Structural Calculation Report for a River-Channel Aluminum Alloy Flood Barrier

Type 40 aluminum alloy panels · Retained water height: 2.0 m
Overall calculation span: 2.0 m with a center post

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Calculation organization: Institute of Building Industry,
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Item	Description
Project	Aluminum Alloy Panel Works for a River-Channel Flood Barrier in Thailand
Drawing reference	Thailand River-Channel Type 40, 2 m Aluminum Alloy Panel Flood Barrier (Revision 20260913)
Scope of calculations	Strength and stiffness checks of flood panels, center posts, rear braces and post-base connections
Structural safety class	Class II (γ_0 = 1.0)
Design water level	Retained water height H = 2.0 m (maximum flood-protection height shown in drawing: 2022 mm)
Calculation date	2026-10-18

1 Project Overview

The project is a demountable aluminum alloy flood barrier for a river channel. It can be completely dismantled during normal conditions and erected during the flood season to retain water. The structural system consists of three parts:

(1) Flood panels: Type 40 extruded aluminum alloy panels, with a section 40 mm wide × approximately 222 mm high, 2.0 mm wall thickness and three hollow chambers. EPDM sealing strips are provided between panels and at panel-to-post interfaces. Panels are installed horizontally in successive stacked layers and supported by posts at both ends.

(2) Posts: Aluminum alloy center and side posts, approximately 110 mm × 95 mm, with a 4.0 mm water-facing wall and 3.0 mm side walls. Each post base is secured to the concrete foundation through a T16 aluminum alloy flange plate and two M24 anchor bolts.

English translation of the Chinese source. Section numbering, formulas, values and stated conclusions are retained. Organization names are translated descriptively.

1 Project Overview (continued)

(3) Rear braces: SUS304 stainless steel square hollow sections, SHS 50 × 3.0, spaced horizontally at 750 mm along the wall. The upper ends connect to the wall top at approximately 2.08 m above the base through cast grade 304 top clamping fittings. A second brace is provided at approximately 1.57 m. The lower ends are anchored into the rear concrete foundation using L-shaped cast-in anchor bars.

Design case verified in this report

Parameter	Adopted value
Retained water height H	2.0 m
Calculation span between side posts	2.0 m, with one center post at midspan; post spacing: 1.0 m
Panel support span	1.0 m; an additional panel-strength check is included for a 2.0 m span without a center post
Rear brace spacing	750 mm

2 Basis of Calculations

1) Code for Design of Aluminum Structures, GB 50429-2007.

2) Load Code for the Design of Building Structures, GB 50009-2012.

3) Standard for Design of Steel Structures, GB 50017-2017 (bolted connections and compression-member stability factors).

4) Technical Specification for Stainless Steel Structures, CECS 410:2015 (design strength of stainless steel).

5) Technical Specification for Post-Installed Fastenings in Concrete Structures, JGJ 145-2013 (anchor-bolt anchorage and detailing review).

6) Drawing: Thailand River-Channel Type 40, 2 m Aluminum Alloy Panel Flood Barrier (20260913).

3 Materials and Section Properties

Member / material	Section (mm)	A (mm^2)	I (mm^4)	W (mm^3)	f (N/mm^2)	E (N/mm^2)
Flood panel 6063-T6	40 × 222.3 t = 2.0 (3 chambers)	1906	I_z = 1.119×10^6	W_z = 55 968	90	70 000
Center post 6063-T6	110 × 95; water-facing wall 4.0; side wall 3.0	1372	I_x = 2.667×10^6	W_x = 48 481	200	70 000
Rear brace SUS304 stainless steel	SHS 50 × 3.0	564	2.085×10^5	-	175	193 000

Note 1. Design strengths are adopted in accordance with Table 4.3.4 of GB 50429-2007 (6063-T5: 90 N/mm^2; 6063-T6: 200 N/mm^2) and CECS 410 (SUS304: 175 N/mm^2).

3 Materials and Section Properties (continued)

Note 2. The material designation “6063-T6” in the drawing title block is taken as the customary industry grade 6063-T6. Please check and confirm it against the extrusion material certificate. If the actual material is 6063-T6 (f = 150 N/mm²), the post stress ratio will increase to approximately 0.73 and will still satisfy the requirements.

Note 3. The flood panel bends about the vertical neutral axis (40 mm in the panel-thickness direction). I_z is calculated for the three-chamber section by deducting the hollow areas.

4 Loads and Structural Analysis Models

4.1 Hydrostatic pressure

$$p(z) = \gamma_w \cdot (H - z) = 10 \times (2.0 - z)\ \text{kN/m}^2$$

The pressure has a triangular distribution, with p_{max} = 20 kN/m² at z = 0 at the wall base. Hydrostatic pressure only is considered; waves, vessel wakes and floating-debris impact are excluded. Separate checks are required if these actions are to be included. Hydrostatic pressure is treated as a variable action with a partial factor γ_Q = 1.4. Characteristic values are used for deflection checks.

4.2 Analysis unit

Adopt a post tributary width B = 1.0 m (post spacing 1.0 m). The characteristic line load at the post base is:

$$w_k = p_{max} \times B = 20 \times 1.0 = 20\ \text{kN/m}$$

The line load is triangular, decreasing to zero at the top. The characteristic total water thrust per linear meter of wall is:

$$P_k = \tfrac{1}{2}\gamma H^2 B = 20.0\ \text{kN}$$

Its point of application is H/3 = 0.667 m above the base. The design value is 28.0 kN.

4.3 Structural analysis models

Flood panel: A horizontal continuous beam supported by posts (at least two spans). The envelope is based on simply supported / two-span continuous-beam coefficients.

Center post: A vertical flexural member supported at the base (0 m) and by a rear brace at 1.573 m. The post top at 2.077 m is restrained by the top brace.

Rear brace: A pin-ended member in axial compression. Its inclination is determined from the geometry shown in the drawing.

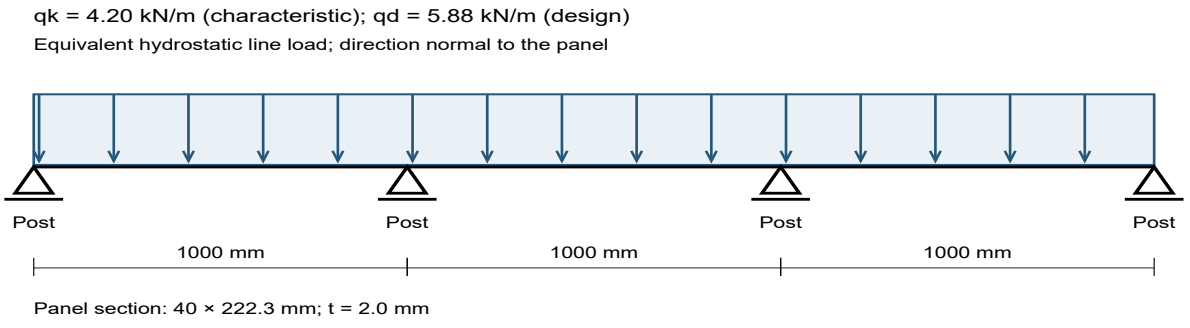


Figure 4-1. Flood-panel analysis model: horizontal continuous beam with 1.0 m post spacing.

Span L = 1.0 m. One center post is provided within the 2000 mm overall bay. The panel is analyzed as a three-span continuous beam; M = qL²/8 is adopted as the conservative simply supported envelope.

4 Structural Analysis Diagrams (continued)

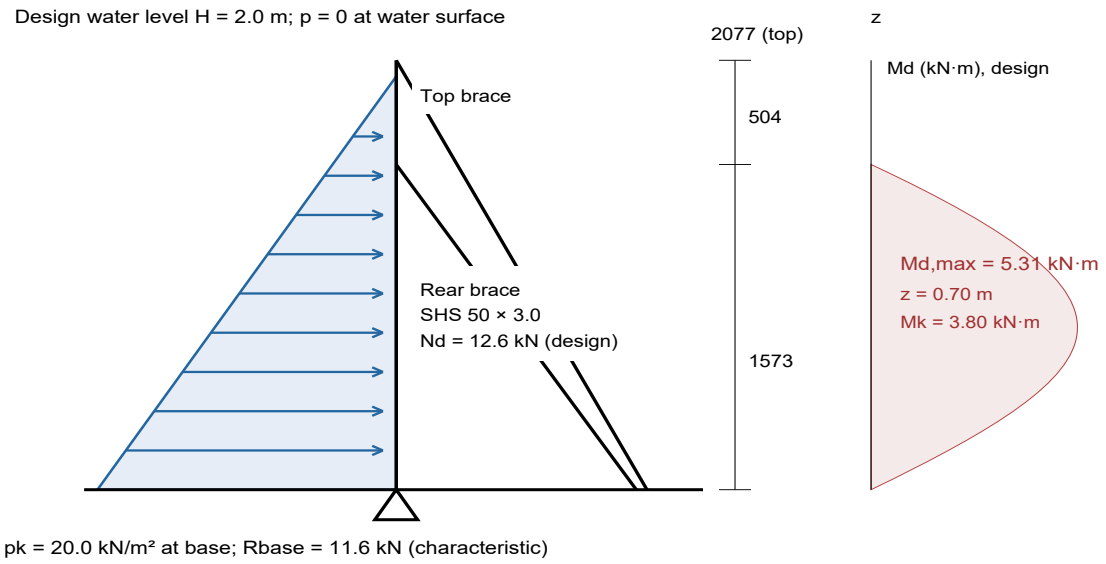


Figure 4-2. Center-post analysis model: loads and supports (left); design bending-moment diagram (right).

Figure note in the source: The post is analyzed as a vertical flexural member, fixed at the base, laterally supported by the rear brace at 1.573 m and restrained by a top brace.

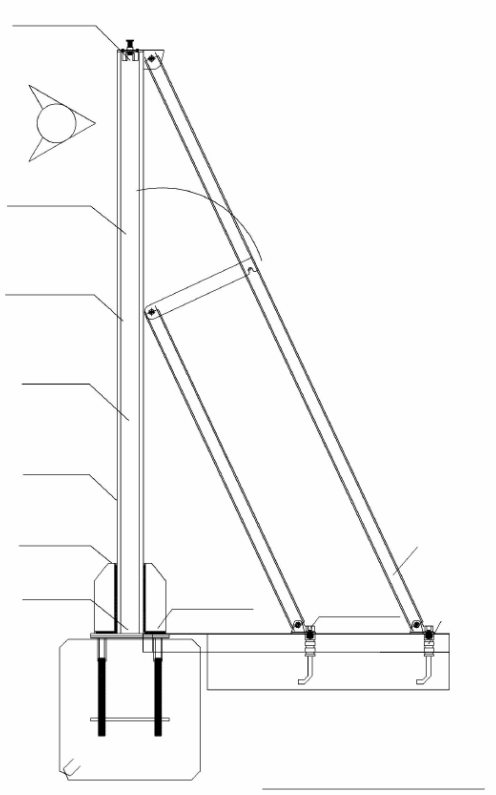


Figure 4-3. Post and rear-brace system (side view of the center post from the drawing).

Post and rear-brace system (side view of the center post from the drawing).

Figure 4-3 is reproduced from the source drawing. Figures 4-1 and 4-2 are re-typeset with English labels. The source figure note describes a fixed base, whereas the calculation text uses a pinned-base assumption; the original wording is retained.

5 Flood-Panel Checks (Type 40, 6063-T6)

5.1 Load

The bottom panel is the most unfavorable. Panel height h_b = 0.2223 m; water depth at the panel center is approximately 1.889 m:

$p_k = 10 \times (2.0 - 0.2223/2) = 18.89$ kN/m²
$q_k = 18.89 \times 0.2223 = 4.20$ kN/m
Design value: $q_d = 1.4 \times 4.20 = 5.88$ kN/m

5.2 Strength (1.0 m support span; simply supported envelope)

$M_d = q_d L^2/8 = 5.88 \times 1.0^2/8 = 0.735$ kN·m
$\sigma = M_d/W_z = 0.735 \times 10^6/55\,968 = 13.1$ N/mm² < f = 90 N/mm²

Stress ratio σ/f = 0.15. Satisfactory.

Supplementary check: 2.0 m panel span without a center post. M_d = 2.94 kN·m; σ = 52.5 N/mm²; σ/f = 0.58 < 1.0. Strength is also satisfactory.

5.3 Deflection (characteristic values)

$v = 5q_k L^4/(384EI_z)$
$= 5 \times 4.20 \times 1000^4/(384 \times 70\,000 \times 1.119 \times 10^6)$
$= 0.70$ mm ≤ [v] = L/200 = 5.0 mm

Ratio: 0.14. Satisfactory. For a 2.0 m panel span, the simply supported envelope deflection is 11.2 mm = L/179; for the actual continuous multi-span condition, it is approximately 5.7 mm = L/350. The source states that neither governs the design.

6 Center-Post Checks (110 × 95, 6063-T6)

6.1 Reactions and internal forces (characteristic; B = 1.0 m)

The calculation span extends from the post base to the lower rear brace at 1.573 m, under a triangularly decreasing load:

Total span load W_1	Base reaction R_{base}	Lower-brace reaction R_{mid}	Maximum moment M_k
19.09 kN	11.61 kN	7.48 kN	3.80 kN·m (at z ≈ 0.70 m)

6.2 Strength

$M_d = 1.4 \times 3.80 = 5.31$ kN·m
$\sigma = M_d/W_x = 5.31 \times 10^6/48\,481 = 109.6$ N/mm² < f = 200 N/mm²

Stress ratio σ/f = 0.55. Satisfactory.

The calculation conservatively assumes a pinned post base and includes only one intermediate rear brace. In practice, the base flange (2 × M24 + T16 plate) provides partial fixity, an additional top brace is installed at 2.077 m, and rear braces at 750 mm spacing act together along the wall. These provide additional strength reserve.

6 Center-Post Checks (continued)

6.3 Deflection

For the calculation span L = 1573 mm, integration of the bending-moment diagram under a triangularly decreasing load gives $v_{max} \approx 5.2$ mm < [v] = L/250 = 6.3 mm. Ratio: 0.82. **Satisfactory.** The stacked panels and sealing strips provide lateral restraint on both sides of the post; overall stability does not govern.

6.4 Shear

$V_d = 1.4 \times 11.61 = 16.3$ kN
$\tau \approx 3V_d/(2A) = 3 \times 16.3 \times 10^3/(2 \times 1372)$
$= 17.8$ N/mm² < $f_v = 115$ N/mm². Satisfactory.

A side post has half the tributary width of a center post and the same detailing. Its loading is no greater than that of the center post, so a separate check is not repeated.

7 Rear-Brace Checks (SHS 50 × 3.0, S304)

$A = 564$ mm²; $i = \sqrt{(I/A)} = 19.2$ mm

7.1 Lower brace

Connection height: 1.573 m; horizontal projection: 1043 mm; member length: 1887 mm; inclination: 56.5°.

$N_d = 1.4 \times R_{mid}/\sin 56.5° = 1.4 \times 7.48/0.833 = 12.6$ kN
$\lambda = 1887/19.2 = 98.2$; equivalent slenderness ratio = 91.7
Buckling curve b: $\varphi = 0.621$
$\sigma = N_d/(\varphi A) = 12.6 \times 10^3/(0.621 \times 564)$
$= 35.9$ N/mm² < $f = 175$ N/mm²

Stress ratio: 0.21. Satisfactory.

7.2 Upper brace

Connection at the post top: 2.077 m; horizontal projection: 1016 mm; member length: 2312 mm; inclination: 63.9°.

The load on the wall portion above 1.573 m is only 0.9 kN (characteristic). Adopt an envelope value of 2.0 kN:

$N_d = 1.4 \times 2.0/\sin 63.9° = 3.1$ kN
$\lambda = 120.3$; $\varphi = 0.516$
$\sigma = 10.7$ N/mm² < 175 N/mm²

Stress ratio: 0.06. Satisfactory.

7.3 Top braces between posts

Spacing: 750 mm; connected through top clamping fittings.

$N_d = 1.4 \times (0.75 \times 20 \times 2.0/10)/\sin 63.9° = 4.7$ kN
$\sigma = 16.1$ N/mm²; stress ratio: 0.09. Satisfactory.

7 Rear-Brace Checks (continued)

7.4 Joint connections

Pin connections using M16 bolts (or concealed M12 grade 304 stainless steel bolts) are provided at both ends of each brace. The shear resistance of a single bolt is much greater than 12.6 kN and is satisfactory. At the lower end, L-shaped cast-in anchor bars are embedded in the concrete foundation. Pull-out and shear resistance shall be ensured by the concrete foundation design, with a detailing review under JGJ 145-2013.

8 Post-Base Connection Checks

Post-base connection: T16 aluminum alloy flange plate (280 × 160) plus two M24 anchor bolts (property class 8.8).

Shear per bolt: $V = 16.3/2 = 8.1$ kN
8.1 kN < single-bolt shear resistance ≈ 113 kN
($f_v^b = 320$ N/mm²; $A_s = 353$ mm²)

Stress ratio: 0.07. Satisfactory. Local foundation bearing and anchor-bolt pull-out resistance shall be satisfied by the concrete foundation design, incorporating L-shaped cast-in bars or chemical anchors.

9 Overall Stability

The design total water thrust is 28.0 kN per linear meter of wall. It is resisted jointly by the horizontal components of the rear braces at 750 mm spacing, shear at the post bases and friction at the foundation base, providing a clear load path.

The overturning moment behind the wall is balanced by the vertical components of the rear braces and the self-weight of the rear concrete foundation. Resistance to overturning about the wall toe and pull-out resistance of the brace anchor bars shall be reviewed together with the site-specific concrete foundation design.

Under normal conditions without retained water, structural self-weight is much smaller than the available resistance and does not govern.

10 Summary of Checks and Conclusions

Check	Member	Design value	Limit / resistance	Ratio	Result
Bending strength	Flood panel (1.0 m span)	σ = 13.1 N/mm²	f = 90 N/mm²	0.15	Pass
Deflection	Flood panel (1.0 m span)	0.70 mm	L/200 = 5.0 mm	0.14	Pass
Bending strength	Center post	σ = 109.6 N/mm²	f = 200 N/mm²	0.55	Pass
Deflection	Center post	5.2 mm	L/250 = 6.3 mm	0.82	Pass
Shear stress	Center post	17.8 N/mm²	f_v = 115 N/mm²	0.15	Pass
Axial compression stability	Lower rear brace	σ = 35.9 N/mm²	f = 175 N/mm²	0.21	Pass
Axial compression stability	Upper rear brace / inter-post top brace	σ = 10.7 / 16.1 N/mm²	f = 175 N/mm²	0.06 / 0.09	Pass
Shear resistance	M24 post-base anchor bolt	8.1 kN per bolt	Approx. 113 kN per bolt	0.07	Pass

Conclusion

For a retained water height of **2.0 m**, an overall calculation span of **2.0 m** with **one center post at midspan and 1.0 m post spacing**, and **rear brace spacing of 750 mm**, all strength, stiffness and stability checks for the Type 40 aluminum alloy flood panels, center posts, rear braces and post-base connections satisfy GB 50429-2007, GB 50009-2012 and the other referenced standards. The structural performance is satisfactory, and fabrication and installation may proceed in accordance with the drawing specifications.

The conclusion above is translated from the source report.

Calculation Assumptions and Notes

1. The calculations consider hydrostatic pressure only. Waves, vessel wakes and floating-debris impact are not included. If such actions occur, separate checks are required.

2. The post base is assumed pinned and only one intermediate rear brace is included in the calculations. Additional resistance provided by the actual detailing is treated as a safety reserve.

3. Material properties are adopted from the drawings with reference to customary industry grades: 6063-T6 flood panels, 6063-T6 posts and SUS304 rear braces. Verify the extrusion materials before construction.

4. The site foundation design documents shall ensure the required concrete strength class, anchor-bar embedment depth and foundation ballast / counterweight.

5. Rear-brace geometry (inclination and member length) is based on the dimensions indicated in the drawing: height 2077 / horizontal projection 1016, and height 1573 / horizontal projection 1043.

Calculated by:	Checked by:
Date: October 18, 2026	Date: October 19, 2026

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Translation notes

This is an English translation of the nine-page Chinese document titled “Structural Calculation Report for a River-Channel Aluminum Alloy Flood Barrier”. All sections, tables, formulas, numerical results, assumptions and stated conclusions have been translated. The document has been re-typeset, so page breaks differ from those in the source.

Material designations, strength values, formulas and support descriptions are reproduced as stated, including apparent internal inconsistencies in the source. In particular, Note 2 retains the source reference to 6063-T6 with f = 150 N/mm², and the Figure 4-2 note retains “fixed at the base” although the calculation text assumes a pinned base. No recalculation or technical correction is incorporated into this translation.

The English organization names are descriptive translations, not independently verified registered English names.