

Beam reinforcement report

รายงานวิเคราะห์และออกแบบเหล็กเสริมคาน

B1
Axis A · Story 1
Revision 02

Beam Studio - Default example

SELECTED CHECKS SATISFIED / ผ่านเฉพาะรายการที่ตรวจ

PRELIMINARY · ENGINEER REVIEW REQUIRED BEFORE CONSTRUCTION

Prepared by: Software exampleGenerated: 12/10/2026, 20:50:20 ICT

Project note: Illustrative default beam. Replace inputs and complete engineering review before using results for a real project.

01 · Model and materials / รูปแบบและวัสดุ

Parameter	Value	Material	Entered strength / converted
Support	A: Pin / หมุด · B: Roller / ลุกกลิ้ง	Concrete f'c	200.00 kgf/cm ² / 19.613 MPa
Analysis span L	4.00 m	Main reinforcement fy	4,000.00 kgf/cm ² / 392.266 MPa
Section b × h	20.00 × 40.00 cm (200 × 400 mm)	Stirrup reinforcement fyr	2,400.00 kgf/cm ² / 235.360 MPa
Clear cover to outside stirrup	40.0 mm	Concrete density	2,400 kg/m ³
Nominal aggregate	20.0 mm	Self-weight included in D	192.00 kgf/m / 1.883 kN/m
E entered independently	25.00 GPa	Stirrup size / selected grade	RB9 · SR24
Effective I / gross I	1.000	Conversion	1 kgf = 9.80665 N; 1 tf = 9.80665 kN; 1 kgf/cm ² = 0.0980665 MPa
Gross I = bh ³ /12	106,666.7 cm ⁴		
Effective EI	26,666.67 kN·m ²		

Material strengths are entered values. Confirm the concrete test basis and reinforcement mill certificates, including stirrup grade. kgf is a force unit; steel quantities below use kg mass.

02 · Unfactored loading / น้ำหนักบรรทุกก่อนคูณ

Load	Category	Value	Position / basis
Uniform dead load	D	200.00 kgf/m / 1.961 kN/m	Excludes automatically added self-weight
Uniform live load	L	300.00 kgf/m / 2.942 kN/m	Entire analysis span

03 · Load combination register / ชุดน้ำหนักบรรทุก

Name	Use	Category	D factor	L factor	Load factors
D + L	Enabled	service	1.00	1.00	1.00D + 1.00L
1.4D	Enabled	strength	1.40	0.00	1.40D + 0.00L
1.4D + 1.7L	Enabled	strength	1.40	1.70	1.40D + 1.70L

Website preset basis: Thai ministerial regulation B.E. 2566, Clause 7(1), gravity-only 1.4D + 1.7L. The actual enabled factors used here are recorded in the table, including any custom rows. Section checks retain ACI-style φM = 0.90 and φV = 0.75; complete Thai compliance is not assessed. All rows are recorded, including disabled rows. Strength design envelopes the enabled strength rows. Diagram results follow the selected row: **D + L (1.00D + 1.00L)**. Only D and L vertical-load factors are supported; wind, seismic, axial, torsional and P-Delta combinations require a different model.

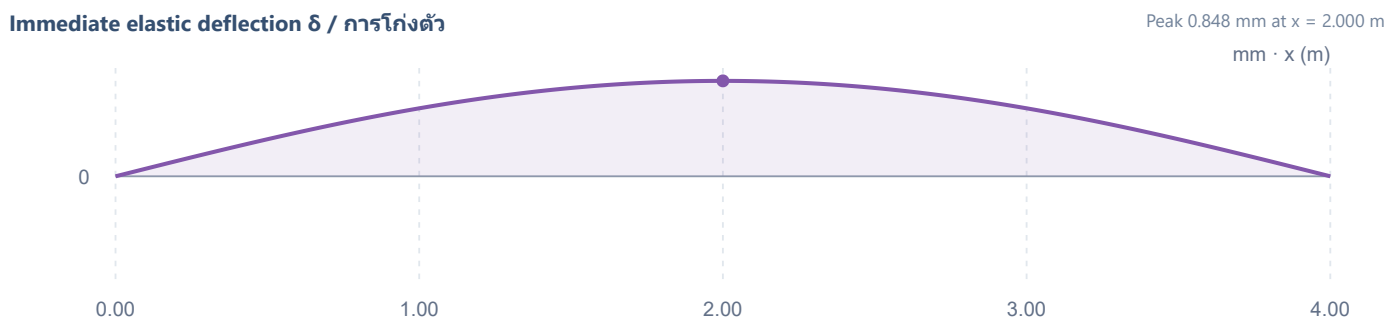
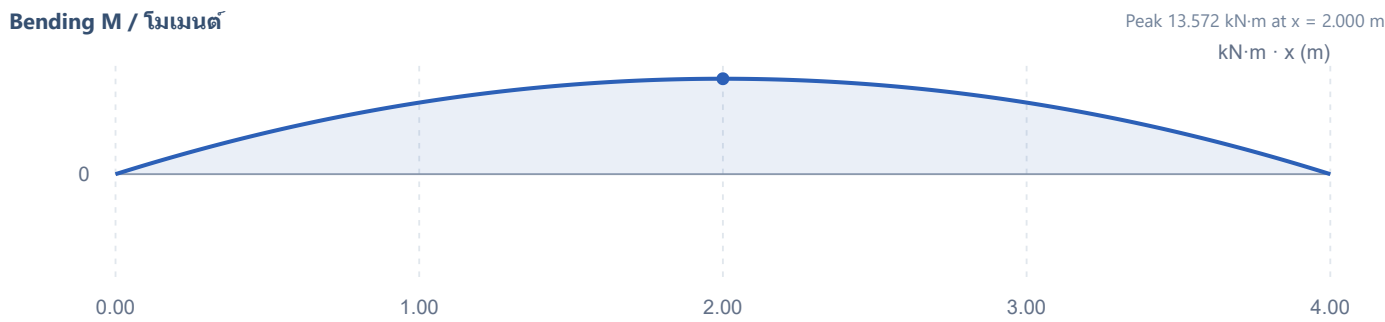
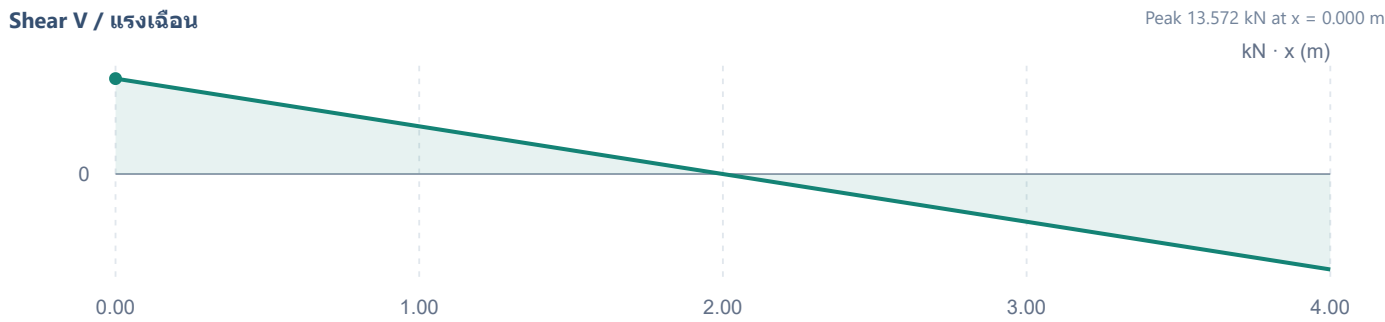
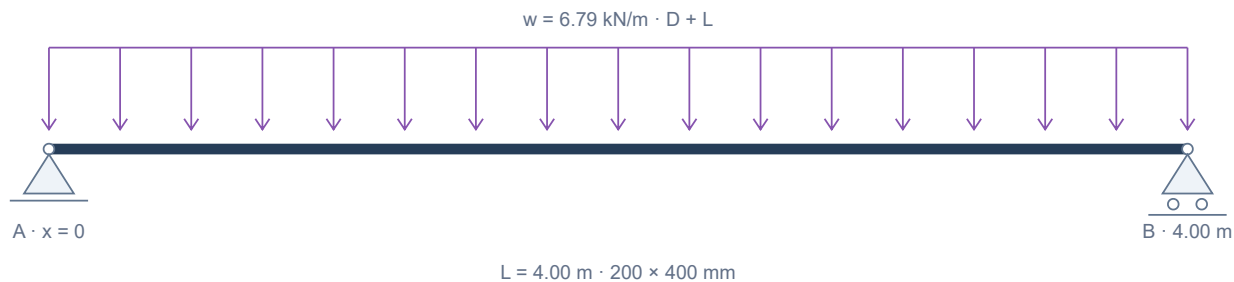
04 · Governing cases / กรณีควบคุม

Case	Category	Total load (kN)	V max (kN)	M max (kN·m)	Elastic δ max (mm)
D + L	service	27.14	13.57	13.57	0.848
1.4D	strength	21.53	10.76	10.76	0.673
1.4D + 1.7L	strength	41.53	20.77	20.77	1.298

Strength bending envelope: 20.77 kN·m · 1.4D + 1.7L at x = 2.000 m.
Strength shear envelope: 20.77 kN · 1.4D + 1.7L at x = 0.000 m.

05 · Selected-case diagrams / กราฟของกรณีทีเลือก

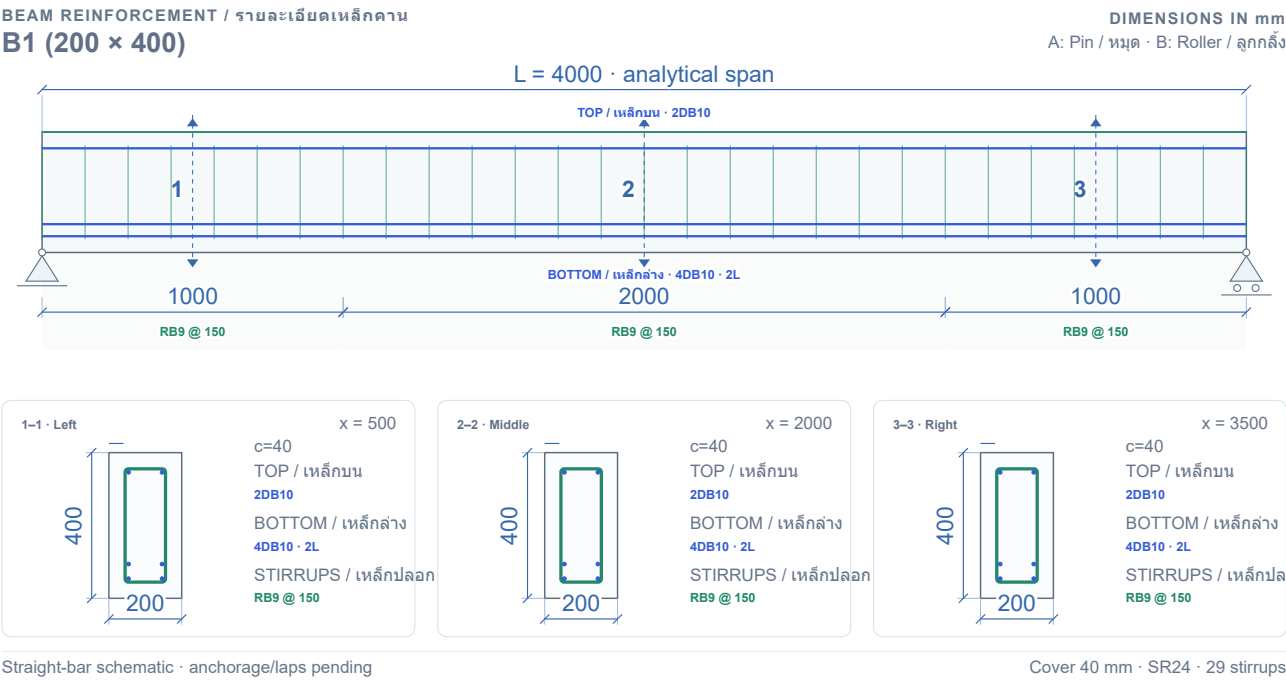
D + L · 1.00D + 1.00L · A: Pin / หมุด · B: Roller / ลูกกลิ้ง. These diagrams show one case; the design envelope above may govern in another case.



V and M use their signed values; positive is drawn above the axis. Deflection is positive downward physically and plotted above the axis here. Independent scales. x is measured from A.

Selected-case response	Value
Reaction A	13.57 kN
Reaction B	13.57 kN
Reaction moment at A (CCW +)	0.00 kN-m
Reaction moment at B (CCW +)	0.00 kN-m
Force equilibrium residual	0.000000 kN
Moment equilibrium residual	0.000000 kN-m

06 · Selected reinforcement / แบบเหล็กที่เลือก



Face	Bars	As provided (mm ²)	d (mm)	Clear bar gap (mm)	Required gap (mm)	Design role
Top / บน	2 DB10 · 1 layer(s)	157.1	346.0	82.0	26.7	Hanger bars; fit only
Bottom / ล่าง	4 DB10 · 2 layer(s)	314.2	326.0	82.0	26.7	Tension strength + fit

Full span, straight-bar schematic. Dimensions are in mm. No anchorage, hook, lap or support extension is represented. Minimum steel, innermost-layer strain and strength are checked on each face with tension demand. Layer centroids set effective depth. Horizontal clear gap $\geq \max(25 \text{ mm}, 2db, 4agg/3)$; vertical clear gap $\geq \max(30 \text{ mm}, 2db, 4agg/3)$, as specified by the review brief. Compression reinforcement is not credited.

07 · Bending at three stations / โมเมนต์ดัด 3 ตำแหน่ง

Face / station	Mu (kN·m)	Governing row	d (mm)	As from moment (mm²)	As min (mm²)	As required (mm²)	As provided (mm²)
Top · Left (x=0.000 m)	0.00	No tension demand	346.0	0.0	Hanger; not checked	Hanger; not designed	157.1
Top · Middle (x=2.000 m)	0.00	No tension demand	346.0	0.0	Hanger; not checked	Hanger; not designed	157.1
Top · Right (x=4.000 m)	0.00	No tension demand	346.0	0.0	Hanger; not checked	Hanger; not designed	157.1
Bottom · Left (x=0.000 m)	0.00	No tension demand	326.0	0.0	232.7	232.7	314.2
Bottom · Middle (x=2.000 m)	20.77	1.4D + 1.7L	326.0	186.7	232.7	232.7	314.2
Bottom · Right (x=4.000 m)	0.00	No tension demand	326.0	0.0	232.7	232.7	314.2

Station demands use the actual support model and the strength envelope, without assumed fixed-end moments. The exact maximum between stations is retained in the global design check. For a simply supported span, end bending is zero; a fixed support may carry hogging moment at either end.

Global tension-face flexure	Result
Design tension face	bottom
Mu envelope	20.77 kN·m (1.4D + 1.7L)
φMn for selected tension bars	34.11 kN·m
Mu / φMn	60.9%
Tension strain εt	0.01811
Required εty + 0.003	0.00496
Selected φ for tension-controlled model	0.90
Compression steel contribution	Not credited

08 · Shear design by zone / แรงเฉือนแบ่งช่วง

Zone / x (mm)	Vu (kN)	Governing row	Vc (kN)	Vs (kN)	φVn (kN)	Vu / φVn	Ceiling (kN)
Left · 0 to 1,000	20.77	1.4D + 1.7L	49.09	65.08	85.63	24.3%	179.75
Middle · 1,000 to 3,000	10.38	1.4D + 1.7L	49.09	65.08	85.63	12.1%	179.75
Right · 3,000 to 4,000	20.77	1.4D + 1.7L	49.09	65.08	85.63	24.3%	179.75

Zone	Stirrups	Spacing max from checks (mm)	Largest placed interval (mm)	Allocated count	Status
Left	2 legs RB9 @ 150 mm · SR24	163.0	142.9	8	Selected checks satisfied
Middle	2 legs RB9 @ 150 mm · SR24	163.0	142.9	14	Selected checks satisfied
Right	2 legs RB9 @ 150 mm · SR24	163.0	142.9	7	Selected checks satisfied

φ = 0.75. Vc = 0.17√f'c bwd; Vs = Av fy d/s. Capacity is capped by the implemented shear ceiling. Zones include both sides of every point-load shear jump and do not reduce demands at a support face. Adjacent zones share one boundary stirrup; counts sum to 29 unique positions.

09 · All selected-layout checks / รายการตรวจแบบที่เลือก

PASS · Beam mark Beam mark is supplied.	PASS · Top layers Top: 1 layer(s), at least 2 bars per layer.
PASS · Top bar count Top: 2 total bars.	PASS · Top bar diameter Top: DB10.

PASS - Top horizontal fit Top clear bar gap 82.0 mm; required at least 26.7 mm.	PASS - Top vertical enclosure Top bar diameter 10 mm; clear height inside stirrup 302.0 mm.
PASS - Bottom layers Bottom: 2 layer(s), at least 2 bars per layer.	PASS - Bottom bar count Bottom: 4 total bars.
PASS - Bottom bar diameter Bottom: DB10.	PASS - Bottom horizontal fit Bottom clear bar gap 82.0 mm; required at least 26.7 mm.
PASS - Bottom vertical enclosure Bottom bar diameter 10 mm; clear height inside stirrup 302.0 mm.	PASS - Gap between top and bottom rows Clear vertical gap 242.0 mm; required at least 30.0 mm for this layout check.
PASS - bottom minimum tension steel bottom As 314.2 mm ² ; minimum 232.7 mm ² .	PASS - bottom tension-controlled strain bottom innermost-layer strain 0.01811; required 0.00496. All layers must yield for the centroid calculation.
PASS - bottom flexural strength bottom ϕ Mn 34.11 kN-m; Mu 20.77 kN-m (1.4D + 1.7L).	PASS - Minimum tension steel bottom As 314.2 mm ² ; minimum 232.7 mm ² .
PASS - Tension-controlled strain Tension strain 0.01811; required at least 0.00496 for the implemented ϕ = 0.90 check.	PASS - Flexural strength ϕ Mn 34.11 kN-m; Mu 20.77 kN-m, governed by 1.4D + 1.7L.
PASS - Left zone length Left zone length 1000.0 mm.	PASS - Right zone length Right zone length 1000.0 mm.
PASS - Zone coverage Three adjacent zones cover the analytical beam span.	PASS - Left spacing input Left spacing is automatic.
PASS - Left spacing feasibility Left spacing 150 mm; this release supports spacing of at least 50 mm.	PASS - Left shear ceiling Left Vu 20.77 kN; implemented concrete shear ceiling 179.75 kN.
PASS - Left longitudinal stirrup spacing Left spacing 150 mm; maximum from strength, minimum steel and spacing limits 163.0 mm (150 mm after 25 mm rounding).	PASS - Left transverse leg spacing Left two-leg centre spacing 111.0 mm; maximum 326.0 mm.
PASS - Left minimum stirrup steel Left Av/s 0.8482 mm ² /mm; minimum 0.2974 mm ² /mm.	PASS - Left shear strength Left ϕ Vn 85.63 kN; Vu 20.77 kN, governed by 1.4D + 1.7L.
PASS - Middle spacing input Middle spacing is automatic.	PASS - Middle spacing feasibility Middle spacing 150 mm; this release supports spacing of at least 50 mm.
PASS - Middle shear ceiling Middle Vu 10.38 kN; implemented concrete shear ceiling 179.75 kN.	PASS - Middle longitudinal stirrup spacing Middle spacing 150 mm; maximum from strength, minimum steel and spacing limits 163.0 mm (150 mm after 25 mm rounding).
PASS - Middle transverse leg spacing Middle two-leg centre spacing 111.0 mm; maximum 326.0 mm.	PASS - Middle minimum stirrup steel Middle Av/s 0.8482 mm ² /mm; minimum 0.2974 mm ² /mm.
PASS - Middle shear strength Middle ϕ Vn 85.63 kN; Vu 10.38 kN, governed by 1.4D + 1.7L.	PASS - Right spacing input Right spacing is automatic.
PASS - Right spacing feasibility Right spacing 150 mm; this release supports spacing of at least 50 mm.	PASS - Right shear ceiling Right Vu 20.77 kN; implemented concrete shear ceiling 179.75 kN.
PASS - Right longitudinal stirrup spacing Right spacing 150 mm; maximum from strength, minimum steel and spacing limits 163.0 mm (150 mm after 25 mm rounding).	PASS - Right transverse leg spacing Right two-leg centre spacing 111.0 mm; maximum 326.0 mm.
PASS - Right minimum stirrup steel Right Av/s 0.8482 mm ² /mm; minimum 0.2974 mm ² /mm.	PASS - Right shear strength Right ϕ Vn 85.63 kN; Vu 20.77 kN, governed by 1.4D + 1.7L.

PASS - Left placed stirrup intervals

Left largest placed interval 142.9 mm; maximum 163.0 mm.

PASS - Middle placed stirrup intervals

Middle largest placed interval 142.9 mm; maximum 163.0 mm.

PASS - Right placed stirrup intervals

Right largest placed interval 142.9 mm; maximum 163.0 mm.

A PASS applies only to its listed check. It does not establish complete code compliance or approval for construction.

10 · Immediate deflection reference / ค่าอ้างอิงการโก่งตัว

Response	Value	Reference
Service envelope (D + L)	0.848 mm	x = 2.000 m
L/360	11.111 mm	User-selected reference
Envelope / reference	7.6%	Comparison only; no code conclusion

Euler-Bernoulli immediate elastic response uses the entered E and I multiplier. Cracking, creep, shrinkage, load duration, finishes and long-term deflection are not assessed.

11 · Selected-layout steel quantities / ปริมาณเหล็กที่เลือก

Item	Count	Size (mm)	Length each (m)	Total length (m)	Mass (kg)
Top bars / เหล็กบน	2	10	4.000	8.000	4.932
Bottom bars / เหล็กล่าง	4	10	4.000	16.000	9.865
Stirrups / เหล็กปลอก	29	9	0.844	24.476	12.223

Total nominal steel mass: **27.020 kg**

Both top and bottom bars and all 29 actually placed stirrups are included. Nominal mass/m = $(\pi \phi^2/4) \times 0.00785$. Main bars use the analytical span length. Stirrup lengths follow the section centreline rectangle. No development, laps, hooks, bend allowance, cutting waste or support extensions are included. This is an estimate, not a bar bending schedule or procurement quantity.

Nominal steel density 7,850 kg/m³. Supplier masses and tolerances may differ. Main bars use the analysis span only; anchorage, support extensions, cutoffs and laps are excluded. Stirrups use the centreline rectangle; hooks, bends and cutting allowances are excluded. Shared zone boundaries are counted once. These quantities are estimates, not a bar bending schedule or a procurement schedule.

12 · Calculation basis and review / สมมติฐานและการตรวจทาน

Analysis: $I = bh^3/12$; $EI = E \times I \times \text{stiffness multiplier}$; $V(x) = RA - wx - \Sigma P$; $M(x) = M(0) + RAx - wx^2/2 - \Sigma P(x-a)$. Elastic curvature is integrated with the selected support boundary conditions.

Flexure: $a = A_s f_y / (0.85 f'_c b)$; $\beta_1 = \max[0.65, 0.85 - 0.05 \max(0, f'_c - 28)/7]$; $c = a/\beta_1$; $\epsilon_t = 0.003(d-c)/c$; $\phi M_n = 0.90 A_s f_y (d-a/2)$. $A_{s,min} = \max(0.25 \sqrt{f'_c} / f_y, 1.4/f_y) bwd$.

Shear: $A_v = 2\pi \phi^2/4$; $A_{v,min/s} = \max(0.062 \sqrt{f'_c}, 0.35) bw / f_y$; $\phi V_n = \min[0.75(V_c + V_s), 0.75(V_c + 0.66 \sqrt{f'_c} bwd)]$. Section calculations use mm and MPa (N/mm²).

Preliminary calculations for one normal-weight rectangular beam, with selectable ideal pin, roller, fixed or free ends, constant E and I, downward vertical loading, one to three layers of bars on each face and two-leg vertical stirrups.

Only the displayed strength, strain and geometric fit checks are implemented. This report is not a complete Thai-standard or ACI-compliance assessment and is not a construction drawing.

Axial force, torsion, wind, earthquake, P-Delta and frame interaction are not modelled. A zero axial or torsional demand is not established by this analysis.

Support-face geometry, development length, hooks, laps, bar cutoffs, seismic confinement, cracking, creep, shrinkage and long-term serviceability require a separate engineering design.

Both faces are checked for strength when their bending demand is nonzero. Compression reinforcement is not credited. Stirrup positions use the analytical span including its endpoints.

Scope item	Assessment
Axial / torsion / P-Delta	Not modelled; separate analysis required
Wind / earthquake / construction-stage loading	Not generated or analysed
Code and local requirements	Engineer must verify applicable edition and Thai requirements
Independent review / sign-off	Not provided by this application

MIT OpenCourseWare: solid mechanics and beam bending

<https://ocw.mit.edu/courses/1-050-solid-mechanics-fall-2004/pages/readings/>

NIST SP 811: SI conversions (kgf to N)

<https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication811e2008.pdf>

ACI: flexural strength and tension-controlled strain

https://www.concrete.org/portals/0/files/pdf/webinars/ws_2021_Floyd_TeachingFlexural.pdf

ACI: shear design provisions and minimum stirrup steel

<https://www.concrete.org/frequentlyaskedquestions.aspx?faqid=910>

Thai ministerial regulation B.E. 2566: Clause 7(1), gravity load factors

<https://ratchakitcha.soc.go.th/documents/140A054N0000000000400.pdf>

ACI: reference gravity combinations (separate from the Thai preset)

https://www.concrete.org/portals/0/files/pdf/webinars/ws_S22_Liu.pdf

BEAM STUDIO · Preliminary single-beam calculation record · Not for construction without engineering review