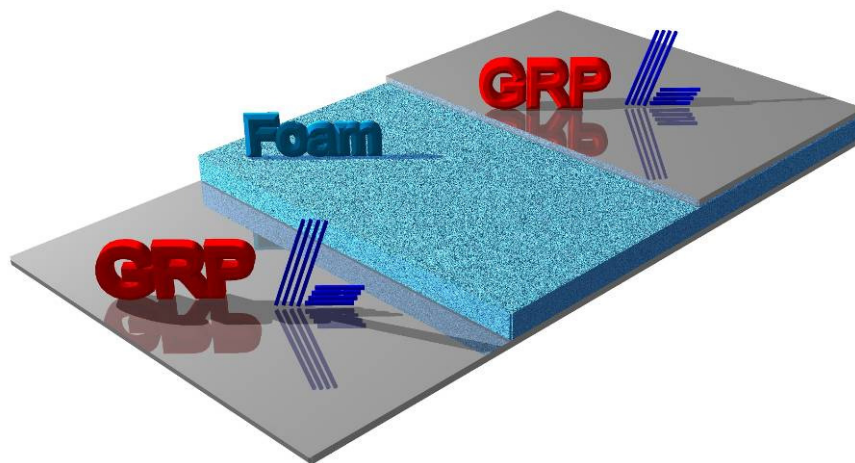




Ways of gluing GRP - Composite panels

Overview



- Storage and handling
- Required equipment
- Preparation before bonding
- Bonding (Vacuum, Hydraulic Press, Mechanical Press)
- Inspection of the bonding
- Problems and causes

Storage and Handling Instructions



- Storage
 - LAMILUX-products should be stored indoors at room temperature in a well ventilated, dry area, at least 48 hours before gluing
 - The coils should stand in a vertical position and may not lay flat.
 - If it is necessary to store products outside, they must be covered and protected from weather and sunlight exposure.

Storage and Handling Instructions



- Storage
 - The glue should be stored within 18 – 23 °C in order to achieve a good wetting
 - If wood or plywood is used in composite panels it must be stored at dry conditions and has to be dry for processing

Storage and Handling Instructions



- Storage time
 - Max. 6 months
 - The surface tension of corona treated products should be checked with test ink (> 38 Dyn/cm) before gluing at any time.



Required Equipment



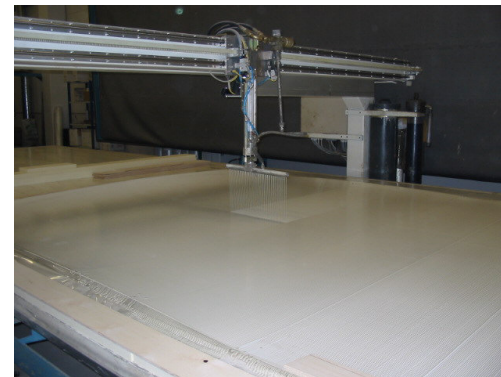
- Vacuum table
or
Sandwich-Press
(Mechanical / Hydraulic)
- 2K-PU-Glue
- Composite-materials



Required Equipment



- Application-System for the 2K-PU-Glue
 - mechanical per hand with applicator roll („Gupfo“)
 - automatical with injectorline or spray-coating
 - automatical with injectorline
 - eg. Barkvall engineering www.barkvall.com



Required Equipment

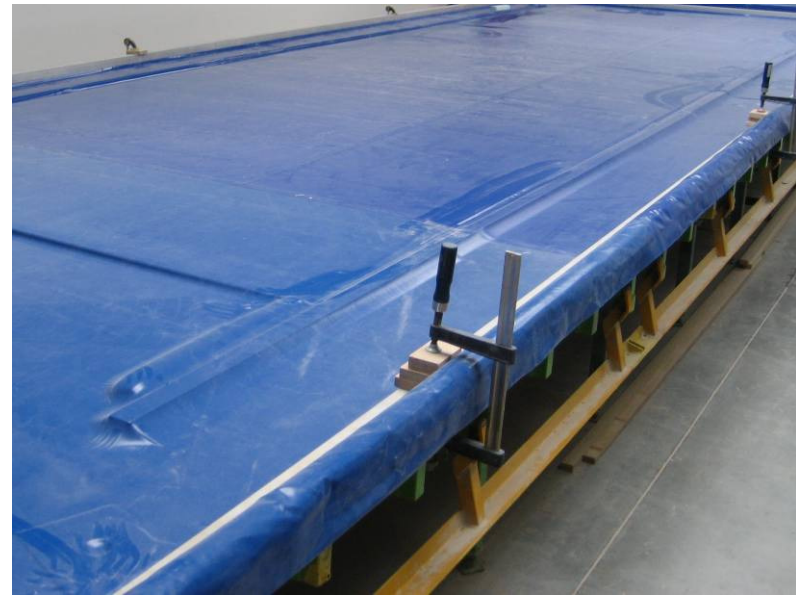


- requirements on the vacuum table
 - must have a flat and clean surface (it's advised to use floatglas or „marothaan“® selve levelling 2K-PU)
 - constant vacuum between 150 – 600 mbar
 - (app. 15 – 60 kN/m²)
 - eg. Leybold Vacuum
 - <http://www.oerlikon.com/vacuumservices/de/>
 - make sure that there is no silicon, grease or oil in the near of the vacuum table

Required Equipment



- example of a vacuum table



Required Equipment



- requirements on the sandwich-press
 - must have a flat and clean surface
(it's recommended to have heatable pressing tables)
 - constant pressing between 20 – 50 kN/m²
 - make sure that there is no silicon, grease or oil in the near of the pressing table
 - Supplier:
Wemhöner, <http://www.wemhoener.de/>
Dieffenbacher, <http://www.dieffenbacher.com/flash.html>
Italpresse, <http://www.italpresse-eng.com/>

Required Equipment



- requirements on the glue
 - 2K-PU-glue with a low viscosity and reactivity
 - long „open time“ and a short „conditioning time“
 - exact type depends on
 - the materials which should be bonded
 - the required processing-time
 - the mechanical and environmental demands
 - attention: for bonding it`s important to follow the manufacturers requirements listed in the relevant glue data sheet

Preparation before Bonding



- the GRP should be stored at least 48 hours at room temperature
- the glue should have a temperature between 18 and 23 °C
- control and clean the vacuum table the sandwich-press that it's free from scratches, dust, grease and oil

Preparation before Bonding



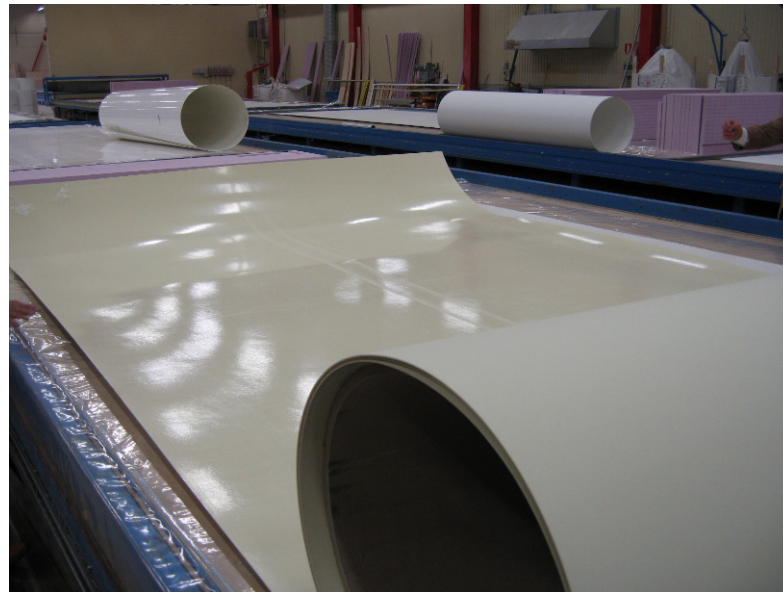
- vacuum clean the GRP and make sure that it's also free from dust, grease and oil (don't use solvents)
- check the surface energy of the corona treated GRP, that it's higher than 38 Dyn/cm with test ink



Bonding on Vacuum Table



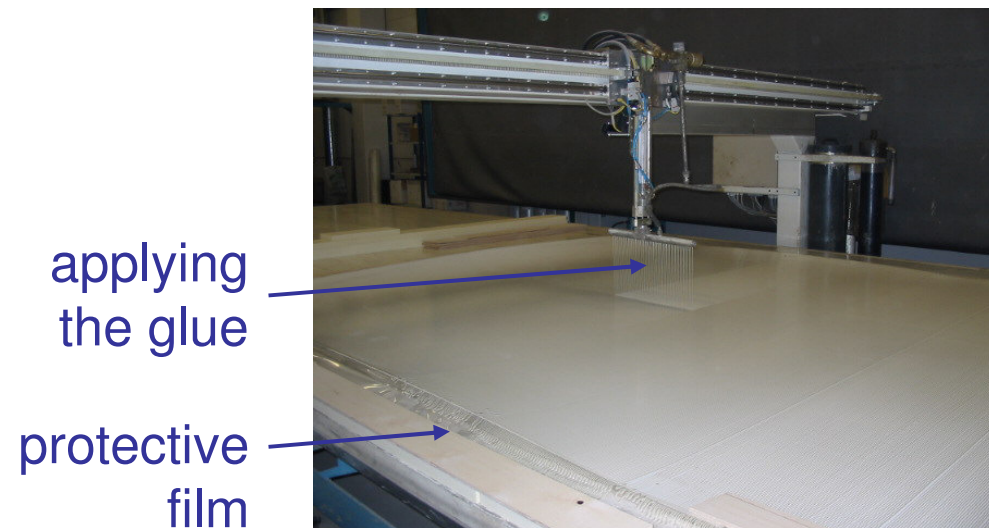
- now you are ready for start bonding (all production steps are carried out on the vacuum table)
- therefore put the GRP and the foam layer by layer in the right order on the top of each other (avoid asymmetric constructions)



Bonding on Vacuum Table



- and apply the 2K-PU glue evenly distributed and in a correct amount between all layers which should be bonded; according to manufacturers requirement of the relevant glue



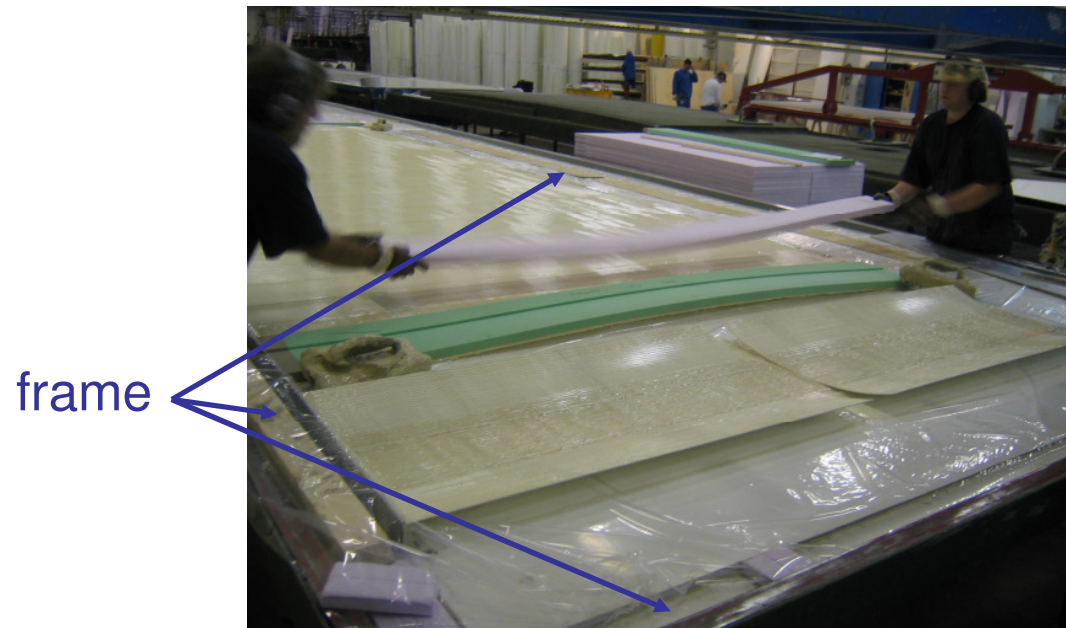
- attention: use a protective film on the vacuum table to catch excessive glue

Bonding on Vacuum Table



- if the sandwich is ready put a frame or piece of foam around it
- the frame should have the same height as the sandwich
- the frame prevents the foam from being compressed at the edges
- otherwise the edges would become round

Bonding on Vacuum Table



- finally cover the sandwich with the vacuum foil

Bonding on Vacuum Table



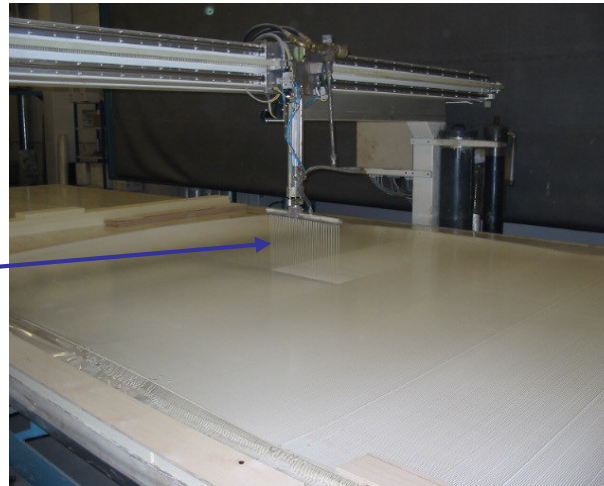
- now turn on the vacuum between 150 – 600 mbar (dependend on the sandwich)
- hold it constant, without loosing vacuum, until the glue reaches his handling-strength
- after reaching the handling-strength turn off the vacuum and remove the bonded composite panel from the vacuum table

Bonding on Hydraulic Sandwich Press



- therefore put the GRP and the foam layer by layer in the right order on the top of each other (avoid asymmetric constructions)
- and apply the 2K-PU glue evenly distributed and in a correct amount between all layers which should be bonded; according to manufacturers requirement of the relevant glue

applying
the glue



Bonding on Hydraulic Sandwich Press



- if the sandwich is ready, put it in the hydraulic press
- the tables of the presse should have a temperature between 32 and 35 °C
- now you are ready to turn the press on
(pressing between 20 – 50 kN/m², depending on the sandwich)
- hold the pressure for appr. 30 minutes

Bonding on Mechanical Sandwich Press



- therefore put the GRP and the foam layer by layer in the right order on the top of each other (avoid asymmetric constructions)
- and apply the 2K-PU glue evenly distributed and in a correct amount between all layers which should be bonded; according to manufacturers requirement of the relevant glue

Bonding on Mechanical Sandwich Press

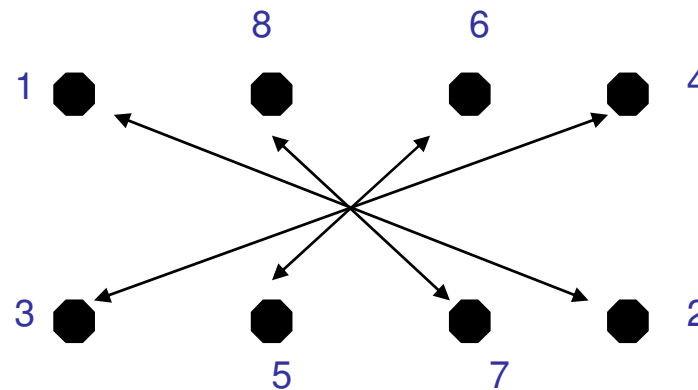


- if the sandwiches are ready, put them layer by layer in the mechanical press
- therefore be aware of the following points:
 - use a polyethylen foil between every sandwich-element
 - use wooden plates (thickness 30 – 40 mm) and foam after every 8 – 10 elements to have a good pressure distribution

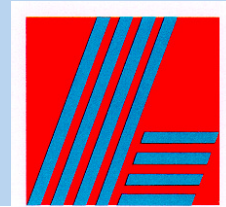
Bonding on Mechanical Sandwich Press



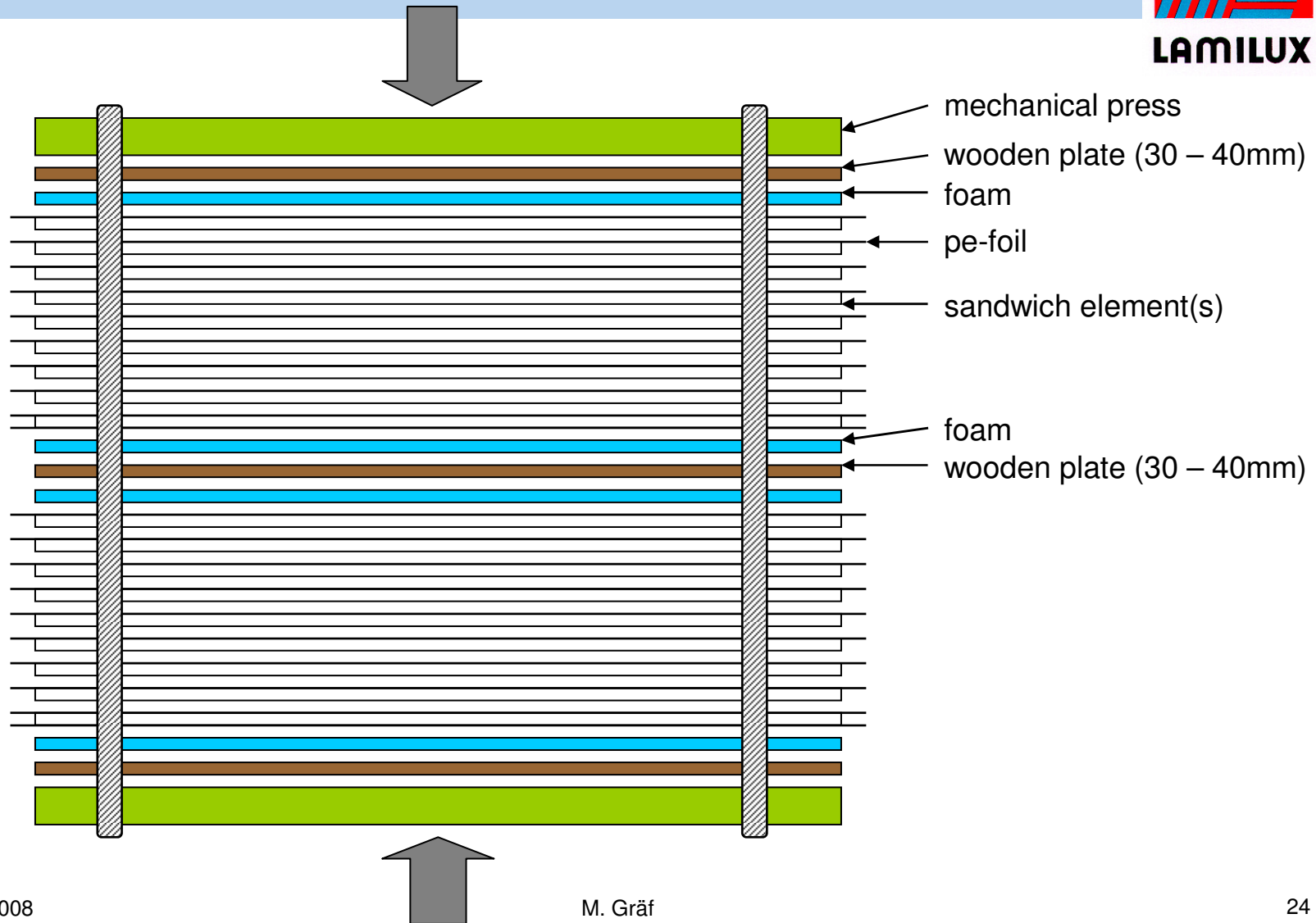
- if you fix the screw-clamps to build up the pressure on the sandwich-panels, do that always diagonal across
- start with screw 1 and go up to screw 8
- then repeat this procedure until you have the right pressure on the sandwich elements



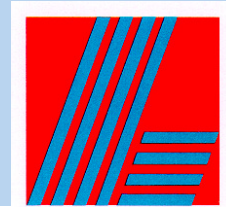
Bonding on Mechanical Sandwich Press



LAMILUX

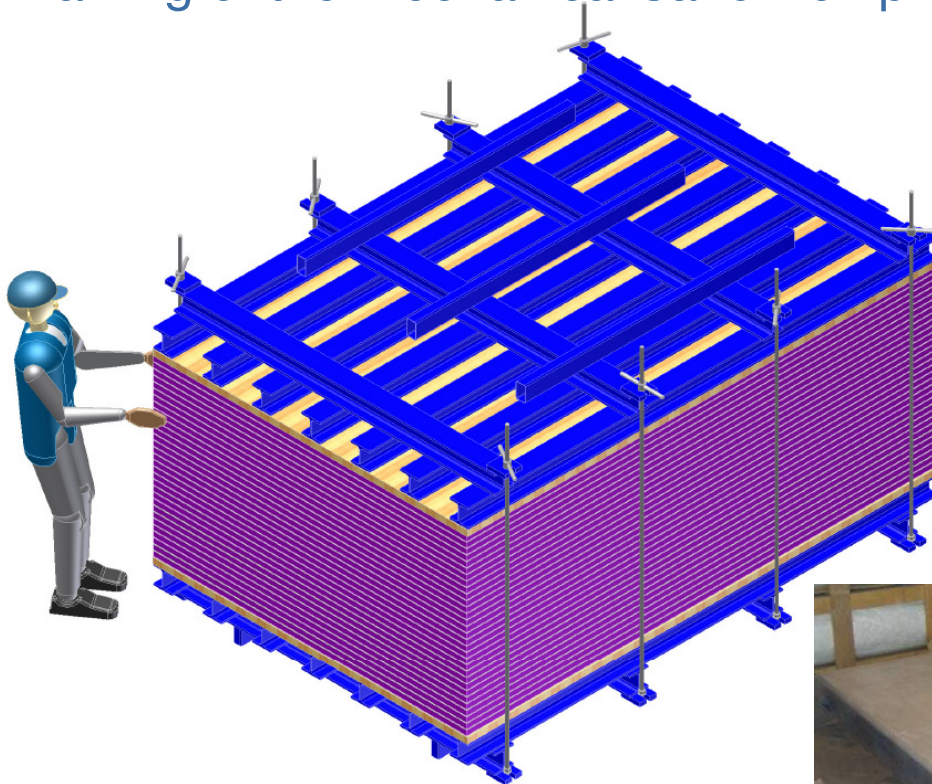


Bonding on Mechanical Sandwich Press



LAMILUX

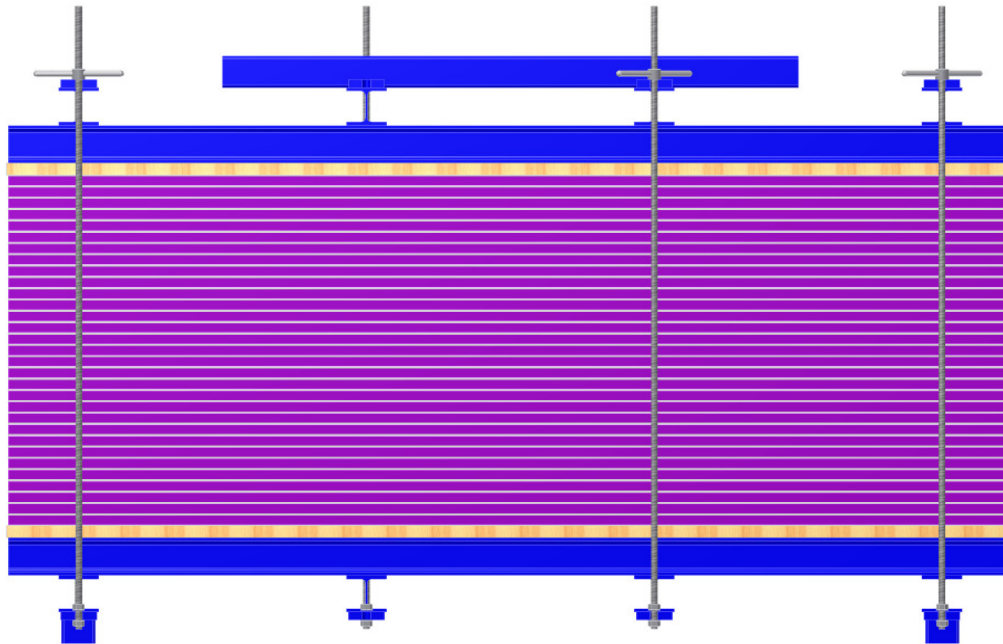
- Drawing of the mechanical sandwich press from LAMILUX



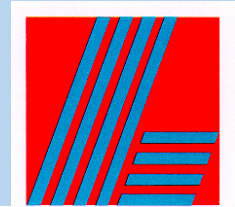
Bonding on Mechanical Sandwich Press



- Drawing of the mechanical sandwich press from LAMILUX

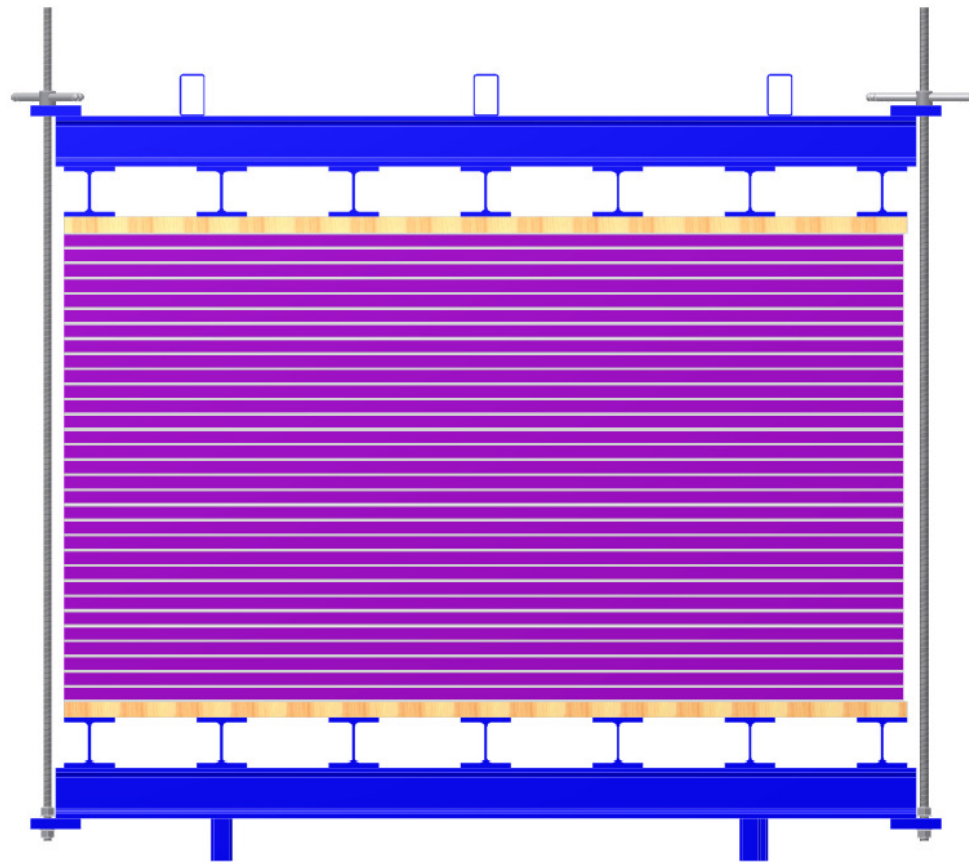


Bonding on Mechanical Sandwich Press



LAMILUX

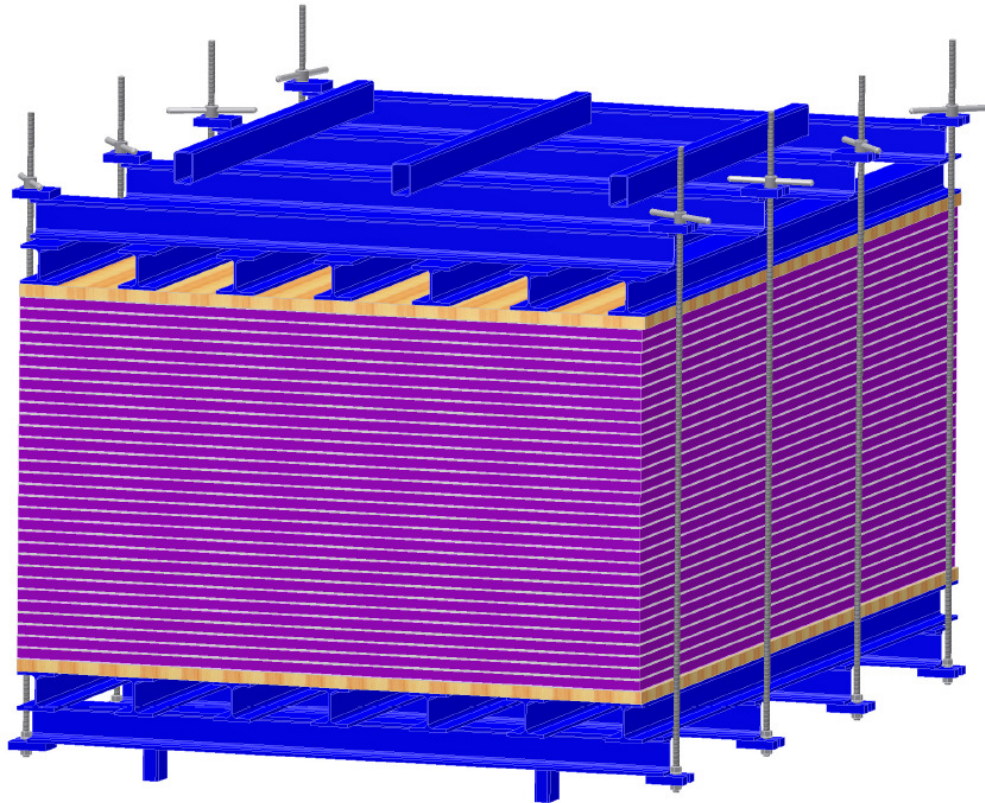
- Drawing of the mechanical sandwich press from LAMILUX



Bonding on Mechanical Sandwich Press



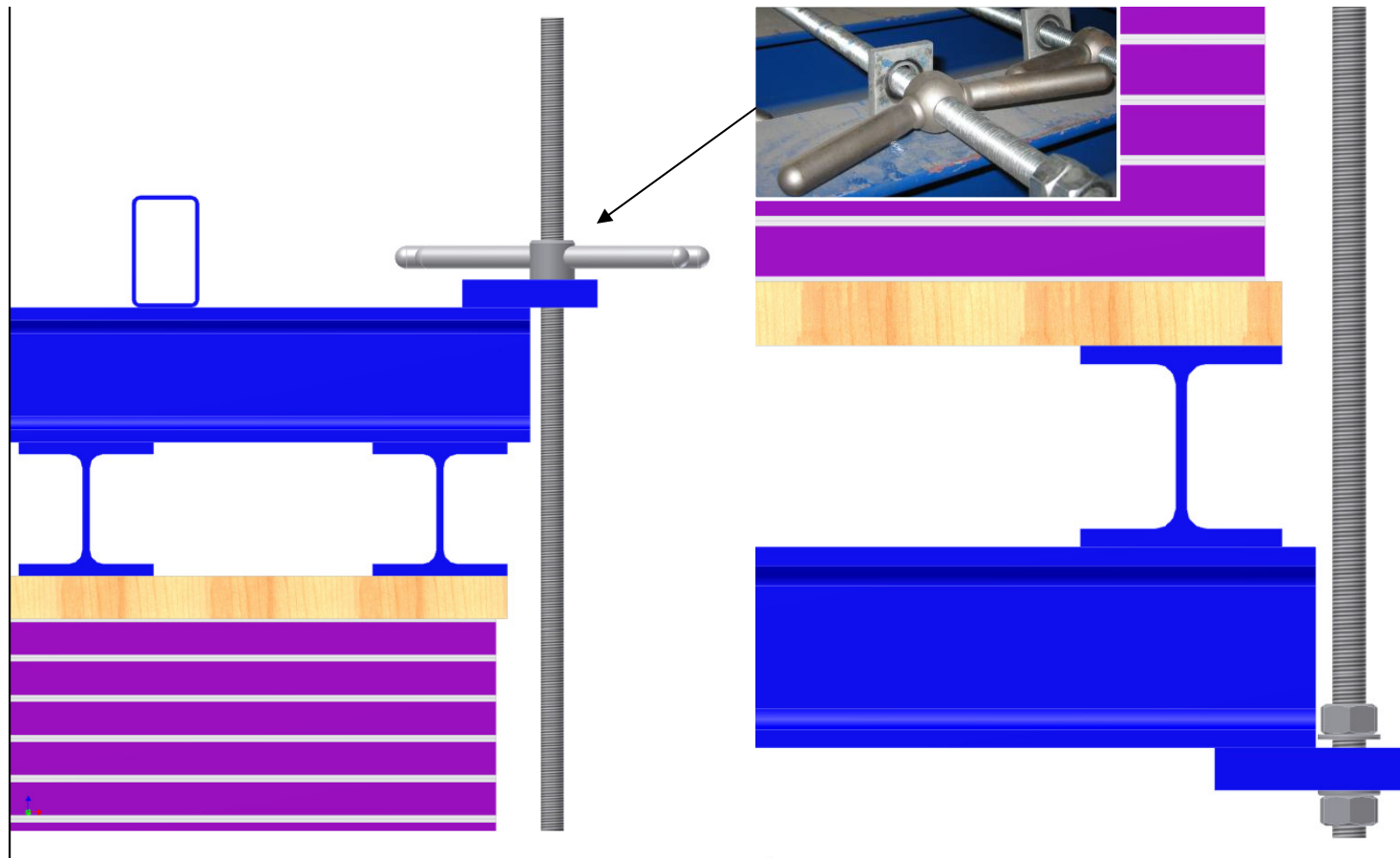
- Drawing of the mechanical sandwich press from LAMILUX



Bonding on Mechanical Sandwich Press



- Drawing of the mechanical sandwich press from LAMILUX



Bonding on Mechanical Sandwich Press



- Processing parameters:
 - Glue: Cosmopur 859 / Hardener 805
 - Amount: PU-Foam 200 – 250 g/m²
XPS-Foam 100 – 170 g/m²
 - Quantity: appr. 40 elements in one mechanical press
 - Pressing time: appr. 12 hours
 - Wooden plate: thickness appr. 30 – 40 mm
- the pressing time in the mechanical press with the glue listed above is appr. 12 hours

Inspection of the Bonding



- check the surface if it`s wavy
- check the adhesion between the bonded materials by trying to peel it away
- look at the glued joint if there are pores or holes in it
- inspect the edges towards edge-curling or edge-shrink

Inspection of the Bonding



- test the bonding under outside weathering conditions, for example:
 - storage under heat or cold ($-30\text{ }^{\circ}\text{C}$ up to $+80\text{ }^{\circ}\text{C}$)
 - or charging it with extreme sunlight or ultrared-light (surface temperatures up to $90\text{ }^{\circ}\text{C}$) if the material has a dark surface or dark graphics

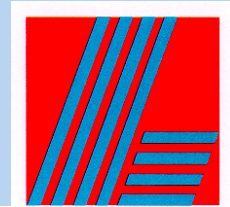


Problems and Causes



Problem:	Causes:
missing or low adhesion between the bonded materials	dust, grease or oil on the bonded surface; no even distribution or correct amount of the glue; incorrect mixing ratio of the 2K-PU-glue; wrong glue or <u>incorrect treatment of the 2K-PU-glue („open time“, „conditioning time“)</u>; wrong processing temperatures; incorrect vacuum; too minor surface energy  A photograph of a grey industrial mixing machine with a digital display and various control buttons. It is connected to hoses and has a mixing chamber at the bottom. The machine is labeled 'ProMix Easy'.

Problems and Causes



LAMILUX

Problem:

missing or low adhesion between
the bonded materials

Causes:

**dust, grease or oil on the bonded surface
(rubbed with acetone wetted tissue)**



Problems and Causes



Problem:

Waves in the surface

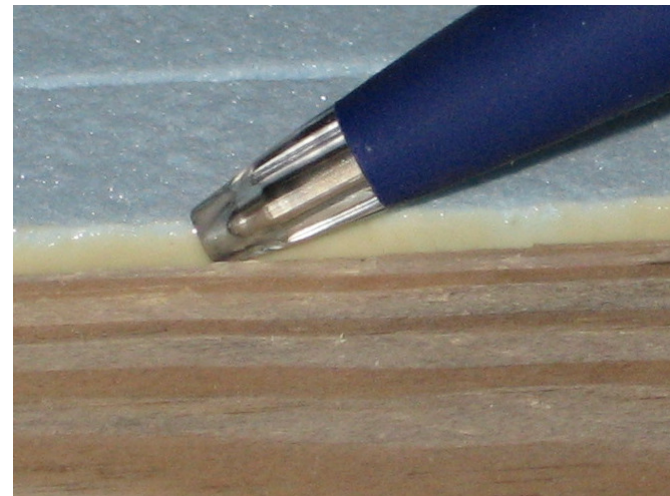
Bubbles

Uneven surface



Causes:

Varieties in the thickness of the core-material and the inserts or frames



Problems and Causes



Problem:

Waves in the surface

Bubbles

Uneven surface



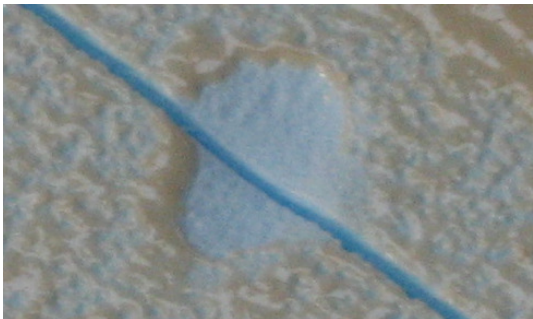
Causes:

Gaps between core-materials



Problems and Causes



Problem:	Causes:
Dents and bubbles in the sandwich-panel surface	Dents in the core-material Dust on the core surface 

Problems and Causes



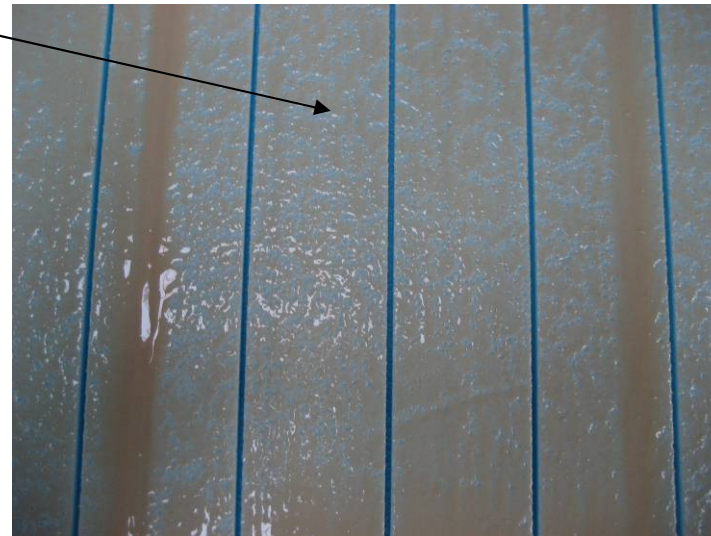
Problem:

Waviness in the panel surface
Bubbles (areas with too less glue!)



Causes:

Inconsistent glue layer thickness



Problems and Causes

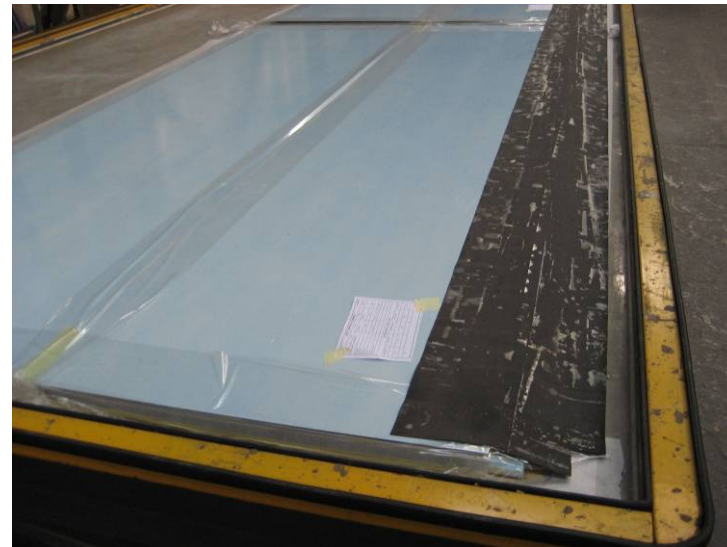


Problem:

rounded edges of the sandwich

Causes:

no frame around the sandwich on the vacuum table



Problems and Causes

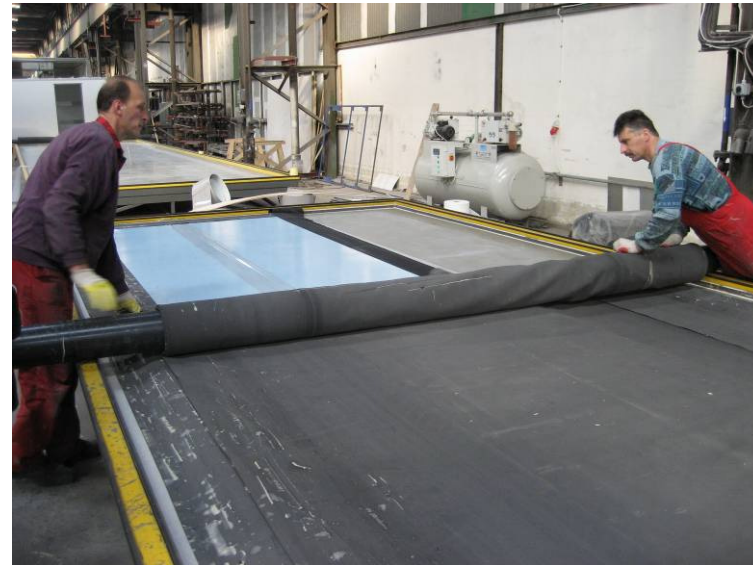


Problem:

Vacuum plaid (rubber membrane) is too flexible.

Causes:

Reduction of vacuum pressure



Problems and Causes



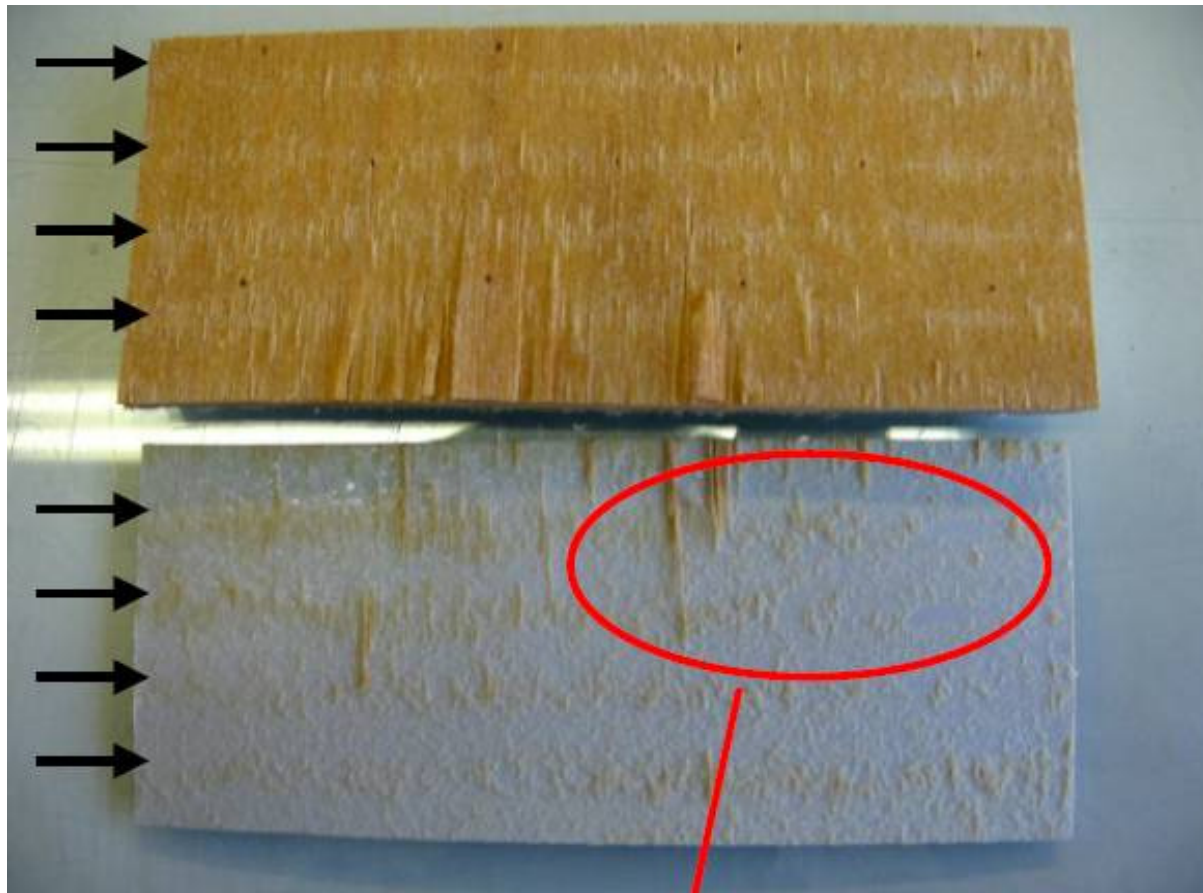
- example for bad glue-distribution



Problems and Causes



- example for bad adhesion and glue distribution



Problems and Causes



- example for dents in the surface

