

Structural performance of heavy duty composite railway sleeper



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Introduction

- Heavy duty mono-block prestressed concrete sleeper currently suffers from rail-seat deterioration and unexpected cracking due to chemical attack.
- Early failure of sleeper increases the track maintenance cost.
- The production of cement for infrastructure (e.g., concrete sleeper) contributes to more than 5% of global carbon dioxide emission.
- Composites are now an emerging materials because they are environmentally friendly, have high strength and good resistance to chemical attack.



Fig. 1: Environmental and durability issues

Are composite materials a suitable alternative for heavy duty railway sleeper application?

Objective

- To investigate the performance of sandwich composites coated with polymer concrete and determine their suitability for heavy duty sleeper application.

Materials and method

Composite railway sleeper concept



Fig. 2: Composite sleeper concept

Optimization

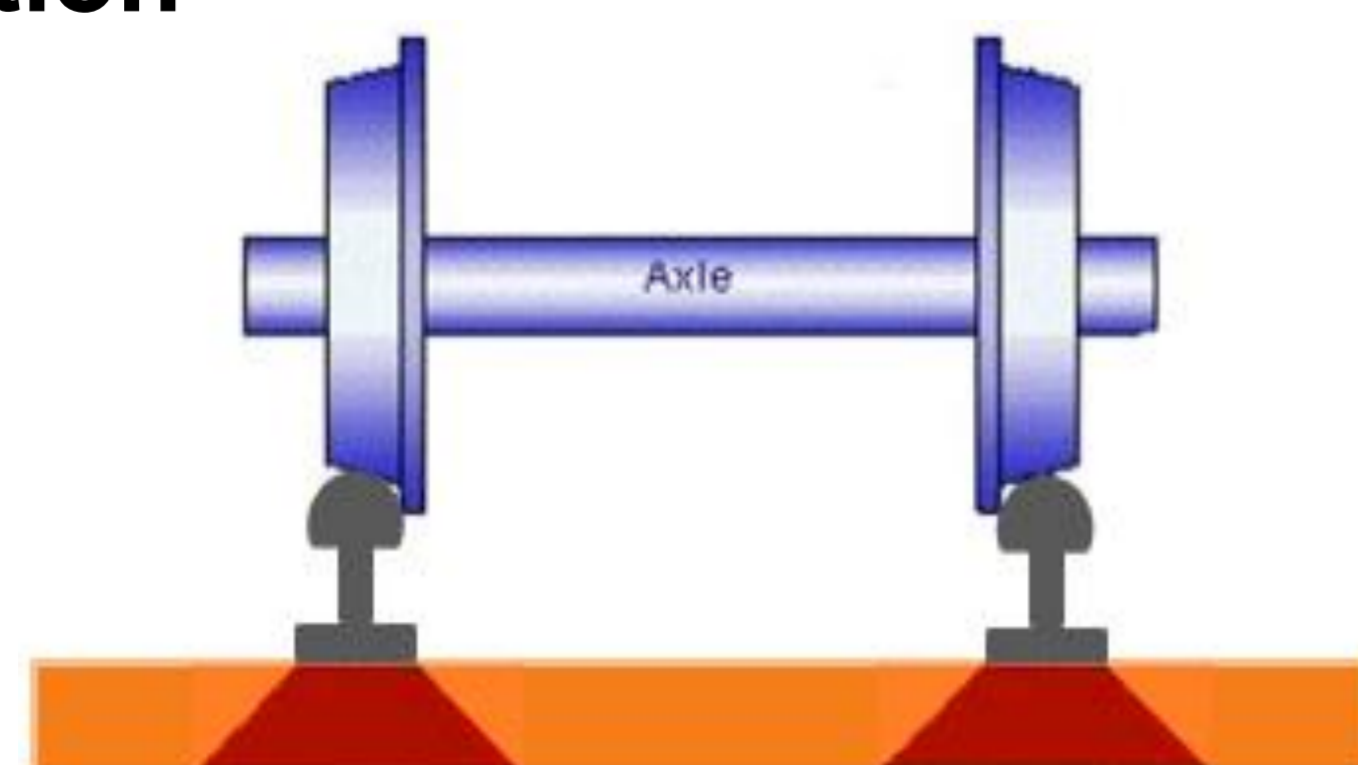


Fig. 3: Load distribution

Analysis and results

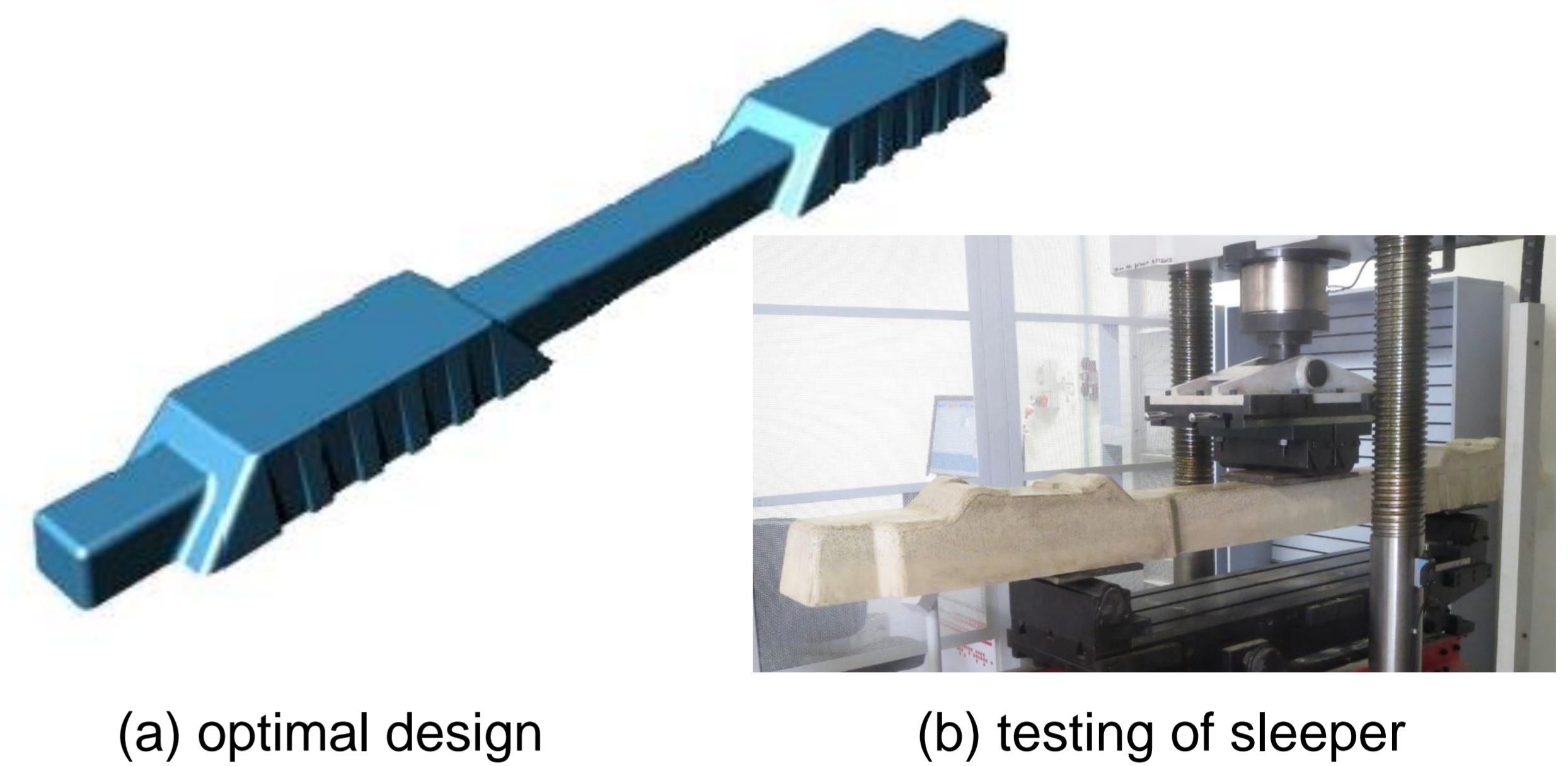


Fig. 4: Optimised composite sleeper

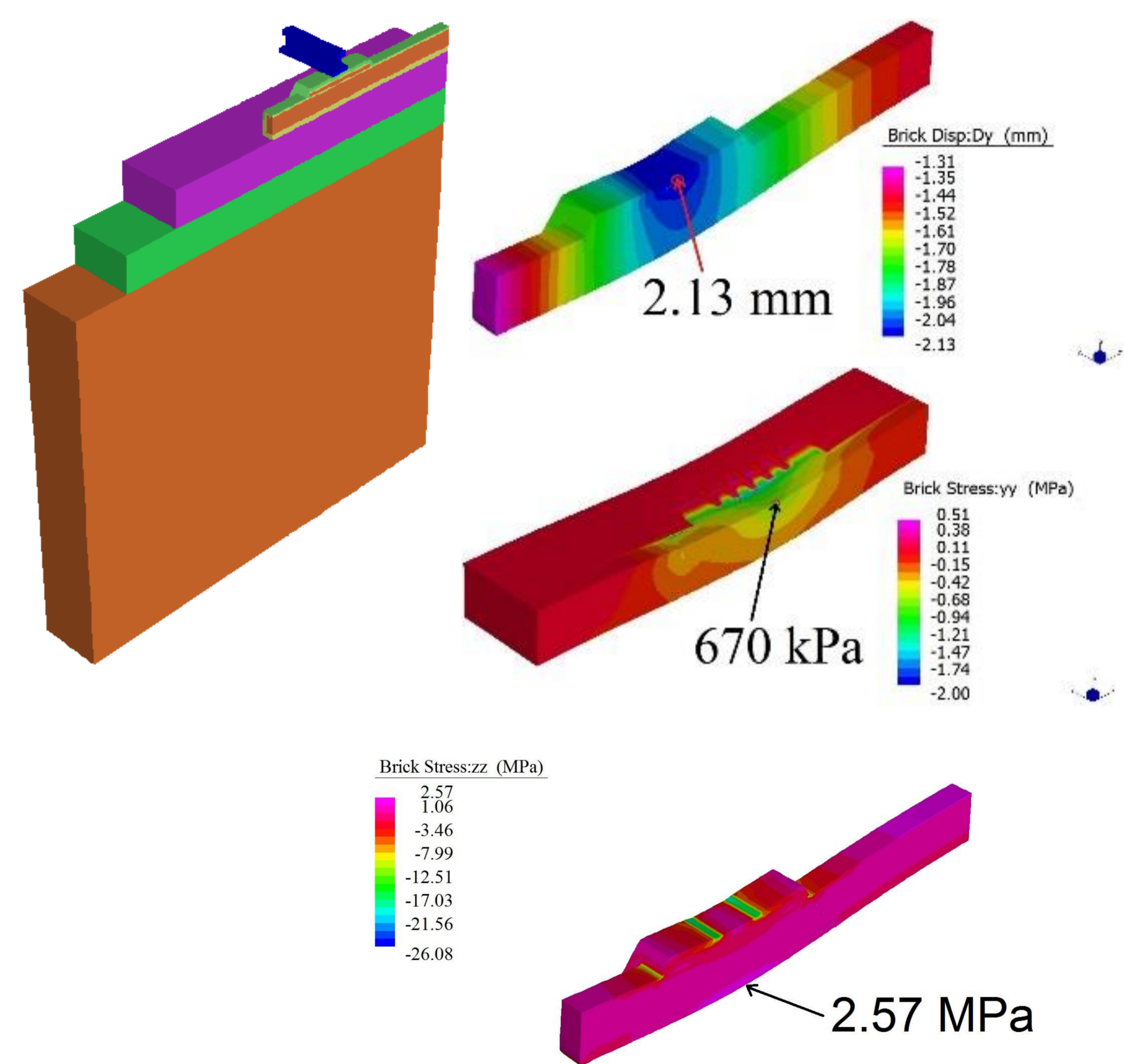


Fig. 5: Composite sleeper on high stiffness support foundation

Table 1: Performance of composite sleeper

Parameters	Results	Allowable limits
Deflection of sleeper, (mm)	2.13	6.35
Sleeper-ballast contact pressure, (kPa)	670	750
Tensile bending stress, (MPa)	2.57	5.5

Conclusions

- Optimal composite sleeper design reduces approximately two-third volume of material usage.
- Structural performance of composite sleeper complies with the design requirements for heavy duty railway sleeper.

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