

Supporting presentation for
lecturers of Architecture/Civil
Engineering

Chapter 09
Joining & Fabrication of
Stainless Steels

Contents

1. Joining
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1 - Joining

Applicable joining processes: all of them!

Process (Refs)	Videos	Preferred process for
Welding (1-5) (widely used)	MIG Welding TIG Welding Welding robot	High strength of the joints No dismantling
Fastening (widely used)	Webinar	Easy on-site assembly Assembling dissimilar materials (wood, glass...) Dismantling at a later stage
Brazing/Soldering	Soldering	Water tightness (Used mostly in roofing)
Mechanical Press-fitting Folding Other	Press-fit example	Permanent joining of tubes Water tightness
Adhesive Bonding (not used often, but growing)		Surface finish integrity

Arc Welding

Advantages of arc welding

- weld properties equal to that of annealed condition
- provides the strongest joints
- can be done on site or in the shop
- joins thin and thick material of any shape
- joins similar or dissimilar metals (usually carbon steel with proper choice of filler material)
- resists fatigue and cyclic loads
- same corrosion and heat resistance as the annealed base metal

Limitations of arc welding

- not possible with all grades
- require qualified operators and procedures
- may cause heat-induced distortions
- post-weld finishing operations are required for a good-looking finish (such as sand blasting)
- loss of mechanical properties in case of cold-worked material

Arc Welding

[Video: polishing a weld](#)



Mechanical fastening

Advantages of mechanical fastening

- Can be dismantled
- Ideal for on-site building
- Fast
- No need of qualified operators

Limitations of mechanical fastening

- Not as strong as welds
- May cause crevice corrosion (see corrosion resistance chapter)

Selecting the appropriate fastener:

The German Institute for Building Technology* has issued recommendations for the selection of fasteners according to the environment. Please read Reference 4, Table 1a (exposure classes) and Table 8 (stainless grades by class)



* Deutsches Institut für Bautechnik (DIBt)



Press fitting (a process used for tubes only)

Advantages of press fitting

- Perfectly tight for liquid and gases
- Fast
- No flame
- Perfectly clean surfaces
- No need of qualified operators

Limitations of press fitting

- Cannot be dismantled
- Require sleeves for each tube diameter

Adhesive Bonding

Advantages of adhesive bonding

- makes a joint almost invisible, enhancing product appearance
- provides uniform distribution of stress and a greater stress-bearing area
- joins thin and thick material of any shape
- joins similar or dissimilar materials
- minimizes or prevents electrochemical (galvanic) corrosion between dissimilar materials
- resists fatigue and cyclic loads
- provides joints with smooth contours
- seals joints against a variety of environments
- insulates against heat transfer and electrical conductance
- is free from heat-induced distortions
- dampens vibrations and absorb shocks
- provides attractive strength/weight ratio
- is frequently faster or cheaper than mechanical fastening

Limitations of adhesive bonding

- does not permit visual examination of the bond area
- requires careful surface preparation, often with corrosive chemicals
- may involve long cure times, particularly where high cure temperatures are not used
- may require holding fixtures, presses, ovens and autoclaves, not usually needed for other fastening methods
- should not be exposed to service temperatures above approximately 180 °C
- requires rigid process control, including emphasis on cleanliness, for most adhesives
- depends on the environment to which it is exposed

Adhesive bonding applications



Attaching of banister elements (Delo-Duopox AD895)

- Fills gaps, suitable for small and large bonding gaps
- Good chemical resistance and aging resistance
- For interior and exterior use
- Efficiency: flexible modular system in banister construction. The additional process steps required for welding, such as grinding or polishing, are avoided

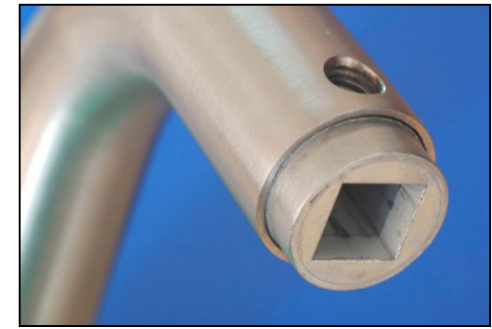


Stainless steel panels (Grade 1.4404) are attached to the outer walls of this 6-storey office building in Hannover (Germany) using an adhesive bonding system without the need for additional mechanical fastening

Table 1. Selection of adhesives for structural bonding [11]

	With stainless steel	Type of adhesive for semi-structural bonding				
		Silicone	Polymer modified with silane	Polyurethane	Acrylic	Epoxy
Stainless steel	yes	●	●	●	○	●
Carbon steel	yes	●	●	○	○	●
Carbon steel/painted	yes	●	●	X	○	○
Carbon steel/galvanised	yes	●	●	X	○	○
Aluminium	yes	●	●	○	○	●
Wood	yes	●	●	○	○	●
Glass/ceramic	yes	●	●	X	○	●
Plastic PVC	yes	●	●	X	X	X
Plastic PA	yes	○	●	X	○	
Plastic PP/PE	no	X	X	X	X	X

● highly recommendable - ○ recommendable - X not recommendable



Adhesive bonding is used for the assembly of door handles.



Adhesive bonding is a practical solution in building applications, when stainless steel has to be fastened to masonry or natural stone

References on Joining

1. http://www.worldstainless.org/Files/issf/animations/WeldedFabrication/start_1.html
2. <http://www.wikihow.com/Weld-Stainless-Steel>
3. [http://www.nickelinstitute.org/~Media/Files/TechnicalLiterature/WeldingofStainlessSteela
ndotherJoiningMethods_9002_.pdf](http://www.nickelinstitute.org/~Media/Files/TechnicalLiterature/WeldingofStainlessSteela
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4. <http://www.edelstahl-rostfrei.de/page.asp?pageID=1590>
5. [http://www.improve.it/metro/file.php?file=/1/Papers/Metallurgy_of_Welding_Processes/Jo
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6. [https://www.worldstainless.org/Files/issf/non-image-
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7. <http://shura.shu.ac.uk/3115/>
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9. http://www.delo.de/fileadmin/upload/dokumente/en/broschueren/Structural_Bonding.pdf
10. [https://www.ellsworth.com/globalassets/literature-library/manufacture/ellsworth-
adhesives/ellsworth-adhesives-white-paper-structural-bonding.pdf](https://www.ellsworth.com/globalassets/literature-library/manufacture/ellsworth-
adhesives/ellsworth-adhesives-white-paper-structural-bonding.pdf)
11. <http://www.sciencedirect.com/science/book/9781845694357>

2 - Fabrication

Very comprehensive documents are available, see the list of references

Ref 1 is a training course dedicated to the fabrication of stainless steels

Chapter 2 lists a number of applications in architecture, building and construction: fabrication of all shapes and finishes is achieved routinely today

Videos on Processes

- Stainless Steel Melting and Rolling <https://www.youtube.com/watch?v=5zwgl-pQ6kE>
- Shearing and Bending https://www.youtube.com/watch?v=VMu7_W0QE3Y
- Water Jet Cutting <http://www.sastainless.com/videos/index.html>
- Deep Drawing https://www.youtube.com/watch?v=n-ht_5Ysurc
- Wire Bending Machine <https://www.youtube.com/watch?v=kDoSDiiZx6U>
- Spring Forming Machine <https://www.youtube.com/watch?v=SwY-RT4DBxY>
- Roll Forming https://www.youtube.com/watch?v=44XD5mZoM_0
- Machining (milling) <https://www.youtube.com/watch?v=LDxNDWObTyg>

More videos are readily available on the net

References on Fabrication

1. <http://www.issftraining.org/>
2. http://www.imoa.info/download_files/stainless-steel/Austenitics.pdf
3. [http://www.imoa.info/download_files/stainless-steel/Duplex Stainless Steel 3rd Edition.pdf](http://www.imoa.info/download_files/stainless-steel/Duplex%20Stainless%20Steel%203rd%20Edition.pdf)
4. [http://www.worldstainless.org/Files/issf/non-image-files/PDF/ISSF The Ferritic Solution English.pdf](http://www.worldstainless.org/Files/issf/non-image-files/PDF/ISSF%20The%20Ferritic%20Solution%20English.pdf)

Thank you

Test your knowledge of stainless steel here:

<https://www.surveymonkey.com/r/3BVK2X6>