GEOSYNTHETICS INSTALLATION GUIDELINES

2025

GEOSYNTHETICS INSTALLATION GUIDELINES

AGRU America, Inc. or its representatives, upon request, may furnish or may have previously furnished technical advice or assistance regarding the products or their uses at AGRU America, Inc.'s sole discretion. However, it is expressly agreed that any advice or assistance furnished shall be given and accepted at the user's sole risk and liability. Neither any AGRU America, Inc. representative nor AGRU America, Inc. shall be responsible nor liable for any advice or assistance that is given to the user or any other person relating to the products, the application of products, or the results thereof.

Contents

Article I. GENERAL

SECTION 1.01 SUMMARY

(a) This specification includes furnishing and installing high-density polyethylene (HDPE) and linear low-density polyethylene (LLDPE) geomembranes, as well as geotextiles, geonets, geocomposite, and geosynthetic clay liners (GCL). This manual provides guidance and a general overview of the procedures for the installation of AGRU geosynthetics. These procedures are consistent with standard industry-accepted practices and are designed to ensure that geosynthetics are handled and installed to maximize safety, efficiency, and the physical integrity of the products.

(b) These guidelines are based on experience at various sites and should apply to any lining project using AGRU geosynthetics. Any variance from or additional requirements to these guidelines would be at the engineer's discretion. Therefore, it should be noted that strict adherence to the customer's project-specific specifications is also required.

(c) The ultimate performance of AGRU geosynthetics is fully dependent on the quality of installation. Consequently, it is the installer's responsibility to adhere to these guidelines and the project specifications and drawings as closely as possible. Additionally, it is the responsibility of the engineer and owner to provide construction quality assurance (CQA) for the installation to ensure the proper installation. This document covers only general installation guidelines.

For additional guidance or assistance regarding AGRU geosynthetics, contact AGRU America, Inc.'s Technical Product Support Group at (843) 546-0600.

SECTION 1.02 REFERENCES

(a) Geosynthetic Research Institute (GRI), Folsom, PA www.geosynthetic-institute.org:

(i) GRI GM9 (Current Revision), "Cold Weather Seaming of Geosynthetic."

(ii) GRI GM13 (Current Revision), "Test Properties, Testing Frequency for High-Density Polyethylene (HDPE) Smooth and Textured Geosynthetic."

(iii) GRI GM14 (Current Revision), "Selecting Variable Intervals for Taking Geosynthetic Destructive Seam Samples Using the Method of Attributes."

(iv) GRI GM17 (Current Revision), "Test Methods, Test Properties, and Testing Frequency for Linear Low-Density Polyethylene (LLDPE) Smooth and Textured Geosynthetic"

(v) GRI GM19 (Current Revision), "Seam Strength and Related Properties of Thermally Bonded Polyolefin Geosynthetic."

(vi) GRI GCL3 (Current Revision), "Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners."

(b) International Association of Geosynthetic Installers:

(i) (Current Revision) "Guidelines for Installation of High-Density Polyethylene (HDPE) and Linear Low-Density Polyethylene (LLDPE) Geosynthetic Installation Specification."

(c) American Society for Testing and Materials:

(i) ASTM D7002 (Current Revision), "Standard Practice for Electrical leak Location on Exposed Geomembranes Using the Water Puddle Method."

(ii) ASTM D7007 (Current Revision), "Standard Practice for Electrical methods for Locating Leaks in Geomembranes Covered with Water or Earthen Materials."

SECTION 1.03 SUBMITTALS

Submit the following to the project engineer or property owner for review and approval within a reasonable time to expedite the shipment and/or installation of the geosynthetics:

(a) Documentation of Manufacturer's Qualifications.

(b) Manufacturer's Quality Control Program Manual.

(c) Material Properties Sheet.

(d) Material Sample.

(e) Documentation of Installer's Qualifications:

(i) Submit a list of at least ten facilities completed by the installer. For each installation, provide the name of the facility, location, date of installation, type, thickness of geosynthetic used, and surface area of the installed geosynthetic.

(ii) Submit resumes or qualifications of the installation supervisor, master seamer, and technicians assigned to this project.

(iii) Installer's Quality Control Program.

(f) Product and Installation Warranties:

(i) Submit a copy of all product warranties. The product manufacturer shall guarantee the product against defects on a professional data basis for a specified period acceptable to both owner and manufacturer.

(ii) Submit a copy of all installation warranties. The geosynthetics installer shall guarantee the geosynthetic installation against defects in the installation and workmanship for a period satisfactory to all parties commencing with the date of final acceptance.

(iii) Additional submittal requirements specific to the type of geosynthetic installed may be found in their relevant sections below.

SECTION 1.04 QUALITY CONTROL

(a) Manufacturer's Qualifications:

(i) The manufacturer shall have at least five years of experience in manufacturing the specified or similar geosynthetic product and shall have manufactured at least 1,000,000 m2 (10,000,000 ft2) of the specified type of geosynthetic or a similar product during the last five years.

(b) Installer's Qualifications:

(i) The geosynthetics installer shall be an approved installer by the manufacturer.

(ii) The geosynthetics installer shall have at least three years of experience installing the specified or similar geosynthetics. It shall provide a list outlining at least ten projects totaling 500,000 m2 (5,000,000 ft2) of the specified type of geosynthetics or similar completed within the past three years.

(iii) A field installation supervisor performs and assumes responsibility throughout the geosynthetic installation, including geosynthetic deployment, seaming, patching, testing, repairs, and all other outlined responsibilities. The field installation supervisor shall have experience in or supervision in the installation and seaming of at least 10 projects totaling 500,000 m2 (5,000,000 ft2) of geosynthetic or the type specified or similar product.

(iv) Seaming shall be performed under the direction of a master seamer (who may also be the field installation supervisor or crew foreman) with seaming experience of a minimum of 300,000 m2 (3,000,000 ft2) of the geosynthetic type specified or similar product, using the same type of seaming apparatus to be used in the current project. During the seaming, the field installation supervisor and/or master seamer are present.

(v) Qualified technicians employed by the geosynthetic installer complete all seaming, patching, testing, and other welding operations.

Article II. GEOMEMBRANE

SECTION 2.01 SOURCE QUALITY CONTROL

The geomembrane shall consist of new, first-quality products designed and manufactured specifically for this work. The product will satisfactorily complete testing, demonstrating its suitability and durability for the intended purposes. The geomembrane will meet the property requirements as shown in GRI GM13 (HDPE) or GRI GM17 (LLDPE).

(a) Manufacturing Quality Control:

(i) The geomembrane rolls shall be seamless, high-density polyethylene (HDPE - Formulated Sheet Density ≥ 0.94g/cc) or linear low-density polyethylene (LLDPE - Formulated Sheet Density ≤ 0.939 g/cc) containing no plasticizers, fillers, or extenders and shall be free of holes, blisters, contaminants, and leak-free verified by 100% in-line spark or equivalent testing.

(ii) Material conformance testing (quality assurance) by the owner's representative, if required, will be conducted using in-plant sampling as specified for the project.

(iii) The test method and frequencies used by the manufacturer for quality control and quality assurance of the above geomembrane prior to delivery shall be in accordance with the latest revision of the GRI GM13 for HDPE geomembrane or GRI GM17 for LLDPE geomembrane or modified as required for project-specific conditions.

(iv) The manufacturer's geomembrane quality-control certifications, including results of quality control testing of the products, must be supplied to the owner's representative to verify that the materials provided for the project are in compliance with all products and or project specifications.

(v) The certification, signed by a responsible party employed by the manufacturer, such as the QA-QC Manager, production manager, or technical services manager, includes lot and roll numbers and corresponding shipping information.

(vi) The manufacturer provides production-manufacturing certification that the geomembrane and welding rod supplied for the project are from the same material type and are compatible.

SECTION 2.02 DELIVERY, STORAGE, AND HANDLING

(a) Delivery:

(i) Manufacturer labels must be on all rolls delivered to the project.

(ii) A firmly affixed label attached to the rolls shall clearly state the manufacturer's name, product identification, material thickness, roll number, roll type, roll dimensions, and roll weight.

(iii) The manufacturer protects the geomembrane from mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions prior to shipment.

(iv) Continuously and uniformly supported, rolls are stored away from high-traffic areas on a smooth, level surface. Chocks keep the rolls secure when necessary.

(b) Handling:

(i) Prior to unloading and during deployment, care must be taken to ensure that the equipment used to unload or handle the material at the job site is adequate for the task.

(ii) Rolls should not be moved more than necessary to avoid possible damage.

(iii) When moving rolls, ensure that the roll is elevated enough to avoid scraping the roll on the ground.

(iv) When removing rolls from a container, care shall be taken to avoid scraping the roll against the container's top, bottom, or sides.

(v) Care should be taken to avoid damage to the core ends.

(c) Storage:

(i) A roll-storage space should be provided in a location or locations close to the area to be lined to minimize additional handling.

(ii) The storage area should be protected from puncture, theft, vehicular traffic, vandalism, chemical exposure, excessive heat, and other hazards that might create a source of potential damage to the liner.

(iii)The surface on which the liner will rest should be a flat, rigid, and prepared, free of debris and sharp objects (DO NOT store liner on top of wooden pallets).

(iv) If available, geotextile should be placed under the liner rolls to cushion and protect them.

(v) AGRU MicroSpike and Smooth Liner rolls should be stacked to limit the maximum weight applied to the roll on the bottom of the stack to approximately 15,000 lbs. This is approximately five full-length rolls high for AGRU MicroSpike and Smooth Liner and approximately four full-length rolls high for structured geosynthetic (e.g., AGRU MicroDrain™, Drain Liner™, and Super Gripnet™).

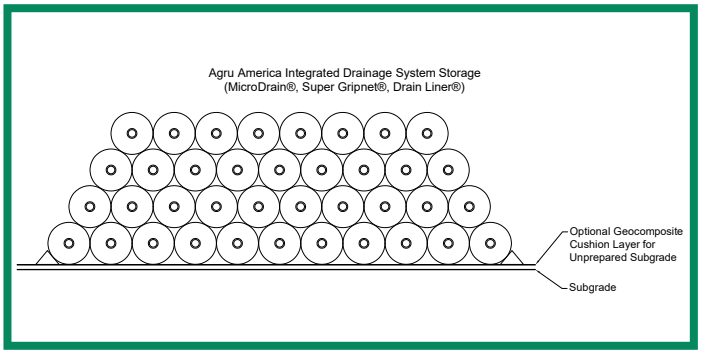
(vi) The ends of cardboard-cored rolls should be capped or taped with weather-resistant tape. If capped, secure the caps with suitable adhesive weather-resistant tape.

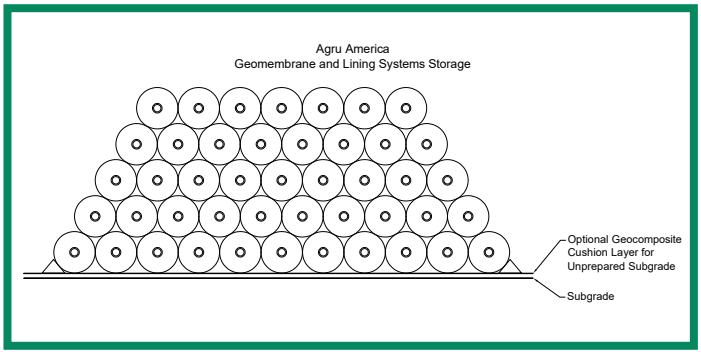
(vii) Rolls at both ends of a stack should be chocked. Chocks should be large enough to adequately secure the rolls and should not dig into the rolls or otherwise damage them.

(viii) If rolls must be stored (exposed to UV) for longer than five years, they should be covered by a UV-resistant material. This covering should be replaced as necessary.

(ix) Provide secure, UV-resistant indoor storage for the slings that were provided during shipment.

(x) Please see below examples of correct roll-stack geometry:





SECTION 2.03 PROJECT CONDITIONS

Do not install geomembrane in the presence of standing water, while precipitation is occurring, during excessive winds, or when material temperatures are outside the limits specified in the latest revision(s) of the International Association of Geosynthetic Installers (Current Revision), "Guidelines for Installation of High-Density Polyethylene (HDPE) and Linear Low-Density Polyethylene (LLDPE) Geosynthetic Installation Specification," GRI GM9 (Current Revision), "Cold Weather Seaming of Geosynthetic," and/or GRI GM9 (Current Revision), "Cold Weather Seaming of Geosynthetic."

SECTION 2.04 GEOSYNTHETIC PRE-CONSTRUCTION MEETING

A pre-construction meeting will be held at the site prior to the installation of the geomembrane, which will include the installer, owner, owner's representative (engineer and/or construction quality assurance firm), and earthwork contractor. A designated person will document the meeting and send a copy of the minutes to each person in attendance.

Topics for this meeting may include, but are not limited to:

(a) Health and Safety.

(b) Lines of authority and communication and resolution of any project document ambiguity.

(c) Methods for documenting, reporting, and distributing documents and reports.

(d) Procedures for packaging and storing archive samples.

(e) Review of a schedule for all installation and testing.

(f) Review of a panel layout and numbering systems for panels and seams, including details for marking on geomembrane.

(g) Procedures and responsibilities for preparing and submitting an as-built panel and seam drawings.

(h) Temperature and weather limitations, installation procedures for adverse weather conditions, defining acceptable subgrade, geomembrane, or ambient moisture and temperature conditions for working during liner installation.

(i) Subgrade conditions, dewatering responsibilities, and subgrade maintenance plan.

(j) Deployment techniques, including allowable subgrade for the geosynthetic.

(k) A plan for controlling expansion/contraction and wrinkling of the geosynthetic.

(l) The covering of the geosynthetic and cover soil placement.

(m) A measurement and payment schedules.

(n) The responsibilities of each party.

SECTION 2.05 SUBGRADE PREPARATION

The subgrade shall be prepared in accordance with the project specifications and the most recent revision(s) of the International Association of Geosynthetic Installers Installation Specifications.

SECTION 2.06 GEOSYNTHETIC PLACEMENT

The geosynthetic shall be placed according to the project specifications and the most recent revision(s) of the International Association of Geosynthetic Installers Installation Specifications. The use of low ground pressure vehicles on top of the geomembrane is permitted during placement provided the ground pressure of the vehicle(s) does not exceed 6 psi (41 kPa). Vehicle tires and/or other points of contact with the geomembrane should be inspected to ensure that they do not exhibit signs of damage, loose and/or angular equipment, exposed wires, or other deleterious items which could damage the geomembrane. No sharp turns or sudden braking should occur when operating low ground pressure vehicles on top of the geomembrane.

SECTION 2.07 SEAMING PROCEDURES

(a) Seaming procedures shall be in accordance with the latest revision(s) of GRI GM19 and the International Association of Geosynthetic Installers Installation Guidelines.

(b) Cold weather installations should follow guidelines as outlined in the latest version of GRI GM9.

(c) Special considerations for seaming of AGRU structured geosynthetic (e.g., MicroDrain, Drain Liner, and Super Gripnet):

(i) Seaming shall primarily be performed using automatic-fusion welding equipment and techniques along the welding edges.

(ii) Welding of the dimensional areas of the structured geomembrane is primarily accomplished using extrusion welding methods.

(iii) Where extrusion welding is used in situations where fusion welding is not possible, such as pipe penetrations, patches, or other repairs, it will be necessary to remove all dimensional studs to allow intimate contact of the area(s) to be welded.

SECTION 2.08 PIPE AND STRUCTURE PENETRATION SEALING

(a) Provide a penetration-sealing system as shown in the Project Drawings.

(b) Penetrations shall be in accordance with the latest revision(s) of the International Association of Geosynthetic Installers Installation Guidelines.

(c) Construct all penetrations from the base of the geosynthetic material, flat stock, prefabricated boots, and accessories as shown on the Project Drawings. In the case of structured liners such as MicroDrain, Drain Liner, Super Gripnet, or similar materials offered by AGRU America, Inc., use the smooth or textured liner of the same density for such fabrications.

SECTION 2.9 FIELD QUALITY CONTROL

(a) The owner's representative must receive information prior to all pre-qualification, production welding, and testing or as agreed upon in the pre-construction meeting.

(b) Field quality control shall be in accordance with the latest revision(s) of the Installation Guidelines of the International Association of Geosynthetic Installers.

(c) Regarding geomembrane with an electrically conductive layer, AGRU's conductive geomembranes are to be installed and subjected to the same quality control measures as traditional non-conductive geomembranes. Conductive geomembranes are designed to be tested according to ASTM D7002 (Current Revision), "Standard Practice for Electrical leak Location on Exposed Geomembranes Using the Water Puddle Method" and ASTM D7007 (Current Revision), "Standard Practice for Electrical methods for Locating Leaks in Geomembranes Covered with Water or Earthen Materials." Please note the ultimate decision as to which method is used to perform leak location surveying is the responsibility of the design engineer. Other methods may be acceptable; please consult with your AGRU America sales representative or AGRU's Technical Product Support Group if use of a different method is preferred or specified.

SECTION 2.10 LINER ACCEPTANCE

The owner's representative accepts the geomembrane liner when:

(a) The entire installation is completed or an agreed upon subsection of the installation is finished.

(b) The Installer submits all completed quality-control documentation to the owner.

(c) Verification of the adequacy of all field seams, repairs, and associated geosynthetic testing is complete.

(d) All submittals are accepted.

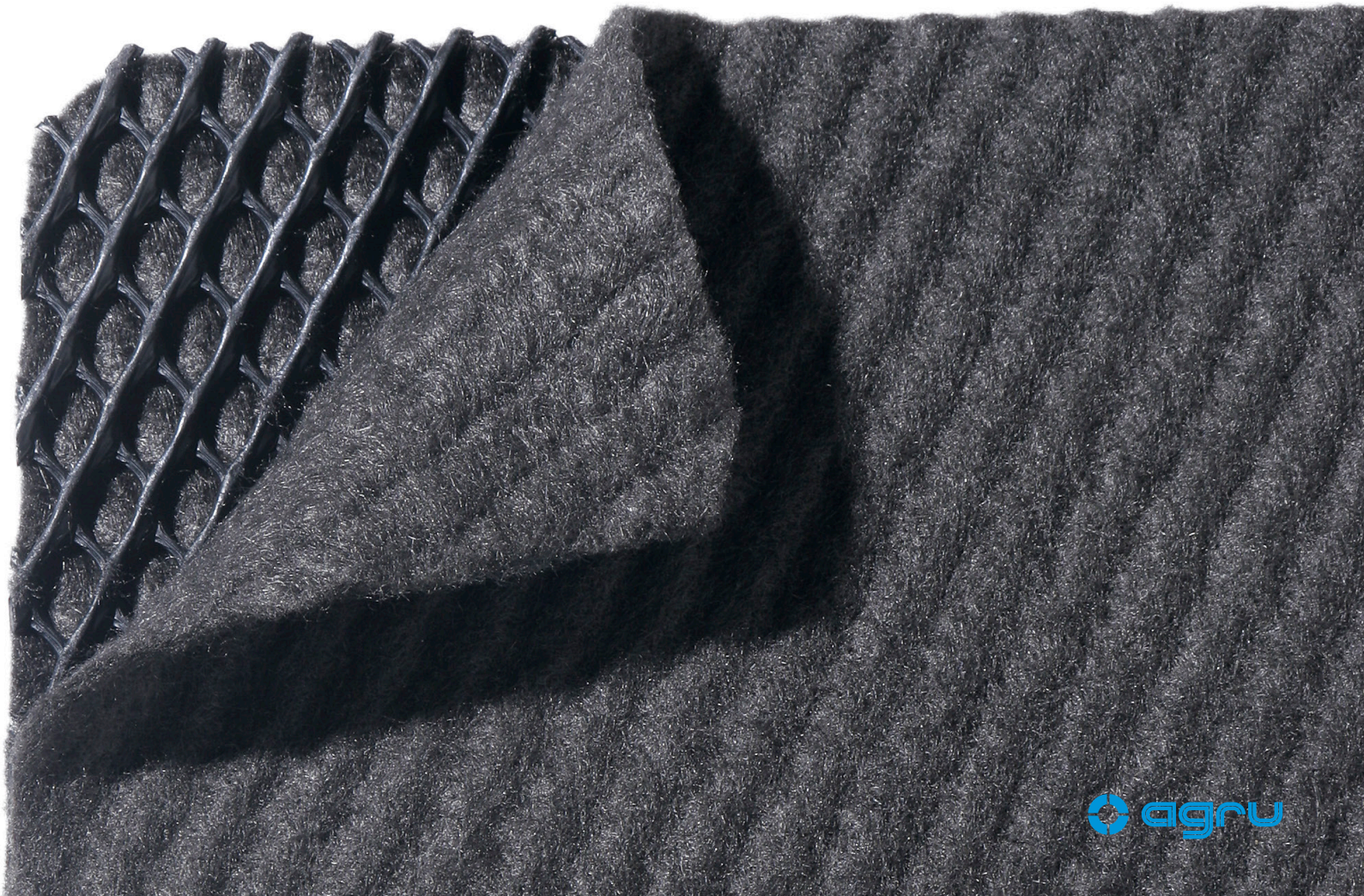
SECTION 2.11 ANCHOR TRENCH

Construct as specified on the project drawings.

SECTION 2.12 DISPOSAL OF SCRAP MATERIALS

On completion of installation, the geomembrane installer shall dispose of all trash and scrap material in a location approved by the owner, remove equipment used in connection with the work herein, and shall leave the premises in a neat and acceptable manner. Finally, remove all scrap material from the surface of the geomembrane.

Article III. GEOTEXTILES, GEONETS, AND GEOCOMPOSITES



SECTION 3.01 GEOTEXTILES

(a) The general arrangement of geotextiles includes aligning seams parallel to the prevailing slope. Seams can be finished by either heat seaming with an approved handheld, self-motivated thermal device, or by sewing with stitching approved by the engineer. Whichever stitching method is used, the thread should be compatible with the fabric and have chemical resistance similar to that of the geotextile used.

(b) When installed over AGRU Integrated Drainage System (IDS) geomembranes, geotextiles will be aligned with seams parallel to the prevailing slope, with the geotextile placed against the IDS geomembrane drainage studs. The geotextile/IDS geomembrane drainage stud interface should have previously been tested for transmissivity and interface friction during design or pre-qualification testing. The side installed in contact with the IDS geomembrane drainage studs should be selected by the design engineer prior to construction.

(c) The use of low ground pressure vehicles on top of the geotextile is permitted during placement provided the ground pressure of the vehicle(s) does not exceed 6 psi (41 kPa). Vehicle tires and/or other points of contact with the geotextile should be inspected to ensure that they do not exhibit signs of damage, loose and/or angular equipment, exposed wires, or other deleterious items which could damage the geotextile. No sharp turns or sudden braking should occur when operating low ground pressure vehicles on top of the geotextile.

(d) Geotextile should be covered within a maximum time determined by the design engineer based on site-specific conditions to minimize UV exposure.

SECTION 3.02 GEONET

a) The use of low ground pressure vehicles on top of the geonet is permitted during placement provided the ground pressure of the vehicle(s) does not exceed 6 psi (41 kPa). Vehicle tires and/or other points of contact with the geonet should be inspected to ensure that they do not exhibit signs of damage, loose and/or angular equipment, exposed wires, or other deleterious items which could damage the geonet. No sharp turns or sudden braking should occur when operating low ground pressure vehicles on top of the geonet.

b) Geonet may be butt-joined or lapped if specified. At approximately 1.5 m (5 ft) intervals along the edge, the Installer applies nylon/plastic cable ties to the net edge. Complete end splices as follows: On slopes, the ends will overlap approximately 2 ft (0.6 m) with uphill panels on top and two rows of cable ties applied at 6-in spacing or per engineers' specification. In flat areas, the ends will overlap a minimum of approximately 6 in (15 cm) and one row of three cable ties applied.

SECTION 3.03 GEOCOMPOSITES

(a) Geocomposites can overlap with the net portion tied, and the geotextile portion can be thermally bonded or seamed as required by the project specifications.

(b) Geocomposite should be covered within a maximum time determined by the design engineer based on site-specific conditions to minimize UV exposure.

(c) The use of low ground pressure vehicles on top of the geocomposite is permitted during placement provided the ground pressure of the vehicle(s) does not exceed 6 psi (41 kPa). Vehicle tires and/or other points of contact with the geocomposite should be inspected to ensure that they do not exhibit signs of damage, loose and/or angular equipment, exposed wires, or other deleterious items which could damage the geocomposite. No sharp turns or sudden braking should occur when operating low ground pressure vehicles on top of the geocomposite.

SECTION 3.04 REPAIRS

(a) Repair any holes, tears, or burns through the geotextile from thermal seaming by patching with the same geotextile. The patch will be a minimum of 12 in (30 cm) larger—in all directions—than the area repaired and will be spot-bonded thermally.

(b) Repair all geonet holes and/or tears using a patch of the same geonet. Patches are a minimum of 12 in (30 cm) larger—in all directions—than the area repaired. Tie the patch in place using a minimum of four nylon cable ties.

SECTION 3.05 DELIVERY, STORAGE, AND HANDLING

(a) Delivery:

(i) Manufacturer labels must be on all rolls delivered to the project.

(ii) A firmly affixed label attached to the roll shall clearly state the manufacturer's name, product identification, material thickness, roll number, roll type, roll dimensions, and roll weight.

(iii) The manufacturer protects the geocomposite, geonet, and geotextile from mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions prior to shipment.

(iv) Continuously and uniformly supported, rolls are stored away from high-traffic areas on a smooth, level surface. Chocks keep the rolls secure when necessary.

(b) Handling:

(i) Prior to unloading and during deployment, care must be taken to ensure that the equipment to be used to unload or handle the material at the job site is adequate for the task.

(ii) Rolls should not be moved more than necessary to avoid possible damage.

(iii) When moving rolls, ensure that the roll is elevated enough to avoid scraping the roll on the ground.

(iv) When removing rolls from a container, care shall be taken to avoid scraping the roll against the top, bottom, or sides of the container.

(v) Care should be taken to avoid damage to the core ends.

(c) Storage:

(i) A roll storage space should be provided in a location or locations close to the area to be lined to minimize additional handling.

(ii) The storage area should be protected from puncture, theft, vehicular traffic, vandalism, chemical exposure, excessive heat, and other hazards that might create a source of potential damage to the liner.

(iii) The surface on which the liner will rest should be a flat, rigid, and prepared, free of debris and sharp objects (DO NOT store liner on top of wooden pallets).

(iv) If available, geotextile should be placed under the liner rolls to cushion and protect them.

(v) AGRU geocomposite, geotextile, and geonet rolls should be stacked no more than five full-length rolls high.

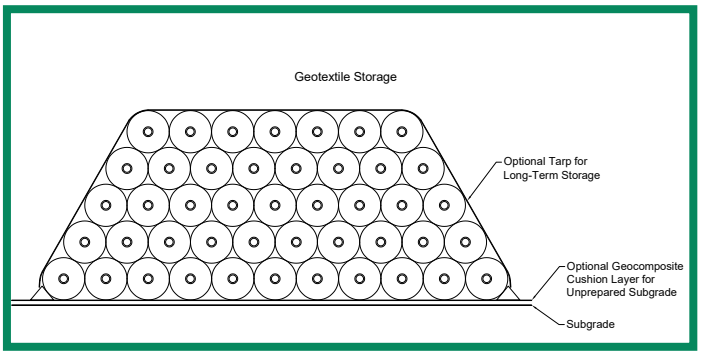
(vi) The ends of cardboard-cored rolls should be capped or taped with weather-resistant tape. If capped, secure the caps with suitable adhesive weather-resistant tape.

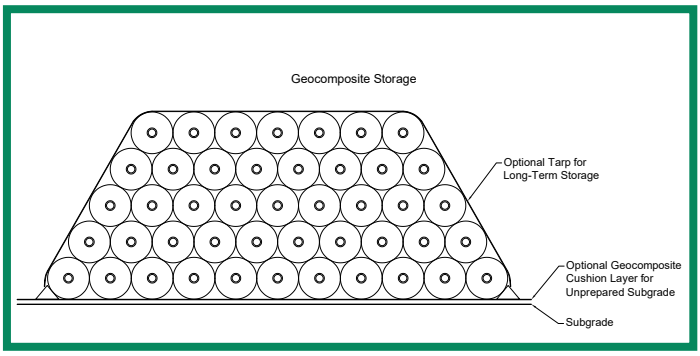
(vii) Rolls at both ends of a stack should be chocked. Chocks should be large enough to adequately secure the rolls and should not dig into the rolls or otherwise damage them.

(viii) If rolls must be stored for longer than 30 days, the opaque wrapping provided with the products should be examined for degradation. AGRU America, Inc. recommends covering geocomposite, geotextile, and geonet with additional UV protection (e.g., a tarp) if products are to be stored longer than 30 days.

(ix) Provide secure, UV-resistant indoor storage for the slings that were provided during shipment.

(x) Please see below examples of correct roll stack geometry:





Article IV. GEOSYNTHETIC CLAY LINER (GCL)

SECTION 4.01 DELIVERY, STORAGE, AND HANDLING

(a) Delivery:

(i) Manufacturer labels must be on all rolls delivered to the project.

(ii) A firmly affixed label attached to the roll shall clearly state the manufacturer's name, product identification, material thickness, roll number, roll type, roll dimensions, and roll weight.

(iii) The manufacturer protects the GCL from mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions prior to shipment.

(iv) Continuously and uniformly supported, rolls are stored away from high-traffic areas on a smooth, level surface. Chocks keep the rolls secure when necessary.

(b) Handling:

(i) Prior to unloading and during deployment, care must be taken to ensure that the equipment to be used to unload or handle the material at the job site is adequate for the task.

(ii) Rolls should not be moved more than necessary to avoid possible damage.

(iii) When moving rolls, ensure that the roll is elevated enough to avoid scraping the roll on the ground.

(iv) When removing rolls from a container, care shall be taken to avoid scraping the roll against the top, bottom, or sides of the container.

(v) Care should be taken to avoid damage to the core ends.

(c) Storage:

(i) A roll-storage space should be provided in a location or locations close to the area to be lined to minimize additional handling.

(ii) The storage area should be protected from puncture, theft, vehicular traffic, vandalism, chemical exposure, excessive heat, and other hazards that might create a source of potential damage to the liner.

(iii) The surface on which the GCL will rest should be a flat, rigid, prepared surface free of debris and sharp objects (Do NOT store products on top of wooden pallets).

(iv) If available, a sacrificial layer of geocomposite or geotextile should be placed under the liner rolls to cushion and protect them.

(v) AGRU GCL rolls should be stacked no more than five full-length rolls high.

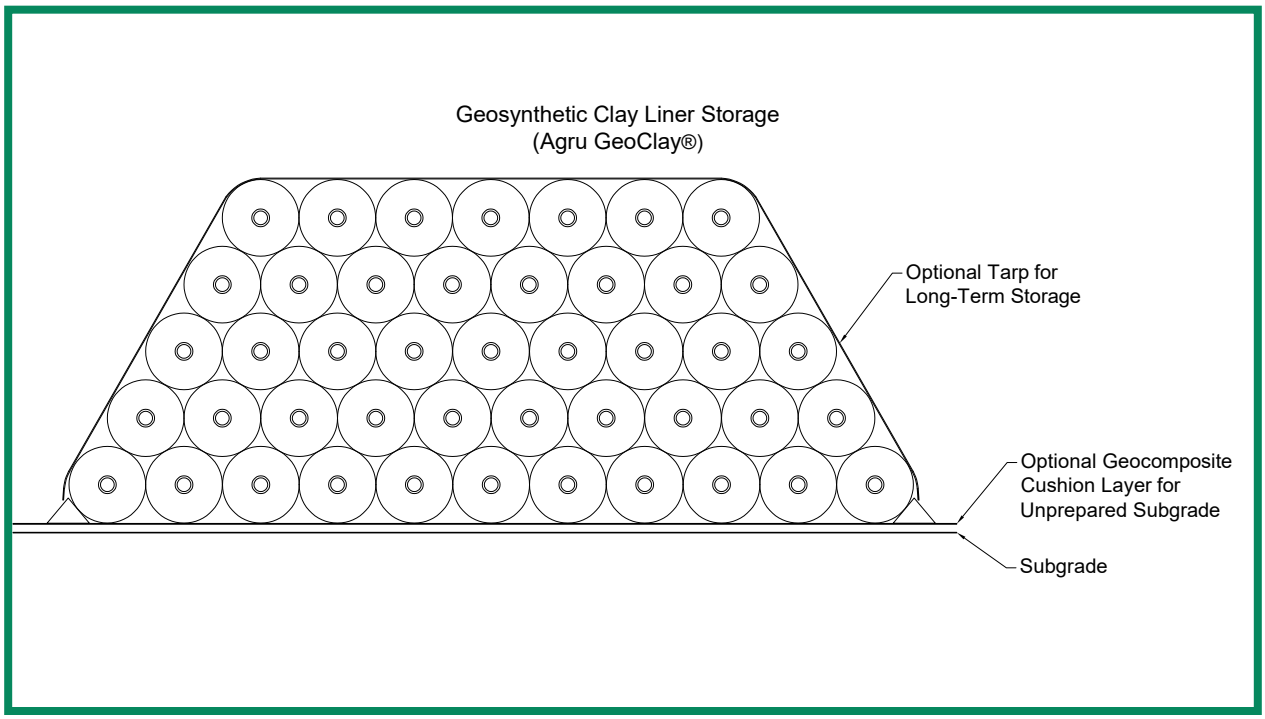
(vi) The ends of cardboard-cored rolls should be capped or taped with weather-resistant tape. If capped, secure the caps with suitable adhesive weather-resistant tape.

(vii) Rolls at both ends of a stack should be chocked. Chocks should be large enough to adequately secure the rolls and should not dig into the rolls or otherwise damage them.

(viii) If rolls must be stored for longer than 30 days, the rolls should be stored indoors. If indoor storage is not available, AGRU America, Inc. recommends additional UV protection (e.g., a tarp). Please note this will provide limited protection. If stored outdoors, additional care should be taken so that the GCL does not become prematurely hydrated

(ix) Provide secure, UV-resistant indoor storage for the slings that were provided during shipment.

(x) Please see below examples of correct roll stack geometry:



SECTION 4.02 MATERIAL DEPLOYMENT

(a) AGRU GCL rolls should be transported to the deployment area in their original packaging. The orientation of the GCL (i.e., which side faces up) may be important if the GCL has differing types of geotextiles/geosynthetics. Always check with the project engineer to determine if there is a preferred installation orientation for the GCL.

(b) Equipment that could damage the GCL should not be allowed to travel directly on it. Allowable equipment that may be utilized on the GCL is limited to lightweight ATVs with a maximum bearing capacity of 6 psi (41 kPa). Care should always be taken when operating any equipment on AGRU GCL to avoid sudden starts and stops, abrupt turns, or other maneuvers that could damage the GCL.

(c) The GCL should always be deployed/placed so that longitudinal seams are parallel to the direction of the slope. End-of-panel or butt-seams should also be located a minimum of 3 ft (1 m) from the toe and crest of any slope steeper than 4H:1V. Butt seams on slopes should be used only if the liner is not expected to be in tension, and interface friction testing confirms this.

(d) All AGRU GCL panels should be placed to lie flat, with no wrinkles or folds, especially at the exposed edges of the panels.

Several general rules for the deployment of AGRU GCL to prevent premature hydration are as follows:

(a) Never install in standing water or during rainy weather.

(b) Only deploy as much AGRU GCL as can be covered at the end of the working day with soil, geomembrane, or a temporary waterproof tarpaulin, and AGRU GCL should not be left uncovered overnight.

(c) If AGRU GCL is allowed to hydrate when no confining stress is present, it may be necessary to remove and replace the hydrated material. AGRU America, Inc. recommends that premature hydration be evaluated on a case-by-case basis. The project engineer or construction quality control inspector should be consulted for specific guidance if premature hydration occurs. The type of GCL, duration of exposure, degree of hydration, location in the liner system, and expected bearing loads should be considered. In many instances, a needle-punched reinforced GCL may not require removal/replacement if the following are true:

(i)The geotextiles have not been separated, torn, or otherwise damaged.

(ii)There is no evidence that the needle-punching between the two geotextiles has been compromised.

(iii)The GCL does not leave deep indentations when stepped upon.

(iv)Any overlapped seams with bentonite enhancement are intact.

SECTION 4.03 SEAMING

(a) AGRU GCL seams are constructed by overlapping adjacent panel edges and ends. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite must be used in seams regardless of the specific AGRU GCL used.

(b) Longitudinal seams are constructed by first overlapping the adjacent panels by a minimum of 6 in (150 mm), exposing the underlying edge, and applying a continuous bead of granular bentonite approximately 3 in (75 mm) from the edge. Bentonite-enhanced butt seams are constructed first by overlapping the adjacent panels, exposing the underlying panel, and then applying a continuous bead or fillet of granular sodium bentonite 12 in (300 mm) from the edge of the underlying panel. The minimum application rate at which the bentonite is applied is one-quarter pound per linear foot (0.4 kg/m).

SECTION 4.04 SEALING AROUND PENETRATIONS AND STRUCTURES

The Installation of AGRU GCL around structures or penetrations should be in accordance with the project drawings and specifications.

(a) AGRU GCL may be secured to structures through the use of mechanical fasteners, clamps, batten bars, or other methods. The AGRU GCL should be sealed around any penetrations, structures embedded in the subgrade, and/or other appurtenances by liberally using granular bentonite (approximately 2 lbs. per in-ft or 3 kg per meter) to seal the GCL to these structures.

(b) When AGRU GCL is placed over a penetration (pipe, piling, or other appurtenance), a "notch" should be excavated into the subgrade around the penetration to a depth of approximately 4 in (100 mm) and at a width of approximately 3 in (75 mm) around the entire structure. The notch should then be filled with granular bentonite. A secondary GCL collar fabricated from AGRU GCL should then be placed around the penetration. It is usually helpful to first trace the outline of the penetration on the GCL and then cut a star-shaped pattern in the collar to enhance the collar's fit to the penetration. The GCL collar should extend a minimum of 12 in (300 mm) from the structure in all directions. Granular bentonite should be placed between the primary GCL and the secondary GCL collar, as well as in minor gaps or voids that may exist around the interface with the structure.

(c) When AGRU GCL is terminated at a structure that is embedded into the subgrade on the containment area floor, the subgrade should be notched as described previously. The notch is filled with granular bentonite, and the GCL should be placed over the notch and up against the structure. Connection to the structure can be accomplished through the placement of soil or stone backfill in this area. If the structure is located at the top of a slope, additional detailing may be required.

SECTION 4.05 DAMAGE REPAIR

(a) If the AGRU GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch of AGRU GCL to cover the damaged area. Any damaged material should be brought to the attention of the engineer to determine the extent of the damage and any repairs that may be required.

(b) If it is determined that the damaged roll is reparable, a patch of AGRU GCL can be cut to cover the damaged area. The patch should be sized such that a minimum overlap of 12 in (300 mm) is achieved around all parts of the damaged area. Granular bentonite should be liberally applied around the damaged area prior to placement of the patch.

(c) Depending on site conditions, it may be necessary to use an adhesive such as wood glue to affix the patch in place to prevent displacement during cover placement. Smaller patches may be tucked under the damaged area to prevent patch movement.

SECTION 4.06 GENERAL COVER INFORMATION

Only as much GCL shall be deployed that can be covered by the end of the working day with soil, geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. As previously noted, if the GCL is hydrated in the absence of confining stress, it may be necessary to remove and replace the hydrated material.

SECTION 4.07 SOIL COVER REQUIREMENTS

(a) The required thickness of soil cover over AGRU GCL varies with the application. However, a minimum of 12 in (300 mm) of cover is typically required to provide the appropriate confining stress to the GCL, thereby eliminating the potential for seam separation and preventing potential damage of exposed or inadequately covered material.

(b) Any soils (including cover soils) used in direct contact with the GCL should be free of angular stones or other foreign matter that could damage the material. In addition, any cover soils should be approved by the engineer with respect to particle size, uniformity, and chemical compatibility. Consult with the engineer and AGRU America, Inc. if cover soils containing high concentrations of calcium (e.g., limestone, dolomite, gypsum, and seashell fragments) are present.

SECTION 4.08 HYDRATION METHODS

(a) Ultimately, hydration of the AGRU GCL will be required for the material to perform properly as a barrier layer. It is very important to note that this hydration must occur in the presence of a confining stress. The confining stress is most often provided through the use of a minimum of 12 in (300 mm) of cover soil.

(b) Hydration is typically accomplished naturally by the absorption of moisture from the soil. However, in cases where the containment of non-aqueous liquid is required, it may be necessary to manually hydrate the covered GCL prior to use. If such manual hydration is necessary, water may be introduced to the GCL by flooding the covered lined area or by using a sprinkler system, irrigation system, or other method of applying the water for hydration.

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