Sculpted Concrete Construction Guidance Checklist

MHFD
MILE HIGH FLOOD DISTRICT

mhfd.org

12575 W Bayaud Avenue
Lakewood, CO 80228

303.455.6277

contact@mhfd.org

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Sculpted Concrete Introduction

Sculpted Concrete is a material that can be used on District projects to construct drop structures on streams and is intended to mimic the look of natural sedimentary rock.

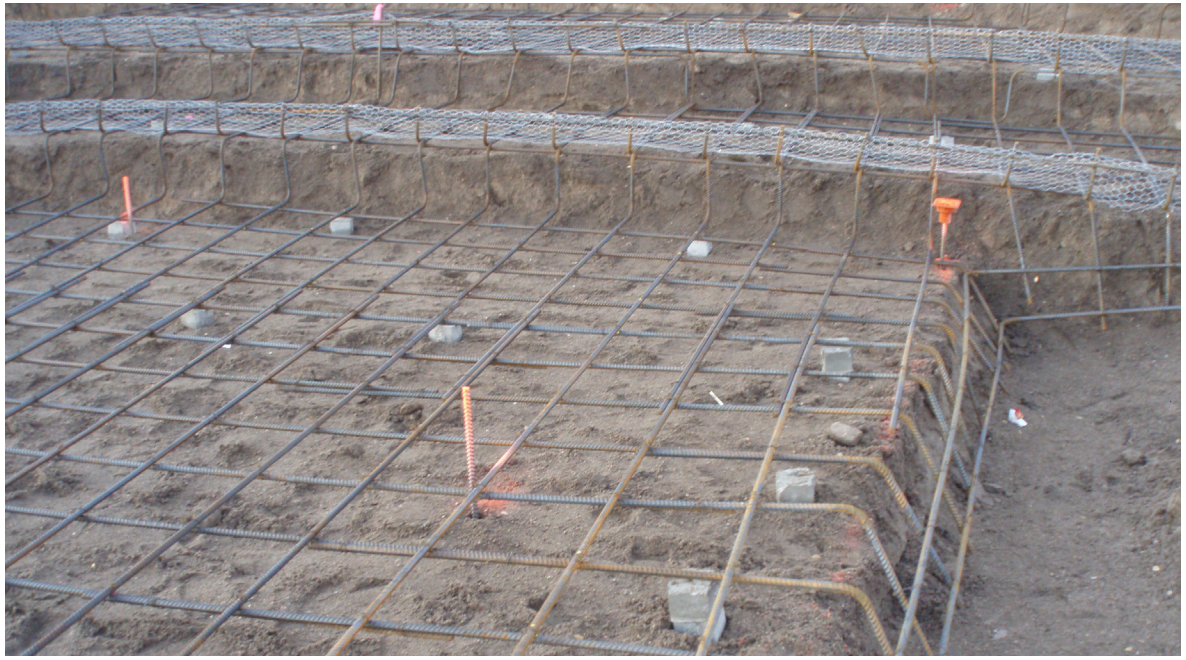
Sculpted Concrete Introduction

- Sculpted Concrete consists of steel reinforcement and concrete - either poured concrete or shotcrete.
- Sculpted Concrete drop structures have varying shaped footprints, step widths and heights.
- Sculpted Concrete is sculpted, carved, textured, and colored or stained to emulate natural rock. Sometimes animal tracks or gravel is used on the surface for additional texture.
- Sculpted Concrete drop structures usually include a sheet pile cutoff wall beneath the structure.

Sculpted Concrete Subgrade

Step 1 (Subgrade):

- It is preferred that the subgrade be shaped to closely mirror the finished structure surface. Verify that the subgrade has been cut or filled to the shape and dimensions on the plans and is properly compacted.
- Keep in mind that after concrete is placed the dimensions will change, especially the crest width.
- In cold weather conditions, subgrade should be protected from freezing by covering with insulation blankets or other measures.



Sculpted Concrete Subgrade

Step 1 (Subgrade - Edge Wall):

- Confirm that a perimeter edge wall has been excavated an extra foot deep or more around the structure. It may be deeper if called out on the plans.

Sculpted Concrete Subgrade

Step 2 (Weep Drains):

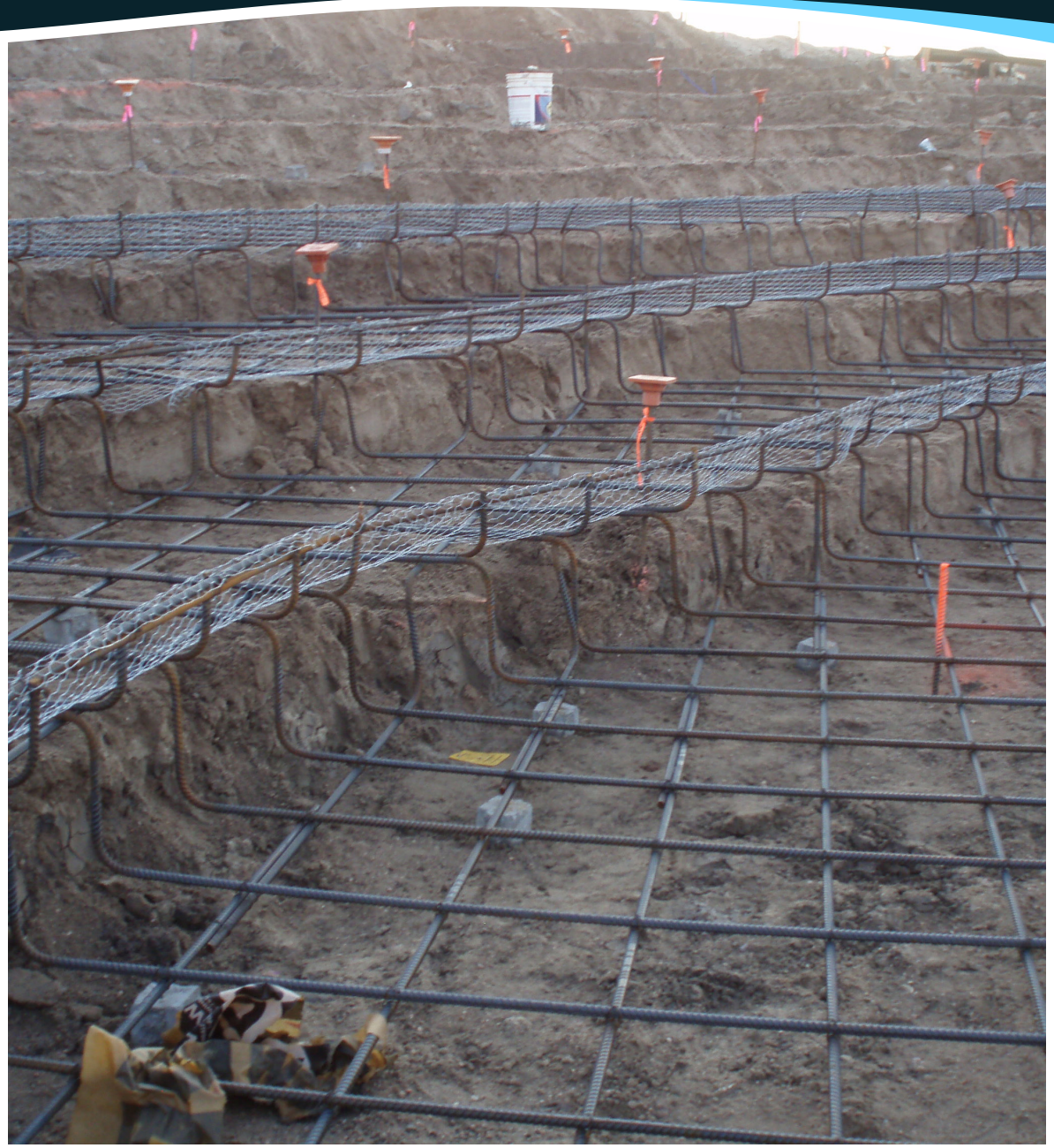
Verify that weep drains are installed if specified and confirm the following:

- Weep drains are positioned at locations specified on drawings.
- Weep drain pipe material and diameter matches details.
- Gradation/size of gravel and filter fabric/geotextile on end of weep drain matches what was specified.
- End of weep pipes are trimmed flush with top of concrete to minimize protrusion.

Sculpted Concrete Steel Reinforcement

Step 3 (Steel Reinforcement):

Check rebar size and spacing. Rebar should be supported by concrete blocks or plastic chairs. Rocks and wood are not allowed to support rebar. Chicken wire is often used on steps or other areas where the concrete is likely to slough off due to a vertical face or wall.



Step 3 (Steel Reinforcement):

If a sheet pile cutoff wall is used, make sure that the rebar is tied to the cutoff wall and connected to the rebar mat for the structure.

Sculpted Concrete Materials

Step 4 (Materials for Concrete Placement):

Verify the following materials before concrete placement:

- Check the delivery ticket to verify that the concrete or shotcrete mix matches what is specified.
- If a color is specified in the concrete, verify that the color is correct.
- The first truck load of concrete should be tested to verify temperature, slump, air content, and concrete cylinder samples made for compressive strength testing.

Sculpted Concrete Materials

Step 4 (Materials for Concrete Placement):

- Verify that texture mats match what is specified or agreed upon by the project team to create a natural looking stone surface.
- Verify that a liquid or powder release agent is provided to keep the concrete from sticking to the mats.

Example texture mat

Sculpted Concrete Installation

Step 5 (Concrete Placement):

Placing concrete or shotcrete.

- Concrete is usually placed with a pump truck so it can reach all areas of the drop structure. All concrete should be thoroughly consolidated with a concrete vibrator.
- Shotcrete is placed with a pneumatic-feed or positive displacement gun.
- Confirm all structure dimensions match plans (crest widths, depths, elevations, etc.). Verify crest elevation during concrete placement.
- Concrete should generally be at least 10'' thick and no more than 2' thick. Confirm that there is sufficient concrete cover over rebar and no surface cracks

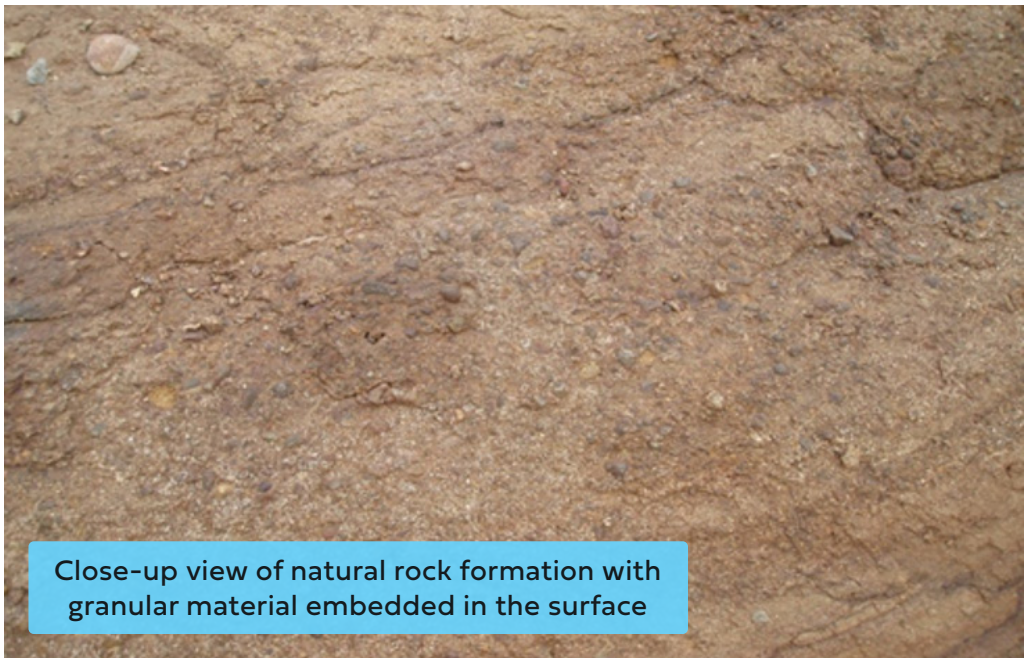
Concrete being place via pump truck

Shotcrete placement

Step 6
(Sculpting, Carving, Texturing):

Verify that concrete/shotcrete is sculpted, carved and textured to achieve the desired appearance of natural rock according to details, test panels, and reference photographs of actual rock outcrops. Reference photographs as shown can be helpful in developing consensus between the owner, engineer, and contractor on the finished appearance.

Natural sandstone outcrop


Close-up view of natural rock formation with granular material embedded in the surface

Step 6 (Sculpting, Carving, Texturing):

Constructing test panels of sculpted concrete prior to the final structure construction can be helpful in reaching consensus on the finished appearance and allowing finishers to practice techniques for shaping/carving/finishing.

Example of a constructed test panel

Sculpted Concrete Installation

Step 6 (Sculpting, Carving, Texturing):

- Verify that the concrete is shaped and troweled to create steps, depressions, and varied surface features as indicated on drawings and test panels.
- Confirm that rock formation scars are carved into the surface in a manner that is similar to test panels and reference photographs.
- Verify the proper sense of scale for carving. Finishers perform work from an arm's reach and at this close range, may "over-carve" resulting in a busy and unnatural looking structure from a distance. Periodically take time to step away from the structure and look at it from a more typical viewing distance to allow finishers to see the structure as a whole.

Subtle carving and shaping can often produce the desired finish. Notice the single horizontal carving through just one of the steps. Horizontal carvings on all the steps could look excessive and distract from the overall aesthetics.

Step 6 (Texturing):

- Verify that the entire structure surface is stamped using rubber texture mats to achieve natural rock finish.
- A form release agent should be used to minimize suction between the stamp and the wet concrete. If specified, this can also impart some color.

Sculpted Concrete Installation

Step 6 (Texturing):

- Sometimes sand, gravel or cobble is embedded into the surface to add texture in certain areas and replicate natural conglomerate formations in rock.
- Verify that granular material is pressed into the sculpted concrete shortly after carving and before the concrete sets. The material should be washed clean and free of debris to promote bonding to the concrete.

Sculpted Concrete Installation

Step 7 (Vegetation Seams, Pockets or Beds):

- Sometimes vegetation seams or pockets within the sculpted concrete are specified to emulate vegetation that can develop within cracks and crevices of natural rock formations.
- Small vegetation pockets can be formed using pvc pipe or lumber which are removed shortly before or after the concrete cures. If removal is planned, verify that the items are coated with a lubricant to facilitate removal.
- Gravel filter material is sometimes specified at the bottom of the seam/pocket to guard against piping of the subgrade soil.

PVC pipes used to form vegetation pockets

The surface of the sculpted concrete can be depressed to capture and direct rainwater to the vegetation

Sculpted Concrete Installation

Step 7 (Vegetation Seams, Pockets or Beds):

- A slightly thickened edge of sculpted concrete around a seam or bed is sometimes specified.
- In some cases where flow overtopping is more of a concern, toewalls around the perimeter of the bed or seam may be necessary along with gravel filter material in the bottom of the bed to guard against piping.

Grass growing in vegetation pockets

Vegetation bed along perimeter of sculpted concrete

Sculpted Concrete Installation

Step 8 (Staining):

- An integral color is sometimes specified within the concrete mix.
- Another method to add color is applying a stain to the finished and cured concrete surface. Confirm that the stains are made specifically for concrete.
- Review Contractor's proposed staining approach with the Design Engineer and Owner and make sure that proper moisture retention/ curing methods are incorporated into the process. A cure sealant is usually applied after staining to maintain moisture and protect the color.

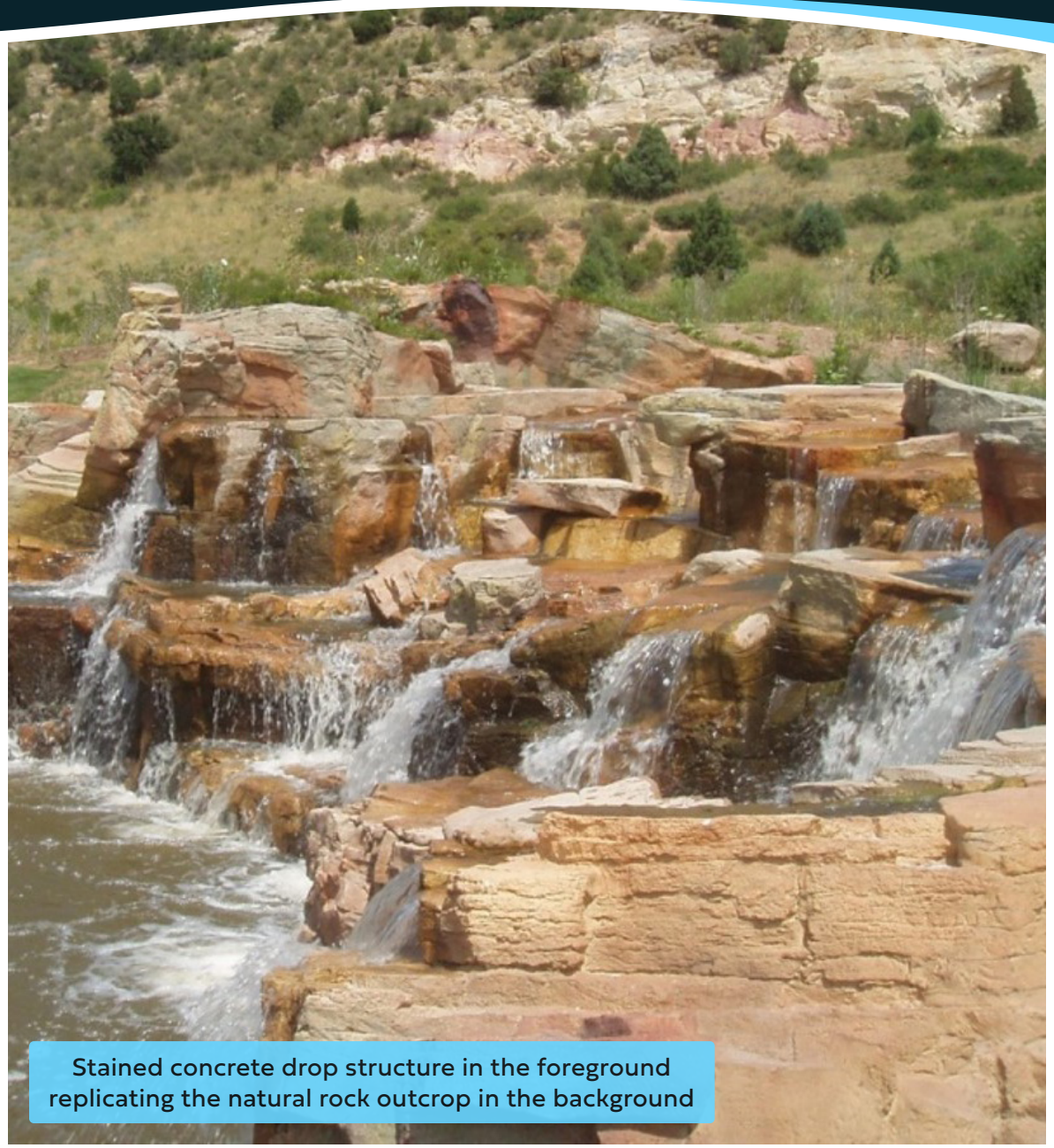
Staining of drop structure with animal tracks on right side

- Verify that the concrete is clean and power wash if necessary before staining.
- Stains are typically applied by hand-held bottle sprayers, mechanical sprayers, and sponges.

Sculpted Concrete Installation

Step 8 (Staining):

- The process of staining includes layering multiple shades of color. Typically, light covered stains are applied first followed by darker accent shades.
- Applying a light coat of watered down black stain as the final coat will create a weathered or aged surface appearance.
- Verify that the staining process follows the desired color scheme developed for the test panel and/or resembles reference photographs.



Stained concrete drop structure in the foreground replicating the natural rock outcrop in the background

Step 9 (Curing):

After stamping is complete the sculpted should be cured in accordance with the specifications. Confirm that appropriate curing methods and hot/cold weather protection is implemented:

- Hot Weather: moisture curing (keep surface continually wet, covering with moisture retaining cover) or spraying with liquid membrane curing compound.
- Cold Weather: covering with insulation blankets or heated enclosures to maintain specified curing temperatures and to keep the concrete surface moist.

Insulation blankets used in cold weather

Sculpted Concrete Installation

Finished Installation:

Photo of a finished sculpted concrete drop structure with complex shaping, carving, and vegetation pockets.

Sculpted Concrete Installation

Finished Installation:

Photo of a finished sculpted concrete drop structure that was stamped with texture mats and stained.

Sculpted Concrete Installation

Things can go wrong during installation and how to prepare for them:

- When concrete trucks are late and placed concrete has set, the joint needs to be considered. Sometimes the following may address the joint.
  - Need to ensure the newly placed concrete overlaps with the concrete that has set by 6 inches to 12 inches.
  - Bonding agents and/or water stops might be required.
- Concrete is too wet out of the truck. Concrete that is too wet will not stack easily so use it in the stilling basin and/or less sloped areas. Leave areas open throughout the structure to give flexibility in placement of concrete that is less ideal.
- Concrete is too dry. Concrete that is too dry is easier to work with but may plug the concrete truck and concrete pump.
- Elevation checks are critical after flattening or screeding of concrete and ahead of stamping. Know the critical elevations and verify before stamping. If elevations are off, work areas again.

Things can go wrong during installation and how to prepare for them (Cont.):

- Rebar used as elevation benchmarks are usually installed by pounding into the ground. It is recommended that they are pulled out during placement of sculpted concrete. If left-in, they will corrode and be a source of weakness for the structure.

- Wrong color of concrete is delivered. An option might be to use this concrete in areas of the structure that may not be exposed like the toe and crest cutoffs. If the wrong color is used on the surface of the structure, staining could minimize the impact but have a conversation with the Engineer and Contractor to understand the feasibility of this solution.

- Cracks are a part of concrete. Assess with the Engineer and Contractor to determine if a crack needs to be repaired and the method for repair.

Sculpted Concrete - Lessons Learned

Lessons Learned:

- Paying more for concrete is worth it if there is consistency and timeliness in delivery. Most structures will require a train of trucks that are timed between 25 to 40 minutes apart so delivery is key to success.

- Army of people (more than 4 people) is essential for sculpted concrete placement with everyone doing their part.

- Protecting subgrade and structure during cold weather is important for concrete placement and for adequate curing time. If weather is expected, determine if subgrade prep, rebar installation, and concrete placement should proceed.