armtec

A division of
WGI Westman Group Inc.

BinWall

Bin-type steel retaining walls.

For over 80 years, BinWall has provided an economical soil retention solution for projects across Canada and around the world

Armtec BinWall is a versatile system of site-assembled adjoining closed-face steel bins that when backfilled, transform into a gravity-type retaining wall. BinWall's sturdy but lightweight components allow easy handling and quick assembly, making it an ideal choice for difficult installation conditions.

Suitable for side or lateral slopes, curves and elevation changes, its standard factory components can be used to construct walls up to 10 metres in height and custom configurations. Even after years of usage at one location BinWall can be reused at another site, extending its service life for years to come.

TYPICAL APPLICATIONS

- Slope retention
- Highway or railway right-of-way enlargement
- Docks and piers at freshwater marinas
- Solid waste transfer units
- Blast walls (military applications)
- Industrial and commercial developments
- Wing walls and bridge abutments

VERSATILE

- Its modular design is suitable for a wide variety of applications and configurations

DURABLE

- Withstands temperature variations and accommodates minor ground movement

EASY INSTALLATION

- Installed without expensive lifting equipment and with minimal excavation

ECONOMICAL

- Lightweight, nested components allow for economical shipping over long distances

WOOD FACING ENHANCES THE NATURAL APPEARANCE OF THIS BINWALL BRIDGE ABUTMENT

In order to meet increasing power demands at its processing plant, Suncor Energy commissioned the Trans-Alta Energy Substation electrical protection project. Two Armtec BinWalls, spanning approximately 110m by 8m in height, were successfully used for soil retention of the substation pad. BinWall's fast assembly and installation resulted in overall cost savings for the customer.

BINWALL'S LIGHTWEIGHT AND MODULAR ASSEMBLY MAKES IT THE PERFECT BRIDGE ABUTMENT SOLUTION FOR REMOTE LOCATIONS

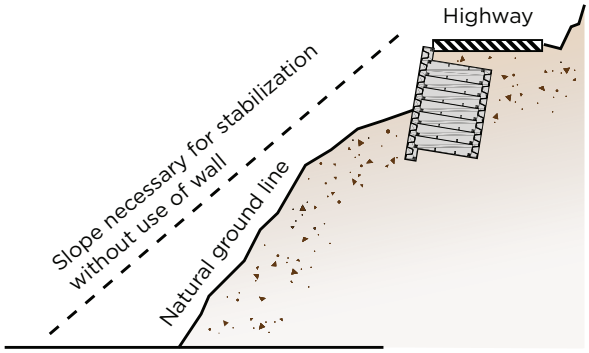
THIS TWO-TIER BINWALL ASSEMBLY FOR AN ACCESS ROAD ACCOMODATES A CURVE AND REACHES A HEIGHT OF 10.77m

Who says BinWall has to be straight? Armtec designers developed a custom curved convex wall solution for Route 341 in L'Épiphanie, Quebec for owner MTQ and contractor Entreprises Genereux. This BinWall supported the road super-structure and spanned 41m in length by 3.35m in height.

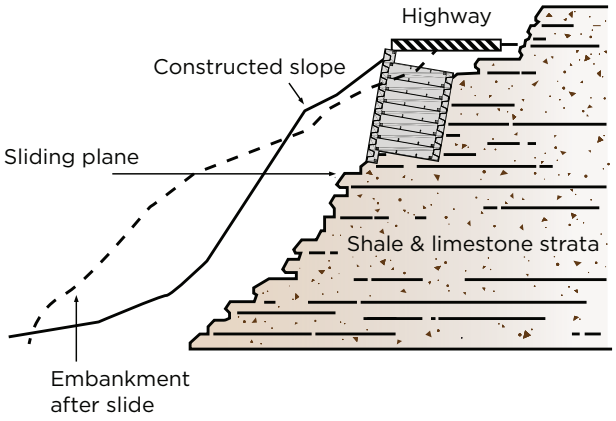
WASTE TRANSFER STATIONS ARE EASILY ASSEMBLED USING BINWALL

Typical BinWall Applications

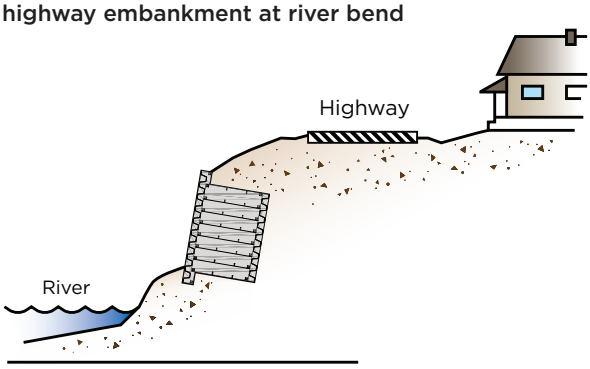
Eliminating excessive fills with the use of walls



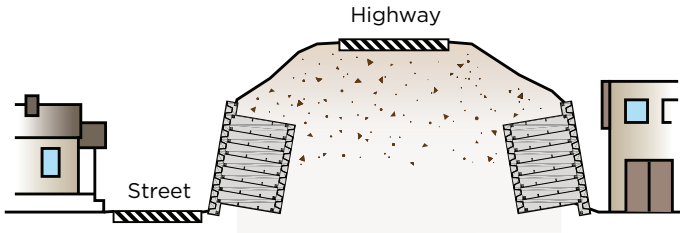
Repairing break in roadway after slide



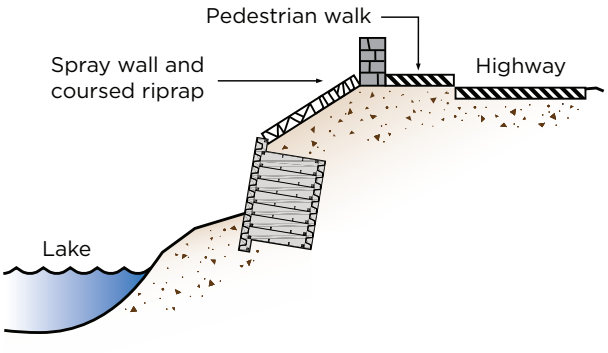
Preventing encroachment on highway embankment at river bend



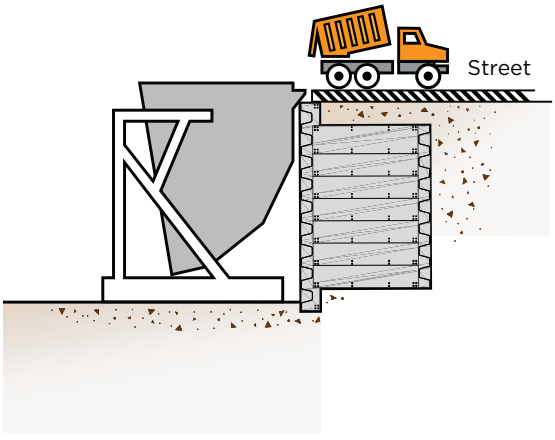
Solving right-of-way problem on grade separation with twin walls



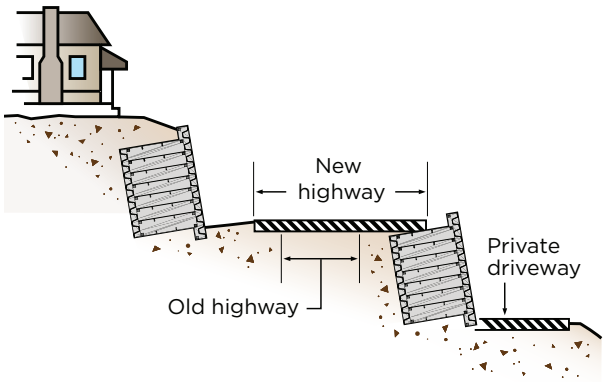
Wave wall to prevent washout of highway during storms



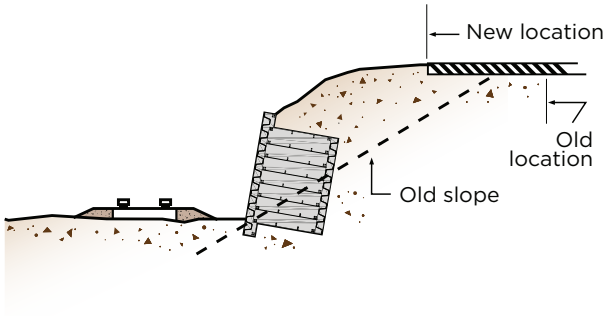
Construction of waste transfer station



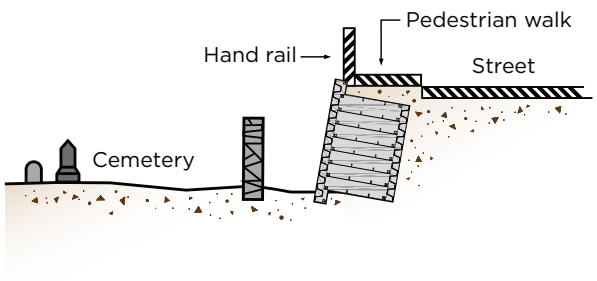
Road widening made possible through the use of walls



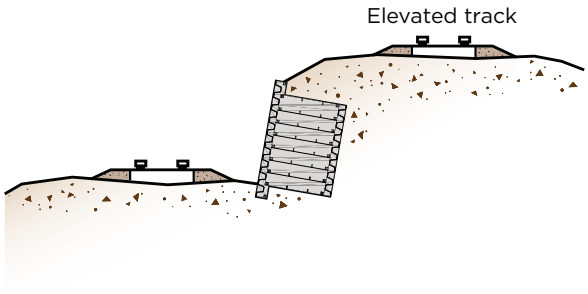
Solving right-of-way problem when highway is relocated



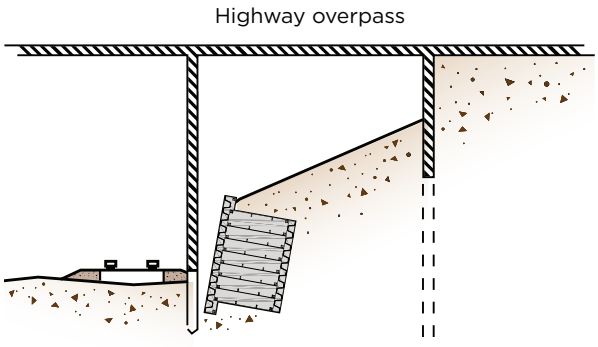
Avoiding encroachment of street fill on adjacent property



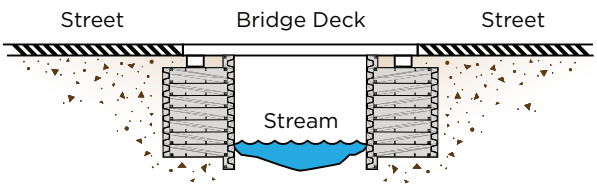
Stabilizing elevated track on adjacent railroad lines



Preventing encroachment of approach fill on railroad



Construction of abutments for short span bridges



DESIGN OF BINWALL GRAVITY RETAINING WALLS

Bin-Type Retaining Walls are a gravity retaining wall system in which an earth mass inside the bins acts as the gravity wall and steel members hold the earth mass intact. Together, these two components combine to resist overturning and sliding forces imposed by the retained soil and other super-imposed loads (i.e. traffic loads). Because of this design, support for the wall is needed under the earth mass. On rigid foundations, a compressible cushion under the grade plates with approximately 200mm of loose fill is provided to allow slight settlement of the vertical corner members. If solid rock or other unyielding soil is within 200mm of the final elevation of grade plates, the rock and/or soil must be removed at grade plate locations for an area of approximately 600mm x 600mm and replaced with a 200mm thick layer of uncompacted fill.

Individual walls should be designed for stability in accordance with established design criteria for gravity walls. While it is no substitute for individual site design, Design Chart A presents long-used gravity wall criteria for depth-to-height ratio under the typical loading conditions displayed in Figure 1. However, they are presented here as suggested guidelines for estimating purposes only.

A critical factor in wall design is the adequacy of the foundation. The resistance of the foundation to overturning and sliding forces acting on the wall requires a sophisticated engineering evaluation. Proper site investigations and analyses should be carried out for any retaining wall.

BATTER BINWALL BETTER ACCOMMODATES MINOR GROUND MOVEMENT

BINWALL'S RUGGED MODULAR LOOK BLENDS WELL WITH ITS ENVIRONMENT

Batter vs. Vertical Design

Batter BinWalls are more stable than vertical BinWalls and should always be considered first. The receding slope of the batter design better accommodates minor ground movements and maintains structural integrity at shorter heights. BinWalls designed with a typical 1 to 6 batter ratio (approx. 9.5° incline angle) will be shorter than vertical wall construction for similar loading conditions.

There are situations however where vertical BinWalls are more suitable and still meet all structural design criteria. Even a deeper vertical wall will sometimes prove economical once land values are considered. For example, a vertical 7m wall will provide 1.2m^2 of valuable land for every metre of wall, as compared to a 1 to 6 batter wall with its toe in the same location.

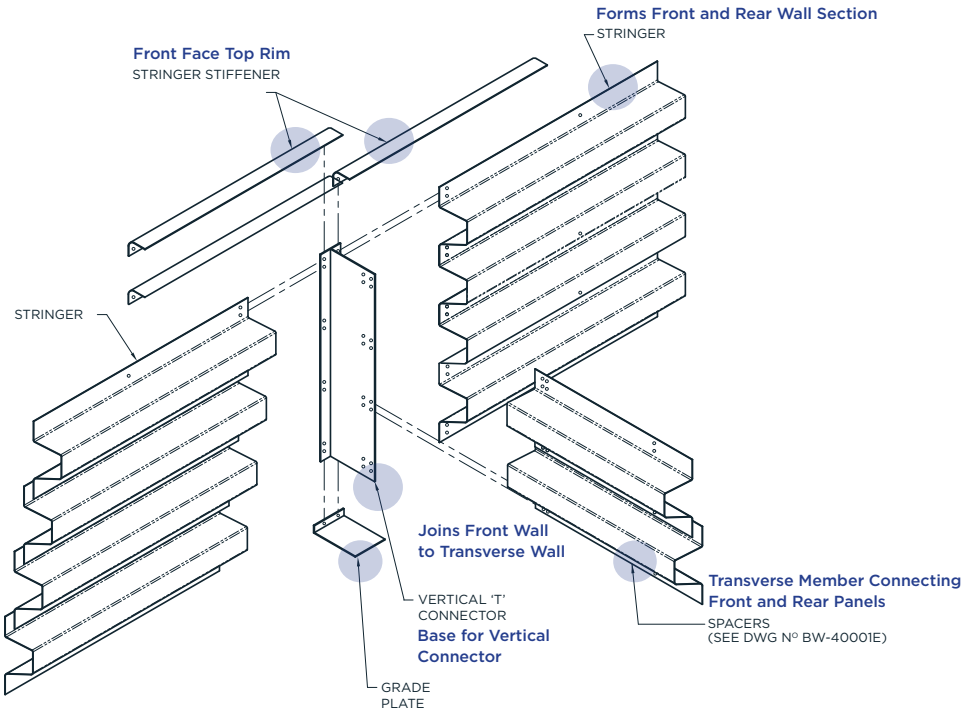
It is also easier to construct a vertical BinWall on a curve. For example, short stringers can be used in adjacent bins without restriction and if the design includes sharp bends, the special plates required are simplified and more economical.

VERTICAL BinWall WITH WOOD FACING

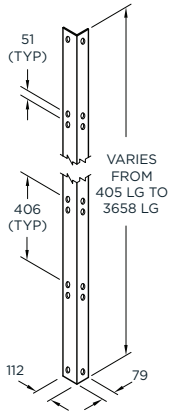
NOTE: ARMTEC BINWALLS ARE FLEXIBLE STRUCTURES THAT WILL ADJUST TO MINOR GROUND MOVEMENTS. TO ALLOW FOR THIS, AS WELL AS NORMAL CONSTRUCTION TOLERANCES, VERTICAL WALLS ARE SOMETIMES INSTALLED ON A SLIGHT BATTER.

BINWALL COMPONENTS

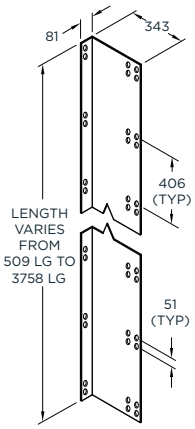
Exploded Isometric



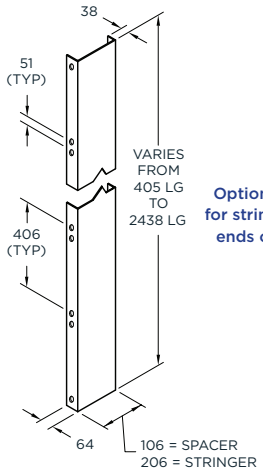
Split Vertical Connector



Corner Vertical Connector

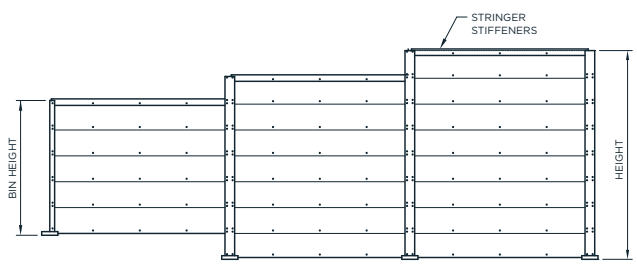


Spacer and Stringer Closure

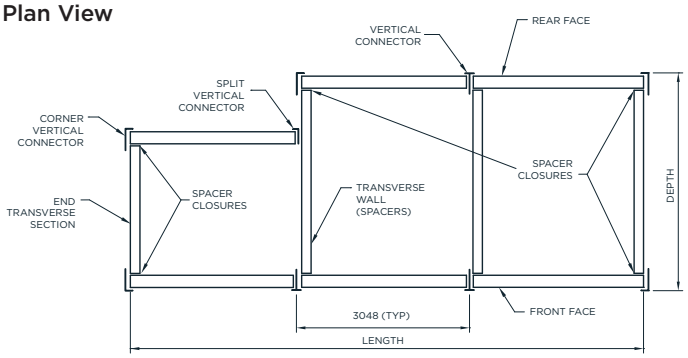


Optional closure piece for stringers / spacers at ends of wall or corner

Elevation (Front Face Wall)



Plan View



Preliminary design of BinWall gravity retaining walls is performed by using the following procedure:

1. Select the loading condition (1 – 6) for the batter or vertical wall design using Figure 1.

2. Using the approximate height of the wall (H) use Chart A to determine the corresponding wall design (depth) for your given loading condition. Wall designs are outlined in Figure 2.

BinWall's unique design allows it to flex against minor, unforeseen ground movements that might damage or destroy rigid walls.

Figure 1: Loading condition (1-6) for batter and vertical wall designs

$$R = \frac{\text{WALL DEPTH}}{\text{WALL HEIGHT}} = \frac{D}{H}$$

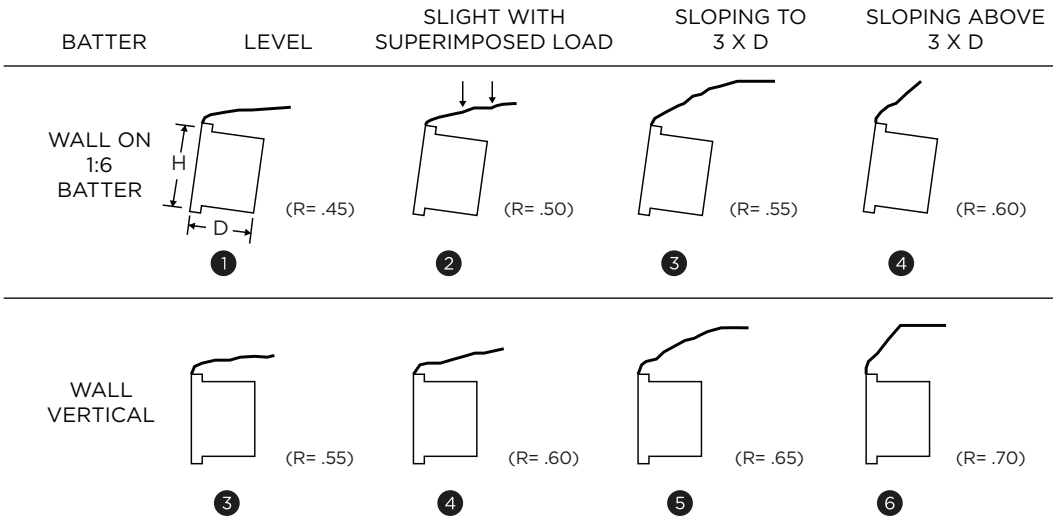
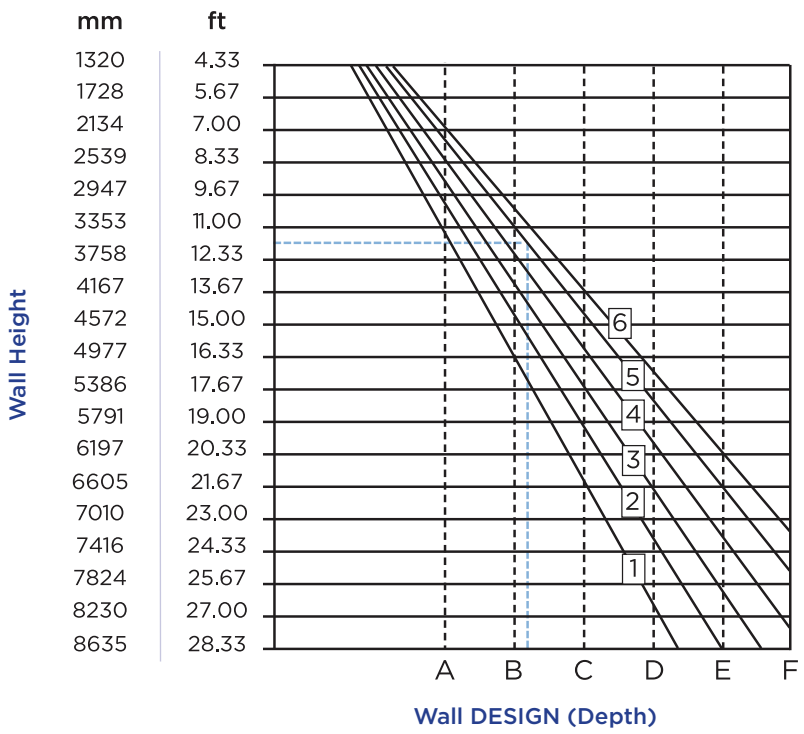


Chart A: Wall height vs. wall design (depth)



For example:

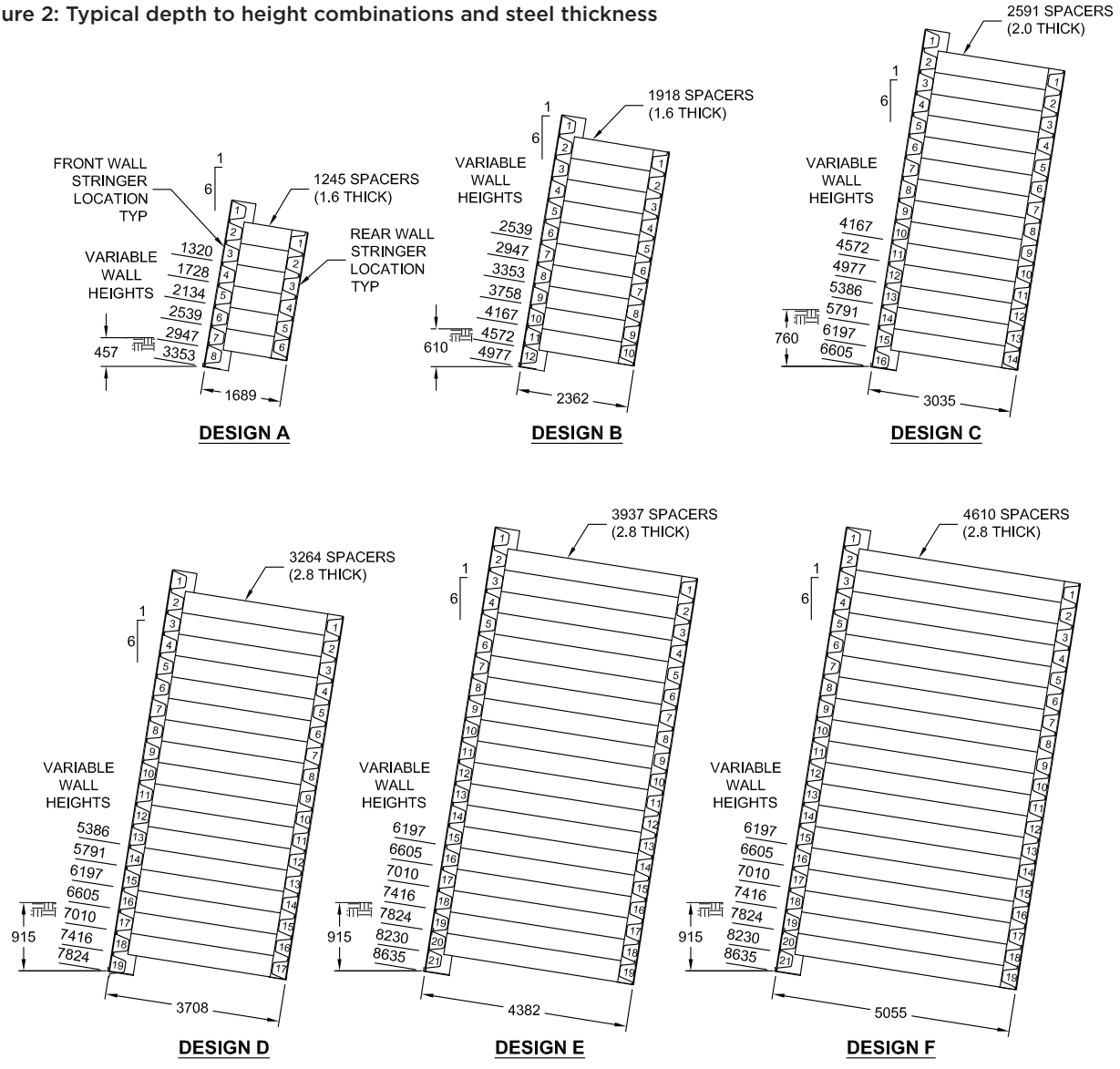
- **Wall height: 3500mm**
- **Loading Condition: 5**
- **Wall Design: C**
- **Actual Height: 3758mm**

TYPICAL DEPTH TO HEIGHT COMBINATIONS AND STEEL THICKNESSES

The diagram below shows the various BinWall design options available. As the wall height increases the spacer length (wall depth) and material thickness (gauge) also increase to maintain structural stability.

Increasing wall heights are achieved by increasing the bin depths - the bigger the embankment the bigger the bin volume needs to be.

Figure 2: Typical depth to height combinations and steel thickness



NOTE: STRINGERS AVAILABLE IN **STANDARD LENGTH (3035mm)** AND **SHORT LENGTH (2959mm)**, SPACER DEPTH RANGE: **1689mm TO 5055mm**

Front Wall Stringer Location	Rear Wall Stringer Location	Minimum Thickness (mm)
1 through 8	1 through 6	1.6
9 through 12	7 through 10	2.0
13 through 19	11 through 17	2.8
20 through 21	18 through 19	3.5

DESIGN AND BUILDING OF BINWALLS ON CURVES AND BENDS

Armtec BinWalls are available with factory made components to fit curved wall alignments and/or bends. Two common assembly techniques are used whenever the wall layout follows a curve, or requires an inside/outside corner.

ASSEMBLY TECHNIQUES

Curved Wall Alignment

BinWalls constructed along a curve follow an arc with a known radius as shown in Figures 3A and 3B. A concave or convex wall curvature is achieved by replacing standard stringers in either the front or rear wall of the bin respectively with short stringers. Varying the ratio of bins containing short stringers to the number of bins with standard length stringers along the length of the arc determines the radius of the curve. Table 1 lists the deflection angle turned for the six BinWall design depths whenever short stringers are located in the front or rear wall face. The minimum radii of curvatures available are also dependent upon the BinWall design depths and wall batter as listed in Table 2. The largest bin depth determines the governing minimum radius for wall layouts containing multiple design depths. Vertical walls are more easily built along a curved alignment and should be considered.

Figure 3A: Concave BinWall on curves

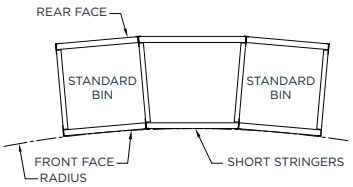
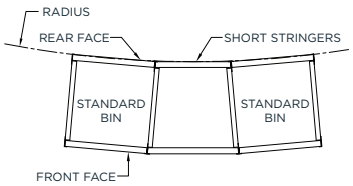


Figure 3B: Convex BinWall on curves



Bends and Corners

Distinct changes to the wall alignment require installing custom cover plates on the front face of the bin wherever the bend or corner is located as shown in Figure 3C. The deflection angle between the diverging alignments can vary up to 90 degrees. Cover plates are typically reinforced with structural members located on the soil side of the plate to maintain a flat surface on the visible wall face.

Figure 3C: Corner detail of BinWall cover plate

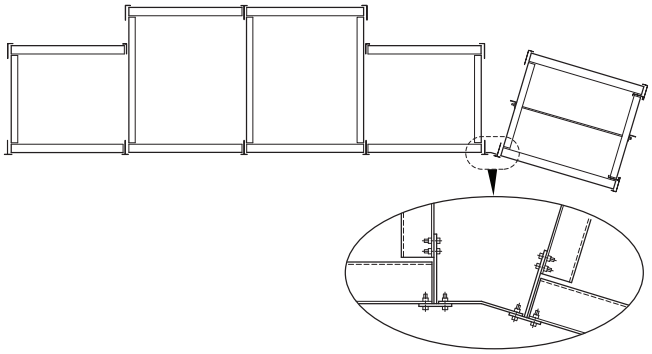


Table 1: Deflection angle turned per BinWall design (depth)

Deflection Angle Turned		
Wall Design	Bin Combination[1] Standard Stringer Bin: Short Stringer Bin	Bin Combination[2] Standard Stringer Bin: Short Stringer Bin
A	1°-18'	2°-36'
B	0°-56'	1°-52'
C	0°-43'	1°-26'
D	0°-36'	1°-12'
E	0°-30'	1°-0'
F	0°-26'	0°-52'

1 Applicable to all walls

2 Applicable to vertical walls only

Table 2: Minimum radii for BinWalls built along a circular curve[a]

	Vertical Wall[c]	1:6 Batter
Wall Design	Minimum Radius (m)	Minimum Radius (m)
A	67	134[b]
B	94	188[b]
C	121	241[b]
D	148	295[b]
E	174	349[b]
F	201	402[b]

[a] The sharpness of the curve is determined by the choice of radius. Large radius curves produce relatively flat alignments. Small radius curves result in relatively sharp alignments. The radius of the wall is measured relative to wall face containing the short stringers.

[b] Maximum wall height limitations apply for listed radii on a 1:6 wall batter. Contact an Armtec Sales Representative for details.

[c] Vertical walls are more easily built on a curve and should be considered

CHOOSING BinWall OVER A CAST-IN-PLACE CONCRETE WALL SAVED THIS PROJECT MORE THAN 30% OVER THE ORIGINAL DESIGN

STRINGERS AND SPACERS SUPPLIED IN ALUMINIZED TYPE 2 FOR ADDED CORROSION PROTECTION

SPECIFICATIONS

This specification covers fabricated steel members, field-assembled into a series of connected closed-face bins for use as bin-type retaining walls. Corrugated components shall be formed from galvanized steel sheet produced in accordance with CSA G401-01. Sheets to be zinc coated by a continuous hot-dip galvanizing process with zinc mass guaranteed not less than 610g/m^2 (Z610) when tested by the triple spot test. Stringers and spacers can also be supplied in Aluminized Type 2 for additional corrosion protection.

The wall shall consist of parts that conform to the dimensions and thicknesses specified on the plans and when assembled shall present a uniform appearance. All parts shall be so fabricated that parts of the same nominal size shall be interchangeable. No drilling, punching or drifting to correct defects in manufacture shall be permitted.

INSTALLATION

Armtec BinWall can be quickly and easily assembled using an unskilled crew. There is no framework to build, no curing delays, no forms to be stripped or extra finishing required for the front wall face material. Individual parts are lightweight, allowing easy handling and positioning with light equipment.

MINIMAL EXCAVATION

It is unnecessary to excavate the complete area to the elevation of the wall base. However, sufficient room must be available to bolt and backfill properly. It is extremely important that the wall be set on the correct elevations to ensure a straight, level front face at the correct batter.

FULLY BOLTED ASSEMBLY

A wrench is the only required tool for erecting a BinWall. Power wrenches and hoisting equipment may also prove useful, particularly on large, high walls. While small walls can be erected in place, it is recommended that larger walls be ground-assembled and sections lifted into place. Sub-assembly on level "saw-horses" adjacent to the site is recommended to facilitate access to either side of the section being pre-assembled.

BACKFILL MATERIAL

Quality structural backfill and proper compaction properties are critical to the ultimate long term performance of the wall. An excellent backfill material is a well-graded, granular material with less than 10% fines passing the #200 mesh (0.075mm) size. Relatively clean pit-run or crusher-run stone is also suitable. If the wall is being used as a dock, pier, breakwater, or in any similar water-contact application, the gradation should be modified to eliminate material smaller than 3mm. Alternatively, bins can be lined with Armtec non-woven geotextile prior to backfilling.

BINWALL ASSEMBLY IS QUICK AND EASY

COMPACTION

Compaction should be a minimum of 95 percent Standard Proctor Dry Density both within the bins and behind the BinWall.

DRAINAGE

The backfill must be free draining in and behind the walls. Perforated pipe, surrounded by non-woven geotextile and porous aggregate, should be placed behind and below the rear base with a positive outlet. The slope above and in front of the wall should be graded to ensure water does not pond or flow through the backfill. The ground under the toe of the wall must not be softened by ponding water as this is the point of maximum load.

BACKFILL PLACEMENT

Fill material should be placed in and behind the bins in maximum 200mm lifts, and thoroughly compacted. Segregation of materials should be avoided and all corrugations should be filled and tamped to eliminate any voids.

BINWALL CAN BE BOLTED TOGETHER ON SITE OR DELIVERED TO THE JOB SITE PREASSEMBLED

BINWALL PROJECT INQUIRY SHEET

Cross Section

Maximum height of wall (A)_____ mm (see Table 4 below for standard BinWall heights)

Wall batter (B): Vertical (Y / N) - If no, provide batter: _____ (Armtec standard batter is 1:6)

Back slope (C): No slope (Y / N) - If no, provide slope: _____

Slope length (if applicable) (D): _____ m

Surcharge loading (E): _____ kPa or Vehicle loading: _____ (e.g. CL-625)

Minimum embedment (F): _____ m

Allowable bearing capacity (G):_____ kPa

Geotechnical report available: Y / N

Water level below base of wall: Y / N

Layout

BinWall length: _____ m (BinWall typically comprised of standard 3.048m lengths)
Custom lengths can be accommodated. **Please contact an Armtec Sales Representative.**

Levelling curbs required: Y / N

Are there inside or outside corners along the wall: Y / N

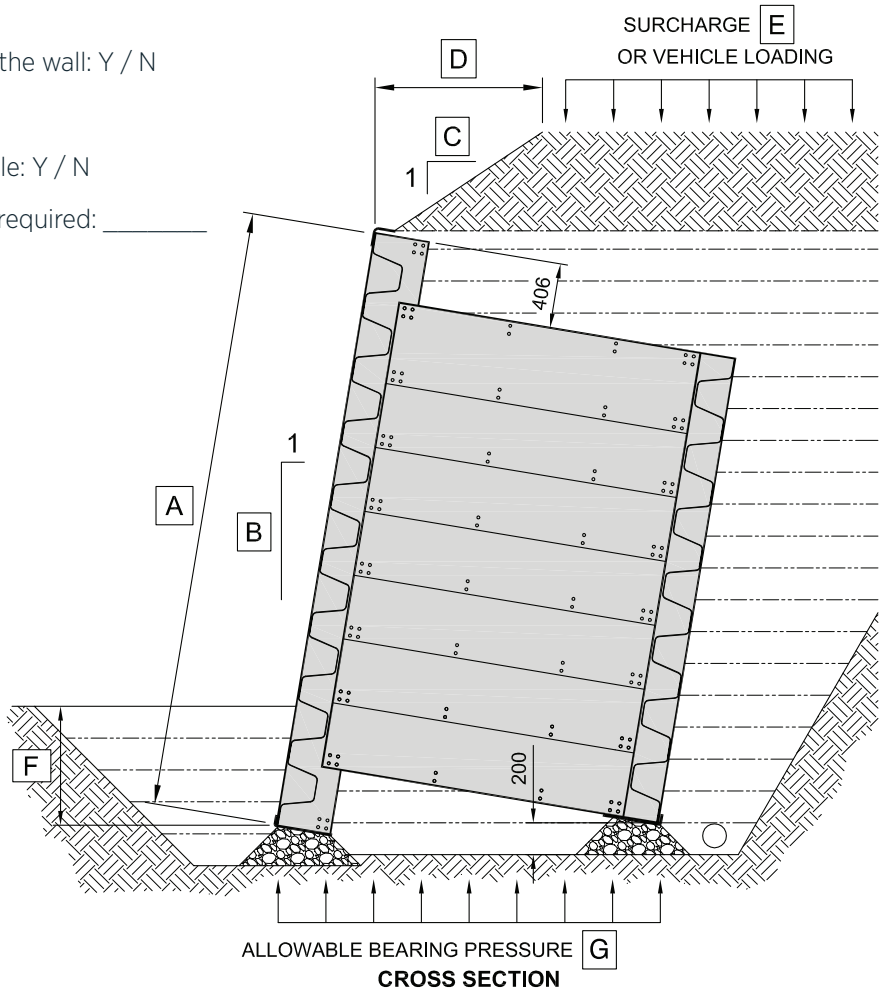
Plan view available: Y / N

Top and bottom of wall elevations available: Y / N

Any additional details or special features required: _____

Table 4: Standard BinWall Heights

No. of Front Stringers	Standard Height of Wall (mm)
3	1320
4	1728
5	2134
6	2539
7	2947
8	3353
9	3758
10	4167
11	4572
12	4977
13	5386
14	5791
15	6197
16	6605
17	7010
18	7416
19	7824
20	8230
21	8635



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by supporting limited paper usage.

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