

MEMORANDUM FOR RECORD 022

SUBJECT: FMM REACH 1-DRAIN 30 RAILING DESIGN—DESIGN REVISIONS TO BE COMPLETED UPON PROJECT RE-START

**INITIAL MEMORANDUM**

Recently, questions have been brought up about the Drain 30 railing design, and if the current design follows applicable safety codes and is satisfactorily signed and marked to protect the public. Additional concerns are present because the area is subject to deep snow and snowmobile traffic. This MFR discusses COE findings after additional safety code review, as well as possible modifications/improvements that may be looked at in the future when Reach 1 is taken off the shelf.

The Drain 30 structure is not a public use facility, so the International Building Code does not apply.

EM 385-1-1 applies because this is a COE designed structure. Specifically, EM 385-1-1, Section 21, Safe Access and Fall Protection, Paragraph 21B Standard Guardrails and Handrails applies. This section borrows heavily from OSHA 1910.23, Walking-Working Structures.

Possible railing requirements for this structure would be a handrail for fall protection. Handrail is required on certain structures if a maintenance worker/project inspector may fall 4' or more. In the case of this structure, the 4' distance is measured from the proposed finished grade outside the structure wall to the bottom of the structure inside the wall.

OSHA 1910.23 e) requires that a standard railing have a vertical height of 42" from the upper surface of the top rail to the floor, platform, runway or ramp level. If the concrete wall of the structure is 42" or greater as measured from the proposed finished grade outside of the structure, then the wall itself serves as equivalent to a handrail.

Figure 1 shows the structure design, and locations where handrailing is required per OSHA Standards (elevations are approximate).

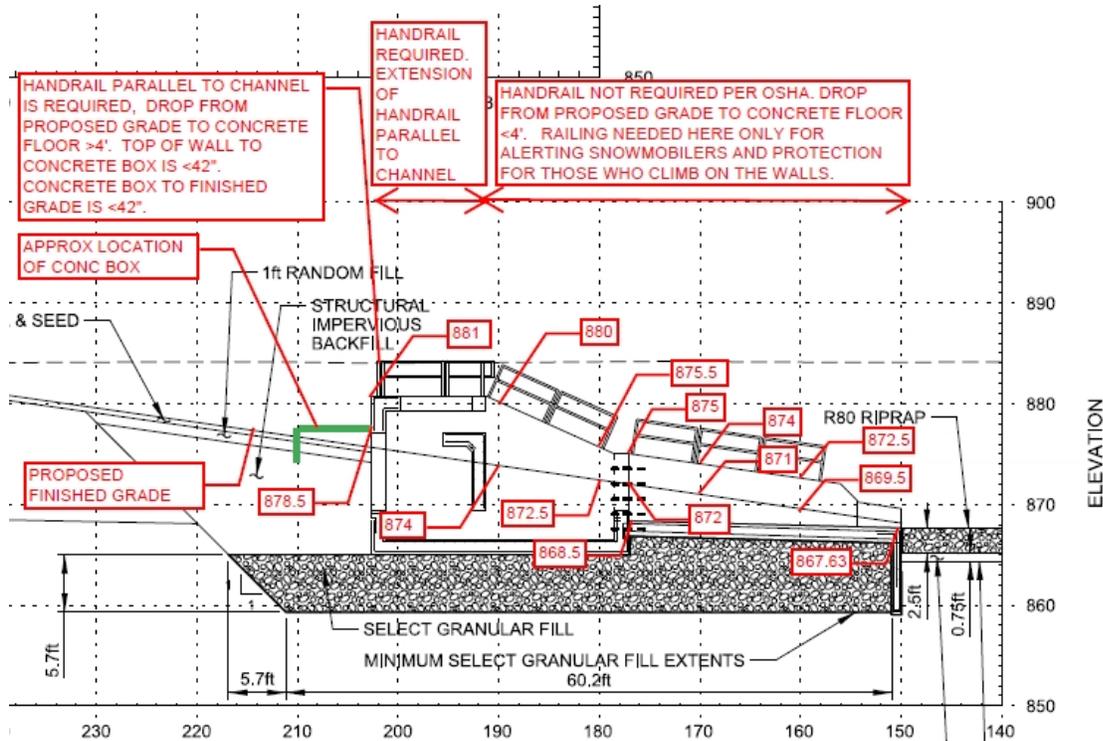


FIGURE 1: DRAIN 30 PROFILE

Handrail is required on the “back” of the structure that is parallel to the diversion channel. Railing is also required on the top “side” of the structure as an extension of the back railing. Where handrail is required by OSHA, the following design requirements apply:

- 1) Vertical height of 42”,
- 2) Intermediate rail shall be approx halfway between the top rail and the wall.
- 3) Posts and top and intermediate railings shall be at least 1.5” dia posts spaced not more than 8’ on centers.
- 4) Anchoring posts and framing members shall withstand a load of at least 200 lb.

Handrail is not required by OSHA on the rest of the structure. However, there are still safety concerns such as:

- People climbing on walls and falling into the structure,
- Snowmobilers may hit walls and/or fall into structure when snow is deep and obscures the walls.

To help reduce these safety concerns, the COE design includes railing along the sides of the structure. This railing is intended to help inhibit access, and is similar to the design used at a diversion channel inlet at a similar project in Winnipeg. In Winnipeg, the rails were marked with fluorescent orange tape to make them stand out even better in the winter (see Figure 3). The COE also recommends adding signage that tells the public to keep out of this potentially dangerous structure.

**EP 310-1-6a**  
**01 Jun 06**

**Undesignated Safety Signs**

The signs illustrated below may be used to warn project visitors about hazards and to restrict potentially dangerous activity. Unlike the other signs illustrated in this section, they do not relate to a specific functional area at a Corps project, but may be needed anywhere along a lake or river.

The color, typography, and wording of these signs have been chosen for readability and comprehension. They are consistent with the safety signs placed around a lock or dam (see Section 14). Because of this, the wording of particular sign legends should not be changed. If a condition requires a sign with wording

other than what is shown in this manual, there is a procedure for requesting approval for site-specific safety signs (page 1-13).

These signs are intended for relatively short viewing distances. If a large area is to be signed, use more than one sign rather than depending on a single large sign. Placement and sizing of these Undesignated Safety signs should be reviewed with the project Safety Officer.



UNS-01

DNG-01

\*\*In an earlier revision to the Corps Sign Standards Manual, a sign type identification code was added for the new Danger signs (DNG). The original Undesignated Safety signs (UNS) retain the original code to maintain continuity on all plans and program records.

Sign Type	Legend Size (A)	Panel Size	Post Size	Specification Code	Mounting Height	Color Bkg/Lgd
UNS-01/DNG-01**	1.5"	17.375"x11.25"	4"x4"	HDO-5/ALU-5	36"	RD/WH
UNS-01/DNG-01**	2"	23.175"x15"	4"x4"	HDO-5/ALU-5	36"	RD/WH
UNS-01/DNG-01**	3"	34.75"x22.5"	4"x4"	HDO-3/ALU-3	36"	RD/WH
UNS-01/DNG-01**	4"	46.375"x30"	4"x4"	HDO-3/ALU-3	36"	RD/WH

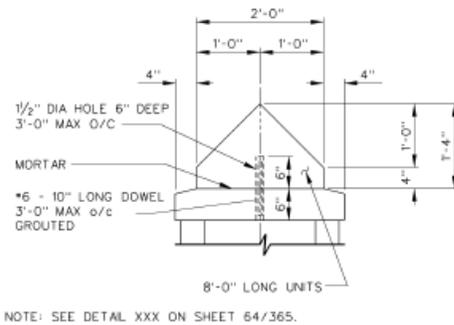
FIGURE 2: SIGNAGE FOR STRUCTURE RAILING



FIGURE 3: WINNIPEG STRUCTURE RAILING

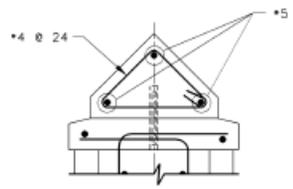
There are alternatives to the design shown in Figure 1 that may be considered:

- 1) Instead of railing along the sides of the structure, a pointed concrete cap could be added to the top of the wall that would provide additional height, and further reduce a person's ability and/or desire to climb up and over the wall (See Figure 4 for example from East Grand Forks project). If this alternative is used, markers similar to fire hydrant locator posts would be recommended for visibility in winter. Danger signs would also be recommended.
- 2) Keep the railing but design it so that the risers are vertical instead of perpendicular to the sloped walls. This would give a cleaner look, and help close up the openings that the current design has. Danger signs would also be recommended.



NOTE: SEE DETAIL XXX ON SHEET 64/365.

DETAIL	GG
SAFETY CAP	64/287
SCALE: 3/4" = 1'-0"	64/290
	64/354
	64/355
	64/397
	64/398



NOTE: SEE DETAIL XXX THIS SHEET.

DETAIL	GG
SAFETY CAP	64/287
SCALE: 3/4" = 1'-0"	64/290
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	64/397
	64/398

FIGURE 4: EAST GRAND FORKS SAFETY CAP

## LOCAL SPONSOR COMMENTS ON INITIAL MEMORANDUM

The Local Sponsor reviewed the initial memo and had the following comments:

“The Local Sponsor recognizes that the Corps is the Designer of Record for this facility and will make the final determination of safety features. However, the Local Sponsor is responsible for O&M and requests that O&M be considered when designing to meet the safety requirements. The Local Sponsors preferred approaches to meeting the safety requirements are, in order of preference:

- 1) Limit fall potentials to less than 4'-0" and provide wall heights of 42" or higher by a specific grading plan around the structure. Provide top of wall profile/caps similar to East Grand Forks. Provide attachment points for the installation of easily replaceable high visibility delineators or flags to warn of hazard. Safety signs as proposed are acceptable.
- 2) Raise walls (if grading changes are not sufficient) to provide wall heights of 42" or higher. Provide top of wall profile/caps similar to East Grand Forks. Provide attachment points for the installation of easily replaceable high visibility delineators or flags to warn of hazard. Safety signs as proposed are acceptable.
- 3) Provide concrete guard walls (instead of metallic railings). Provide top of wall profile/caps similar to East Grand Forks. Provide attachment points for the installation of easily replaceable high visibility delineators or flags to warn of hazard. Safety signs as proposed are acceptable.
- 4) Provide handrails as proposed.”

### COE PROPOSED DESIGN REVISION

The proposed design revision is shown in Figure 5 below. Because project is presently on-hold, design revisions will be made upon re-start of project. If project is on-hold for more than 6 months, safety codes should be reviewed upon re-start to ensure adherence to most current regulations.

The railing at the top of the structure, and on each side of the top of the structure, will remain. A grading design change to eliminate the OSHA requirement for railing in this location (wall height greater than 42" above design grade in all locations) is not a cost effective solution. In addition, the current design allows for access to the concrete box grating for inspection of the flap gates, and to the top of the structure for inspection of the structure from above. The top of the structure has a 2'-11" wide concrete lip, which can be used to stand on for inspection. Therefore, the handrail for fall protection running along the lip is required. The railing is designed for easy removal during high water events. Danger signs will be installed on the railings at the midpoint on each side and at each concrete box location on the railing parallel to the channel.

As mentioned earlier in this memo, railing along the sloped side of the structure is not required per OSHA, but was included in the design to help inhibit access and to warn snowmobilers. The railings are not required per OSHA because:

- The drop from proposed grade to the concrete floor is less than 4', or
- The wall height from proposed grade is greater than 42".

The proposed design revision is to remove the railings in this location and replace with a 6" high (min.) pointed concrete cap. This revision will provide a minimum wall height of 42" from the design grade in all locations, and the pointed top will help deter the public from climbing on and/or over the side walls. To warn snowmobilers, reflective spring mounted fiberglass posts will be installed at 8 foot intervals. These posts are similar to what is used in the Fargo area to mark fire hydrants.

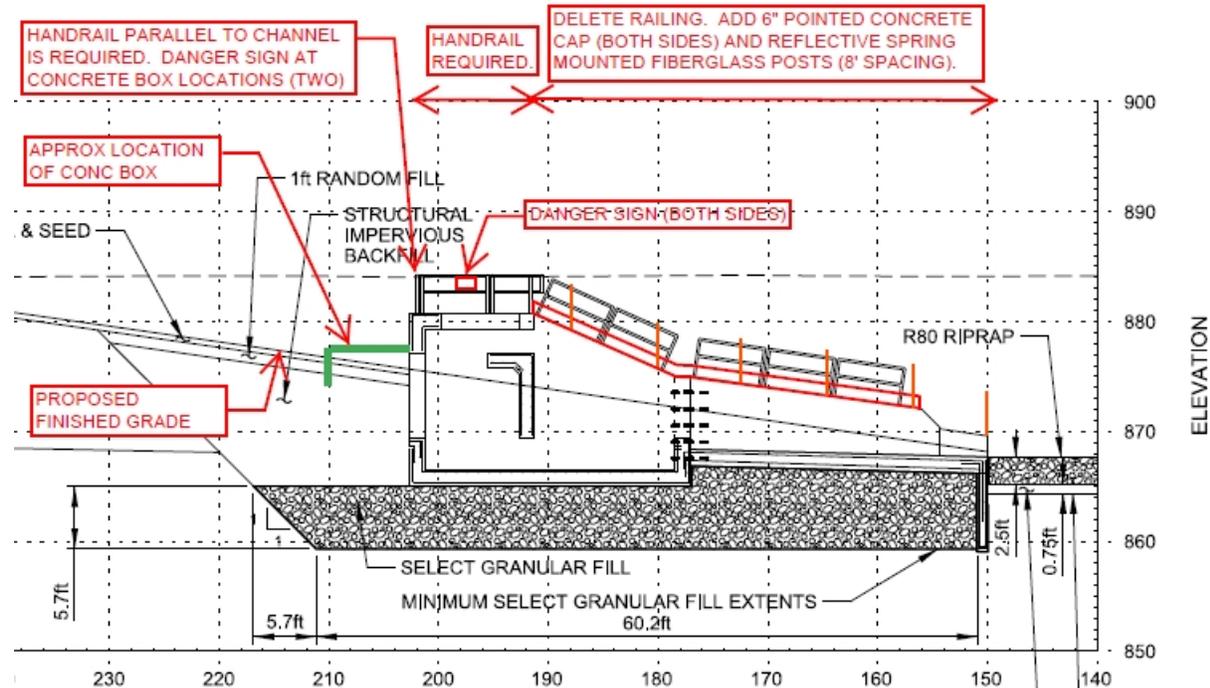


FIGURE 5: DRAIN 30-PROPOSED DESIGN REVISION

## FINAL DESIGN REVISION

The proposed design revision was discussed in a teleconference. The Local Sponsor is very concerned about ongoing maintenance issues with any railing; especially railing that is perpendicular to flow in the diversion channel. The Local Sponsor understood the need to access and inspect the structure from above, but thought that inspection from the top side provided no additional benefit and is not necessary. Therefore, it was requested that the railing along the top side be removed and replaced with a concrete cap and the reflective posts. It was agreed that a railing or some other means of fall protection be provided on the top back of the structure.

The railing along the top side is only required if a person can walk around from the top back to the top side. If the railing design is revised to provide an extension on each side of the top back railing to eliminate this access route, then the top side railing can be deleted. From an O&M perspective, the COE generally agrees that the structure can adequately be maintained and inspected from the top back, and from the bottom during low water conditions.

On the top back of the structure, the COE recommends that the existing railing design remain, with the addition of an end loop on each side to prevent a person from accessing the top side of the structure. See Figure 6 for the final design revision, which will be made upon re-start of the project.

The Local Sponsor requested that the COE look at a concrete wall instead of metal railing. The thought is that the concrete wall would cost more initially, but would have less long term cost than a metal railing that may have to be replaced often if it cannot be removed before a high water event occurs. A concrete wall is possible, but not with the current structure design. The 2'-11' wide lip on the top is not wide enough to accommodate a person and a wall. Upon re-start of the project, a concrete wall may be looked at in lieu of the metal railing.

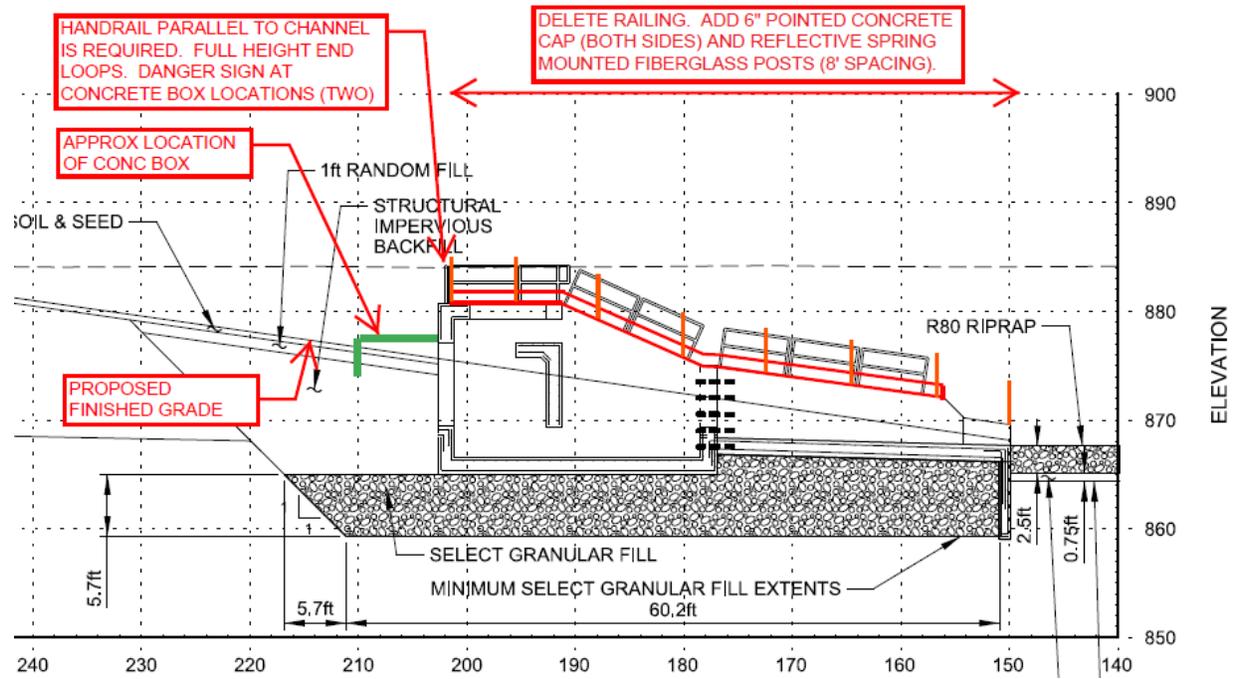


FIGURE 6: DRAIN 30-FINAL DESIGN REVISION