

Jablite Fillmaster in Floor Raising

Table 1

Thickness	U-value					
	0.25Wmk	0.27Wmk	0.28Wmk	0.38Wmk	0.15Wmk	0.10Wmk
100	0.18	0.17	0.16	0.15	0.14	0.13
150	0.17	0.16	0.15	0.14	0.13	0.12
200	0.16	0.15	0.14	0.13	0.12	0.11
250	0.15	0.14	0.13	0.12	0.11	0.10
300	0.14	0.13	0.12	0.11	0.10	0.09
350	0.13	0.12	0.11	0.10	0.09	0.08
400	0.12	0.11	0.10	0.09	0.08	0.07
450	0.11	0.10	0.09	0.08	0.07	0.06
500	0.10	0.09	0.08	0.07	0.06	0.05

Design Consideration

Traditional fill materials used to construct new embankments or placed against civil engineering structures, can cause unacceptable vertical and/or horizontal stresses in the underlying soil or against the structure. The use of Fillmaster expanded polystyrene as a fill material offers a reliable, cost-effective lightweight solution to these problems, reducing the probability of further settlement or unacceptable lateral forces and often simplifying the construction.

Vencel Resil manufactures Fillmaster expanded polystyrene (EPS) blocks for use in civil engineering projects, especially road construction. The material is available in a range of sizes and strength grades. The cellular structure of the EPS material gives a high strength-to-weight ratio ensuring that the blocks are able to withstand the mechanical loads encountered in road construction.

Advantages

- Lightweight and easy to handle on site. Approximately 1% of the weight of traditional fill materials.
- Available in a range of grades allowing the appropriate compressive strength to be chosen to suit each particular application.
- Closed-cell structure inhibits water absorption.
- Unaffected by normal range of climatic conditions.
- Immune to insect, bacterial and fungal attack.

Description

Grade

Fillmaster is supplied in the grades shown in Table 1. Normally supplied as Euroclass F defined to BSEN 14933: 2007, it is also available as Euroclass E, flame-retardant additive material, if required.

Dimensions

Fillmaster standard block size:

2440 x 1220 x 610mm; other sizes available to order to reduce the need for cutting to size on site. The stability of a lightweight embankment depends greatly on the uniformity of the blocks. Tolerances: ± 3 mm on thickness; ± 4 mm on width; and ± 6 mm on length. Maximum bow, 5mm over length of block.

Application

Expanded polystyrene has been successfully used as a fill material for highway embankments since 1972. Its first such use in the UK was in 1985. The material is particularly beneficial in the following situations where its use will obviate the need for either specialised foundations, or long surcharge periods designed to preload the ground and reduce settlement problems following construction:

- Areas adjacent to existing embankments.
- Areas of unstable ground.
- Areas of weak or compressible soil.
- Sites where access is difficult or restricted.
- Transition zones between bridges or underpasses and normal fill materials.

Figure 1. HA Loadings

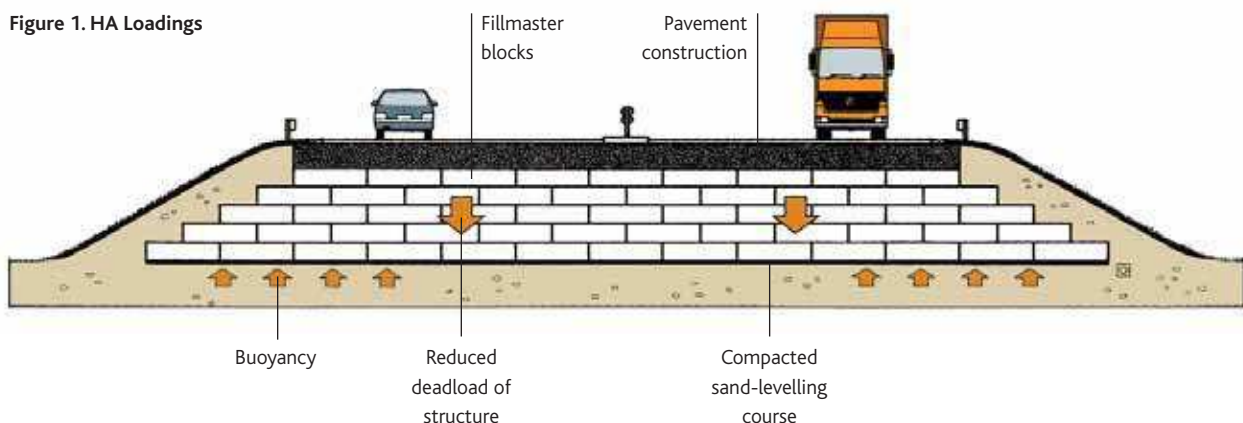


Table 1

Physical Properties – Fillmaster										
Fillmaster Grade	FM50	FM70	FM100	FM150	FM200	FM250	FM300	FM350	FM400	FM500
Compressive Stress at 1% strain (kPa)	10	20	45	70	90	100	120	140	160	190

Design

Embankment forces

There are three main design considerations when constructing embankments using Fillmaster:

- Downward pressure due to wheel loadings and the self-weight of the embankment.
- Upward forces due to buoyancy in wet conditions.
- Lateral forces acting against abutments.

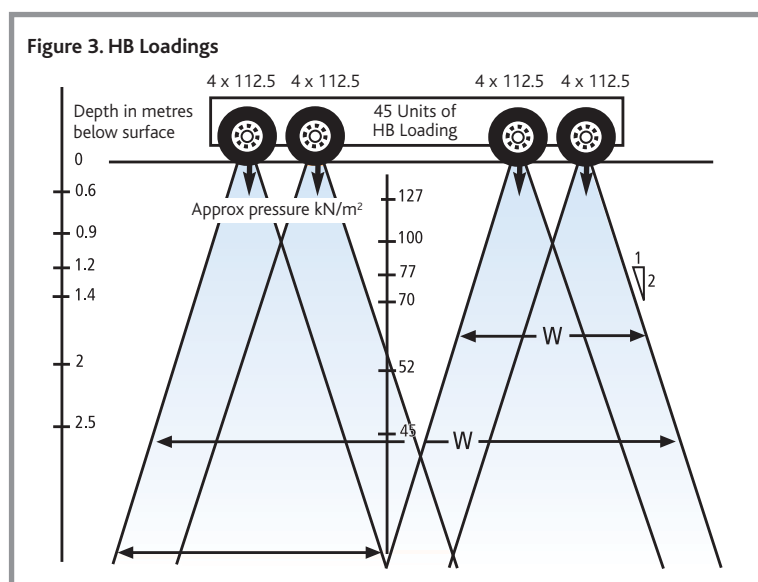
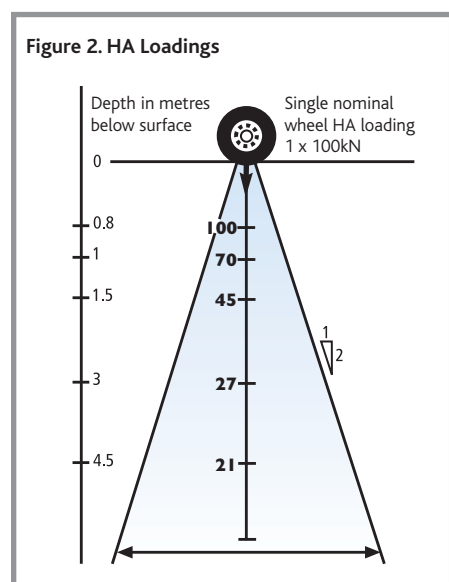
Wheel loadings

In order to avoid unacceptable deflections and permanent deformation of the highway surface, the compressive stresses due to wheel loadings, etc., should be carefully calculated and the appropriate grade of Fillmaster selected to ensure that these fall within the design compressive strength of the material. It is recommended that this is carried out in accordance with the method of calculation for the thickness of sub-base/subgrade set out in BS 5400. This uses the convention of 'HA' and 'HB' units of loading.

HA loading assumes a single 100kN wheel load exerting a pressure of 1110kPa over a square of 300 x 300mm; the pressure is exerted downwards at a gradient of 2:1. This represents the effects of normally permitted vehicles.

HB loading represents the effects of abnormal loads on motorways and trunk roads. It is usual to design for 45 units of HB loading; this represents the effect of 16 wheel loads each of 112.5kN exerting a pressure of 1110kPa over a square of 318 x 318mm. The pressure is dispersed downwards at a gradient of 2:1.

See Figures 2 and 3.



Design Consideration

Downward pressure

When calculating the self-weight of Fillmaster blocks an allowance should be made for water absorption of less than 1% by volume. This gives a design weight of approximately 100kg/m³.

Buoyancy pressures

EPS is a proven flotation material and exerts a flotation force of 900kgf/m³.

This takes into account a potential level of water absorption of 8% for blocks which are permanently submerged.

Care must be taken during the design process to ensure that the potential flotation forces can be accommodated within the hydrological conditions of the site and take account of the self weight of the permanent structure.

Alternatively, the material can be installed above the water table. The water table can be lowered by installing suitable cut-off drains at the toe of the embankment or beneath the embankment itself.

Lateral pressures

When using Fillmaster for approach embankments to bridge abutments, the horizontal forces exerted on the abutment are almost eradicated. This allows economies to be made in the design of bridge foundations, which are no longer required to resist large rotational moments.

Installation

Construction of the embankment should proceed as follows:

Levelling course

Fillmaster blocks are placed on a levelling course consisting of a layer of compacted sand to a maximum thickness of 100mm. This course should be laid to a level tolerance not exceeding ± 10 mm over any 3m length. On sites which have very soft foundations, a geotextile layer may be placed on top of the soft soil before placing the sand fill, this prevents the sand from being 'punched' into the soil.

Laying the blocks

The blocks in each layer should be laid with broken joints; there should be no vertical or horizontal joints running through the construction.

There is no need to compact the blocks during construction.

The coefficient of friction (μ) between adjacent blocks can be taken as 0.5; this is normally sufficient to prevent any slippage or movement.

When required, for example at the edges of the embankment, a positive fixing can be obtained by driving 12mm diameter reinforcing bars down through the layers.

The final profile of the side slope will depend on the properties of the soil used. Where soil conditions restrict the available space for an embankment, a range of techniques is now available for constructing steep sides or vertical faces.

Cutting

Blocks which require trimming can be easily cut using a hot-wire cutter, handsaw or chain saw.

Protection

The Fillmaster should be protected from possible accidental contact with petroleum or solvents using a suitable polymer barrier, where necessary.

Fill or capping layer

The final fill should be placed over the Fillmaster blocks taking care not to puncture any membrane.

No construction plant, other than compaction equipment, should be driven across, or placed on the Fillmaster until there is a minimum cover of 200mm of acceptable fill material, or until the capping layer has been placed.

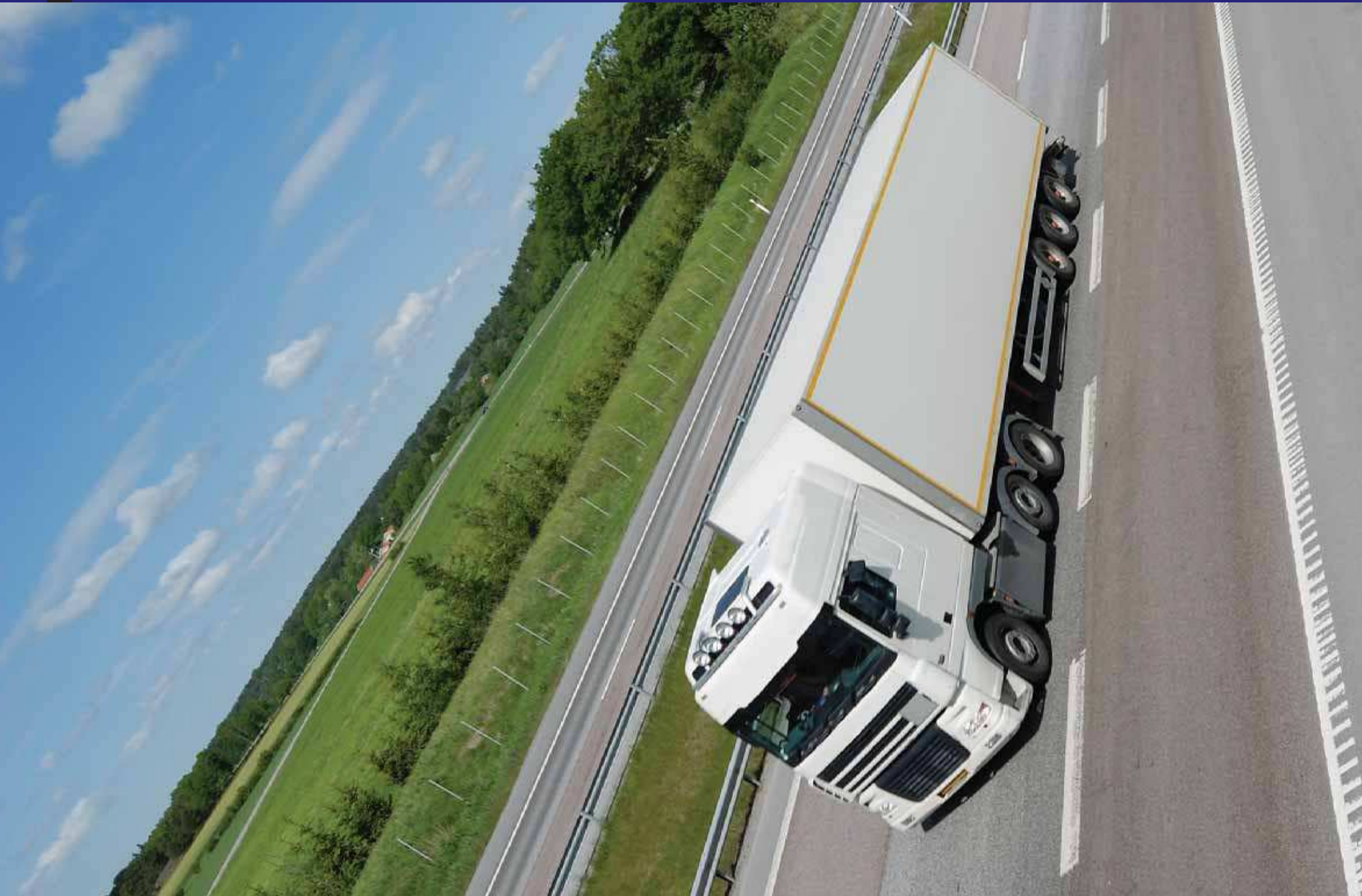
Vibratory compaction plant should not be used within 500mm vertically, or 2m laterally, of the Fillmaster blocks.

Cover

The sides of the Fillmaster blocks should be covered with general fill and compacted in layers. The sides should be graded and covered with top soil. The minimum cover should be 300mm.

References

- BS 5400 Steel, concrete and composite bridges. Part 2 Specification for loads. Department of Transport Standard BD 37/88. Loads for highway bridges.
- Geotechnical considerations and techniques for widening highway earthworks. Department of Transport.
- Plastic foam in road embankments. Proceedings of the conference of the Norwegian Plastics Federation. June 1985.
- TRL Contractor report 356. The use of polystyrene for embankment construction.



Floor Raising

Fillmaster provides a fast economic solution in the conversion of existing industrial buildings when raising the existing floor levels. The lightweight material reduces load on the existing floor structure and exerts no lateral force on the existing walls. This eliminates any requirement for strengthening of the existing structure. Multiple layers can be placed below the new floor slab producing any height required.

Figure 23. Floor Raising

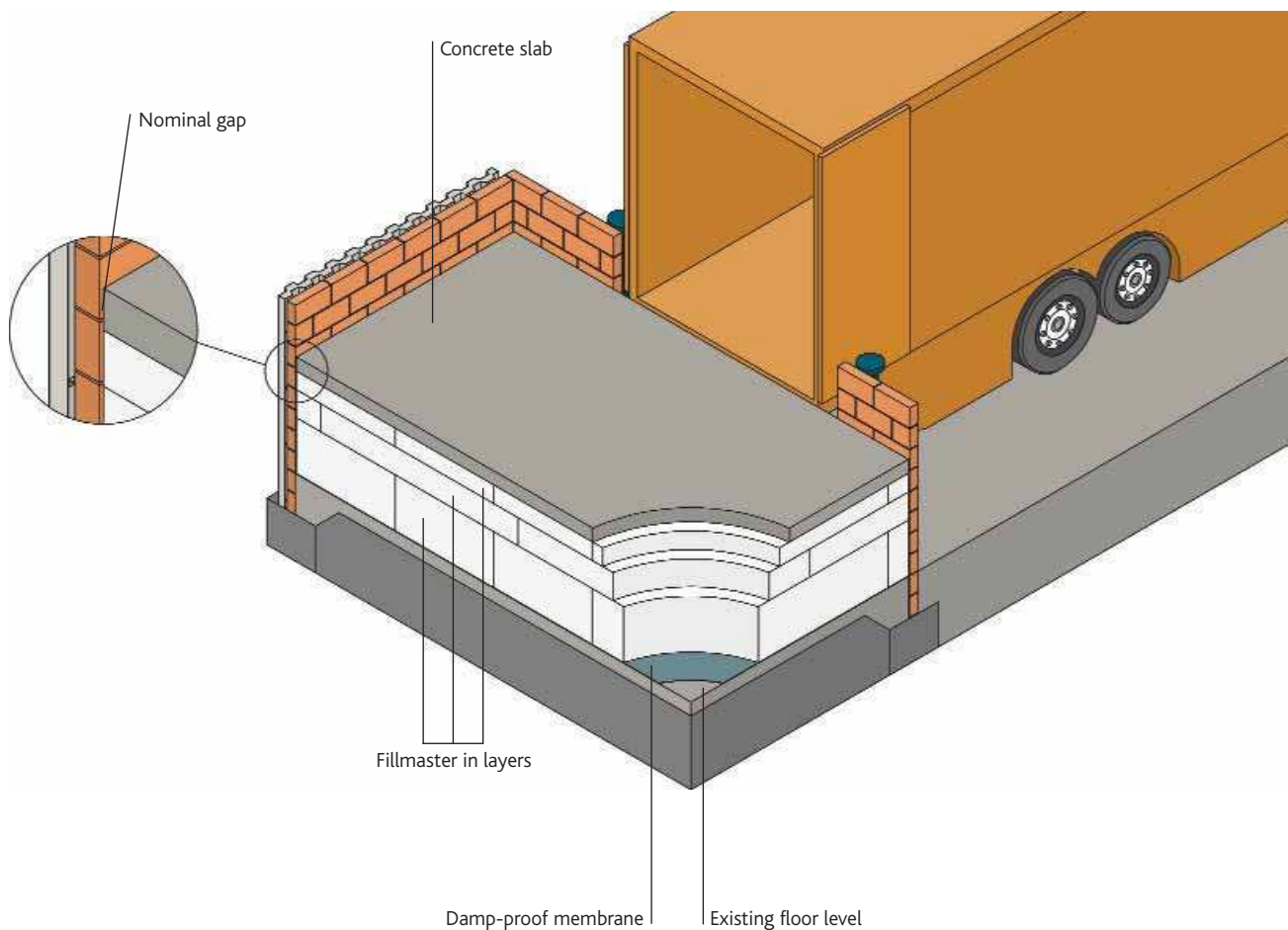
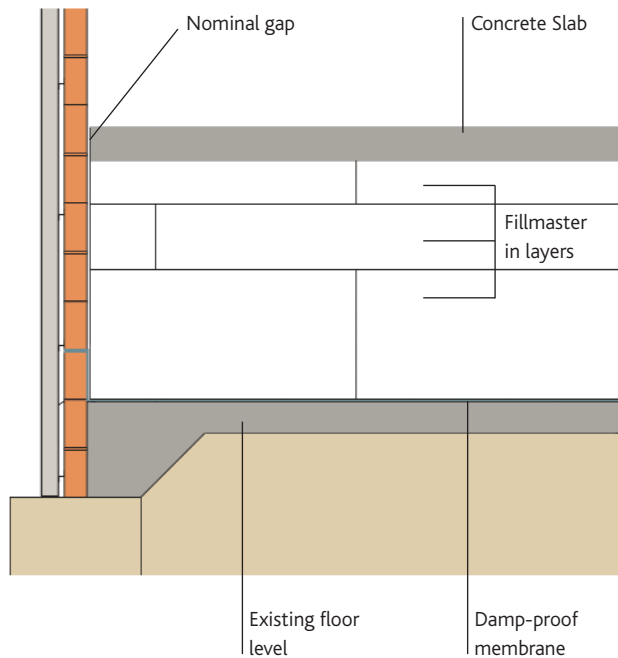


Figure 24. Floor Raising



Dock leveller at ASDA, Belvedere, Kent

6,000 square metres of Fillmaster was used to construct a dock leveller inside a warehousing unit for ASDA in Kent. The floor level of the building was raised by 1.1 metres to allow vehicles to reverse up to the new floor level, to make loading and unloading much quicker and easier. The material was then covered with a 200mm concrete slab. Fillmaster provided the perfect solution because being so close to the River Thames, the added weight of traditional fills would have caused high levels of settlement, with possible implications for the existing foundations. The lateral forces created by the traditional fill would have created issues with the perimeter wall. The alternative, of excavating around the building was not an option either because of the relatively high water table caused by the proximity to the river. Fillmaster provided a very cost effective method of achieving the required infill to create the dock leveller, making for a much more functional building.

Client: ASDA

Consulting Engineer: RPS Burkes Green

Contractor: Harris Construction Management

Volume: 4500m³



Royal Mail sorting office at Thurrock, Essex

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Fillmaster provided the perfect fill material for raising the floor level of an existing building in Thurrock, Essex. The building was being converted to enable the relocation of the Royal Mail, East London Network Hub sorting office from another site.

The level of the floor and the truck beds needed to be the at the same height, therefore the existing floor in the building needed to be raised by just over 1 metre to enable easier loading of vehicles. Civil and structural engineering contractor Curtins Consulting had concerns that traditional fill materials would add unnecessary pressures on the ground below. Use of traditional fill would also have exerted lateral forces on the perimeter wall, which could have caused damage to the structure of the building.

In total 3000m³ of Fillmaster 150E was supplied in two layers of 535mm deep, which were loose laid, covered with a damp proof polythene membrane and finished with a 150mm thick concrete slab. All the material was installed within four days by main contractor Fitzpatrick.

As the sorting office was located relatively close to the River Thames, over the long term, the added weight of traditional fills could have caused high levels of settlement, with possible implications for the existing foundations.

Client: Royal Mail

Consulting Engineer: Curtins Consulting

Contractor: Fitzpatrick

Volume: 3000m³

Technical Data

Table 5. Physical Properties – Fillmaster

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Fillmaster Grade	FM50	FM70	FM100	FM150	FM200	FM250	FM300	FM350	FM400	FM500
Compressive Stress at 1% strain (kPa)	10	20	45	70	90	100	120	140	160	190

Biological properties

EPS is not susceptible to attack by fungus or bacteria and is non-biodegradable. It offers no nourishment to vegetation or animal life.

Chemical resistance

EPS is resistant to most substances which occur naturally in soil, as well as to a wide range of common substances at ambient temperatures, including:

- alkalis
- dilute inorganic acids
- gypsum plaster
- most alcohols
- portland cement
- silicone oil
- solvent-free bitumen

If there is any possibility that the soil with which it is likely to come into contact is contaminated, for example when constructing embankments on reclaimed industrial land, laboratory tests should be conducted to determine the exact nature of the contaminants. Some materials, including vegetable oils, paraffin, animal fats and oils may attack the surface of the EPS causing shrinkage and deformation. However, they are not able to dissolve the EPS nor to penetrate the mass of the material and do not affect long-term stability.

EPS should not allowed to come into contact with hydrocarbons, chlorinated hydrocarbons, organic solvents such as ketones, ethers and esters; diesel and petroleum fuels; and concentrated acids.

If there is any possibility of contact with these substances, either during or after construction, the material should be protected by using an impermeable polymer membrane as a physical barrier. Further information is available from Vencel Resil's technical services department.

Durability

When correctly specified and installed as a lightweight embankment fill, Fillmaster can be considered as a permanent material. Fillmaster also has the added advantage of being floor-proof.

Mechanical properties

EPS behaves as a linear elastic material up to strains of 1% where the elastic limit is exceeded. A typical stress strain curve is shown in Graph 3. Fillmaster creep deformation can be disregarded in embankment applications.

The coefficient of friction (μ) between blocks is around 0.5 along the moulded faces; the figure is higher on cut faces since the surface roughness is increased.

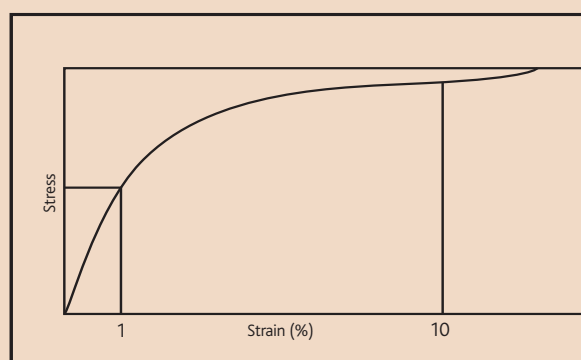
Poissons ratio 0.02.

Moisture properties

EPS is not soluble in water and will not usually exceed a moisture absorption level of 8-10% after long-term immersion.

The closed-cell structure prevents the migration of liquids through the mass of the material.

Graph 2. Typical stress strain curve



Fire

Fillmaster is normally supplied as Euroclass F material as defined in BS EN 14933: 2007; Euroclass E, flame-retardant additive material is also available. EPS will ignite on contact with an open flame and will burn readily in the presence of air. Care should be taken during construction to ensure that the material is not exposed to possible sources of ignition. The use of the flame-retardant additive material will inhibit the early stages of the development of a fire.

Small quantities of residual blowing agent may be present and advice should be sought from Vencel Resil's technical services department when incorporating the product in areas of low natural ventilation.

Fire is not normally a hazard once the material has been placed and covered.

Combustion

EPS is 'combustible' as defined in BS 476:Part 4. When burning, EPS behaves like other hydrocarbons such as wood and paper. For Euroclass F material, the products of uncontrolled combustion are carbon monoxide, carbon dioxide, styrene, and water vapour; the decomposing styrene will emit a certain amount of dense black soot. Euroclass E material also emits hydrogen bromide when burning.

Ignition temperature

Flash ignition temperature is between 350 and 490°C depending on the application and the exact circumstances of use. Under certain circumstances the material can be readily ignited by a naked flame, but providing it is correctly installed this does not present any disadvantage in use.

Calorific value: 40MJ/kg.

Specific heat capacity: 1.13kJ/kg°C.

Environmental issues

EPS does not contain or produce HCFCs, nor are these compounds used in its manufacture. In use, it is non-toxic, non-irritant and odourless.

Due to the high volume and low weight of a lorry load of Fillmaster there are environmental advantages over traditional materials in reducing the number of lorry runs required to supply a contract. This can be particularly advantageous in built-up environments. (90m³ of EPS compared to typically 10m³ of traditional fill per lorry load).

The low density of Fillmaster, which is typically 95-98% air, directly reduces the volumes of quarried materials required.

Health & Safety

EPS scores particularly highly when it comes to health and safety. It has many positive attributes, not the least of which is its proven safety record from production through useful life to recycling. EPS is non-toxic and biologically inert. The material is not irritating to the skin or eyes; no medical treatment or action is required as a result of accidental ingestion.

No special precautions are required during handling or cutting where carried out in a well ventilated area. Dust produced by cutting is very light and may cling to the skin or clothing through static electricity; it may be simply brushed away.

The volume of air in EPS boards is 98%, consequently the components in a given volume are correspondingly low, typically 15 to 50 kg/m³. In polystyrene, styrene monomer, shown to be safe in use, constitutes up to 0.1% by weight of the product. This minute trace of styrene monomer constitutes no threat to health.

The expanding agent pentane, is a saturated hydrocarbon (not to be confused with (HCFCs) and is non-toxic and constitutes no threat to the ozone layer. Euroclass E, flame-retardant additive material, contains around 0.5% of the flame retardant hexabromocyclododecane (HBCDD) which is entrapped in the polymer matrix of the EPS. The HBCDD additive should not be confused with aromatic flame retardants (such as PBBs and PBBOs).

Floors | Walls | Roofs

Table 2.1

R-value	U-values					
	0.25 W/m ² K	0.22 W/m ² K	0.20 W/m ² K	0.18 W/m ² K	0.15 W/m ² K	0.10 W/m ² K
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.10	0.10	0.10	0.10	0.10	0.10	0.10
0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.20	0.20	0.20	0.20	0.20	0.20	0.20
0.25	0.25	0.25	0.25	0.25	0.25	0.25
0.30	0.30	0.30	0.30	0.30	0.30	0.30
0.35	0.35	0.35	0.35	0.35	0.35	0.35
0.40	0.40	0.40	0.40	0.40	0.40	0.40
0.45	0.45	0.45	0.45	0.45	0.45	0.45
0.50	0.50	0.50	0.50	0.50	0.50	0.50
0.55	0.55	0.55	0.55	0.55	0.55	0.55
0.60	0.60	0.60	0.60	0.60	0.60	0.60
0.65	0.65	0.65	0.65	0.65	0.65	0.65
0.70	0.70	0.70	0.70	0.70	0.70	0.70
0.75	0.75	0.75	0.75	0.75	0.75	0.75
0.80	0.80	0.80	0.80	0.80	0.80	0.80
0.85	0.85	0.85	0.85	0.85	0.85	0.85
0.90	0.90	0.90	0.90	0.90	0.90	0.90
0.95	0.95	0.95	0.95	0.95	0.95	0.95
1.00	1.00	1.00	1.00	1.00	1.00	1.00

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