



SLOPE INSTALLATION AND MAINTENANCE GUIDELINES - LANDLOK® 450

Thank you for purchasing the Landlok® 450 Turf Reinforcement Mat (TRM) by Propex Operating Company, LLC (Propex). This document provides installation and maintenance guidelines for Landlok® 450 used as slope armouring to increase earthen slope resiliency. Landlok® 450 provides permanent erosion protection on either the flood side and/ or protected side of an earthen slope or cut batter.

Temporary securing pins (pins) are used during installation to hold Landlok® 450 in place. Pins also promote vegetation establishment keeping Landlok® 450 in intimate contact with the soil.

Landlok® 450 is an engineered solution with a unique design for each specific project. Whilst Propex has made every effort to ensure general validity, this information should not be used for a specific application without independent professional examination and verification of its suitability, applicability, and accuracy. The information provided herein is for general information only, and is intended to present installation guidance. Project specific contract documents take precedence when pin placements are different than what is represented in this document. Depending upon the critical nature of the structure to be armoured/vegetated, work restrictions may be in place such as limiting work based on growing seasons, weather patterns, etc. Work should be performed under the provisions set forth for the specific project. Please feel free to call our local Global Synthetics representative, refer www.globalsynthetics.com.au for support during installation as required.

BEFORE INSTALLATION BEGINS

- Coordinate with a Global Synthetics Representative: A pre-construction meeting with the construction team and a representative from Global Synthetics is recommended prior to installation. This meeting should be scheduled by the contractor with sufficient notice prior to construction.
- Gather the Tools Needed: Tools that you will need to install Landlok® 450 include a pair of industrial shears to cut Landlok® 450, tape measure, and a mallet or hammer.
- Determine Vegetation Establishment Strategy: The method of vegetation establishment should be determined prior to the start of installation. Different vegetation establishment methods require different orders of installation. Refer to Establish Vegetation for further guidance.

INSTALLATION OF LANDLOK® 450 FOR CHANNELS

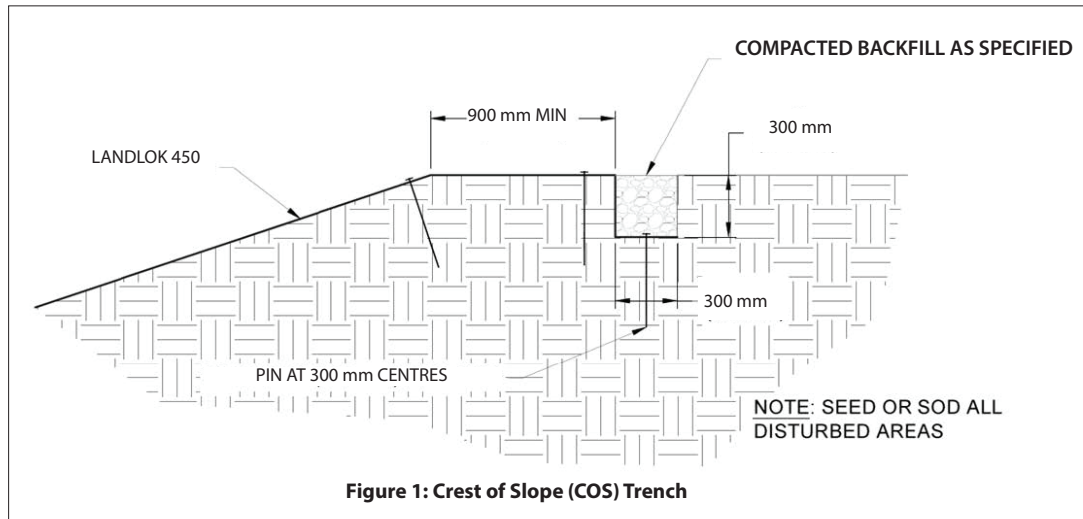
PREPARE THE SITE

It is recommended during all stages of site preparation that disturbed soils remain unprotected for not more than a single day. Depending on project size this may require progressive site preparation during installation.

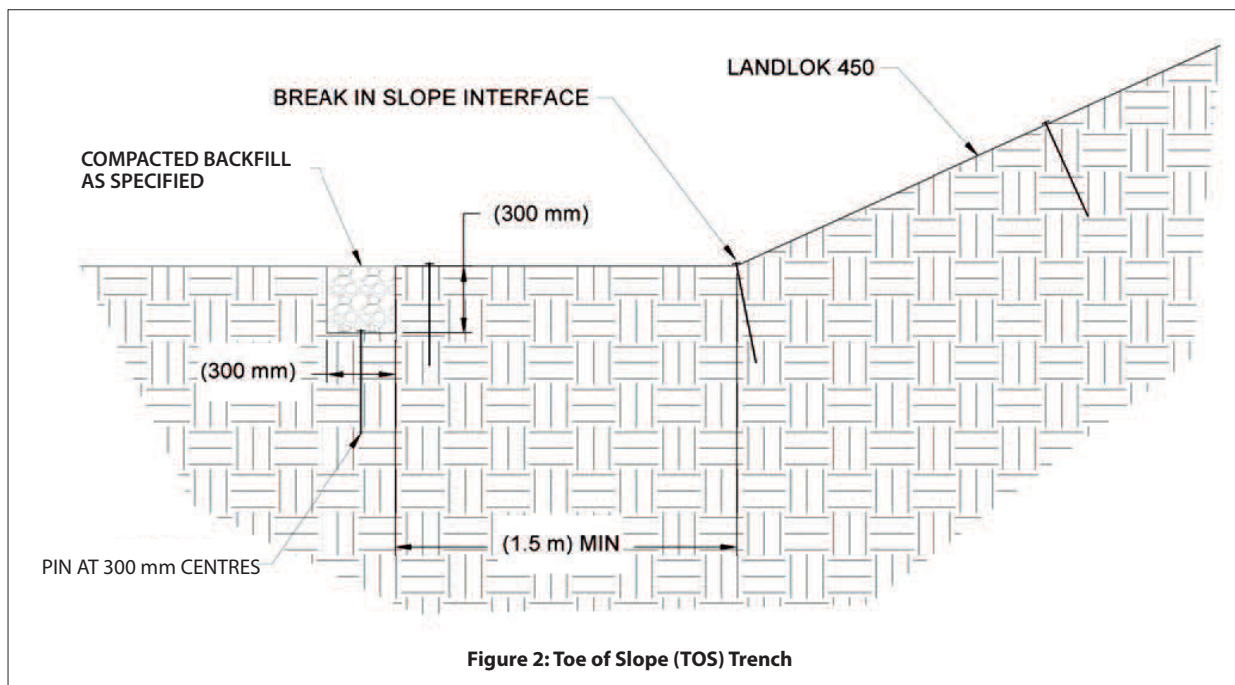
1. Grade and compact the area on the slope where Landlok® 450 will be installed. The slope surface should be uniform and smooth, having deleterious matter such as rocks, clods, vegetation or other objects removed so that during placement, Landlok® 450 comes in direct, intimate contact with the slope surface.



2. Prepare the area to be armoured with Landlok® 450 by loosening the topsoil to promote better vegetation establishment. This may be accomplished with a rotary tiller on slopes 3:1 or flatter. For slopes greater than 3:1, prepare topsoil in a safe manner.
3. Excavate a Crest of Slope (COS) trench 300 mm deep x 300 mm wide minimum at a distance of 900 mm from the crest of the slope. (Figure 1).

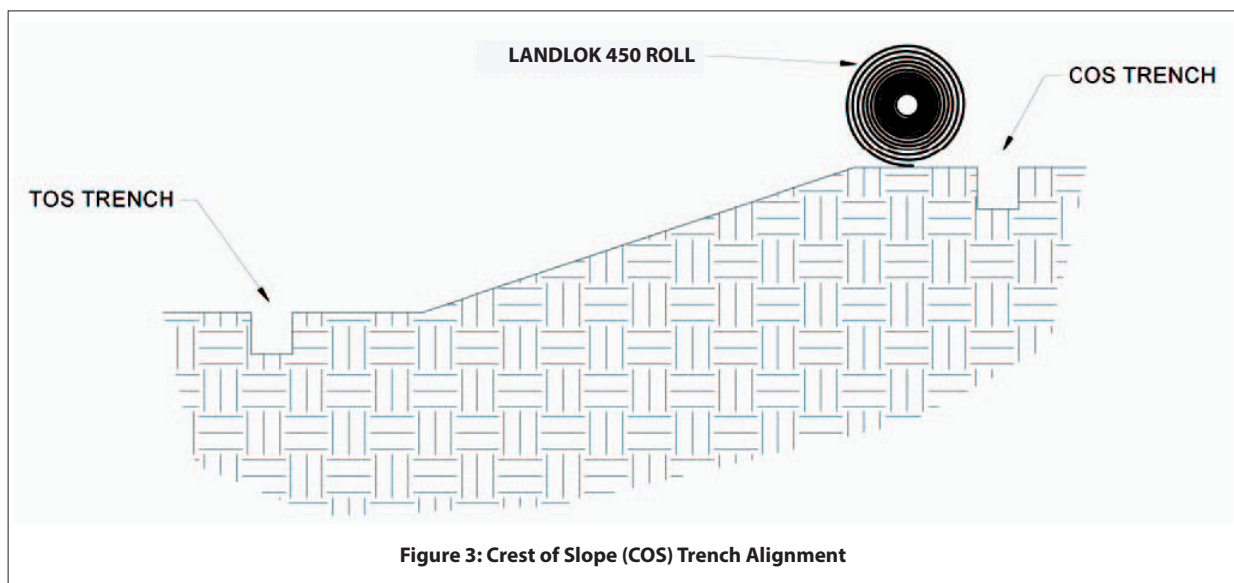


4. Excavate a Toe of Slope (TOS) trench 300 mm deep x 300 mm wide minimum at a minimum distance of 1.5 m from the toe of the slope. (Figure 2)
5. If seeding, refer to Vegetation Establishment for additional considerations during site preparation.



LANDLOK® 450 LAYDOWN

1. Begin the Landlok® 450 laydown process by starting with the downstream / downwind end of the site. To ensure proper pinning of the overlapped areas the proceeding roll width must be laid out before the current roll width can be pinned with exception of the final roll width. For straight sections of a slope, Landlok® 450 panel lengths should be long enough to construct COS and TOS trenches while also covering the surface of the slope being armoured (Figure 12). Panel edges should rest approximately perpendicular to the slope centre line. For best results, panels of Landlok® 450 should be continuous and free from seams or roll end overlaps that are parallel to the centreline of the slope. Panel edge overlapping should follow a pattern of placing each proceeding panel's edge over the top of the previous panel edge, shingling the panels in the direction of the water flow or prevailing wind.
2. Starting at the COS trench, lay Landlok® 450 roll so that the roll ends point towards the crest of the slope (Figure 3), with a 75 mm overlap created at adjacent panel edge locations. Ensure the adjacent panel edges maintain a minimum 75 mm overlap during Landlok® 450 laydown. (Figure 8)



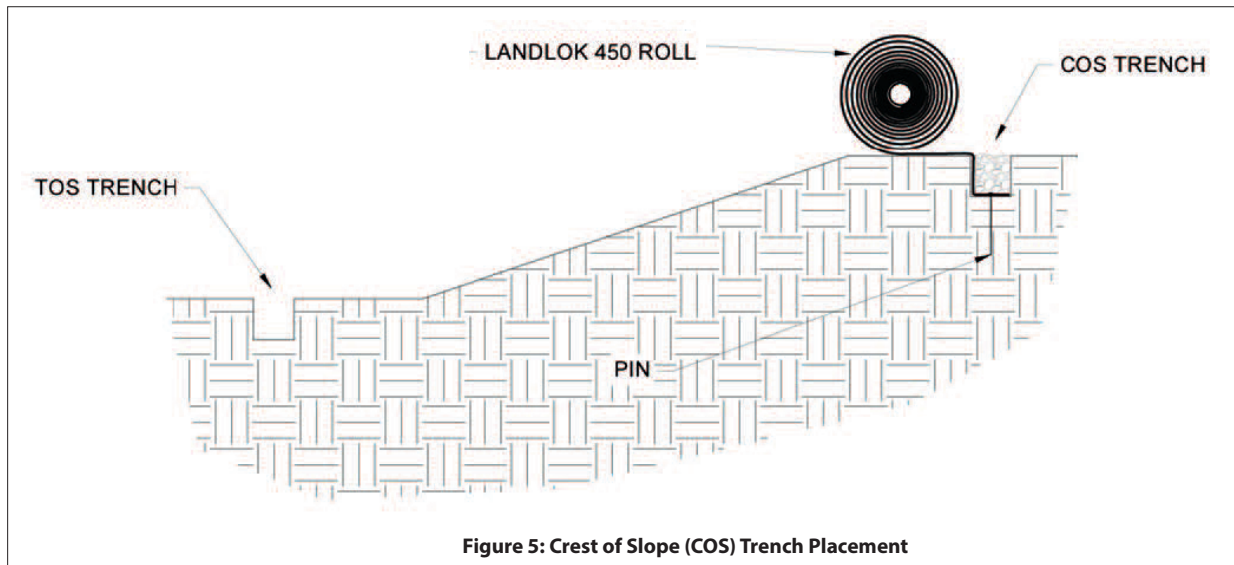
3. Secure Landlok® 450 with pins in the COS trench. Pins should be U shaped and made of mild steel with a 4 mm minimum diameter and a length of between 150 and 300mm with sufficient ground penetration to resist pullout (Figure 4). Longer pins may be required for looser soils. Heavier metal stakes may be required in rocky soils. Suggested placement of pins for the COS trench is along the bottom of the trench with pins at 300 mm centres. Pins should also be installed on panel edge overlaps in the COS trench.



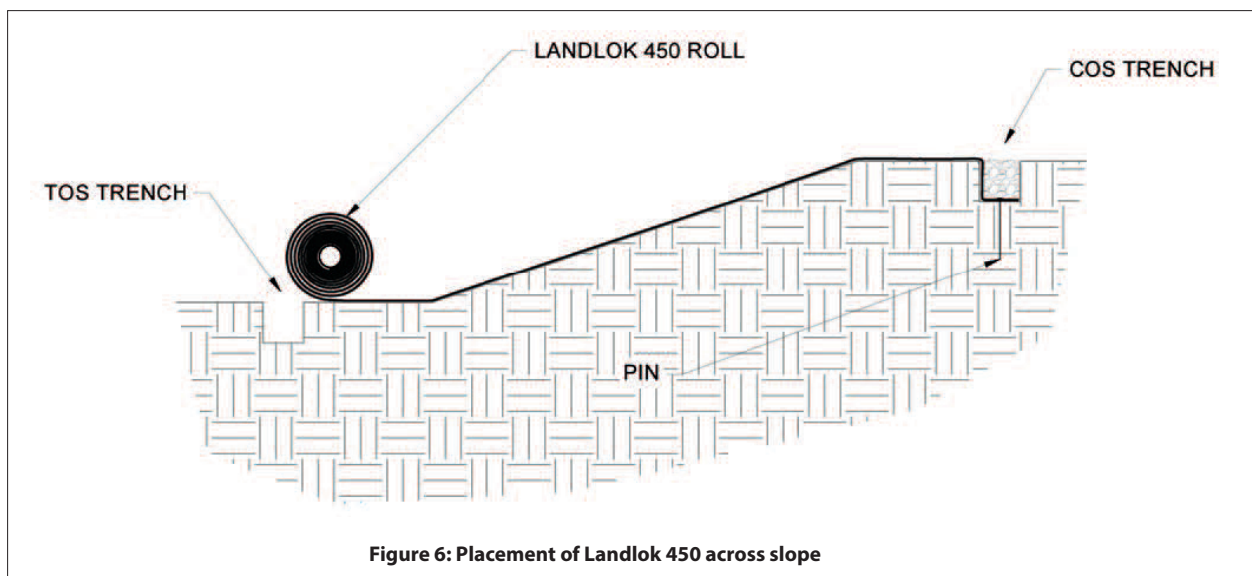
Figure 4: Securing Pin



4. Backfill and compact the COS trench in the location of the first Landlok® 450 panel only (Figure 5).



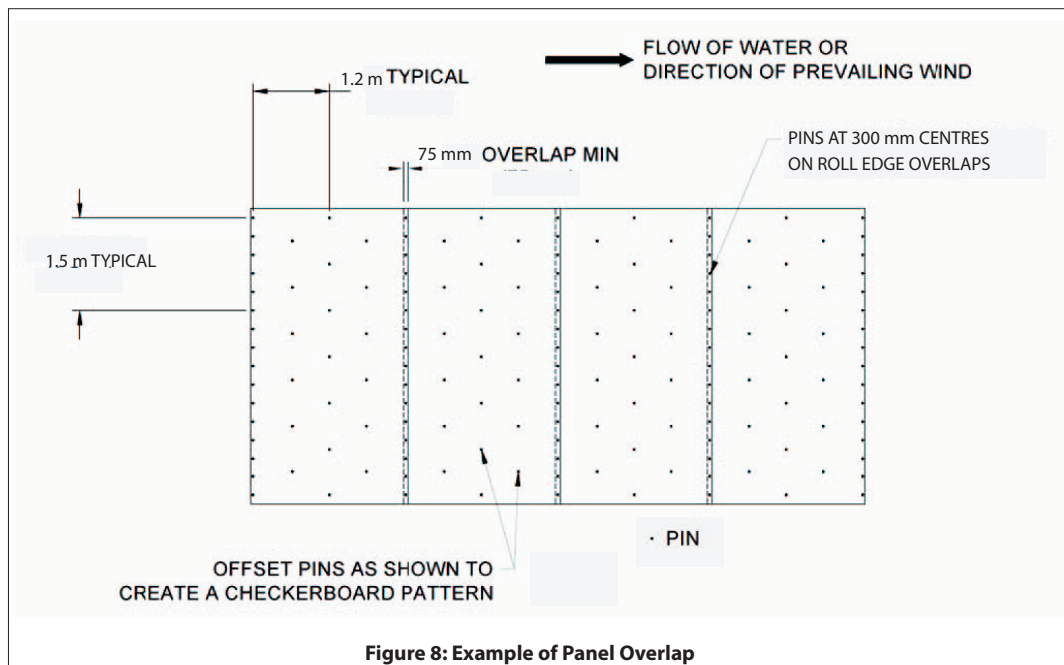
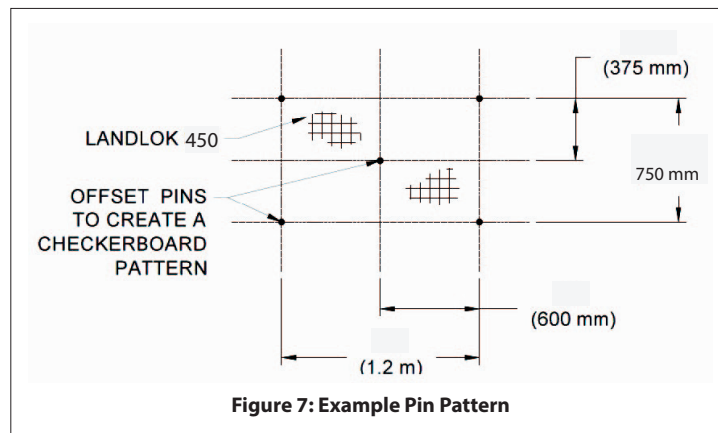
5. Unroll the Landlok® 450 roll on the slope surface in the area to be armoured (Figure 6). Ensure that Landlok® 450 has intimate contact with the ground and all irregular surfaces beneath Landlok® 450 are removed.

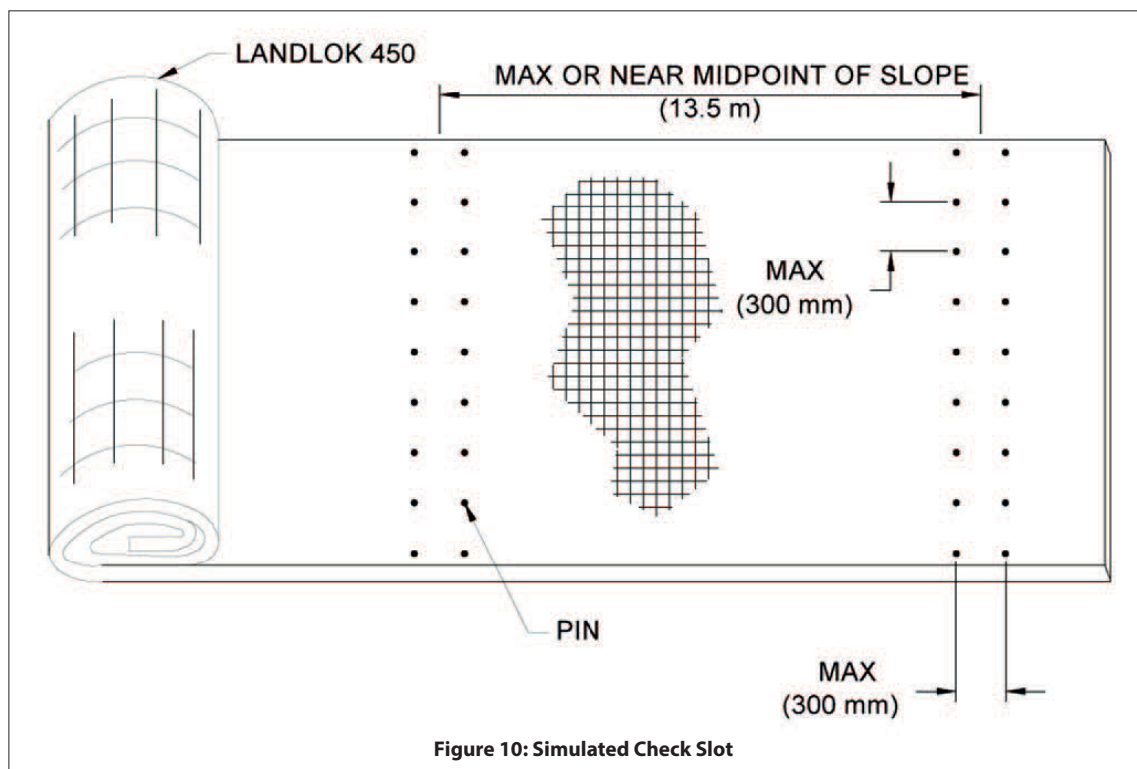
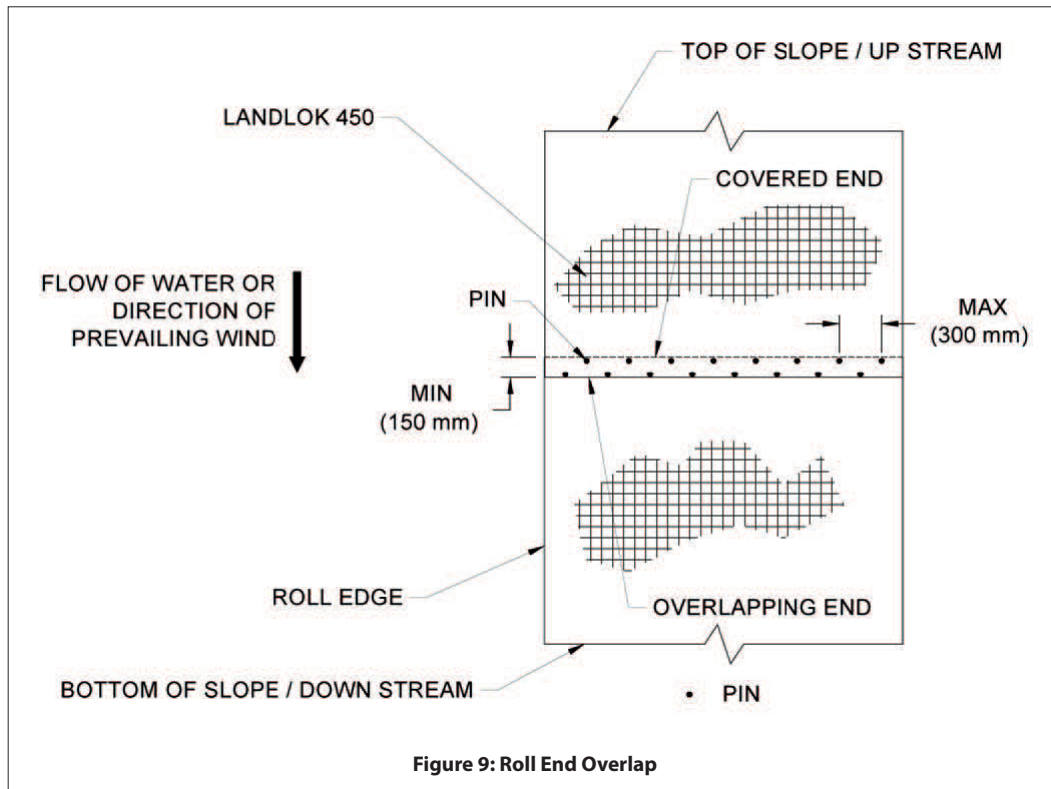


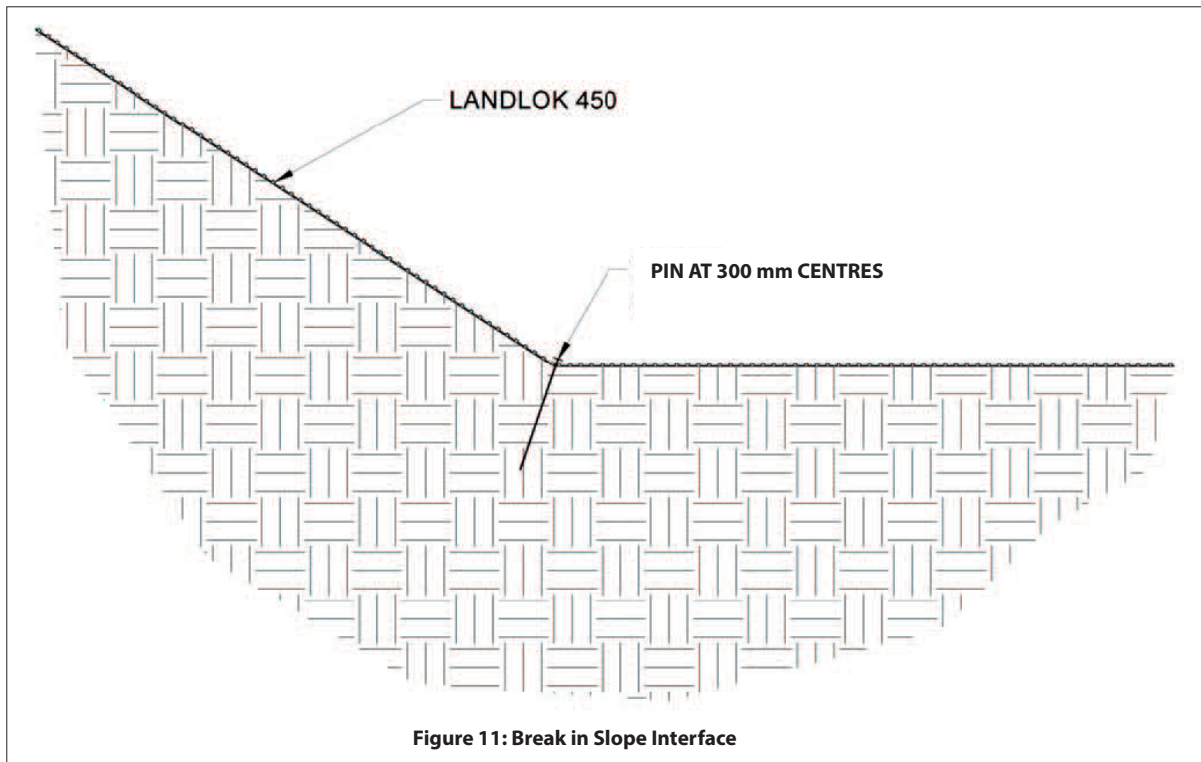
6. Secure Landlok® 450 panels in place using pins across the slope surface according to the project's engineered design. Pin placement shall be at no more than 1m centres.
 - The leading edge of the first Landlok® 450 panel should be secured on the Slope Armouring Edge (SAE) with pins at 300 mm centres.



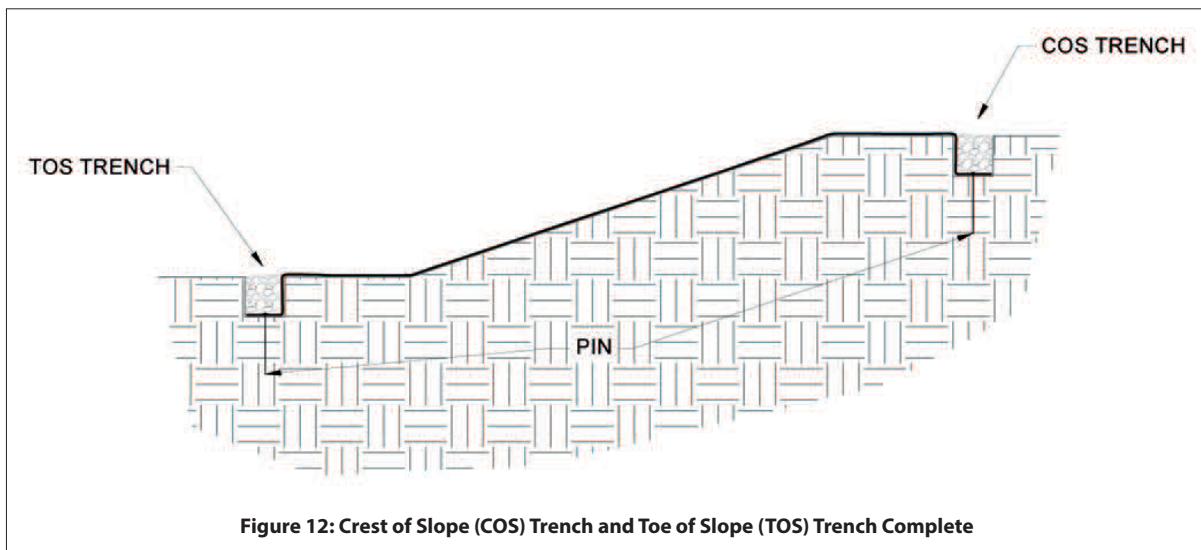
- Roll edges shall be overlapped a minimum of 75mm with pins placed at 300mm centres (Figure 8).
- Roll ends shall be overlapped a minimum of 150mm with upstream/upslope/upwind panel on top. Secure roll end overlaps with two rows of pins staggered 150mm apart at 300mm centres (Figure 9).
- For slope lengths greater than 13.5m, install simulated check slots. This method includes placing two rows of pins 300mm apart at 300mm centres at 13.5m maximum intervals or across the midpoint of the slope for slope lengths less than 25 m (Figure 10).
- At the break in slope interface towards the TOS, it is suggested that pins be installed at 300 mm centres (Figure 11).







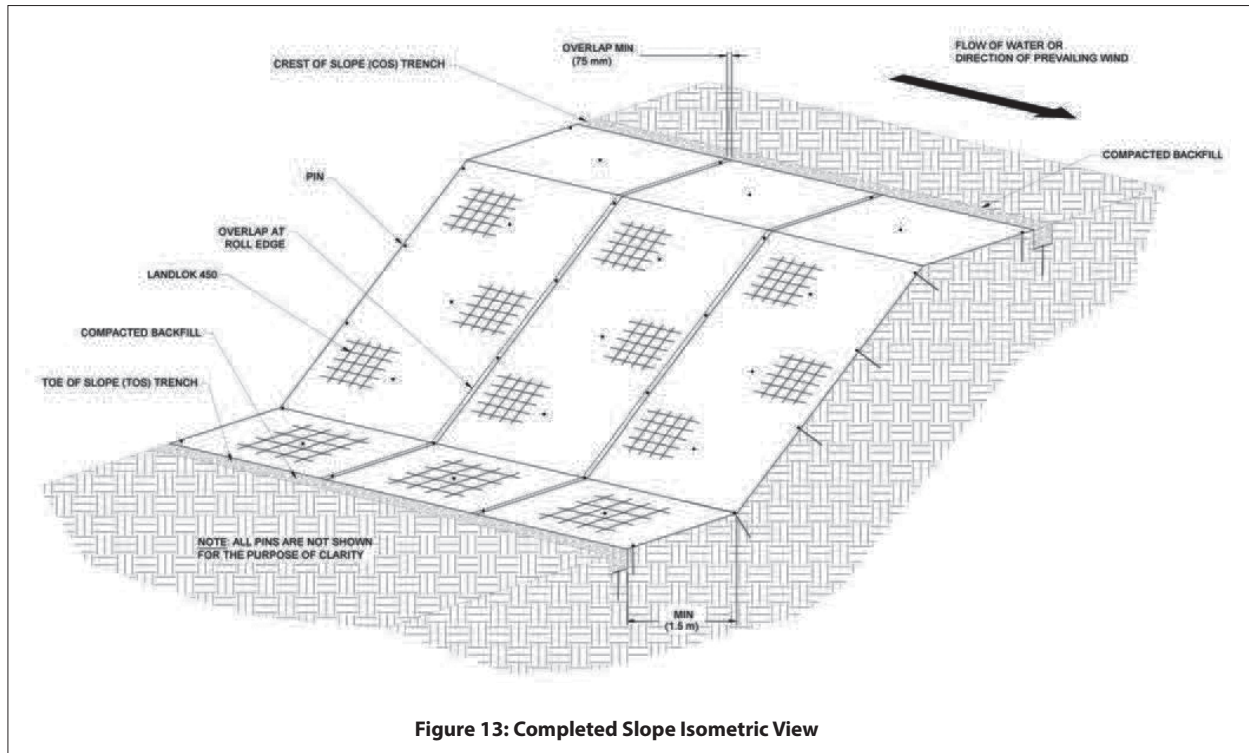
- Secure Landlok® 450 with pins in the TOS trench. Suggested placement of pins for the TOS trench is along the bottom of the trench with pins at 300mm centres (Figure 12).



- Backfill and compact the TOS trench. (Figure 12)



- Continue to work down the length of the slope by repeating steps 1 through 8 overlapping each adjacent Landlok® 450 panel by 75mm (figure 8). The last Landlok® 450 panel should terminate on the Slope Armoring Edge (SAE) with pins at 300 mm centres. As a minimum, Landlok® 450 panels should be pinned entirely across the slope surface, pins should be installed in the trenches, and the trenches should be backfilled and compacted at the end of each day to minimise rework in the case of a major rain event. Specific project conditions may warrant further evaluation of installation order for ease. An example isometric view (Figure 13) of a slope armoured with Landlok® 450 can be seen below for overall reference.



ESTABLISH VEGETATION

Vegetation can be established with Landlok® 450 by broadcast seeding, hydraulic seed application (hydroseeding), turf, or Hydromulching over or under the Landlok® 450. Seed application rate, seed type, and irrigation rate should be selected based on local or site specific knowledge and time of year. For best results, consider having a site specific soil test performed to help determine what soil amendments, such as lime and fertiliser, need to be incorporated into the soil to promote healthy vegetation.

WITH SEED

- Determine the seed location. Seed can be placed entirely on top of soil filled Landlok® 450, or alternatively 50% below Landlok® 450 prior to pinning, with the remainder placed on top of soil filled Landlok® 450. If a rain event occurs prior to vegetation establishment, having 50% of the seed below Landlok® 450 ensures that some seed remains in place. Seed placed entirely on top of soil filled Landlok® 450 will allow for faster vegetation establishment.



2. If seeding below Landlok® 450, ensure 50% of the seed is placed prior to the installation of Landlok® 450.
3. Once Landlok® 450 is in place, distribute soil on top by filling the open structure of the Landlok® 450. The proper amount can be visually measured by making the tops of the Landlok fibre projections barely visible, or approximately 25 mm thickness. Soil filling can be accomplished manually or by using a small piece of equipment. Do not place excessive soil above Landlok® 450. See Consider Project Specific Needs for guidance on driving equipment across Landlok® 450.
4. Irrigate as necessary to establish and maintain vegetation until 75% of vegetation has established and has reached a height of 50mm. Frequent, light irrigation will need to be applied to seeded areas if natural rain events have not occurred within two weeks of seeding. When watering seeded areas, use a fine spray to prevent erosion of seeds or soil. Do not over irrigate. Proper irrigation guidance is provided under the Maintenance portion of this document.

WITH HYDROMULCH

1. Hydromulch can be placed beneath Landlok® 450, however hydroseed alone is sufficient when spraying before Landlok® 450 placement.
2. Hydromulch can be applied over Landlok® 450 due to the open nature of Landlok® 450.

WITH TURF

1. Turf can be always placed on top of Landlok® 450 for immediate vegetative growth.
2. Turf should be pinned to secure the turf against Landlok® 450. During the placement of the turf, ensure that Landlok® 450 is 100% covered by tightly adjoining rolls or squares of turf along edges. Any voids in between turf/ sod pieces should be filled with clean loose soil.
3. Irrigate as necessary. Proper irrigation guidance is provided under the Maintenance portion of this document.
4. Monitor to identify areas where browned/dead turf emerges. These areas may need to be addressed to ensure proper grass establishment.

CONSIDER PROJECT SPECIFIC NEEDS

1. A deeper terminal trench and/or hard armouring may be required when slopes have severe scour potential at the toe location.
2. For installing Landlok® 450 panels around curved sections of a slope, trim panels at an angle so that no more than two layers of Landlok® 450 overlap at any point in time. Additional pins may be needed to secure panel edges towards the toe of the slope depending upon the radius of the curved slope. Install pins as necessary to securely fasten Landlok® 450 to the ground.
3. Vehicular traffic should not be allowed on Landlok® 450 at any time.



4. Disturbed areas should be reseeded. If ruts or depressions develop for any reason, rework soil until smooth and reseed such areas.

SHORT-TERM AND LONG-TERM MAINTENANCE OF LANDLOK® 450

The purpose of this section is to provide some general guidelines for performing short-term and long-term maintenance of Landlok® 450 with respect to maintaining vegetation reinforced with Landlok® 450, and patching of Landlok® 450 (in the event it needs to be removed or replaced). These procedures are to be considered minimum guidelines for proper maintenance, and further maintenance techniques may be appropriate considering local practices and procedures.

LANDLOK® 450 PROTECTED SLOPES

For Landlok® 450 to be most effective, it is important to ensure that it is properly maintained both during construction and after construction. Identifying trouble areas is easy with Landlok® 450, and it can make identifying potential threats much simpler and manageable. Look for areas with sparse, dying, or no vegetation as these are obvious signs that Landlok® 450 is losing intimate contact with the slope surface. If loss of ground surface occurs, Landlok® 450 will need to be removed and reinstalled as described in Patching and Repairs Section after the eroded area is backfilled with compacted soil that is similar to material of the slope. After Landlok® 450 is reinstalled, re-establish vegetation on the newly installed Landlok® 450 and disturbed areas. Monitor the sites to determine if frequent watering may be required to establish vegetation.

To minimise exposure to unwanted maintenance and repair, Landlok® 450 armoured slopes should be free of unauthorised vehicular traffic. Routine maintenance and slope inspections should be performed by foot traffic only. Tracked equipment such as skid steers, excavators, or dozers should only be allowed to traffic over Landlok® 450 in times of emergency after vegetation establishment is complete. Failure to control unauthorised traffic can result in Landlok® 450 being damaged resulting in erosion below Landlok® 450 during storm events.

MAINTAINING VEGETATION

Good vegetative cover will ensure maximum performance of Landlok® 450. Vegetative cover care starts before a project is complete and is ongoing until all Landlok® 450 is installed. Vegetative cover should be given every opportunity to grow and establish well. This will require that a contractor periodically fertilise and water the grasses as needed until a project is complete in the short-term, with the owner of the slope fulfilling the maintenance of the slope in a similar fashion for the long-term. For the entire lifecycle of Landlok® 450, every effort must be made to prevent unauthorised encroachments, grazing, vehicle traffic, the misuse of chemicals, or burning during inappropriate seasons.

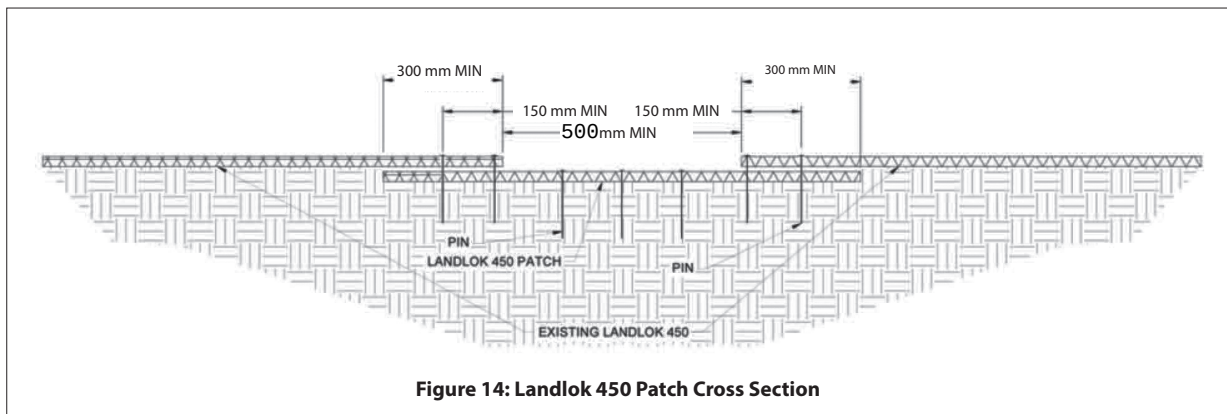
PATCHING AND REPAIRS

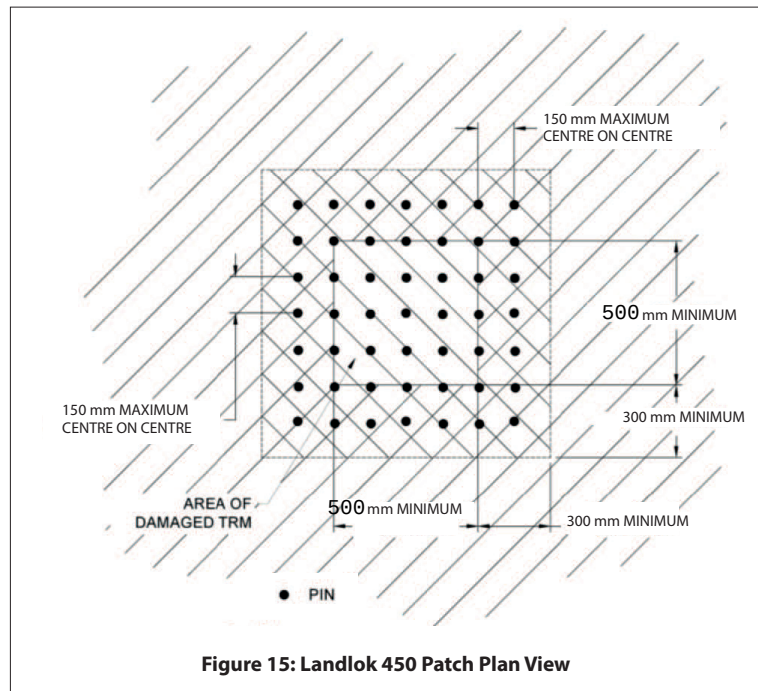
Landlok® 450 may require localised repair at times. For emergency repairs, an adequate supply of Landlok® 450 should be maintained in inventory with the necessary tools to install. This will allow for a timely, initial repair of the system.

1. In order to identify areas in need of repair, the site should be patrolled immediately after rain events of 50 mm or more. When patrolling look for areas of sparse vegetation, exposed edges of Landlok® 450, and areas where direct contact between Landlok® 450 and the slope surface is compromised. Landlok® 450 should be rated as Acceptable, Minimally Acceptable, or Unacceptable during inspection.



- A. Acceptable (A) - The rated area is in satisfactory, acceptable condition, and will function as designed and intended during the rain event. Landlok® 450 has no exposed edges, is installed tightly by maintaining direct contact to the slope surface with no rilling beneath, and has over 90% vegetation cover. There is no noticeable damage present.
 - B. Minimally Acceptable (M) - The rated area has a minor deficiency that needs to be corrected. The minor deficiency will not seriously impair the functioning of the area during the next rain event; however, the overall reliability of the project will be lowered because of the minor deficiency. Landlok® 450 has 75% vegetation cover with un-vegetated patches as large as one square metre. Edges of Landlok® 450 are exposed with noticeable damage. Minimal erosion has occurred underneath Landlok® 450.
 - C. Unacceptable (U) - The rated area is unsatisfactory. The deficiency is so serious that the area will not adequately function in the next rain event. Landlok® 450 has been physically torn, ripped, or lifted from the slope surface. Less than 75% vegetation cover is present with un-vegetated patches being greater than one square metre, and there is evidence that erosion is occurring beneath Landlok® 450.
2. Repair any raised or exposed edges of Landlok® 450 by driving existing and additional pins along the edges as necessary to securely fasten to the ground. Inspect areas where the vegetation is not growing on top of Landlok® 450. Many times this is an indicator that Landlok® 450 has lost contact with the ground beneath. Check for voids beneath Landlok® 450 and fill any holes, gullies, etc. with compacted fill material if possible. Replace Landlok® 450 as described below.
 3. To repair Landlok® 450, cut out and remove damaged areas in a square configuration a minimum size of 600mm by 600mm. Remove all vegetation and debris atop of Landlok® 450. Loosen the top 25mm to 50mm of soil in the patch area then seed. The subgrade of area to be patched shall be prepared to be smooth and uniform and transition smoothly into the in-situ area. Cut a square Landlok® 450 patch a minimum of 300mm greater than the damaged area for all four sides of the patch. Overlap the patch area in all directions a minimum of 300mm. The patch overlaps shall be tucked under the existing damaged Landlok® 450 material (Figure 14 and Figure 15).





4. Install pins at 150 mm (max) centres. For larger areas of damage, pins should be installed to match existing pin pattern. Once Landlok® 450 is in place, vegetate per project specifications.

SUMMARY

Maintenance should consist of watering and weeding, repair of all erosion, and any re-seeding as necessary to establish a uniform stand of vegetation during construction and beyond. A minimum of 70% of the armoured area should be covered with no bare or dead spots greater than one square metre. Throughout the duration of the project, the contractor should water all grassed areas as often as necessary to establish satisfactory growth and to maintain its growth throughout the duration of the project. After the project is complete, it is the responsibility of the owner to maintain and upkeep all Landlok® 450 installed areas for long term performance and best results as described herein for superior slope armouring.

DISCLAIMER : All information provided in this publication is correct to the best knowledge of the company and is given out in good faith. The information presented herein is intended only as a general guide to the use of such products and no liability is accepted by Global Synthetics Pty Ltd and Global Synthetics QLD Pty Ltd for any loss or damage however arising, which results either directly or indirectly from the use of such information. Global Synthetics Pty Ltd and Global Synthetics QLD Pty Ltd have a policy of continuous development so information and product specifications may change without notice.

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