



DEPARTMENT OF THE ARMY  
U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT  
915 WILSHIRE BOULEVARD, SUITE 930  
LOS ANGELES, CALIFORNIA 90017-3489

CESPL-EDH

03 September 2020

MEMORANDUM FOR RECORD

SUBJECT: Hydrology & Hydraulics (H&H) Branch Policy Memorandum #3  
"Hydraulic Design and Criteria for Underpasses and Access Ramps"

1. **Purpose:** The purpose of this memorandum for record (MFR) is to establish policy for the hydraulic design and criteria for underpasses and access ramps in flood control channels within the Army Corps of Engineers, Los Angeles District (Corps). This memorandum supersedes the MFR entitled H&H Policy Memorandum Number 3, draft dated 31 July 2014. Specifically, paragraph 3a has been amended.

2. **References:**

a. CESPL-ED-H MFR, Subject: "H&H Policy Memorandum Number 3, "Hydraulic Design and Criteria for Underpasses and Access Ramps," draft dated 14 July 2014.

b. LARIO San Gabriel River Trail System, Final Feature Design Memorandum, US Army Corps of Engineers, Los Angeles District, date May 1979.

c. Highway Design Manual, California Department of Transportation, dated 1 July 1990.

3. **Discussion:**

a. The following discussion applies to channel reaches of subcritical flow (low-velocity); however, the final determination is at the discretion of the Hydrology and Hydraulics Branch of the Los Angeles District. Underpasses shall not be located in reaches of subcritical flow where the Froude Number is greater than 0.9 and supercritical flow (high-velocity) unless it can be demonstrated through physical and/or multi-dimensional numerical modeling that their hydraulic impacts will be minimal or can be simply mitigated.

b. For underpasses and access ramps in trapezoidal channels, hydraulic design criteria presented in Attachment 1 shall be followed unless a revised geometric section can be shown to be acceptable from hydraulic modeling. This table was expanded from the existing handwritten calculations and general guidance information that had been loosely acquired over the years to include additional common channel side slopes.

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Attachment 2 illustrates a typical underpass ramp under a bridge and provides additional detail information to facilitate the subject underpass ramp design.

c. Access ramps for subcritical flow rectangular channels where the Froude Number is greater than 0.9 and supercritical rectangular channels should have a ninety-degree entrance angle, and the opening in the channel wall should not exceed 35 feet (10 meters). Access ramps should be located in tangent reaches of the channel wherever possible; however, if they must be located in a curved reach, the opening should be located on the inside of the curve. A splash guard should be provided at sufficient dimensions to prevent any water from spraying outside of the access ramp. Attachment 3 illustrates a typical access ramp in a rectangular channel and provides typical detail information to facilitate access ramp design.

4. **Deviations:** Any deviation from criteria in this MFR shall require written approval by the H&H Branch of the Corps through the Section 408 Program Manager.

RENE VERMEEREN, P.E., D.WRE  
Chief, Hydrology & Hydraulics Branch  
Corps of Engineers, Los Angeles District

#### Attachments

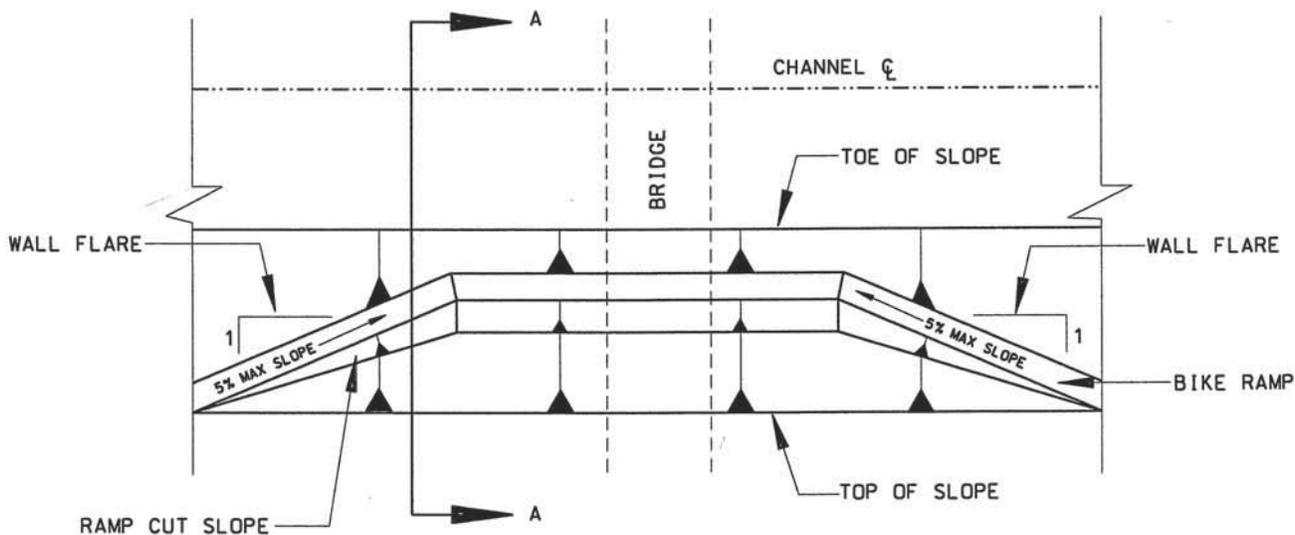
1. Recommended Flare Ratio for Bicycle Ramps Under
2. Typical Underpass Along Channel Side Slope
3. Typical Access Ramp Rectangular Channel

## ATTACHMENT 1

Recommended Flare Ratio (Horizontal to Longitudinal) for Bicycle Ramps Under					
Mean Channel Velocity	Channel Side Slope	Cut Slope of Ramp			
		Vertical	0.5H:1V	1H:1V	1.5H:1V
10 - 15 ft/s	3 to 1	<b>1:10</b>	<i>1:8.5</i>	<b>1:7</b>	<i>1:5.5</i>
	2.25 to 1	<b>1:10</b>	<i>1:7.75</i>	<b>1:5.5</b>	<i>1:3.25</i>
	2 to 1	<i>1:10</i>	<i>1:7.5</i>	<i>1:5</i>	<i>1:2.5</i>
	1.5 to 1	<i>1:10</i>	<i>1:7</i>	<i>1:4</i>	<i>1:1</i>
15 - 30 ft/s	3 to 1	<b>1:15</b>	<i>1:12.5</i>	<b>1:10</b>	<i>1:7.5</i>
	2.25 to 1	<b>1:15</b>	<i>1:11.75</i>	<b>1:8.5</b>	<i>1:5.25</i>
	2 to 1	<i>1:15</i>	<i>1:11.5</i>	<i>1:8</i>	<i>1:4.5</i>
	1.5 to 1	<i>1:15</i>	<i>1:11</i>	<i>1:7</i>	<i>1:3</i>
30 - 40 ft/s	3 to 1	<b>1:20</b>	<i>1:17</i>	<b>1:14</b>	<i>1:11</i>
	2.25 to 1	<b>1:20</b>	<i>1:15.5</i>	<b>1:11</b>	<i>1:6.5</i>
	2 to 1	<i>1:20</i>	<i>1:15</i>	<i>1:10</i>	<i>1:5</i>
	1.5 to 1	<i>1:20</i>	<i>1:14</i>	<i>1:8</i>	<i>1:2</i>

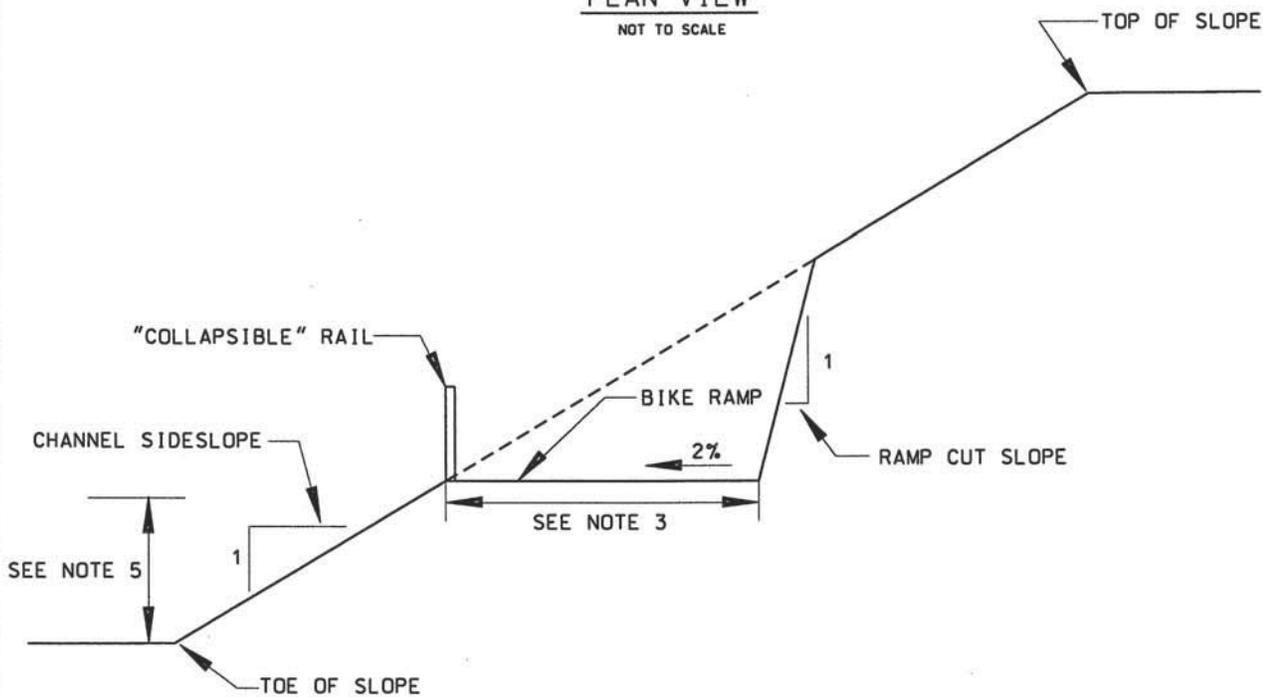
## Notes:

- (1) Values in bold type were taken from Reference 2a. Values in italics were interpolated from the values in bold type.
- (2) A maximum ramp slope of 5% set by the American Disabilities Act (ADA) shall be used for the bike ramps.



**PLAN VIEW**

NOT TO SCALE



**SECTION A-A**

NOT TO SCALE

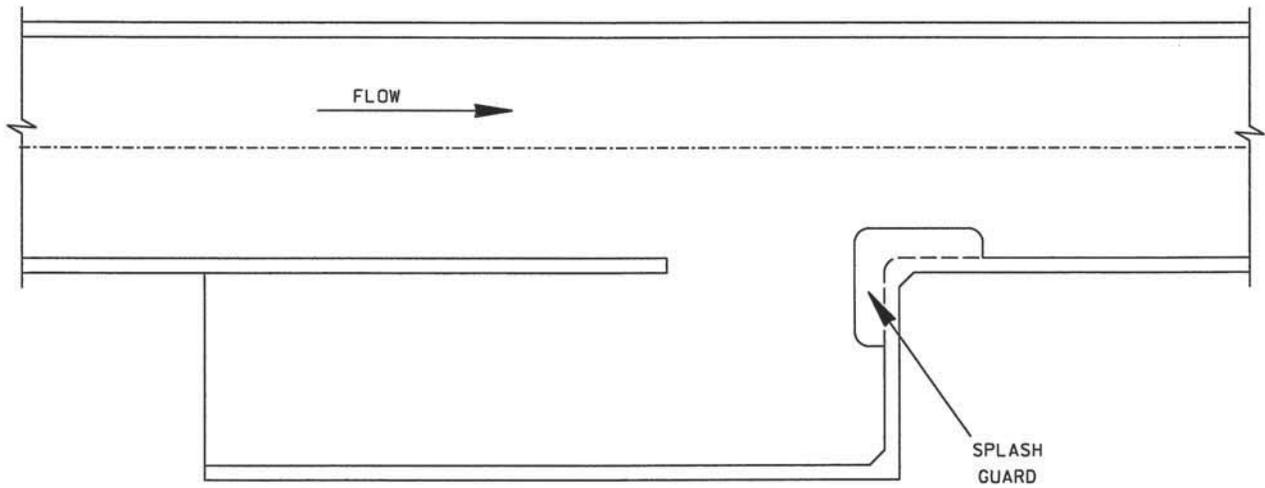
**NOTES:**

1. REFER TO LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS STANDARDS AND CALTRANS HIGHWAY DESIGN MANUAL FOR ADDITIONAL DESIGN CRITERIA.
2. THE VERTICAL CLEARANCE TO OBSTRUCTIONS ACROSS THE CLEAR WIDTH OF THE PATH SHALL BE A MINIMUM OF 10 FT.
3. PATH WIDTH SHALL BE 12' MINIMUM AND 20' MAXIMUM
4. CONCRETE SHALL HAVE A LIGHT BRUSH FINISH.
5. THE MINIMUM HEIGHT OF THE RAMP INVERT ABOVE THE CHANNEL INVERT SHALL NOT BE LESS THAN 10% OF THE DESIGN FLOW DEPTH.

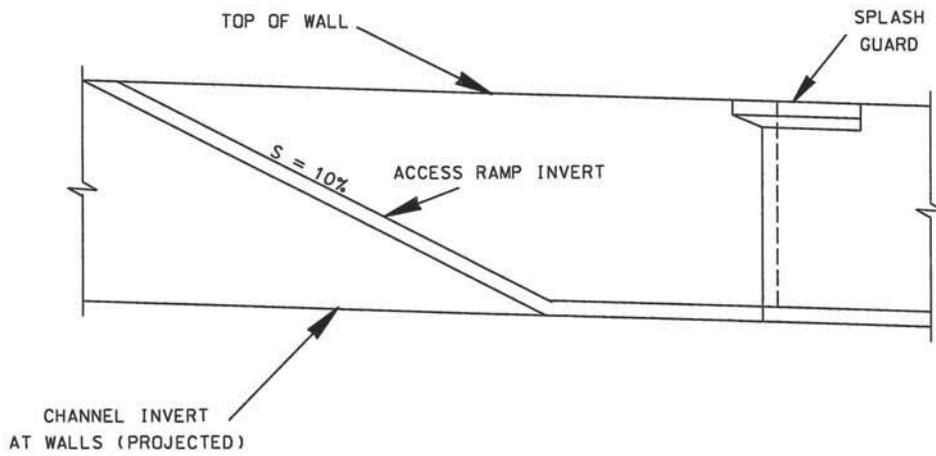
POLICY MEMORANDUM

**TYPICAL UNDERPASS  
ALONG CHANNEL SIDE SLOPE**

US ARMY CORPS OF ENGINEERS  
LOS ANGELES DISTRICT



PLAN VIEW  
NOT TO SCALE



INVERT ACCESS RAMP - PROFILE  
NOT TO SCALE

POLICY MEMORANDUM

TYPICAL ACCESS RAMP  
RECTANGULAR CHANNEL

US ARMY CORPS OF ENGINEERS  
LOS ANGELES DISTRICT