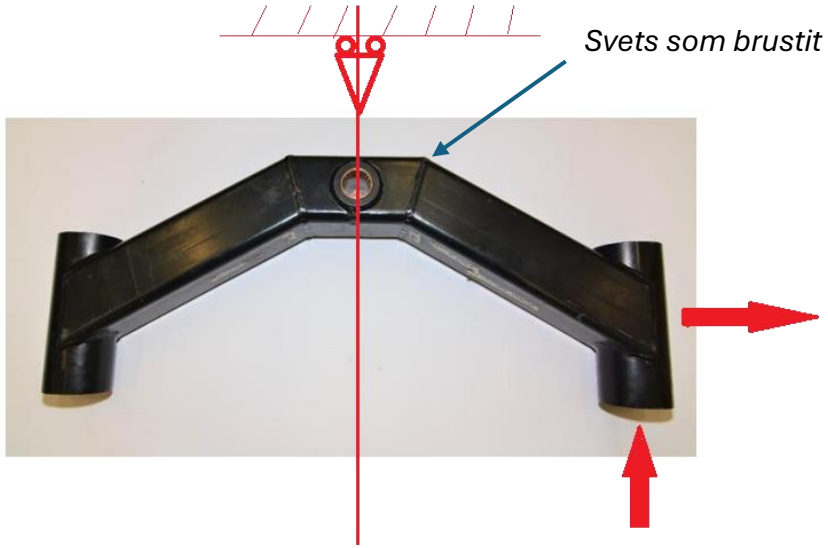
Gröna Lund Haveriet

(Enkla överslag med Nominell Metod resp ENS / APP)

5 sept 2024

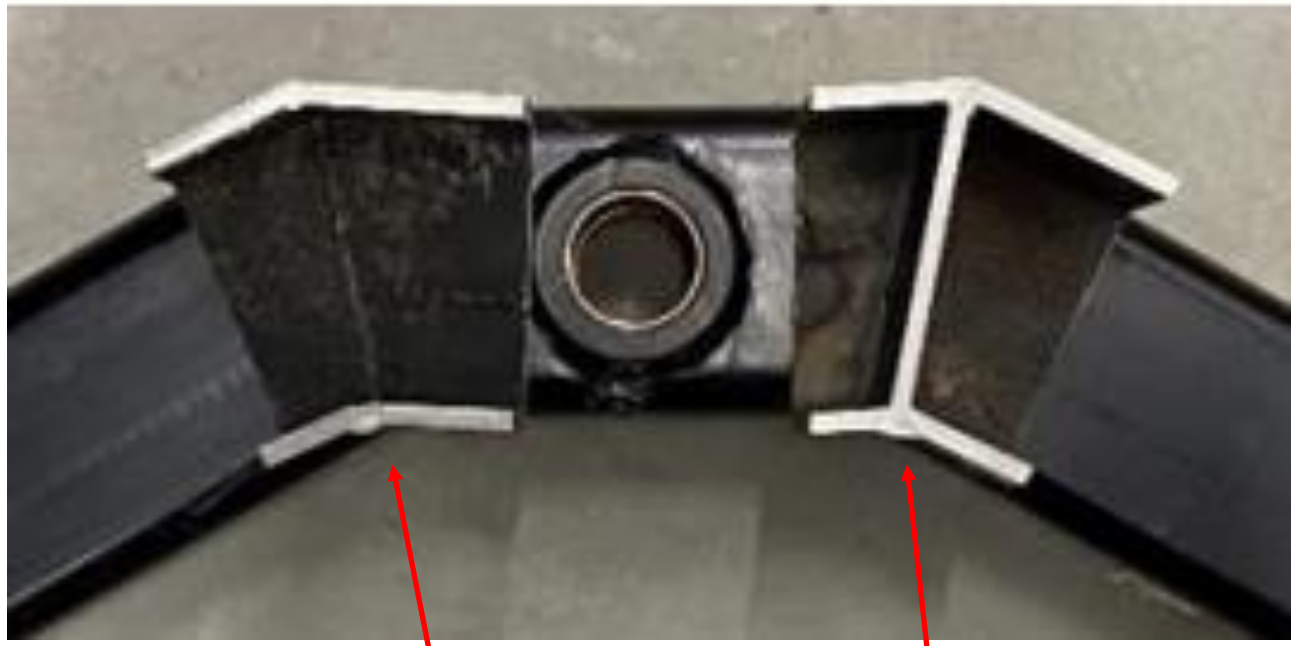
Bertil Jonsson

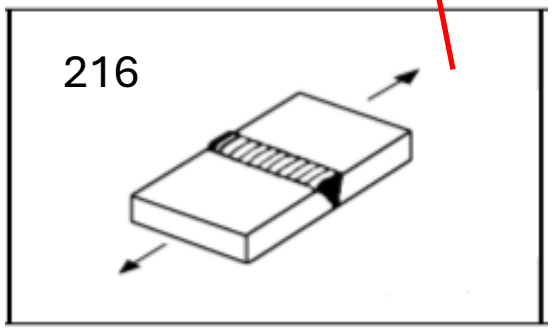
Främre bärarm



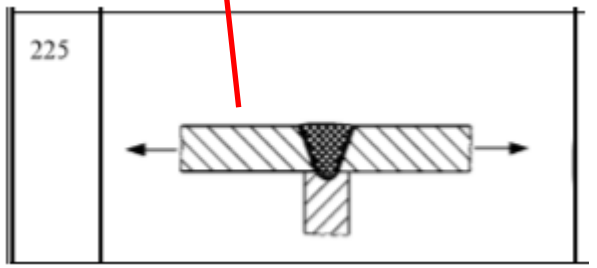
Dagens bärarm
(utan rotstöd)

Ursprunglig bärarm
(med rotstöd)





Single symmetry
2 choices of BC at right end
Nominal FAT 71/63/36

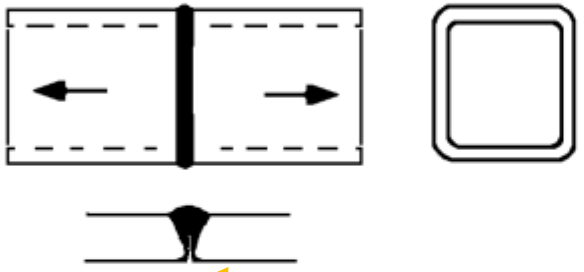
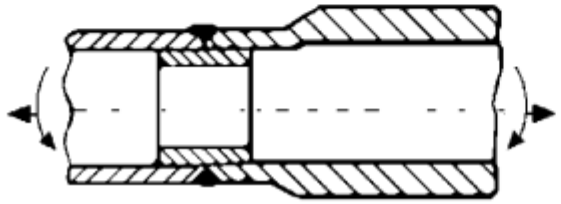


Symmetry assumed
Nominal FAT 71

<u>Nominell Metod:</u>

Med rotstöd ger FAT 71
Utan rotstöd ger FAT 36
Livslängd = $(36/71)^3 \approx 0.13$
→
Livslängden sjunker till ca 1/8-del !

Det finns FAT-värden för rekt. profiler

No.	Structural Detail	Description (St.= steel)	FAT St.
234		Transverse butt weld splice in rectangular hollow section, welded from one side, full penetration, root crack root inspected by NDT no NDT	 56 36
233		Tubular joint with permanent backing	71

Obs!

Utan rotstöd: FAT 36

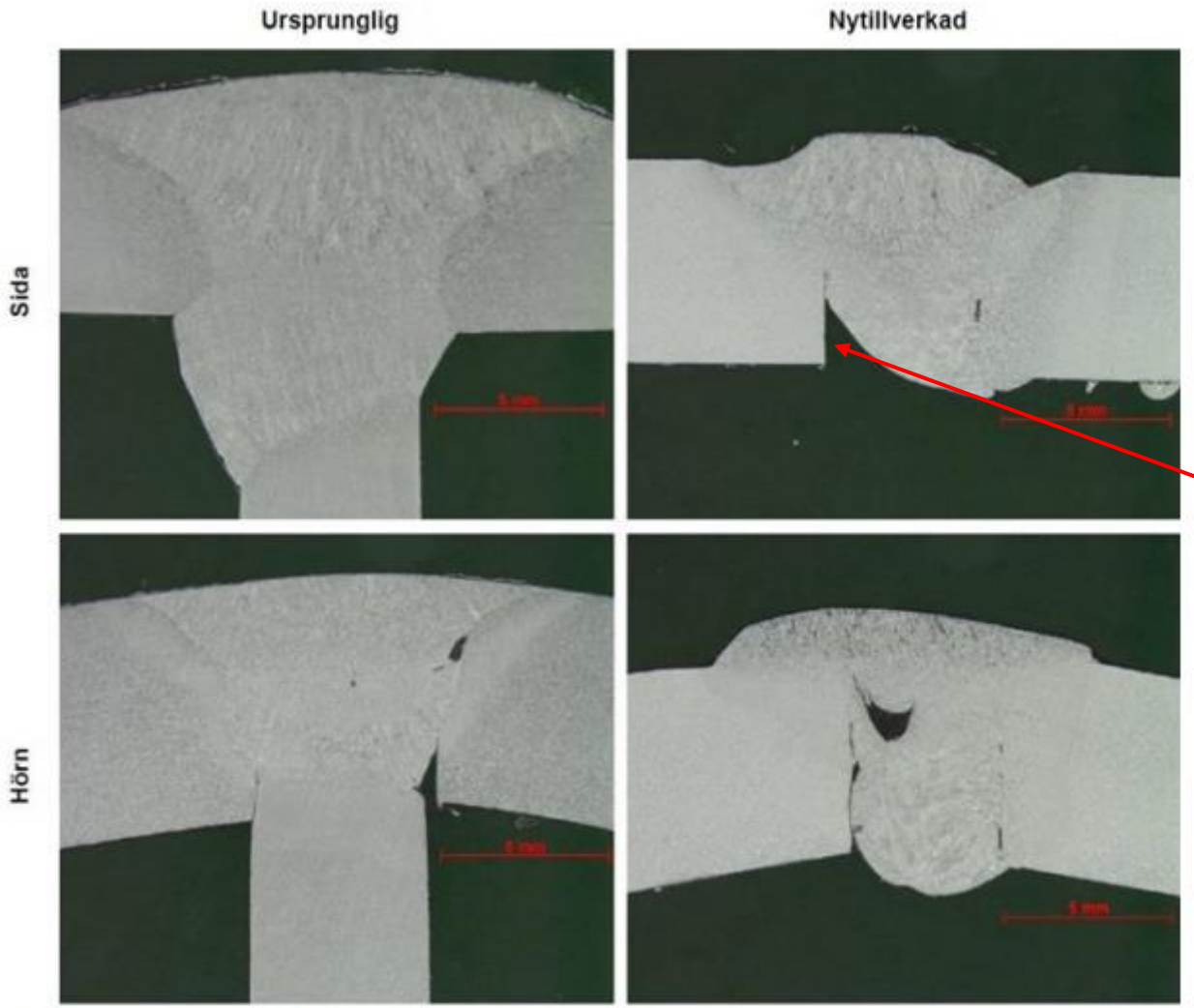
Med rotstöd: FAT 71

Dessa FAT stämmer med stumfogar ovan

Snitt genom svetsar, man hittade rotfel

Inget rotfel

Rotfel ca 2 mm



Figur 20. Tvärsnitt av svetsen på en ursprungligt tillverkad och en nytillverkad bärarm. Bild: Element Materials Technology AB.

Rotfel ca 2.5 mm

Ingen fogberedning ??

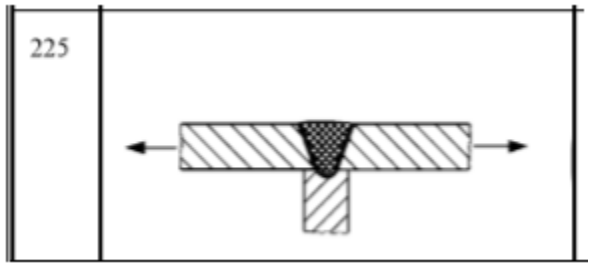
Rotfel ca 3 mm

Case 225 (med rotstödet)

ENS (R=0.3 mm)

Draglast = 71 Mpa (=Fat)

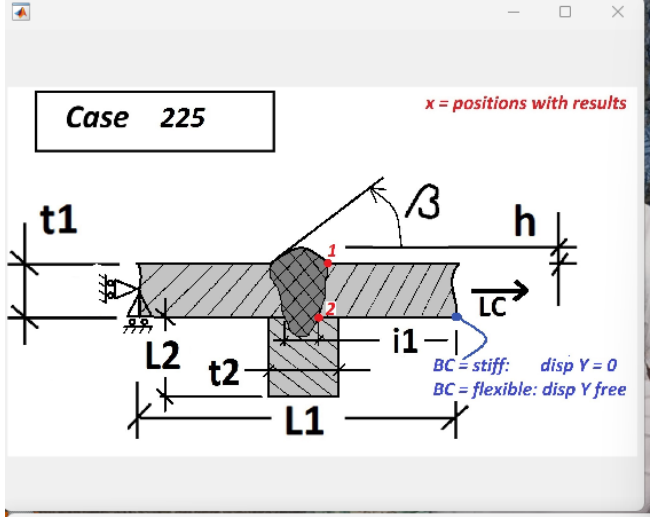
Rotfel = 2.0 mm

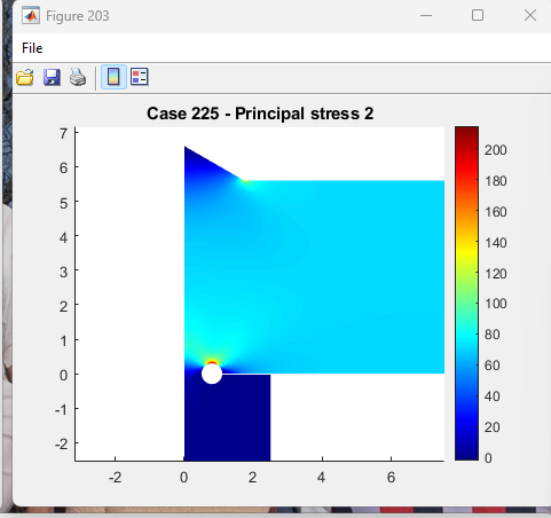


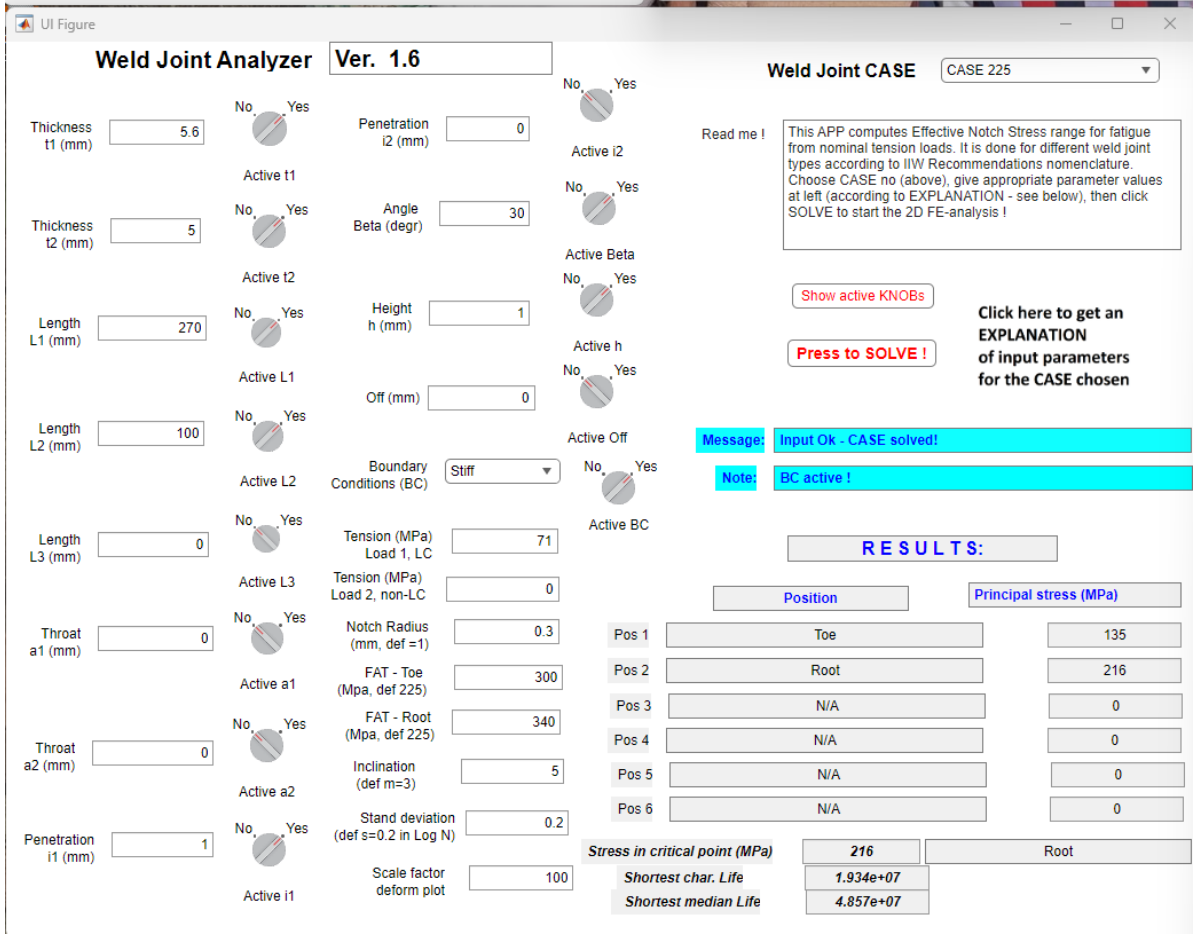
Symmetry assumed

Nominal FAT 71

Livslängd N ≈ 19E6 cykler

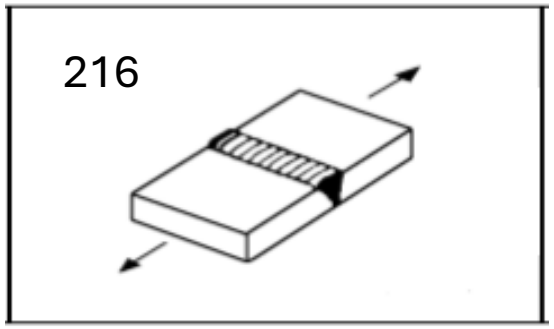


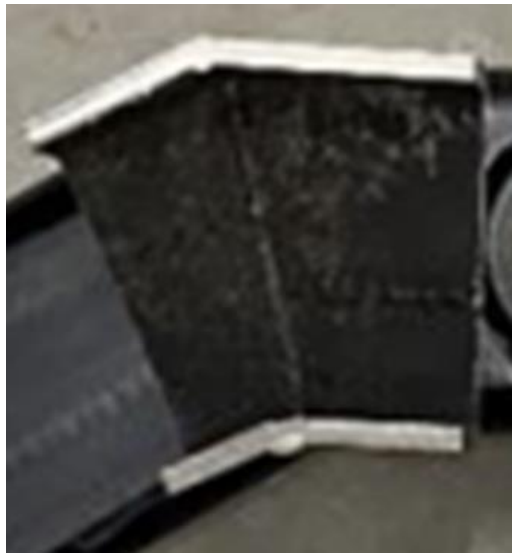




Case 216 (utan rotstödet)

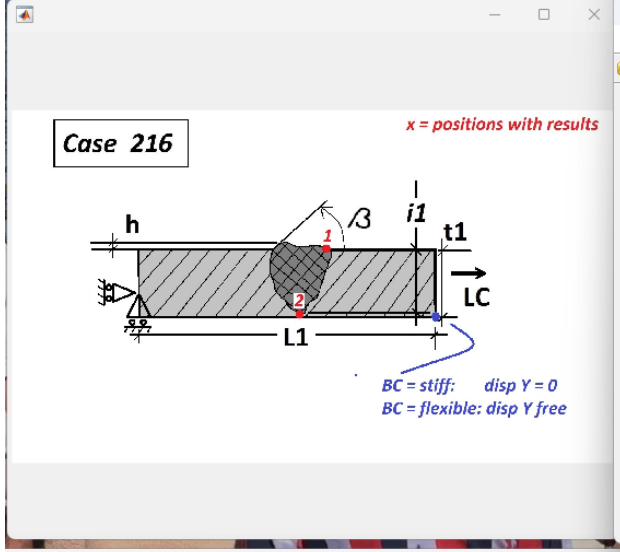
ENS (R=0.3 mm)
Draglast = 71 Mpa (=Fat)
Rotfel = 0.5 mm

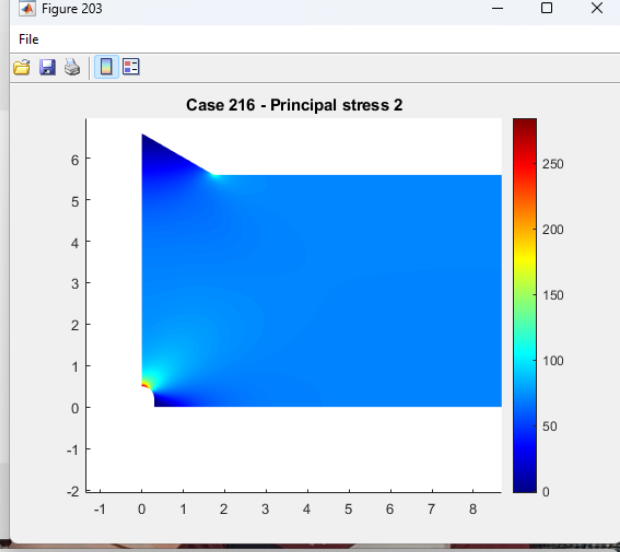


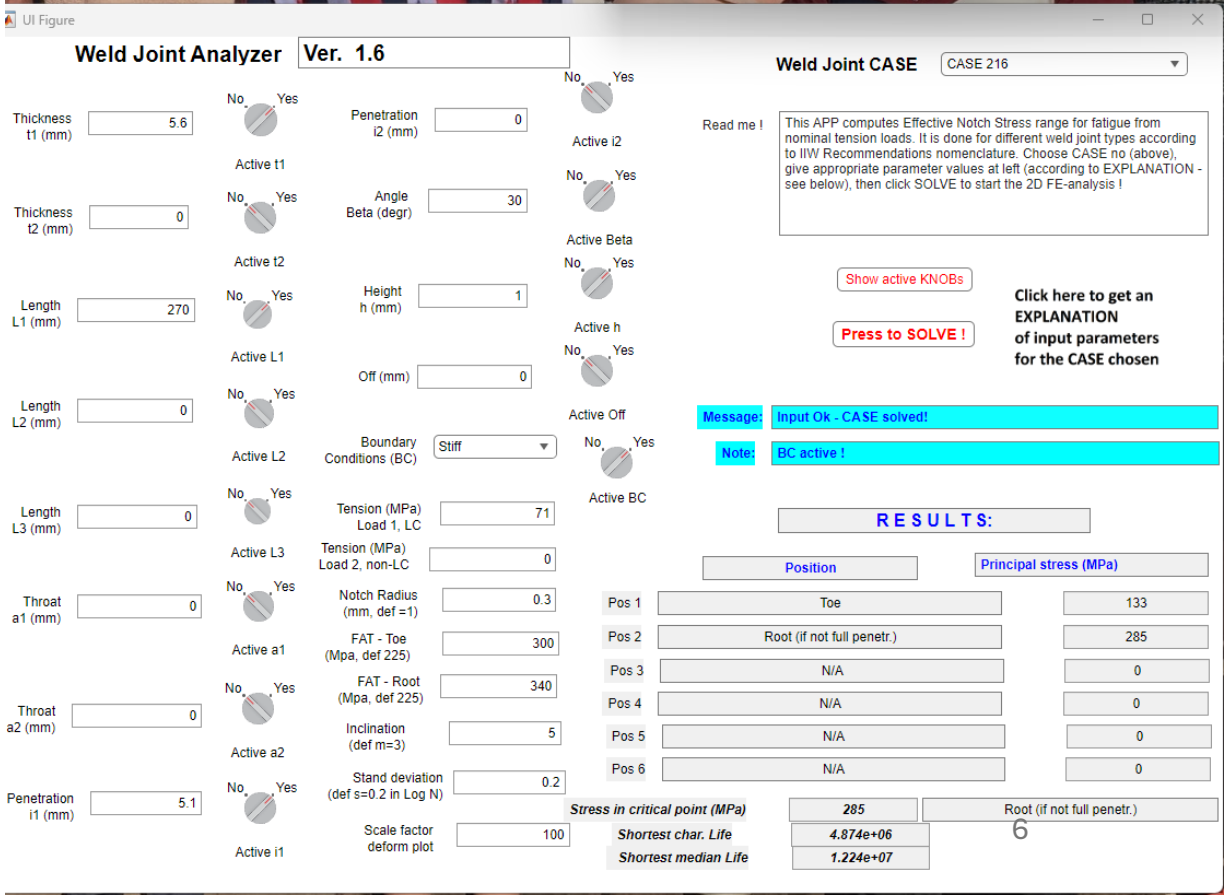


Single symmetry
2 choices of BC at right end
Nominal FAT 71/63/36

Livslängd N ≈ 5E6 cykler





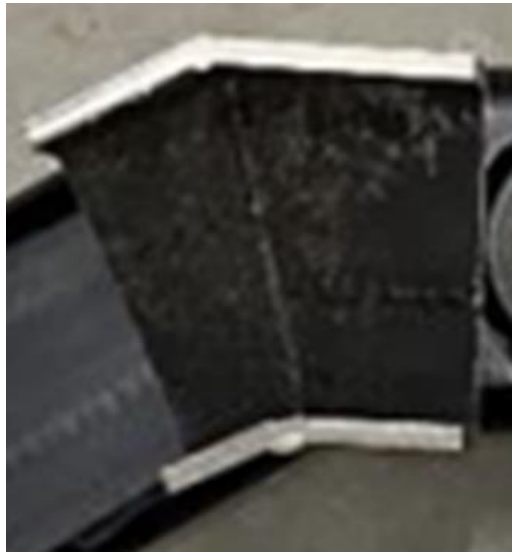


Case 216 (utan rotstödet)

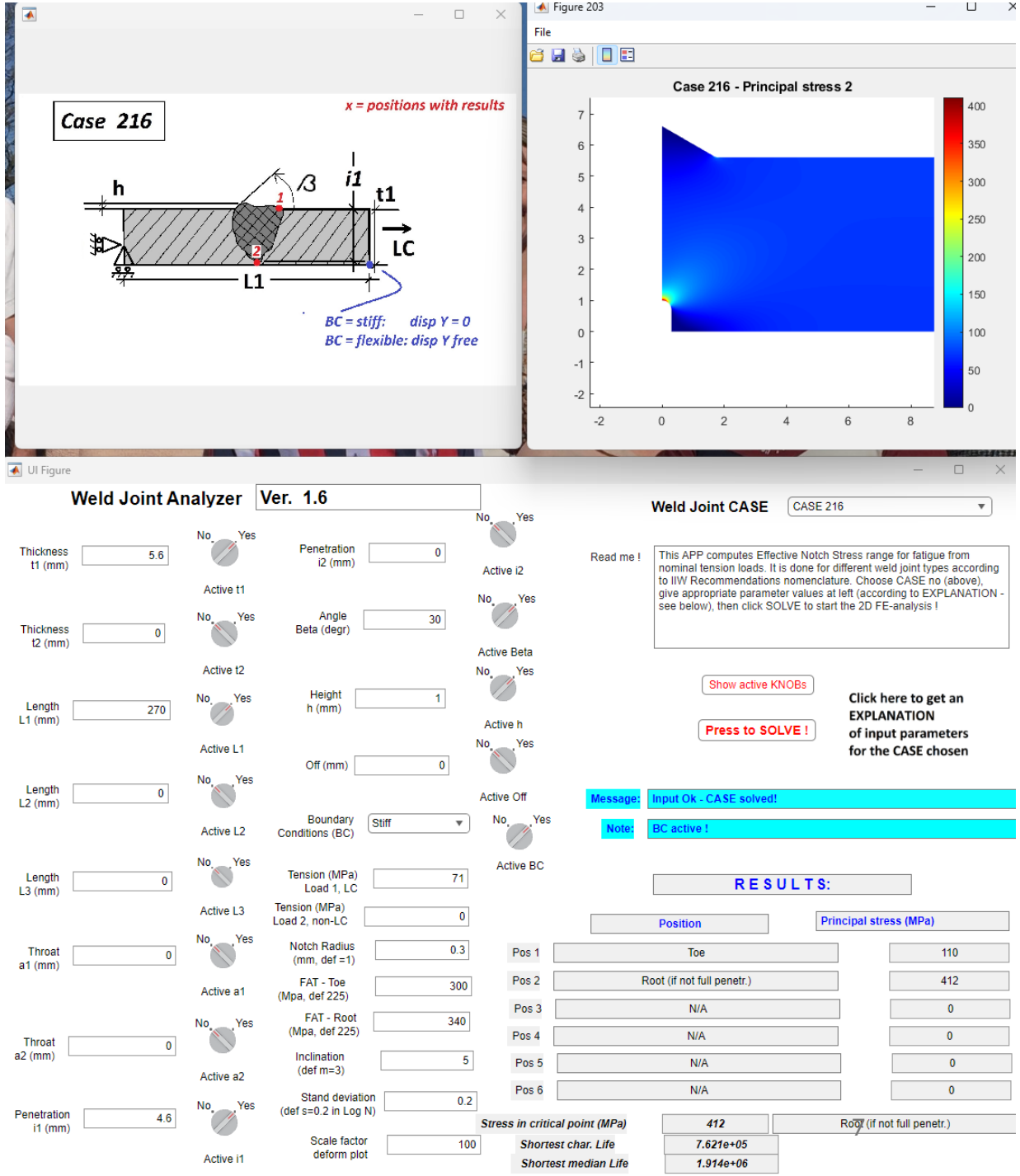
ENS (R=0.3 mm)

Draglast = 71 Mpa (=Fat)

Rotfel = 1.0 mm



Livslängd N ≈ 1E6 cykler

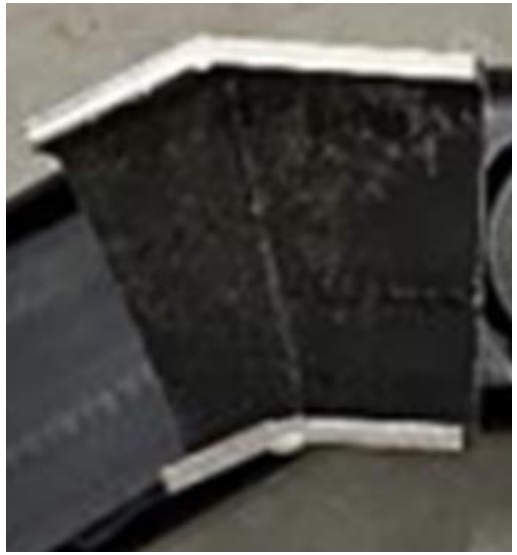


Case 216 (utan rotstödet)

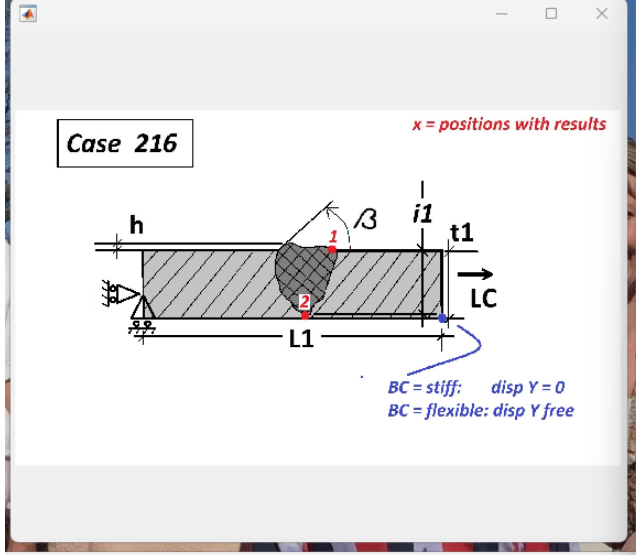
ENS (R=0.3 mm)

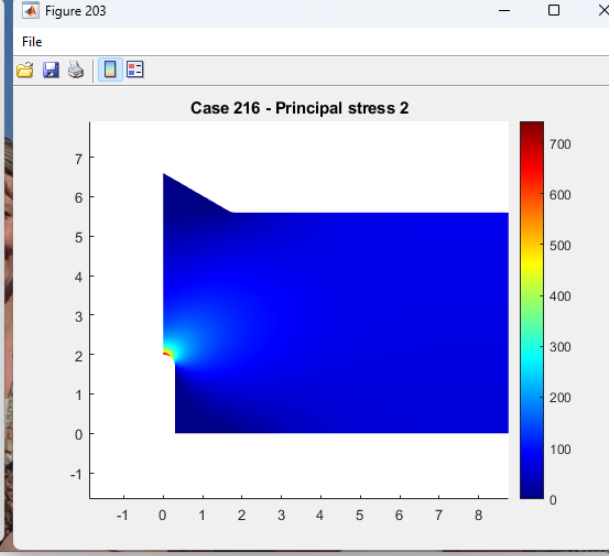
Draglast = 71 Mpa (=Fat)

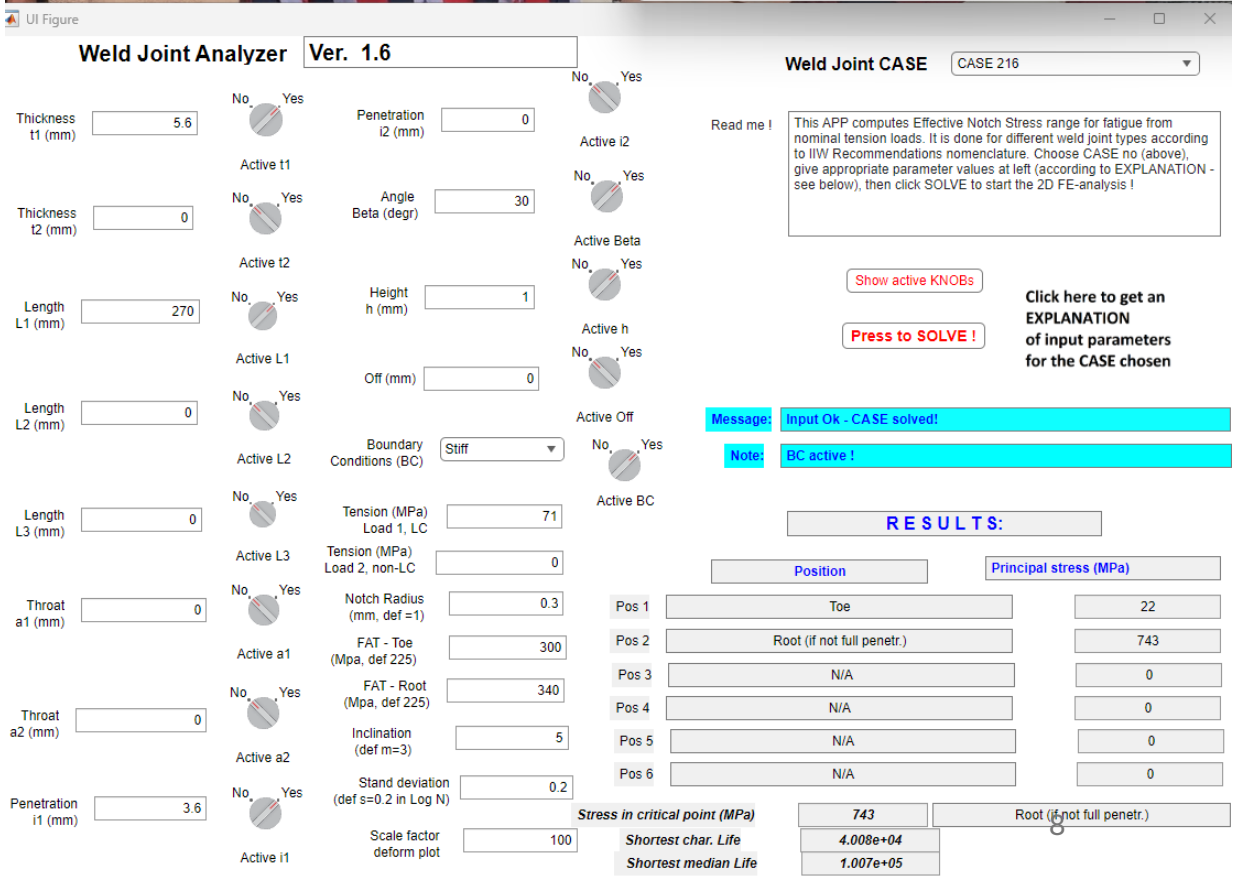
Rotfel = 2.0 mm



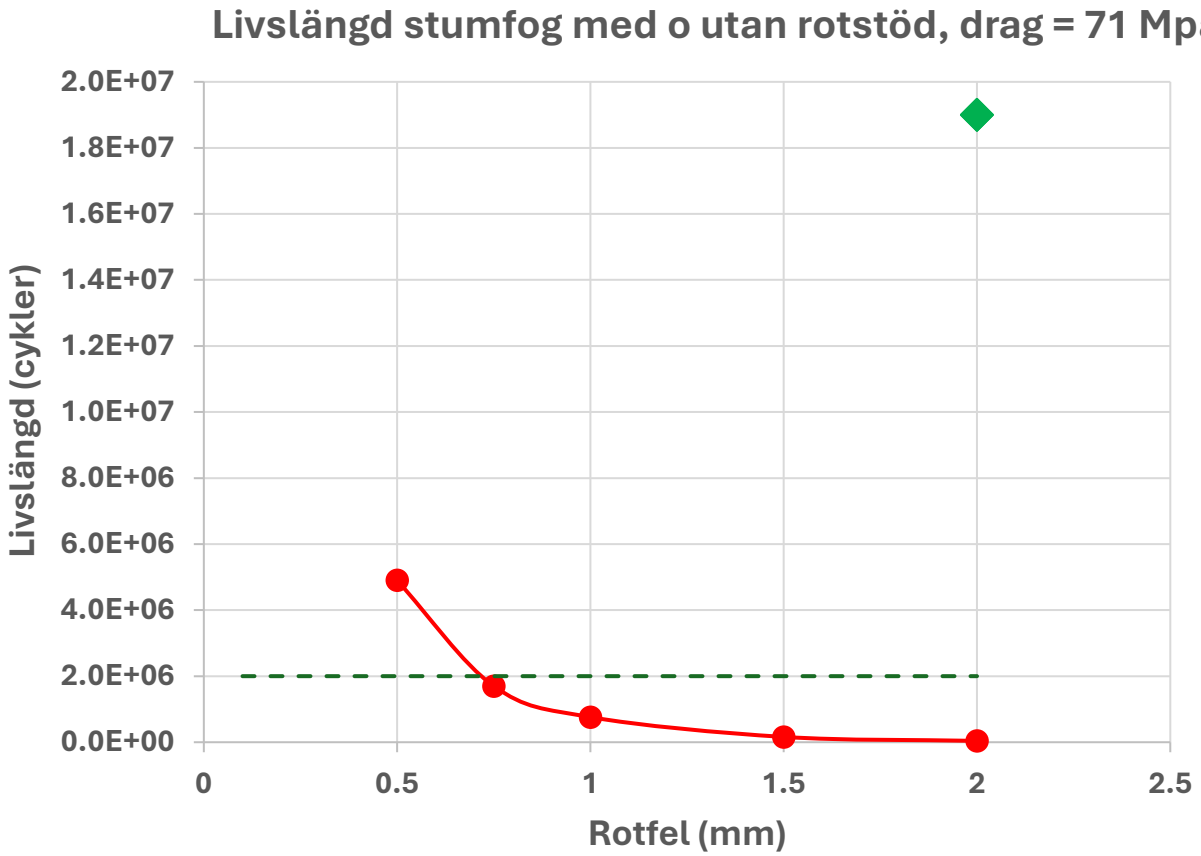
Livslängd N ≈ 0.04E6 cykler

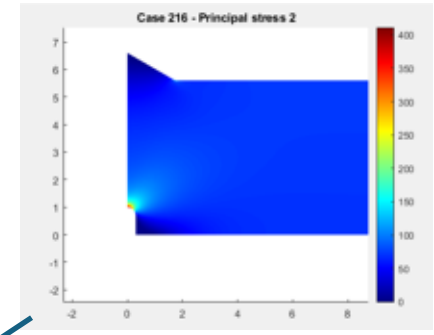


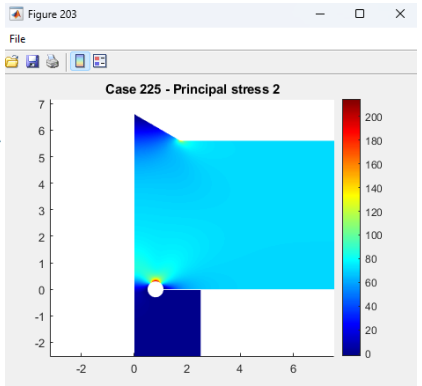




Livslängden för olika rotfel







Slutsats:

Utan rotstöd faller livslängden dramatiskt om rotfelet ökar.
Med rotstöd fås mycket större livslängd

Summerat

- Haverikommissionen identifierade följande brister
  - Beställning (aningslös)
  - Tillverkning (slarvig)
  - Kontroller (fel punkt)

- Jag tycker också Konstruktion och design är en brist
  - Borde tydligt pekat ut rotsidan som kritisk
  - Borde beskrivit detta på ritningen (tex kvalitets- och inbränningskrav)
  - →
  - Då hade fokus hamnat på
    - Hur man ska svetsa för att undvika inre fel
    - Vad och hur som ska kontrollerats (förstörande provning?, ultraljud?)