TECHNOPOL SA
ENERGY SAVING MATERIALS

TECHNICAL DESIGN GUIDE

EPS Lightweight Fill

EPS block fill & void formers · geofoam for civil & geotechnical works

Technopol EPS geofoam blocks on site — lightweight structural fill, delivered in large blocks and cut to shape.

This guide covers Technopol's EPS lightweight fill in its geotechnical role — where the blocks are known internationally as **geofoam** — selected, designed and built into embankments, bridge approaches, retaining and buried-structure works. It follows the geotechnical specifications **ASTM D6817** (material) and **ASTM D7180** (design), mapped to Technopol's supplied EPS grades and block sizes.

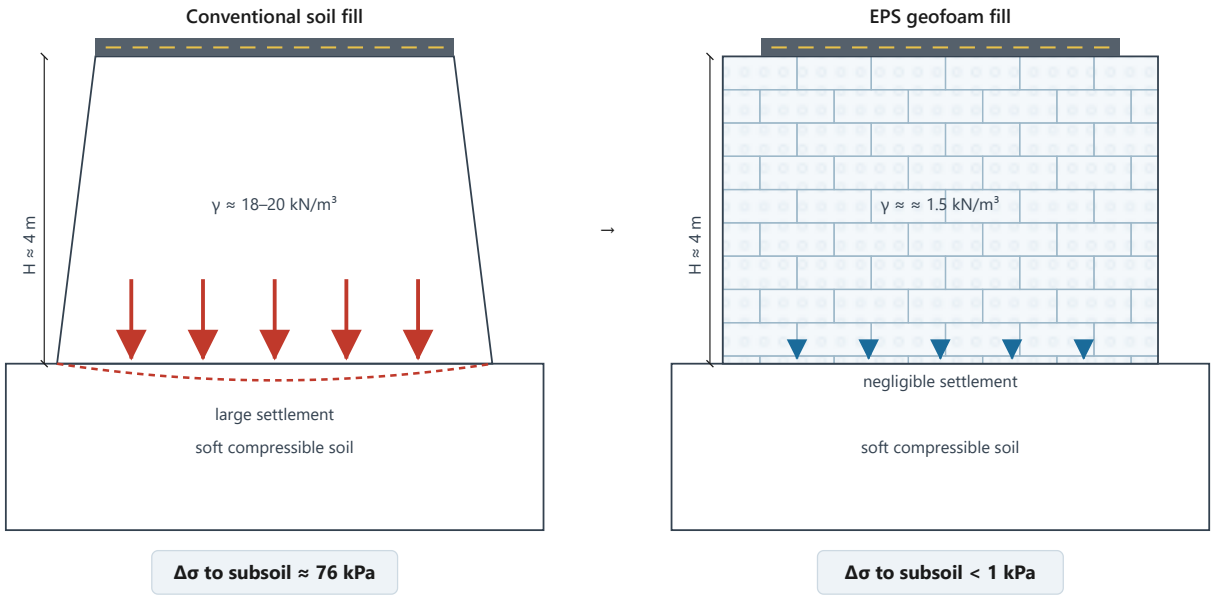
Embankments | Bridge approaches | Retaining walls | Buried structures | Slope stability | Void fill

1 · Why geofoam — the load-reduction principle

EPS geofoam is **not a soil-strength substitute**; it is a way to **remove weight**. Ground settlement, bearing demand and lateral earth pressure are all proportional to the unit weight of the fill. Geofoam weighs roughly 1% of soil (≈ 0.1–0.3 kN/m³ against 18–20 kN/m³), so substituting it for conventional fill strips almost all of the self-weight stress that would otherwise reach a soft subsoil or bear against a structure.

The load-reduction principle

EPS geofoam weighs about 1% of soil — it replaces mass, not strength



Δσ to subsoil ≈ 76 kPa → **Δσ to subsoil < 1 kPa**

Fill self-weight stress delivered to the soft subsoil, σ = γ·H — geofoam removes ~99% of it, so settlement and bearing/slope demand collapse.

Self-weight stress delivered to the soft subsoil, σ = γ·H. For a 4 m fill the geofoam case removes ~99% of it.

Where geofoam wins

- Embankments and road widening over soft clay or peat
- Bridge approaches and abutment backfill
- Retaining, quay and basement wall backfill
- Slope stabilisation and landslide reinstatement
- Protection of culverts, pipes and tunnels
- Void fill, compensating foundations, roof gardens, stadium seating

What you gain

- **Settlement control** on ground that would otherwise consolidate for years
- **Speed** — placed dry, no compaction or surcharge/wait period
- **Lighter structures** — reduced bearing, lateral thrust and pile demand
- **Handling** — one block lifted by 1–2 people, no heavy plant
- **Adaptability** — field-cut to any profile with a hot-wire or saw

Design in one line. Choose the EPS grade so that the working stress at the base of the fill stays within the **compressive resistance at 1% strain** (the elastic limit), then verify buoyancy, sliding and the load-distribution slab.

2 · Grade selection & design basis

Geofoam is manufactured to a target compressive resistance, so the grade is chosen to the design load — higher-strength blocks in high-stress zones (e.g. under a load-distribution slab or wheel path) and lower grades elsewhere to save cost. The governing material standard is **ASTM D6817**:

EPS grade (ASTM D6817)	EPS12	EPS15	EPS19	EPS22	EPS29	EPS39	EPS46
Density, min. (kg/m³)	11.2	14.4	18.4	21.6	28.8	38.4	45.7
Compressive resistance @1% strain (kPa)	15	25	40	50	75	103	128
Compressive resistance @5% strain (kPa)	35	55	90	115	170	241	300
Compressive resistance @10% strain (kPa)	40	70	110	135	200	276	345
Flexural strength, min. (kPa)	69	172	207	240	345	414	517
Oxygen index, min. (vol %)	24	24	24	24	24	24	24

ASTM D6817 physical-property requirements. The highlighted row (1% strain) is the design load limit — see below.

Technopol supplied EPS grades

Technopol's production grades map to the ASTM types as follows. Use the **safe working load @1% strain** row for sustained design loads.

Technopol grade	EPS12	EPS15	EPS20 (SD)	EPS24 (HD)	EPS30 (EHD)
Nominal density (kg/m³)	12	15	20	24	30
Thermal conductivity λ (W/m·K)	0.045	0.040	0.035	0.034	0.033
Compressive stress @10% (kPa, min)	60	65	110	160	200
Safe working load @1% strain (kPa)	15	17	45	70	100
Nearest ASTM D6817 type	EPS12	EPS15	EPS22	—	EPS29

Design load limit — 1% strain. EPS behaves as a linear-elastic material up to about 1% strain. The recommended sustained-load design limit is the compressive resistance at **1% strain**, which keeps long-term creep negligible. **Do not design to the 5% or 10% values** — those lie beyond yield and cause permanent deformation. A typical approach is to keep the total sustained stress (dead + long-term live) at or below the 1%-strain resistance of the selected grade, with transient/live peaks checked against a higher-strain resistance.

Creep. Negligible below ~1% strain; it rises sharply at 5–10% strain. Working strains are normally 0.4–1%.

Block sizes

Technopol moulds geofoam in three block families, all field-cut to shape on site. Longer and taller blocks reduce the number of joints on large fills; the fat block is the most common stock size.

Block family	Grade range	Length × width × height (mm)
Fat block **(most common)**	EPS 12–32	**2550 × 1250 × 960**
Long block	EPS 12–32	4860 / 5150 / 5200 / 5350 / 6080 × 1230 × 640
Budha block	EPS 12–20	6500 / 7000 / 7500 × 1230 × 1030

All blocks are cut to shape on site. Made-to-order grades/sizes carry a minimum production run; low-density (EPS 12) blocks are produced to order. Confirm current stock sizes and grades with Technopol.

3 · Design considerations

Settlement & immediate deformation

Because Δσ on the subsoil collapses, long-term consolidation settlement is largely eliminated. Allow for a small **immediate elastic strain (~0.5%)** of the geofoam itself; tall fills (>10 m) can show >100 mm immediate compression.

Buoyancy / flotation

Geofoam is light and closed-cell, so a fill below the water table wants to float. Provide enough permanent surcharge (slab + pavement + cover) so that **downward dead load ≥ FS · γ_w · $h_{submerged}$** (FS ≈ 1.2), or control groundwater / add uplift anchors. Check the drawdown and flood cases.

Load-distribution slab

A reinforced-concrete slab over the geofoam spreads concentrated wheel and footing loads (spread ~50–70° in the slab versus ~20° within the foam), keeping peak stress on the blocks within the 1%-strain limit.

Sliding & friction

Interface friction coefficient **μ ≈ 0.5** along moulded/cut faces. On slopes or under horizontal (seismic, traffic braking) loads, add **barbed connector plates** between block layers and check sliding on every interface.

Seismic

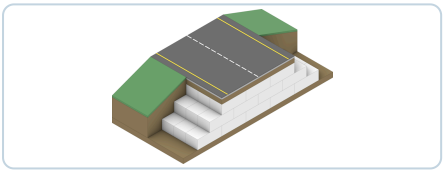
Low mass means low inertial (seismic) force — a recognised advantage. Verify inter-layer sliding and overall stability under the design horizontal acceleration; connector plates tie the mass together.

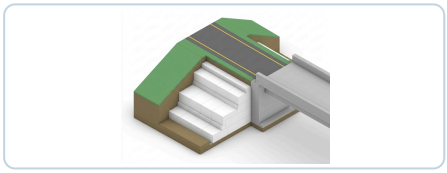
Water, chemicals & fire

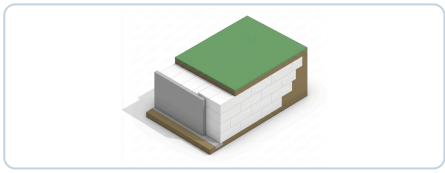
Water absorption < 4%. EPS is **dissolved by petrol, oils and solvents** — protect with a geomembrane where hydrocarbons or contaminated ground are present. EPS is **combustible**; use FR grade, keep flame/hot-works away during construction, and cover promptly. In service the block is protected by soil, slab or pavement (also handling UV).

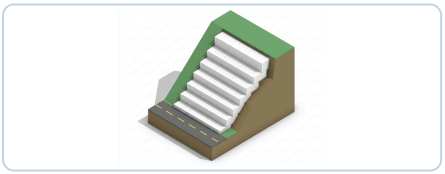
Transitions. Where geofoam meets conventional fill, **step the block layers down** to spread the stiffness change and avoid a differential-settlement step in the pavement. Stagger vertical joints and lay successive layers perpendicular.

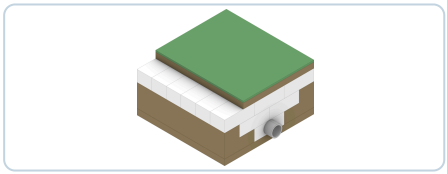
Applications at a glance

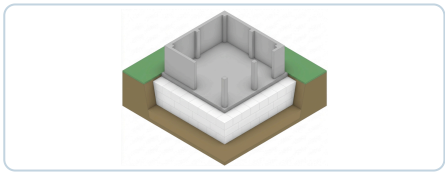

Roads & embankments

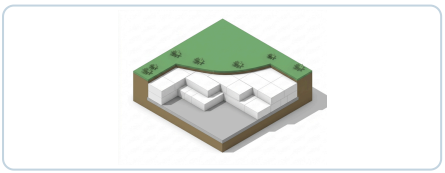

Bridge approaches

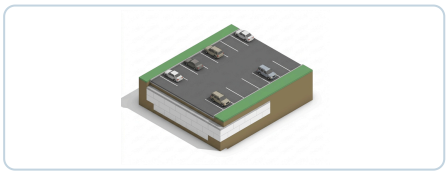

Retaining walls

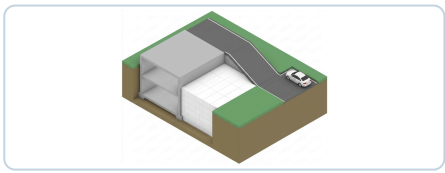

Slope stabilisation

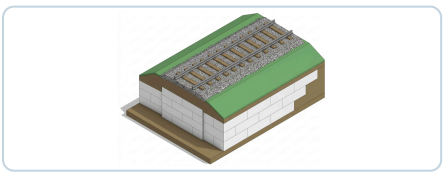

Buried structures

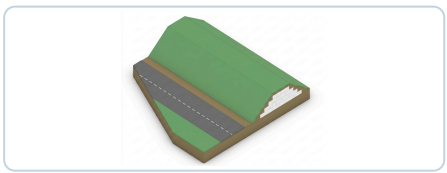

Void fill / foundations

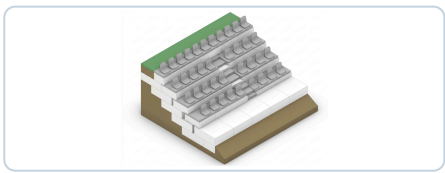

Green roofs / podiums


Parking lots


Basement backfill & ramps


Rail embankments


Noise bunds / levees

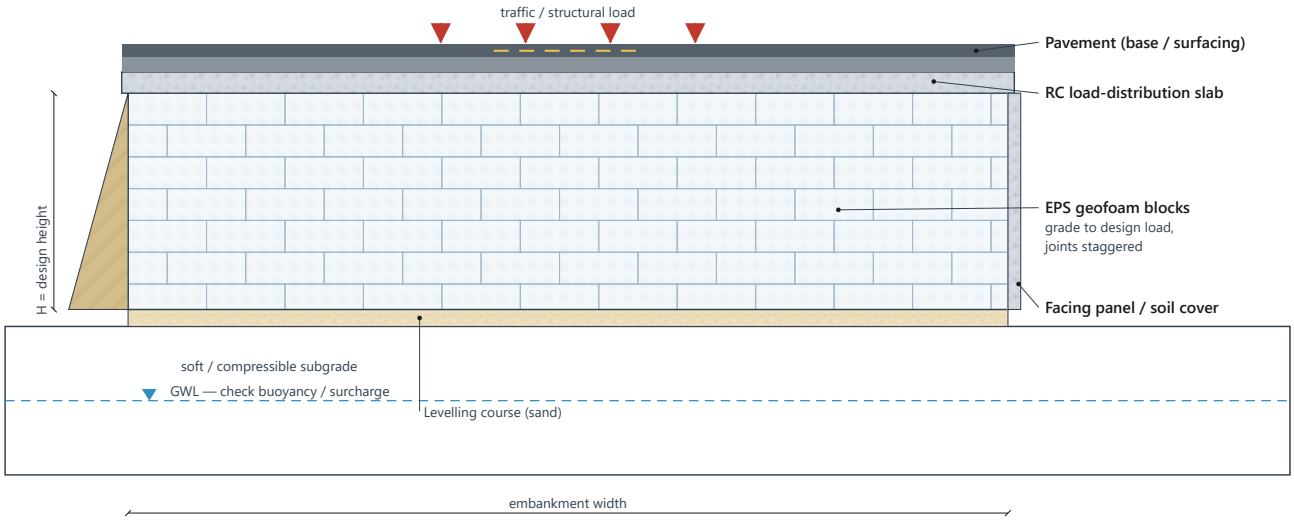

Stadium seating

4 · Application details

4.1 Lightweight embankment over soft ground

Lightweight embankment over soft ground

Geofoam fill · load-distribution slab · pavement — typical cross-section



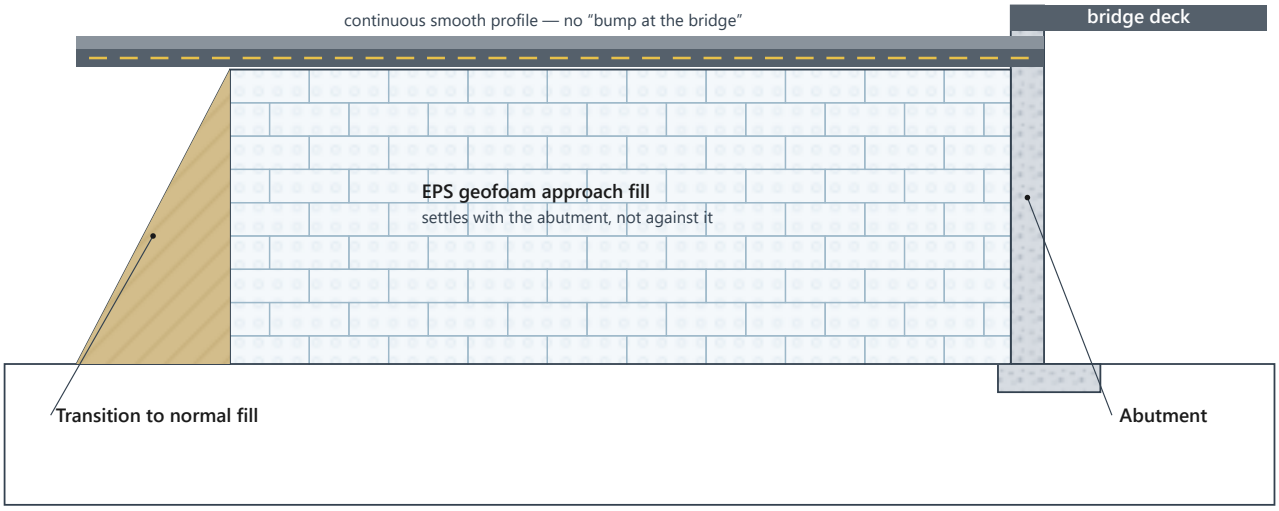
Common block 2550 × 1250 × 960 mm · placed dry, no compaction · field-cut by hot-wire / saw

Blocks on a levelling course, RC load-distribution slab, pavement above; side facing panel or soil cover. Check GWL/buoyancy.

4.2 Bridge approach embankment

Bridge approach embankment

Matched settlement removes the differential "bump at the bridge"



Light geofoam approach fill barely loads the soft soil, so it settles at the same rate as the pile-founded abutment — eliminating the differential "bump".

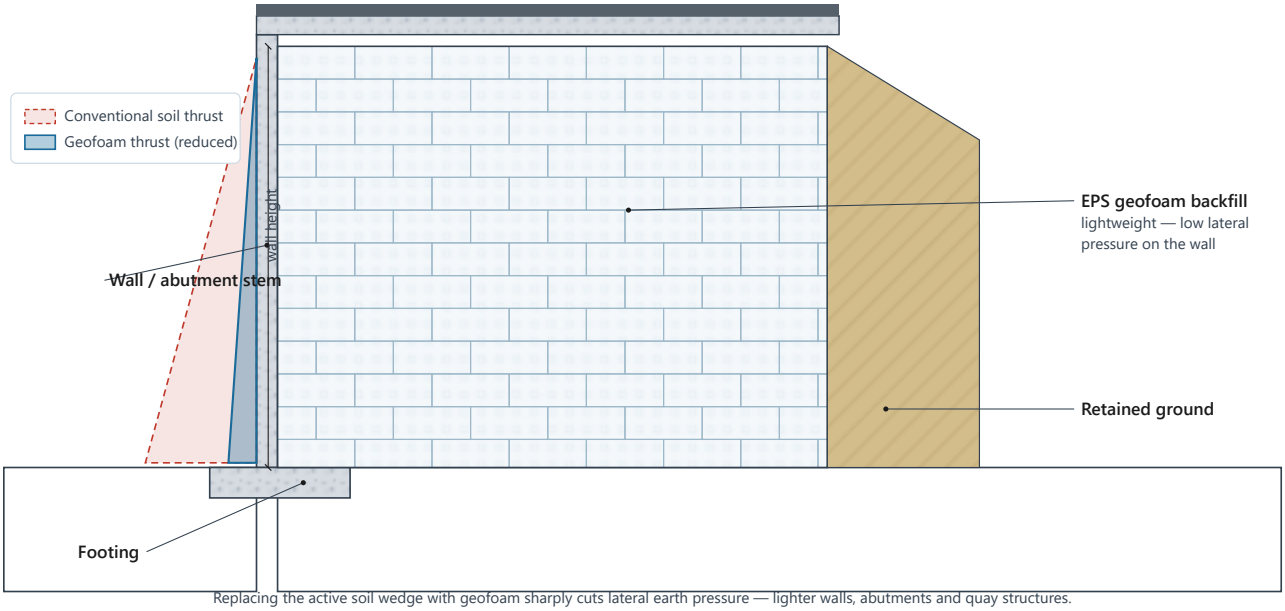
Light approach fill settles with the pile-founded abutment rather than against it — removing the differential "bump at the bridge".

4 · Application details (cont.)

4.3 Retaining wall & abutment backfill

Retaining wall & bridge-abutment backfill

Geofoam replaces the active wedge — lateral thrust on the structure drops



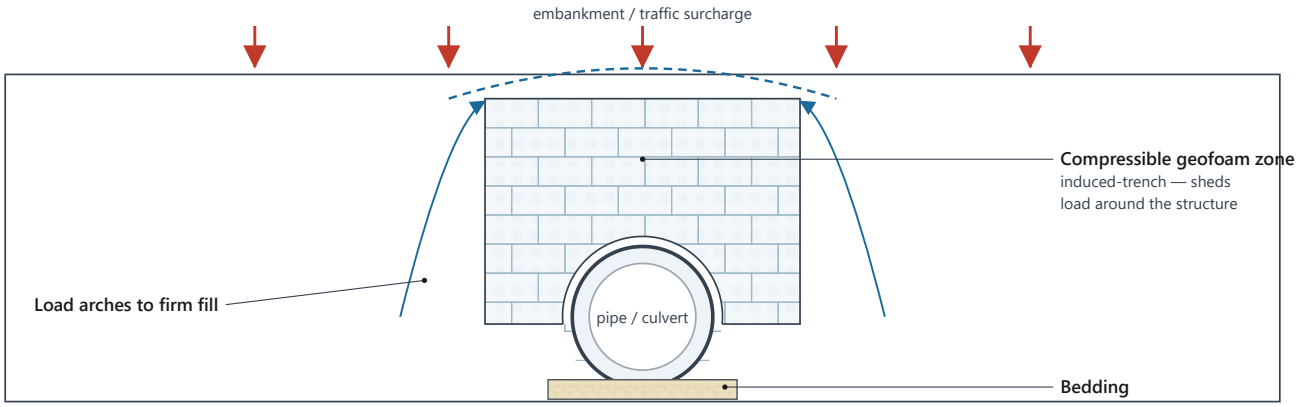
Replacing the active soil wedge with geofoam sharply cuts lateral earth pressure — lighter walls, abutments and quay structures.

Replacing the active soil wedge with geofoam sharply reduces lateral thrust — lighter walls, abutments and quay structures.

4.4 Protection of buried structures

Protection of buried structures

Induced-trench load-shedding over pipes, culverts & tunnels



A geofoam column over a buried pipe or culvert compresses first, transferring surcharge to the stiffer fill on either side — protecting the structure.

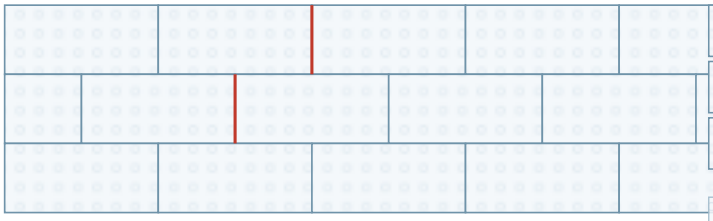
An induced-trench geofoam column over a pipe/culvert compresses first, arching surcharge to the stiffer fill on either side.

5 · Construction, placement & QA

Block placement & jointing

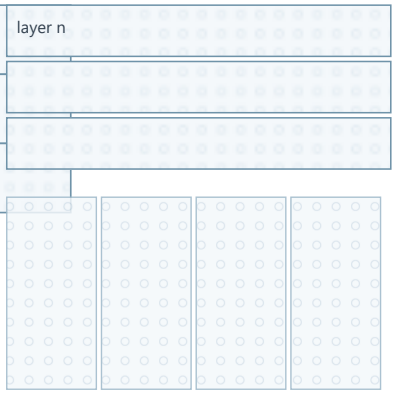
Staggered joints · perpendicular layers · connectors · prompt cover

Elevation — stagger vertical joints between layers



joints offset ≥ ½ block, layer to layer

Plan — lay successive layers perpendicular



layer n+1 (rotated 90°) — breaks continuous joints in both directions

- Minimise gaps between blocks (tight butt joints).
- No continuous vertical joint through the fill.
- Field-cut with hot-wire, hand or chain saw.
- Mechanical connector plates (barbed) between layers on slopes/uplift.
- Cover promptly — protect from UV, flame and solvents.

Stagger vertical joints ≥ ½ block between layers; lay successive layers perpendicular; connect on slopes; cover promptly.

Placement sequence

- Trim subgrade; place a thin **levelling course** (sand) to a true plane
- Lay blocks with **tight butt joints**; minimise gaps
- **Stagger** vertical joints layer-to-layer; rotate alternate layers 90°
- Field-cut with hot-wire, hand or chain saw to suit profile and services
- Add **barbed connector plates** on slopes / uplift zones
- Cast the **load-distribution slab**; build pavement / facing; cover promptly

Quality & protection

- Grades and dimensions to **ASTM D6817**; sampling to **ASTM D7557**
- Confirm block density/strength per delivery against the specified grade
- Protect from **flame, hydrocarbons and solvents** at all times
- Provide a **geomembrane** where contaminated soils / fuel spill risk exist
- Keep permanent **surcharge** for buoyancy; manage groundwater
- Do not leave blocks exposed to UV long-term — cover in the works

Fire note. Fire-retardant grade EPS carries a **Class B-s1,d0** reaction-to-fire classification (SANS 53501-1) — lowest smoke, no flaming droplets — but EPS remains a combustible material and is relied upon in service only when covered by soil, slab or pavement. This is a reaction-to-fire class, not a fire-resistance (minutes) rating.

6 · Worked example & references

Load take-down — 4 m approach embankment on soft clay

Indicative comparison of vertical stress delivered to the soft subsoil. Confirm with site-specific consolidation parameters.

Component	Conventional soil fill	EPS geofoam fill
Fill self-weight (3.5 m)	3.5 m × 19 = 66.5 kPa	3.5 m × 0.15 = 0.5 kPa
RC load-distribution slab (0.3 m)	—	7.2 kPa
Pavement (0.5 m)	0.5 m × 20 = 10 kPa	10 kPa
Traffic surcharge	12 kPa	12 kPa
Δσ on subsoil	**≈ 88 kPa**	**≈ 30 kPa**

Net stress on the soft clay falls by roughly **two-thirds**. Since primary consolidation settlement scales with Δσ, an anticipated settlement of the order of ~250 mm under conventional fill drops to the order of ~80 mm — often turning an otherwise unbuildable soft site into a straightforward one, without preload or wait.

Buoyancy check (same case). If 1.0 m of blocks sits below the water table, uplift ≈ 1.0 × 9.81 ≈ 9.8 kPa. Permanent downward dead load (slab 7.2 + pavement 10 + geofoam self-weight) comfortably exceeds FS·uplift (1.2 × 9.8 ≈ 11.8 kPa) — otherwise increase cover, lower the block toe or manage groundwater.

Governing standards

- **ASTM D6817** — Rigid Cellular Polystyrene Geofoam (material)
- **ASTM D7180** — Use of EPS Geofoam in Geotechnical Projects (design)
- **ASTM D7557** — Sampling of EPS Geofoam (QA)
- **ASTM C578** — Rigid Cellular Polystyrene (thermal)
- **SANS 53501-1** — reaction-to-fire (FR grade B-s1,d0)

For SANRAL / provincial road works confirm the local acceptance route for lightweight fill.

Precedent

- Norway — first EPS road embankment, 1972 (in service 50+ yrs)
- USA — I-15 Salt Lake City, ≈ 100,000 m^3
- Japan — fills to 15 m, stable in earthquakes
- Technopol / SA — structural EPS void formers & civil fills (Zutari, municipal water infrastructure)

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7 · EPS lightweight fill in the field

Technopol EPS blocks on South African projects — large closed-cell blocks (2550 × 1250 × 960 mm) delivered, placed dry and cut to shape into load-reducing fills beneath slabs, podiums and roads, and into geotechnical embankments and bridge approaches.

Delivered & stacked — blocks set out on site; light enough to place without heavy lifting plant.

Placement — blocks positioned over the reinforced base and worked into the fill by hand.

True scale — a single 2550 × 1250 × 960 mm block, cut and shaped on site with a saw.

Completed works — RC slab cast over the fill, ready for the structure above.

Road embankment — lightweight fill over soft ground.

Bridge approach — geofoam against the abutment.

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