

**Two-scale modelling of composite 'steel-reinforced resin' interaction (INTERMOD)
Towards reusable and demountable structures & infrastructure**

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Two-scale modelling of composite 'steel-reinforced resin' interaction (INTERMOD)

Towards reusable and demountable structures & infrastructure

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Introduction

Steel-concrete composite beams are widely used in practice because of the **simple** construction sequence and the **economic** cross-section design. The application of welded headed studs in composite beams prevents the **non-destructive separation** of the composite beam, which leads to a very low scoring in the **sustainability assessment** in terms of the reuse of **structural components**. A **demountable** connection between the steel beam and concrete deck must be made to allow for **reusability** and **adaptability** of the structure, which maximizes its **functional lifetime** and minimizes its **environmental footprint**.

Traditional connection. Concrete deck and steel beam are **inseparable**. **Low sustainability** score as **reusability** and **adaptability** of the structure are impossible

Designing for reuse

A key condition for a reusable structure is that **assembly** and **disassembly** is easy, quick and possible under **all circumstances**. Therefore, **tolerances** and geometrical **deviations** are taken into account through **oversize** holes in the beam flange. After installation of the **external bolt**, the remaining bolt-to-hole clearance is **injected** with a (**steel-reinforced**) epoxy **resin** to obtain composite **interaction**. This process has been successfully tested under laboratory conditions.

Steel-reinforced resin

The **static**, fatigue and **time-dependent** properties of epoxy resins can be **enhanced** by reinforcing them with **steel particles**. A hybrid **homogenization method** was developed to model the static behaviour of steel-reinforced resins. The **Young's Moduli** of steel-reinforced resins **2.8-3.0 times higher** compared to the resin itself. Apart from traditional structures, steel-reinforced resin can also be applied in steel railway and highway **bridges** to obtain a **slip- and fatigue-resistant** connection between various members.

Conclusion

Steel-reinforced epoxy resins play an **instrumental** role in designing **demountable** and **reusable** structures, and offer a **stiff and reliable** connection. The demountability and reusability leads to a **lower environmental footprint** through a longer **functional lifetime** of the structure.

Component test on a bolt in an oversize hole injected with steel-reinforced epoxy resin. The resin is fully intact after fracture of the bolt.

