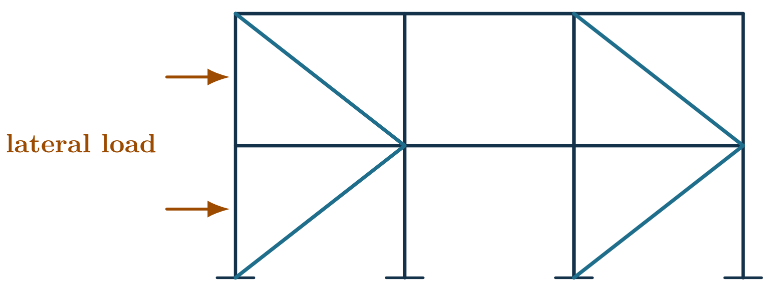
Structural Load Calculation and Analysis Report

Two-Storey Steel Office Building

Project	Demonstration Project — Independent Calculation Example
Document number	SLR-001
Revision	0 — Initial issue
Issue date	2 August 2026
Design stage	Illustrative / preliminary design
Units	SI units unless noted otherwise



Role	Name / designation	Status	Date
Prepared by	Structural Engineering Calculation Note	Issued	2 Aug 2026
Checked by	Independent check required before project use	Open	—
Approved by	Licensed engineer of record	Open	—

IMPORTANT: This is a worked engineering example based on assumed inputs. It is not a sealed design, does not describe a real site, and shall not be used for permitting, procurement, fabrication, or construction.

Document Control

Revision history

Rev.	Date	Description	Status
0	2 Aug 2026	Initial calculation issue; all geometry, hazards, and material data are explicitly assumed.	Illustrative

Purpose and permitted use

This report demonstrates a transparent workflow for determining gravity and lateral loads, distributing those loads through a regular steel frame, and completing representative member and footing checks. The calculations are suitable for method review and template development only.

Before the method is used on a real project, a licensed structural engineer shall replace every assumed input with verified project information, obtain site-specific wind, snow, rain, seismic and geotechnical parameters, coordinate the adopted code edition with the authority having jurisdiction (AHJ), analyse the complete three-dimensional structure, design all members and connections, and independently check the final construction documents.

Calculation status key

Status	Meaning
PASS	Demand does not exceed the stated resistance or serviceability limit for the calculation shown.
OPEN	Information, coordination, or a design check remains necessary before project use.
N/A	The action is screened out only for this illustrative example; the decision must be revisited for an actual site.

Contents

1 Executive Summary

The illustrative structure is a regular, two-storey steel office building measuring 18 m by 12 m, with a roof height of 7.2 m. Composite floor construction bears on secondary steel beams, which frame into girders and columns. Braced bays resist lateral action. The numerical example uses ASCE/SEI 7-22 load concepts, ANSI/AISC 360-22 steel resistance concepts, and ACI 318-19(22) concrete resistance concepts. Local adoption and project-specific amendments are outside this example.

The governing illustrative results are summarized below.

Table 1: Summary of representative results

Check	Demand	Capacity / limit	Result
Typical floor beam B1, flexure	122.6 kN m	286.0 kN m	**PASS**
Typical floor beam B1, total-load deflection	12.1 mm	25.0 mm	**PASS**
Interior girder G1, flexure	245.2 kN m	540 kN m	**PASS**
Interior column C1, beam-column interaction	0.50	1.00	**PASS**
Brace BR1, compression	245 kN	465 kN	**PASS**
Maximum illustrative storey drift ratio	0.0058	0.0200	**PASS**
Footing F1, service bearing pressure	151 kPa	180 kPa	**PASS**

Seismic base shear governs the illustrative global lateral force comparison: 288 kN versus 136 kN wind in the more highly loaded direction. The selected trial members pass only the checks explicitly shown. Connection design, diaphragm design, robustness, fire resistance, vibration, facade support, construction-stage stability, and full foundation settlement remain open.

2 Basis of Design

2.1 Reference standards

The following editions form the stated basis of this worked example. They are not a substitute for the adopted building code or amendments applicable to a real site.

Reference	Application in this report
ASCE/SEI 7-22	Minimum design loads, load combinations, and conceptual wind and seismic procedures. Hazard values themselves are assumed, not obtained from the ASCE Hazard Tool.
ANSI/AISC 360-22	LRFD resistance and stability concepts for structural steel members.
ANSI/AISC 341-22	Seismic detailing is identified as a required project-stage check; it is not completed in this example.
ACI 318-19 (reapproved 2022)	Strength concepts for the preliminary reinforced concrete footing checks.
IBC 2024	Administrative context only; the AHJ must confirm the adopted edition and amendments.

2.2 Design philosophy

Strength checks use load and resistance factor design (LRFD), written generally as

$$U = \sum_i \gamma_i Q_i \leq \phi R_n, \tag{1}$$

where Q_i is a nominal action, γ_i is its load factor, R_n is nominal resistance, and ϕ is the applicable resistance factor. Serviceability checks use unfactored actions. Stability effects are represented by a second-order analysis amplification stated in Section 3.3.

2.3 Units, signs, and rounding

Forces are reported in kN, line loads in kN/m, area loads in kPa, moments in kN m, stresses in MPa, and dimensions in mm or m. Downward gravity load is positive in gravity calculations. Lateral actions may act in either sign. Displayed values are rounded; checks use unrounded intermediate values where practical.

2.4 Reliability and importance

The example assumes Risk Category II and importance factor $I_e = 1.0$. No essential facility, hazardous occupancy, special inspection, disproportionate-collapse, or enhanced resilience requirement is assumed. These classifications are project and jurisdiction dependent.

3 Structure and Analysis Model

3.1 Geometry and framing

Table 3: Assumed building geometry

Parameter	**Assumed value**
Plan dimensions	18 m × 12 m
Primary grid	Three 6 m bays in X; two 6 m bays in Y
Occupied levels	Ground and Level 1; roof above Level 1
Storey height / total height	3.6 m / 7.2 m
Secondary beam spacing	3.0 m
Typical beam and girder span	6.0 m
Lateral system	Steel braced bays in each principal direction
Floor diaphragm	Composite slab idealized as rigid in plane
Foundations	Isolated reinforced-concrete spread footings

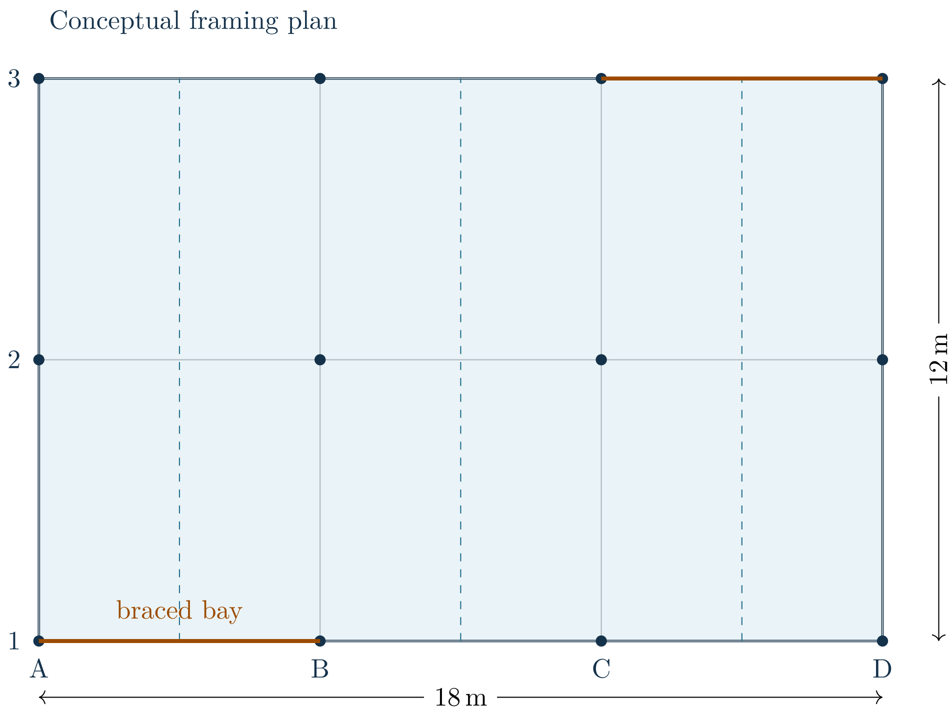


Figure 1: Assumed plan grid; dashed lines indicate secondary beam lines.

3.2 Load path

Floor and roof pressure loads act on the slab/deck and pass to secondary beams, then to girders, columns, footings, and supporting soil. Facade wind passes to the floor and roof diaphragms, which distribute it to vertical braced bays. Brace forces pass through columns and base connections to the foundations. Every real-project design must demonstrate continuity at deck fasteners, collectors, connections, base plates, anchors, footings, and soil.

3.3 Analysis assumptions

The representative gravity members are checked as simply supported. The global lateral model idealizes rigid diaphragms, pinned beam-to-column gravity connections, and concentric bracing. Nominal member stiffness is used. A notional second-order review gives an illustrative amplification $B_2 = 1.04$; reported lateral member demands include this amplification. Accidental torsion is included conceptually in the reported brace demand but is not reconstructed as a full three-dimensional analysis here.

These assumptions are acceptable only for the worked example. A project model must include actual stiffness, offsets, releases, diaphragm flexibility where applicable, cracked concrete stiffness, P–Δ and P–δ effects, foundation restraint, and construction sequence where significant.

4 Materials and Trial Sections

Section properties below are adopted calculation inputs and shall be checked against the certified supplier table for the actual country and product series.

5 Gravity Loads

Table 4: Material properties used in calculation

Material	Property	Value
Structural steel	Yield stress, F_y	355 MPa
Structural steel	Elastic modulus, E	200,000 MPa
Reinforcing steel	Yield stress, f_y	420 MPa
Concrete	Specified strength, f'_c	30 MPa
Normal-weight concrete	Unit weight, γ_c	24 kN/m^3
Soil	Allowable service bearing, q_a	180 kPa

Table 5: Trial member properties

ID	Trial section	Use / property	Value	Units
B1	W360×51	I_x; Z_x	141; 0.895	10^6 mm^4; 10^6 mm^3
G1	W460×74	I_x; Z_x	332; 1.69	10^6 mm^4; 10^6 mm^3
C1	W310×60	A_g; r_y	7,640; 51	mm^2; mm
BR1	HSS152×152×8	A_g; $r_{\min}$	4,420; 58	mm^2; mm

5.1 Dead-load take-off

Dead loads include permanent construction and an allowance for fixed services. The steel framing allowance is included in the area load take-off for column and seismic weight calculations; explicit beam self-weight is used in the representative beam line-load calculation.

Table 6: Typical occupied floor dead load

Component	Load (kPa)
Normal-weight concrete slab on metal deck	3.00
Ceiling and building services	0.35
Raised floor / finishes	0.40
Movable partition allowance treated as dead load	0.35
Structural steel framing allowance	0.15
Total floor dead load, D_f	**4.25**

The facade is assumed to weigh 0.75 kPa of wall area. Parapets and localized plant loads are represented by the roof seismic-weight allowance in Section 6.2; they require explicit placement in a project model.

5.2 Imposed, roof, snow, and rain loads

Concentrated loads, storage, corridors, stairs, assembly areas, movable equipment, solar arrays, suspended services, facade maintenance systems, and construction loads are not included. In a real building they can govern even when the uniform loads do not.

Table 7: Typical roof dead load

Component	Load (kPa)
Metal deck and concrete / cover system	0.55
Roofing, insulation, and membrane	0.20
Ceiling, services, and suspended allowance	0.25
Structural steel framing allowance	0.15
Total roof dead load, D_r	**1.15**

Table 8: Assumed variable gravity actions

Action	Nominal load (kPa)	**Comment**
Office floor live load, L	2.40	No live-load reduction used in the beam check.
Roof live load, L_r	0.96	Unreduced screening value.
Balanced flat-roof snow, S	0.75	Assumed site result; drift and sliding are open.
Rain / ponding, R	0.30	Screening value; roof drainage design is open.

5.3 Representative line loads

For the typical secondary beam, tributary width $b_t = 3.0\,\text{m}$ and an explicit steel self-weight of $0.35\,\text{kN/m}$ give

$$w_D = D_f b_t + w_{sw} = 4.25(3.0) + 0.35 = 13.10\,\text{kN/m}, \tag{2}$$

$$w_L = L b_t = 2.40(3.0) = 7.20\,\text{kN/m}. \tag{3}$$

For the typical interior girder, an equivalent tributary width of $6.0\,\text{m}$ is used for preliminary design:

$$w_{D,G} = 4.25(6.0) + 0.70 = 26.20\,\text{kN/m}, \tag{4}$$

$$w_{L,G} = 2.40(6.0) = 14.40\,\text{kN/m}. \tag{5}$$

Actual girder design shall use the point reactions and pattern loading from framing beams.

6 Environmental Loads

6.1 Wind action

The wind calculation is intentionally a screening-level MWFRS calculation. The assumed basic wind speed is $V = 45\,\text{m/s}$, with $K_z = 0.85$ at the roof, directionality factor $K_d = 0.85$, topographic factor $K_{zt} = 1.0$, and air density coefficient 0.613. Thus,

$$q_z = 0.613 K_z K_{zt} K_d V^2 = 0.613(0.85)(1.0)(0.85)(45)^2 = 0.90\,\text{kPa}. \tag{6}$$

After applying assumed external and internal pressure effects, the adopted net design pressure is $1.05\,\text{kPa}$. Applied to the two projected elevations,

$$W_X = 1.05(12)(7.2) = 90.7\,\text{kN}, \tag{7}$$

$$W_Y = 1.05(18)(7.2) = 136.1\,\text{kN}. \tag{8}$$

Table 9: Illustrative wind force distribution in the governing Y direction

Level	h_x (m)	F_x (kN)	V_x (kN)	M_x (kN m)
Roof	7.2	68.1	68.1	490
Level 1	3.6	68.0	136.1	245
Base	0.0	—	136.1	735

The equal diaphragm split is a simplifying assumption. Component-and-cladding pressures, corner zones, parapets, rooftop equipment, openings, torsion, wind drift, and cladding deflection require separate project checks.

6.2 Seismic action

The example assumes $S_{DS} = 0.50g$, response modification coefficient $R = 3.0$, importance factor $I_e = 1.0$, and the lower-bound preliminary coefficient

$$C_s = \frac{S_{DS}}{R/I_e} = \frac{0.50}{3.0} = 0.167. \tag{9}$$

The assumed effective seismic weights are assembled as follows:

$$w_1 = (4.25)(216) + \text{facade/framing allowance} + 0.25(2.40)(216) = 1{,}298\,\text{kN}, \tag{10}$$
$$w_r = (1.15)(216) + \text{parapet/plant allowance} + 0.20S(216) = 430\,\text{kN}, \tag{11}$$
$$W = w_1 + w_r = 1{,}728\,\text{kN}. \tag{12}$$

The equivalent base shear is therefore

$$V = C_s W = 0.167(1728) = 288\,\text{kN}. \tag{13}$$

For the short-period illustrative structure, $k = 1.0$ is assumed and

$$F_x = V \frac{w_x h_x^k}{\sum_i w_i h_i^k}. \tag{14}$$

Table 10: Equivalent lateral force distribution

Level	h_x (m)	w_x (kN)	F_x (kN)	Storey shear (kN)
Roof	7.2	430	114.8	114.8
Level 1	3.6	1,298	173.2	288.0
Total	—	1,728	288.0	—

The corresponding base overturning moment is

$$M_o = 114.8(7.2) + 173.2(3.6) = 1{,}450\,\text{kN m}. \tag{15}$$

This is not a site seismic study. Site class, mapped spectral ordinates, multi-period spectra, period limits, redundancy, accidental torsion, orthogonal effects, vertical seismic effect, diaphragm forces, collector forces, anchorage, overturning, and system-specific detailing must be established for the actual site.

6.3 Hazard screening

Flood, tsunami, tornado, atmospheric ice, earth pressure, hydrostatic pressure, and impact loads are taken as not applicable only for this example. Snow drift, rain ponding, thermal action, differential movement, and accidental action remain open. No screened hazard may be omitted from a real design without documented site and code evidence.

7 Load Combinations

The action symbols are: D dead, L floor live, L_r roof live, S snow, R rain, W wind, E_h horizontal seismic effect, and E_v vertical seismic effect. The following strength combinations are the subset relevant to the assumed actions:

$$U_1 = 1.4D, \qquad U_2 = 1.2D + 1.6L + 0.5(L_r \text{ or } S \text{ or } R), \tag{16}$$
$$U_3 = 1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (L \text{ or } 0.5W), \qquad U_4 = 1.2D + W + L + 0.5(L_r \text{ or } S \text{ or } R), \tag{17}$$
$$U_5 = 0.9D + W, \qquad U_6 = 1.2D + E_v + E_h + L + 0.2S, \tag{18}$$
$$U_7 = 0.9D - E_v + E_h. \tag{19}$$

Both signs of W and E_h apply. Companion actions are included only when they increase the effect under review. Service checks use the applicable unfactored combinations, including $D + L$, $D + S$, $D + 0.6W$, and the corresponding stability or uplift combinations. The actual adopted code must be consulted for the complete combination set and vertical seismic definition.

For typical occupied-floor gravity members, U_2 controls:

$$w_{u,B1} = 1.2(13.10) + 1.6(7.20) = 27.24\,\text{kN/m}, \tag{20}$$
$$w_{u,G1} = 1.2(26.20) + 1.6(14.40) = 54.48\,\text{kN/m}. \tag{21}$$

8 Representative Steel Member Checks

8.1 Typical secondary beam B1

The trial W360×51 beam spans 6.0 m. The slab provides continuous lateral restraint to the compression flange in the positive-moment region; connection and construction-stage restraint must be verified. For a simple span under uniform load,

$$M_u = \frac{w_u L^2}{8} = \frac{27.24(6.0)^2}{8} = 122.6\,\text{kN m}, \tag{22}$$
$$V_u = \frac{w_u L}{2} = \frac{27.24(6.0)}{2} = 81.7\,\text{kN}. \tag{23}$$

With $Z_x = 895{,}000\,\text{mm}^3$ and $F_y = 355\,\text{MPa}$,

$$\phi M_n = 0.9 F_y Z_x = 0.9(355)(895000)10^{-6} = 286.0\,\text{kN m} > M_u \quad \textbf{PASS}. \tag{24}$$

Using an adopted web shear area $A_w = 2{,}540\,\text{mm}^2$,

$$\phi V_n = 1.0(0.6 F_y A_w) = 541\,\text{kN} > V_u \quad \textbf{PASS}. \tag{25}$$

The strength utilization is $122.6/286.0 = 0.43$ in flexure and $81.7/541 = 0.15$ in shear.

For service deflection, $I_x = 141 \times 10^6\,\text{mm}^4$ and

$$\Delta_{\max} = \frac{5wL^4}{384EI}. \tag{26}$$

The live-load deflection is 4.3 mm, less than $L/360 = 16.7$ mm. Total-load deflection is 12.1 mm, less than $L/240 = 25.0$ mm; both checks **PASS**. Camber, vibration, ponding, and composite construction-stage checks remain open.

8.2 Interior girder G1

For the preliminary equivalent uniform load on the 6.0 m girder,

$$M_u = \frac{54.48(6.0)^2}{8} = 245.2\,\text{kN m}, \tag{27}$$

$$V_u = \frac{54.48(6.0)}{2} = 163.4\,\text{kN}. \tag{28}$$

For the trial W460×74, the adopted design resistances are $\phi M_n = 540$ kN m and $\phi V_n = 875$ kN. Utilization is therefore 0.45 in flexure and 0.19 in shear, both **PASS**. With $I_x = 332 \times 10^6\,\text{mm}^4$, total service deflection is 10.3 mm, less than $L/240 = 25.0$ mm, **PASS**.

8.3 Interior column C1

The base column gravity take-down uses one occupied suspended floor, the roof, column self-weight, and the applicable variable actions. The representative second-order frame-analysis envelope is

$$P_u = 410\,\text{kN}, \qquad M_{ux} = 72\,\text{kN m}, \qquad M_{uy} = 28\,\text{kN m}. \tag{29}$$

For W310×60, $A_g = 7{,}640\,\text{mm}^2$, $r_y = 51$ mm, and $KL = 3{,}600$ mm:

$$\frac{KL}{r_y} = 70.6, \qquad F_e = \frac{\pi^2 E}{(KL/r)^2} = 395\,\text{MPa}. \tag{30}$$

The adopted inelastic buckling result is $F_{cr} = 244$ MPa, giving

$$\phi P_n = 0.9 F_{cr} A_g = 1{,}680\,\text{kN}. \tag{31}$$

Using adopted flexural resistances $\phi M_{nx} = 480$ kN m and $\phi M_{ny} = 210$ kN m, the compression-flexure interaction is

$$\mathcal{I} = \frac{P_u}{\phi P_n} + \frac{8}{9}\left(\frac{M_{ux}}{\phi M_{nx}} + \frac{M_{uy}}{\phi M_{ny}}\right) \tag{32}$$

$$= \frac{410}{1680} + \frac{8}{9}\left(\frac{72}{480} + \frac{28}{210}\right) = 0.50 < 1.00 \quad \textbf{PASS}. \tag{33}$$

Column splices, panel zones, base plates, local slenderness, fire protection, and frame out-of-plumb effects require project design.

8.4 Diagonal brace BR1

The governing amplified brace compression from the illustrative lateral analysis is $P_u = 245$ kN. For HSS152×152×8, $A_g = 4{,}420\,\text{mm}^2$, $r_{\min} = 58$ mm, and an adopted effective length $KL = 7{,}000$ mm:

$$KL/r = 121, \qquad \phi P_n = 465\,\text{kN}. \tag{34}$$

Compression utilization is $245/465 = 0.53$, **PASS**. The gross-section tension resistance exceeds the compression resistance. Net-section fracture, connection eccentricity, gusset yielding and buckling, block shear, brace ductility, and seismic compactness are not demonstrated and remain mandatory project checks.

9 Global Serviceability and Stability

The illustrative elastic lateral analysis produced displacements $\delta_{e,1} = 5\,\text{mm}$ at Level 1 and $\delta_{e,2} = 12\,\text{mm}$ at the roof. With an assumed deflection amplification factor $C_d = 3.0$ and $I_e = 1.0$,

$$\delta_x = \frac{C_d \delta_{e,x}}{I_e}. \tag{35}$$

Table 11: Illustrative amplified storey drift check

Storey	Lower disp. (mm)	Upper disp. (mm)	Drift ratio	Limit
Level 1–Roof	15	36	0.0058	0.0200
Base–Level 1	0	15	0.0042	0.0200

The maximum ratio is 0.0058, less than the illustrative 0.0200 life-safety limit, **PASS**. This limit is not a facade criterion. A stricter wind-drift or cladding limit may govern. The preliminary stability review gives $B_2 = 1.04 < 1.10$, indicating modest second-order amplification for the stated model. A project calculation shall document the code stability coefficient, notional loads, stiffness reductions, and all torsional modes.

10 Preliminary Foundation Check

10.1 Service bearing

For the interior column, the service load take-down is approximated as

$$P_D = 202\,\text{kN}, \qquad P_L = 86.4\,\text{kN}, \qquad P_S = 27.0\,\text{kN}. \tag{36}$$

A $1.50\,\text{m} \times 1.50\,\text{m}$ footing, 0.45 m thick, weighs approximately 24.3 kN. The service bearing pressure is

$$q_s = \frac{202 + 86.4 + 27.0 + 24.3}{1.50(1.50)} = 151\,\text{kPa} < q_a = 180\,\text{kPa} \quad \textbf{PASS}. \tag{37}$$

This is a concentric bearing check. Actual minimum and maximum pressures shall include biaxial moment, load eccentricity, overturning, uplift, and load combinations consistent with the geotechnical definition of allowable bearing.

10.2 Footing flexure and shear

Take a 350 mm square column, factored soil pressure $q_u = 188\,\text{kPa}$, and effective depth $d = 367\,\text{mm}$. The cantilever projection is $\ell = (1.50 - 0.35)/2 = 0.575\,\text{m}$. Per metre width,

$$M_u = \frac{q_u \ell^2}{2} = \frac{188(0.575)^2}{2} = 31.1\,\text{kN m/m}. \tag{38}$$

Strength calculation requires less steel than the adopted minimum distributed reinforcement. Provide, for this example, T16 bars at 240 mm centres each way at the bottom, giving $A_s = 838\,\text{mm}^2/\text{m}$.

At the punching perimeter $d/2$ from the column face, the adopted demand is $V_u = 298\,\text{kN}$, $b_o = 2{,}868\,\text{mm}$, and

$$v_u = \frac{V_u}{b_o d} = 0.283\,\text{MPa} < \phi v_c = 1.36\,\text{MPa} \quad \textbf{PASS}. \tag{39}$$

The one-way shear stress is 0.11 MPa, below the adopted design resistance 0.70 MPa, **PASS**. These checks do not constitute a final foundation design. Settlement, sliding, frost or scour depth, groundwater, liquefaction, soil variability, adjacent foundations, property lines, anchor rods, pedestals, development length, cover, and durability remain open.

11 Load Take-Down and Equilibrium Audit

A simple equilibrium audit is included to make transcription errors visible.

Table 12: Whole-building vertical load audit

Action	Total (kN)	**Basis**
Occupied suspended-floor dead load	918	4.25(18)(12)
Roof dead load	248	1.15(18)(12)
Floor live load	518	2.40(18)(12)
Balanced roof snow	162	0.75(18)(12)
Roof live load	207	0.96(18)(12)

For a symmetric gravity model, the sum of column reactions at each level shall equal the applied level load to within the numerical tolerance of the analysis. The total lateral reactions shall equal the applied base shear, and the sum of reaction moments shall equal the applied overturning moment. The illustrative target checks are:

$$\sum R_X = V_X, \qquad \sum R_Y = V_Y, \tag{40}$$

$$\sum (R_i r_i) = M_o, \qquad \left| \frac{\sum R - \sum Q}{\sum Q} \right| < 0.5\%. \tag{41}$$

No software reaction file is supplied with this example, so completion of this audit is marked **OPEN** for a project analysis.

12 Design Conclusions and Required Follow-Up

12.1 Conclusions for the worked example

Under the stated illustrative assumptions:

- the W360×51 secondary beam and W460×74 girder pass the shown strength and vertical-deflection checks;
- the W310×60 interior column passes the shown compression-flexure interaction check;
- the HSS152×152×8 brace passes the shown gross-member axial compression check;
- seismic action governs the global lateral base-shear comparison;
- the illustrative amplified storey drift is below the stated limit; and
- the 1.50 m square preliminary footing passes the shown bearing, flexure, one-way shear, and punching-shear screens.

Passing these representative checks does not establish adequacy of the complete structure. It only demonstrates internal consistency of the selected calculation examples.

12.2 Items required before any project use

1. Confirm occupancy, Risk Category, grids, elevations, framing, openings, equipment, facade, fire rating, and performance objectives from coordinated architectural and building-services documents.
2. Obtain AHJ-confirmed code editions, local amendments, site wind and snow parameters, drainage design, seismic spectra and site class, flood data, and a project geotechnical report.
3. Complete a three-dimensional analysis with actual member properties, diaphragm behaviour, torsion, second-order effects, pattern loading, construction stages, and verified load combinations.
4. Design every beam, girder, column, brace, slab/deck, diaphragm, collector, connection, splice, base plate, anchor, pedestal, and foundation, including robustness and progressive-collapse requirements where applicable.
5. Check vibration, facade compatibility, wind drift and acceleration, fire, fatigue where relevant, durability, thermal movement, ponding, temporary works, erection stability, and special inspection requirements.
6. Perform an independent calculation check, resolve all review comments, and obtain the signed and sealed approval of the engineer of record.

13 Calculation Quality Checklist

No.	Quality-control item	Status
1	Units, signs, member labels, grid dimensions, and calculation conventions are stated.	Complete
2	Permanent and variable gravity loads are itemized and summed.	Complete
3	Wind and seismic assumptions are visible and not represented as site data.	Complete
4	Strength and service combinations relevant to the example are listed.	Complete
5	Representative beam, girder, column, brace, drift, and footing checks are shown.	Complete
6	Certified steel section properties are matched to the procured sections.	Open
7	Full software input, reactions, equilibrium, and independent model validation are archived.	Open
8	Connections, diaphragms, collectors, anchorage, and seismic detailing are designed.	Open
9	Geotechnical parameters and foundation settlement are verified.	Open
10	Independent checker and licensed engineer approve the project issue.	Open

A Symbol List

Symbol	Definition
A_g	Gross cross-sectional area
A_s	Area of reinforcing steel
B_2	Global second-order amplification factor used in the example
b_o	Critical punching-shear perimeter
C_d	Deflection amplification factor
C_s	Seismic response coefficient
D, L, L_r, S, R	Dead, floor live, roof live, snow, and rain actions
E_h, E_v	Horizontal and vertical seismic effects
F_e, F_{cr}, F_y	Elastic buckling, critical buckling, and yield stresses
F_x	Equivalent lateral force applied at level x
I_e	Seismic importance factor
I_x	Second moment of area about the major axis
K	Effective length factor
M_u, P_u, V_u	Required factored moment, axial force, and shear
R	Response modification coefficient when used in a seismic equation; rain load when used as an action symbol, as identified by context
W	Effective seismic weight; wind action when used in load combinations
Z_x	Plastic section modulus about the major axis
γ_i	Load factor for action i
ϕ	Resistance factor
Δ, δ	Member deflection and building displacement

B Selected Reference Documents

References

[1] American Society of Civil Engineers, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, ASCE/SEI 7-22, Reston, Virginia, 2022.

[2] American Institute of Steel Construction, *Specification for Structural Steel Buildings*, ANSI/AISC 360-22, Chicago, Illinois, 2022.

[3] American Institute of Steel Construction, *Seismic Provisions for Structural Steel Buildings*, ANSI/AISC 341-22, Chicago, Illinois, 2022.

[4] American Concrete Institute, *Building Code Requirements for Structural Concrete and Commentary*, ACI 318-19 (reapproved 2022), Farmington Hills, Michigan.

[5] International Code Council, *International Building Code*, 2024 edition, Country Club Hills, Illinois.

C Engineer-of-Record Input Sheet

This page identifies the minimum inputs needed to convert the worked example into a project calculation. Completion changes the calculation basis and requires the full report to be re-analysed and independently checked.

Input	Required evidence	Status
Project address and coordinates	Survey / owner information	Open
Occupancy and Risk Category	Architectural code analysis	Open
Adopted codes and amendments	AHJ confirmation	Open
Structural grids and levels	Coordinated drawings / model	Open
Dead and equipment loads	Product data / services schedules	Open
Live loads and special loads	Occupancy and owner criteria	Open
Wind, snow, rain, flood, and ice	Site-specific code data	Open
Seismic spectra and site class	Hazard data / geotechnical report	Open
Soil bearing and settlement criteria	Geotechnical report	Open
Fire, durability, and exposure criteria	Code analysis / specifications	Open
Performance and drift criteria	Owner, facade, and code requirements	Open
Independent check requirements	Project quality plan	Open

END OF STRUCTURAL LOAD CALCULATION AND ANALYSIS REPORT