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Editorial

International Journal of Physical Modelling in Geotechnics

Editorial: Physical modelling in the service of a more sustainable geotechnics

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My own work sits largely in offshore geotechnics, where physical modelling has long been indispensable, so I will admit to a particular delight in this issue: seeing the same experimental thinking put to work across such different corners of our field. There is a quiet shift underway in what we ask our centrifuges, shaking tables and model containers to do. For decades, physical modelling earned its place by answering questions that analysis alone could not, capturing the stress-dependent, non-linear behaviour of soil at realistic effective stresses, and validating the numerical tools on which modern design depends. That role has not diminished. But increasingly, the questions themselves are being reframed around sustainability, waste reuse, and resilience to a changing climate. The three papers in this issue, though very different in subject, share that common thread, and together they show how well suited physical modelling is to answer this new generation of questions.

The pressure is real. Extreme weather is driving soil instability in regions that once considered themselves temperate, and the corrective techniques we reach for, such as nailing, piling, anchoring, and retaining walls, are often costly or carbon-intensive. At the same time, the sheer volume of industrial and demolition waste we generate is becoming its own geotechnical problem. It is telling that two of our three papers set out, quite explicitly, to divert material from landfill or mine dumps and put it to structural use. Physical modelling is the natural proving ground for such ideas, because it lets us examine unfamiliar materials and unproven systems under controlled, repeatable, and prototype-representative conditions before anything is committed to the field.

Ma *et al*. (2026), in ‘Using recycled plastic posts and geogrid to resist soil sliding’, offered a good example of this. The posts, made from polythene diverted from landfill, are cheaper, more durable and far less carbon-intensive than the steel nails they might replace, yet their mechanical behaviour is quite different, being more flexible and ductile, and their interaction with the soil was not well understood. Using a large-area direct-shear apparatus mounted on a beam centrifuge, the authors show that the reinforcing effect peaks when the slip plane sits near the mid-length of the post, and that the geogrid mobilises the whole group of posts to work together. What I find valuable is their honesty about the trade-off: connecting the posts stiffens the system and limits movement, but at the cost of additional bending stresses that could yield the posts if deformation is left unchecked. That is exactly the kind of nuanced, design-relevant insight that a well-instrumented model test delivers and a simple field trial might miss.

Verma *et al*. (2026) took a comparable approach to a different waste stream in ‘Mechanical performance of MSE walls with coal mine overburden as backfill’, asking whether coal mine overburden, generated in India at a rate of some 2.5 billion tonnes a year, might replace conventional granular backfill in mechanically stabilised earth walls. Through 1 g model tests of a wall supporting a ballastless railway track, they examine how geogrid spacing governs stress distribution, wall deformation, and track settlement under realistic train loading. Their finding that closer reinforcement spacing produces markedly more uniform load transfer is not in itself surprising, but the demonstration that overburden can keep wall deflections and settlements comfortably within international serviceability limits is an encouraging result for anyone weighing the reuse of marginal materials. Their candour about the limitations of single-actuator loading and grain-size scaling is welcome, and a reminder that reduced-scale 1 g modelling is a starting point for such questions rather than the final word.

If the first two papers concern what we model, the third concerns how we measure it. Han *et al*. (2026), in ‘Machine learning analyses for dynamic images recorded from physical model tests’, explored whether an open-source machine-learning object detector, YOLOv5, can track the vibration of structures in shaker and dynamic centrifuge tests using nothing more than high-speed video and, in some cases, a smartphone. Traditional contact sensors perturb the very motion they measure and sample only at a point, whereas image-based methods promise a non-contact, lower-cost alternative. The authors report that a simple X-shaped marker gave the most reliable tracking, and that their results compared well with established tracking software. This is the sustainability of our own experimental practice, doing more with less and lowering the barrier to instrumentation, and it is a theme I expect this journal to return to as machine-learning tools mature.

Read together, these papers make a persuasive case that physical modelling is not merely keeping pace with the profession's sustainability agenda but actively enabling it, by de-risking the recycled materials, waste reuse, and low-cost methods that a resource-constrained future will demand. They also share a healthy honesty about their own limitations, a quality worth preserving as our ambitions grow. Finally, the journal's latest articles are available on Emerald Insight Earlycite, offering readers early access to new work.

I hope you find as much to reflect on in these papers as I did.

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