

**STATE OF OHIO
DEPARTMENT OF TRANSPORTATION**

**SPECIAL PROVISION
FORM LINERS FOR NOISE BARRIERS**

I. DESCRIPTION

A. General. This work consists of designing, creating scale modeling, preparing working drawings, producing full-size bas-relief patterns; fabricating custom form liners from approved full-size bas-relief patterns; casting sample panels at the Project site, as required by the Engineer; constructing raised relief patterns on exposed surfaces of precast concrete panels used in sound barrier walls using the custom form liners; and preparing form liners for storage and reuse; as described herein, shown on the Plans, and directed by the Engineer. The custom form liners shall be provided in accordance with these specifications and in reasonably close conformity with the lines, grades, and dimensions shown on the Plans. The requirements in this Special Provision govern the construction of the highway-facing side of all noise walls. The nonhighway facing side shall be governed by Ohio Department of Transportation (ODOT) Standard Drawing NBS-1-09.

B. Standard Specifications. Unless otherwise described herein, the work shall be in accordance with American Concrete Institute ACI 303R-91, Guide to Cast-In-Place Architectural Concrete Practice, ODOT Standard Drawing NBS-1-09, and the ODOT Construction and Material Specifications (CMS).

C. Definitions.

Bas-relief: a kind of sculpture in which forms are created to project slightly higher from a flat background, with or without undercuts.

Contractor: as defined in CMS 101.03.

Work: as defined in CMS 101.03.

Engineer: as defined in CMS 101.03.

Form Liner Company: the individual, firm, or corporation with whom the Contractor subcontracts to provide the custom form liners described herein.

Dimple: a small oval or circular indentation in the surface of urethane rubber surface

Scale Model: a representation or copy of a bas-relief that is smaller than the actual size of the bas-relief being represented.

Simulated Stone: a concrete surface pattern resembles the appearance of a natural stone.

Manual Sculpting Technique: a traditional process of making patterns by carving, modeling, or assembly using real-life substance such as clay, wood, or other construction materials.

3D CAD modeling: a digital sculpting using computer software that offers tools to manipulate a digital object as if it were made of a real-life substance such as clay.

Suitable Materials: any material that is strong enough to sustain handling, shipping and able to create a mold or form liner from.

D. Form Liner Ownership. The custom form liners created for the Project shall be the property of the Ohio Department of Transportation (ODOT) at the completion of the project and are intended for possible reuse on future highway and bridge projects or other disposition, at the sole discretion of the Department. After the Noise Walls are accepted and approved, the form liners shall be delivered, used but in good condition (not requiring any repair) to the ODOT Kelly Avenue Outpost (1240 Starlight Drive, Akron Ohio 44308) as directed by the engineer. The form liners shall be stacked on a pallet, flat and level with dunnage, such as soft or hard styrofoam insulation in between. The contractor shall unload and place the form liners as directed by the Department. The Contractor shall be responsible for the care and treatment of the custom form liners during their use on the project site and until returned to the Department. In the event of damage to the form liners while in the Contractor's possession, the Contractor shall restore or replace the form liners at its own expense. Prior to delivery, the form liners shall be carefully cleaned, with holes (if any) created by Contractor's ties through the liners repaired. Form liner surfaces shall be free of concrete, concrete release agent residue, and other irregularities when stored, and shall be loaded by the Contractor for shipment by the Contractor to the outpost location above. If future use or other disposition is not elected by the Department, at the sole discretion of the Department, the form liners shall be returned to the Contractor for disposal, as directed by the Engineer. No additional payment will be made whether the form liners are delivered for future reuse or returned to the Contractor for disposal.

E. Approved Form Liner Companies.

1. Architectural Polymers
Ph: 616-350-0779
kschrock@apformliner.com

2. Artistic Rock, LLC
Ph: 216-291-8856
ronibasler@att.net

3. Creative Form Liners, Inc.
Ph: 301-864-3676
info@creativeformliners.com

4. Custom Rock Formliners
Ph: 651-699-1345
info@customrock.com

5. Fitzgerald Formliners
Ph: 714-547-6710
efitz@formliners.com

6. Spec Formliners, Inc.
Ph: 714-429-9500
postmaster@specformliners.com

or approved equal meeting the requirements of this specification, at the sole discretion of the Engineer and Department.

II. MATERIALS

- A. **Form Liners.** Use urethane rubber.
- B. **Plywood Backing.** If required by Engineer or Contractor, use 0.75-inch ACX plywood.
- C. **Form Release Agent.** Use Polytek Pol-Ease 2650, Armcon CRA3, Cresset Crete-Lease 20-VOC, or approved equal.

III. CONSTRUCTION REQUIREMENTS

A. Scale Models, Working Drawings, and Full-Size Patterns.

1. Scale Models.
 - a. Two-dimensional bas-relief images as shown in the plans are available from the Engineer. If required by the Engineer, developing three-dimensional models of the proposed designs, whether by manual sculpture techniques, 3D CAD modeling, or any combination thereof, is the sole responsibility of the Form Liner Company.
 - b. Original bas-relief scale models of the proposed designs for the project shall be designed and fabricated by the Form Liner Company from a suitable material for approval by the Engineer prior to development and fabrication of the full-size patterns. The scale models shall be in minimum of 1:4 scale ratio, and the selection of bas-relief images for the scale model fabrication will be recommended by the Engineer. Larger scale models, up

to and including full-scale models, may be provided instead of reduced scale models at the discretion of the Engineer.

c. The 3D scale models must be approved by the Engineer prior to commencing full-scale pattern development and form liner fabrication. Approval by the Engineer may be made following on-site evaluation of the models at the Form Liner Company, or by evaluation of high-resolution photographs of the models provided by the Form Liner Company. Alternatively, at the Engineer's expense and risk, the models may be shipped to a location specified by the Engineer for evaluation.

d. The Engineer will advise the Form Liner Company of approval or rejection of the models within 10 days from the date of the on-site evaluation, or from the date of the Engineer's receipt of the model or the model images.

2. Working Drawings.

a. Following model acceptance, the Form Liner Company shall submit to the Engineer for review and acceptance Shop Drawings containing plans, elevations, sections, and details required to construct the custom bas-relief images, including panel dimensions, joint details, form tie locations, and edge, perimeter, and other special conditions as necessary to completely fabricate the form liners and construct the raised relief images.

b. Shop drawings shall be of sufficient scale to show the detail of all bas-relief and the assembly and connection of all form liner components. The form liner shall be patterned such that long continuous horizontal or vertical lines do not occur on the finished exposed surfaces.

3. Full-Size Patterns.

a. Following shop drawing acceptance, the Form Liner Company shall design and fabricate full-size patterns for use in making the urethane rubber form liners.

b. The Engineer will inspect the full-size patterns at the Form Liner Company's facility prior to fabrication of the urethane rubber form liners or approve the pattern by reviewing high resolution photographs provided by the Form Liner Company. The full-size patterns must be approved prior to commencing form liner fabrication. Poor workmanship, lack of consistency with approved shop drawings, or other deficiencies, at the Engineers sole discretion, shall be sufficient cause for rejection of the full-size patterns. The Engineer will advise the form liner company of approval or rejection of the full-size pattern within 10 days from the date of the on-site evaluation, or from the date of the Engineer's receipt of the full-size pattern images.

c. Refer to the plans for additional information.

B. Form Liner Fabrication, Handling, and Storage.

1. Fabrication.

a. All form liners shall be constructed with urethane rubber for multiple use unless specified otherwise on the Plans.

b. The Form Liner Company may attach the urethane rubber form liners to the plywood backing by direct mold bonding during form liner fabrication or the Contractor may screw through the form liner face to the plywood backing on the job site. The screw head shall be buried slightly below the form liner surface to avoid dimples in the urethane rubber surface. Also, the form liners may be attached by screwing through the plywood surface of the Contractor's form to hold the urethane rubber against it. Gluing the urethane rubber form liners to the plywood backing is not an acceptable method of attachment.

2. Requirements and Tolerances.

a. The form liners shall be fabricated with shapes that allow removal of the forms without damage or visual impairment of the concrete and shall use 1/8-inch minimum radii and no sharp edges.

b. The dimensions of the form liners shall conform to plan dimensions within 1/4-inch per 10-foot of length in either direction.

c. The squareness of any rectangular form liner shall be within 1/4-inch as determined by the difference between the two diagonals.

d. The Form Liner Company's name, Project number, and image identification shall be permanently recorded on the back or sides of the form liners.

3. Shipping, Handling and Storage.

a. Each form liner shall be checked for tolerances and quality prior to leaving the Form Liner Company's facility.

b. Form liners shall be stored flat and level in a climate controlled indoors environment when possible, or outdoors in a cool, dry place.

c. Form liners shall be elevated off the ground and covered with polyethylene sheet or a tarp when not in use.

d. Form liners shall be protected from moisture, heat and sunlight. Form liners degrade when exposed to intense sunlight for extended periods of time. Degradation can affect the life of the liner, and in some cases, cause discoloration of the concrete surface.

e. If stacked, form liners shall be oriented front to back with compressible dunnage such as Styrofoam used to separate them with the spacers uniformly located and smaller pieces stacked on top of larger pieces.

f. Surface temperatures in excess of 190° F shall be avoided as this may cause permanent thermal distortion and diminish the physical properties of the form liner.

g. The surface of the form liners shall be kept clean and free of precipitation, oil, dust, and debris.

C. Sample Panels and Full-Size Mock-Up.

1. Sample Panels. The Contractor shall construct five 3-foot by 3-foot sample panels which shall be delivered to the Project site for review and acceptance by the Engineer. Sample panels areas will be chosen by the Engineer and will represent the most detailed bas-relief aesthetic treatments. Any sample panel that is not accepted by the Engineer shall be removed from the project site and a new sample panel cast at no additional expense to the project, until Engineer acceptance is achieved for all custom form liner sample images.

2. The Engineer will review the sample panels based on its accuracy of conformance intent of the approved scale model, on level of details, color, texture, uniformity, and other visual characteristics. The sample panels shall be cast using the approved concrete material and poured simulating actual jobsite conditions and procedures, including pour rate, height of wall, tie details, reveals, joints in form liner panels, etc. The actual construction shall proceed throughout the project using the same methods and materials as used on the approved sample panels.

3. Full-Size Mock-up. After all sample panels are approved, the Contractor shall cast one (1) full-size mock-up of one of the bas-relief images specified in the Plans, as selected by the Engineer. A mockup will consist of one set of noise wall panels comprising a full noise wall section between posts (typically 24 feet long and 16 feet high). The full-size mock-up shall meet all design requirements including the acceptance criteria specified on ODOT Standard Drawing NBS-1-09 and will be reviewed and approved by the Engineer prior to forming or casting the production images. The sample panels and full-scale mock-up shall establish the standard of quality for determining acceptance of the production images. Architectural surface treatments and patterns of the production images shall achieve substantially the same final appearance and effect as demonstrated on the approved sample panels and full-size mock-up. Upon acceptance of the completed structures, the Contractor shall dispose of the sample panels. The full-size mock-up may be incorporated into the project if accepted by the Engineer.

D. Preparation, Casting, and Stripping.

1. Form Liner Preparation. Prior to each concrete pour, the form liners shall be clean and free of build-up. Each liner shall be visually inspected for blemishes and tears. Repairs shall be made in accordance with the manufacturer's recommendations. Repairs shall be inspected and approved by the Engineer before being reused. Form liners that cannot perform as intended or are no longer repairable shall be replaced after notifying the Engineer.

2. Form Liner Placement. The form liners shall fit snugly and square within the Contractor's forms, resulting in minimal voids or misalignments and in accordance with the lines, elevations, reliefs, and locations shown on the Plans. The form liners shall be capable of withstanding the applied concrete pour pressures without leakage, physical, or visual defect.
3. Form Liner Registration. Once placed in form, the form liners shall be visually checked to confirm registration between form liner sections. All seams between liners shall register horizontally and vertically, and all final surfaces shall be flush with one another. If the surface of a form liner is not flush with the adjacent one due to variations in the supporting form surface, the form liners shall immediately be adjusted to be flat and true. If there are slight variations or differences in height between the liner sections, small 1/32-inch shim(s) can be placed under the edge and/or along the seam of one liner to bring the surface flush with the adjacent liner prior to caulking. After the registration is adjusted as necessary, the registration will be approved by the Engineer.
4. Form Liner Caulking. Prior to casting, all joints between liners shall be filled with silicone caulking and scraped back to keep adjacent surfaces flush and level and to prevent cement paste from bleeding. Liner butt joints shall be carefully blended into the approved pattern to minimize visible seams in the concrete. When caulking seams through textured areas, the Contractor shall make every attempt to match the texture on either side of the joint by tooling the caulking to minimize visible joints in the concrete.
5. Form Ties. Form ties shall be designed to allow breakback and complete removal to a depth of 2-inch from the concrete face without spalling or damaging the concrete.
6. Concrete Placement. Concrete shall be placed using a pump and an elephant trunk to avoid mix separation, splatter and trapped air. Placement shall be made in two-foot lifts prior to horizontal movement to avoid flow lines in the finished surface. To avoid cold joints, concrete placement shall never be stopped part way up the form liner pattern.
7. Concrete Vibration. Concrete shall be vibrated to ensure a good consolidation and prevent honeycombing. When vibrating the concrete, the vibrator shall not lie on or against the form liner surface.
8. Form Stripping.
 - a. Forms and form liners shall be stripped from the concrete within 24 hours of the pour.
 - b. Maintain a consistent time interval between placement and stripping throughout the project to avoid variations in concrete color. If additional curing time beyond 24 hours is required, break the liners free from the concrete within the first 24 hours, then place the form back on the wall to finish curing. The more time that elapses between pouring and initial stripping, the more difficult releasing the form liners will be.

E. Surface Finish and Color.

1. Surface Pointing. Once cast, tie recesses, minor honeycombing and bug holes in the surface of the concrete shall be repaired by pointed with concrete mortar that closely matches the color and consistency of the base pour.
2. Surface Cleaning and Finishing.
 - a. Pressure washing with water (minimum 3000 psi) is the preferred method of removing latent concrete from raised relief or recessed aesthetic treatments. Following surface cleaning, the final surface shall be free of blemishes, discolorations, voids, and form marks, to the satisfaction of the Engineer.
 - b. Sandblasting shall not be allowed for cleaning concrete surfaces within areas of aesthetic treatments, including bas-reliefs, recessed text, medallions, or standard form liner finishes, as it will compromise the contrast and clarity of the images.
 - c. Grout cleaning and rubbed surface finishing shall not be used within areas of aesthetic treatments, as these methods will compromise the contrast and clarity of the images.
3. Surface Color.
 - a. Concrete Sealer. An epoxy-urethane sealer shall be applied to all exposed areas of concrete noise wall panel and panel cap as specified in the finish elevations shown in the plans. Sealer shall not be applied to the noise wall posts or post caps.

IV. MEASUREMENT AND PAYMENT

A. The development and preparation of working drawings including shop drawings, the development and furnishing of all form liners, installation of all sample panels and mock-ups, construction, concrete finish, relocation and disposal of all sample panels and mock-ups, the services of the manufacturer's representative, and all materials, labor, equipment, tools, and any incidentals necessary to complete the work will not be measured separately but will be incidental to the Contract unit price for the item as listed below.

B. Payment will be made under:

Pay Item	Pay Unit Symbol
Special – Form Liners for Noise Barriers	Lump Sum