FFU™ SINCE 1980

SEKISUI

FFU™ Synthetic Sleeper it works

Working guidelines

List of contents

Introduction

General

These working guidelines for FFU synthetic sleeper | railway technology serve to improve occupational safety when working on the project, and to optimise competent working by the experienced specialist.

All statutory regulations that are applicable to carrying out the work must be observed, especially those relating to the working of materials such as glass fibres.

All persons involved in handling FFU synthetic sleeper must read these working guidelines carefully before start to work, and observe them during working.

Material specification

Basic principles

FFU synthetic sleeper is made up of continuous glass fibers, which are soaked with polyurethane and then cured at an elevated temperature.

FFU synthetic sleeper can be machined or worked using the same methods and tools as those used for railway sleepers of natural wood.

Compared to natural wood, the following in particular must be heeded when machining FFU synthetic sleeper:

- FFU synthetic sleeper has greater hardness and strength than natural wood.
- The specific weight of FFU 74 is approx. 740kg/m^3.
- **To prevent the glass fibres in FFU synthetic sleeper from melting and tools becoming stuck, it is advisable to reduce the RPM as well as the feed rate of equipment adequately.**
- In the course of their work with FFU synthetic sleeper, **the workforce must take precautions against dust and fine particles**. **Wearing protective clothing (overalls, gloves, breathing masks, safety goggles etc.)** must ensure that **dust and fine particles are kept away from the body and respiratory passages**. All other persons must be a safe distance away or wear protective gear while work is in progress.
- FFU synthetic sleeper is a closed pore material. **Water and/or low temperatures can lead to a surface of the material posing a slip hazard**. Adequate safety precautions must be taken.
- It is only allowed to bring the load into the sleeper perpendicular to the laminate area and at no time parallel to that.

Slim tie:

When using 12cm height FFU slim ties at a railway track with 22.5 tonnes axle load, hard synthetic plate with 2 mm height (like Lupolen) must be used under the ripped baseplate.

Mechanical working

Drilling

Depth of bore hole:

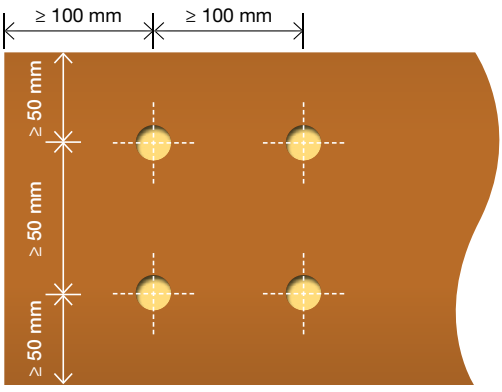
The bore hole for the screw in the FFU synthetic sleeper should **be at least 10 mm deeper** than the final penetration depth of the sleeper screw. We recommend the use of a drill stopper to maintain the correct bore hole depth. The very high proportion of glass fibre can result in rapid wear of machining tools.

Drill: must be suitable for metal materials or of WIDIA quality

Vacuum cleaner: Drillings are to be vacuumed out while the hole is being drilled. Once the hole is finished, it has to be cleaned.

Minimum distance of drill holes:

- From the beginning or the end of the sleeper it must be always bigger than 100 mm
- For glass fibers running in the longitudinal direction, the distance from hole centre to hole centre must be >= 100 mm
- For glass fibers running in the transverse direction, the distance from hole centre to hole centre must be >= 50 mm
- From the edge of the sleeper – it must be always bigger than 50 mm
  Furthermore minimum distance regulations for wooden sleepers must be followed



Bore hole diameters for sleeper screws

There needs to be a 4mm to max. 5 mm smaller than the screw diameter in the thread area.
For example, if the screw has a thread diameter of 24 mm, the drill hole needs to be a diameter of 19 or 20 mm.

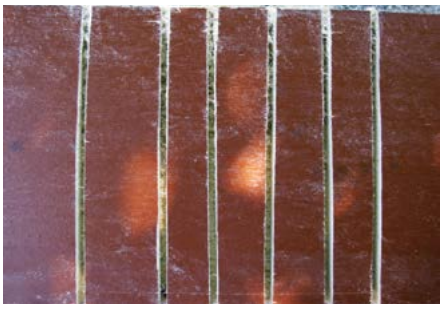
In order to avoid any surface cracks in the screw connection area, the drill hole has to expand to the thread diameter in the head area only.

Sawing

A significant number of glass fibers are in FFU synthetic sleeper. This means that when sawing or generally machining FFU synthetic sleeper, care must be taken to **ensure the fibres do not melt**, otherwise tools may become stuck.

Sawing, like drilling, should proceed **at a suitable RPM and lower tool feed rate** than for natural wood. Too high a temperature at the saw blade may result in it **sticking, due to melted glass fibres**.

We recommend the use of Widia circular saw blades with fine teeth for working glass fibre materials.



Grinding

The grinding machine must have a sealed collecting bag for the shavings. The abrasive paper must be suitable for working hard material. Temperature related melting of the glass fibre must be avoided.

Chiselling

The recess required, e.g. for the support area of a bridge girder, can be, among others, chiselled out. Saw cuts to the desired depth are made at the ends of the intended recess in the FFU synthetic sleeper.

The area to be chiselled out between these two cuts is then cut into strips of 2 to 5 cm wide.

The strips can now be chiselled out with a suitable caulking tool.

Finished recess E.g. support area of a bridge longitudinal girder

Milling

For milling FFU synthetic sleeper a machine that has a sealed bag to collect the milled material has to be used. The milling tool itself must be an extra hard milling disc for working hard material.

As with drilling and sawing, the milling speed must also be controlled so that the glass fibres do not melt at any time. Otherwise, the milling tool **may become totally stuck** and be rendered useless.

Repair of boreholes

Europe: Repair method using FFU™ 2C Quickfiller

For the filling and repairing of boreholes in FFU synthetic sleeper only

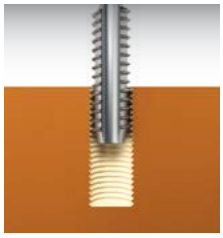
The Sekisui FFU™ 2C Quickfiller system is a 2-component reaction resin system based on polyester resin in a mixing ratio of 10:1. The two components are packed separately in a 410 ml 2-component plastic cartridge and dispensed under pressure via the attached static mixer using a cartridge applicator gun. The static mixer which is designed to achieve complete mixing of the product; no additional mixing is required to be carried out by the user. The Sekisui FFU™ 2C Quickfiller repair system is used to repair incorrectly drilled holes for the insertion of sleeper screws in Sekisui FFU synthetic sleeper. It does this by completely filling the incorrectly drilled hole with mortar so as to enable the sleeper screw to be reinserted correctly (this can also occur in the immediate vicinity of the repaired hole). Once the temperature-dependent curing time has elapsed, the repair system is fully operational and the sleeper screw can be inserted.

Temperature (subsurface)	Processing time	Minimum curing time
+ 5 °C to + 9 °C	25 mins	120 mins
+ 10 °C to + 14 °C	20 mins	90 mins
+ 15 °C to + 19 °C	15 mins	60 mins
+ 20 °C to + 24 °C	6 mins	30 mins
+ 25 °C to + 34 °C	4 mins	20 mins
+ 35 °C to + 40 °C	2 mins	15 mins
Cartridge temperature during processing	+5°C to +40°C	

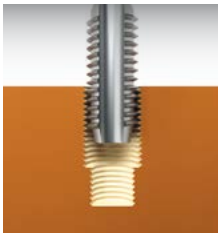
Storage temperature: +5°C to +25°C Minimum shelf life: 18 months

Old and new boreholes in the same place or overlapping.

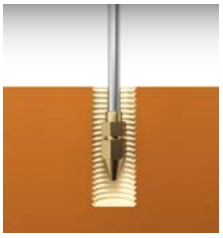
If the repair is to be carried out solely using FFU™ 2C Quickfiller in accordance with the work steps shown below, the drill hole repaired in this way can be processed like regular FFU synthetic sleeper following a curing time of 15 minutes.



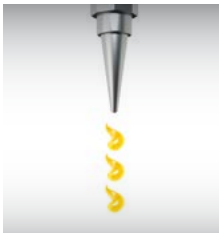
Profiling
Prior to the repair, the borehole wall is profiled for the safe insertion of Sekusui FFC 2C Quickfiller and FFU sleeper using a screw thread. The profiling can be carried out with a tap or sleeper screw



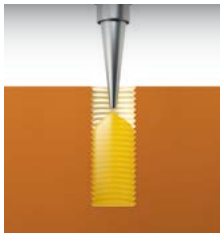
Expansion of damaged or worn-out boreholes
Boreholes that are worn out in the course of ongoing operation must be expanded / drilled open for repair using a profiling tool such that the newly profiled borehole Is situated entirely in fully functional FFU material.



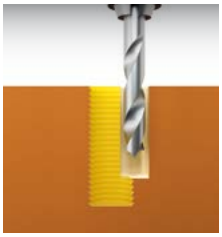
Cleaning
The borehole is to be cleaned after profiling using (e.g.) pressurised air.



Activation – 3 full actuations
The mixer is screwed onto the cartridge. The complete mixing of the Sekisui FFU 2C Quickfiller is achieved by performing 3 full actuations (approx. 10 cm). The tip is then inserted into the borehole.



Filling of borehole
The borehole is filled from the bottom to the top using Quickfiller, whereby cavities must be avoided. Excess material can be removed once filling is complete. After curing, removal must be carried out mechanically.



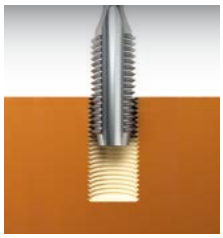
Boring
The new borehole can now be drilled in the correct position.

Insertion of screw
The screw is screwed into the new borehole.

Repair method using FFU dowel and resin

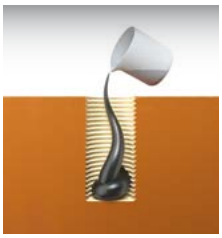
Old and new boreholes are not in the same place/not overlapping

If the repair is carried out using a FFU dowel and resin in accordance with the work steps shown below, the borehole being repaired can be processed like regular FFU synthetic sleeper following a minimum **curing time of 4 hours.**

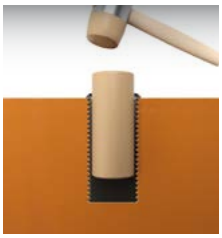


Expansion of damaged or worn-out boreholes
Boreholes that are worn out in the course of ongoing operation must be expanded / drilled open for repair using a profiling tool such that the newly profiled borehole Is situated entirely in fully functional FFU material.

Cleaning
The borehole is to be cleaned after profiling using (e.g.) pressurised air.



Pouring of synthetic resin
The synthetic resin is mixed and prepared in sufficient quantity directly before being poured into the prepared borehole. The quantity should be chosen such that excess synthetic resin is pushed out of the opening when the FFU dowel is inserted



Insertion of FFU dowel
The prepared borehole is sealed through complete insertion of the FFU synthetic sleeper.

Drilling of new borehole
The new borehole is drilled in the correct position.

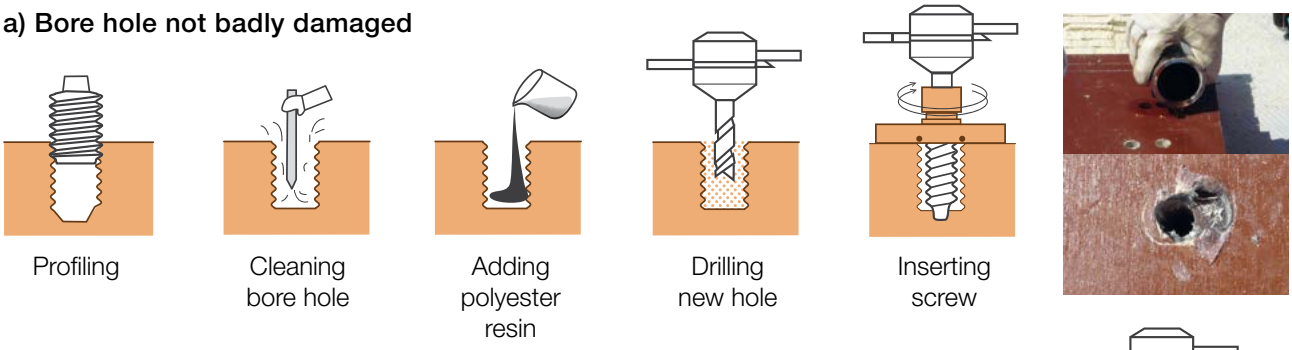
Insertion of screw
The screw is screwed into the new borehole.

Asian-Pacific: Repair method using polyester resin

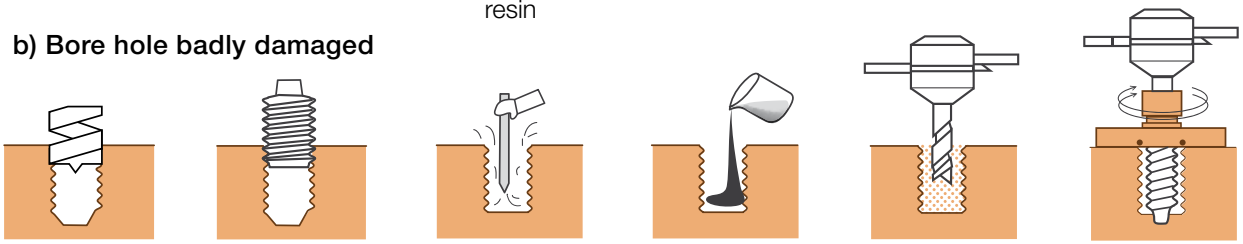
Old and new bore hole at the same spot or overlapping

If polyester resin is used for repair, as shown in the work steps below, the repaired bore hole can be worked at the earliest **after a curing time of 30 minutes, similar to FFU synthetic sleeper.**

a) Bore hole not badly damaged



b) Bore hole badly damaged

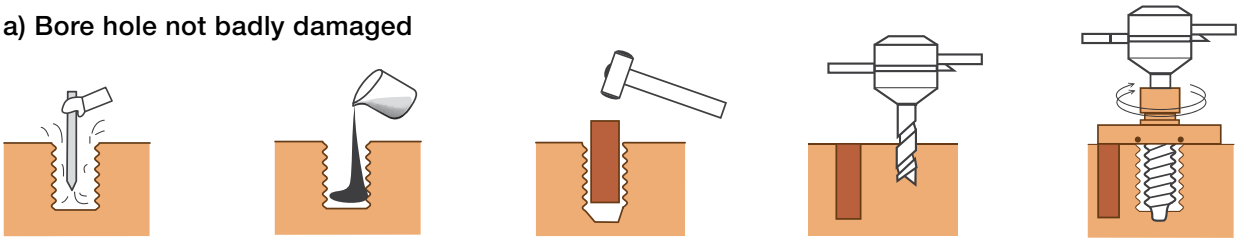


Repair method with FFU dowel and resin

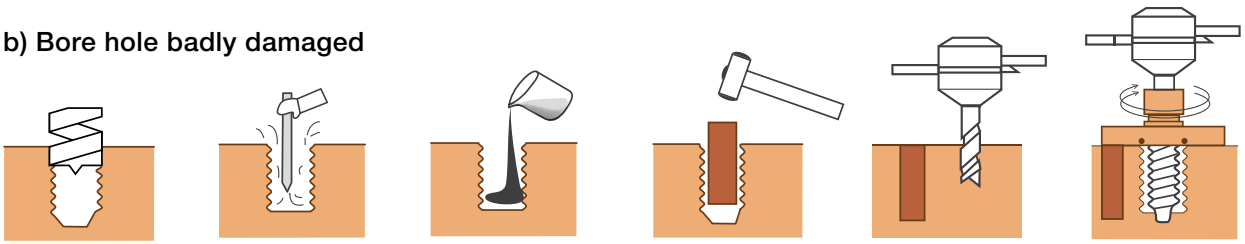
Old and new bore hole is not at the same spot or overlapping

If FFU dowel and resin are used for repair, as shown below in the work steps, then, as with FFU synthetic sleeper, the repaired hole can be worked at the earliest **after a curing time of 4 hours**.

a) Bore hole not badly damaged



b) Bore hole badly damaged



Handling of Polyester Resin

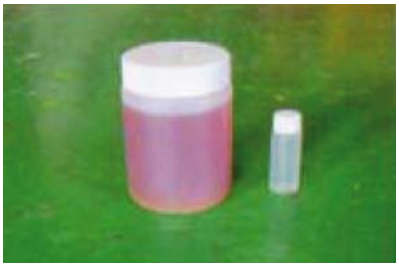
Polyester resin suitable for making repairs to FFU synthetic sleeper, e.g. in the eventuality of bore holes not made at the correct spot, damaged bore holes, damage that has arisen and remedying old damaged spots.

In isolated cases, repair work to FFU synthetic sleeper using polyester resin can be carried out under boundary conditions with **low** humidity.

Due to the **very short shelf life** of polyester resin, the materials are supplied **for special orders!**

Preparation required

- Polyester resin (base + hardener)
- Plastic measuring cup - clean
- Stirring sticks - clean
- Cleaning cloth



Pour base (300 g)
Hardener (6 g)

Mixing

Pour base (white 300g) into a suitable clean mixing vessel.
Add the hardener and stir straight away.
This mix can be used once only.

Precautions when handling polyester resin

- Keep the polyester resin and its components safely out of reach of children.
- Keep the polyester resin and its components safely away from fire.
- Handling or working polyester resin or its components **near naked flames or heat** is forbidden.
- Immediate medical assistance must be sought if polyester resin or its components are swallowed by mistake.
- Safety goggles must be worn when working with polyester resin or its components.
- Should polyester resin or its components get into the eyes, **flush out with clean water immediately** and seek medical assistance straight away.
- Rubber gloves must be worn when working with polyester resin or its components.
- Immediate medical assistance must be sought if the skin exhibits a rash or other changes.
- Protective clothing badly soiled with synthetic resin or its components must be cleaned with a cloth.
- The polyester resin mix produced must be used up in a single work operation (one use only).
- Please order the polyester resin components only in the quantities needed since they can only be stored for approx. one month.

Fire Prevention

Inspections:

Spontaneous combustion pursuant to ISO 871: 530°C
Fire classification pursuant to ISO 11925-2, ISO 9239-1 and DIN EN 13501-1: B1 flame retardant, self-extinguishing
Fumes pursuant to ISO 5659-02 and DIN 5510-2: FED 0.5

Welds:

If the sleeper ignites during welding, the welding materials must be removed from the sleeper and/or the sleeper bay. The sleeper can subsequently be covered with sand.

Heating, neutralising the rail:

The flash point is 450°C. If the sleeper should ignite during the heating or neutralising of the rails, the sleeper will self-extinguish as soon as the energy source is removed.

Actions to be taken in the event of a fire:

If materials such as welds should ignite on the sleeper, as much of the material as possible must be removed before extinguishing operations begin. Then, traditional extinguishing agents: sand, CO_2 or water may be used.

Exposure assessment during processing activities of FFU™ synthetic sleeper

This investigation shows values that apply for processing without protective equipment.
For this reason, this section is only for your information in respect of safe working with FFU in compliance with the legal regulations.

Compliance with the specifications in this processing guideline, with respect to the wearing of protective equipment, is mandatory irrespective of this information.

No.	Component	Inhalable dust		Respirable dust		Isocyanates		Glass fibres	
	Scenario	A	B	A	B	B	B	A	B
2	Drilling	0.2 / 0.2	< 0.1	0.2 / 0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
3	Drilling / vacuuming	0.2 / 0.2	< 0.1	0.2 / 0,2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
4/5	Sawing-chainsaw	0.8 / 0.9	0.2 / 0.2	1.1 / 0.9	0.3 / 0.2	< 0.1	< 0.1	< 0.1	< 0.1
6	Electric planer	4 / 5	1 / 1.2	1.3 / 1.1	0.3 / 0.3	< 0.1	< 0.1	0.4	< 0.1
7	Electric planer / vacuuming	0.8 / 1	0.2 / 0.2	0.8 / 0.6	0.2 / 0.2	< 0.1	< 0.1	0.2	< 0.1
8A	Belt sander	2 / 2.5	0.5 / 0.6	1.3 / 1.1	0.3 / 0.3	< 0.1	< 0.1	< 0.1	< 0.1
8B	Manual sanding	0.2 / 0.3	< 0.1	0.2 / 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

Table: The exceedance factor of measurement results of inhalable/respirable dust, isocyanates and respirable glass fibres compared with relevant OELVs.

Exceedance factor is the analysis result divided by the OEL V; a value above 1 means that the OELV is exceeded and in general a value under 1 means compliance with the OELV. However, when comparing results also measurement uncertainty has to be taken into account. For example: exceedance factor is 0.8 but uncertainty is 30% then still exceedance is possible, because maximum exceedance factor could be 0.8 + (0.8 x 30%) = 1.04. Therefore both measurement results that exceed the OELV or may exceed the OEL V when measurement uncertainty is taken into account are presented underlined.

- Scenario A: continued activity for 8 hours (worst case - not realistic situation)
- Scenario B: 15 minutes of activity every hour (realistic situation)
- Green colour: compliance with the OELV
- Grey colour: non-compliance with at least one of the OELVs (AGS or DFG)
- First number: exceedance factor compared with the limit values defined by the German AGS
- Second number: exceedance factor compared with the limit values defined by the German DFG.

Conclusions and recommendations

In order to gain effective insight into the exposure risks during processing activities (drilling, sawing, planing and sanding) of FFU synthetic sleeper, „worst case“ measurements have been performed on respirable and inhalable dust, respirable glass fibres and fibre fragments and diisocyanates including thermal degradation products. An indicative occupational exposure assessment has been performed by comparing „worst case” results with relevant OELVs with two task-based scenarios: continued activity for 8 hours and every hour 15 minutes of activity. The following conclusions can be made:

- For all processing activities, the exposure to respirable glass fibres, diisocyanates and thermal degradation products remain well below OELVs for all task-based scenarios.
- For **drilling** and **manual sanding**, the exposure to respirable and inhalable dust remain well below OELVs, for all task-based scenarios.
- For **sawing with a chainsaw** exposure to respirable and inhalable dust may exceed OEL Vs when tasks are carried out in an almost continuous manner for 8 hours. For task-based scenarios where tasks are performed less than 60% of the time (> 5 hours per day), compliance with OELVs is expected.
- For **sanding with a belt sander** exposure to respirable and inhalable dust may exceed OEL Vs when tasks are carried out more than 30% of the time (>2.5 hours per day). When applying a belt sander emission reduction measures such as vacuuming can be used to lower the exposure. When applying vacuuming it is expected that OELVs are no longer exceeded, even when tasks are carried out in a continuous manner for 8 hours.
- **Electric planing** generates the mast dust. Without emission reduction measures, such as vacuuming, for task-based scenarios where tasks are performed more than 10% of the time (> 1 hour per day), OELVs may be exceeded. When electric planing is performed with a low capacity vacuum cleaner, already a reduction in exposure is achieved by a factor 2 - 5 for respirable respectively inhalable dust. With a high capacity vacuum cleaner, it is expected that OEL Vs are no longer exceeded, even when tasks are carried out in a continuous manner for 8 hours.

A similar study performed by TNO during different processing activities with hardwood shows that in general concentrations of inhalable dust during processing activities with FFU synthetic sleeper are lower than during activities with hardwood.

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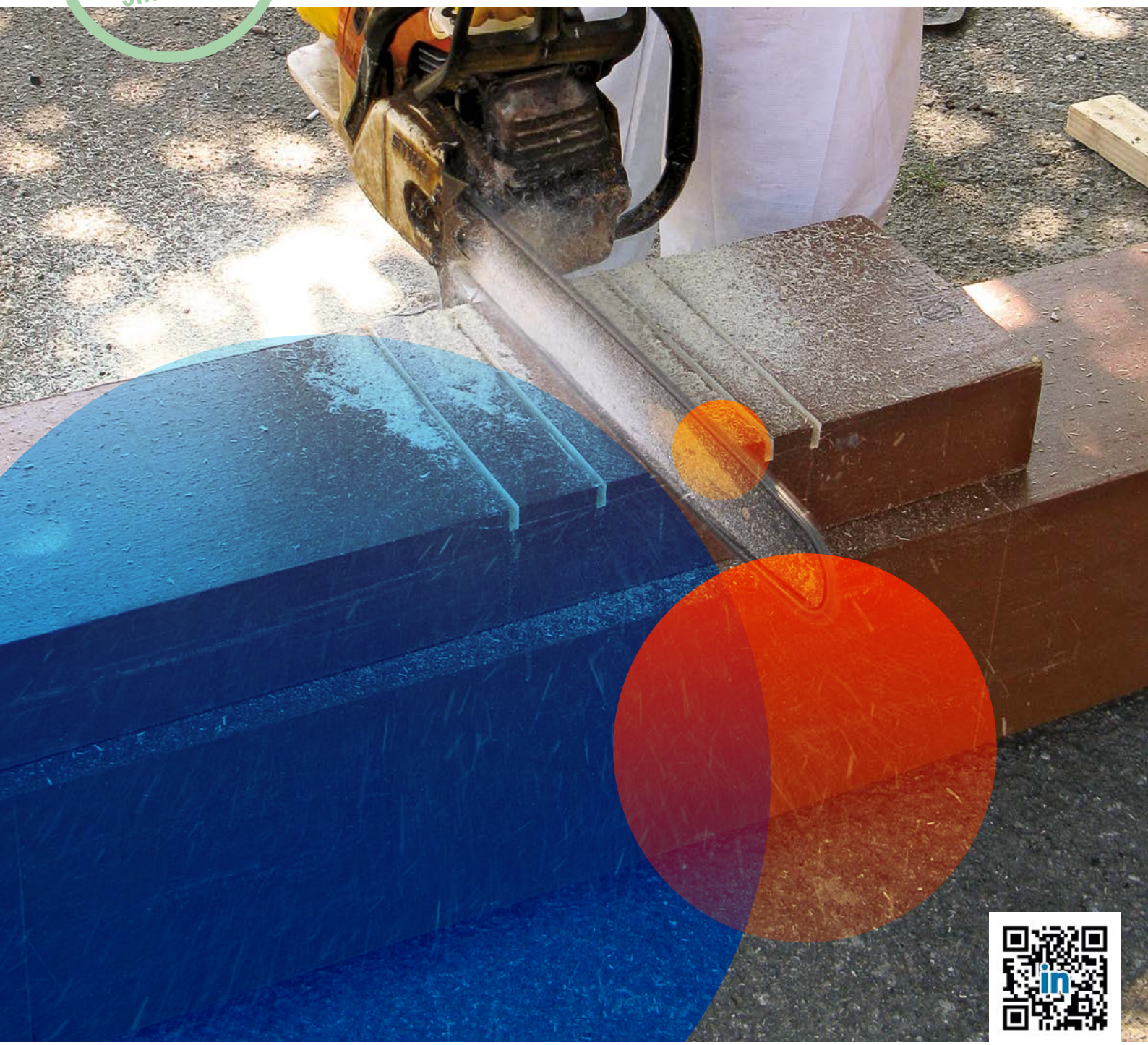

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