Part 2

CRIB WALLS

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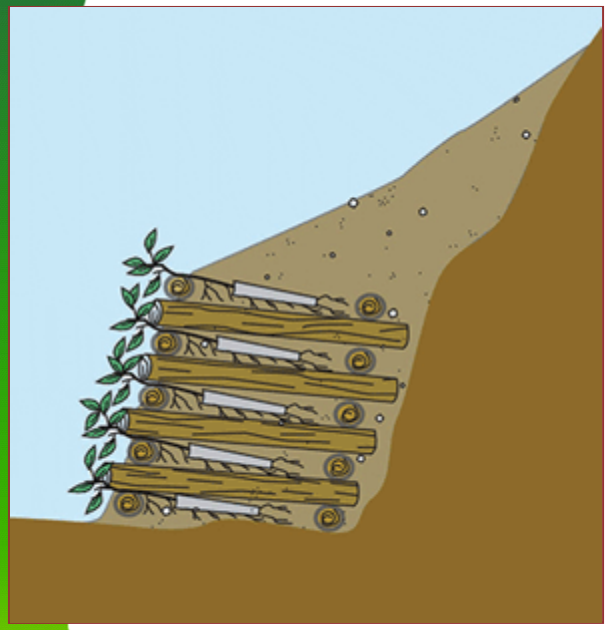
Wood Crib Walls



Wood crib walls have low reflectance and can be planted to create a more natural appearance

- Crib walls are one of the oldest gravity wall systems, comprised of a series of stacked members creating hollow cells filled with soil or rock. This image shows a telephone pole crib wall built during the Second World War by the California Division of Highways near Sonoma, California.

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- In 1919 precast concrete elements began being cast for use in crib walls in the Cleveland area. These have since appeared in a myriad of forms, such as the one shown above.

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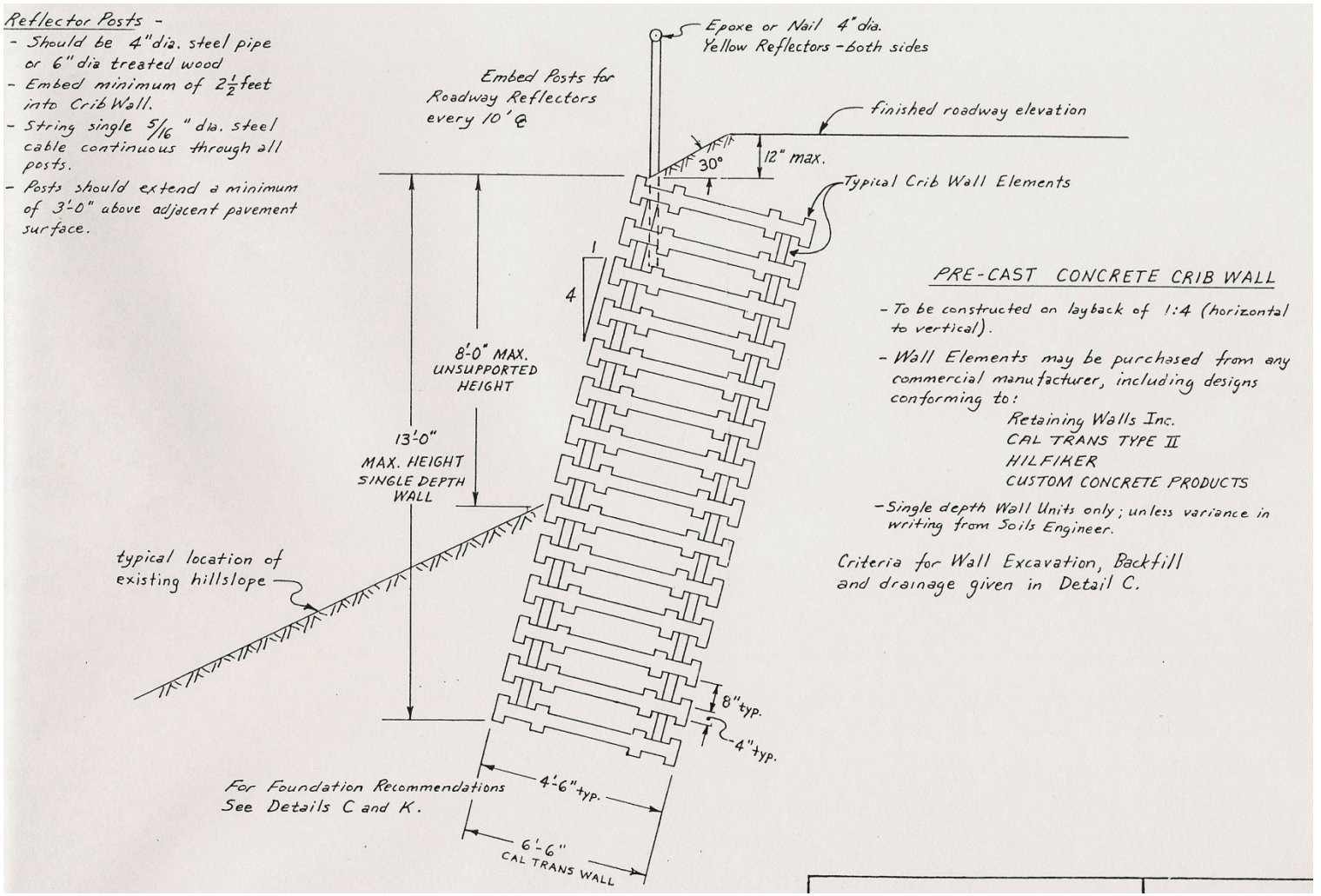
Crib Walls available in all sizes

During the last four decades a number of manufacturers have begun producing precast concrete and treated timber crib wall elements, suitable for “back yard” applications, where there is restricted site access. The Criblok system employs a maximum weight of weight of just 106 pounds, which allow individual workmen to man-handle the elements.



- **Typical section through a single cell crib wall, showing the header elements that tie the wall together, into the slope. Note maximum exposed height of 8 feet on a descending slope and 13 ft limit for a single depth wall. This figures assume backfilling with crushed rock**

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	$i =$	−30°	−12°	±0	+12° 1:4.7	+30° 1.1:7
$\phi = 20°$	$\beta' = +20°$		0.57	0.65	0.81	
	$\beta' = +10°$		0.50	0.55	0.68	
	$\beta' = \pm 0°$		0.44	0.49	0.60	
	$\beta' = -10°$		0.38	0.42	0.50	
	$\beta' = -20°$		0.32	0.35	0.40	
$\phi = 30°$	$\beta' = +20°$	0.34	0.43	0.50	0.59	1.17
	$\beta' = +10°$	0.30	0.36	0.41	0.48	0.92
	$\beta' = \pm 0°$	0.26	0.30	0.33	0.38	0.75
	$\beta' = -10°$	0.22	0.25	0.27	0.31	0.61
	$\beta' = -20°$	0.18	0.20	0.21	0.24	0.50
$\phi = 40°$	$\beta' = +20°$	0.27	0.33	0.38	0.43	0.59
	$\beta' = +10°$	0.22	0.26	0.29	0.32	0.43
	$\beta' = \pm 0°$	0.18	0.20	0.22	0.24	0.32
	$\beta' = -10°$	0.13	0.15	0.16	0.17	0.24
	$\beta' = -20°$	0.10	0.10	0.11	0.12	0.16

for $\phi_w = 0$; $\beta' = \beta - 90°$

Coefficient of active stress as function of inclination of wall and backfill.

- **The Rankine active pressure coefficient, k_a, is a function of the wall's batter from vertical. Significant reductions in k_a can be realized by battering walls.**

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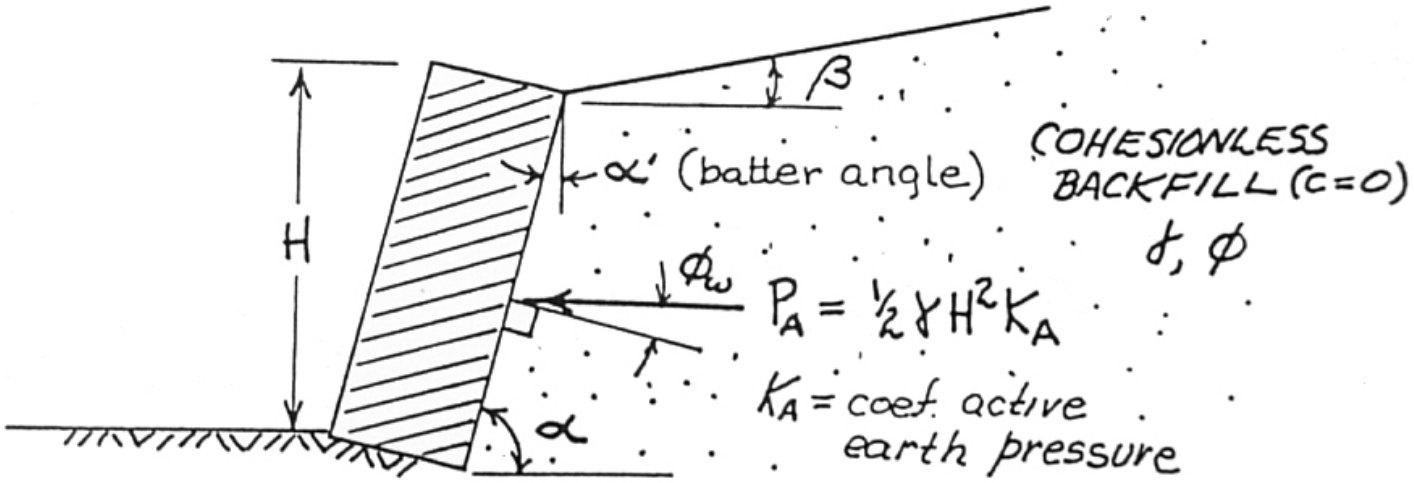
LOADING DIAGRAM FOR CRIB WALL



- This diagram portrays the basic loads acting on a gravity retaining wall system, like a crib wall (ignoring live load surcharges).

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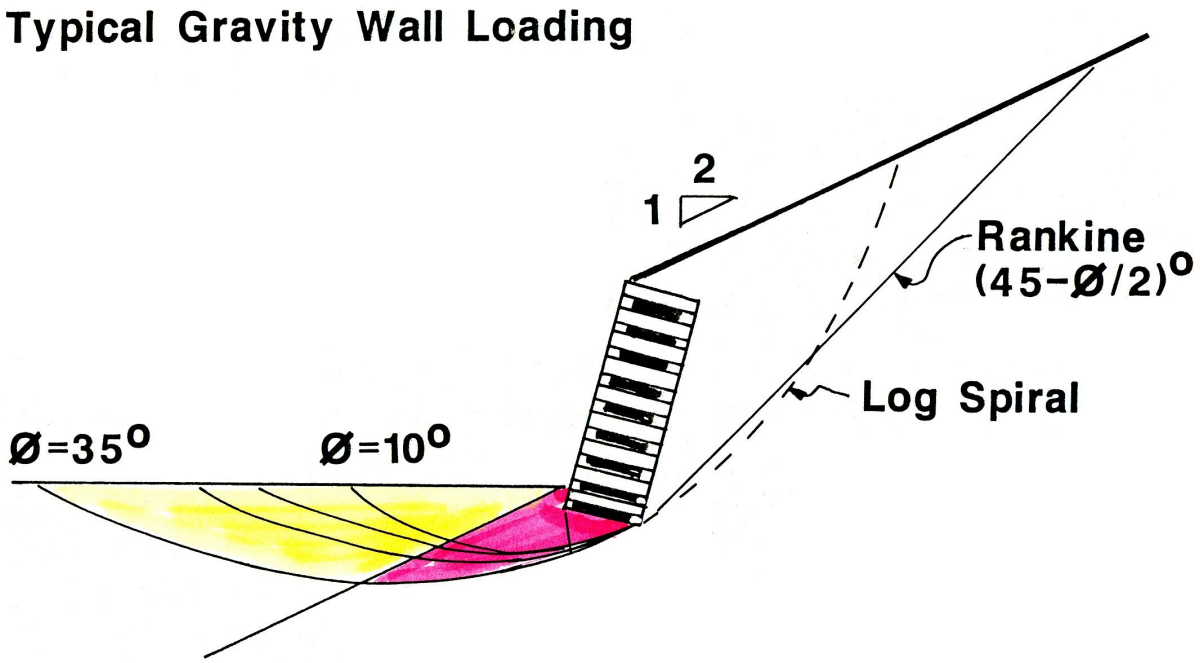
SLOPE REDUCTION FACTORS



- A significant reduction in passive resistance must be considered when placing crib walls on or adjacent to sloping ground

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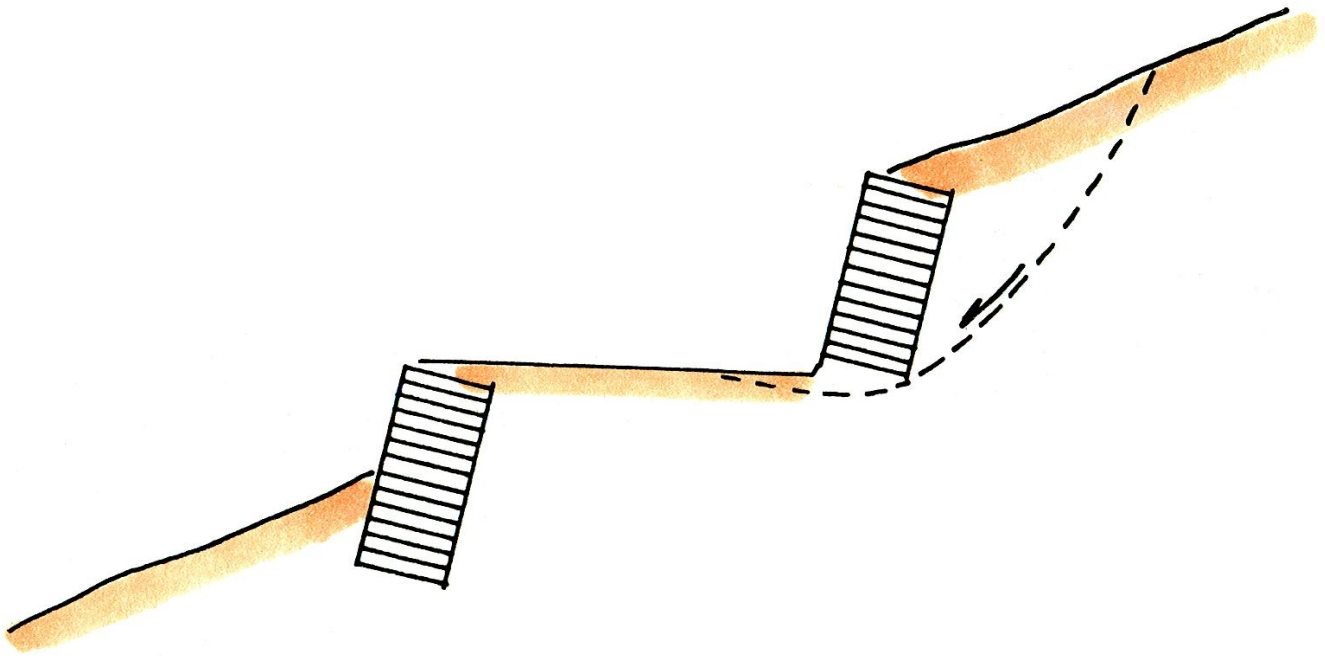
Inadequate Toe Embedment



- One of the common failure modes for crib walls is inadequate toe embedment, on both uphill and downhill walls, as sketched above.

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- These **crib wall failures** occurred because of ***inadequate toe embedment.*** The contractor constructed the walls, but did not place the aggregate base and pavement because the job was shut down for the winter.

- The pavement section was included in the original design and assumed to buttress the toe of the walls, which were supporting road cuts.

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- This is the same crib wall after repair and placement of the pavement section the following year. The road had a maximum grade of 20%.

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- In some case the severity of the toe slope necessitates placement of deep foundations; in this case, a footing on cast-in-ground cylindrical caissons. The slope is inclined about 35 degrees.

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- Crib wall systems can be aesthetically pleasing because they can accommodate complex curvature and be planted with climbing vines, giving them a much “softer” appearance than more conventional support systems. Dying the concrete in an brown or tan earthen color will also tend to enhance the final appearance.

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Steel Bin Walls

- **Steel bin walls** are usually bolted together and then filled with crushed rock or other free-draining material. They are very resilient structures, even across channels (note minor damage to wall at left that is periodically overtopped).

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- Steel bin walls are designed using the same basis as crib walls and are generally conservative. This steel bin wall failed because it was designed for active soil pressures, not the landslide feature that lay above the wall.

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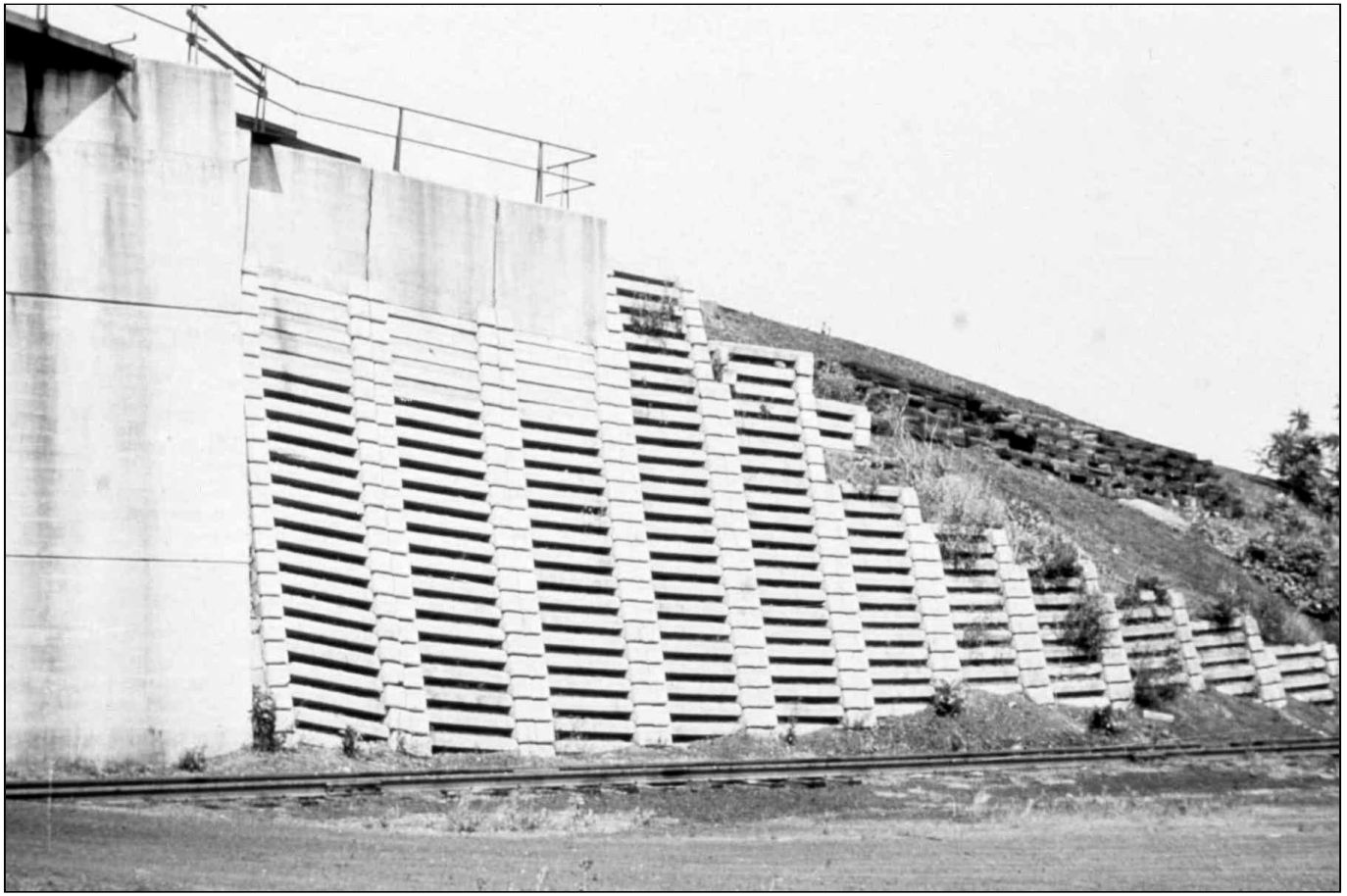

- This crib wall failure was caused by **differential settlement** of the approach fill it supported, against the pile-supported bridge at left.

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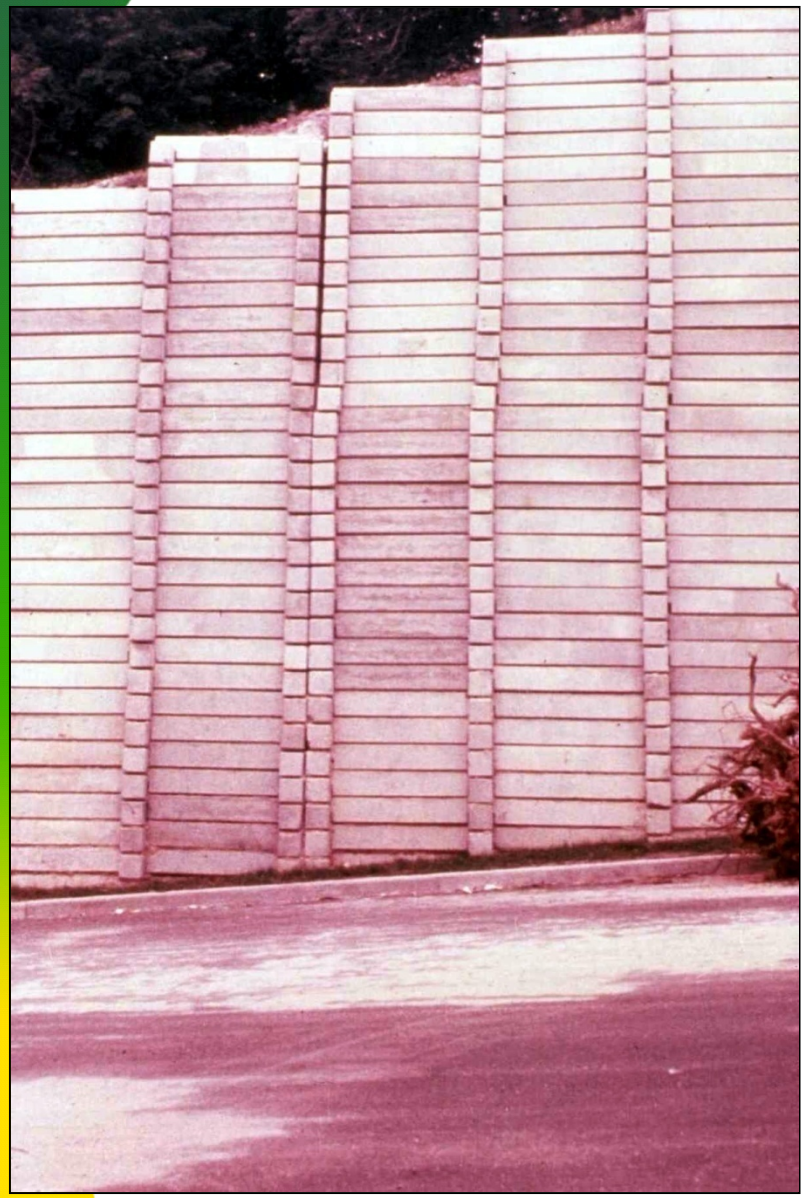

Native soil backfill in crib cells is dangerous for walls > 25 feet high because these materials tend to hydrocompress with absorption of moisture and time, causing severe deflection and cracking, as shown in these photos.

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- One of the most dangerous conditions for retaining walls are the **temporary backcuts** made for such structures, as shown here. Soil materials can lose significant strength through creep, relaxation and soil moisture loss, failing after a few days.

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- Series of stacked crib walls supporting State Highway 24 in Oakland, CA. Stacked walls can be dangerous if placed too close to one another.

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