



CITY OF CORONADO
COMMUNITY DEVELOPMENT

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City of Coronado Public Handout #10

RETAINING WALLS

- Purpose:** Ensure uniformity in construction of concrete masonry retaining walls.
- Authority:** 2001 California Building Code – Chapter 16
- Diagrams:**
1. Figure 1 – Type III or IV retaining wall with level backfill
 2. Figure 2 – Type V retaining wall with level backfill
 3. Figure 1 – Type I retaining wall with sloping backfill
 4. Figure 2 – Type II retaining wall with sloping backfill
- Notes:**
1. A dimensioned site plan (3 copies) with location of planned CMU retaining walls is required for Planning Department review prior to permit issuance. See Site Plan Handout #4.

MINIMUM REQUIREMENTS FOR
Retaining Wall/Level Backfill

I. INSPECTIONS

Inspections must be performed during several phases of construction. Please call for inspections at the following times:

A. A footing inspection is needed when the excavation for a footing has been dug with the steel tied securely in its final position, and the site is ready for the concrete to be placed.

B. A masonry pregrout inspection is required when the block has been laid and the steel is in place, but before the grout has been placed.

1. If cleanout holes *are* used, block may be laid to the full height at the grout pour before calling for the pregrout inspection. Grout shall be placed in a continuous pour in grout lifts not exceeding 6 feet.

2. If cleanout holes *are not* used, a masonry pregrout inspection is required prior to each grout pour. Block cannot be laid higher than the grout pour. Note that cleanouts are required for all grout pours over 5 feet in height.

C. After grouting is completed and rock or rubble wall drains are in place, but before earth backfill is placed, call for a backfill/drainage inspection.

D. When all work has been completed, call for a final inspection.

II. WALL HEIGHT

Wall height is measured from the top of the footing to the top of the wall.

Walls not shown in Tables A on page 2 must be designed specifically for the existing conditions. The walls shown here are designed to retain earth banks with level backfill. No building foundation, driveway, or other loading on the upper level is allowed with a distance equal to the height of the wall.

III. BLOCK

All block must be type "N" grouted solid with $f'_m = 1,500$ psi.

IV. MIX REQUIREMENTS

Note that use of plastic cement is not permitted in retaining walls located in Seismic Zone No. 3 or 4.

A. The concrete mix for footings must meet a compressive strength of $f'_c = 2,000$ psi minimum, or the following proportions by volume:

- 1 part Portland cement
- 2 1/2 parts sand
- 3 1/2 parts 3/4-inch maximum-size gravel
- 7 gallons of water maximum per sack of cement

B. The mortar mix must have a compressive strength equal to 1,800 psi minimum. One possible mix contains the following proportions by volume:

- 1 part Portland cement
- 3 1/2 parts sand
- 1/4 part hydrated lime or lime putty

C. Grout must have a compressive strength equal to 2,000 psi minimum. One possible mix contains the following proportions by volume:

- 1 part Portland cement
- 3 parts sand
- 2 parts pea gravel (3/8-inch aggregate)

Add water until pouring consistency is achieved without segregation of the grout constituents. Rod or vibrate immediately. Rerod or revibrate grout about 10 minutes after pouring to ensure solid consolidation. Stop grout 2 inches from top of masonry units when grouting of second lift is to be continued at another time.

Note: All cells must be filled solid with grout.

V. MORTAR KEY

To insure proper bonding between the footing and the first course of block, a mortar key must be formed by embedding a flat 2x4 flush with and at the top of the freshly placed footing. It should be removed after the concrete has started to harden (about 1 hour). A mortar key may be omitted if the first course of block is set into the fresh concrete when the footing is placed and a good bond is obtained.

VI. WALL DRAINS

Wall drains (four-inch-diameter) must be placed at 6-foot intervals along the length of the wall and located just above the level of the soil or paving on the front face of the wall. The drains may be formed by placing a block on its side at 6-foot intervals, by leaving out the mortar in the vertical spaces between all the blocks in the first course above the soil or paving (head joint) on the front face of the wall or by any other acceptable equivalent method. Backfill behind wall drains or open head joints must be loose rubble or gravel 12 inches wide and extending from the top of the wall to the top of the footing.

VII. SOIL

Wall design, footing sizes, and reinforcing steel are all based on an active earth pressure with an equivalent fluid weight of 30 pounds per cubic foot. All footings must extend at least 12 inches into undisturbed natural soil or compacted fill which has been compacted to at least 90 percent density. Soil should be dampened prior to placing concrete in footings. A soils report, compiled by a licensed civil engineer, may be required.

A minimum of 7 feet must be provided horizontally from the toe of the footing to daylight where the ground slopes away from the base of the wall.

Footing sizes given in Table A are based on a 1,000 psf maximum soil bearing value; use of a larger bearing value will require design by a licensed architect or civil engineer specifically for the existing conditions. A soils report, compiled by a licensed civil engineer, may be required.

VIII. REINFORCING STEEL

Reinforcing steel must be deformed and comply with ASTM specification A615-85, Grade 40 or 60. When one continuous bar cannot be used, a lap or splice of 40-bar diameters is required.

Two #3 bars must be placed longitudinally in the footing as shown in figures 1 and 2.

For 6-inch or 8-inch blocks, one #3 reinforcing bar must be placed longitudinally in the center of the wall in a bond beam block every 16 inches as the blocks are laid up. For 12-inch blocks, one #4 reinforcing bar must be placed longitudinally in the center of the wall in a bond beam block every 16 inches as the blocks are laid up.

Table A/Requirements for Various Wall Heights ^{1,2,3}

Wall Height (H)	Wall Type ⁴	Toe Dimension (L)	Footing Width (W)	Key Size (K)	"A" Bars	"B" Bars
1'-4"	III	2"	1'- 3"	None	#3s @ 24" o.c.	None
2'-0"	III	2"	1'- 6"	None	#3s @ 24" o.c.	None
2'-8"	III	3"	1'-10"	None	#3s @ 24" o.c.	#3s @ 48" o.c.
3'-4"	III	4"	2'- 1"	None	#3s @ 24" o.c.	#3s @ 48" o.c.
4'-0"	IV	6"	2'- 6"	None	#4s @ 24" o.c.	#3s @ 32" o.c.
4'-8"	IV	11"	2'-11"	None	#4s @ 24" o.c.	#4s @ 24" o.c.
5'-4"	IV	12"	3'- 2"	6" x 6"	#4s @ 16" o.c.	#4s @ 24" o.c.
6'-0"	V	16"	3'-10"	8" x 8"	#4s @ 16" o.c.	#4s @ 24" o.c.
6'-8"	V	16"	4'- 4"	8" x 8"	#4s @ 16" o.c.	#4s @ 16" o.c.
7'-4"	V	16"	5'- 0"	12" x 12"	#5s @ 16" o.c.	#4s @ 16" o.c.
8'-0"	V	20"	5'- 8"	12" x 12"	#6s @ 16" o.c.	#4s @ 16" o.c.

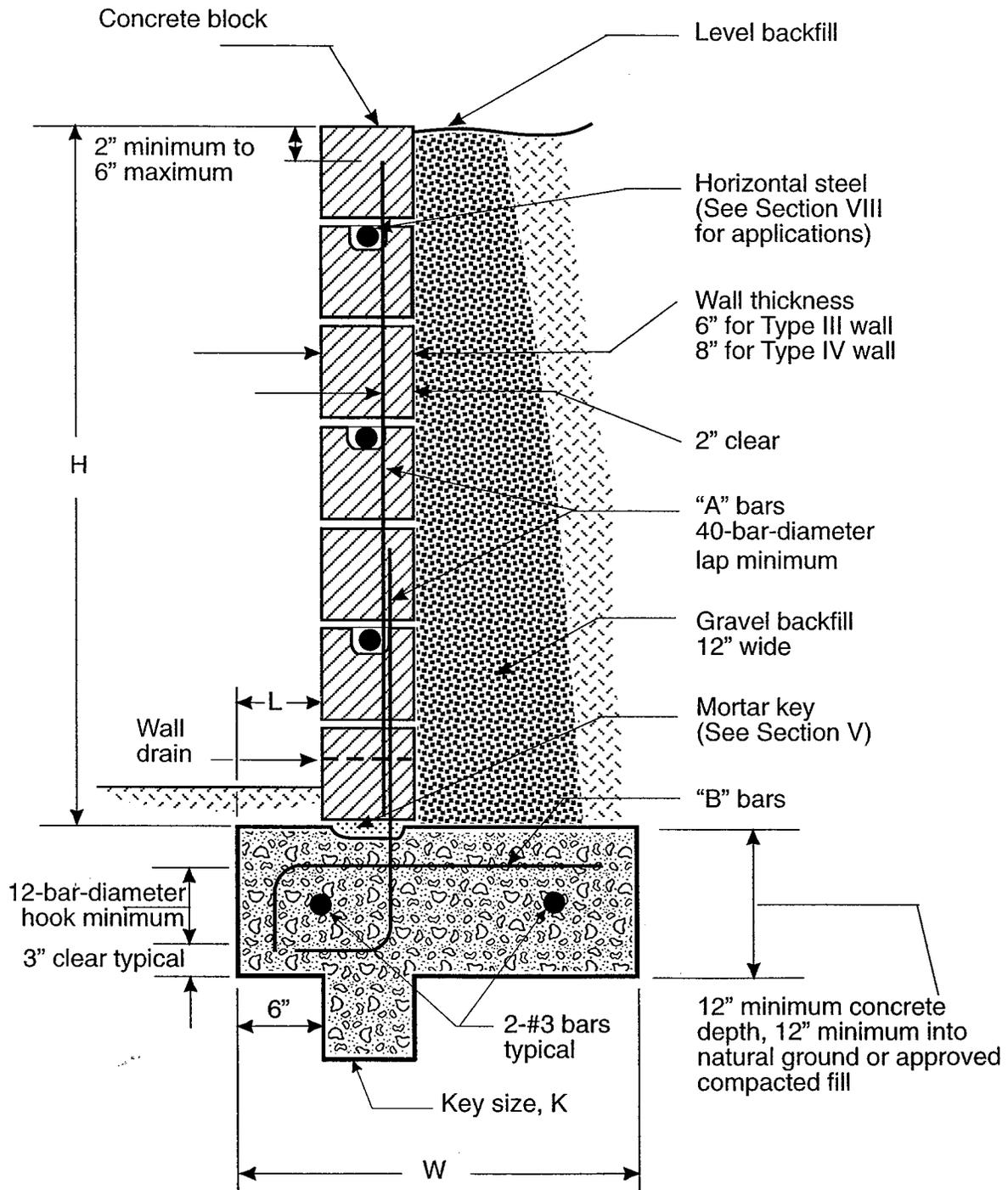
Footnotes

- ¹ Footing sizes are based on 1,000 psf maximum soil bearing value. The resultant is within the middle third of the footing.
- ² Wall not shown in Table A above must be designed specifically for the actual condition.
- ³ All construction must comply with the specifications shown in this information bulletin.
- ⁴ When Wall Type V is required, the first 32 inches of block, regardless of wall height, must be 12-inch-wide masonry units.

III= 6" Block

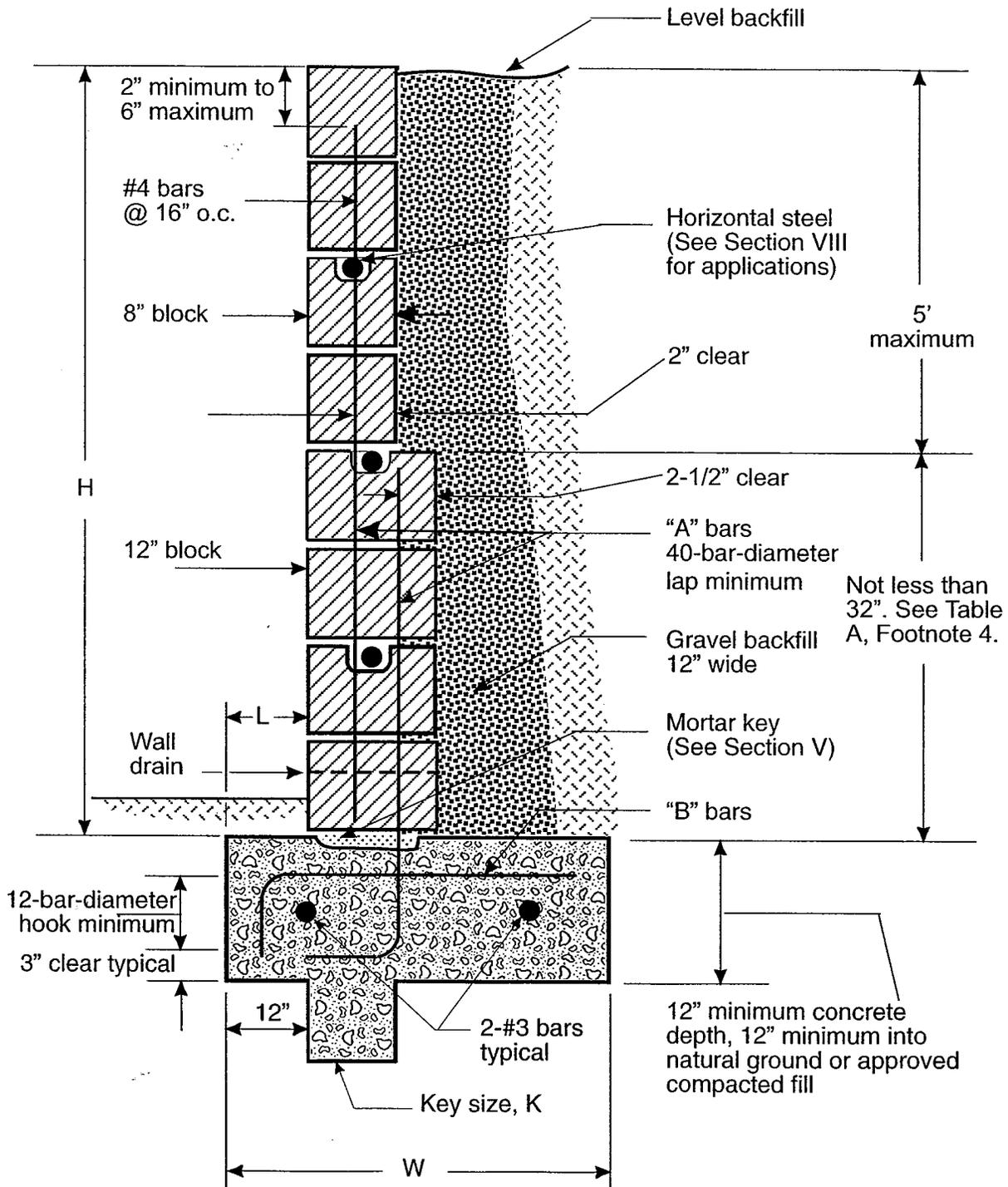
IV= 8" Block

Figure 1/Type III or IV retaining wall with level backfill



Note: A minimum of 7 feet must be provided horizontally from the toe of the footing to daylight where the ground slopes away from the base of the wall.

Figure 2/Type V retaining wall with level backfill



Note: A minimum of 7 feet must be provided horizontally from the toe of the footing to daylight where the ground slopes away from the base of the wall.

MINIMUM REQUIREMENTS FOR
Retaining Wall/Sloping Backfill

I. INSPECTIONS

Inspections must be performed during several phases of construction. Please call for inspections at the following times:

A. A footing inspection is needed when the excavation for a footing has been dug with the steel tied securely in its final position, and the site is ready for the concrete to be placed.

B. A masonry pregrout inspection is required when the block has been laid and the steel is in place, but before the grout has been placed.

1. If cleanout holes *are* used, block may be laid to the full height at the grout pour before calling for the pregrout inspection. Grout shall be placed in a continuous pour in grout lifts not exceeding 6 feet.

2. If cleanout holes *are not* used, a masonry pregrout inspection is required prior to each grout pour. Block cannot be laid higher than the grout pour. Note that cleanouts are required for all grout pours over 5 feet in height.

C. After grouting is completed and rock or rubble wall drains are in place, but before earth backfill is placed, call for a backfill/drainage inspection.

D. When all work has been completed, call for a final inspection.

II. WALL HEIGHT

Wall height is measured from the top of the footing to the top of the wall. Walls not shown in Tables A and B on page 2 must be designed specifically for the existing condition. The walls shown here are designed to retain earth banks from level to a slope of 1 horizontal to 1 vertical (sloping surcharge). No building foundation, driveway, or other loading on the upper level is allowed with a distance equal to the height of the wall.

III. BLOCK

All block must be type "N" grouted solid with $f'_m = 1,500$ psi.

IV. MIX REQUIREMENTS

Note that use of plastic cement is not permitted in retaining walls located in Seismic Zone No. 3 or 4.

A. The concrete mix for footings must meet a compressive strength of $f'_c = 2,000$ psi minimum, or the following proportions by volume:

- 1 part Portland cement
- 2 1/2 parts sand
- 3 1/2 parts 3/4-inch maximum-size gravel
- 7 gallons of water maximum per sack of cement

B. The mortar mix must have a compressive strength equal to 1,800 psi minimum. One possible mix contains the following proportions by volume:

- 1 part Partland cement
- 3 1/2 parts sand
- 1/4 part hydrated lime or lime putty

C. Grout must have a compressive strength equal to 2,000 psi minimum. One possible mix contains the following proportions by volume:

- 1 part Portland cement
- 3 parts sand
- 2 parts pea gravel (3/8-inch aggregate)

Add water until pouring consistency is achieved without segregation of the grout constituents. Rod or vibrate immediately. Rerod or revibrate grout about 10 minutes after pouring to ensure solid consolidation. Stop grout 2 inches from top of masonry units when grouting of second lift is to be continued at another time.

Note: All cells must be filled solid with grout.

V. MORTAR KEY

To insure proper bonding between the footing and the first course of block, a mortar key must be formed by embedding a flat 2x4 flush with and at the top of the freshly placed footing. It should be removed after the concrete has started to harden (about 1 hour). A mortar key may be omitted if the first course of block is set into the fresh concrete when the footing is placed and a good bond is obtained.

VI. WALL DRAINS

Wall drains (four-inch-diameter) must be placed at 6-foot intervals along the length of the wall and located just above the level of the soil or paving on the front face of the wall. The drains may be formed by placing a block on its side at 6-foot intervals, by leaving out the mortar in the vertical spaces between all the blocks (head joint) in the first course above the soil or paving on the front face of the wall or by any other acceptable equivalent method. Backfill behind wall drains or open head joints must be loose rubble or gravel 12 inches wide and extending from the top of the wall to the top of the footing.

VII. SOIL

Wall design, footing sizes, and reinforcing steel are all based on an active earth pressure with an equivalent fluid weight of 30 pounds per cubic foot. All footings must extend at least 12 inches into undisturbed natural soil or compacted fill which has been compacted to at least 90 percent density. Soil should be dampened prior to placing concrete in footings. A soils report, compiled by a licensed civil engineer, may be required.

A minimum of 7 feet must be provided horizontally from the toe of the footing to daylight where the ground slopes away from the base of the wall.

Footing sizes given in Table A are based on a 1,000 psf maximum soil bearing value; use of a larger bearing value will require design by a licensed architect or civil engineer specifically for the existing conditions. A soils report, compiled by a licensed civil engineer, may be required.

VIII. REINFORCING STEEL

Reinforcing steel must be deformed and comply with ASTM specification A615-85, Grade 40 or 60. When one continuous bar cannot be used, a lap or splice of 40-bar diameters is required.

Two #3 bars must be placed longitudinally in the footing as shown in figures 1 and 2.

For 6-inch or 8-inch blocks, one #3 reinforcing bar must be placed longitudinally in the center of the wall in a bond beam block every 16 inches as the blocks are laid up. For 12-inch blocks, one #4 reinforcing bar must be placed longitudinally in the center of the wall in a bond beam block every 16 inches as the blocks are laid up.

IX. USE OF TABLES

Determine height of wall to be constructed as described above and the slope of retained earth. Using Table A with the appropriate wall height and slope of retained earth, read T, R, K, and W designations. Then proceed to Table B.

Example: Wall height of 5 feet, slope of retained earth 3 horizontal to 1 vertical.

From Table A: T = B, R = 5, K = E, W = 2'-9"

From Table B:

B = Type I, 8" concrete block (See page 3.)

5 = #4 reinforcing bars @ 16" on center

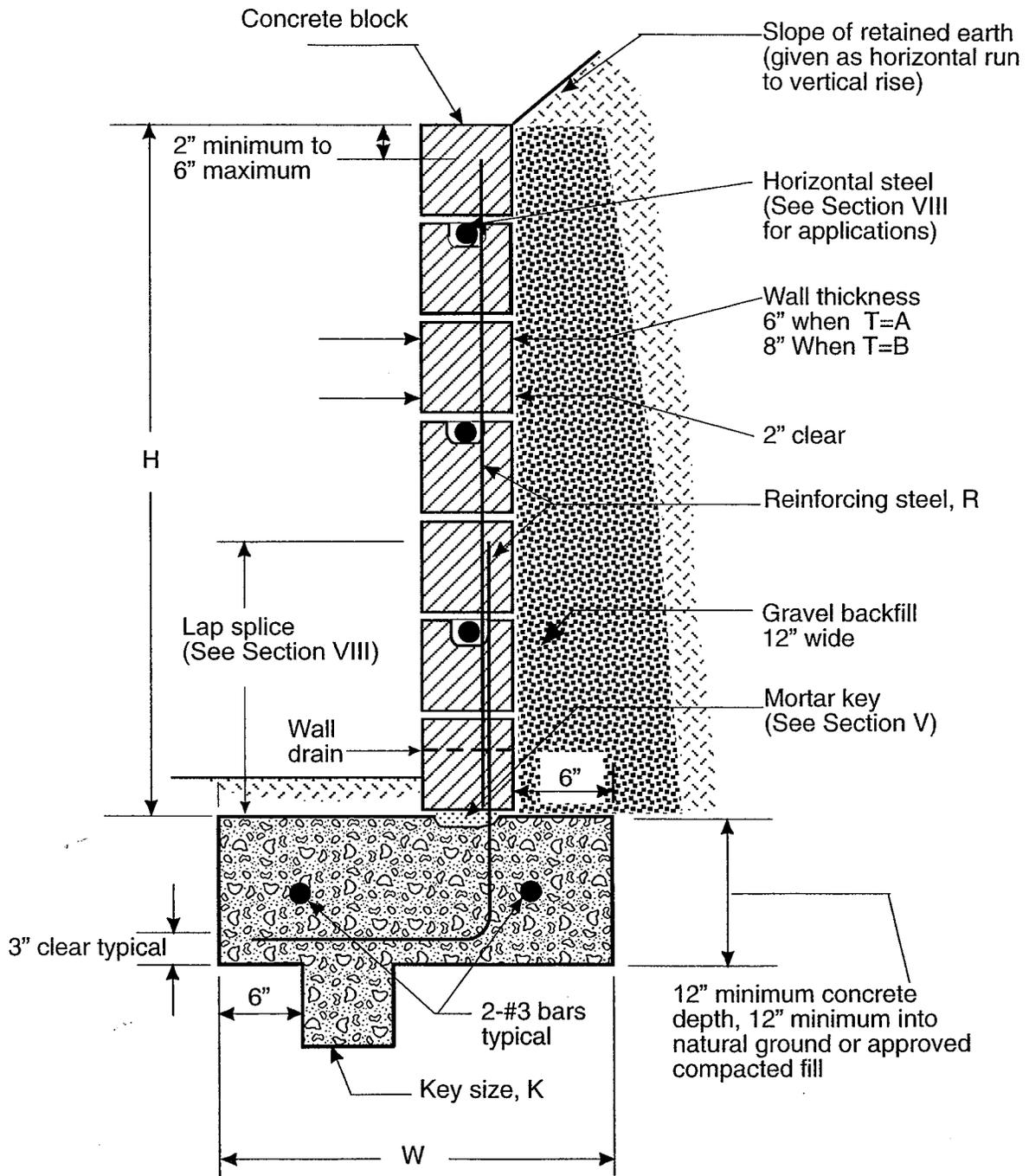
E = Key size of 8" wide by 8" deep

Table A/Requirements for Various Slopes of Retained Earth (Horizontal Run to Vertical Rise)																																				
Wall Ht.	Level				5 to 1				4 to 1				3 to 1				2 to 1				1 1/2 to 1				1 to 1											
	T	R	K	W	T	R	K	W	T	R	K	W	T	R	K	W	T	R	K	W	T	R	K	W	T	R	K	W								
1'-6"	A	1	N	1'-4"	A	1	N	1'-4"	A	1	N	1'-4"	A	1	N	1'-4"	A	1	N	1'-4"	A	1	N	1'-6"	A	1	N	1'-6"	A	1	D	1'-7"				
2'-0"	A	1	N	1'-4"	A	1	N	1'-4"	A	1	N	1'-4"	A	1	N	1'-4"	A	1	N	1'-4"	A	1	N	1'-4"	A	1	D	1'-8"	A	1	D	1'-10"				
2'-6"	A	1	N	1'-7"	A	1	N	1'-7"	A	1	N	1'-7"	A	1	N	1'-7"	A	1	N	1'-7"	A	1	N	1'-7"	A	1	N	1'-7"	A	1	D	1'-10"	A	1	E	2'-2"
3'-0"	A	1	N	2'-0"	A	1	N	2'-0"	A	1	N	2'-0"	A	1	N	2'-0"	A	1	N	2'-0"	A	1	D	2'-0"	A	1	E	2'-2"	B	1	F	2'-5"				
3'-6"	A	1	N	2'-1"	A	1	N	2'-1"	A	1	N	2'-1"	A	3	D	2'-1"	A	3	D	2'-1"	A	3	D	2'-1"	B	1	E	2'-4"	B	4	F	2'-4"				
4'-0"	B	1	N	2'-4"	A	1	N	2'-4"	B	1	N	2'-4"	B	1	D	2'-4"	B	1	D	2'-4"	B	1	D	2'-4"	B	4	F	2'-5"	B	6	G	3'-4"				
4'-6"	B	1	N	2'-6"	B	2	D	2'-6"	B	2	D	2'-6"	B	2	D	2'-6"	B	2	D	2'-6"	B	4	E	2'-6"	B	6	F	3'-1"	C	5	G	3'-9"				
5'-0"	B	4	D	2'-9"	B	4	D	2'-9"	B	5	E	2'-9"	B	5	E	2'-9"	B	5	E	2'-9"	B	6	F	2'-9"	C	5	G	3'-5"								
5'-6"	B	5	D	3'-0"	B	6	D	3'-0"	B	6	E	3'-0"	B	6	E	3'-0"	B	6	E	3'-0"	C	5	F	3'-2"	C	5	G	3'-9"								
6'-0"	C	5	E	3'-3"	C	5	E	3'-3"	C	5	E	3'-4"	C	5	E	3'-4"	C	5	E	3'-4"	C	5	F	3'-6"	C	6	G	4'-2"								
7'-0"	C	5	E	3'-9"	C	5	F	3'-10"	C	6	F	3'-10"	C	6	G	3'-11"	C	6	G	3'-11"	C	7	G	4'-1"												
8'-0"	C	5	G	4'-6"																																

Table B ^{1,2,3,4} /Values for T, R, and K		
Wall type and Thickness, T	Reinforcing Steel, R	Key Size, K (Width by Depth)
A - Type I, 6" block	1 - #3 bars @ 24" o.c.	D - 6" x 6"
B - Type I, 8" block	2 - #4 bars @ 32" o.c.	E - 8" x 8"
C ⁵ - Type II, 8" and 12" block	3 - #3 bars @ 16" o.c.	F - 12" x 12"
	4 - #4 bars @ 24" o.c.	G - 12" x 18"
	5 - #4 bars @ 16" o.c.	N - None
	6 - #5 bars @ 16" o.c.	
	7 - #6 bars @ 16" o.c.	

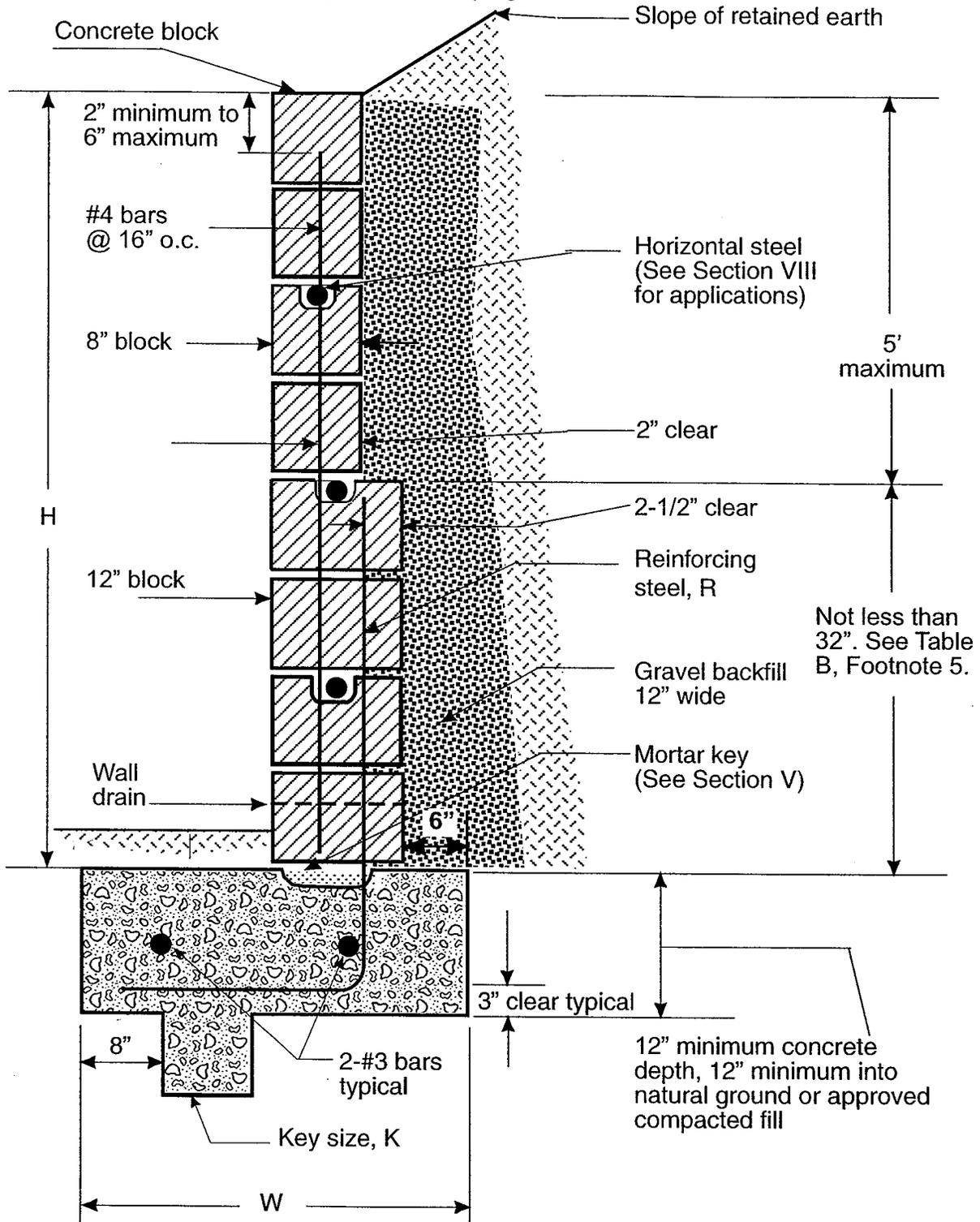
Footnotes
¹ Footing sizes are based on 1,000 psf maximum soil bearing value. The resultant is within the middle third of the footing.
² Walls not shown in the tables above must be designed specifically for the actual condition.
³ All construction must comply with the specifications shown in this information bulletin.
⁴ All blocks must be grade "N" grouted solid with an $f'_m = 1,500$ psi.
⁵ For Wall Type II, the first 32 inches of block, regardless of wall height, must be 12-inch-wide masonry units.

Figure 1/Type I retaining wall with sloping backfill



Note: A minimum of 7 feet must be provided horizontally from the toe of the footing to daylight where the ground slopes away from the base of the wall.

Figure 2/Type II retaining wall with sloping backfill



Note: A minimum of 7 feet must be provided horizontally from the toe of the footing to daylight where the ground slopes away from the base of the wall.