DETAILED SYSTEM SPECIFICATION

1.1 General

This section covers the waterproofing for all underground structures by means of a **KRUBBER® Base-X,** prefabricated composite elastomeric terpolymer waterproofing membrane installed continuously under raft slab, on retaining wall and basement roof top slab.

The waterproofing shall be such that all underground structures with waterproofing systems are watertight. The basement sections along which the installation of a waterproofing system will be required, will be approved by the manufacturer and the engineer.

1.2 Description

The purpose of the membrane waterproofing to underground structures is to prevent leakage of groundwater into the basement and to protect the interior of the basement against the ground water and deleterious chemical influences. Waterproofing shall be applied under the raft slab, over the retaining wall and basement roof slab. The waterproofing membrane shall always be continuous and provide an envelope to the entire underground structure.

1.2.1 For raft slab, retaining wall and basement roof slab:

Under Raft Slab and Confined Retaining wall, Waterproofing membrane shall be minimum 1.8 mm thick **Krubber Base-XH**, prefabricated composite elastomeric terpolymer waterproofing membrane, designed for watertightness, fully bonded grip and better resistance to wear and tear. Prefabricated composite membrane shall have elastomeric terpolymer core of minimum 1.2 mm thick engaged with geotextile fleece on both the sides.

Waterproofing membrane shall be loosely laid over a compacted surface with minimum 95% proctor compaction density or PCC. Thereafter, Raft slab is directly casted over waterproofing membrane and thus fully bonded with raft concrete from beneath. For Confined retaining wall, Waterproofing membrane shall be installed over shoring piles /skinwall/diaphragm wall.Thereafter ,retaining wall shall be casted against waterproofing membrane with single side shutter on internal side

For Retaining wall in unconfined application i.e on positive face of retaining wall , Waterproofing membrane shall be minimum 1.5 mm thick **Krubber Base-XV**, prefabricated composite elastomeric terpolymer waterproofing membrane, designed for watertightness, fully bonded grip and better resistance to wear and tear. Prefabricated composite membrane shall have elastomeric terpolymer core of minimum 1.2 mm thick engaged with geotextile fleece on one side.

For Unconfined retaining wall, the waterproofing membrane is fully adhered and bonded onto prepared concrete surface and shall be then followed by dimple drain geocomposite

protective board bonded with adhesive to Membrane or a Dash coat of 8 to 10mm in CM(1:4).

While the waterproofing and sealing function shall be provided by the elastomeric terpolymer core of composite membrane, the layer of inbuilt geotextile fleece is required to fully bond with concrete and to protect the waterproofing membrane against damage from reinforcement cage, backfilling and other wear and tears on site.

1.2.2 For construction joints, waterstops shall be installed and additional waterproof mortar grouts can be injected at honeycomb and leaking areas.

1.2.3 Pressure release pipe shall be placed in PCC subgrade layer in a grid pattern and the diameter of pipe shall be decided, based on the uplift water pressure.

1.2.4 Active or Passive Rock anchors shall be grouted with non-shrink high strength grouts/epoxy mortar and further treated with Krubber Lapseal, liquid applied sealant around the periphery of anchors.

1.3 Submissions

The following submissions shall be furnished for approval in accordance with the contract requirements:

1.3.1 Certificates of compliance attesting that the materials meet specifications.
1.3.2 Samples
1.3.3 Shop drawings

1.4 Quality Assurance

Manufacturer's representative shall be present at least during the first installation of waterproofing systems on site.

Execute all installation and testing under the direct supervision of an individual with recent continuous, acceptable experience in the installation of waterproofing membrane.

Provide all personnel involved in waterproofing system installation and testing with adequate training prior to beginning work.

Installation records are to be submitted to the Engineer for approval with all relevant data for all checks etc. These records shall form a part of the submission to obtain approval to proceed with the installation subsequent layers over waterproofing system.

1.5 Materials

1.5.1 Krubber Base-X, composite elastomeric Terpolymer waterproofing membrane

The waterproofing membrane shall be Composite prefabricated elastomeric terpolymer waterproofing membrane. It shall be able to meet requirements listed below in **Table 1.**

Table 1: Composite prefabricated elastomeric terpolymer Waterproofing membrane characteristics

No.	Parameter	Test Method	Performance Spec as per ASTM Standard	Test Values
1	1.1) Under Raft and Confined Retaining wall: **Krubber Base-XH**, Thickness of Composite Terpolymer Membrane with Fleece on both sides (mm), 1.2) For Retaining Wall (Unconfined) and Basement roof slab : **Krubber Base-XV** , Thickness of Composite Terpolymer Membrane with Fleece on one side (mm)	ASTM D-412	-	1.8 1.5
2	Thickness of Terpolymer Membrane Core (mm)	ASTM D-412	1.2 (+15% / -10%)	1.2
3	Specific Gravity of Terpolymer Membrane Core (g/cm3)	ASTM D-297	1.23 (+/- 10%)	1.23
4	Tensile Strength (MPa) Terpolymer Membrane core	ASTM D-412	9 (Min)	9.8
5	Elongation ultimate (%) Terpolymer Membrane core	ASTM D-412	300 (Min)	410
6	Tensile Set (%) Terpolymer Membrane core	ASTM D-412	10 (Max)	8
7	Tear Resistance (kN/m) Terpolymer Membrane core	ASTM D-624	26.27 (Min)	29
8	Brittleness Point (°C) Terpolymer Membrane core	ASTM D-2137	(-45) Max	-48
9	Ozone Resistance Terpolymer Membrane core, No Cracks	ASTM D-1149	Pass	Pass
10	Heat Aging of Terpolymer Membrane core	ASTM D-573		
	Tensile Strength (MPa)	ASTM D-412	8.30 (Min)	8.5
	Elongation Ultimate (%)	ASTM D-412	210 (Min)	285
	Tear Resistance (kN/m)	ASTM D-624	21.9 (Min)	22.5
	Liner Dimension Change Max (%)	ASTM D-1204	±1	+0.2
11	Water Absorption of Terpolymer Membrane core (Mass %)	ASTM D-471	+4	+2
12	Weather Resistance of Terpolymer Membrane core Visual Inspection No Cracks or Crazing	ASTM G -155 ASTM G-151 ASTM D-518	Pass	Pass
13	Puncture Resistance (Kgs) of Terpolymer Membrane core	ASTM D-5602	32	42
14	Hardness (Shore A) of Terpolymer Membrane core	ASTM D-2240	60 (+/- 10)	62
15	Fleece Material	-	PP/PE	PP/PE

The above-mentioned material specification shall comply with the properties in ASTM D 7465 Standard spec for geomembrane waterproofing membrane applications in underground / Below grade. The Krubber Base-X Waterproofing system is also in compliance with BS 8102-2022 TYPE A.

1.5.2 Accessories

Fixing and sealing material, flashing, sealing flanges and preparation of corners and intersections, termination bars etc. shall be made as recommended by the manufacturer of the membrane.

1.6 Application

Prior to the application of the waterproofing, all surfaces to which it shall be applied, shall be inspected and approved by the Engineer.

The application shall follow the written Instructions of the manufacturer. Generally, procedures are as follows:

1.6.1 FOR RAFT:

Prerequisite

The PCC subgrade slab shall be free from stagnant water, debris, oil spills, mud, muck, slush etc.

The PCC layer shall be cured enough before starting the waterproofing works.

In case of compacted earth as a substrate, minimum 95% of proctor compaction density shall be achieved.

The sharp matters from the workplace shall be removed or barricaded.

Designated areas shall be marked for waterproofing works and no other trades shall be permitted within that area.

The crane movements shall be planned to avoid any safety hazards.

Loading and unloading of material by other trades within the designated waterproofing workplace area shall not be permitted.

The site shall be lightened and dewatered enough to carry out the waterproofing works during execution.

SUBSTRATE PREPARATION

All prerequisites shall be met prior to installation of the **KRUBBER Base-XH waterproofing system** for raft slab.

Any defects in the substrate need to be corrected and the final surface has to be prepared to meet the requirement.

PLACING & RESTING OF KRUBBER® Base-XH waterproofing membrane

Place the membrane roll as close as possible to its final position over the properly compacted earth or cured PCC substrate. It is easier to locate the roll in this position than to have to reposition the membrane sheets after they have been unrolled. Then all membranes shall be unrolled, unfolded and positioned without stretching. To keep allowances for overlaps, the sheets can be moved sideways over the substrate by floating and allowing air underneath. Prior to any attachment, cutting or splicing, each sheet shall be allowed to relax a minimum of 45 minutes.

OVERLAPS AND SEAMS of KRUBBER® Base-XH waterproofing membrane

Position adjoining sheets with an overlap of 50 to 75 mm as side laps as well as for end laps. Fold the first membrane back, evenly onto itself so as to expose the underside and the substrate. The sheet fold should lay smooth so as to minimize the formation of wrinkles during and after installation. Before applying KRUBBER adhesive for seams, remove excess of dust or other foreign loose particles from the overlap portions.

Overlaps of the KRUBBER® composite Base- XH waterproofing Membrane sheets are to be fully bonded with KRUBBER® Adhesive. Stir the KRUBBER® Adhesive before and during application to achieve a uniform mix with no sediment at the bottom. Properly mixed adhesive is critical for desired performance and uniformity of the bond.

The KRUBBER® Adhesive must be applied in a thin even coat on both mating surfaces of overlaps to form a seam. Avoid globs or puddles of adhesive during application. An excess of adhesive will prolong the drying time and reduce production.

Wait until the adhesive is tacky. Drying time will differ with various climatic conditions and coverage rate. Never use a hot air dryer to accelerate this process. Touch the surface with a clean, dry finger to check the adhesive for dryness. When applying the adhesive manually, use rollers to press and apply the adhesive evenly.

LAYING REBARS AND CASTING RAFT SLAB

The Rebars and formwork shall be fixed and rested without puncturing waterproofing system as per the construction schedule. Reinforcement cage shall be carefully installed to avoid any damage to the waterproofing system. Treat puncture if any with Krubber Lapseal liquid waterproofing sealant or a membrane patch.

PROTECTIVE MEASURES

Every care shall be taken not to damage the waterproofing membrane during or after installation. Any damages occurred shall be reported to the Engineer, repaired before the casting of concrete placements.

1.6.2 FOR Retaining wall and Basement roof slab:

Prerequisite

The sufficient space shall be available to install a waterproofing system over the positive face of the retaining wall. In case of blind wall construction i.e unconfined wall , wherein membrane is sandwiched between piles/Diaphragm wall, the sequence of works shall be well defined. Smoothening layer of shotcrete or skin wall over piles/rocky strata is highly recommended.

The RCC substrate shall be free from debris, oil spills, mud, muck, slush etc.

The Retaining wall shall be cured enough and shall be dry before starting the waterproofing works.

The sharp matters from the workplace shall be removed or barricaded by the main civil contractor.

Designated areas shall be marked for waterproofing works and no other trades shall be permitted within that area.

The crane movements shall be planned to avoid any safety hazards. Loading or unloading of material by other trades within the designated waterproofing workplace area shall not be permitted.

The site shall be lightened and dewatered enough to carry out the waterproofing works during execution.

SURFACE PREPARATION

All prerequisites shall be met prior to installation **KRUBBER Base-XV waterproofing system** for unconfined retaining wall ,basement roof slab

Grind the concrete surface to remove all sharp edges. Wash the area to clean all loose particles. Let the surface dry and be free from all kinds of moisture, grease, oil etc which won't allow the adhesion of membrane to the substrate. Any defects in the substrate need to be corrected and the final surface has to be prepared to meet the requirement.

PLACING & RESTING OF KRUBBER® Base-XV waterproofing membrane

The waterproofing membrane shall be placed with a smooth side towards retaining wall surface whereas the fleece side shall be on the external backfilling side. Place the membrane roll as close as possible to its final position. It is easier to locate the roll in this position than to have to reposition the membrane sheets after they have been unrolled. Then all membranes shall be unrolled, unfolded and positioned without stretching. The sheets can be moved sideways over the substrate by floating and allowing air

underneath. Prior to any attachment, cutting or splicing, each sheet shall be allowed to relax a minimum of 45 minutes.

OVERLAPS AND SEAMS of KRUBBER® Base-XV waterproofing membrane

Position adjoining sheets with an overlap of 50 to 75 mm as side laps as well as for end laps. Fold the first membrane back, evenly onto itself so as to expose the underside and the substrate. The sheet fold should lay smooth so as to minimize the formation of wrinkles during and after installation. Before applying KRUBBER®adhesive, remove excess of dust or other foreign loose particles.

BONDING of KRUBBER® Base-XV waterproofing membrane (applicable for positive side unconfined application)

The waterproofing Membrane sheets are to be fully adhered from smooth side to retaining wall surface with KRUBBER® Adhesive. All longitudinal overlap seams shall preferably in vertical plane and or along gradient. Stir the KRUBBER® Adhesive before and during application to achieve a uniform mix with no sediment at the bottom. Properly mixed adhesive is critical for desired performance and uniformity of the bond.

The KRUBBER® Adhesive must be applied in a thin even coat on both mating surfaces of prepared concrete substrate and membrane. Avoid globs or puddles of adhesive during application. An excess of adhesive will prolong the drying time and reduce production. When applying the adhesive manually, use solvent resistant rollers with short hairs to apply the adhesive evenly. Use chalk to mark the overlap area that has to remain clean. Wait until the adhesive is tacky. Drying time will differ with various climatic conditions and coverage rate. Never use a hot air dryer to accelerate this process. Touch the surface with a clean, dry finger to check the adhesive for dryness.

Fixing of KRUBBER® Base-XH waterproofing membrane (In case of confined walls /blind wall sandwich application)

The waterproofing Membrane sheets are to be anchored to shore piles/diaphragm/skin wall with membrane disks/rondels or metal strips in the grid pattern of not more than 1.5m apart. All longitudinal overlap seams shall preferably in vertical plane and or along gradient.

JUNCTION OF RAFT SLAB AND RETAINING WALL

The membrane above the raft slab shall be rolled over in upward direction on the retaining wall, fully bonded with Krubber Adhesive and terminate above toe of retaining wall with termination bar. Thereafter the mother membrane of the retaining wall shall be extended downwards with an overlap of minimum 100 mm and bonded with KRUBBER®adhesive.

SEALING PIPE FLANGES,TRAPS,INLETS AND OUTLETS

The annular gap around pipes/conduits shall be filled with suitable microconcret/foam grouts.

All the pipes/conduits entry and exit shall be sealed with an additional patch of Krubber Base-X membrane with KRUBBER®Lapseal liquid membrane sealant around the periphery of intrusions.

LAYING PROTECTIVE DRAINBOARDS OR LAYER OF CEMENT MORTAR AS PROTECTION LAYER (applicable for unconfined walls positive side application)

Fix dimple drain boards to protect waterproofing membrane and also to facilitate drainage function and lower the hydrostatic pressure on external surface of retaining wall all around the periphery of the basement throughout its height. The overlap between two adjacent drain boards shall be minimum 100 mm. The drain board shall be bonded to Composite waterproofing membrane with spot bond by KRUBBER® Adhesive.
OR
Apply 8 to 10 mm thick cement mortar Dash Coat in CM (1:4) directly on the Composite waterproofing membrane as a protection layer.

BACKFILLING

Only Soft soil shall be permitted for backfilling behind retaining walls and soil compaction shall be done in layers. No boulders and rocks shall be permitted for backfilling as it will damage the waterproofing system.

1.6.3 Testing of Membrane

The installed membrane shall be tested and records of these tests shall be submitted by the Contractor to the Engineer. The purpose of the test is to detect breaches during and after installation of waterproofing membrane before laying any subsequent layers.

Seam Test with probe tester

For seams between adjacent sheets of waterproofing membrane the testing for bonding and fish mouths shall be carried out by means of a sharp probe tester. The probe tester shall be dragged at seam joint longitudinally and if any breach in seam is observed shall be sealed with KRUBBER®Lapseal liquid waterproofing sealant.

Holiday Detection Test

Glide Holiday detection tool on to the membrane by passing minimum 50V current. The machine will beep in case of any breaches or pin holes in the membrane. Further it shall be patched with KRUBBER® membrane or sealing by KRUBBER® Lapseal liquid waterproofing sealant.

1.6.4 Protective Measures

Every care shall be taken not to damage the waterproofing membrane during or after installation. Any damages occurred shall be reported to the Engineer, repaired and tested before the casting of concrete placements or backfilling.

1.7 Measurement and Payment

The quantities of the waterproofing membrane to be paid for shall be measured by the unit of square meters Installed. The finished waterproofed area shall be measured after the fixing and finishing of the waterproofing work and shall not include overlaps, folding, and any wastage etc.

The payment shall include all materials and work required to carry out the work in accordance to specifications and shown on the drawings or as instructed by the Engineer.

1.8 Warranties

Waterproofing system shall be warranted for good performance for the period of minimum 15 years for product and installation. In case, any third-party damage is observed during the warranty period, it should be recorded and informed to the waterproofing system provider for corrective actions.

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