Biotechnically engineered designs

In biotechnically engineered designs, plant material alone is not predicted to withstand the peak forces for the anticipated severe event. So the planting needs to be reinforced with structurally engineered components.

Plants still contribute significantly to the maintenance of bank stability but structurally engineered elements are included to ensure that the flood risk management function of the structure is not compromised during a severe flood/weather event. The role of plants in a biotechnically engineered solution is best understood by considering the progression of a severe event over time. Initially, as a severe event begins, the plant material protects the substrate quite adequately. Then, as forces increase or continue to apply, the engineered element helps the plants to remain rooted in the bank edge and continue contributing to erosion protection. Some or all of the plants may subsequently be washed out. The specification of the engineered element should be adequate to maintain bank integrity from this point to the end of the event. To specify engineered elements that could function adequately without the vegetation at all in a 'severe event' would be an over-engineered solution and not the best ecological option.

In some cases, the decision to include such reinforcement may lead to unforeseen difficulties later. This is illustrated in the example in Case Study 4. The strong erosion forces and durations gave cause for the designers to be concerned that brushwood revetments should be both layered (brushwood fascine layering) and then retained with a wire 'rocknet'. In this situation, if the sediment is not deposited as expected, then the brushwood can be exposed to the air and rapidly decay, exposing the mesh and potentially creating a hazard.

Another application of biotechnical engineering to tidal river edge design is shown in Case Study 5. In this case it was concluded that plants could contribute to the integrity of the bank, but only when provided with significant root stabilisation. In this case gabion mattresses were lined with soil fines infill to the stone first and then a thick coir loop mat was laid under the lid of the basket to prevent wash out of content. The importance of careful installation of substrates and matting and the contribution of the vegetation to the integrity of a steel gabion are illustrated by this example of bioengineering. Poor installation leading to vegetation loss and associated loss of some fine substrate material from such a mattress may permit the remaining larger material within the mattress to move around. This moving material may then damage the mattress well before the term of its intended design life.

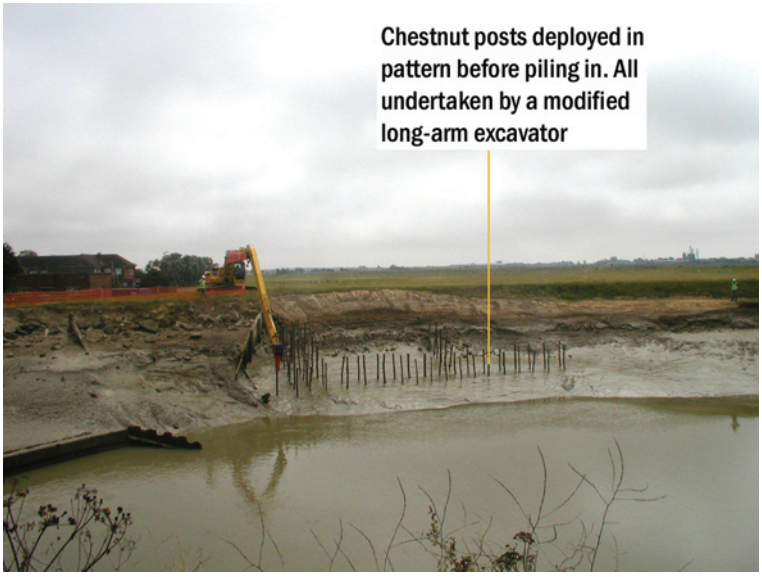
Case Study 4: Monk Bretton, River Rother, East Sussex (completed 2004)
Grid Reference: TQ 925 206

The site

- East bank of River Rother, East Sussex was in poor condition, especially at Monk Bretton bridge (A259 road crossing).
- Around 70m of bank of the outer side of the bend undermined by scour caused by design of bridge abutments.
- At this site the river edge structure helps protect various parts of the town of Rye from flooding including 120 properties and a school.
- Channel locally around 35m wide, 6m tidal range.
- Slow current speeds, high sediment loading and low risk of wave wash, but high occasional fluvial flows.

What the developers did

- Some reprofiling of clay embankment was carried out to ensure overall final smooth edge profile.
- Hardwood posts (125mm) were piled using long-reach excavator with modified hydraulic rammer typically to 1.5m depth.
- Posts created framework at 600mm centres to support a brushwood 'fascine' layering revetment.
- Hazel fascines were installed in 30-40cm layers at 90 degrees to each other to create a 'brushwood mattress'.
- Initially retained under a wire 'rocknet' fixed over piled wooden posts and looped under at the edge nearest the river centre.



Monk Bretton site near bridge: Installation of posts for fascines

Monk Bretton site near bridge: Rocknet and fascine detail showing drainage pattern

Monk Bretton site near bridge: Rocknet and fascine installation showing size of drainage rivulet

The result

- Installation construction process had major health and safety benefits over traditional hard engineering due to both the heavy tidal flows and risk of unexploded ordnance.
- Sedimentation rapidly effective on the lower half of the slope but slow in the upper parts of the slope.
- Settlement of the brushwood and sediment resulted in the exposure of the surface rocknet risking rapid exposure and decay of the brushwood and posts causing a potential maintenance, visual and health and safety issue.
- Possibly would have been preferable to attach the fascines directly to the driven posts and omit the 'rocknet', or remove it post-settlement.
- Low deposition rates of fine sediment could be improved by installing an imported growing medium on the upper slopes, for example pre-established coir pallets or erosion control geotextiles. These would provide protection and encourage re-vegetation.
- Considered to be broadly successful, but may need some modification as a technique.

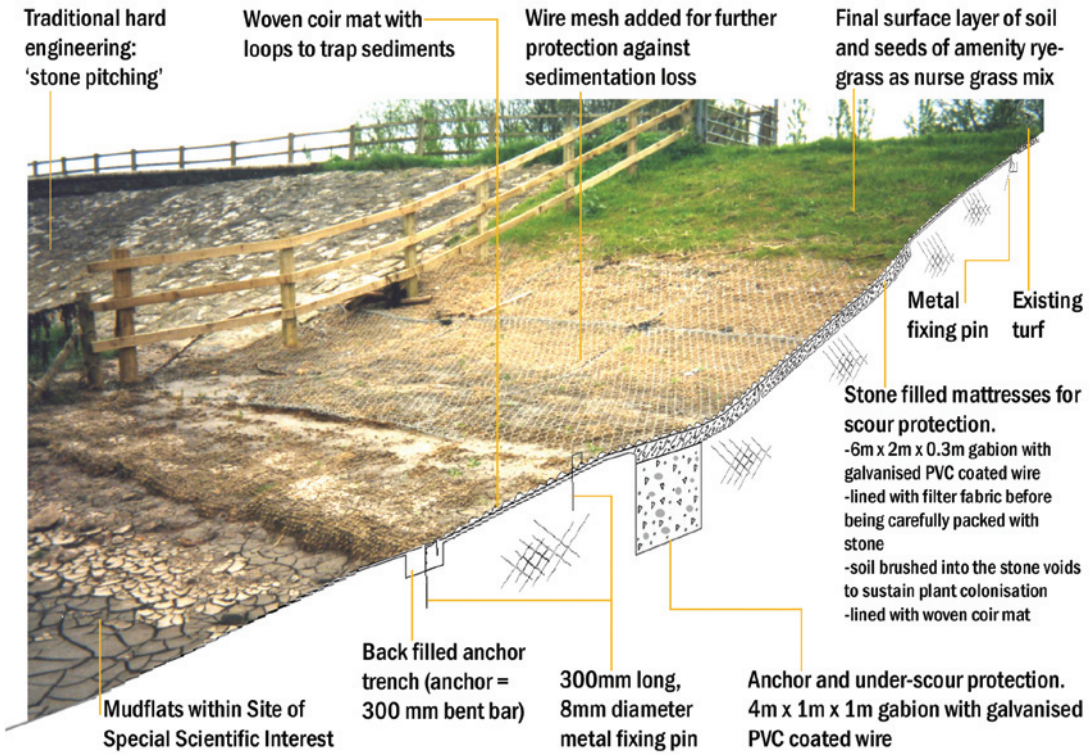
Case Study 5: River Severn, Purton, Gloucestershire (completed 1998)
Grid Reference: ST978 632

The site

- Lower reaches of the River Severn Site of Special Scientific Interest, south bank, 7km upstream of the original Severn Bridge.
- River here is around 3km wide downstream of a stone-pitched section, 10m tidal range.
- Erosion scar was appearing along the high tide line for a length of around 80m.

What the developers did

- The scoured area was excavated to accommodate 30cm deep gabion mattresses installed flush to surface level.
- The gabions were of woven wire, galvanised and PVC-coated for increased durability.
- The mattress was lined with a filter fabric before being carefully packed with stone.
- Seeded soil was brushed into the voids, which made up 30 per cent by volume.
- Before closing the lid, a loop-piled woven coir matting was laid over the surface and extended beyond the mattress both up and down the slope.
- At the river-wards edge, the matting was laid over the mudflat and anchored in a trench.

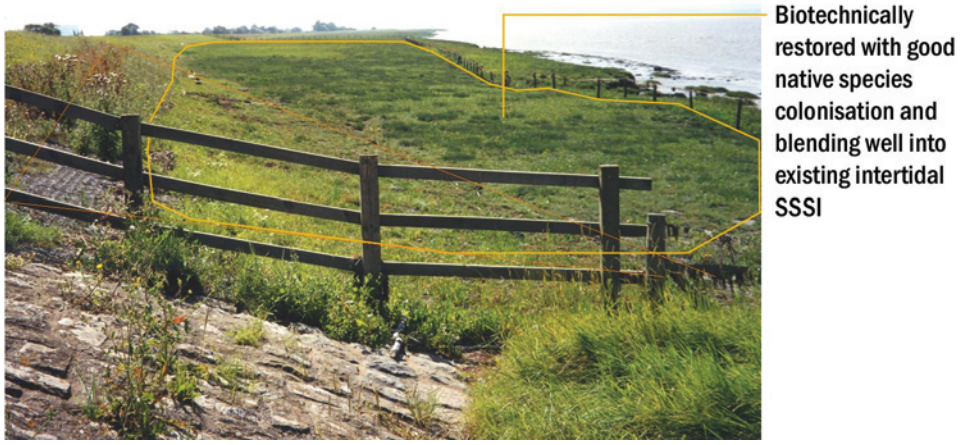


Gabion mattresses installed in SSSI bank

The result

- Initially the coir loop matting was incorrectly attached to the upper surface of some mattresses. This resulted in loss of soil infill and stone movement in the gabions. These were repaired.
- Local vegetation soon colonised the properly installed stone mattresses and no subsequent significant erosion problem was noticed.
- Overall considered to be a highly successful design appropriate to the SSSI.

Gabion mattresses installed in SSSI bank: Early colonisation at high tidal levels



Gabion mattresses installed in SSSI bank with full successful colonisation by species characteristic of the SSSI