Quality STD acc to VCE

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Typical component after welding

Loader front frame

Fillet weld

Situation around 25 years ago

- ***Fatigue issues after new machine releases***

- ***Design problem or production problem ?***

- →→

- ***Start of many research projects with > 10 Dr-students from 1995….***

Starting point was analysis

DESIGN FOR PURPOSE

(from fatigue point of view)

Weld requirements depend on purpose

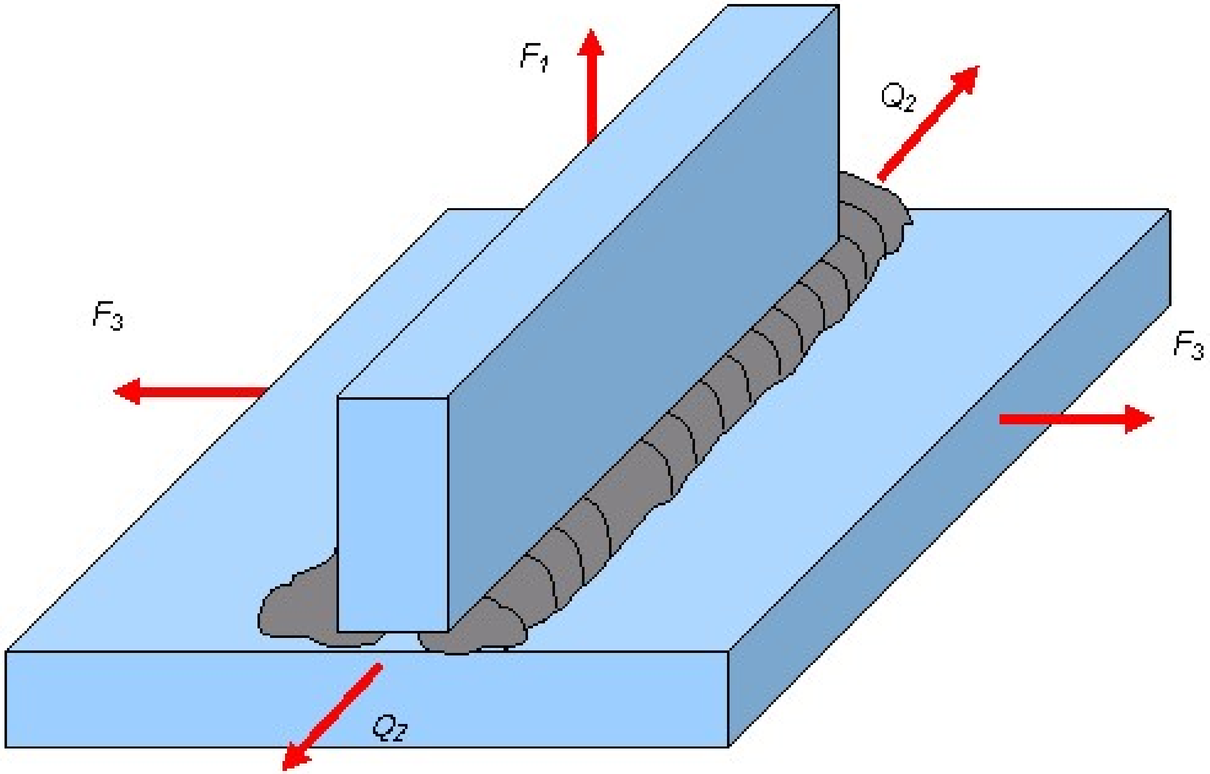
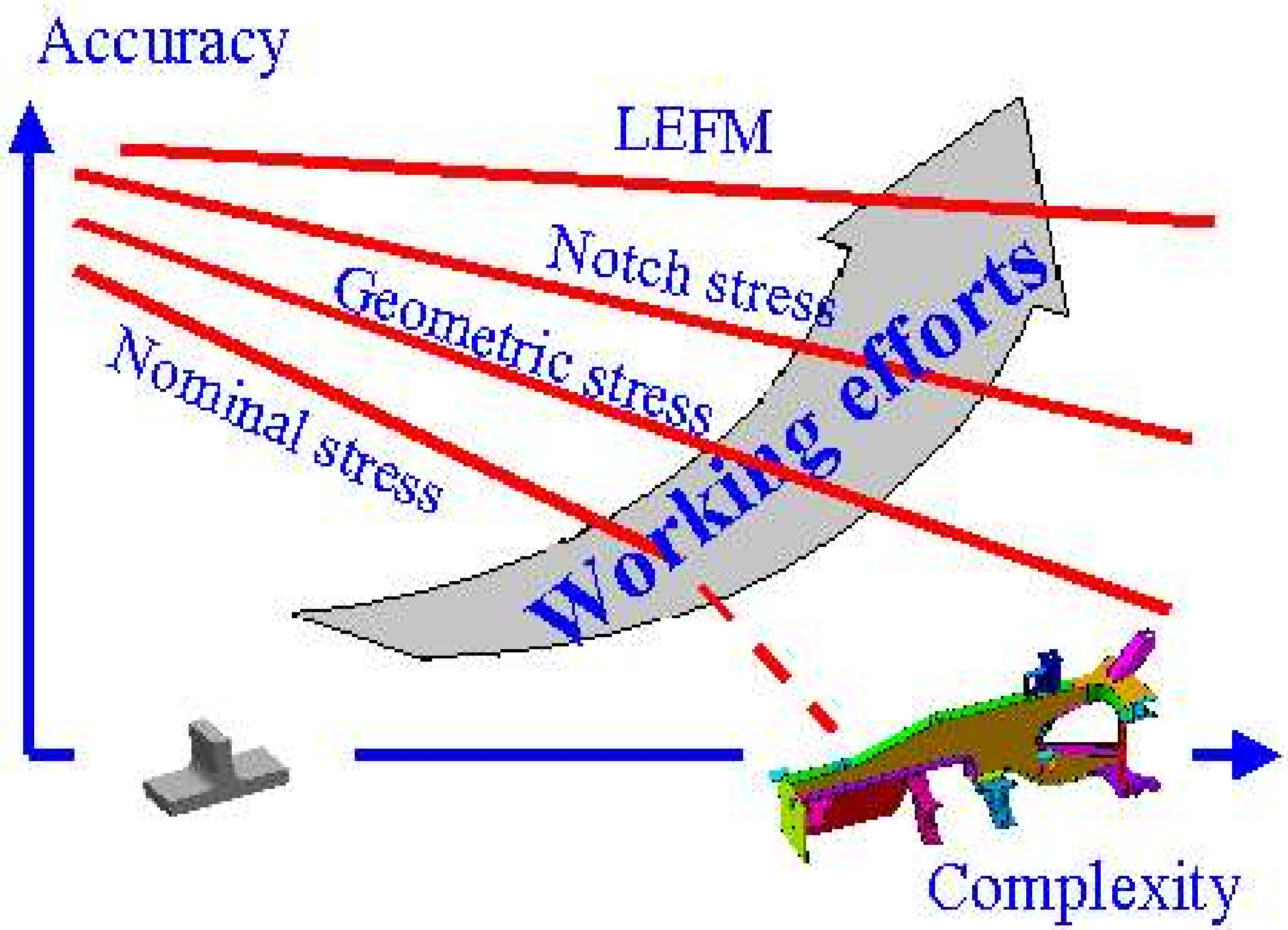


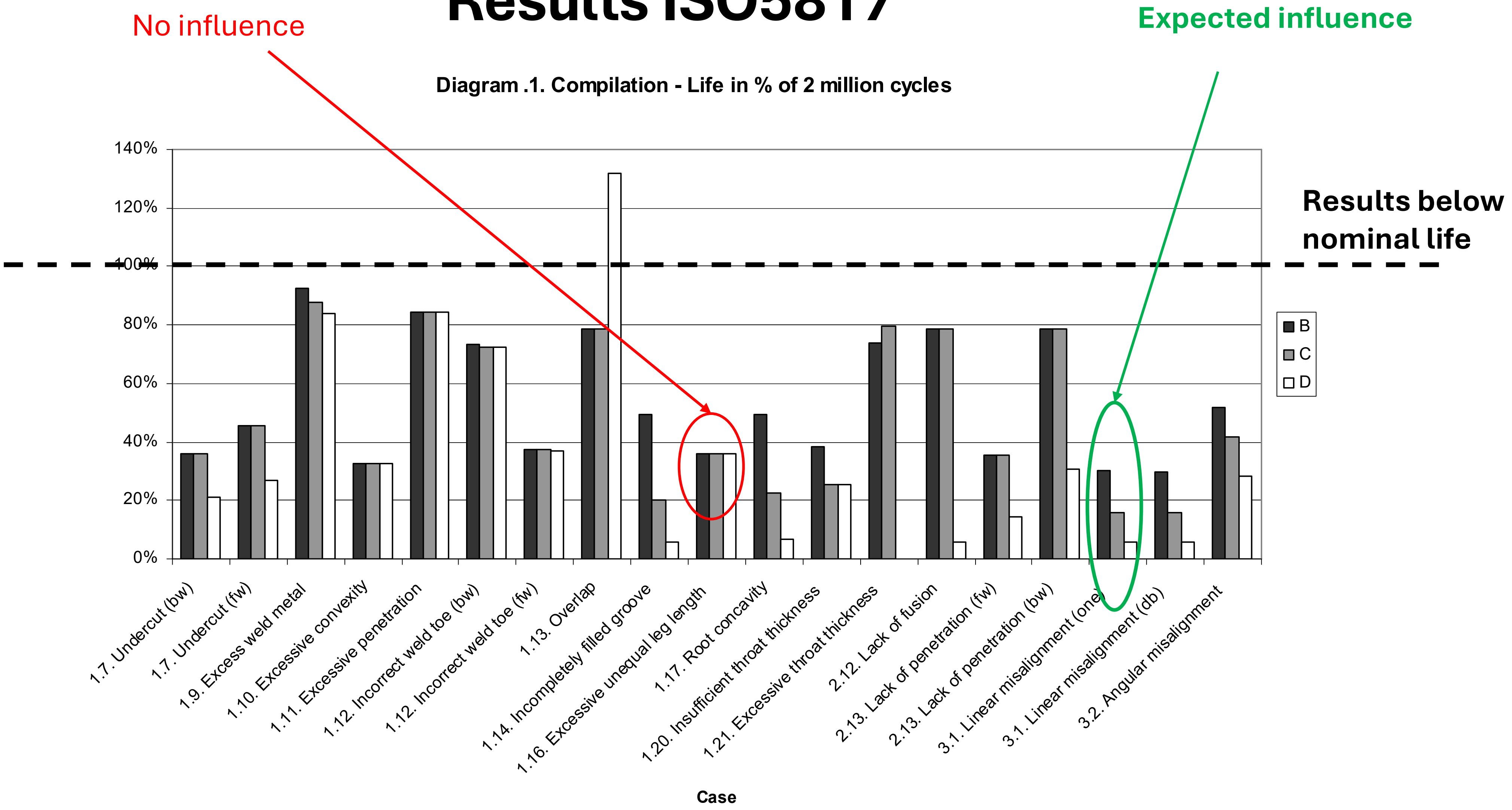
Figure 4 Example of how to categorize welds: The type of weld depends on the load:
F1 → load-bearing weld that requires full strength,
F3 → Non-load-carrying weld that only creates a stress concentration
Q2 → Fixating weld, where a break would result in a decreased shearing capacity.

” Low accuracy in fatigue design”



How about the quality system – does it work ?

Results ISO5817



How fix the situation ?

- *→→Define a new weld class system*
  - *Keep only important acceptance limits*
  - *Add new acceptans like "transition radius" instead of "even transition"*
  -
  - *Skip "cosmetics"*

Summary - acceptans limits

Discontinuity type	VD (as welded normal quality)	VC (as welded high quality)	VB (post treated)
Cold lap	a < 0,5 mm	a < 0,1 mm	Not allowed
Inner lack of fusion	Not allowed	Not allowed	Not allowed
Transition radius	R > 0,25 mm	R > 1 mm	R > 4 mm
Undercut	a < 0,05t [max 1,0 mm]	a < 0,025t [max 0,5 mm]	Not allowed
Throat deviation	< -0,2a [max 2 mm] (bigger OK)	Not allowed (bigger OK)	Not allowed (bigger OK)
Misalignment	a < 0,1t [max 2 mm]	Not allowed	Not allowed
One pore inner/outer Clustered pores (inner/outer)	0,4t [max 4] / 0,3t [max 3] 6% / 3%	0,3t [max 3] / 0,2t [max 2] 4% / 2%	0,2t [max 2] / 0,1t [max 1] 2% / 1%

Weld class selection

(+ 1 class → double fatigue life)

Corresponds to IIW FAT-levels

Choice of weld class

The choice of weld class follows the lines in table 4:

Table 4 Choice of weld class

Weld class	**VS**	**VD**	**VC**	**VB**
Case at hand	Static loads	Fatigue loads Normal quality as welded	Fatigue loads High quality as welded	Fatigue loads Post treated
Life (N) expected	Not applicable	N	2N	4N

Static loaded welds have weld class VS, where local defects play a small roll, but the size of the weld is important. The most common weld class for fatigue loaded welds is VD, a standard quality that can be produced with a high degree of safety and a good productivity. For welds with high demands or high stress levels a higher weld class -VC or VB- may be needed. The choice between these three weld classes should always be supported by (FE-) analysis of the weld covering the toe side and the interior of the weld, see "Strength analysis". Naturally, the analysis must also take the root side of the weld into account, giving the needed penetration. In order to better choose the weld class the production department should be incorporated into the design process, see figure 1.

Other things to consider when selecting weld class is the probability of rupture, and the consequences of a possible rupture. The probability of rupture is affected by the operating conditions: load condition, corrosive environment, etc., and also by object-related parameters such as material, dimensions, welding process, heat treatment, clamping conditions.

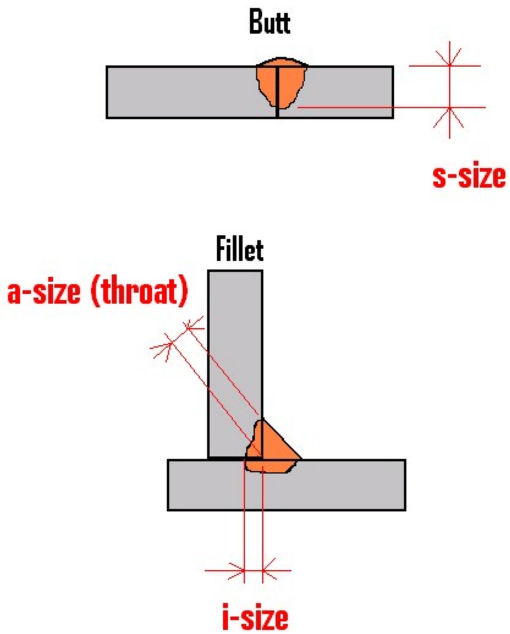
Effect on weld designations

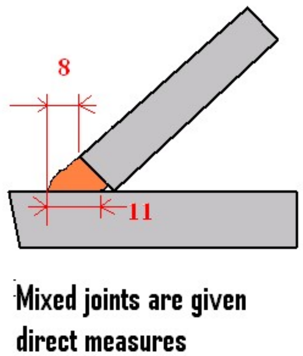
Example

- **Example fillet weld:**

” i2a5 VD [3] ” (earlier: a5 DU [3])

penetration = 2 mm
throat size = 5 mm
weld class = VD
criticality = 3





More general …

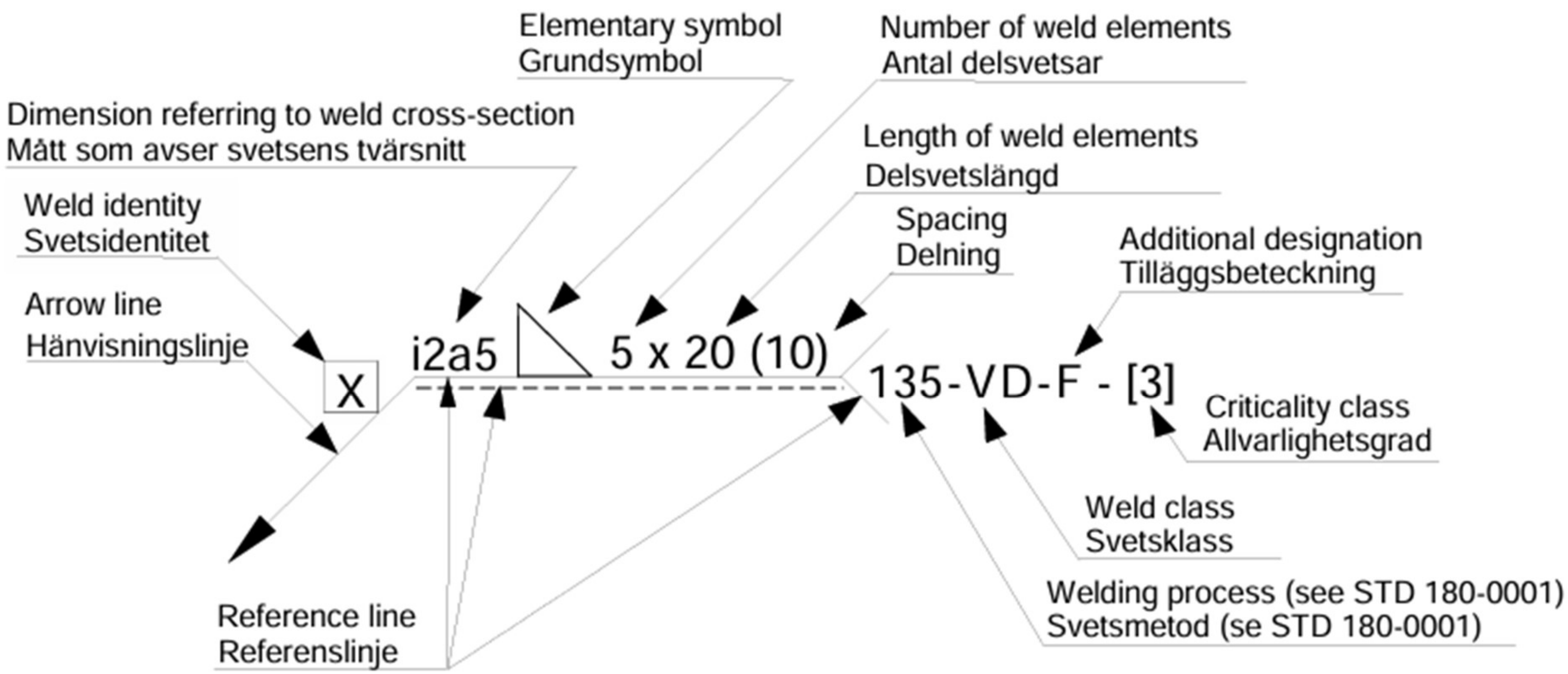
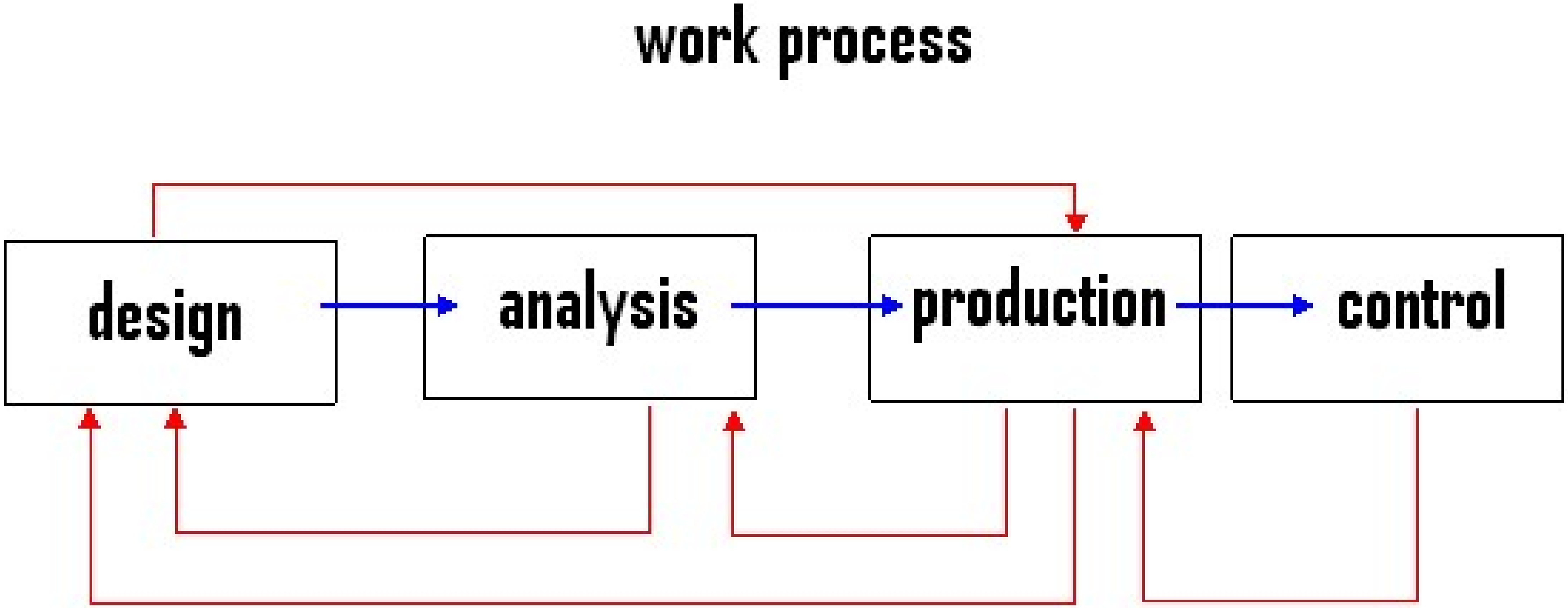


Fig. 1 Symbolic representation of weld / Svetsbeteckning

Working with the new weld STD

→ Looping !



Summary

- *Identifying analysis low accuracy →*
- *A new quality assessment system →*
- *A new way to designate welds on the drawing →*
- *A better way to find appropriate welding process (WPS)*
- →
- *Secure product fatigue life according to targets*
- *Reduce of cost & weight*
- *Automated inspection (laser)*
  - *In future, maybe automated welding with auto-correction*