SOLMAX

INSTALLATION GUIDELINE

GSE Studliner

Contents

1. INTRODUCTION

GSE® Studliner® can be supplied in either sheet form or prefabricated pieces for precast applications. Standard roll dimensions for **GSE** Studliner are 2.44 m (8 ft) widths and up to 75 m (246 ft) lengths approximately. Rolls may be precut and fabricated to any size dimension required, or shipped to site in rolls. When material is received on site it should be placed on a clean smooth surface to prevent damage. Light reflective StudLiner® should be kept out of direct exposure to sunlight. Solmax can supply thin mil HD liners to act as a temporary cover.

2. TYPICAL PRECAST GUIDELINES

A. Material handling and storage

GSE Studliner can be supplied in either sheet form or prefabricated pieces for precast applications. Standard roll dimensions for **GSE** Studliner are 2.44 m (8 ft) widths and up to 75 m (246 ft) lengths approximately. Rolls may be precut and fabricated to any size dimension required, or shipped to site in rolls. When material is received on site it should be placed on a clean smooth surface to prevent damage. Light reflective **GSE** Studliner should be kept out of direct exposure to sunlight. Solmax can supply thin mil HD liners to act as a temporary cover. Unloading of StudLiner® rolls should be performed by equipment that will lift the roll from the center core. Rolls should be placed on a firm, smooth surface free of large, sharp stones.

B. Pipes and manholes

Precasting of materials is advantageous to most projects. Costs are minimized and quality control is maximized. Material may be supplied in either precut sheets, or prefabricated tube sleeves. Typical precast pieces do not require any working or welding of the plastic materials unless sheet materials are supplied. When prefabricated items are utilized, materials are shipped from the manufacturer ready to be placed over forms and have concrete applied. In either case before applying the liner, the form should be clean of any defects or protrusions, and any concrete residue which may damage the liner when the form is expanded.

1. **Sheet materials**

   If bulk material is provided, cut to the proper dimension and wrap the liner around the inner form, and secure using mechanical devices such as banding or wire. Bands should be located in the interstitial space between studs to prevent crushing or tilting of the embedment studs. It should not be necessary to cut or remove any of the embedment material in order to accommodate banding. Seams can be welded prior to placing a metal reinforcement cage to prevent migration of concrete between overlapped longitudinal seams.

   a. **Butt welding**

      When butt seaming, the joint should have a maximum gap of 0.2 in. The weld should be made by applying an extrusion bead to the back of the butt joint or by some other method acceptable to prevent concrete from migrating between overlapped surfaces. After the forms have been stripped, a second extrusion weld bead is then applied over the butt joint on the smooth face of the liner.

   b. **Overlap with extrusion weld**

      In order to facilitate an overlap weld, it will be necessary to remove the studs on the underlying portion of the liner that is to be welded. This can be accomplished through the use of a sharpened chisel and a small hammer. Care should be taken not to damage the parent liner when removing the studs. The overlap should consist of approximately a 4 in overlap fused together by an extrusion weld or some other acceptable method to prevent the concrete from migrating under the overlapped sheet. Once forms are removed the internal overlap should also be extrusion welded.

2. **Prefabricated materials**

   a. If the material is provided in prefabricated tubular form, lower the liner over and around the collapsed inner form. The form should then be expanded until the liner is taught over form. It is necessary to monitor the expansion of the form to avoid over-stressing the liner during this process as overstressing may lead to unwanted elongation of the liner material.

   b. The liner should sit flush with the inner edge of the bell or spigot end of a pipe section. If needed or desired the liner may extend beyond the opposite end approximately 4 in depending upon the type of lining joint to be made with the adjoining concrete pipe. Embedment studs should be removed within the 4 in to produce a smooth layer for overlap lining joint.

   c. Care should be taken when using a vibration method during the pouring of the concrete in order to avoid damaging the liner. It is important to achieve a tense homogeneous bond between the concrete, this will ensure the maximum performance of the studded surface of the Solmax **GSE** Studliner. Once concrete has been poured into the form, standard curing procedures should be followed.

C. Partial or 270° installation

If the specifications require that the tube form or pipe be lined only 270° around the perimeter, Solmax can prefabricate the tube or sheet with 270° of embedment liner and the remaining area lined with a smooth sheet. The smooth sheet can be removed after curing to allow for standard operating procedures of precast form to continue while meeting the specifications. This also provides a termination point within the liner that is flush and smooth with the concrete pipe itself.

D. Speciality shapes and sizes

Solmax can prefabricate any unique system which may be encountered through specifications. Contact the Solmax Fabrication Department to coordinate dimensions and details. Precast procedures are the same as above.

3. TYPICAL CASE-IN-PLACE GUIDELINES

A. Material handling and storage

GSE Studliner can be supplied in either roll form or prefabricated panels for critical applications. Standard roll dimensions for **GSE** Studliner are 2.44 m (8 ft) widths and up to 75 m (246 ft) lengths approximately. Rolls may be precut and fabricated to any size dimension required, or shipped to site in rolls. When material is received on site it should be placed on a clean smooth surface to prevent damage to the liner. The area should be clear of any rock or debris, and material should be kept under protective cover to reduce exposure to dirt and limit damage. Light reflective **GSE** Studliner should be kept out of direct exposure to sunlight. Solmax can supply thin mil HD liners to act as a temporary cover. Unloading of **GSE** Studliner rolls should be performed by equipment that will lift the roll from the center core. Rolls should be placed on a firm, smooth surface free of large, sharp stones.

B. Installation for larger structures

The **GSE** Studliner System installation involves a series of construction steps that have been coordinated to increase the level of quality, reduce project costs by minimizing the time involved, and avoid damages during the various installation phases. The following sequence has shown the best results for the standard construction of a cast in place structure with **GSE** Studliner:

1. Weld wall panel joints in the ceiling area (when applicable)
2. Fix and weld ceiling panels (when applicable)
3. Weld wall panels
4. Install and weld floor panels
5. Concrete installation for the floor area

a. Wall panel fixation

1. If **GSE** Studliner is received in roll form it is advised to lay out panels in order to facilitate straightening of the material. Prior to attachment to formwork, unroll the needed amount and place weight on the material to flatten. Replace the temporary cover on **GSE** Studliner roll. Since the **GSE** Studliner sheets will be custom sized for the formwork, the **GSE** Studliner sheets must remain covered to reduce thermal expansion from direct UV exposure after they have been measured and cut. Controlling thermal expansion is critical for a quality installation. When necessary, panels may be transported by crane or front-end loader into position to be fixed onto the forms.
2. It is important all sheets are hung plumb so all joints can butt with the least amount of space between sheets. Solmax offers pre-fabricated corner pieces made with **GSE** Studliner if corner pieces are preferred.
3. The panels are placed with the smooth side on the forms. **GSE** Studliner sheets should be secured to formwork by the use of mechanical attachments including nails, screws, tie wire or banding. Screws or nails should be placed within 0.25 in of the edge of the sheet, placed every 12 in. Form ties will offer support for the rest of the sheet. To prevent damage to the **GSE** Studliner sheet, the mechanical attachments must allow for some expansion of the **GSE** Studliner while awaiting the concrete pour. The formwork must be free of sharp objects that could penetrate the **GSE** Studliner. The **GSE** Studliner panels are attached to the formwork prior to the installation of concrete reinforcement products (i.e., rebar). Note, do not mechanically attach the interior structural steel (rebar) to the **GSE** Studliner sheets. The rebar should be free-standing to stay in place during the concrete pour. Damage to the **GSE** Studliner sheets could occur if interior structures come loose during the concrete pour. During mounting of the panels wave formation in the liner must be minimized when the casts are in an upright position, however it is easier to position and fix the panels onto the forms while they are still on the ground.
4. To eliminate gaps between panels, the seams can be overlapped approximately 4 in. This is accomplished by removing the studs with a grinder or sharpened chisel or stud removal tool, from the overlap portion of the bottom sheet (closest to the formwork) to ensure a smooth overlap. In order to minimize penetrations in the **GSE** Studliner, place attachments in overlap seam where possible.
5. Prior to the concrete being poured, temporary sealing should be used to prevent concrete from getting between the **GSE** Studliner sheet seams. Such temporary sealing methods include HDPE tape and/or hot air bonding to provide temporary attachment.
6. It is recommended that concrete pouring times occur during early morning, dusk, or night hours when the **GSE** Studliner sheet is thermally contracted. Care should be taken to ensure **GSE** Studliner embedment, a vibrator must be used to properly distribute the concrete. Allow for curing of concrete prior to removal of formwork.

b. Wall panel joint welding in the ceiling area

1. The joints in this area can be welded before the ceiling panels are installed. This will ensure consistent ceiling to wall welding with one seam in the corner of the tank and will prevent ceiling to wall overhead welding under the ceiling which is much more complex and time-consuming
2. Wall panel welding can be brought forward if weather conditions allow, however, the possibility of damage caused by form handling for the concrete ceiling work should be considered.

c. Ceiling panel fixation and welding

When a ceiling is to be utilized within the structure, the following steps will help to ensure a smooth installation.

1. The first step is to make sure that the reinforcement bars between the walls and ceiling are not bent but in a vertical position. This will allow an adequate area in the corner that is required for the extrusion welding equipment. Liner installation is also greatly simplified.
2. The panels are placed on the forms studs up. Adjacent panels are installed next to each other and a grinder is used to fit them into corners. The panels are then tacked with a hot air gun. A grinder is then also used to prepare the seam for welding. A copper wire is installed for testing purposes whenever access with a vacuum box is difficult.

3. Standard seam welding is then performed. After welding of panel seams and panels to the wall, the extra length wall panel required to weld onto the ceiling is cut so as to accommodate reinforced steel bars. It is advised that ceiling to wall panels be welded from the top side to ease installation.
4. Please note, the lining work and surface appearance should be approved prior to installation of the reinforced bars for the ceiling. This will expedite the final approval of the job.

d. Installation and welding of floor panels since the floor is the last area to be lined, a "relining" technique is utilized by installing the GSE Studliner with the assistance of grouting to the existing slab.

1. The existing concrete surface must fulfill specific conditions to ensure successful installation. The most important criterion is proper cohesion between the concrete surface and grout concrete. This can be determined through standard testing techniques when required. Normal concrete screeding is usually sufficient for this requirement to be fulfilled.
2. It is possible to grout approx. 100 m^2 (1,000 ft^2) of floor surface a day with a standard crew. If more than a day is required, the surface should be separated with a **GSE** HD strip which is installed into a slot in the floor and fixed with concrete. The **GSE** Studliner is welded to this strip to limit the grout or concrete flow. The installation of the strips should coincide with the seams to minimize welding work.
3. The installation of the **GSE** Studliner panels for the floor is similar to the installation for the ceiling, whereby the studs face the concrete. This side will be anchored into the grout. The panels are overlapped, and the studs in this area have to be removed.
4. Both panels in the area of the seams are prepared and welded together. In the corner seams, the horizontal seam covers the joints of the vertical ones. This reduces the possibility of weak areas in comparison to the execution of seams on the walls covering the horizontal corner seam (welding the wall panels after the installation and welding the floor).

e. Concrete floor installation

Concrete grout is filled into the area between the existing concrete floor and **GSE** Studliner panels.

1. **Option 1: GSE** HD pipes are installed vertically to the panels by welding thus ensuring that the concrete flows correctly and that the air exits properly. The distance between pipes shouldn't exceed 2.5 m (8 ft). Pipes in the corners of the tank will prevent trapped air from forming. The best results are reached with 100 mm (4 in) diameter pipes having a length of 500 mm (20 in). The **GSE** Studliner panels should be ballasted with a load of not less than 400 kg/m^2 (0.567 psi). Various methods from water barrels to reverse forms can be used. For further information contact Solmax.

   The Concrete grout should be mixed and poured in one uninterrupted process. To prevent the formation of trapped air, the concrete should be poured systematically in one direction. As soon as the pipes are full and the concrete cannot flow into the room, the surface should be knocked to locate trapped air. The ensuing vibrations will force the air into the next pipe. The panel can be opened in certain areas to allow the air to escape.

   After work completion, the pipes can be removed and a **GSE** HD plate is used to cover the holes.

2. **Option 2:** Layout a grid on 8 foot centers or less, attach screed boards, **GSE** HD, concrete, oak, or plastic lumber. Attach to concrete matching the planned grid. Pre cut **GSE** Studliner panels and prefit to each grid. Fill the grid to be lined with grout and screed level. With the **GSE** Studliner prefit and rolled, place at one end and start to unroll, after the first 6 to 8 ft place a sheet of plywood on top of the **GSE** Studliner. You can tamp or use a jitterbug to vibrate on top of the plywood to ensure entrapped air is removed. Place several sandbags on top of the plywood to ensure a tight fit. Repeat until the entire panel is installed. Repeat until the entire floor is completed.

c. Installation of prefabricated drop in units Solmax can fabricate most any size and dimension of sump or trench that is required to meet the various job criteria. These materials are supplied to the site ready to be installed with minimal effort.

1. Place the prefabricated unit into a predetermined location. This location should be prepared with an exterior form to support concrete.
2. If an internal form was not supplied with the unit one will need to be constructed. The form should be rigid enough to prevent the collapse of the liner structure from the weight of concrete.
3. Concrete is then poured using standard operations and procedures. Proper vibration and curing techniques should be followed.
4. Once the concrete is cured, forms are removed and any pipe or welding that is needed, is performed.

4. SEAM WELDING AND TESTING

A. Seaming

GSE Studliner is manufactured from virgin high density polyethylene to produce a flexible, but strong finished product with excellent stress crack resistance. These characteristics allow for the material to be rewelded or patched, at any time during the life of the system provided that proper surface preparation is performed. Field seaming involves bonding adjacent panels using approved thermal methods such as extrusion welding, wedge welding or electro-fusion welding. Testing and verification of the resulting welds are imperative to a quality installation.

1. Installation equipment

Standard HDPE geomembrane welding equipment is used for welding joints between **GSE** Studliner sheets and concrete formwork. This typically requires an extrusion welder, wedge welder or by use of the electro-fusion process.

2. Seaming method

All field seams should be welded to provide a continuous impermeable barrier. This is typically done by the use of an extrusion welder. Extrusion welding incorporates hot, molten HDPE that is pressed through a port onto the materials to be welded. The molten plastic then fuses with the exposed surface(s) to create a homogenous bond of material.

3. Surface preparation

a. As formwork is stripped, all penetrations, tie rods, nail holes, and any damage in the **GSE** Studliner sheets must be identified and marked to speed the welding portion of the installation.

b. Preparation of the material surface is vital to the quality of the weld. The surfaces must first be cleaned, dried and free of debris prior to welding. In order to achieve a strong bond between the extrusion material and the surface, the liner should be slightly scored using a grinder and proper techniques.

c. The welder should be set to parameters defined by the manufacturer of the welding equipment. All seams and penetrations must be properly ground to roughen the surface of the **GSE** Studliner if an extrusion welder is to be used.

d. A copper wire can be inserted prior to welding so holiday spark testing can be performed on extrusion weld seams. Whenever feasible, all welds shall be vacuum tested. Boot and weld all pipe penetrations in accordance with Solmax drawings.

e. Wedge welding or electro-fusion welding requires a dry clean surface for welding. A wipe-down with a clean wet (water) rag may be used.

B. Trial seams

Prior to any field welding of a lined surface, it is advantageous to perform a trial seam to ensure that the technician and method are adequate. Trial seams should be performed on materials from the current project; three feet in length is adequate. Trial weld seams should then be tested to ensure equipment settings are sufficient to produce quality welds. Testing can consist of both non-destructive and destructive methods.

1. **Non-destructive seam testing**
    a. Non-destructive testing consists of primarily vacuum box testing.
    b. Vacuum box testing per ASTM D5641-94 (01)e1 will be performed on all accessible welds according to procedures set forth by a manufacturer. Typically, a negative pressure of approximately 5 psi shall be applied to the seam. A defect in the weld will be noted by the presence of bubbles along the seam. The defect shall be marked and repaired with approved methods.
    c. Repairs of pinholes and defective areas should be performed by extruding a bead of molten plastic over the surface, or if too large, a patch shall be utilized. Once complete, retest using the vacuum box.
    d. If spark testing of the finished seams is required per ASTM D6365-99, a copper wire may be set into the weld joint prior to welding. This will allow for spark testing for the welded seam to determine the presence of possible leaks in the weld. This process is not necessary but may provide an alternative method for non-destructive testing of the welds.
2. **Destructive testing**
    Destructive testing is not advised once the product has been embedded in concrete.
3. **GSE Studliner final sheet test**
    After all seam welding and construction have been completed it is recommended that 100% of the **GSE** Studliner sheet be spark tested to ensure any construction damage has been repaired. Spark test reference ASTM 6365–99.

About Solmax

Solmax is a world leader in sustainable construction solutions, for civil and environmental infrastructure. Its pioneering products separate, contain, filter, drain and reinforce essential applications in a more sustainable way – making the world a better place. The company was founded in 1981, and has grown through the acquisition of GSE, TenCate Geosynthetics and Propex. It is now the largest geosynthetics company in the world, empowered by more than 2,000 talented people. Solmax is headquartered in the province of Quebec, Canada, with subsidiaries and operations across the globe.

Uncompromised quality

Our products are manufactured to strict international quality standards. All our products are tested and verified at our dedicated and comprehensive laboratories which maintain numerous accreditations. We offer our partners a wide scope of testing according to published standards to ensure products delivered to sites meet specified quality requirements.

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