



## The Incomat® system: Basic principle

**Incomat®** is essentially a geotextile lost form-work. Two layers of synthetic fabrics are internally connected by spacing binders: by varying the length of these spacing elements the thickness of the mattress is controlled. The internal space created is filled with fine aggregate concrete by pumping.

This combination of geotextile mattress with concrete filling constitutes the **Incomat®** system, which has been providing successful erosion protection and sealing functions to projects for almost 50 years.







# Incomat® - Advantages

The different **Incomat®** types offer versatile application possibilities. The general advantages of the **Incomat®**-system are:

- **Incomat®** can be installed above and below the water surface without any difficulty.
- The system offers sealing in combination with protection (**Incomat®** Standard)
- Long term experience (first projects in the 1960's)
- Simple installation; No time-consuming wooden formworks are required
- High UV-resistance and increased abrasion resistance compared to other systems (like Flexible Membrane Liners)
- Good resistance to alkalis, acids, organic solvents and biological active materials
- Extremely durable protection and lining system
- Geotextile separation between the subgrade and the concrete
- Predetermined mattress shape; thickness from 6 cm up to 60 cm
- Different coefficients of hydraulic friction from low to high available
- During filling the mattress adapts to the subgrade due to the flowing concrete
- Controlled thickness of mattress – even on sloping ground



*Connection by industrial zippers*

The **Incomat®** system is a very versatile system: the geotextile encasement can be varied in shape, permeability (e.g. Filter Points) and thickness. Additionally different types of **Incomat®** mattresses can be combined and joined by site sewing or factory installed industrial zippers. Moreover the mattress characteristics can be varied by using different concrete admixtures to obtain the desired strength and durability of the finished mattress. As the porous mattress fabric allows the slow release of excess water from the concrete mixture, the strength cured of the concrete filling is increased.

This concrete filled geotextile “envelope”-system allows for fast and economic construction in numerous applications. The **Incomat®** system offers many advantages over conventional methods such as cost effectiveness, strength, flexibility, durability, hydraulic efficiency and minimal maintenance.



*Installed 1977 – Condition 2008*

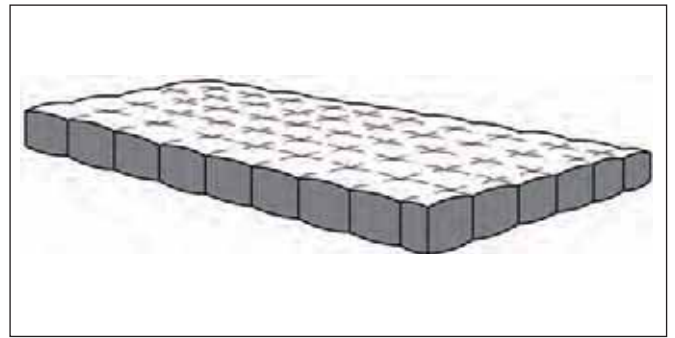
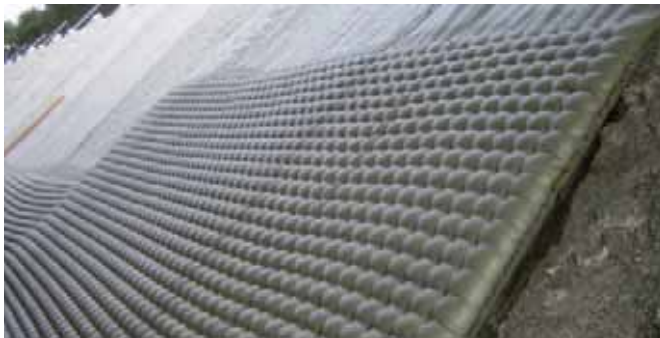


*Installed 1973 – Condition 2010*

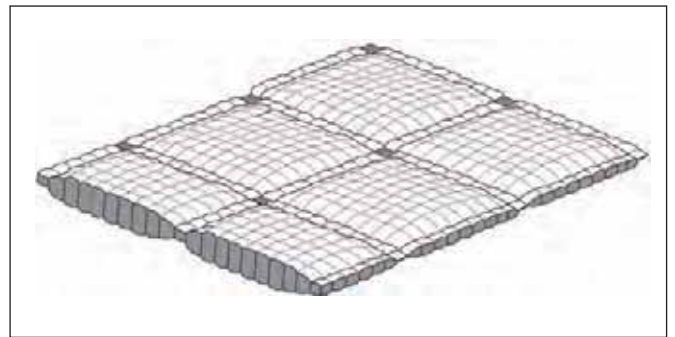


# Incomat® - Types and Applications Overview

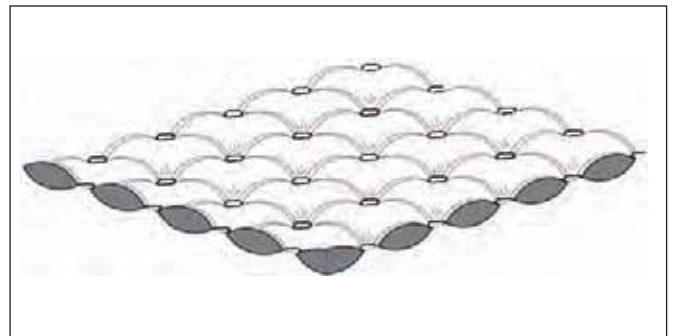
Incomat® comes in four versions:



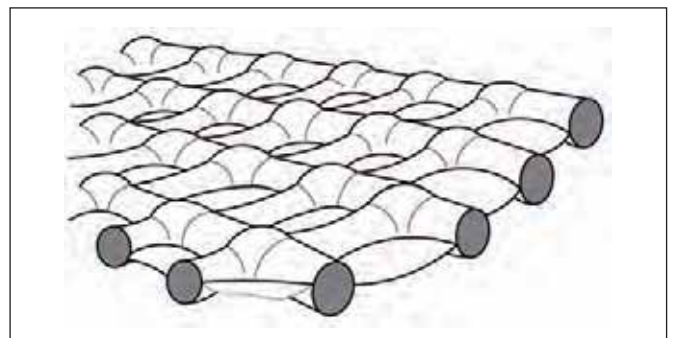
**Incomat® Standard** with continuous, solid cross-section for erosion protection and sealing works.



**Incomat® Flex** cushion mat for erosion protection with “hinged” intermediate junctions allowing certain flexibility and minor drainage through the mat by the incorporated drainage points.



**Incomat® FP (Filterpoint)** for erosion protection with multiple drainage points for low hydrostatic pressures applications.



**Incomat® Crib** a tubular grid profile mat with unfilled central apertures for technical/environmental slope protection above the permanent water surface, especially where establishment of vegetation is desired.

# Incomat® - Application Areas



**Incomat®** provides a wide application range from hydraulic to ground engineering. Primarily Incomat is used as erosion protection in hydraulic and coastal works. Common application areas are:

- Channel bed and slope protection
- Berth protection
- Stormwater holding (attenuation ponds)
- Stormwater overflow structures
- Detention reservoirs
- Shroud for pipes and inverted siphon systems
- Overflow sections of dams
- Weir structures
- Irrigation Canal sealings/remedial repairs
- Discharge canals
- Drainage ditches
- Ponds / reservoirs
- Spillways



# Incomat® - Installation



Installation of **Incomat® Crib**

**Incomat®** panels are prefabricated at our factory. On the construction site these individual segments can be sewn or zipped together with special manual sewing machines or factory incorporated industrial zippers in order to create large panels. Subsequently the panels are laid out on the prepared and leveled installation area. After securing the **Incomat®** panel in place (by anchors or anchoring trenches) the filling with fine aggregate concrete can be carried out. The pumping process should be carefully controlled to ensure a satisfactory installation is achieved. Under water installation requires the aid of divers in order to control the degree of filling of the mattress as well as the proper installation locations.

With respect to soil erosion beneath the permeable mattresses (**Incomat® Flex**, **Filterpoint**, **Crib**) and regarding the long-term performance of the filter points it is recommended to install a non-woven geotextile beneath these types of mattresses. This measure effectively increases the overall system stability. The non-woven can be factory stitched to the **Incomat®** panels if required thus the additional of a non-woven does not result in an additional installation step.



Installation of **Incomat® Flex** under water



Installation of **Incomat® Flex**

# Incomat® - Standard



*Progressive filling process of **Incomat®***

The primary functions of **Incomat®** Standard are erosion protection or sealing, the two functions can even be combined. Less common applications for **Incomat®** Standard are for use as a protective layer or as negative buoyancy for pipes and inverted siphons.

**Incomat®** Standard consists of two layers of synthetic material connected with high-strength spacing elements of equal length, which are attached into the fabric in pairs in a square grid pattern, thus guaranteeing a uniform cross-section thickness after filling with concrete.



***Incomat®** Standard panels prepared for filling with concrete.*



# Incomat® - Standard

By altering the length of the spacing binders different mattress thicknesses from 6 cm to 60 cm can be produced. Therefore a constant lining is achievable which creates a solid, high quality concrete lining.

**Incomat®** Standard can adapt to corners, curvatures and bends while it's being installed and once hardened it forms a durable and impermeable protective layer.

After filling with fluid concrete the surface and the visual appearance of the mattress is slightly dimpled. This slightly undulating surface is the reason for relatively low hydraulic resistance.

After completion of work an installed **Incomat®** Standard section is comparable to a traditional concrete slope paving (permeability approximates to that of high quality concrete pavements).

The significant difference is the simplified installation procedure and the associated cost savings of the **Incomat®** system.

As the uniform cross-section provides maximum impermeability **Incomat®** Standard is the first choice for erosion protection works in combination with sealing requirements.



*Filling process (1)*



*Installation with complicated geometric shapes (2)*



*Incomat® Standard as a negative buoyancy collar for an inverted siphon system*



*After completion (3)*

# Incomat® - Flex



Slope protection with **Incomat® Flex**

The heavy duty compartments are interconnected by thinner webs. Interwoven filter points in the crossover points of the webs permit a hydrostatic pressure relief and therefore further increase the system stability, e.g. wave induced uplift pressures during wave run-down. The webs, as predetermined breaking zones in the event of extreme loads, also offer a certain two-dimensional pliability in the case of unexpected subsoil settlements or undermining effects of the concrete mattress. In such

an extreme and extraordinary case the fabric and the spacing binders, acting as reinforcement, still keep the individual elements in place and permit a certain degree of articulation.

Note that the thinner cross-section of the intermediate junctions does not affect the filling process of the mattress.



Slope protection with **Incomat® Flex**



# Incomat® - Flex



*Erosion problems at outlet structure (1)*



*Slope preparation (earth works) (2)*

The fundamental purpose of **Incomat® Flex** is to resist higher hydraulic loads. This is achieved by the specially designed dimension and shape of the **Incomat® Flex** system. Once filled, the **Incomat® Flex** becomes a mattress of cushion-shaped, almost square concrete blocks arranged in a regular checkerboard pattern. Modifying the spacing binder length enables the creation of thick section of **Incomat® Flex** which, with their inherent weight, counteracts destructive hydraulic forces. With increasing cushion size an increase of the hydraulic roughness is realised.



*Installation (filled and unfilled section) (3)*



*Repaired outlet after completion (4)*

# Incomat® - Filterpoint (FP)



Slope protection with **Incomat® FP**

**Incomat®** Filterpoint is again a double-layer fabric which is joined by interwoven filter points on regular spacings to form a deeply cobbled appearance. This type of concrete-filled mattresses is typically installed wherever relatively small hydrostatic loads occur. The rigid mat with filter points (drains) provides an effective permeable concrete lining for structures constructed

over firm subgrades with relatively low hydrostatic loads.

The cobblestone type design of the mat makes it easily adaptable to all kinds of slope profile. It also reduces the volume of flow of incoming and receding waves and of flowing water.



**Incomat® FP** prepared for installation (1)



**Incomat® FP** after filling with concrete (2)



# Incomat® - Filterpoint (FP)



*Installation process*



*After completion [2]*

The **Incomat®** Filterpoint mattress, with its undulating surface, can be used to attenuate hydraulic energy in order to achieve lower velocities and reduce wave run-up. The cobbled surface has a higher coefficient of hydraulic friction, providing a significant advantage over a mass concrete slab. In general **Incomat®** Filterpoint is used in lieu of stone riprap or slope paving due to the lower cost and higher performance.

An **Incomat®** Filterpoint lining has greater stability than conventional slope paving because of several factors – it can mitigate uplift pressure from ground water, reduce hydraulic uplift of flowing water by slowing channel velocities, and conform to soil contours during installation to reduce the potential for underscour.



*Completed canal lining using **Incomat®** FP*

# Incomat® - Crib



Sewn connection between two **Incomat®** Crib panels (left unfilled – right filled)

**Incomat®** Crib consists of tubular elements filled with micro concrete which are interlinked in a grid and provide open apertures, between the ribs. The two layers of fabric are woven to make square or rectangular frame shapes. A single geotextile layer remains within each central aperture after the cementitious fill hardens. This single fabric layer may be cut to allow planting of vegetation or it may be covered with

small cobbles to simulate the rectangular patterned appearance of normal slope pavings. Optionally, the latter can be filled with top soil and seeded or plant boxes can be placed in them immediately after installing the mat. Due to these large permeable areas of **Incomat®** Crib no hydrostatic uplift pressures can form beneath the concrete mattress.



Attenuation pond with **Incomat®** Crib during construction (1)



Attenuation pond with **Incomat®** Crib after apertures have been filled with soil (2)



# Incomat® - Crib



*During installation (1)*



*Filling with soil (2)*

In general, this tubular grid profile mat is used to provide technical/environmental slope protection for lakes and flowing bodies of waters in the water-washed area and above the waterline. Moreover it offers effective and sufficient protection against periodic high floods.

After greening **Incomat®** Crib provides an aesthetic and environmentally compatible erosion protection. Finally it must be stated that this lattice-type mat enables engineers to create vegetated, engineered surfaces above the permanent water line.



*Established vegetation after construction (3)*

