

Assembly Techniques – SS 2020

Christian Leinenbach, Christopher Plummer

Structure of the course – SS 2020

Two teachers:

Christopher Plummer: Polymers

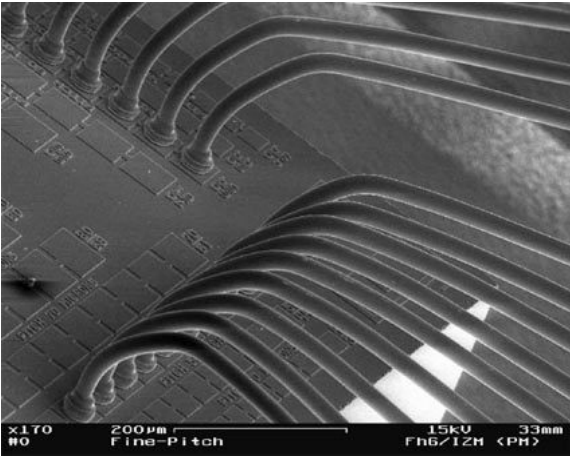
Christian Leinenbach: Metals

Grading:

Seminar presentations and **small exam** of the two blocks.

Date	topic	teacher
Feb 18	Introduction + Seminar prop.	Leinenbach/Plummer
Feb 25	Surfaces and Interfaces	Leinenbach
March 3	Metals 1: solid state welding	Leinenbach
March 10	Metals 2: liquid state welding	Leinenbach
March 17	Metals 3: soldering, brazing & TLP bonding	Leinenbach
March 24	Metals 4: mechanics of joints & joint reliability	Leinenbach
March 31	Polymers 1: polymer welding I	Plummer
April 7	Polymers 2: polymer welding II	Plummer
April 21	Polymers 3: mechanical joining	Plummer
April 28	Polymers 4: adhesives I	Plummer
May 5	Polymers 5: adhesives II	Plummer
May 12	Exam	Leinenbach/Plummer
May 19	Seminar Presentations	Leinenbach/Plummer
May 26	Seminar Presentations	Leinenbach/Plummer

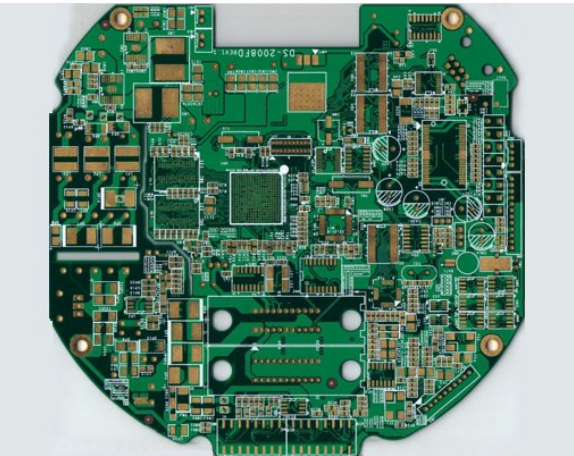
Why joining?



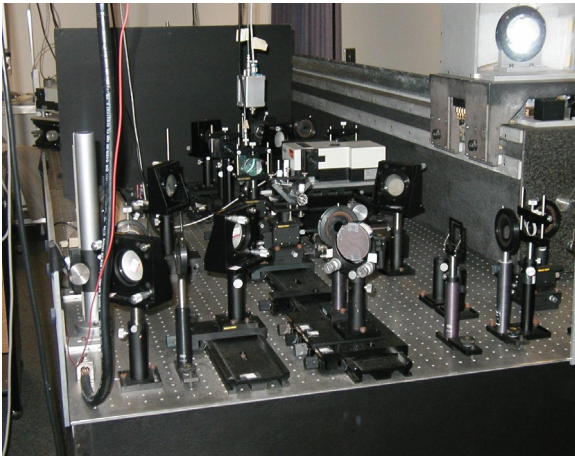
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Functionality of a joint

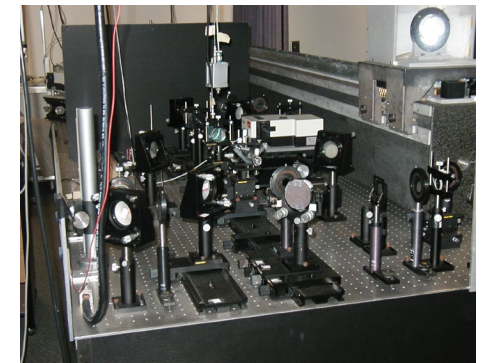
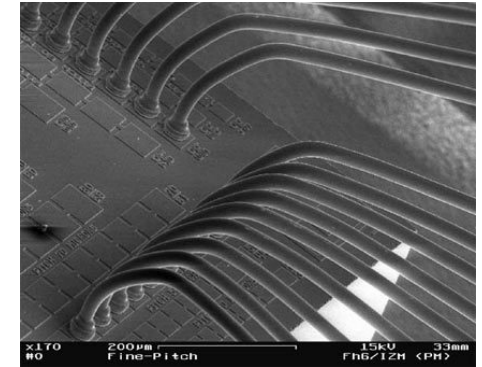
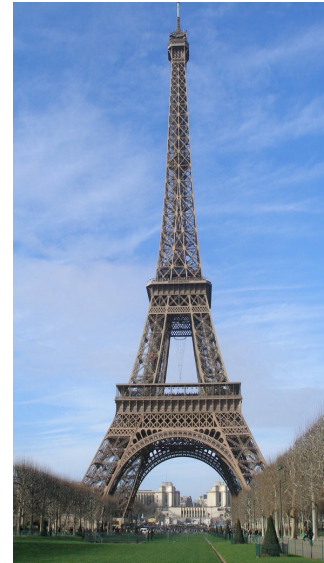
Establishing a continuity enabling...

- ... transmission of forces
- ... transport properties
 - Heat
 - Current

Keep a relative position of the assembled pieces

Create a closed volume

- Containers, vacuum chambers
- Hermetic seals



Why joining?

- Size of the object (Eiffel tower, bridges)
- Combination of different materials (and properties)
- Complex shapes (cost effectiveness compared to other production methods)

... and why not?

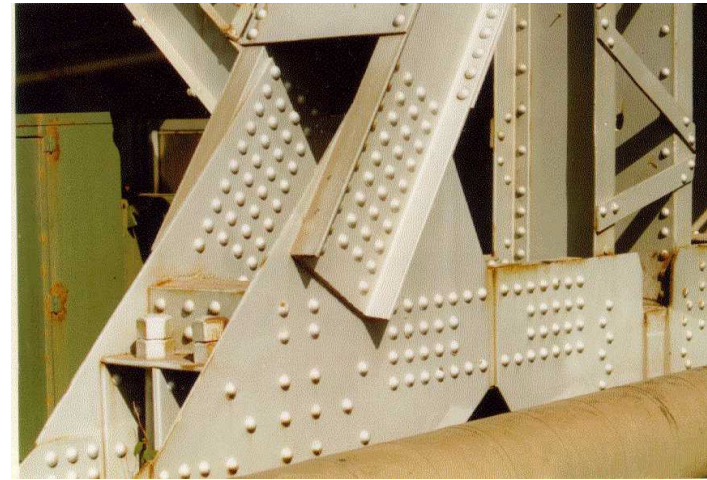
- Precision (relative position, differential thermal expansion issues)
- Cost (large series of simple or very complex shapes)
- Materials properties affected by the joining procedure, e.g. heat-treated steels, precipitation hardened Al-alloys etc.

Classification of joints

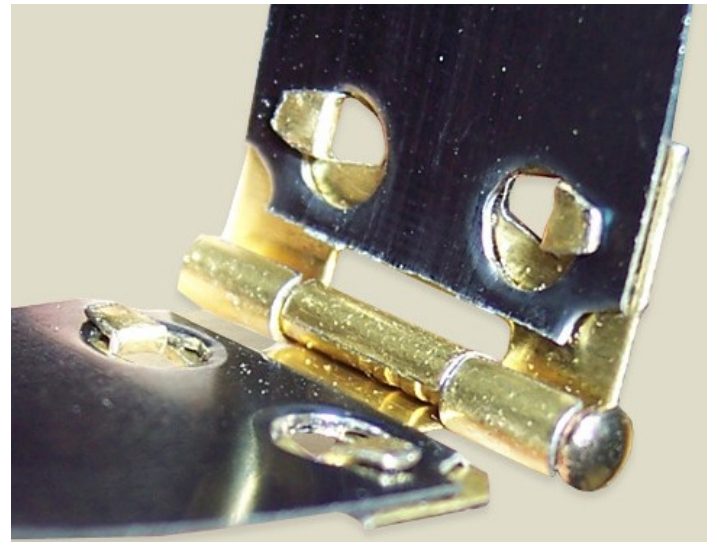
- Mechanical
e.g. bolts, rivets, screws, nails, pins



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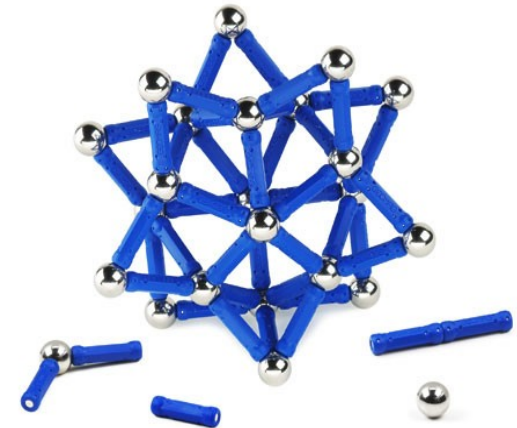


Classification of joints

- Physical
e.g. by capillary forces, magnetic forces



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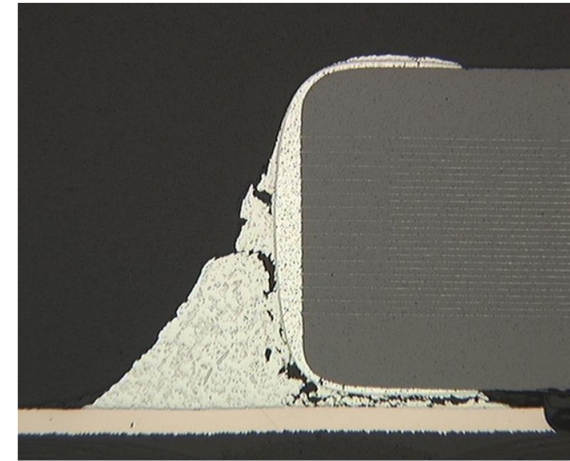
Mechanical and physical joints can be easily undone

Classification of joints

- Chemical
(glues, brazing, welding, soldering)



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Chemical joints are permanent joints

Goals of the course (part on metals)

The student should be capable of:

- Identifying the different welding, brazing, and soldering processes and to be aware of their main characteristics
- Explaining the physical principles of the various joining techniques
- Assessing the appropriateness of the various processes in view of their applicability to a given technical situation
- Making a reasonable choice between joining techniques to comply with technical requirements

Brazing, soldering or liquid phase welding?

Brazing and soldering

- Processing temperature below T_m of the base metal
- The parts to be brazed can have largely differing T_m
- Always with a filler
- The microstructure of the base metal may be kept unchanged.
- Local or global heating

Welding

- Welding temperature above T_m of the base metal
- The parts to be welded should have small difference in T_m
- With or without a filler
- The microstructure of the base metal is modified in the vicinity of the weld seam (the heat affected zone “HAZ”)
- Always local heating

Overview on welding, brazing and soldering processes

Welding

Brazing

Solid state

- Friction
- Ultrasound
- Explosion
- Hot-/Cold-pressing
 - Extrusion
 - Drawing
 - Rolling
 - Forging
- Diffusion bonding

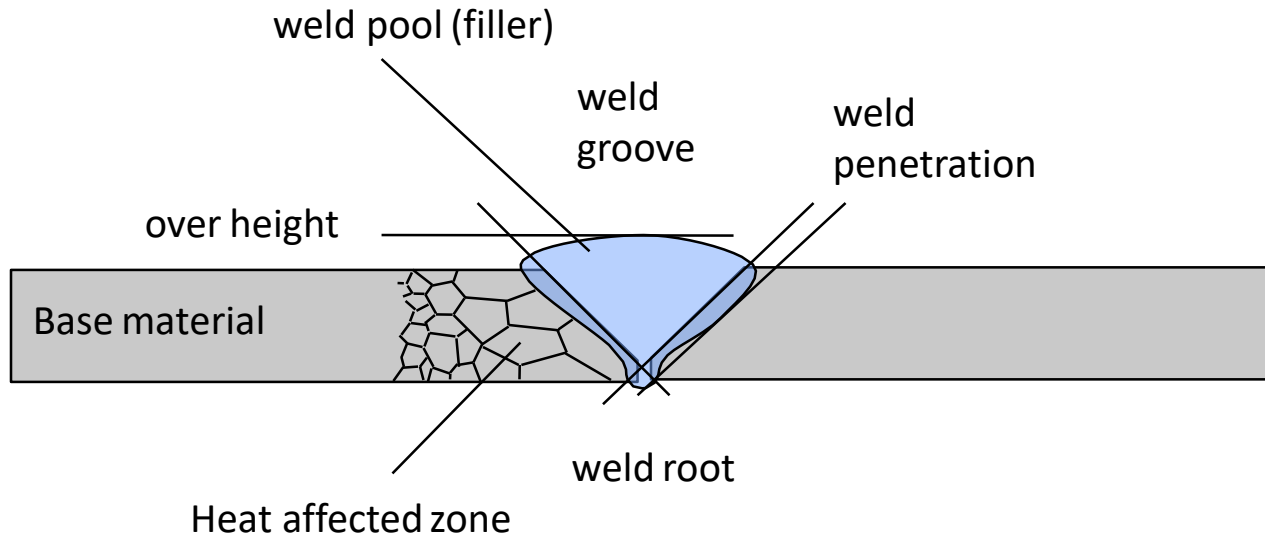
Liquid state

- Arc welding
 - Shielded electrode
 - MIG/MAG
 - TIG
 - Plasma
- Beam welding
 - Laser
 - Electron beam
- Resistance welding
- Thermo-chemical welding

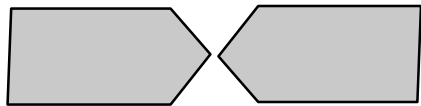
Soldering

- Soldering iron
- Vapor phase
- Wave
- Brazing
 - Immersion
 - Torch
 - Resistance
- HT-Brazing

A few technical terms in a weld



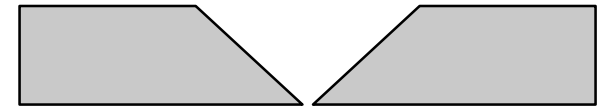
Groove Shapes



"X"





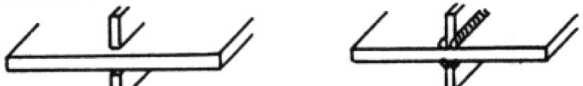

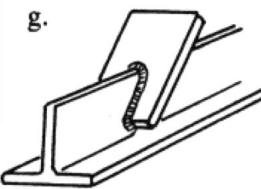
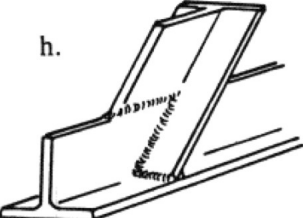


"Y"

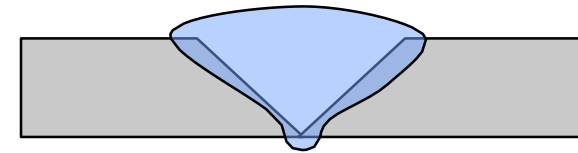


"V"

A few technical terms in a weld ctd.

Butt weld	
Overlap	
Angle	
T-weld	
Cross-weld	
Peripheral weld	
Peripheral fork weld	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>g.</p>  </div> <div style="text-align: center;"> <p>h.</p>  </div> </div>

Single-pass



Multi-pass

