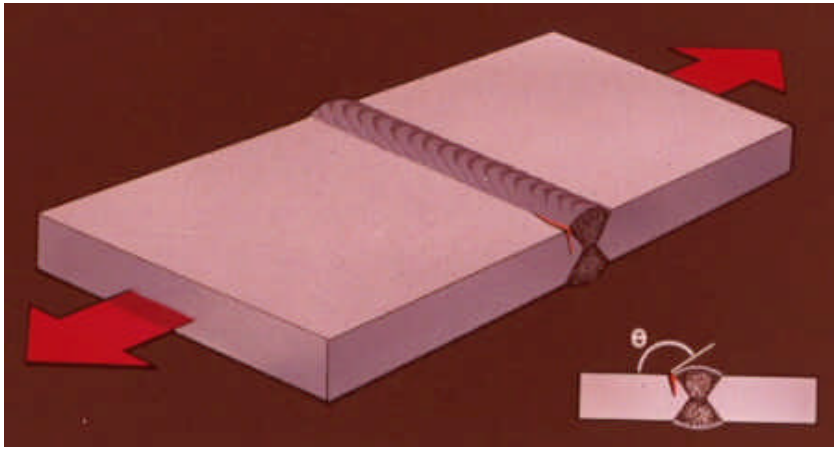
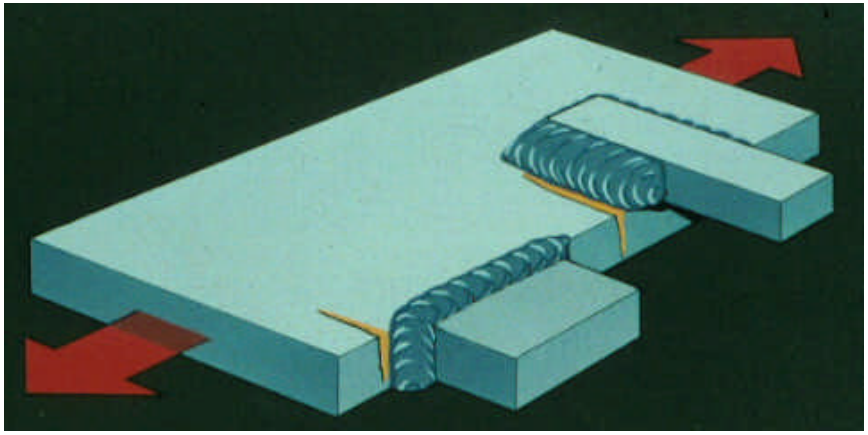
VI Classifications of Weldments



Good

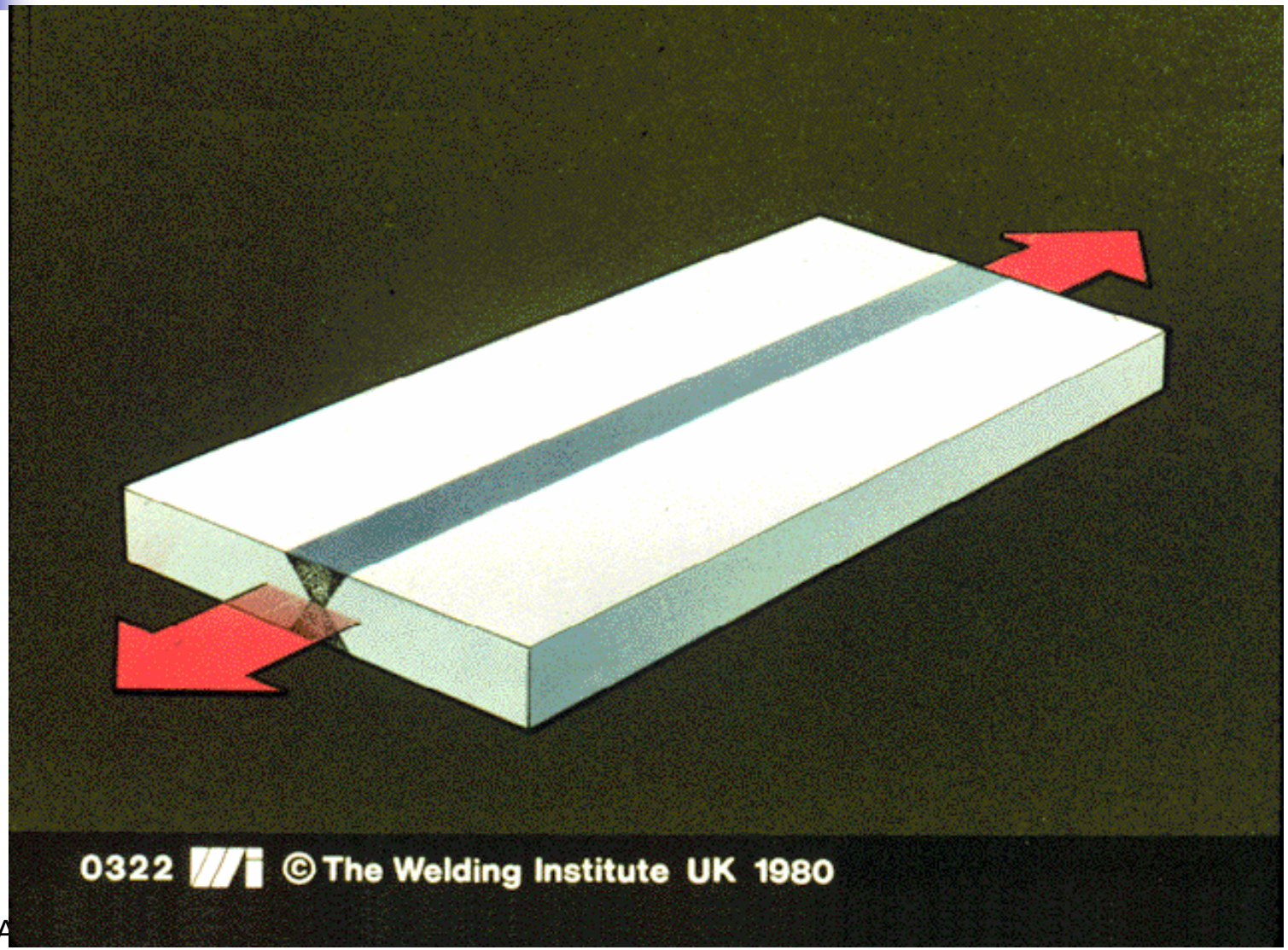


Bad

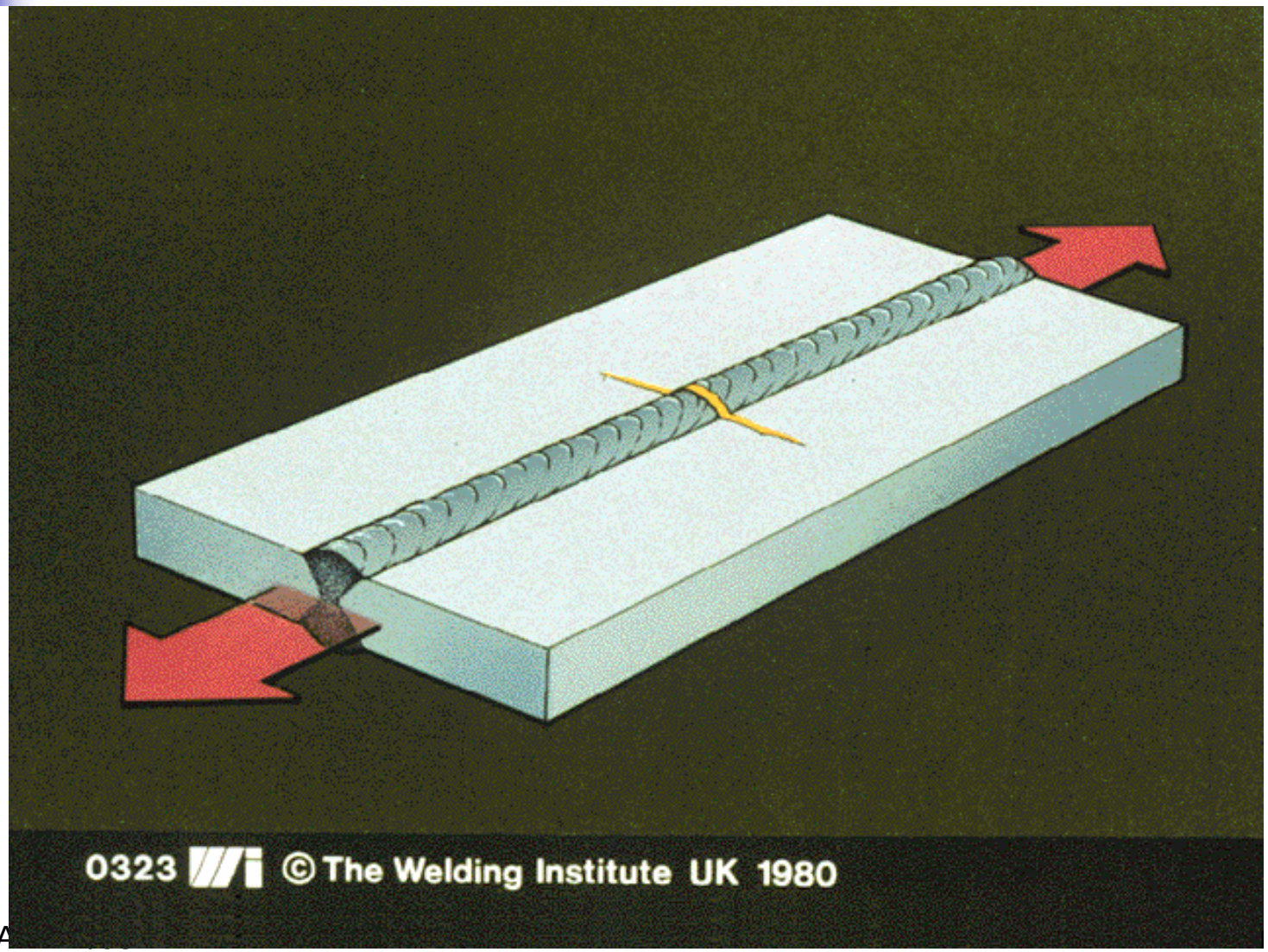
Outline

- TWI Classification system
- AISC classification system
- An alternative classification system

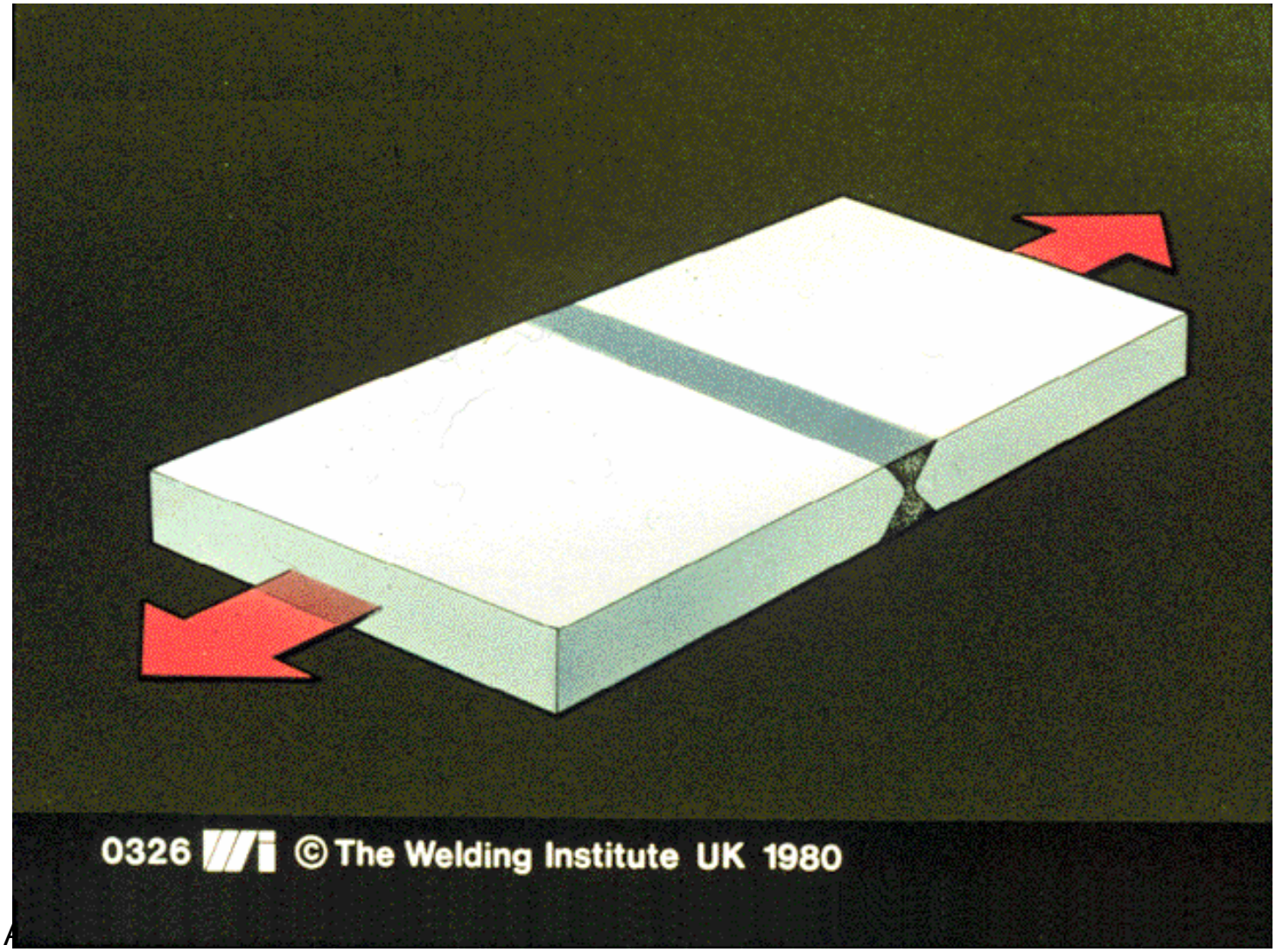
B - Longitudinal butt



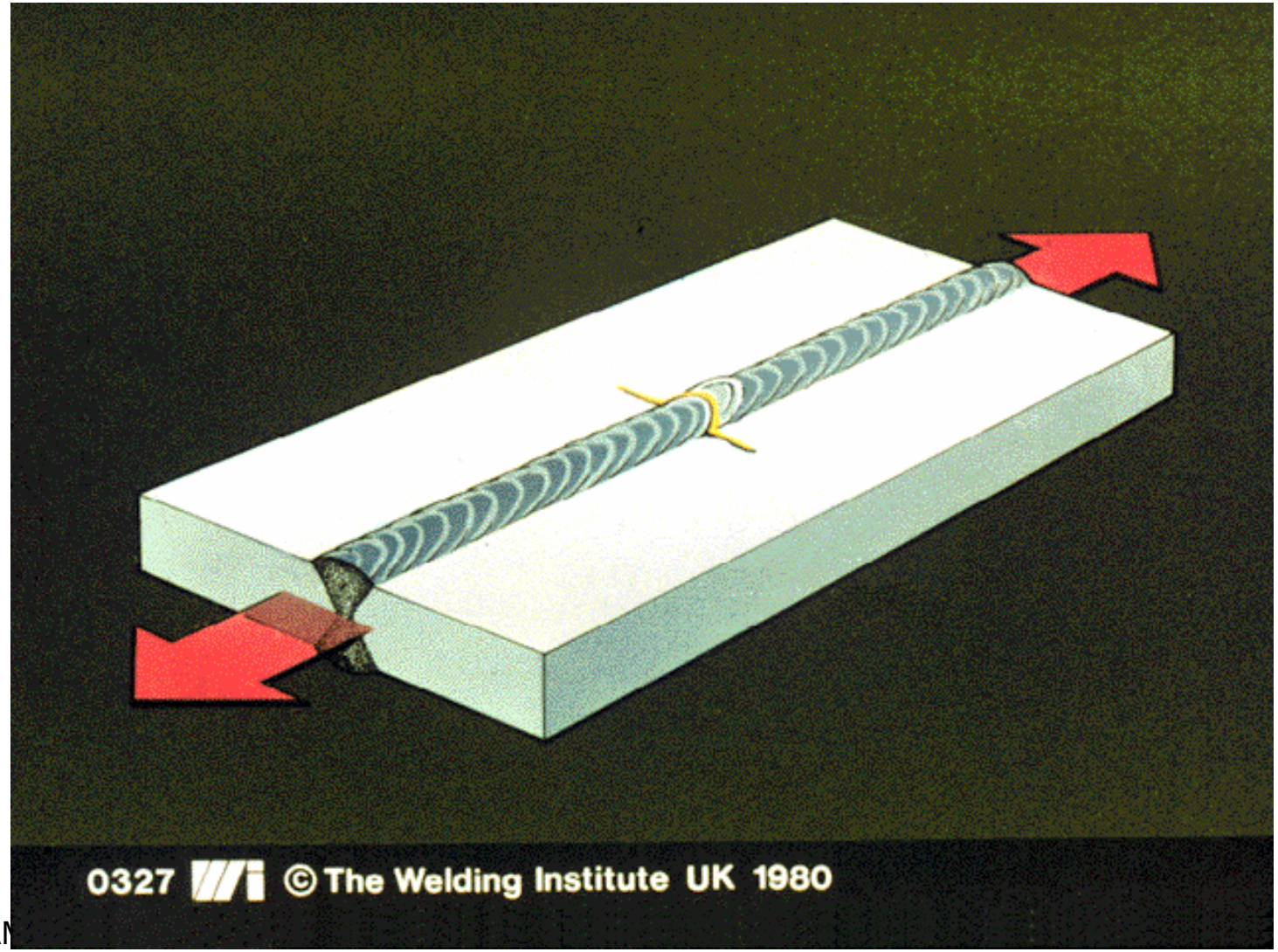
C - longit. Butt w/ Reinforcement



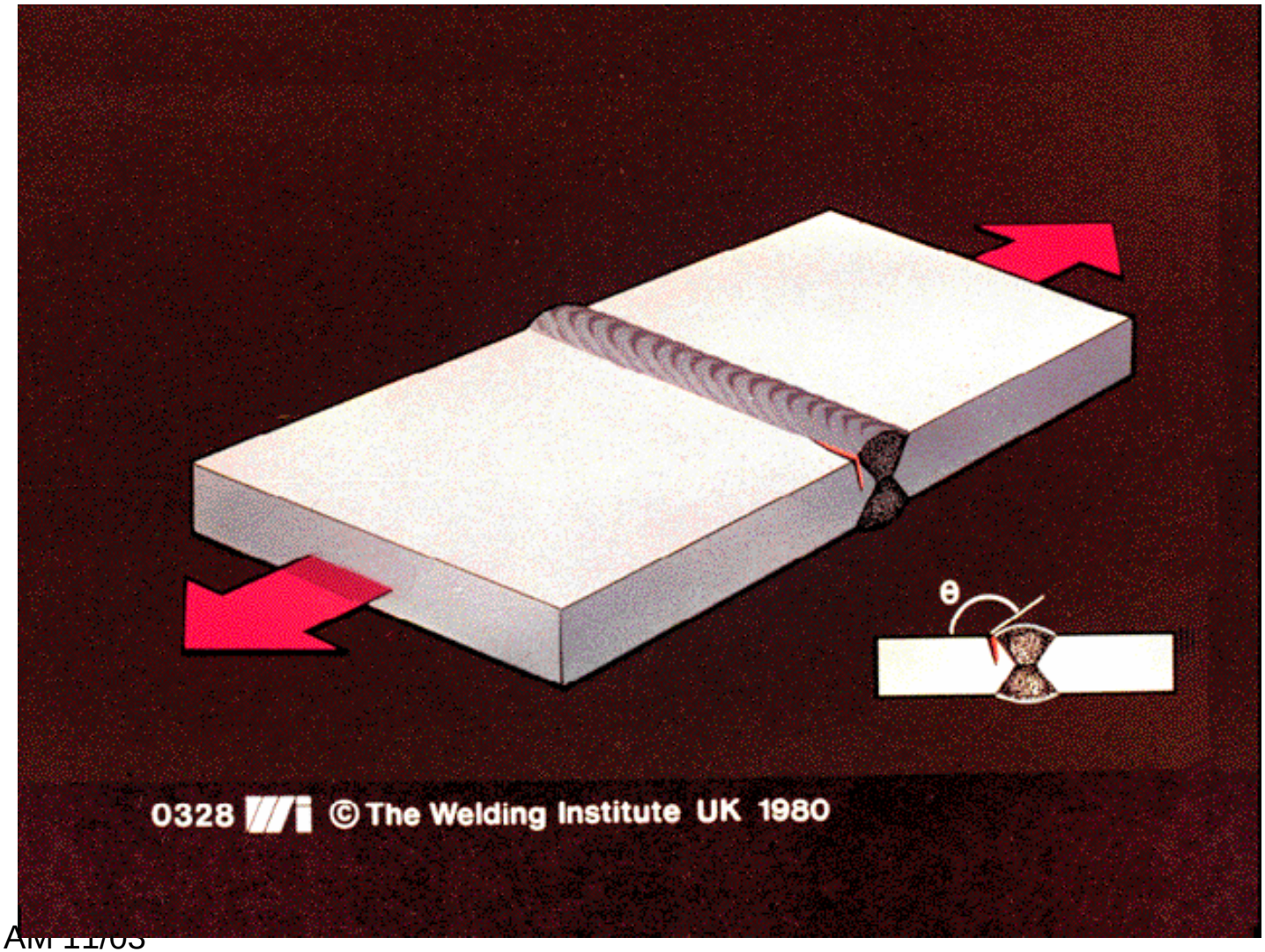
C - Transverse Butt, Machined



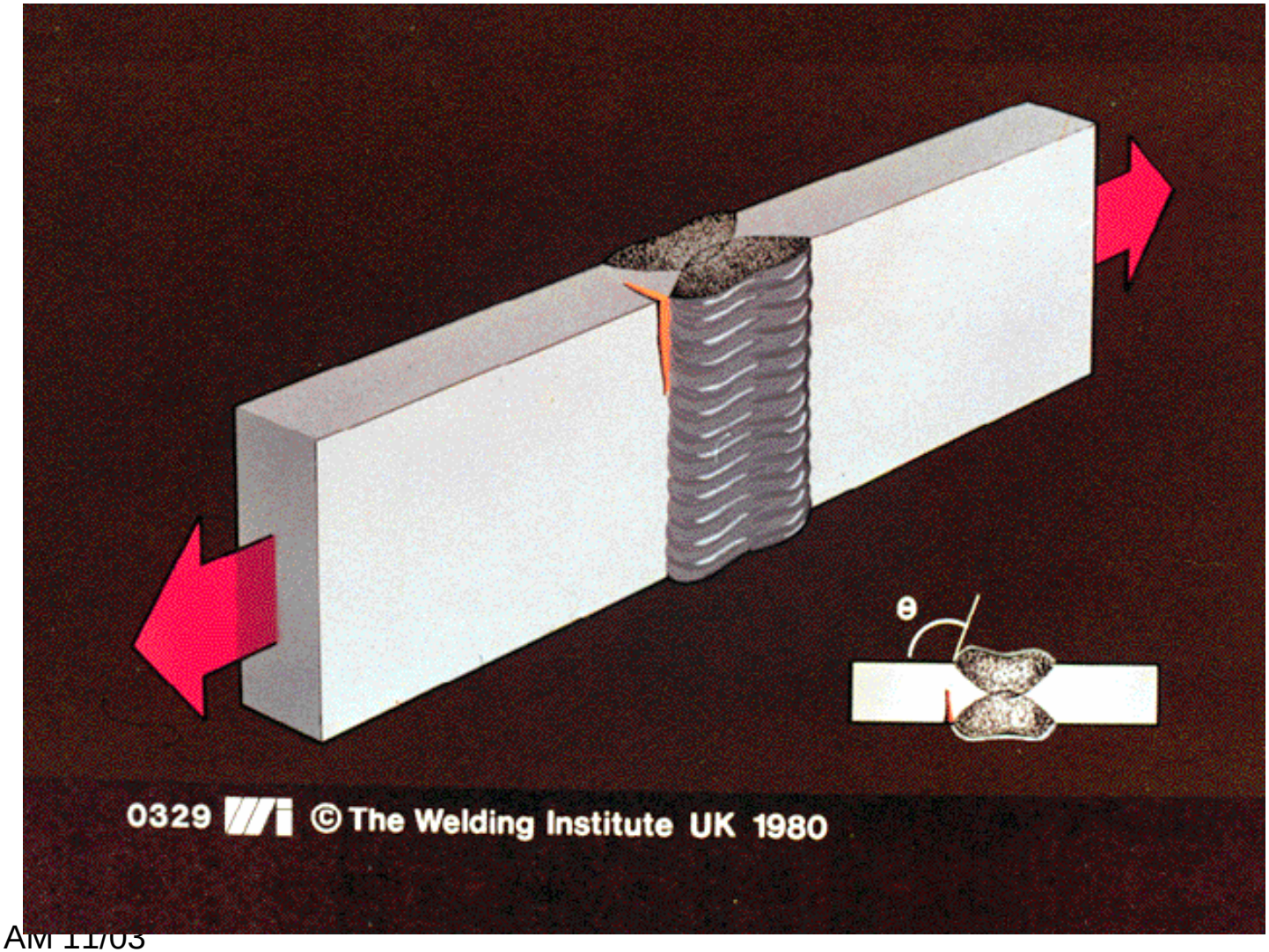
D - Long. Butt w/ Start-stop



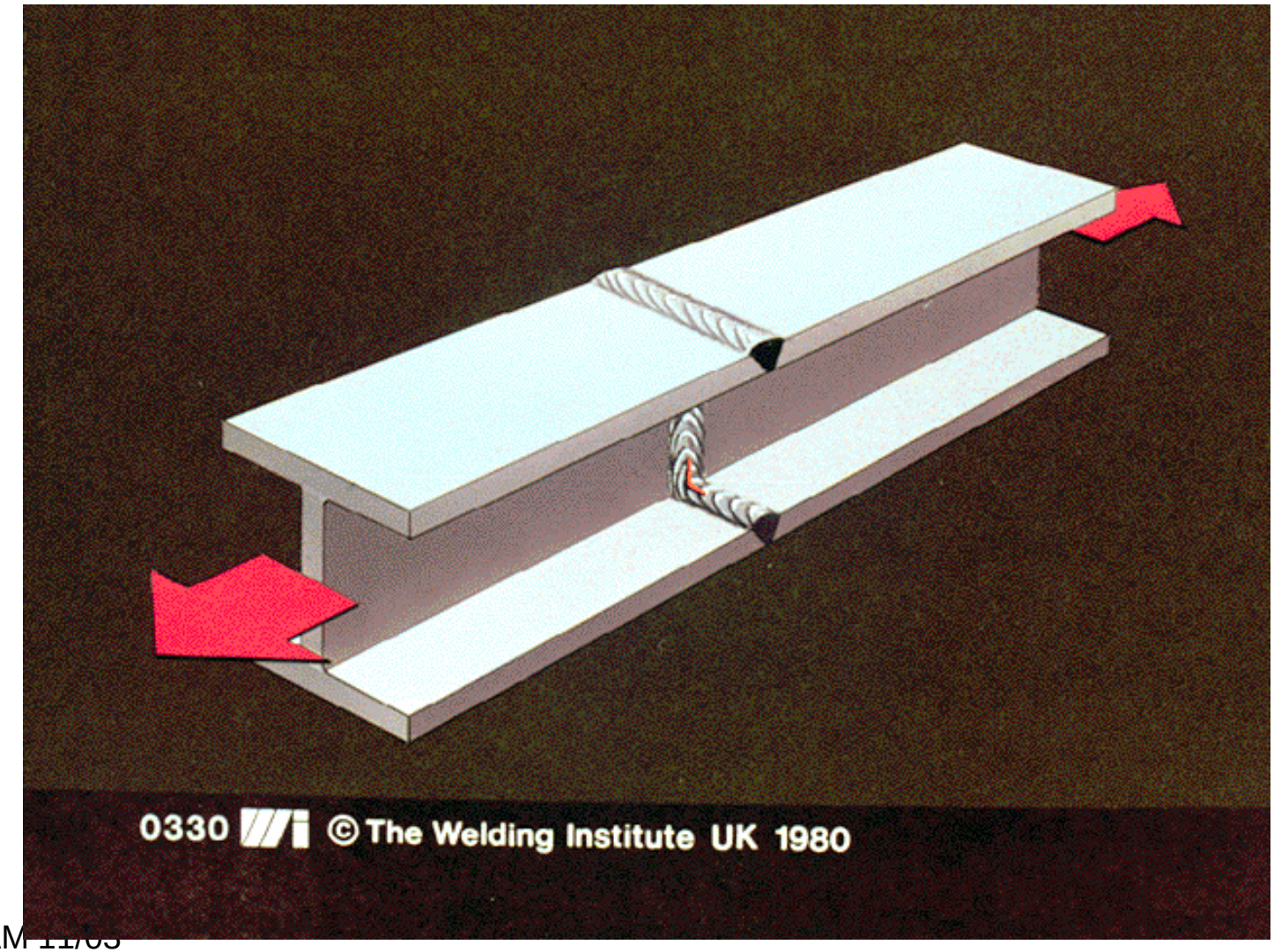
D - Butt weld w/ good toe



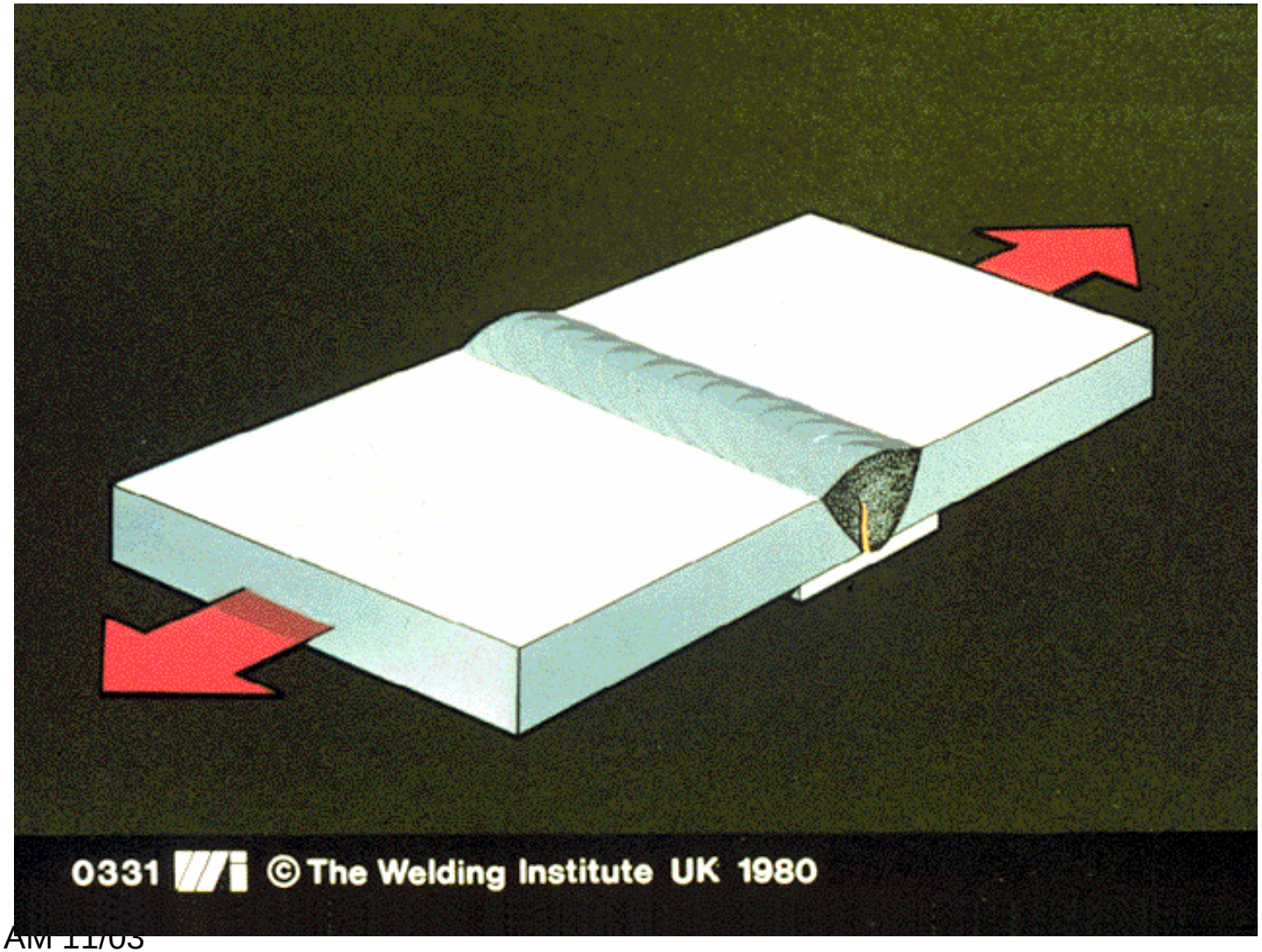
E - Butt weld w/ bad toe



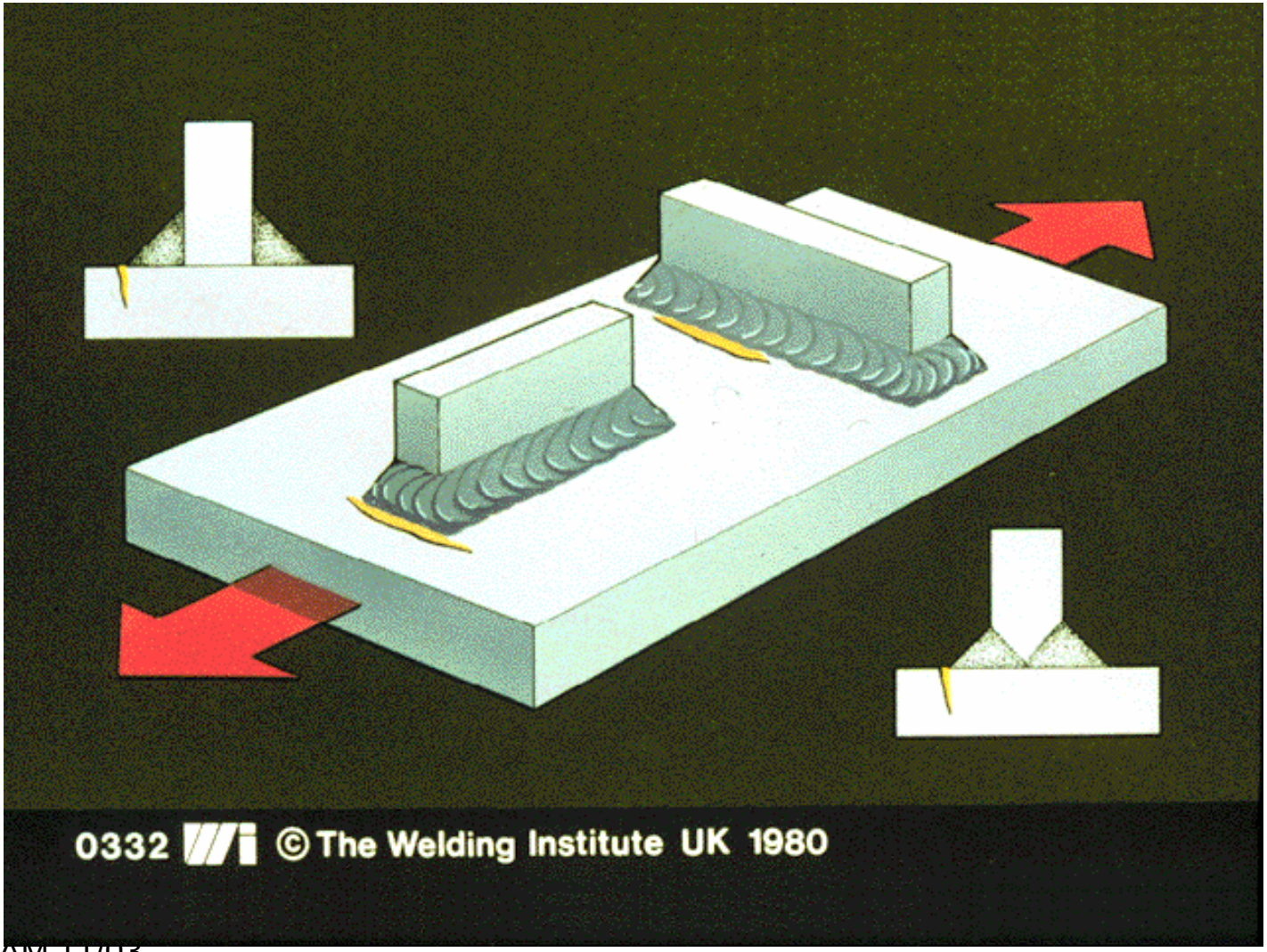
F2 - Trans. butt in rolled section



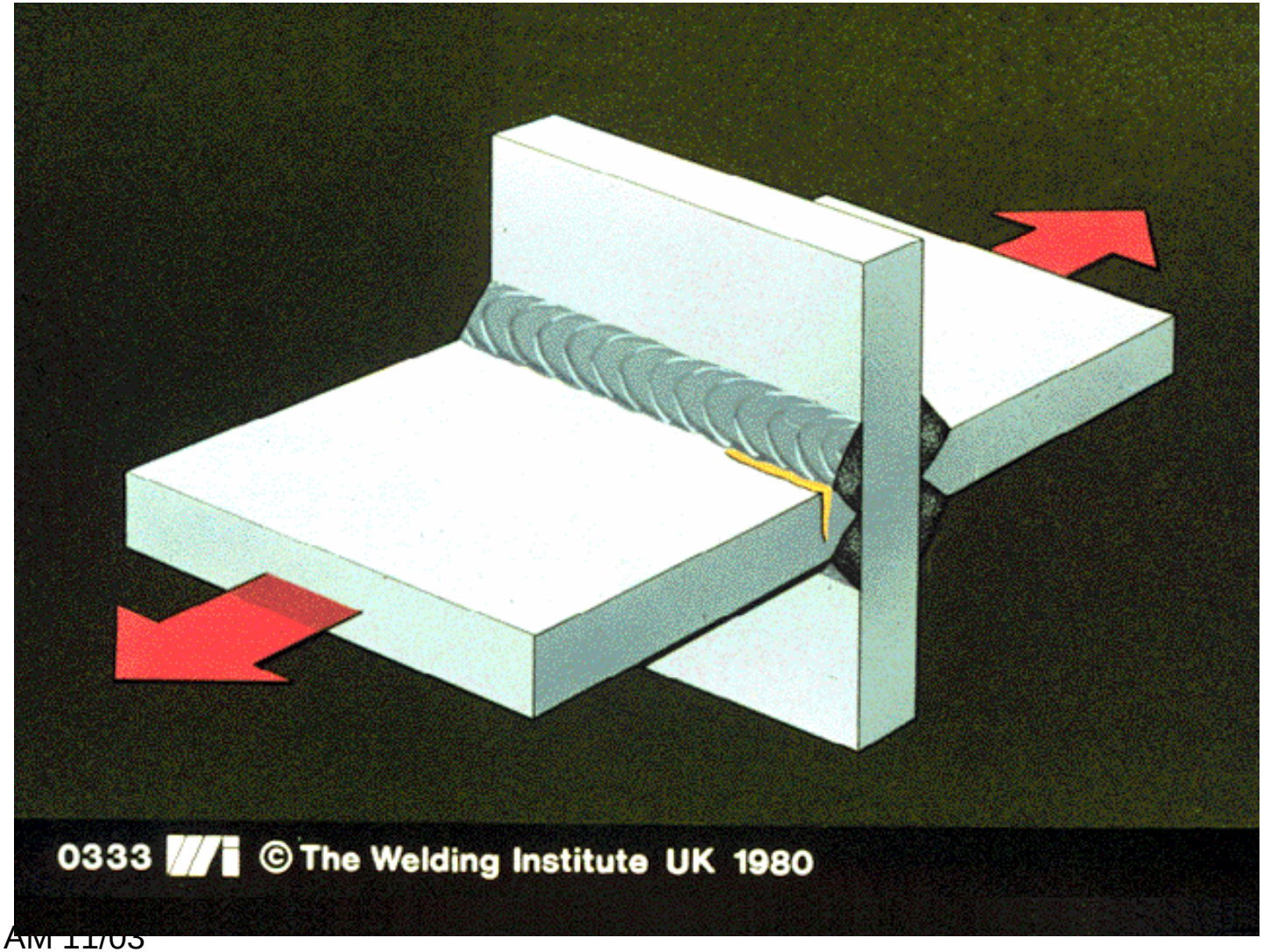
F - Trans. Butt w/ backing strip



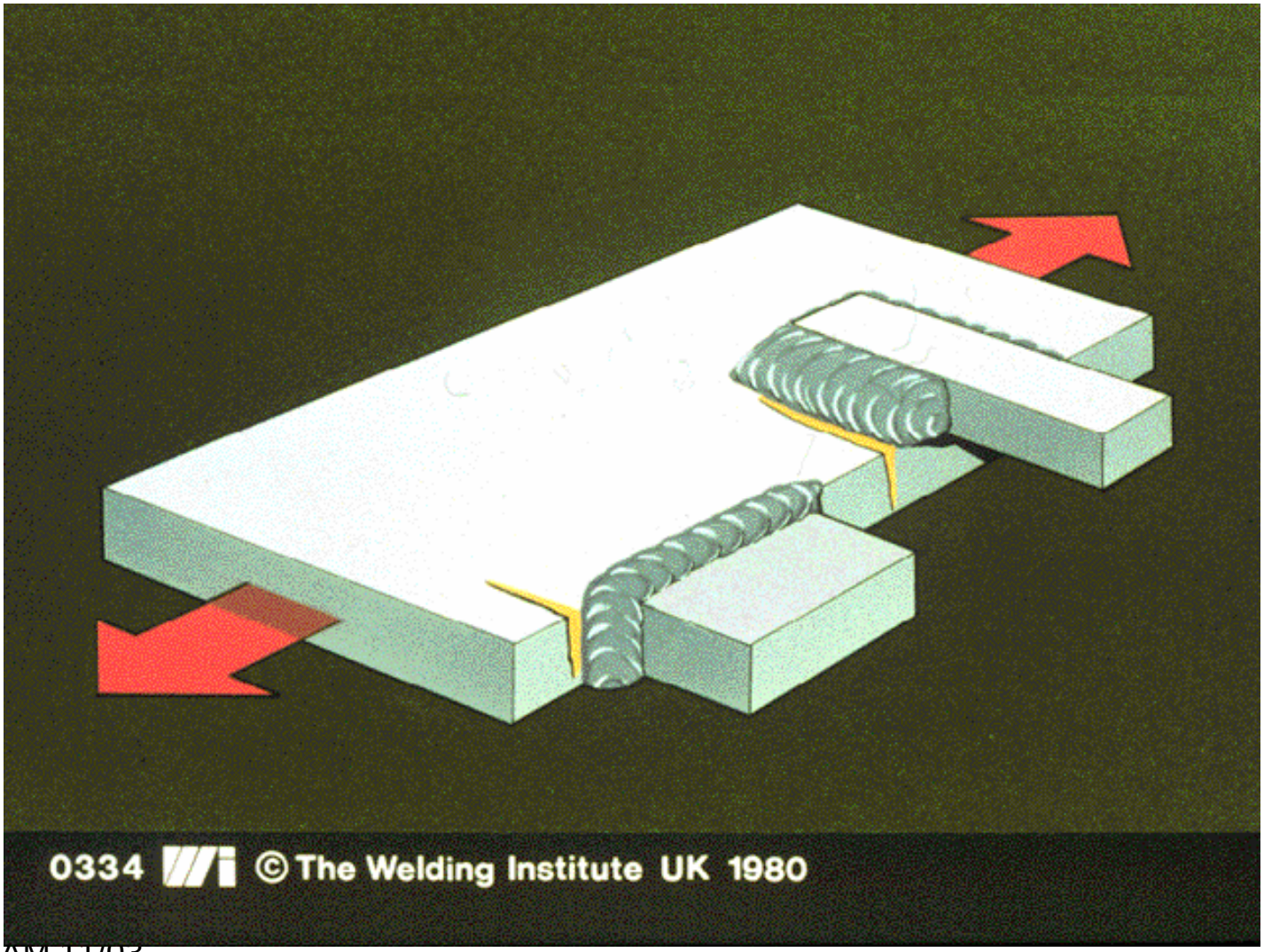
F - Attachments on plate face



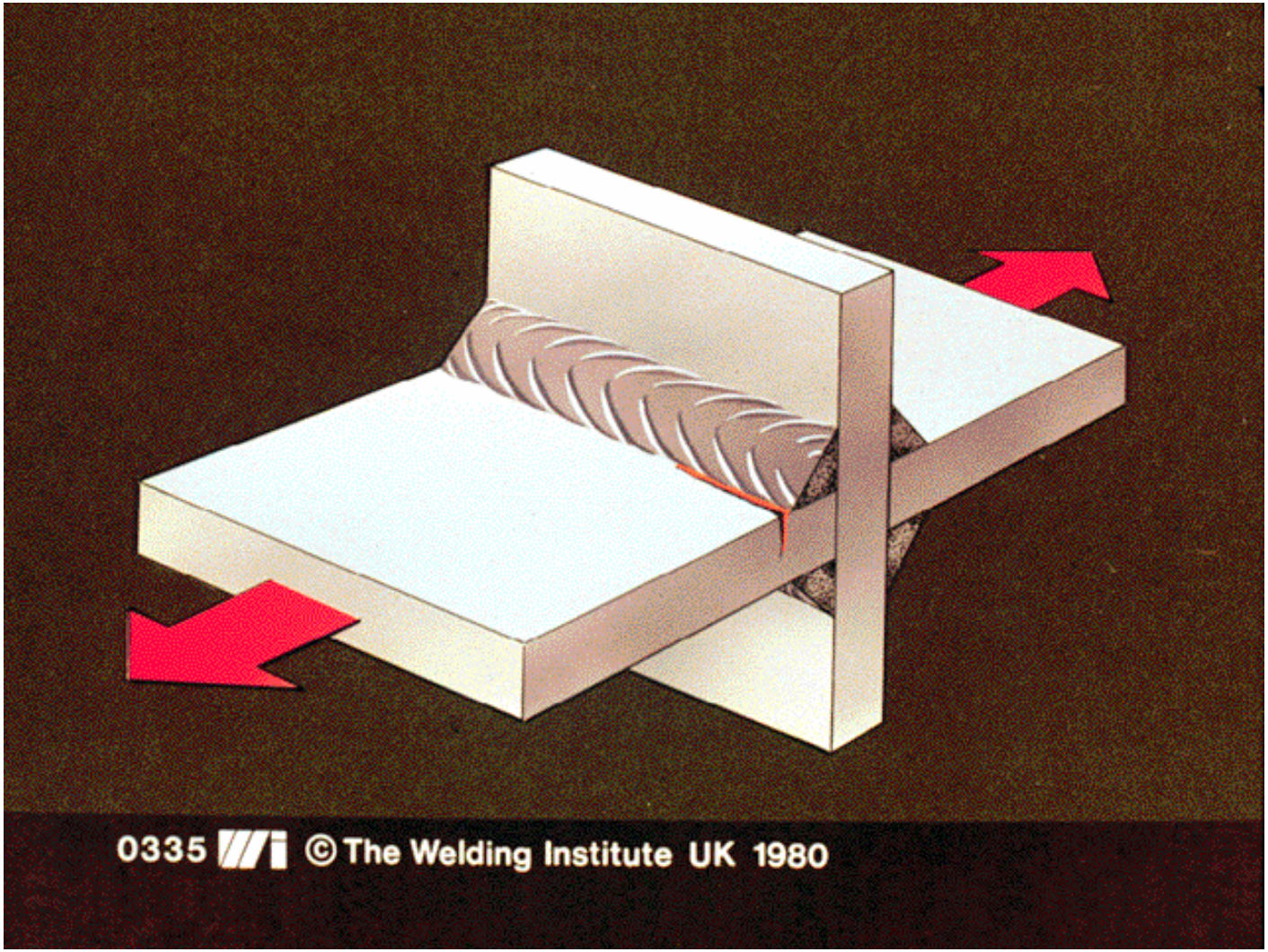
F - Groove welded cruciform



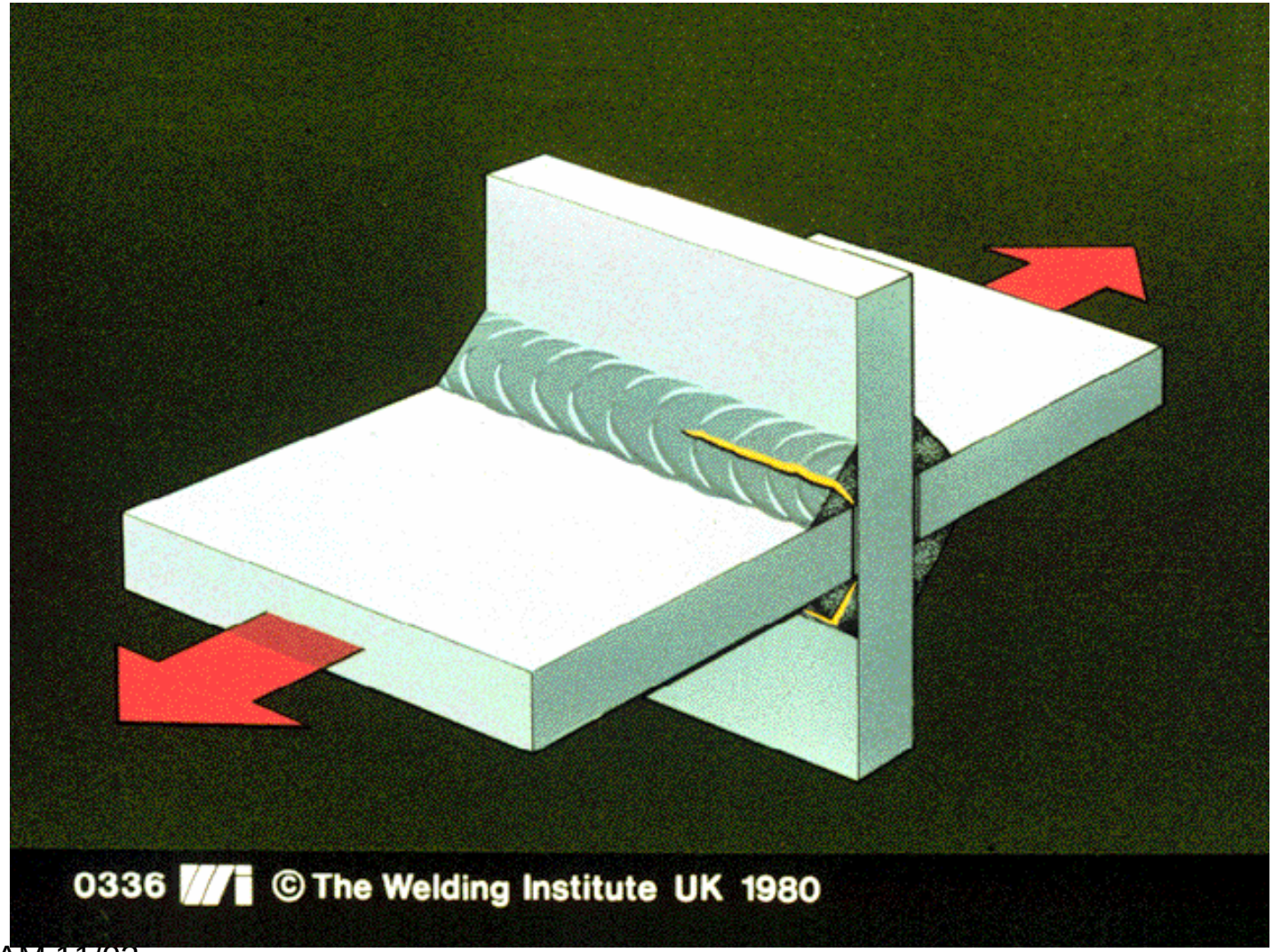
G - Attachments near edge



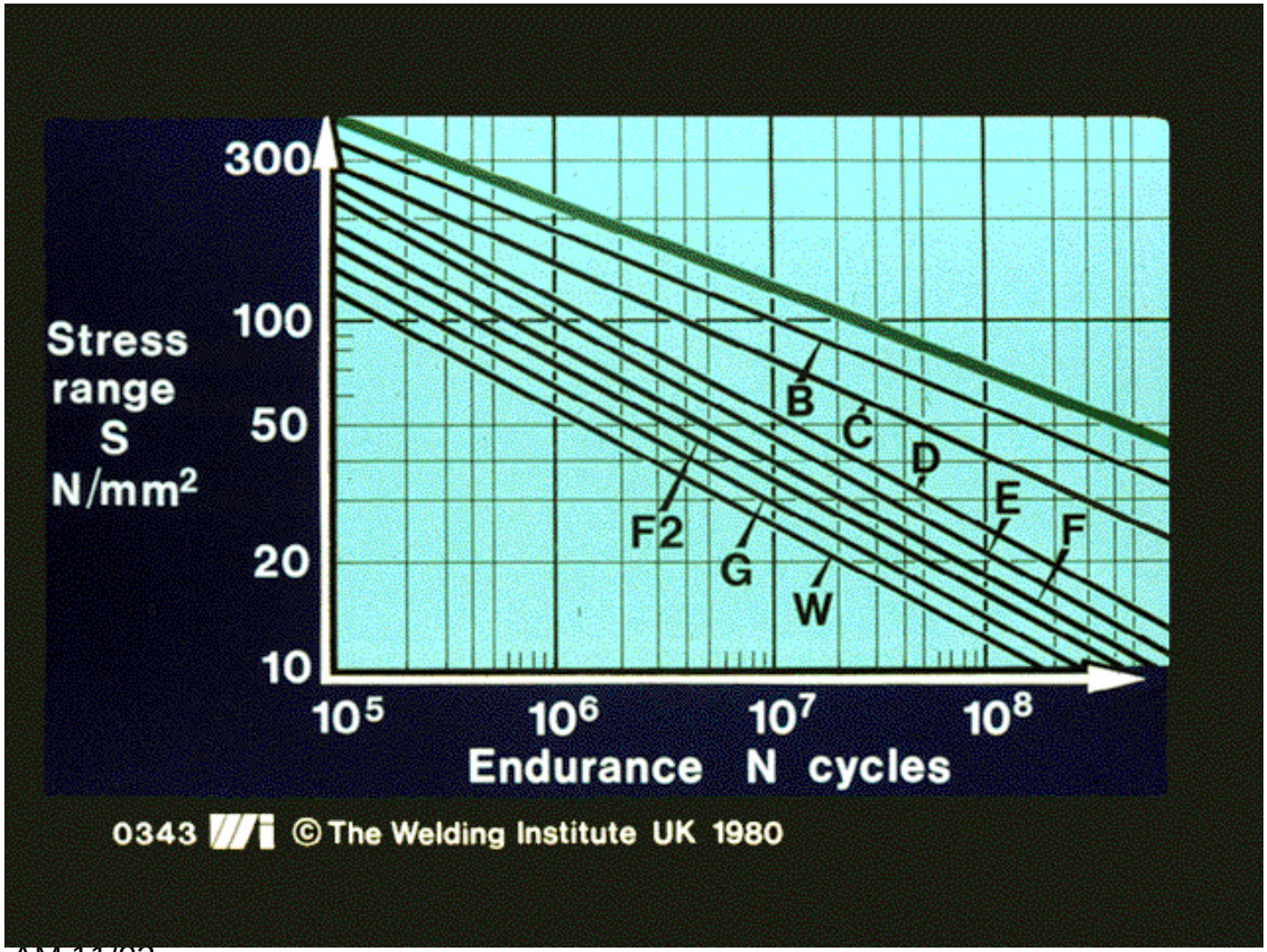
F2 - Load carrying fillet weld



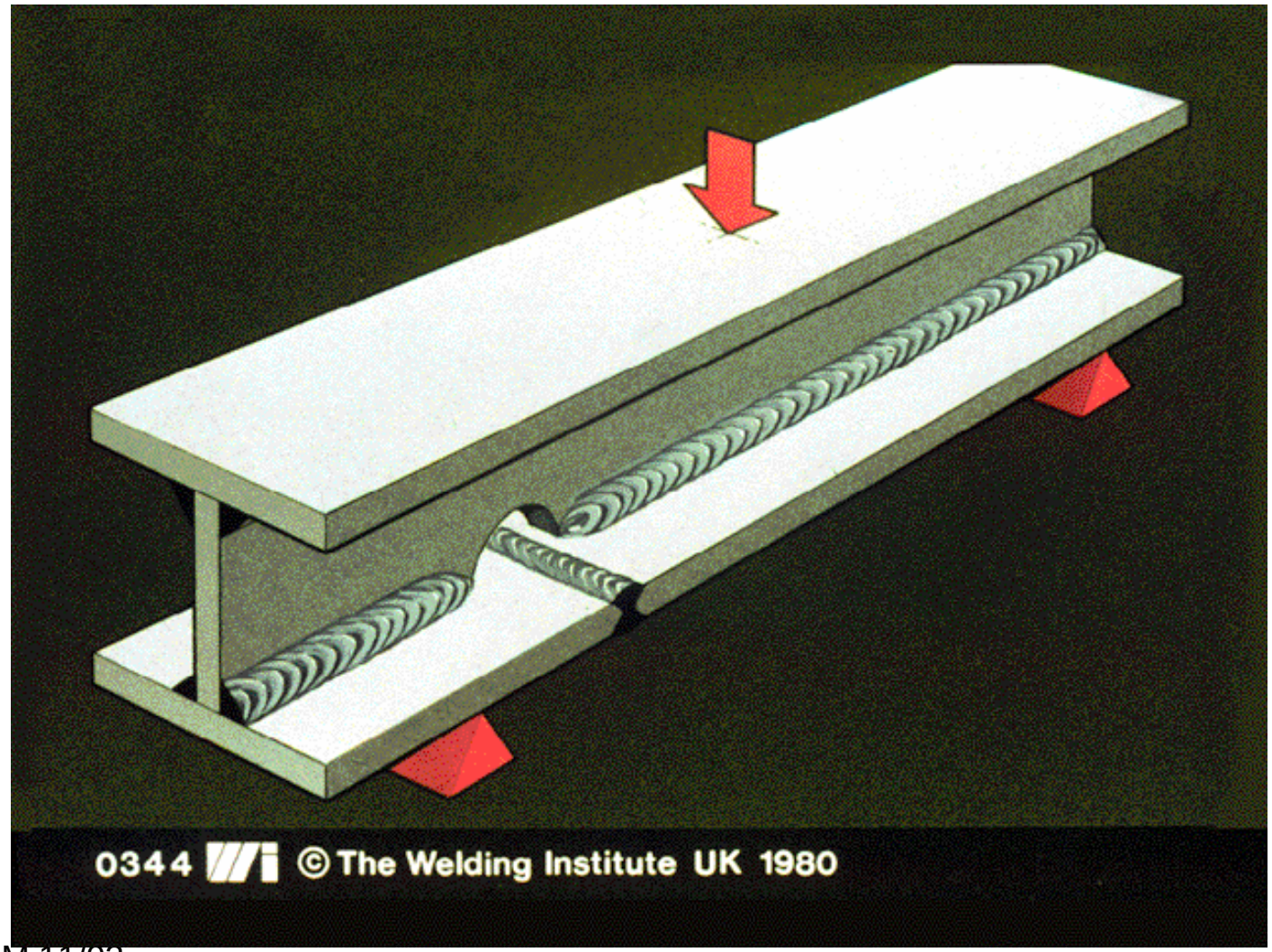
W - Fillet weld metal



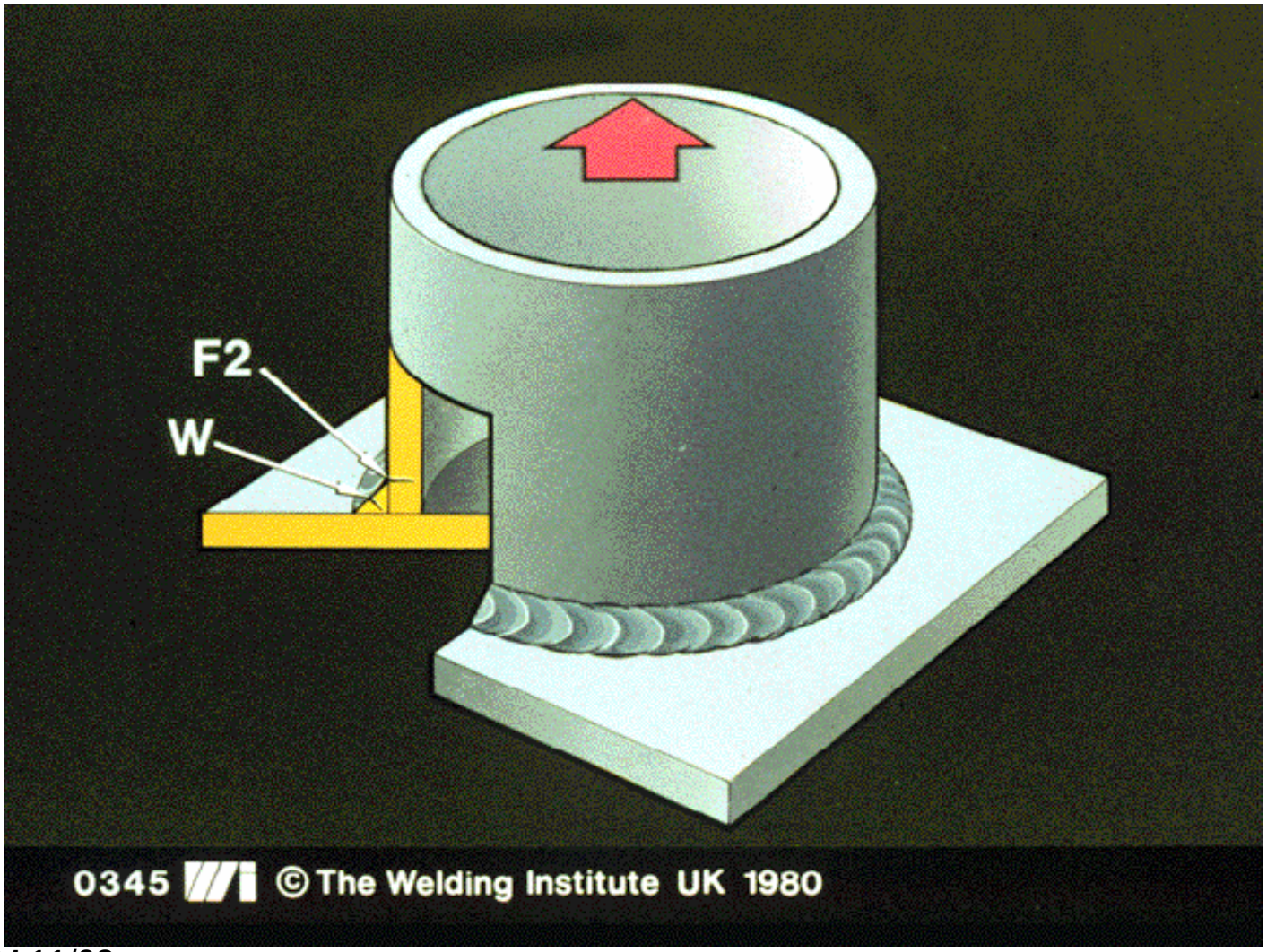
TWI - Classification system



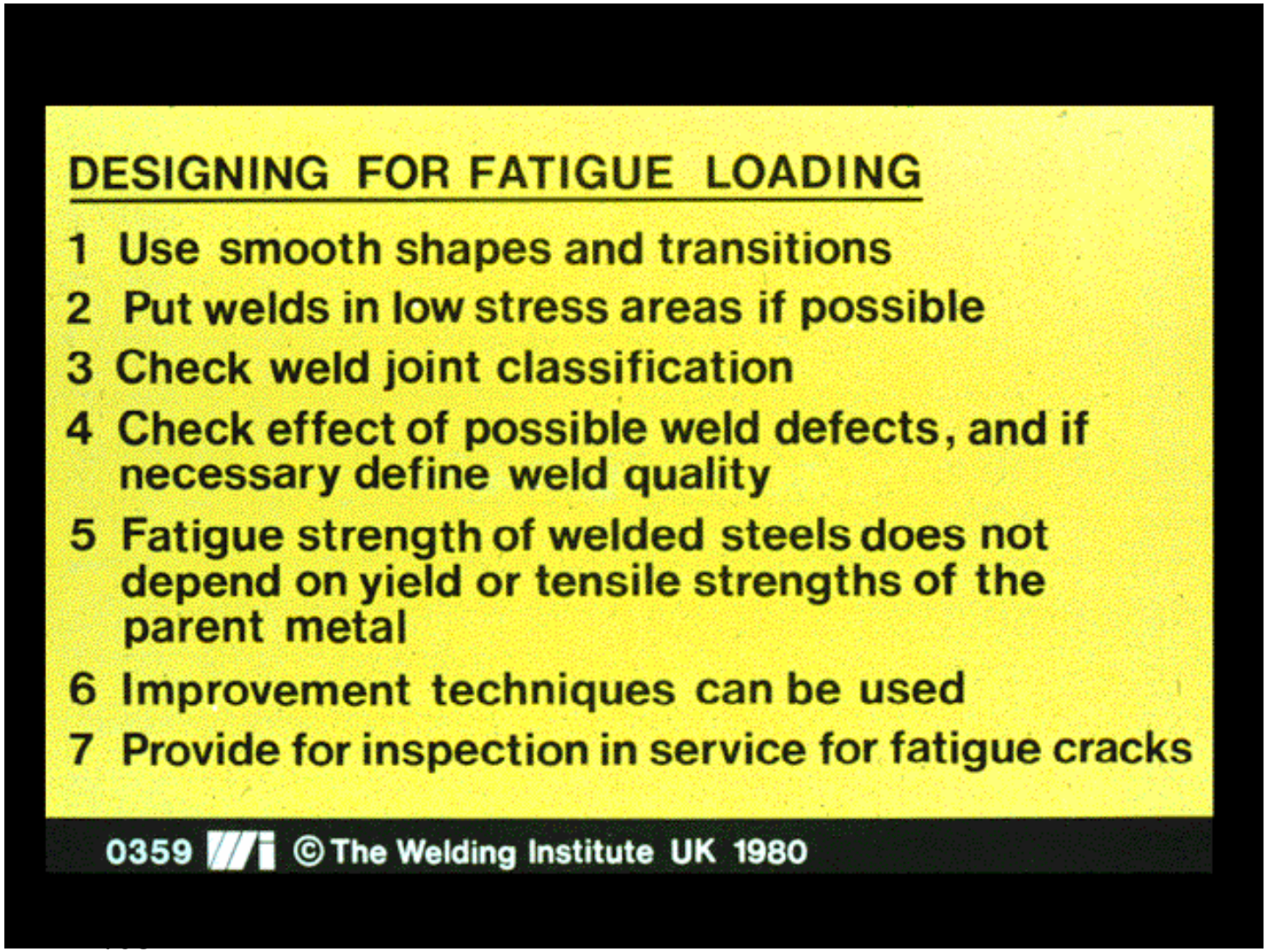
Application of TWI system



Application of TWI system



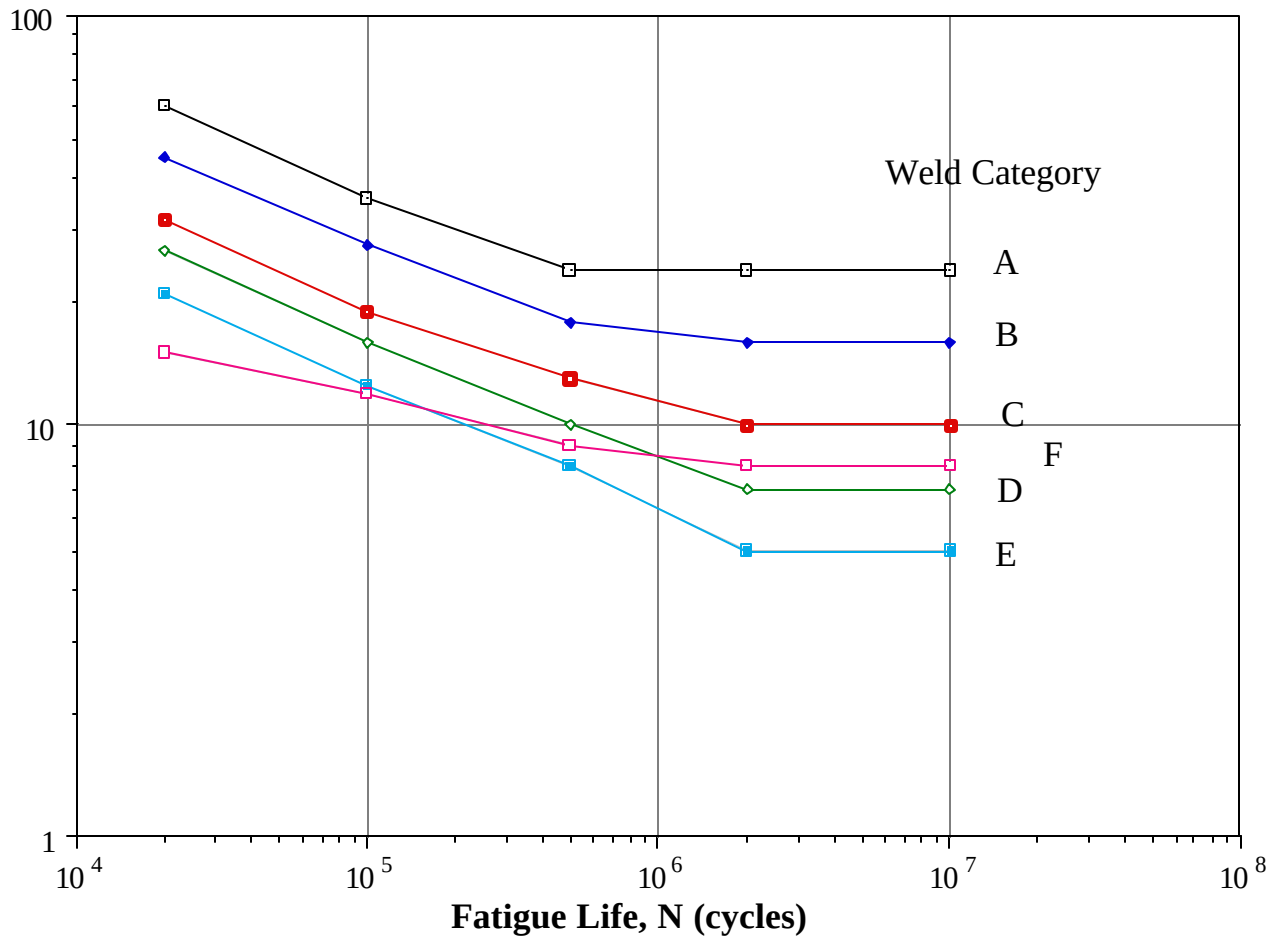
TWI rules


DESIGNING FOR FATIGUE LOADING
1 Use smooth shapes and transitions
2 Put welds in low stress areas if possible
3 Check weld joint classification
4 Check effect of possible weld defects, and if necessary define weld quality
5 Fatigue strength of welded steels does not depend on yield or tensile strengths of the parent metal
6 Improvement techniques can be used
7 Provide for inspection in service for fatigue cracks
0359
© The Welding Institute UK 1980

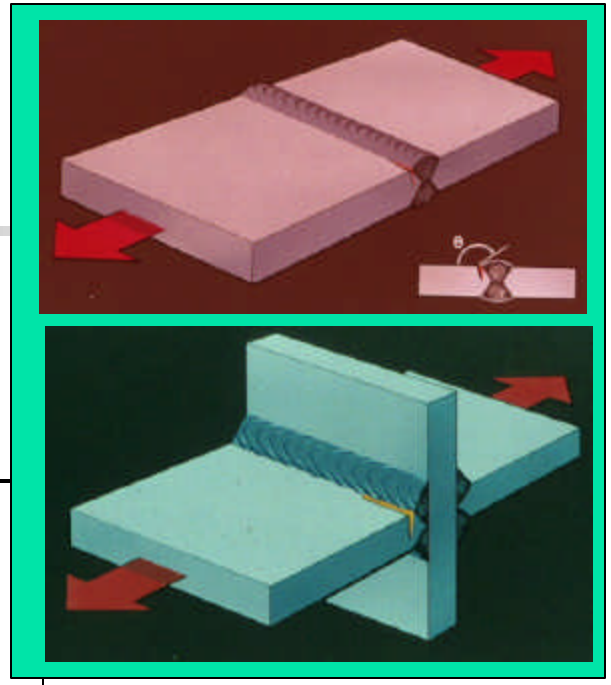
Outline

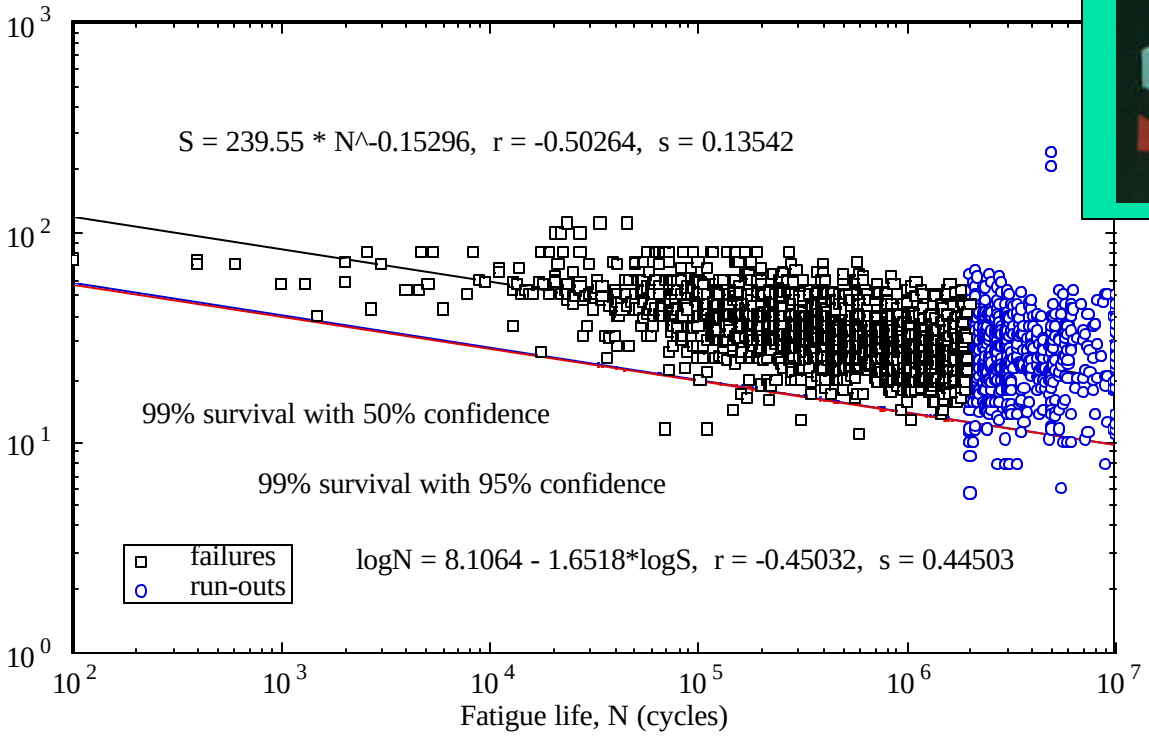
- TWI Classification system
- AISC classification system
- An alternative classification system

AISC classification system



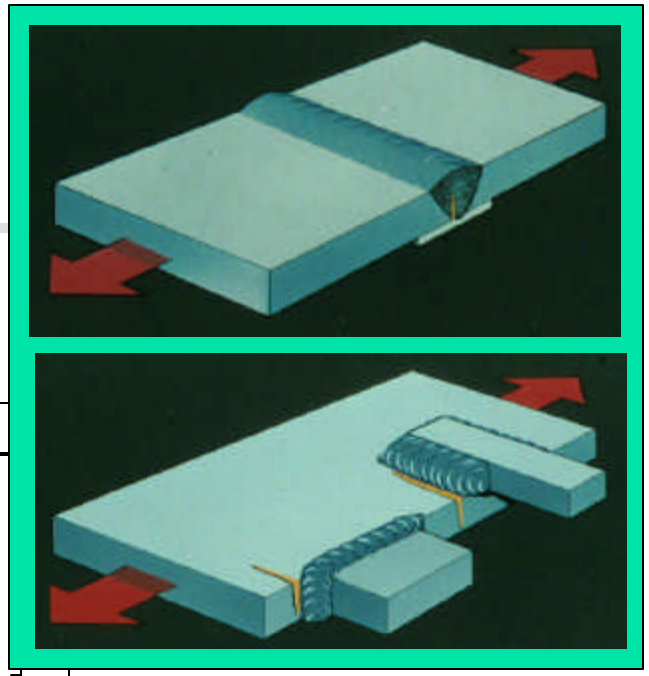
AISC category B and C

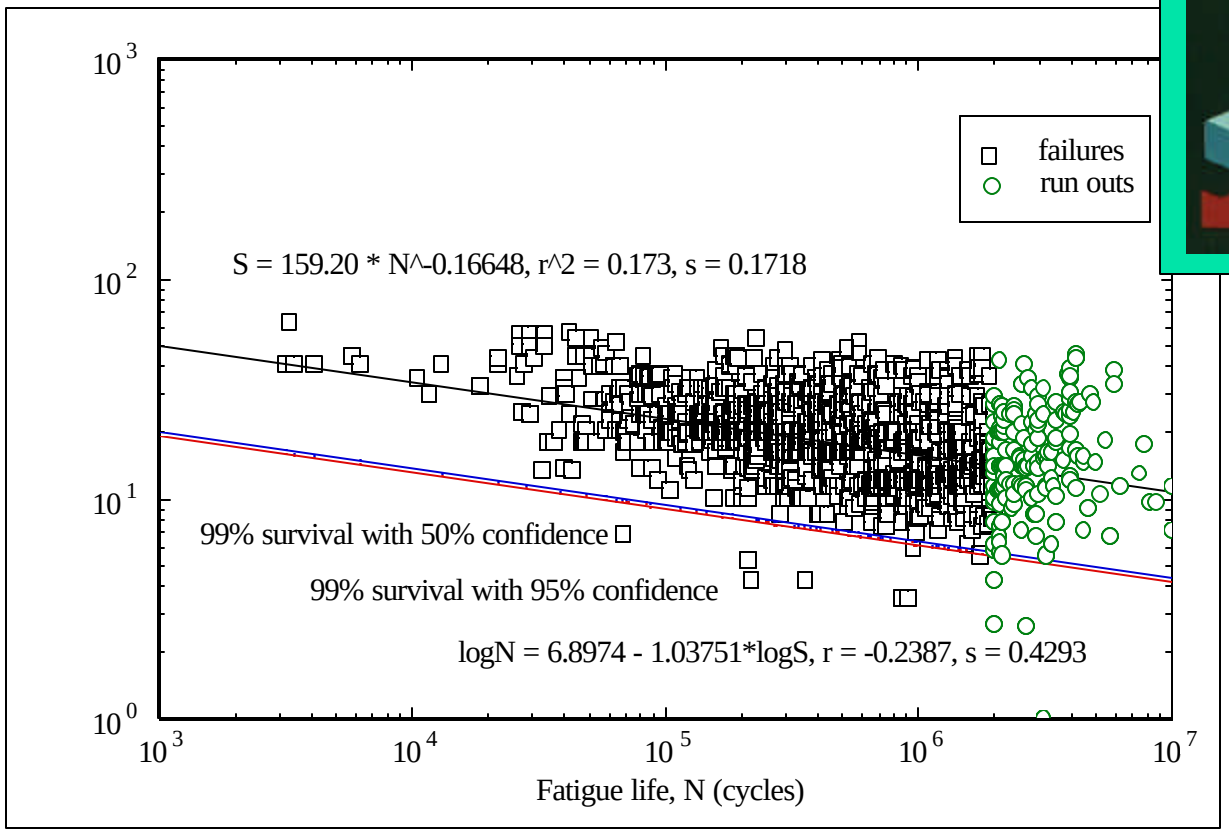




The good welds!

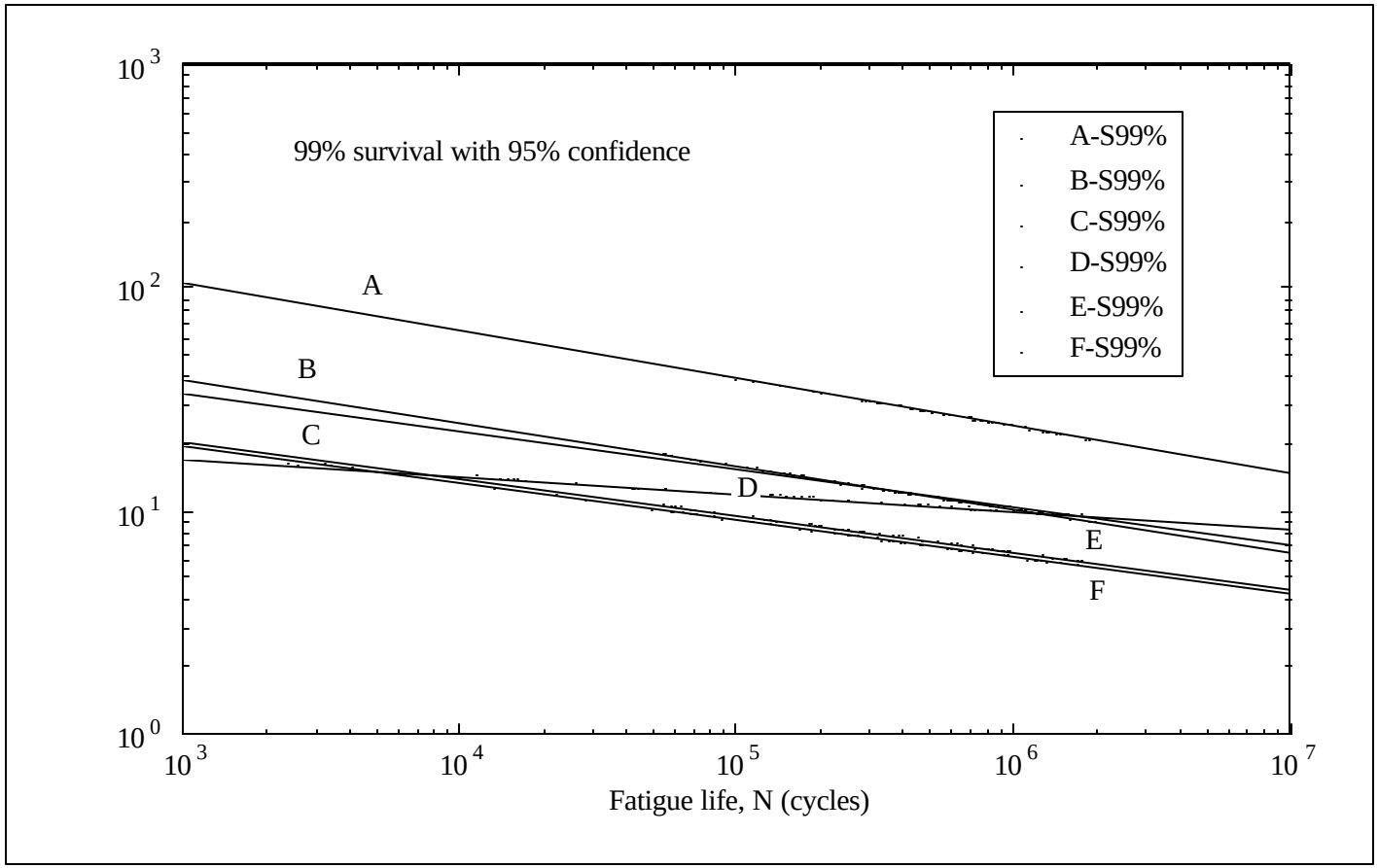
AISC category D and E



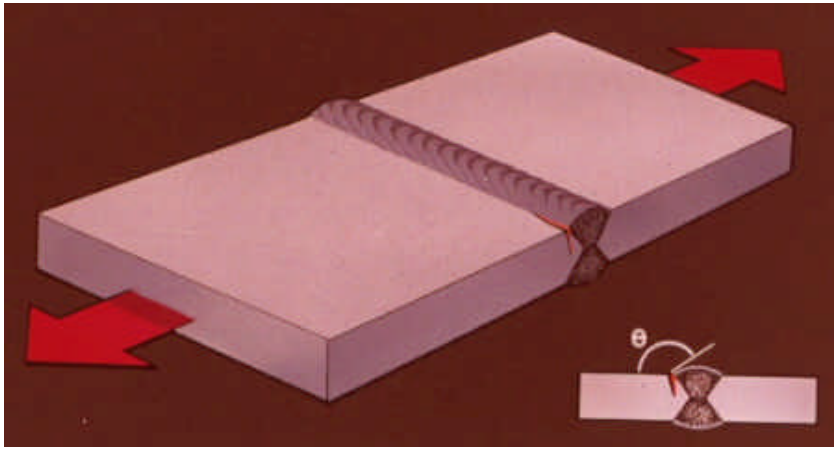


The bad welds!

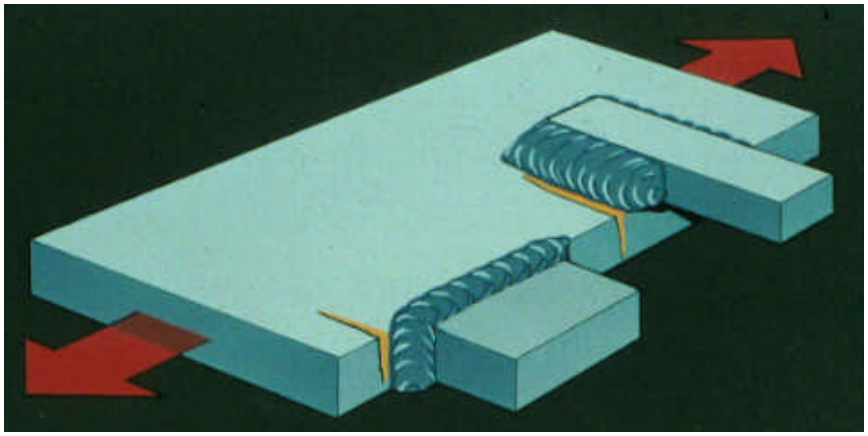
AISC category best fit lines to data



6.3 A Suggestion for the Classification of Weldments

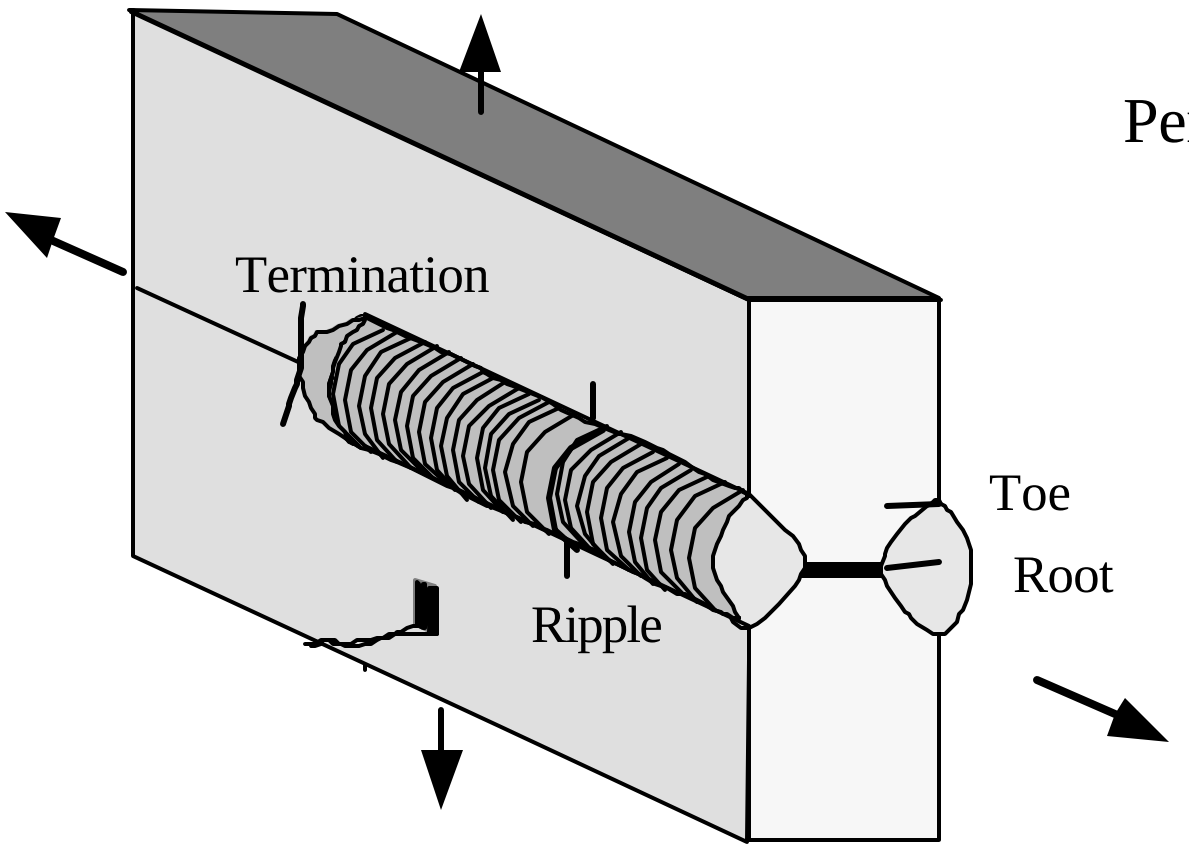


Good



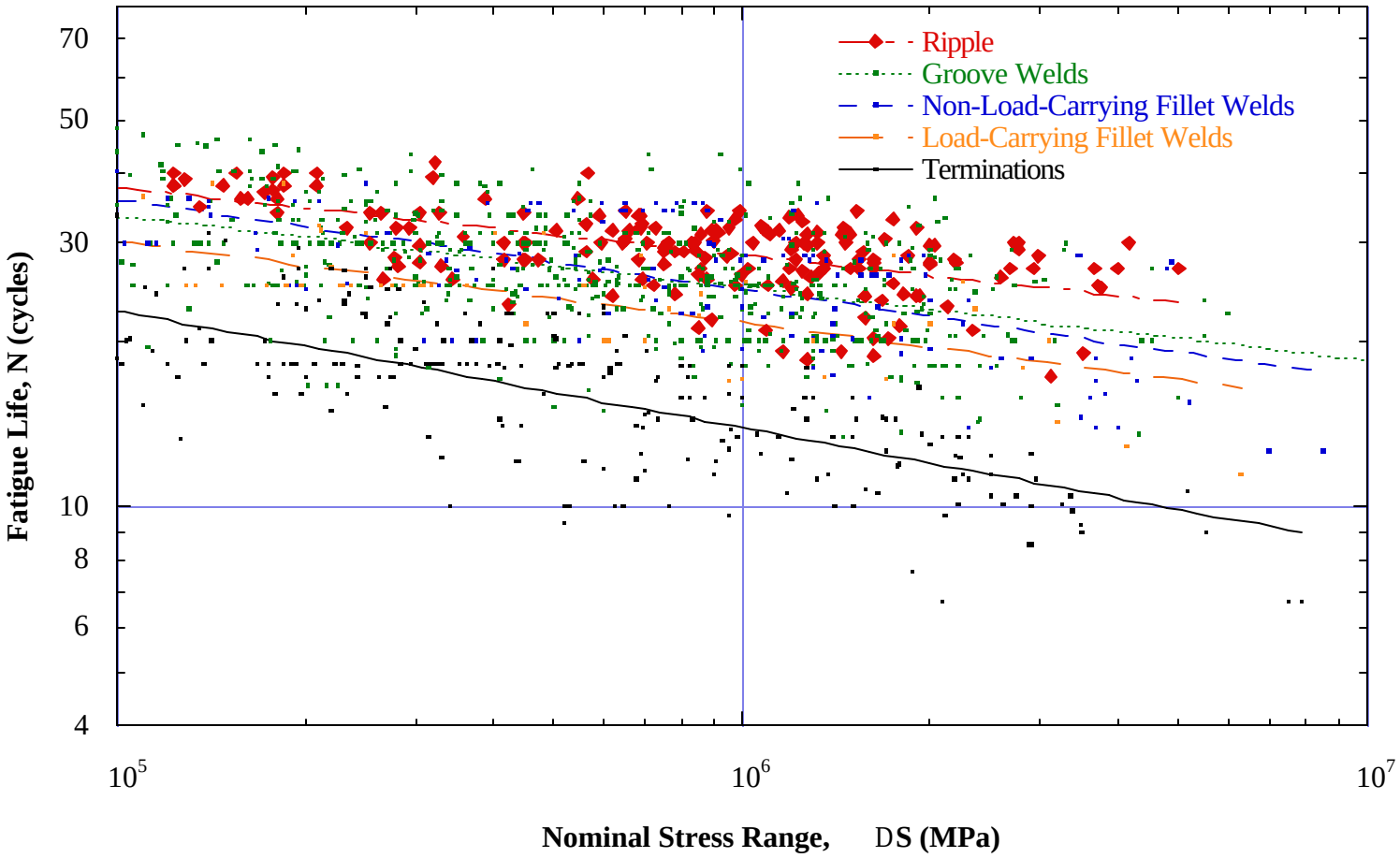
Bad

Weld stress concentrations

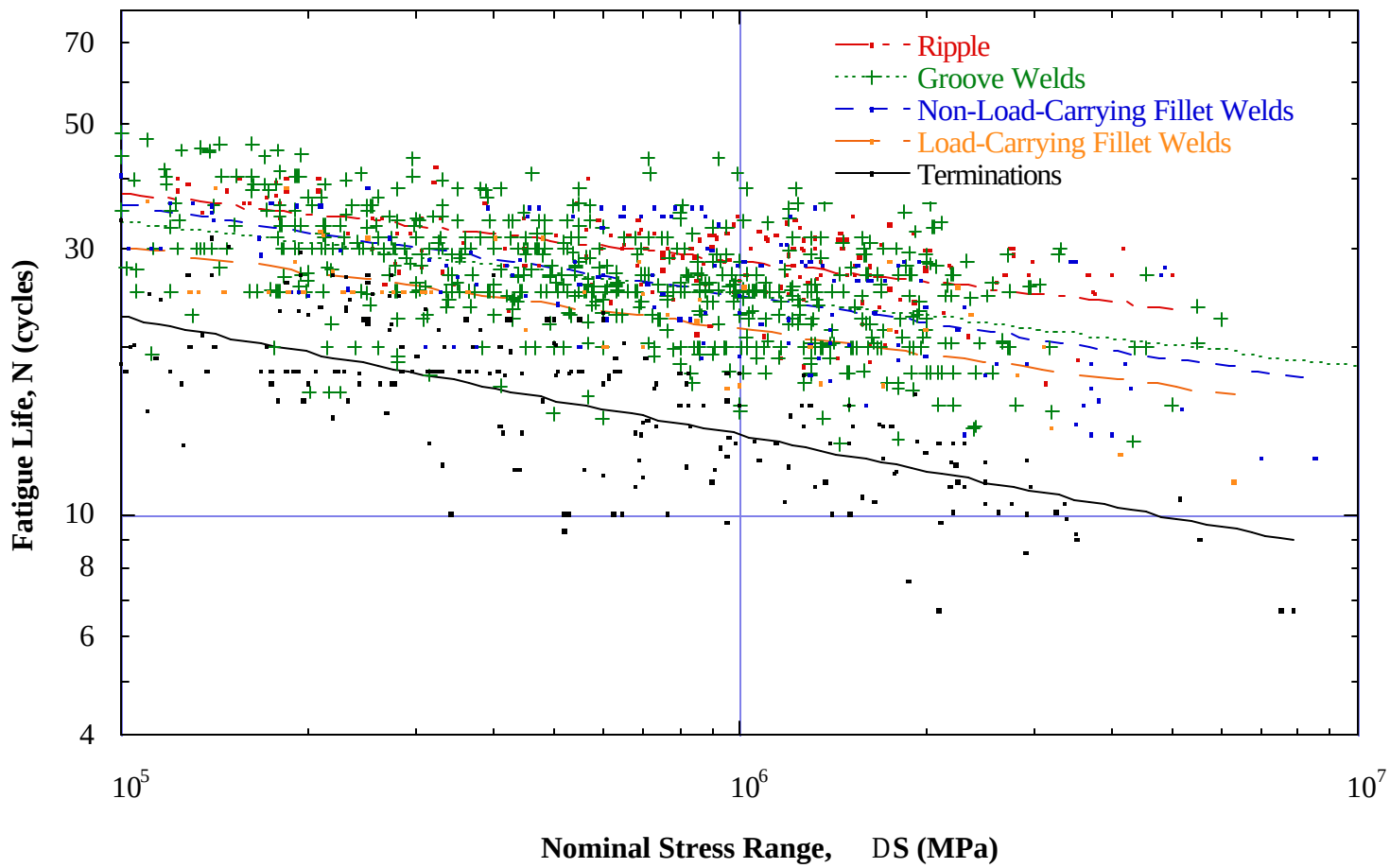


Personal view

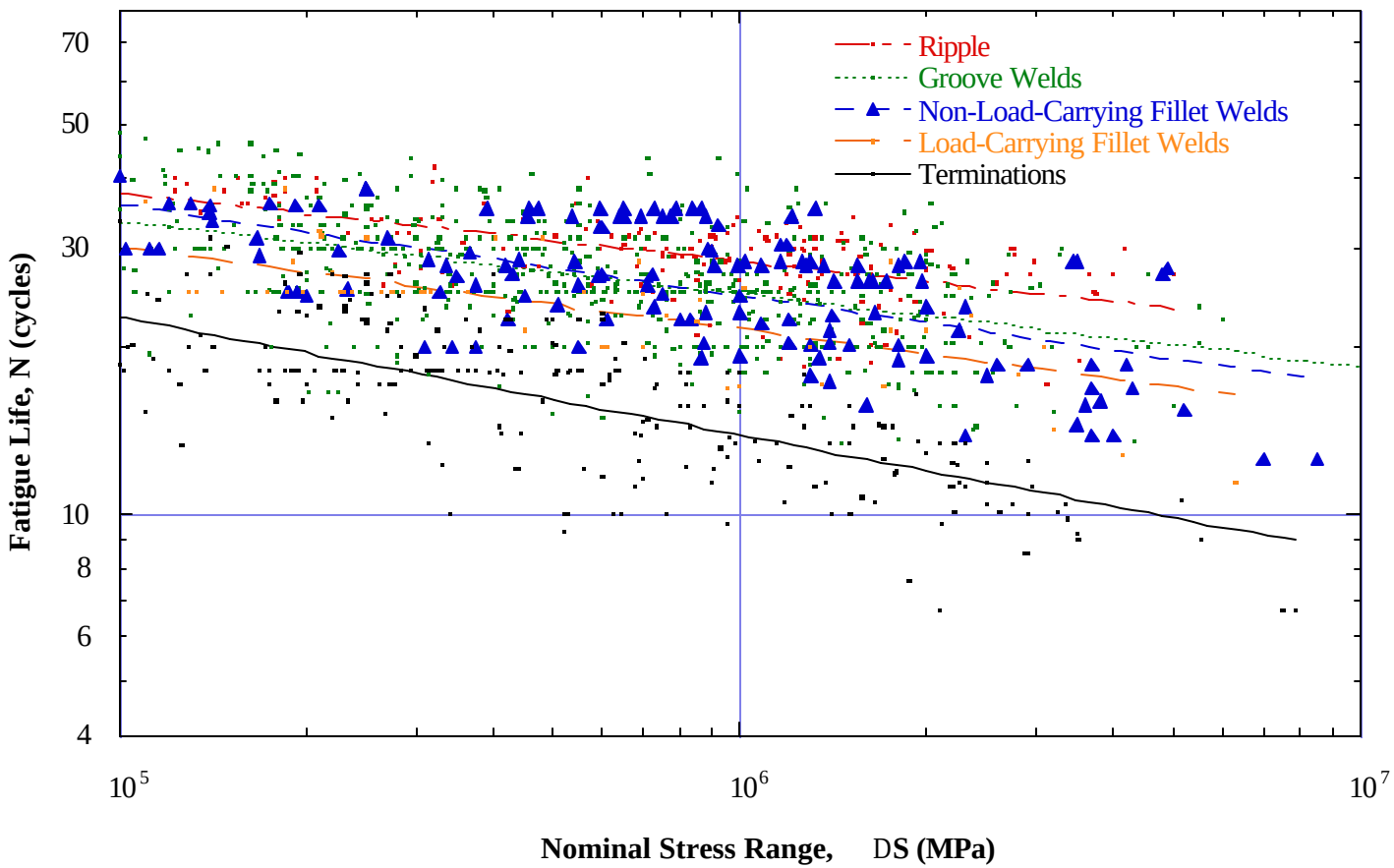
Ripple


Ripple
Groove Welds
Non-Load-Carrying Fillet Welds
Load-Carrying Fillet Welds
Terminations
70
50
30
10
8
6
4
Fatigue Life, N (cycles)
10^5
10^6
10^7
Nominal Stress Range, DS (MPa)

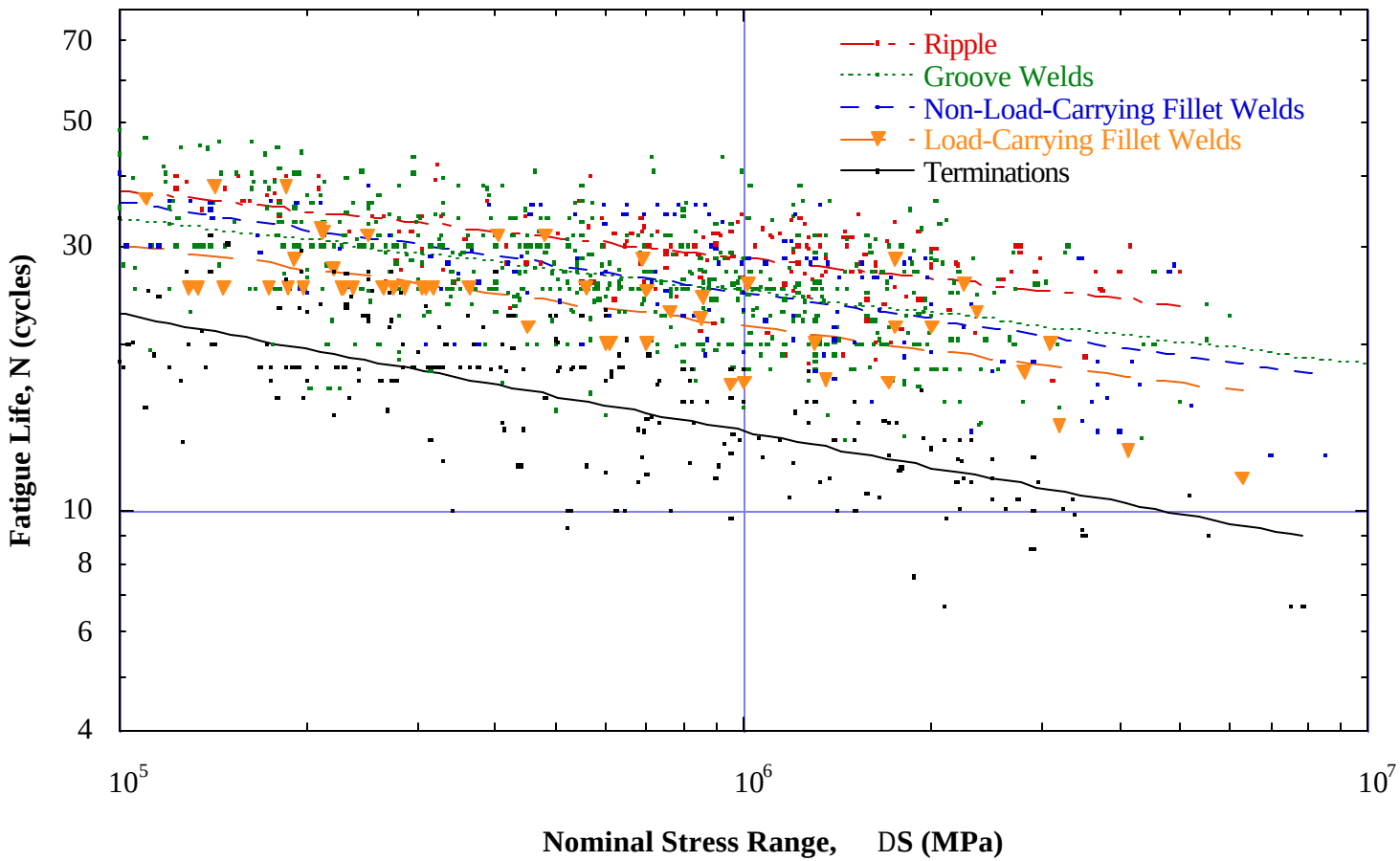
Groove welded butt joints



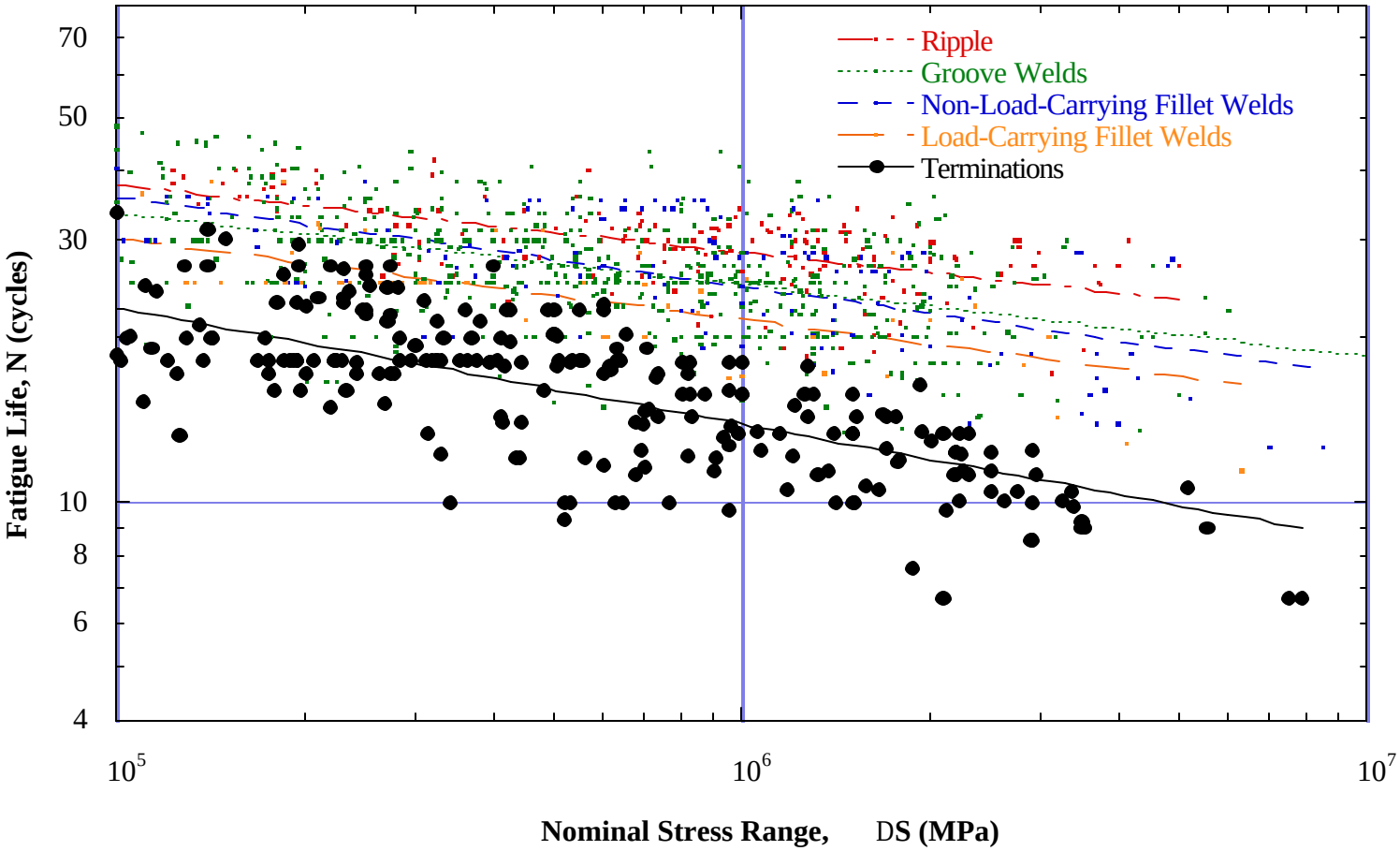
Non-load-carrying fillet welds



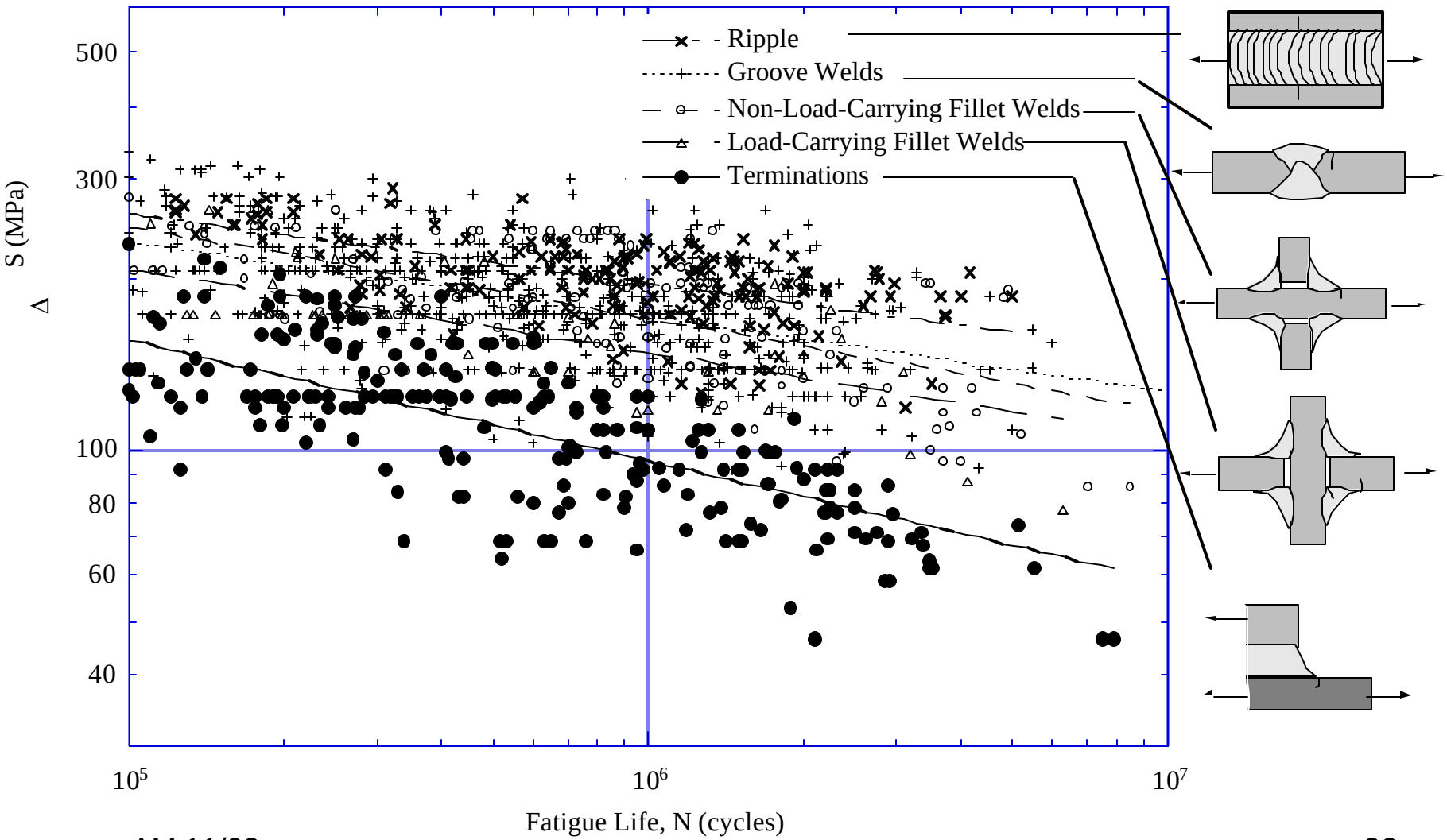
Transverse attachments



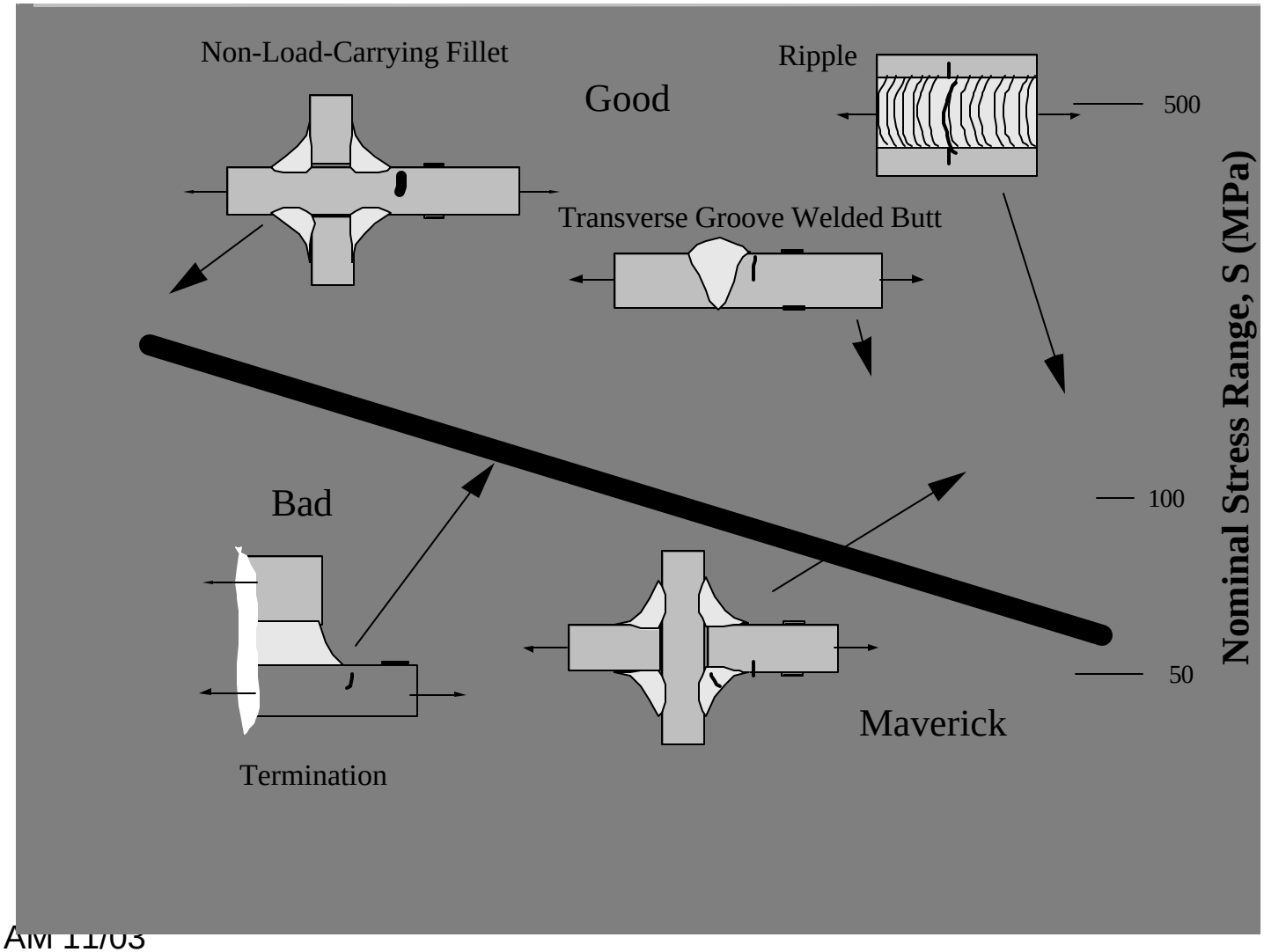
Longitudinal attachments



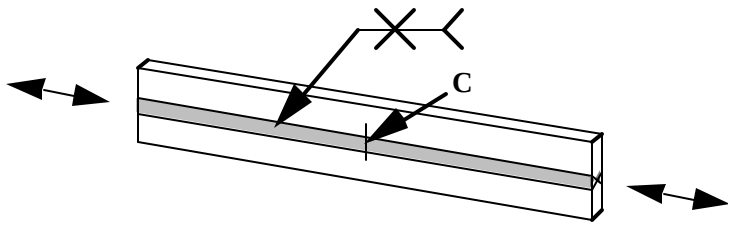
Good, bad, maverick



Good welds, Bad welds, Mavericks



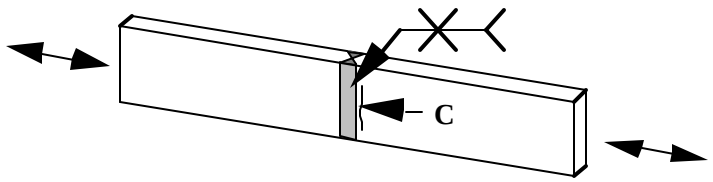
The good welds: weld toe failures



Detail #3

$K_f = 1.87$

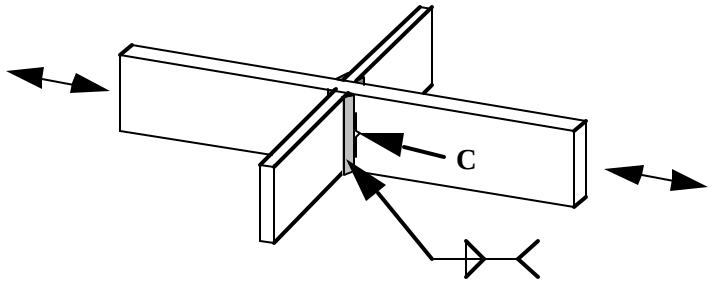
$^2S_{design} = 27.0$ ksi.



Full-Penetration Groove Weld: Detail #10

$K_f = 2.12$

$^2S_{design} = 23.3$ ksi.

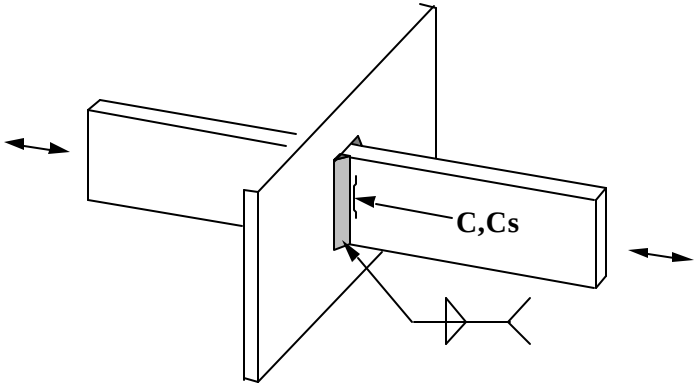


Non-Load Carrying Fillet Weld: Detail #25

$K_f = 2.23$

$^2S_{design} = 22.1$ ksi.

The bad welds: terminations

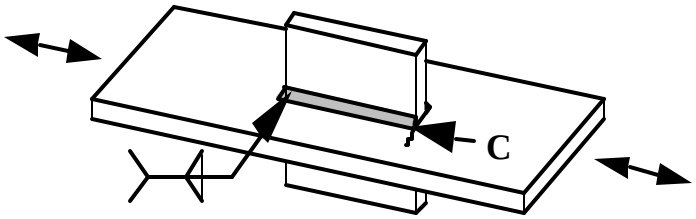


Load Carrying Fillet Weld:

Detail #20

$K_f = 3.12$

$^2S_{design} = 17.5$ ksi.



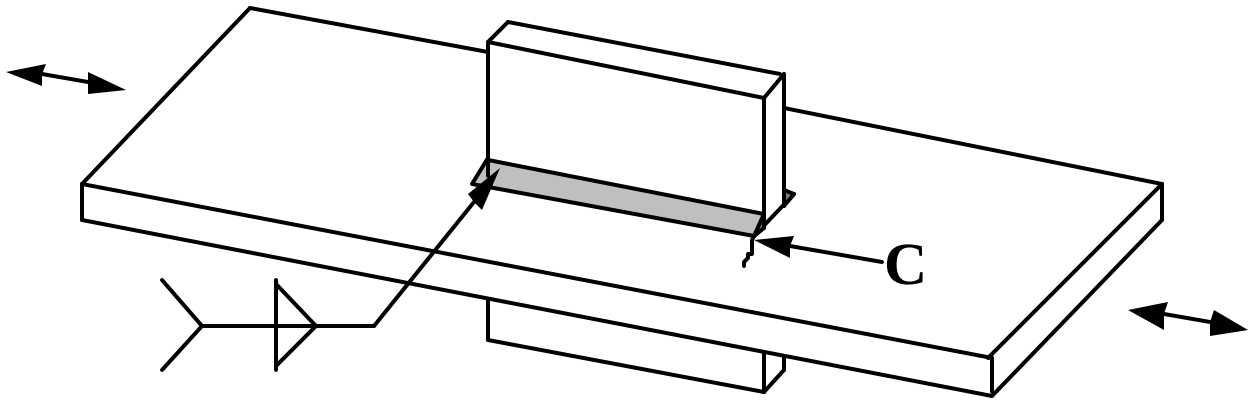
Weld Termination:

Detail #30

$K_f = 3.27$

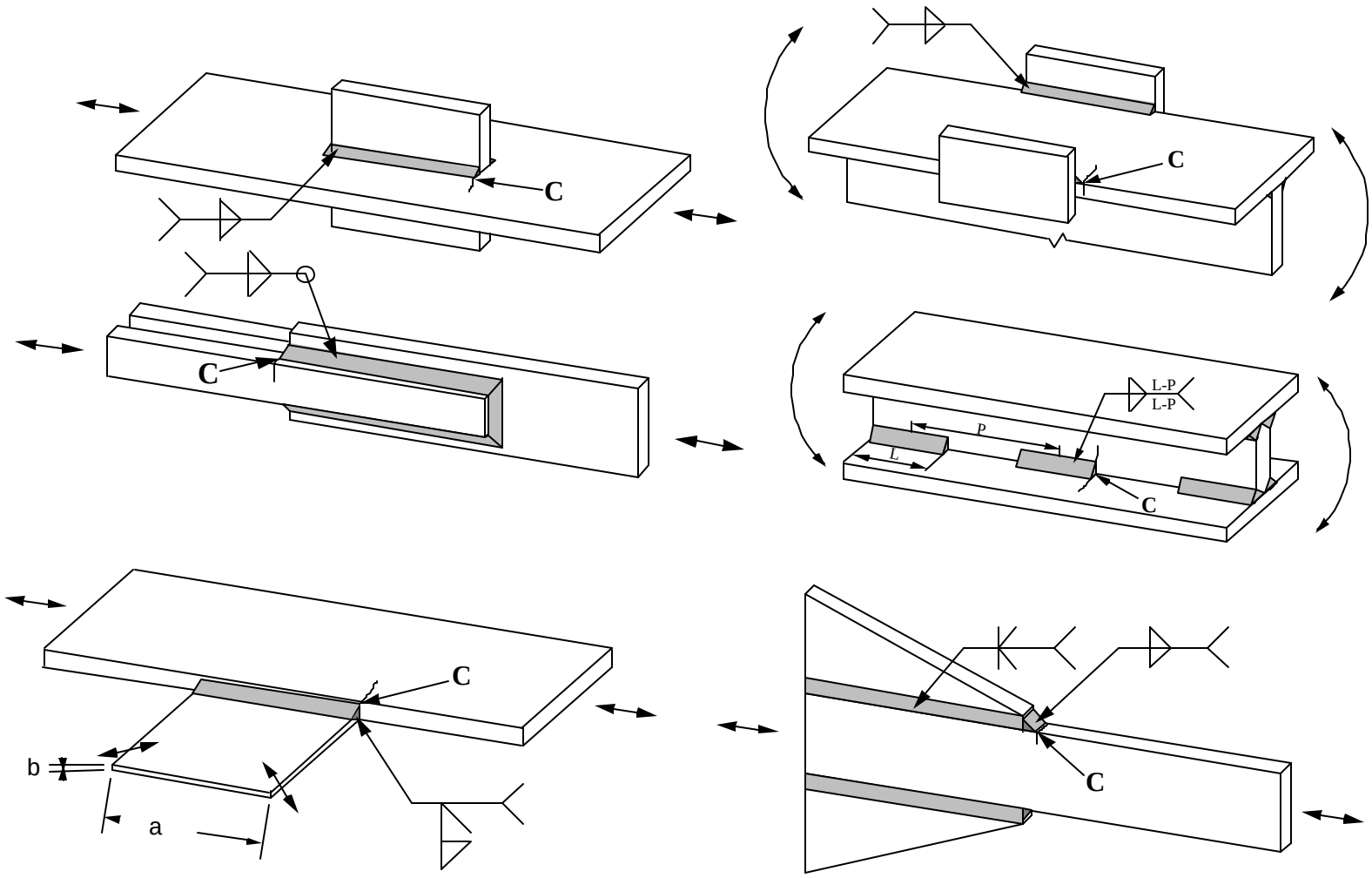
$^2S_{design} = 14.5$ ksi.

Fatigue severity of terminations

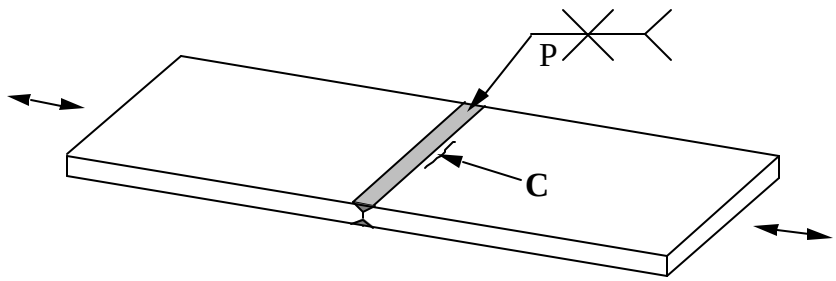


- Starts and stops introduce weld discontinuities.
- Residual stresses very high.
- 3-D stress concentrations effects.

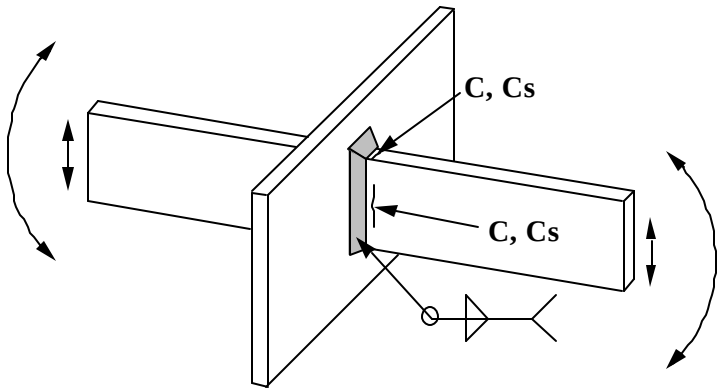
Examples of terminations



The mavericks: something undefined

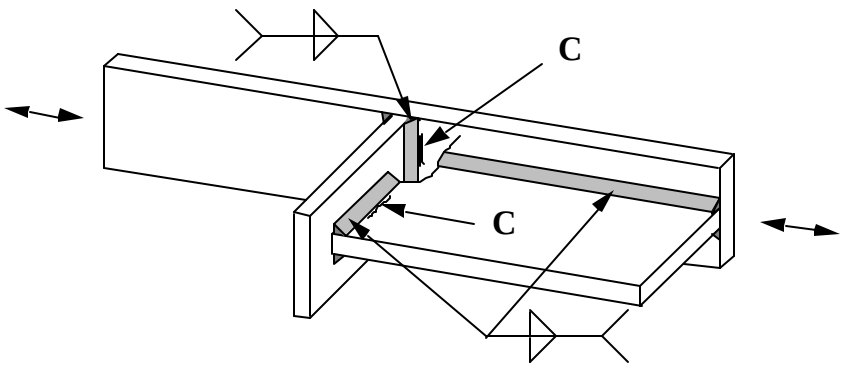


- Partial penetration weldment. The amount of penetration is generally unknown.

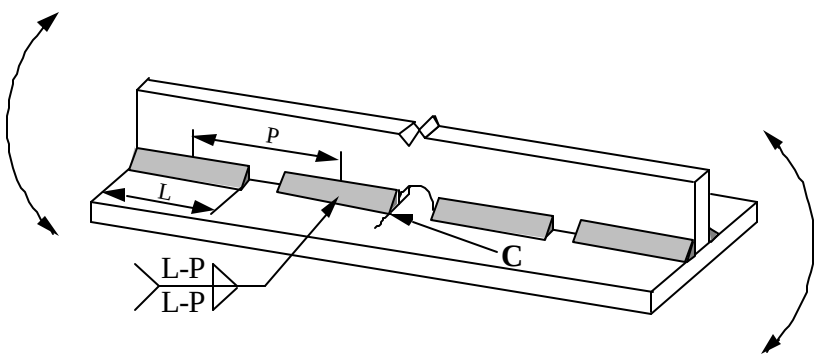


- Undercut. Failure occurs at the undercut on wrap-around weld where the arris of the plate is melted. the amount of the undercut is generally unknown.

The mavericks: complex components



- Multiple failure sites. The stress distribution in the joint changes as fatigue cracks initiate and grow at various locations.



- Local stresses uncertain because of structural redundancy

Summary

- Viewed from the perspective of crack initiation site, weldments could be grouped into four categories: ripple, toe, root, and terminations.
- This classification scheme leads to the conclusion that there are “Good” and “Bad” weldments and “Mavericks” - weldments for which a critical piece of information is unavailable and hence their behavior is undefined.