NDS®
We put water in its place

# Dura Slope™ Installation Manual


## Grate Top (page 2)

## Curved Alignments & Angled Connections (page 8)

## Slot Top (page 12)

## Summary of Part Numbers (page 18)

**Heel-Proof and ADA-Compliant grates available.**

## Tools & Materials

| | |
|---|---|
| Shovel/Excavating equipment | Phillips screw driver |
| Hammer | Concrete vibrator |
| Butyl caulk or adhesive silicone sealant | #4 Rebar (1/2") |
| Caulking gun | Tie-wire and self-tapping screws |
| Stringline | Pliers and cordless screw driver |
| Level or laser line | 4" Hole saw |

Concrete. Compressive strength and mix design per Engineer's recommendation.
It can vary from 2,500 psi for pedestrian to 4,000 psi for heavy loads.

⚠ **Observe all safety precautions when operating electrical equipment.**

## 1 Excavation – Excavate a trench for the Dura Slope™ channels.

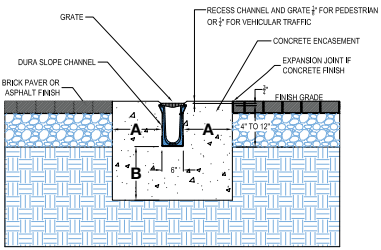
The width and depth of the excavation depends on the size of the Dura Slope™ channel (4 to 12 inches in depth and 6 inches in width), the dimensions of the concrete encasement (4 to 8 inches), and the method of installation (form board or rebar suspension). See Table 1 and Figure 1 below.

**Table 1: Concrete Encasement and Excavation Dimensions**

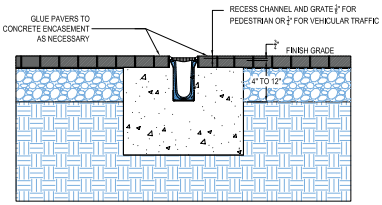
| Type of Traffic | Concrete Encasement - Width each side "A" & Depth Below Channel "B" | Width of Channel | Depth of Channel | Depth of Grate | Width of Excavation* | Depth of Excavation* |
|---|---|---|---|---|---|---|
| Pedestrian/Class A | 4" | 6" | 4" to 12" | 0.75" | 14" | 8.75" to 16.75" |
| Light Duty/Class B | 4" | 6" | 4" to 12" | 0.75" | 14" | 8.75" to 16.75" |
| Medium Duty/Class C | 6" | 6" | 4" to 12" | 0.75" | 18" | 10.75" to 18.75" |
| Heavy Duty/Class D | 8" | 6" | 4" to 12" | 0.75" | 22" | 12.75" to 20.75" |

* Does not include formwork or 1/8 to 1/4 inch recess.
Increase depth of excavation by 3/4 inch when installing Dura Slope™ channels with ductile iron frames.

**FIGURE 1: Concrete Encasement Dimensions**




BRICK PAVER, ASPHALT FINISH, OR CONCRETE FINISH - CONCRETE ENCASEMENT VISIBLE




BRICK PAVER OR ASPHALT FINISH - CONCRETE ENCASEMENT HIDDEN

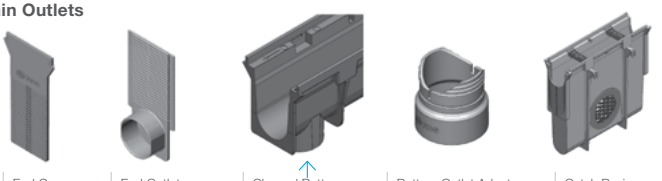
# 2 Assembly of Accessories

1 At the deepest end of the channel run:
- Install a **Dura Slope™ Catch Basin DS-340 OR**
- Install an **End Outlet DS-227**. Cut the end outlet to fit the channel using the guidelines molded on the part. Attach End Outlet to the channel drain using screws and screw driver. Connect SDR-35 pipe **OR**
- Install an **End Cap DS-224**. Cut the end cap to fit the channel using the guide lines molded on the part. Attach End Cap to the channel drain using screws and screw driver. Drill out the bottom outlet using a 4" hole saw by sliding the saw into the bottom outlet and cutting through the bottom of the channel.
- Connect As Follows:
  - > For 4" Schedule 40 fittings: Slide a Sch 40 fitting over the molded outlet.
  - > For 4" SDR-35 pipe: Slide a DS-126 into the bottom outlet.+

2 At the shallowest end of the channel run:
- Cut an **End Cap DS-224** to the depth of the shallowest channel section using the guidelines molded into the part. Slide End Cap into female connection at end of channel.

**FIGURE 2: Assembly of Accessories**

**Drain Outlets**



End Cap DS-224 | End Outlet DS-227 | Channel Bottom Outlet | Bottom Outlet Adapter DS-126 | Catch Basin DS-340

# 3 Assembly of Channel Sections

- Place a bead of butyl caulking or silicone sealant in the channel's joint or groove, if a water-tight seal is required.
- Snap the channel sections together.
- Wipe down excess caulking or silicone from the inside of the channel.
- Repeat the steps above for the remaining sections.

**FIGURE 3: Assembly of Channel Sections**

**Joined Channels**

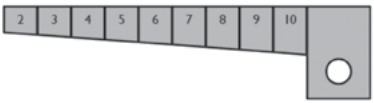
# 4 Layout of Channel Sections

- Lay the channels alongside the trench. Do not lock channels together.
- Channel sections marked with an N are Neutral (non-sloped) Sections.
- Sloped Sections: Start the layout at the drain outlet with the deepest (highest numbered) channel section, proceeding to the shallowest (lowest numbered) channel section. Ensure that all channels drain toward the end of the channel with the bottom outlet (i.e., the male end). Point the arrows on each channel section toward the drain outlet.
- If a channel must be cut to fit the available dimension, it is best to cut the channel furthest from the drain outlet (i.e., the first/shallowest channel). It is easiest to cut the channels in half, but it can be cut in 6" increments. Make sure to leave the reinforcing rib in place so that an end cap or end outlet can be attached to the cut channel.

**FIGURE 4: Layout of Neutral & Sloped Channel Sections**

**Neutral Channel Layout**

**Sloped Channel Layout**




# 5 Assembly of Flexible/Radius Couplings

**Use only when curved layout or length greater than 48 ft. are required, or else proceed to Step 7.**

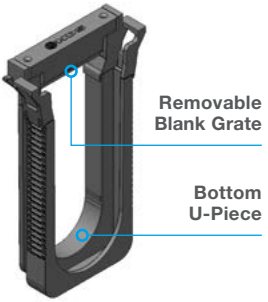
The patented single-size, flexible Dura Slope™ Flexible/Radius Coupling works seamlessly with all sizes of Dura Slope™ channels. Flexible/Radius coupling grates will not match with Dura Slope™ decorative grates.

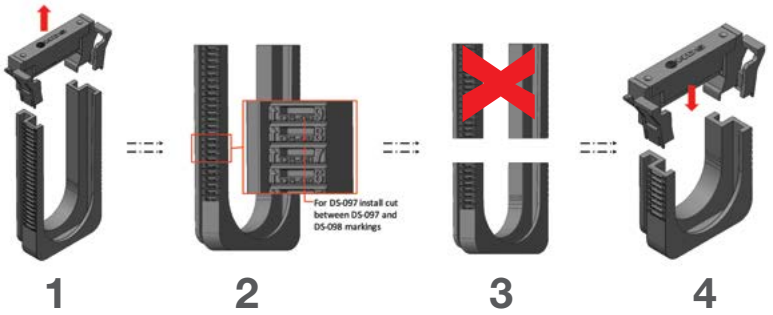
NDS recommends installing one (1) flexible/radius coupling per 48 feet for channels that are 48 feet of greater in length. The flexible coupling shall be installed in the middle of the run.

## Assembly of Flexible/Radius Couplings (cont.)

Each Flexible/Radius Coupling consists of a removable top piece and a bottom U-shaped piece. The Flexible/Radius Coupling can be cut at the guide-lines to match the channel size.

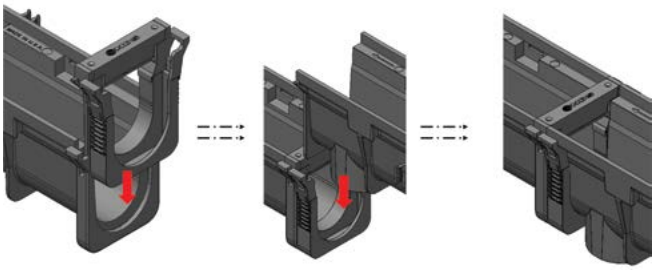
1. Remove the top piece.
2. Cut the coupling at the appropriate guide-line on the coupling to fit the channel size, e.g., for DS-097 the cut line would be between the DS-097 and the DS-098 markings.
3. Discard the two upper stems and retain the bottom U-shape fitting.
4. Slide the upper fitting with blank grate onto the U-shaped attachment.




## 6 Connection of Flexible/Radius Couplings to Dura Slope™

Connect Radius Couplings to Dura Slope™ as shown below. Do not remove radius coupling blank grates (this is done only after concrete encasement has hardened). Install the channel sections with coupling and pour concrete encasement.



# 7 Installation of Channel Sections

- Set a string line in the trench along each side of where the channel will be placed, at final elevation of channel.
- Place the pre-assembled channel sections in the trench beginning with the outlet/deepest end.
- Starting at the drain outlet, remove blank grates by removing the screws from the end of the blank grate insert located at the male side of the channel.
- Use one of the suspension methods outlined below in Figure 6.

### Rebar Suspension Method

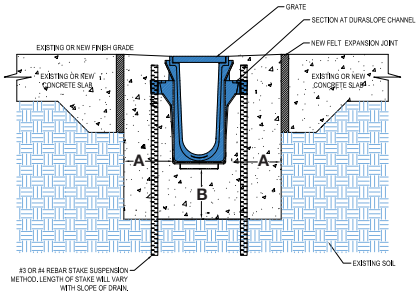
Use when saw cutting existing concrete slab or removing asphalt or brick pavers for installation.

- Install rebar into the Leveloc rebar support. Drive rebar straight into the ground about 6 to 12 inches or until rebar is firmly held in place.
- Set channel to desired grade level and align for straightness using string line.
- Continue attaching pre-assembled channel sections and install rebar until run is complete.
- Proceed with final adjustments for grade level and straightness using tie-wire to self-tapping screws; secure rebar to the Leveloc rebar support using the wire support or screw support as show below.

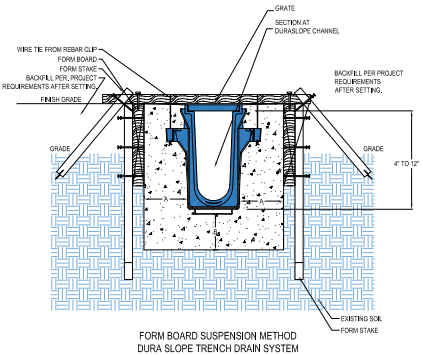
### Form Board Suspension Method

Use when installing the channels in bare dirt, with surrounding concrete/asphalt/brick paver to be poured after installation of channels.

**FIGURE 6: Installation of Channel**
See Table 1 for “A” and “B” concrete encasement dimensions (page 1)




REBAR SUSPENSION METHOD
DURA SLOPE TRENCH DRAIN SYSTEM




FORM BOARD SUSPENSION METHOD
DURA SLOPE TRENCH DRAIN SYSTEM

## 8 Pouring the Concrete Encasement

- Cover the openings of the blank grate tops with tape to prevent concrete getting into the channel.
- NDS recommends pouring concrete within 14 days of installing the channel sections for optimal performance.
- Place the concrete around the base of rebar posts on each side of the channel as well as underneath the channel between the rebar posts.
- Pour equal amounts of concrete on each side of the channel to prevent it from shifting. All concrete shall be a single monolithic pour.
- Vibrate the concrete to avoid bubbles or voids using wand vibrator.
- Engineer shall identify the appropriate concrete mix design and field test parameters to achieve strength requirements for the anticipated traffic load. The Contractor shall follow American Concrete Institute standard practices for delivery, field testing, placement, and curing.
- Remove regular (and radius coupling, if applicable) blank grates and insert the appropriate grates about 24 to 48 hours after the concrete pour is complete, i.e., when the concrete is able to support the weight of the person removing and installing the grates.

## 9 Expansion Joints

Install expansion joints parallel and perpendicular to channel. NDS standard recommendation on expansion joints is to locate these within 8" of all sides of the channel.

## 10 Final Appearance

Final finish of assembled units is as shown below.

The Dura Slope™ Channels with Grates can be installed on curved alignments using the patented single-size, flexible Dura Slope Radius Coupling. The coupling works seamlessly with all sizes of Dura Slope channels. The coupling is available with grates that will closely match with Dura Slope regular grates. However, Radius Coupling grates will not match with Dura Slope channel decorative grates.

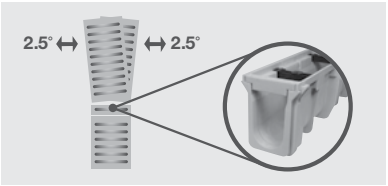
The individual couplings can also be connected to each other for tight curved sections. Once connected the radius coupling remains locked vertically while rotating up to a maximum of 2.5° when connected to another radius coupling and up to a maximum of 5° when connected to a Dura Slope channel.

Contact NDS® DesignWorx™ for help designing your curved alignments using the Radius Coupling.

**Since all installation steps are similar to the Dura Slope Grate Top Installation those are not repeated here.**

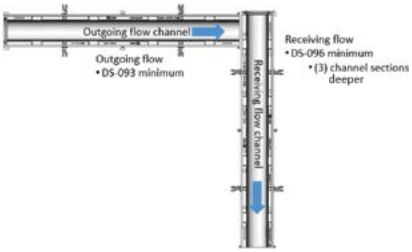
**5° Radius From Coupling to Channel**

**2.5° Maximum Deflection Per Coupling**



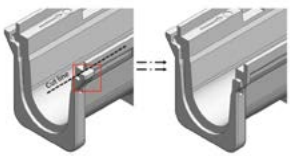

## Dura Slope™ Grate Top - Direct Channel-to-Channel Angled Connection

**Direct Channel-to-Channel connection can be achieved only with Sloped Channels that have a minimum three channel section-depth difference. The minimum channels sections that can be used are DS-093 and DS-096.**



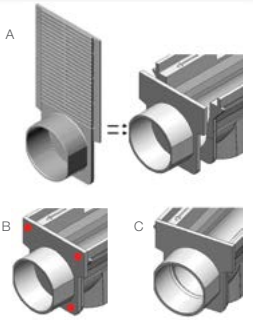

## 1 Removal of Female End of Outgoing Flow Channel

- Using Sawzal remove female end in the outgoing flow channel.



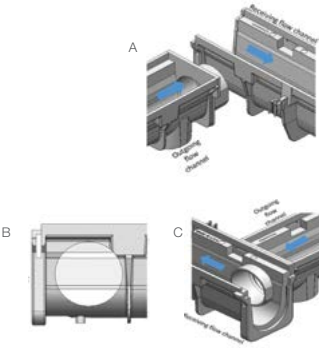
## 2 Attachment of End Outlet to Outgoing Flow Channel

- Cut DS-227 to desired outgoing flow channel height by using reference marks.
- Attach DS-227 to outgoing flow channel using at least four (4) screws.
- Remove DS-227 knockout for drainage and cut off male side tabs.



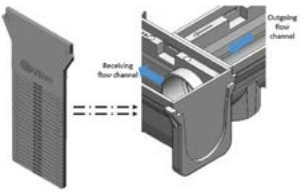

## 3 Attachment of Outgoing and Receiving Flow Channels

- Align outgoing flow channel's male end to receiving flow channel's female end. Trace the outside diameter of the DS-227 outlet onto the receiving flow channel.
- Using a 4-3/4 inch hole saw, cut-out a hole for the DS-227 outlet on the receiving flow channel.
- Butt the outgoing flow channel to the receiving flow channel using the hole previously cut as a guide.



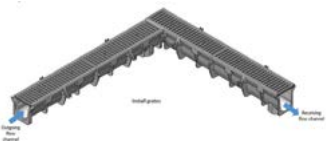

## 4 Attachment of End Cap to Receiving Channel

- Cut DS-224 End Cap to the desired channel height using the reference cut-lines.
- Place modified DS-224 into the female end of the receiving flow channel.
- Install channel section and pour concrete encasement.




## 5 Final Appearance of Direct Channel-to-Channel Connection

Final finish of assembled units is as shown right:



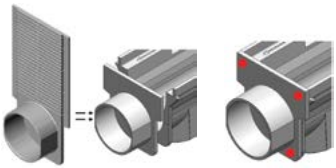
Items needed include the following:

- DS-227 End outlet
- 4" PVC SDR 35 Pipe
- 4" PVC 900 Elbow 4P02 or any other angle

**Note: Start installation at the Indirect Angled Connection and work outward. Adjust other channel lengths to complete the required length.**

## 1 Attachment of End Outlet to Outgoing Flow Channel

- Cut DS-227 to desired flow channel height by using reference marks.
- Attach DS-227 to flow channel using at least four (4) screws.

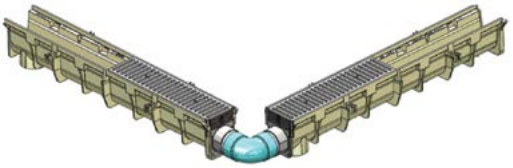


## 2 Attachment of Flexible Couplings to End Outlets

- Attach SDR 35 pipe to the end outlets.

## 3 Attachment of 90° Elbow to Flexible Couplings

- Align elbow with SDR 35 pipe and fix firmly in place.



## 4 Concrete Encasement

- Pour concrete encasement under and around the channels and fittings.

**Table 2: Summary of Direct and Indirect Connections**

| Type of Connection | Angle of Connection | Required Fitting | Channels to be Used | Flow Direction | Difference in Elevation between Connecting Pieces |
|---|---|---|---|---|---|
| Direct (Channel-to-Channel) | 90°, Tee | No Fittings Required | Smallest Channels that can be used: One DS-093 (4.67" to 5.01" deep) and one DS-096 (5.68" to 6.01" deep) | From Shallow to Deep Channel | 3 Channel Section difference between "Outgoing" Channel and "Receiving" Channel |
| Indirect (Pipe) | 90°, 45°, 22.5°, Any Other Angle | 4P02, 4P03, 4P04, 4PVAF respectively | Any Dura Slope Channels along with DS-227 End Outlet | From shallow to deep channel, e.g., DS-091 to DS-092 | Not required |

**Slot Top is Heel-Proof and ADA-Compliant.**

## Tools & Materials

| | |
|---|---|
| Shovel/Excavating equipment | Phillips screw driver |
| Hammer | Concrete vibrator |
| Butyl caulk or adhesive silicone sealant | #4 Rebar (1/2") |
| Caulking gun | Tie-wire and self-tapping screws |
| Stringline | Pliers and cordless screw driver |
| Level or laser line | 4" Hole saw |

Concrete. Compressive strength and mix design per Engineer's recommendation. It can vary from 2,500 psi for pedestrian to 4,000 psi for heavy loads.

⚠ **Observe all safety precautions when operating electrical equipment.**

## 1 Excavation – Excavate a trench for the Dura Slope™ channels.

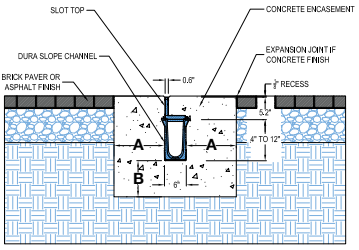
The width and depth of the excavation depends on the size of the Dura Slope™ channel (4 to 12 inches in depth and 6 inches in width), the depth of the Slot Top, the dimensions of the concrete encasement on both sides and below channel (4 to 8 inches), and the method of installation (form board or rebar suspension). See Table 1 and Figure 1 below.

**TABLE 1: Excavation Dimensions**

| Type of Traffic | Concrete Encasement - Width each side "A" & Depth Below Channel "B" | Width of Channel | Depth of Channel | Depth of Slot Top + 1/8" Recess | Width of Excavation* | Depth of Excavation* |
|---|---|---|---|---|---|---|
| Pedestrian/Class A | 4" | 6" | 4" to 12" | 5.3" | 14" | 13.3" to 21.3" |
| Light Duty/Class B | 4" | 6" | 4" to 12" | 5.3" | 14" | 13.3" to 21.3" |
| Medium Duty/Class C | 6" | 6" | 4" to 12" | 5.3" | 18" | 15.3" to 23.3" |
| Heavy Duty/Class D | 8" | 6" | 4" to 12" | 5.3" | 22" | 17.3" to 25.3" |

* Does not include formwork

**FIGURE 1: Concrete Encasement Dimensions**

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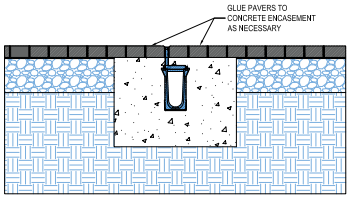



BRICK PAVER OR ASPHALT FINISH - CONCRETE ENCASEMENT HIDDEN

# 2 Assembly of Accessories

1 At the deepest end of the channel run:
- Install a **Dura Slope™ Catch Basin DS-340 OR**
- Install an **End Outlet DS-227**. Cut the end outlet to fit the channel using the guidelines molded on the part. Attach End Outlet to the channel drain using screws and screw driver. Connect SDR-35 pipe **OR**
- Install an **End Cap DS-224**. Cut the end cap to fit the channel using the guide lines molded on the part. Attach End Cap to the channel drain using screws and screw driver. Drill out the bottom outlet using a 4" hole saw by sliding the saw into the bottom outlet and cutting through the bottom of the channel.
- Connect As Follows:
  - > For 4" Schedule 40 fittings: Slide a Sch 40 fitting over the molded outlet.
  - > For 4" SDR-35 pipe: Slide a DS-126 into the bottom outlet.+

2 At the shallowest end of the channel run:
- Cut an **End Cap DS-224** to the depth of the shallowest channel section using the guidelines molded into the part. Slide End Cap into female connection at end of channel.

**FIGURE 2: Assembly of Accessories**

**Drain Outlets**

End Cap DS-224 | End Outlet DS-227 | Channel Bottom Outlet | Bottom Outlet Adapter DS-126 | Catch Basin DS-340

# 3 Assembly of Channel Sections

- Place a bead of butyl caulking or silicone sealant in the channel's joint or groove, if a water-tight seal is required.
- Snap the channel sections together.
- Wipe down excess caulking or silicone from the inside of the channel.
- Repeat the steps above for the remaining sections.

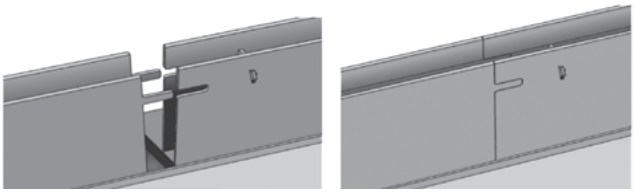
**FIGURE 3: Assembly of Channel Sections**

**Joined Channels**

# 4 Assembly of Slot Tops

- Snap the slot tops together in multiples of two.
- Align the channel with slot tops for straightness. Cover the openings on the slot tops with tape to prevent concrete from getting into the channel.
- Do not install slot tops on channels as yet.

**FIGURE 4: Slot Top Assembly**



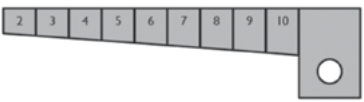
# 5 Layout of Channel Sections

- Lay the channels alongside the trench. Do not lock channels together.
- Channel sections marked with an N are Neutral (non-sloped) Sections.
- Sloped Sections: Start the layout at the drain outlet with the deepest (highest numbered) channel section, proceeding to the shallowest (lowest numbered) channel section. Ensure that all channels drain toward the end of the channel with the bottom outlet (i.e., the male end). Point the arrows on each channel section toward the drain outlet.
- If a channel must be cut to fit the available dimension, it is best to cut the channel furthest from the drain outlet (i.e., the first/shallowest channel). It is easiest to cut the channels in half, but it can be cut in 6" increments. Make sure to leave the reinforcing rib in place so that an end cap or end outlet can be attached to the cut channel.

**FIGURE 5: Layout of Neutral & Sloped Channel Sections**

**Neutral Channel Layout**

**Sloped Channel Layout**



# 6 Installation of Channel Sections

- Set a string line in the trench along each side of where the channel will be placed, at final elevation of channel.
- Place the pre-assembled channel sections in the trench beginning with the outlet/deepest end.
- Starting at the drain outlet, remove blank grates by removing the screws from the end of the blank grate insert located at the male side of the channel.
- Use one of the suspension methods outlined below in Figure 6. Insert slot tops on channel after the channels are secured in the trench.

### Rebar Suspension Method

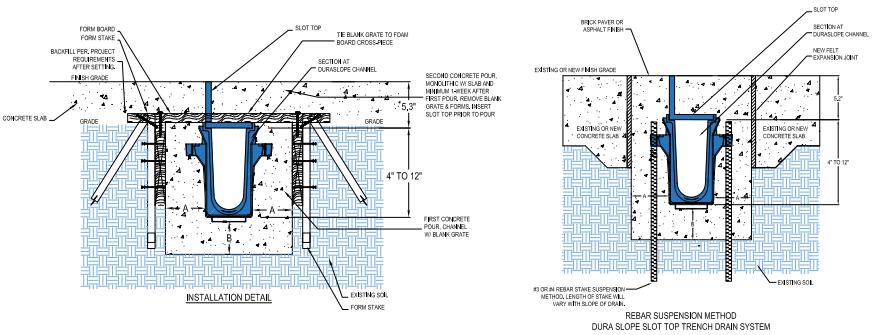
Use when saw cutting existing concrete slab or removing asphalt or brick pavers for installation.

- Install rebar into the Leveloc rebar support. Drive rebar straight into the ground about 6 to 12 inches or until rebar is firmly held in place.
- Set channel to desired grade level and align for straightness using string line.
- Continue attaching pre-assembled channel sections and install rebar until run is complete.
- Proceed with final adjustments for grade level and straightness using tie-wire to self-tapping screws; secure rebar to the Leveloc rebar support using the wire support or screw support as show below.

### Form Board Suspension Method

Use when installing the channels in bare dirt, with surrounding concrete/asphalt/brick paver to be poured after installation of channels.

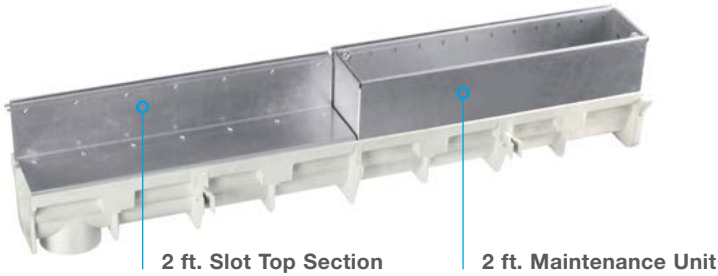
**FIGURE 6: Installation of Channel And Slot Top***
See Table 1 for "A" and "B" concrete encasement dimensions (page 7)



# 7 Installation of Removable Maintenance Units

Install Removable Maintenance Units at the beginning and end of every run and at intervals of approximately 100 ft. The purpose of the removable maintenance unit is to provide access for removing blockages in the channels. The first and last four feet should consist of 2 ft. of Slot Top + 2 ft. of maintenance unit. The maintenance unit can be installed inside the catch basin at the end of the run.

**FIGURE 7: Installation of Maintenance Units**




# 8 Pouring the Concrete Encasement

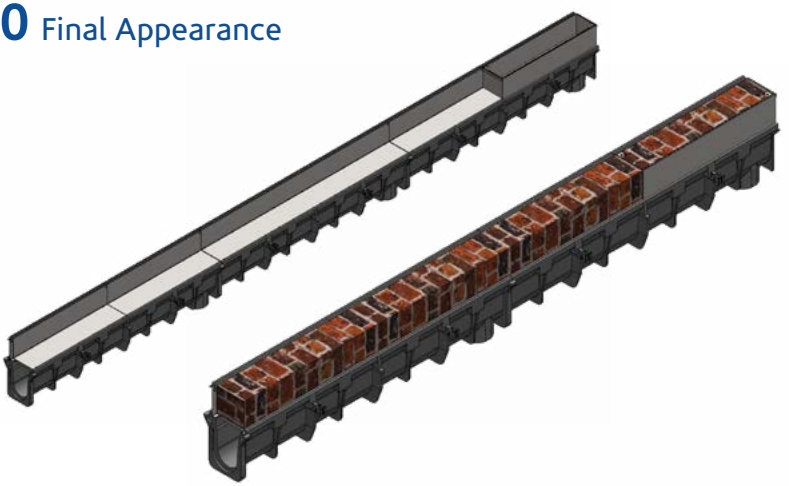
NDS recommends pouring concrete within 14 days of installing the channel sections for optimal performance. Concrete mix design, strength, curing time, and loading are project-specific and shall be per Engineer's recommendations.

- **Rebar Suspension Method:** Place the concrete around the base of the rebar posts on each side of the channel as well as under the channel between the rebar posts. Pour equal amounts on each side of the channel. All concrete shall be a single monolithic pour up to final grade. Vibrate to avoid bubbles using wand vibrator. Curing time shall be per Engineer's specifications.
- **FormBoard Suspension Method:** The first concrete pour shall be around the base and up to the cross bar of the formwork with blank grate in place. Vibrate to avoid bubbles using wand vibrator. Curing time shall be per Engineer's specifications. The second concrete pour shall be up to final grade and occur after removing the forms and blank grate and installing the slot top. Vibrate using wand vibrator. Curing time shall be per Engineer's specifications.

## 9 Expansion Joints

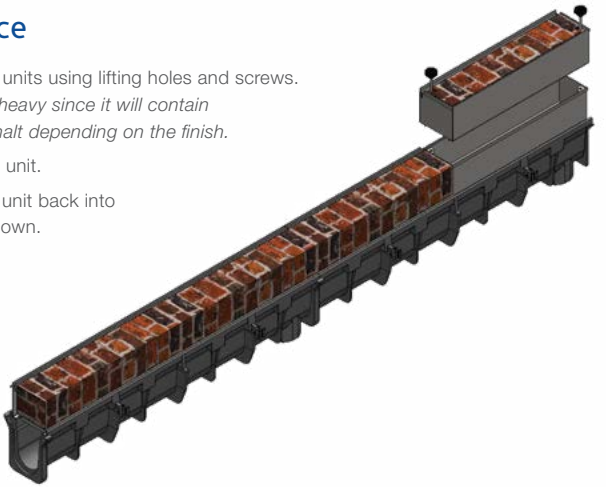
Install expansion joints parallel and perpendicular to channel. NDS standard recommendation on expansion joints is to locate these within 8" of all sides of the channel.

## 10 Final Appearance



## 11 Maintenance

- Remove maintenance units using lifting holes and screws. *Note: The unit will be heavy since it will contain bricks / concrete / asphalt depending on the finish.*
- Clean out the in-place unit.
- Replace maintenance unit back into the in-place unit as shown.



# Summary of Part Numbers

| CHANNELS (COMMON TO GRATE TOP & SLOT TOP) | |
|---|---|
| Sloped (3.99" to 12.06" deep) | DS-091 through DS -114 |
| Neutral/Non-Sloped (3.99" to 11.39" deep) | DS-090N, -091N, -094N, -097N, -100N, -103N, -106N, -109N, and -112N |

| GRATE TOP | |
|---|---|
| Standard | |
| Up to Car Traffic Loading | 660, 661, 661LG, 662, 663, 664, 665 |
| Up to Forklift Loading | DS-231, DS-232, DS-601, DS-602, DS-603, DS-604, DS-609 |
| Up to Semi Truck Loading | DS-221 |
| Heel-proof and ADA Compliant | |
| Up to Pedestrian Loading | DS-226, DS-228 |
| Up to Car Traffic Loading | DS-670, DS-671 |
| Ductile Iron Frame (Use only with Cast Iron & Ductile Iron Grates) | |
| Up to Pneumatic Tire Fork Lifts | DS-200H |

| SLOT TOP | |
|---|---|
| Heel-proof and ADA Compliant | 2' Slot top: DS-ST2 and 4' Slot top: DS-ST4 |

| ACCESSORIES (COMMON TO GRATE TOP AND SLOT TOP) | |
|---|---|
| Catch Basin | DS-340 |
| Universal End Cap | DS-224 |
| Universal End Outlet | DS-227 |
| Bottom Outlet Adapter for SRD-35 pipe | DS-126 |

| ACCESSORIES (GRATE TOP) | |
|---|---|
| Pro-Fit Grate Lock | DS-122 |
| Duraslope Frame and End Screws | DS-123 |
| Grate Screws | 629 |
| Optional Security Screws | DS-650 |
| Duraslope Radius Coupling | DSRC |
| Grates for Radius Coupling | DS-660MG, -661MG, 661LGMG, - 662MG, -663MG, -664MG, -665MG, -681LGMG, -232MG, -226MG, -221MG |

| ACCESSORIES (SLOT TOP) | |
|---|---|
| Maintenance Unit | DS-STMAINT |

## Notes

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