Welding Design Exposure and Application in Construction

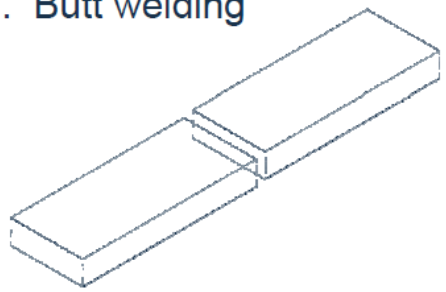
Types Of Welds & Classification Requirement (BV)

OJT CARD 4_001

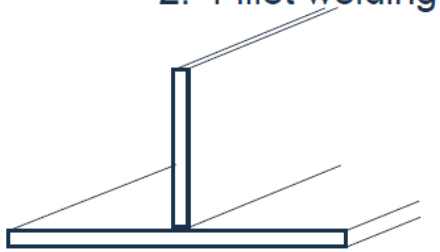
Types of Welds

- Two BV rules to consider :
  1. Rules for the Classification of Naval Ships – **NR 483** Nov 2011
     - requirements given in Pt B, Ch 11
     - cover design & scantlings of welds and edge preparation
  2. Rules on materials and Welding – **NR 216** Feb 2013
     - requirements given in Ch 5
     - cover approval of welding consumables and welding procedures

- BV Rules for naval Ships (NR483) →2 main types of connecting welding:
  1. Butt welding



  2. Fillet welding



Butt Welds

- In general:
  1. Full penetration

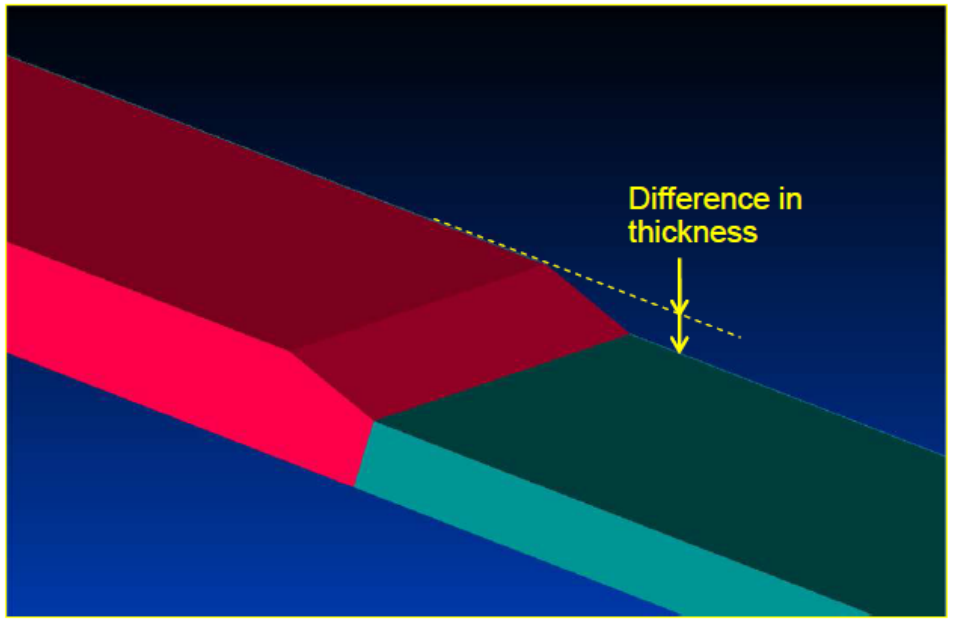
  2. Welded on both sides
     (except special procedures or techniques
     considered equivalent by BV)

  NB: Full pen compulsory for lengths of longitudinals of shell & strength deck plating in 0.6L amidships or elements with high stresses

- Butt welding also possible on permanent backing:
  - Backed by flange of face plate of a stiffener
  - Preparation to be qualified by yard (ref: part 5): type of bevel, gap between plates

Butt Welds

- Tapering: in case of welding of plates with difference in thickness
  - ≥ 3 mm if thinner plate has thickness ≤ 10 mm
  - ≥ 4 mm if thinner plate has thickness > 10mm

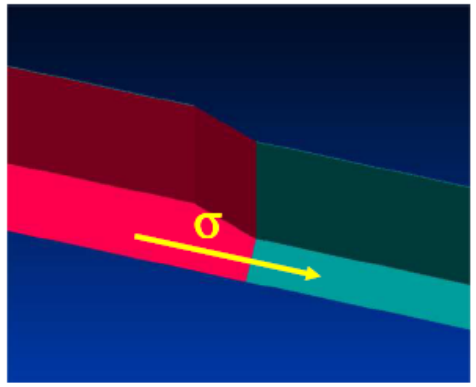


NB: If difference in thickness is less than above → change in thickness is accommodated in weld joint

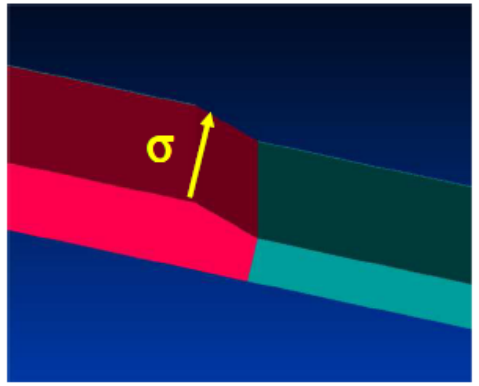
Butt Welds

- Slope of tapering governed by stress flow: to be adjusted to minimize stress concentration iwo change in thickness

  - Slope 1:4 (about 15°) if tapering perpendicular to main stress direction



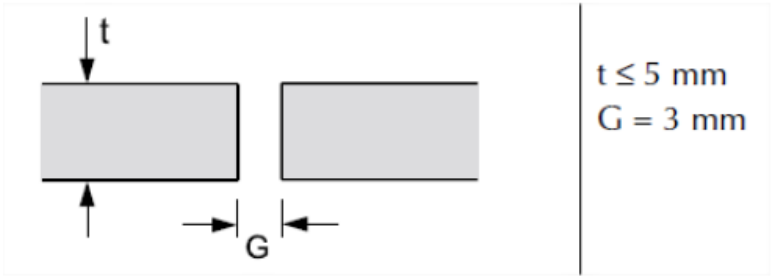
  - Slope 1:3 (about 20°) if tapering parallel to main stress direction



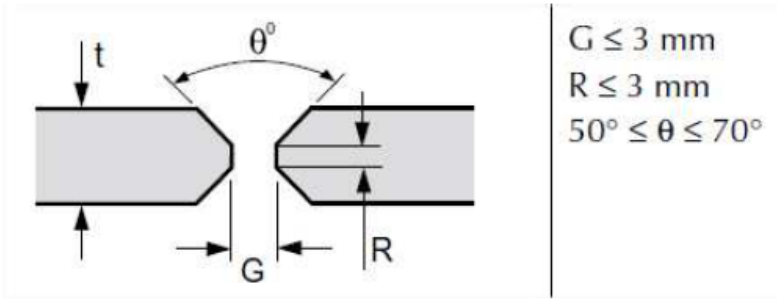
Butt Welds

- Typical preparation :
  - given in BV Rules as guidance only
  - different edge preparation may be accepted on basis of welding procedure specification (ref : part 5)

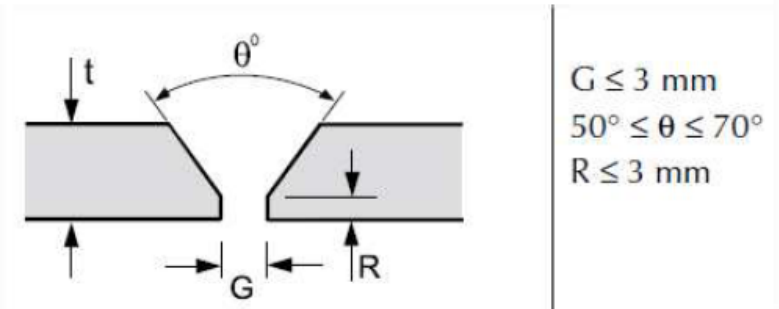
- Some examples (manual welding)



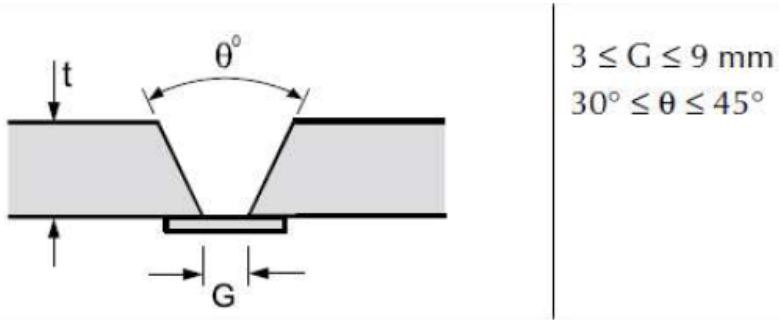
$t \leq 5$ mm
$G = 3$ mm



$G \leq 3$ mm
$R \leq 3$ mm
$50° \leq \theta \leq 70°$



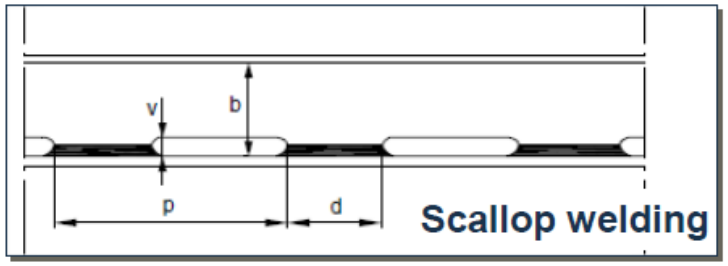
$G \leq 3$ mm
$50° \leq \theta \leq 70°$
$R \leq 3$ mm

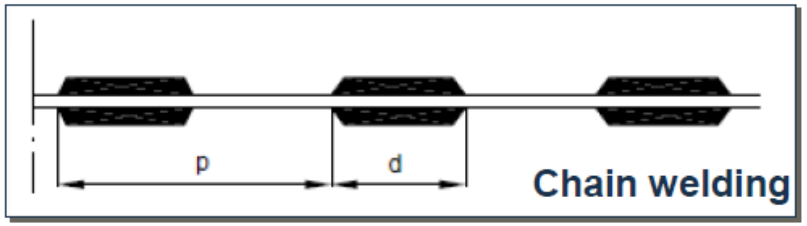


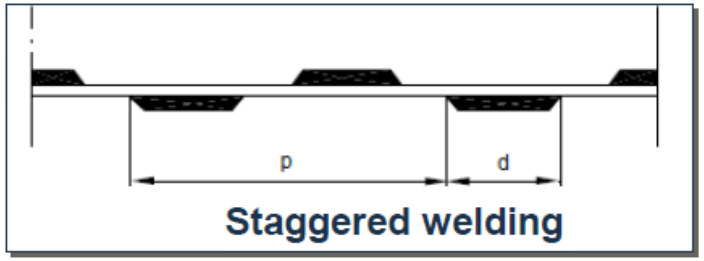
$3 \leq G \leq 9$ mm
$30° \leq \theta \leq 45°$

Fillet Welds

- Fillet welding types:
  1. Continuous fillet welding (continuous fillet on each side of abutting plate)
  2. Intermittent fillet welding: 3 main types (p: spacing or pitch , d: weld length)

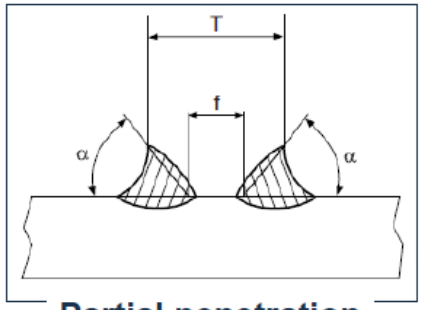




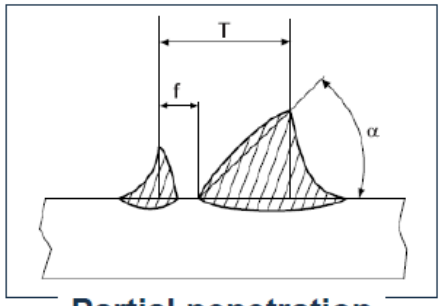


Fillet Welds

- T connections : generally ordinary fillet welding without bevel
- Partial of full T penetration welding required for connections subjected to high stresses (details where fatigue analysis is required / strength deck – side shell / tank top – vertical bulkhead corrugations)



Partial penetration

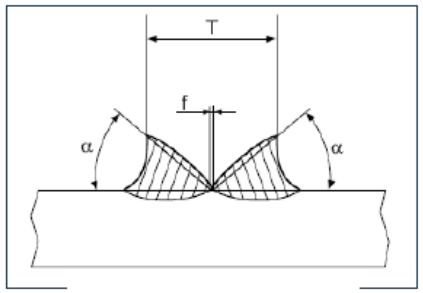


Partial penetration

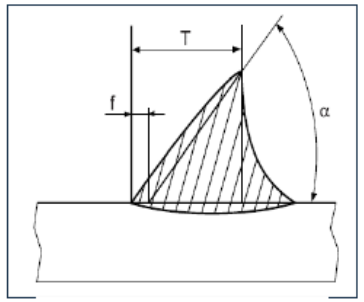
Typical:

f : between 3mm and T/3

α : between 45° & 60°



Full penetration



Full penetration

Typical:

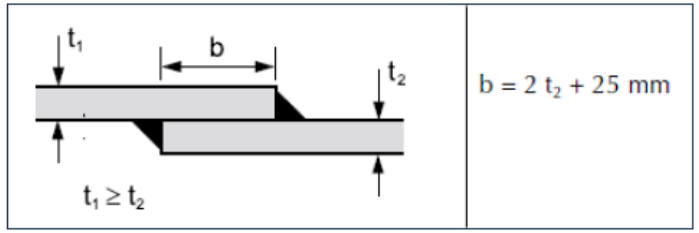
f : between 0 and 3mm

α: between 45° & 60°

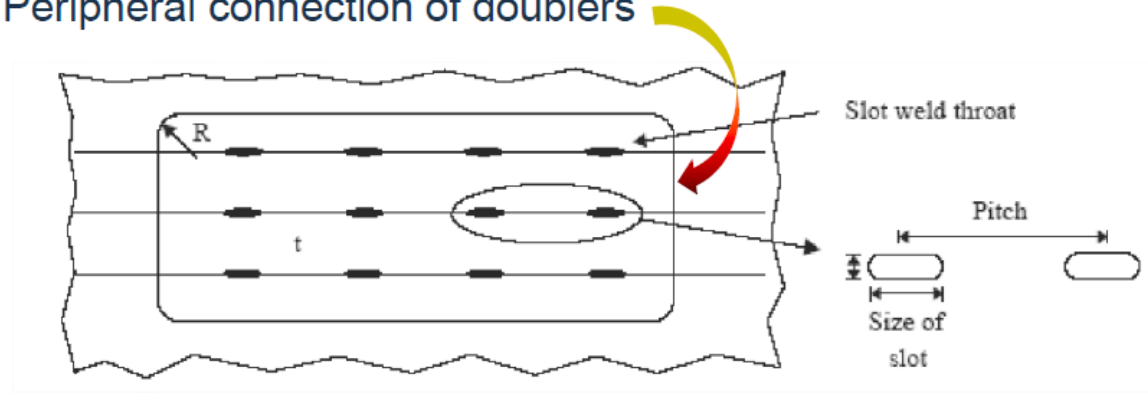
Back gouging generally required

Fillet Welds (Lap Welding)

- Lap-joint welding



- Lap-welding acceptable for:
  - Peripheral connection of doublers

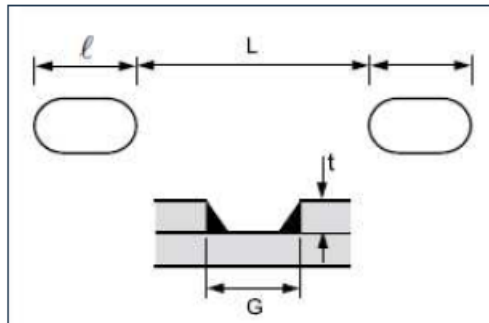


  - Internal structural elements subjected to very loaw stresses

- Continuous welding generally adopted (corrosion)

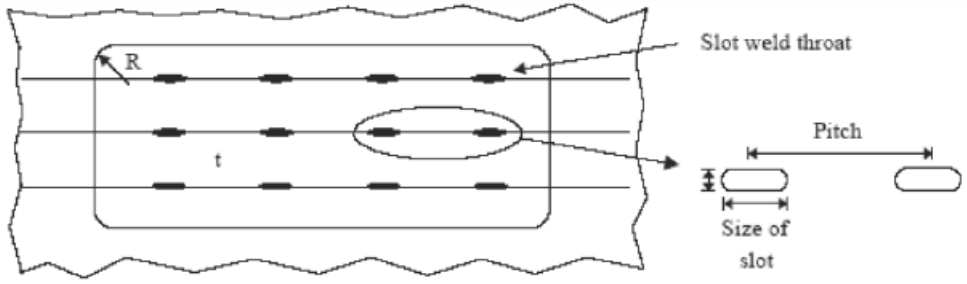
Fillet Welds (Slot Welding)

- Slot welding



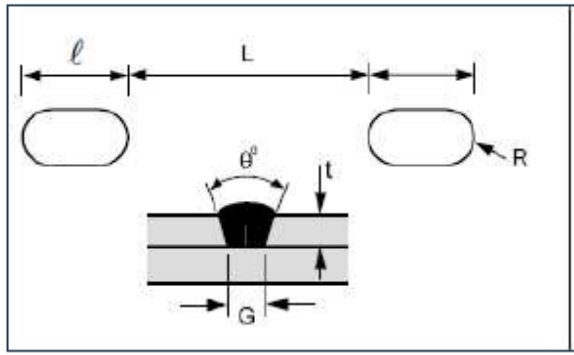
- $t \leq 12$ mm
  G = 20 mm
  ℓ = 80 mm
  $2\ell \leq L \leq 3\ell$, max 250 mm
- $t > 12$ mm
  G = 2 t
  ℓ = 100 mm
  $2\ell \leq L \leq 3\ell$, max 250 mm

- Subject to BV agreement, slot-welding acceptable for :
  - connection of doublers (except on strength deck and shell in 0.6L amidships)
  - only where stresses act in predominant direction: slot welds to be aligned in this direction



Fillet Welds (Plug Welding)

- Plug welding



- $t \leq 12$ mm
  $\ell = 60$ mm
  $R = 6$ mm
  $40° \leq \theta \leq 50°$
  $G = 12$ mm
  $L > 2\ \ell$
- $12 \text{ mm} < t \leq 25$ mm
  $\ell = 80$ mm
  $R = 0{,}5\ t$ mm
  $\theta = 30°$
  $G = t$ mm
  $L > 2\ \ell$

- Plug-welding acceptable only on case by case basis, subject to BV agreement

- Typical exemple: welding of rudder plating on internal structure