



# **FRASER BROWN & STRATMORE LTD.**

**Products for Concrete and Construction**

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**INVINCIBLE**

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## **The use of Krystol Internal Membrane in Concrete Structures with New Zealand**

### **Product:**

The Krystol Waterproofing System consists of products based on reactive, crystalline ingredients used to create waterproof concrete. The system is used to protect below ground concrete from water penetration and to create watertight contain structures such as reservoirs, basements, carparks, liftwells, tunnels and other below-grade structures, . It is also used to for above ground concrete to provide increased water resistance and durability in structures such as balconies, roof slabs, walkways, patios, decks, parking structures etc.

The system is based on the admixture, Krystol Internal Membrane (KIM). In New Zealand, we supply KIM-HS, a specialized version that typically entrains less than 1% air. The Krystol Waterstop system for concrete joints, consisting of Krystol Waterstop Grout and Krystol Waterstop Treatment, completes the system.

### **Scope:**

The use of the Krystol Waterproofing System to create watertight structures requires specific design. Building designers are responsible for incorporation of the system following the details of this document and guidance provided by Fraser Brown and Stratmore Ltd. The designer must provide design and installation detailing within the contract documents.

The use of the Krystol Waterproofing System in concrete that does not conform to the guidelines of this document may be permissible provided that the following conditions are met:

1. The treated concrete is either not subject to hydrostatic pressure, does not form a tanked structure (i.e. footings) or the Krystol Waterproofing System is incorporated as part of a secondary system.
2. The proposed application is reviewed and approved by Fraser Brown and Stratmore Ltd.

### **Technical Specifications:**

Materials supplied by Fraser Brown and Stratmore Ltd. include:

1. Krystol Internal Membrane – HS (KIM-HS)
  - a. Is a crystalline admixture in powder form added at 2% of cementitious content to make concrete waterproof. Secondary properties include 1-2% air entrainment, reduced shrinkage and longer setting times. KIM-HS is supplied in 25 kg pails, 5kg or 10 kg mixer-ready bags.

2. Krystol Waterstop Grout (KWG)
  - a. Is a hydraulic grout containing crystalline waterproofing ingredients used in conjunction with Krystol Waterstop Treatment to waterproof joints and penetrations in KIM or KIM-HS treated concrete. Krystol Waterstop Grout is supplied in 25 kg pails.
  
3. Krystol Waterstop Treatment (KWT)
  - a. Is a hydraulic treatment containing crystalline waterproofing ingredients used in conjunction with Krystol Waterstop Grout to waterproof joints and penetrations in KIM or KIM-HS treated concrete. Krystol Waterstop Treatment is supplied in 25 kg pails.

### **Handling and Storage:**

Handling and storage of all materials whether on or off site is under the control of the trained and approved concrete provider. Dry storage must be supplied for KIM and KIM-HS admixture supplied in mixer-ready bags.

### **Technical Literature**

Technical Literature and design details are available from Fraser Brown and Stratmore Ltd.

### **Design Information:**

The use of the Krystol Waterproofing System to create watertight structures requires specific design. Building designers are responsible for incorporation of the system following the details of the datasheets and guidance provided by Fraser Brown and Stratmore Ltd. The designer must provide design and installation detailing within the contract documents.

The use of the Krystol Waterproofing System concrete that does not conform to the guidelines of this document may be permissible provided that the following conditions are met:

1. The treated concrete is either not subject to hydrostatic pressure, does not form a tanked structure (i.e. footings) or the Krystol Waterproofing System is incorporated as part of a secondary system.
2. The proposed application is reviewed and approved by Fraser Brown and Stratmore Ltd.

Concrete treated with KIM admixture must be supplied by a concrete supplier approved by Fraser Brown and Stratmore Ltd.

The components of the Krystol Waterstop System must be installed by applicators approved by Fraser Brown and Stratmore Ltd.

## Concrete Mix Design

- Minimum Portland cement content of 250 kg/m<sup>3</sup> for all concrete containing KIM or KIM-HS admixture.
- Dose KIM or KIM-HS at 2% by weight of total cementitious material (cement + supplementary cementitious materials such as fly ash, slag or silica fume) to a maximum of 8 kg/m<sup>3</sup>.
- Maximum water-to-cementitious ratio of 0.50 for KIM-HS treated concrete.
- The addition of 1 x 0.68kg bag of Fibermesh 150 fibres (appraisal number 616) is recommended to help control plastic shrinkage cracking.
- For best performance, use 30MPa concrete mixes, especially for elevated slabs.

## Structural Design:

All concrete incorporating KIM-HS admixture must conform to the following criteria:

- Concrete must be proportioned according to the relevant NZ codes.
- Concrete structures incorporating KIM-HS admixture must be designed to the relevant sections of applicable building standards.

## Concrete Permanently Exposed to Water:

(Slabs on Grade, Foundation Walls, Retaining Walls, Water Containment or Similar Structures)

- 150 mm minimum thickness for KIM-HS treated concrete of adequate strength and properly reinforced and jointed as per structural design above.
- A level of reinforcing suitable for the intended purpose of the structure incorporating KIM-HS to ensure cracks are kept below 0.3mm width.
- KIM-HS treated concrete is not suitable for inclusion in unreinforced concrete slab on grade applications as an acceptable solution for vapour flow resistance to E2/AS1.

## Concrete Structures Intermittently Exposed to Water:

(Elevated Slabs, Roofs, Ramps, Balconies, Walkways or Similar Structures)

- 100 mm minimum thickness for KIM or KIM HS treated concrete of adequate strength and properly reinforced and jointed as per structural design above.
- A level of reinforcing suitable for the intended purpose of the structure incorporating KIM or KIM-HS to ensure cracks are kept below 0.3mm width.
- If project specifications require concrete sections thinner than 100mm, consult Fraser Brown & Stratmore Limited. Consideration must be given to the design to ensure that any potential reflective cracking is well controlled – see also Installation Information and consult Fraser Brown & Stratmore Limited for additional details.

## Other Applications:

(Block Wall Infill, Footings, Piles, Columns or Similar Concrete Elements)

- KIM or KIM-HS may be used in concrete not conforming to the minimum design requirements as added waterproofing protection however the use of KIM or KIM HS in these applications is as a secondary system and not covered by a performance warranty.
- Block wall infill applications must be a secondary system to an external waterproofing system.

### Joints & Penetrations:

KIM admixture is used to make a waterproof membrane out of the concrete/shotcrete. This is different from traditional construction, where the concrete just forms the structure. **The KIM concrete will usually be the only barrier to water penetration. This means that common defects found in typical concrete cannot be tolerated. Poor consolidation, unplanned cold joints, random cracking, penetrations, contaminations, etc. will all result in a leaking structure if not accounted for in the design.**

### Cold Joints and Penetrations:

- Consult Fraser Brown and Stratmore Ltd for waterproofing details for cold joints and penetrations in KIM treated concrete.

### Contraction Joints:

- If a sizeable length or expanse of concrete is not provided with adequate joints to accommodate shrinkage, then it will make its own “joints” by cracking. The use of contraction joints is the most effective method of preventing random cracking in concrete elements, and allows cracking to be isolated to areas that can be conveniently treated with the Krystol Waterstop System.
- It is particularly important to control or eliminate cracking when external waterproofing membranes are not being installed.
- Each job must be studied individually to determine where joints must be placed. The locations of joints, penetrations and embedded items must be indicated on the project drawings and be acceptable to the architect/engineer.
- Contraction joints must be placed at all locations prone to cracking, such as abrupt changes in concrete height, thickness or direction, and around penetrations.
- Alternatively, concrete slabs can be poured in separate strips to control shrinkage with waterstops installed between the strips with the guidance of Fraser Brown and Stratmore Ltd.

### Contractions Joints for Concrete Slabs:

- Depth: 25% of slab thickness or a minimum of 25mm.
  - o Preferred dimensions are 40mm deep and 25mm wide for the installation of the Krystol Waterstop System.
- Formation:
  - o Plastic concrete – insert grooves of wood, metal, plastic or other preformed material until it is flush with the concrete surface.
  - o Hardened Concrete - Saw cut grooves timed with the setting time of the concrete so that coarse aggregate cannot be dislodged during cutting (typically 4-6 hours after the concrete hardens). Saws should be completed before drying shrinkage can induce cracking.

Note – Saw cut joints are too narrow to install the Krystol Waterstop System; use the Krystol Crack Repair system to waterproof the saw cut joint – see datasheet for details.

## Joint Spacing Guidelines (in meters) for Concrete Flatwork with Low-Normal Shrinkage

### Characteristics:

<b>Slab Thickness (mm)</b>	<b>Max size aggregate &lt; 20mm</b>	<b>Max size aggregate &gt; 20mm</b>
100	2.4	3.0
125	3.0	3.75
150	3.75	4.5
175	4.25	5.25*
200	5.0*	6.0*
225	5.5*	6.75*
250	6.0*	7.5*

Given spacing are generally appropriate for slumps between 100-150mm. Shorter spacing may be required if the concrete is expected to cool rapidly or is expected to have higher than normal shrinkage.

\*Spacing exceeding 4.5m will markedly reduce load transfer by aggregate interlock.

Adapted from Design and Control of Concrete Mixtures (Portland Cement Association)

It is not recommended to extend joint spacing beyond 5m as uncontrolled cracking could occur.

### Contractions Joints for Concrete Walls:

- Joint Spacing:
  - o Joints should be provided at all abrupt changes in thickness or height, and within 3-4 meters of corners.
  - o Dimensions = Depth = 40mm, width = 25mm.
- Formation – Wood, metal or plastic strips attached to forms.

Waterproofing - unless otherwise advised by Fraser Brown and Stratmore Ltd, the Krystol Waterstop System must be installed at all contraction joints in accordance with the manufacturer's instructions.

### Durability:

The Krystol Waterproofing System, when used as a tanking, waterproofing and damp proofing material, is expected to have a service life of at least 50 years provided that it is installed and maintained in accordance with this certificate and is protected from physical damage.

### Maintenance:

No maintenance is required to preserve the waterproofing performance of concrete treated with the Krystol Waterstop System provided that significant building movement or cracking does not occur. Regular checks must be made for cracks or damage, and Fraser Brown and Stratmore consulted regarding waterproofing related repairs.

Inspection and maintenance related to the structural performance of the treated concrete is beyond the scope of this document.

## External Moisture:

The Krystol Waterproofing System, when installed in accordance with this certificate, will provide an effective barrier to liquid water penetrating into the interior face of basement retaining walls, floors and plaza roof decks.

When resistance to water vapour penetration is required, building designers are responsible to ensure that the concrete is of sufficient density and thickness to ensure a vapour flow resistance of not less than 90 MN s/g. When KIM HS is incorporated into concrete meeting the concrete mix and structural design criteria listed above, the concrete will provide vapour flow resistance of not less than 90 MN s/g.

The system forms sealed joints and seals at penetrations provided such areas are not subject to movement. Fraser Brown and Stratmore Ltd must be consulted regarding the waterproofing of joints intended to move such as expansion joints.

Building designers must ensure junctions with other waterproofing materials, such as membranes or waterstops, form a waterproof joint. Junctions with other waterproofing materials have not been assessed and are outside the scope of this document.

## Installation Information:

### KIM or KIM-HS treated concrete:

- Concrete batching, delivery and placement must conform to NZ codes
- Concrete must be delivered by a Fraser Brown and Stratmore approved concrete supplier.
- Dose KIM or KIM-HS admixture at a central batch plant or on-site if appropriate mix control can be maintained.
- Mix KIM or KIM-HS admixture for a minimum of 10 minutes prior to discharging.
- On-site concrete quality control must conform to NZ codes
- Concrete forms must be clean, secure and mortar tight.
- Reinforcement must be free of loose rust or scale and braced to prevent excessive vibration.

The purpose of using KIM or KIM-HS admixture is to create a waterproof membrane out of the concrete. This requires superior concreting procedures and workmanship; the following three instructions are critical:

- All concrete must be fully consolidated, particularly at construction joints, as voids or rock pockets will leak. Consolidation is best achieved by internal or external vibration as per NZ (code).
- Freshly place concrete must be protected from extreme temperatures or drying conditions as needed. Protect concrete in hot or cold weather as appropriate and use an evaporation retarder such as ER-921 from Fraser Brown & Stratmore Limited during placing.
- All concrete must be cured by moist curing or with an approved curing membrane (such as Fracure or Fracure Emulsion manufactured by Fraser Brown & Stratmore Limited following the procedures in NZ (code). Allow the concrete to be moist cured for at least a few days, followed by a curing compound.

### Inspection:

The contract documents must be referred to during the installation of the Krystol Waterproofing System by building consent authorities or territorial authorities. Critical areas of inspection are:

- KIM or KIM-HS admixture is added at the specified dosage.
- KIM or KIM-HS treated concrete is batched, placed, consolidated, protected and cured according to accepted concrete practices, instructions from Fraser Brown and Stratmore Ltd and the relevant sections of NZ (code).
- Construction joints are prepared and waterproofed according to the guidance of Fraser Brown and Stratmore Ltd.
- Control joints are suitably spaced to prevent random cracking, and are waterproofed as per the guidance of Fraser Brown and Stratmore Ltd.
- The KIM Quality Assurance check sheets and supporting documentation must be completed and returned to Fraser Brown & Stratmore Limited as required by contract.

### Health and Safety:

Safe use and handling procedures for the components of the Krystol Waterproofing System are in the technical literature. The safe handling of KIM or KIM-HS treated concrete is no different than untreated concrete.