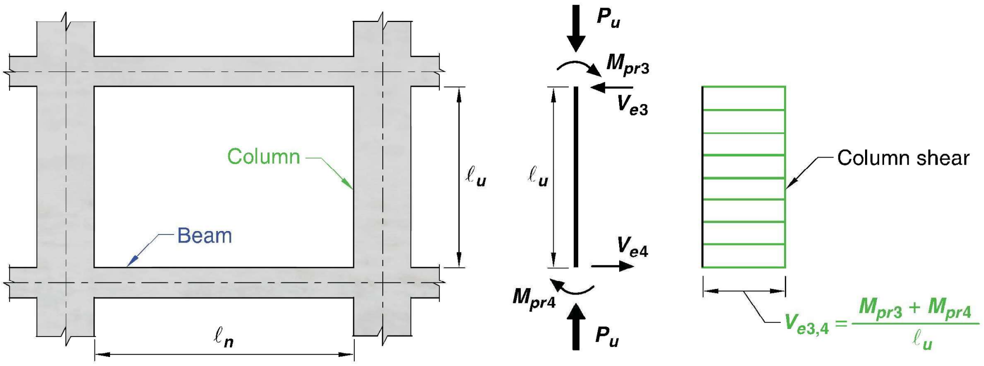
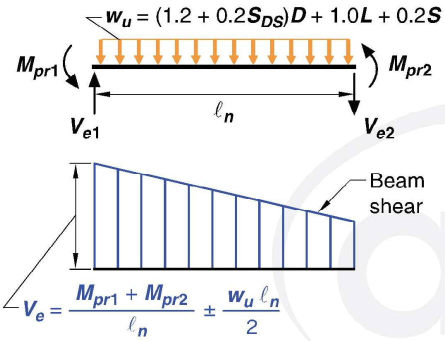
CODE | COMMENTARY





Notes on Fig. R18.6.5:

1. Direction of shear force V_e depends on relative magnitudes of gravity loads and shear generated by end moments.
2. End moments M_{pr} based on steel tensile stress of $1.25f_y$, where f_y is specified yield strength. (Both end moments should be considered in both directions, clockwise and counter-clockwise).
3. End moment M_{pr} for columns need not be greater than moments generated by the M_{pr} of the beams framing into the beam-column joints. V_e should not be less than that required by analysis of the structure.

***Fig. R18.6.5**—Design shears for beams and columns.*

18.7—Columns of special moment frames

18.7.1 *Scope*

18.7.1.1 This section shall apply to columns of special moment frames that form part of the seismic-force-resisting system and are proportioned primarily to resist flexure, shear, and axial forces.

R18.7—Columns of special moment frames

R18.7.1 *Scope*

This section applies to columns of special moment frames regardless of the magnitude of axial force. Before 2014, the Code permitted columns with low levels of axial stress to be detailed as beams.

18.7.2 *Dimensional limits*

18.7.2.1 Columns shall satisfy (a) and (b):

(a) The shortest cross-sectional dimension, measured on a straight line passing through the geometric centroid, shall be at least 12 in.

(b) The ratio of the shortest cross-sectional dimension to the perpendicular dimension shall be at least 0.4.

R18.7.2 *Dimensional limits*

The geometric constraints in this provision follow from previous practice (Seismology Committee of SEAOC 1996).

18.7.3 *Minimum flexural strength of columns*

18.7.3.1 Columns shall satisfy 18.7.3.2 or 18.7.3.3, except at connections where the column is discontinuous above the connection and the column factored axial compressive force

R18.7.3 *Minimum flexural strength of columns*

The intent of 18.7.3.2 is to reduce the likelihood of yielding in columns that are considered as part of the seismic-force-resisting system. If columns are not stronger than beams framing into a joint, there is increased likelihood of inelastic

■Reference 05 (Indian Standard PLAIN AND REINFORCED CONCRETE CODE OF PRACTICE)
Limitation for height for placing concrete is mentioned as 1.5m.

IS 456 : 2000

भारतीय मानक

सामान्य एवं प्रबलित कंक्रीट — रीति संहिता

(चौथा पुनरीक्षण)

Indian Standard

PLAIN AND REINFORCED CONCRETE — CODE OF PRACTICE

(Fourth Revision)

ICS 91.100.30

BUREAU OF INDIAN STANDARDS
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or straightened without the approval of engineer-in-charge.

Bar bending schedules shall be prepared for all reinforcement work.

12.2 All reinforcement shall be placed and maintained in the position shown in the drawings by providing proper cover blocks, spacers, supporting bars, etc.

12.2.1 Crossing bars should not be tack-welded for assembly of reinforcement unless permitted by engineer-in-charge.

12.3 Placing of Reinforcement

Rough handling, shock loading (prior to embedment) and the dropping of reinforcement from a height should be avoided. Reinforcement should be secured against displacement outside the specified limits.

12.3.1 *Tolerances on Placing of Reinforcement*

Unless otherwise specified by engineer-in-charge, the reinforcement shall be placed within the following tolerances:

a) for effective depth 200 mm or less — ± 10 mm

b) for effective depth more than 200 mm — ± 15 mm

12.3.2 *Tolerance for Cover*

Unless specified otherwise, actual concrete cover should not deviate from the required nominal cover by $^{+10}_{\ 0}$ mm.

Nominal cover as given in **26.4.1** should be specified to all steel reinforcement including links. Spacers between the links (or the bars where no links exist) and the formwork should be of the same nominal size as the nominal cover.

Spacers, chairs and other supports detailed on drawings, together with such other supports as may be necessary, should be used to maintain the specified nominal cover to the steel reinforcement. Spacers or chairs should be placed at a maximum spacing of 1m and closer spacing may sometimes be necessary.

Spacers, cover blocks should be of concrete of same strength or PVC.

12.4 Welded Joints or Mechanical Connections

Welded joints or mechanical connections in reinforcement may be used but in all cases of important connections, tests shall be made to prove that the joints are of the full strength of bars connected. Welding of reinforcements shall be done in accordance with the recommendations of IS 2751 and IS 9417.

12.5 Where reinforcement bars upto 12 mm for high strength deformed steel bars and up to 16 mm for mild steel bars are bent aside at construction joints and afterwards bent back into their original positions, care should be taken to ensure that at no time is the radius of the bend less than 4 bar diameters for plain mild steel or 6 bar diameters for deformed bars. Care shall also be taken when bending back bars, to ensure that the concrete around the bar is not damaged beyond the band.

12.6 Reinforcement should be placed and tied in such a way that concrete placement be possible without segregation of the mix. Reinforcement placing should allow compaction by immersion vibrator. Within the concrete mass, different types of metal in contact should be avoided to ensure that bimetal corrosion does not take place.

13 TRANSPORTING, PLACING, COMPACTION AND CURING

13.1 Transporting and Handling

After mixing, concrete shall be transported to the formwork as rapidly as possible by methods which will prevent the segregation or loss of any of the ingredients or ingress of foreign matter or water and maintaining the required workability.

13.1.1 During hot or cold weather, concrete shall be transported in deep containers. Other suitable methods to reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted.

13.2 Placing

The concrete shall be deposited as nearly as practicable in its final position to avoid rehandling. The concrete shall be placed and compacted before initial setting of concrete commences and should not be subsequently disturbed. Methods of placing should be such as to preclude segregation. Care should be taken to avoid displacement of reinforcement or movement of formwork. As a general guidance, the maximum permissible free fall of concrete may be taken as 1.5 m.

13.3 Compaction

Concrete should be thoroughly compacted and fully worked around the reinforcement, around embedded fixtures and into corners of the formwork.

13.3.1 Concrete shall be compacted using mechanical vibrators complying with IS 2505, IS 2506, IS 2514 and IS 4656. Over vibration and under vibration of concrete are harmful and should be avoided. Vibration of very wet mixes should also be avoided.

Whenever vibration has to be applied externally, the design of formwork and the disposition of vibrators should receive special consideration to ensure efficient compaction and to avoid surface blemishes.

■Reference 06 (Nominal Bar Diameter and Nominal Cross-Sectional Area of Rebar)

Table 6.L.4: Dimensions, Mass per Unit Length and Permissible Deviations (BDS ISO_6935-1)

Nominal Bar Diameter, *d* mm	Nominal Cross-Sectional Area [a] A_n mm²	Mass per Unit Length	
		Requirement [b] kg/m	Permissible deviation [c] %
6	28,3	0,222	± 8
8	50,3	0,395	± 8
10	78,5	0,617	± 5
12	113	0,888	± 5
14	154	1,21	± 5
16	201	1,58	± 5
20	314	2,47	± 5
22	380	2,98	± 5

a A_n=0,785 4×d^2

b Mass per unit length =7,85×10^{-3} A_n

c Permissible deviation refers to a single bar.

Table 6.L.5: Dimensions, Mass per Unit Length and Permissible Deviations (BDS ISO_6935-2)

Nominal Bar Diameter [a], *d* mm	Nominal Cross-Sectional Area [b] A_n mm²	Mass per unit length	
		Requirement [c] Kg/m	Permissible deviation [d] %
6	28,3	0,222	± 8
8	50,3	0,395	± 8
10	78,5	0,617	± 6
12	113	0,888	± 6
14	154	1,21	± 5
16	201	1,58	± 5
20	314	2,47	± 5
25	491	3,85	± 4
28	616	4,84	± 4
32	804	6,31	± 4
40	1257	9,86	± 4
50	1964	15,42	± 4

a Diameters larger than 50mm should be agreed between the manufacturer and purchaser. The permissible deviation on such bars shall be ± 4 %

b A_n=0,785 4×d^2

c Mass per unit length =7,85×10^{-3} A_n

d Permissible deviation refers to a single bar.

■Reference 07 (Relationship between psi and Mpa(=N/㎟))

Megapascal to Psi Conversion Table

Megapascal [MPa]	Psi [psi]
0.01 MPa	1.4503773773 psi
0.1 MPa	14.503773773 psi
1 MPa	145.03773773 psi
2 MPa	290.07547546 psi
3 MPa	435.11321319 psi
5 MPa	725.18868865 psi
10 MPa	1450.3773773 psi
20 MPa	2900.7547546 psi
50 MPa	7251.8868865 psi
100 MPa	14503.773773 psi
1000 MPa	145037.73773 psi

How to Convert Megapascal to Psi

1 MPa = 145.03773773 psi
1 psi = 0.0068947573 MPa

Example: convert 15 MPa to psi:
15 MPa = 15 × 145.03773773 psi
= 2175.56606595 psi

Mpa (=N/㎟)	psi
17	2466
18	2611
20	2901
21	3046
24.13	3500
25	3626
31	4500
275	39885
280	40611
300	43511
350	50763
400	58015
414	60000
420	60916
450	65267
500	72519
520	75420
540	78320
550	79771
600	87023
620	89923
675	97900
690	100076
700	101526

■Reference 08 (HIGH-IMPACT RISK AND STRUCTURAL EVALUATION TOOL CHECK)

RAJDHANI UNNAYAN KARTRIPAKKHA
CAPITAL DEVELOPMENT AUTHORITY
DEVELOPMENT CONTROL SECTION
permits@rajukdhaka.gov.bd
www.rajukdhaka.gov.bd

HIGH-IMPACT RISK AND STRUCTURAL EVALUATION TOOL CHECK

Case No: 25.39.0000.099.33.18129.24

Block #M; Plot: 2731, Road #20/A, Basundhara R/A, Dhaka
12 Site Location: Lat: Long: 23°49'18.0"N 90°27'26.2"E

D-16 Site Coefficient: Fa=1.35, Fv=2.7

20 Seismic Zone: 0.2

21 Importance Category: 1.0

平面？立面？Shape of Building: Plan: rectangle, Elevation: rectangle

Generated By: **Mohsina Munir**

Generated On: **08/06/2024 11:32**

この表では、長辺方向Ｘ、短辺方向Ｙと定義されているが、
例題の建物では、逆に設定されていてややこしい。図面のＸ、Ｙの向きでまとめると良さそうだが
とりあえず、表の指示に倣って記入してみた。

Column Check at Ground Floor

Inputs from Structural Diagram

	User Input Description	Variable	Input Value	
6	Building height	H 34.5m		
	First floor height	h1 3.0m		S-S17B
	Plan dimension, long direction	X 30,489m		S-S01
	Plan dimension, short direction	Y 21,951m		S-S01
	Number of columns along one side, long direction 通りの数とした。	nx 7		S-S01
	Number of columns along one side, short direction 1,2通りと7,8通りは各々1とした。	ny 6		S-S01
71	Column dimension, long direction bldg (X) (hx=b) 構造図は、短辺をXとしているので逆。 GF/C-1	hx 300mm		
71	Column dimension, short direction bldg (Y) (hy=h) 構造図は、長辺をYとしているので逆。	hy 625mm		
74	Total number of bars	12		
74	Side B1: Number of Bars Each 長辺方向に有効な本数と考えた	6		
74	Bar size	25mm		
74	Side B2: Number of Bars Each 短辺方向に有効な本数と考えた	2		
74	Bar size	25mm		
74	Number of corner bars	1		
74	Corner bars size	25mm		
74	Area of reinforcing steel at each face of column (hx), long direction (X)	Asx 2-25mmより 2×491＝982mm²		
74	Area of reinforcing steel at each face of column (hy), short direction (Y)	Asy 6-25mmより 6×491＝2,946mm²		
74	Area of corner bar	Ascb 1-25mmより 1×491＝491mm²		
52-53	Concrete compression strength	f'c 31N/mm²		
62	Steel reinforcement yield strength	fy 414N/mm²		
	Modulus of elasticity of steel reinforcement ヤング係数の出力ある？	E	どこに記載あるか確認。	
83	Spacing of column ties at mid height of column	S 200mm		
24	Building weight	W 55,412.25kN		
28	Base shear	Vb 3,823.5kN		

Detailing checks

	No	Question	Response	
Manual A-13, 23	1	Are 135-degree hooks specified for column ties?	confirm	S-G03
84	2	Do the column ties extend into the beam-column joint?	confirm	S-S14a
66	3	Do columns and beams have Class B rebar splices with lengths of at least 72*db (bar diameter)? Where is 72db from?	どこに記載あるか確認。	
85	4.1	Is the column tie/hoop spacing compliant - 1/4 of the minimum column dimension? end area of SMF	IMFより適用外	
85	4.2	Is the column tie/hoop spacing compliant - 6x diameter of smallest longitudinal bar? end area of SMF	IMFより適用外	
85	4.3	Is the column tie/hoop spacing compliant - so= 100+(350-dx)/3, not larger than 150 mm and 100 mm end area of SMF	IMFより適用外	

	minimum, where dx is the distance between longitudinal bars supported by hoops or cross ties?		
5	Are cross ties provided where spacing between laterally supported longitudinal bars exceeds 355 mm? BNBC 8.3.5.4 (c), 350 mm BNBCのどこ？	どこに記載あるか確認。	
6	Do beams have at least two continuous bars, top and bottom? BNBC 8.3.4.2 BNBCのどこ？	confirm	S-S32～
7	Is the location of beam (and column) splices away from beam-column joints by at least 1/3 of the beam span (column height)? Wrong statement. BNBC Fig. 6.8.3, Sec. 8.3.4.2 BNBCのどこ？	どこに記載あるか確認。	S-G04
78 8	Does longitudinal steel meet minimum reinforcing requirements (0.01(Ag) minimum and 0.06(Ag) maximum)?	300×625、12-25φ ∴12×491/(300×625)＝0.031 0.01≦0.031≦0.06 okay	

上記はC-1を入力したが、以下は出力のある3F/C2を対象とした。

Shear capacity check

Vu	ϕVr	Check (Vu≤ ϕVr)
151.4356kN	同じ記号の出力なし 321.6102	OK

Interaction Diagram – X Direction

Column Force in X-Direction

M-N曲線の事の様だが、どこを見ればよいか分からない。

Axial Load (ΦPn) and Bending Moment (ΦMn) calculations for each point.

Points	ΦPn	ΦMn
1	0.00	0.00
2	0.00	0.00
3	0.00	0.00
4	0.00	0.00
5	0.00	0.00
6	0.00	0.00
7	0.00	0.00

Demand in X-Direction

ＲＩＳＥの指示に従うと、Ｘ方向は、54ページの3方向になるとして、下記記入。

Calculated maximum factored axial load in columns (PuMax) and factored moment in column section (Mu).

	Pu max	Mu
Max	2707.3593kN	112.5989kN-m
Min		65.624

何でPumaxとしているのに、表にMinの表示があるか、不明。良く分からないが、
Factored Pu, Muの値のv3（多分3方向）をmaxの所に記載した。minは良く分からない。

Interaction Diagram – Y Direction

Column Force in Y-Direction

M-N曲線の事の様だが、どこを見ればよいか分からない。

Axial Load (ΦPn) and Bending Moment (ΦMn) calculations for each point.

Points	ΦPn	ΦMn
1	0.00	0.00
2	0.00	0.00
3	0.00	0.00
4	0.00	0.00
5	0.00	0.00
6	0.00	0.00
7	0.00	0.00

Demand in Y-Direction

ＲＩＳＥの指示に従うと、Ｙ方向は、54ページの2方向になるとして、下記記入。

	Pu max	Mu
Max	2707.3593kN	−251.8134kN-m
Min		102.1757

何でPumaxとしているのに、表にMinの表示があるか、不明。良く分からないが、
Factored Pu, Muの値のv2（多分2方向）をmaxの所に記載した。minは良く分からない。

Shear Wall Checks

Inputs from Structural Diagram

	User Input Description	Variable	Input Value	
106	Thickness of shear wall どれを記入？ Story1/SW-3	h 300mm		
113	Area of horizontal reinforcing steel	Avh 2-12φ-@75より 2×113=226㎟		
113	Spacing of horizonal reinforcing steel	sh 75mm		
111	Area of vertical reinforcing steel	Avv 2-20φ-@120より 2×314=628㎟		
108	Spacing of vertical reinforcing steel	sv 120mm		
	Overturning Moment 何？	MOT		
108	Area of vertical reinforcing steel, end of the shear walls どの範囲？	AS_Provided 3-20φ？ 3×314=942㎟		
	Number of walls, X-direction 長辺に有効な壁とし、LIFT考慮。SW-1、SW-3、SW-4、SW-5	nx 8		
	Number of walls, Y-direction 短辺に有効な壁とし、LIFT考慮。SW-4、SW-5	ny 3		
28	Base Shear	Vb 3,823.5kN		
56	Concrete compressive strength	f'c 31N/㎟		
62	Rebar yield strength	fy 414N/㎟		
108, 113	Number of reinforcing steel layers, X-direction	nlayerX 2		S-S14, 15
108, 113	Number of reinforcing steel layers, Y-direction	nlayerY 2		S-S14, 15
	Resisting Moment 何？	MR		
113	Bar diameter, horizontal rebar	dbh 12mm		

108 Bar diameter, vertical rebar	dbv	20mm	

Detailing checks

No	Question	Response
109 1	Are the two layers of reinforcement provided for walls with thickness greater than 250mm? BNBC 6.6.3.4	confirm
2	Are special boundary elements provided for concrete shear walls over two levels in height and with height-to-length ratio (hw/lw) ≥ 2.0? BNBCのどこ？	どこに記載あるか確認。
3	Are the longitudinal bars of the boundary elements confined with ties or hoops that are 13mm minimum in diameter, with cross ties at longitudinal bars spaced greater than 355mm, and are the ties or hoops spaced no greater than 100 mm on center? BNBCのどこ？	どこに記載あるか確認。
4	Are the shear walls doweled to the foundation with dowels that match the size and spacing of the vertical bars? BNBCのどこ？	どこに記載あるか確認。
5	Are standard 90-degree hooks provided at the ends of the horizontal reinforcing bars? BNBCのどこ？	どこに記載あるか確認。 S-S16, 17
6	Are there at least two 16mm horizontal and vertical bars around all openings anchored at the ends to develop rebar yield strength (fy)? BNBCのどこ？	どこに記載あるか確認。

上記はSW-3を入力したが、以下は出力のあるSW-1を対象とした。

X Direction – Background Variables

Wall No (1st FL)	hw [m] (梁成引く)	Lw [m] (S-S15)	Hw/lw (H→hが正)	R	R/Sum(R)	Vu [kN]	Pu [Kn] (Kn→kN)	Ag [mm2] (495173)	Vc [kN]
SW-1	3.6-0.6 =3.0	1.6	1.875	何？	何？	478.7066	1748.3001 ↑FlexuralとBoundaryの二か所に記載あるがどっち？	何？	何？

X Direction – Horizontal max spacing and reinforcing steel ratio checks

主旨としては、全部の壁見るべき？デザインレポートで出力された壁を見れば良い？出力のSW-1のTopをとりあえず記入。

Wall No	ϕ Vc [kN]	ϕ Vc/2 [kN] 何に使う？	Number of Layers	Bar Diameter [mm]	Avh [mm2]	sh [mm]	Sh max. [mm]	Check Max Spacing 114 ?	pt	pt min. minとは？	Check Min pt
SW-1	297.7322	148.8661	2	12	2-12φ 2×113 ＝226㎟	75 ピッチ？	75 maxとは？	75mm	226/(300*75) =0.0100 →1.00%	1.00%	1.00%

X Direction – Vertical max spacing and reinforcing steel ratio checks

Wall No	ϕ Vc [kN]	ϕ Vc/2 [kN]	Number of Layers	Bar Diameter [mm	Avv [mm2]	sv [mm]	Sv max. [mm]	Check Max Spacing 109 ?	pl	pl min.	Check Min pl
SW-1	どこ見る？ 上記と同じ？		2	20	2-20φ 2×314 ＝628㎟	120 仮定	120	120	628/(300*120) =0.0174 →1.74%	1.74%	1.74%

X Direction – In-Plane Shear Checks

水平方向を考慮（出力のShear Design）

Wall No	Vu < ϕ Vc/2 [kN]	Vu < ϕ Vc [kN]	Vs [kN]	Vn [kN]	Vn. Max	Vn < Vn. Max	ϕ Vn [kN]	Vu < ϕ Vn
SW-1	478＜148 ダメ？	何？	何？	何？	何？	何？	630.6069	何？

X Direction – Tension Steel Check

鉛直方向を考慮（出力のFlexural Design）

Wall No	Hw [m]	Lw [m]	Vu[kN]	MOT [kN-m]	Pu [Dead Load ,kN]	MR [kN-m]	Tu [Tension, kN]	110 AS_Required [mm2]	111 AS_Provided [mm2]	112 Tension Steel Check
SW-1	一番上と同じ？		478.7066	何？	1872.4209	何？	何？	4976	8616	Adequate

Y方向は、必要鉄筋量の出力がある、LIFTを対象とした。

Y Direction – Background Variables

GF

Wall No	hw [m]	Lw [m]	Hw/lw	R	R/Sum(R)	Vu [kN]	Pu [Kn]	Ag [mm2]	Vc [kN]
LIFT	3.6−0.6 =3.0	4.1	0.73	何？	何？	出力なし	出力なし	出力なし 495173	出力なし

Y Direction – Horizontal max spacing and reinforcing steel ratio checks

Wall No	ϕ Vc [kN]	ϕ Vc/2 [kN]	Number of Layers	Bar Diameter [mm]	Avh [mm2]	sh [mm]	Sh max. [mm]	Check Max Spacing 114 ?	pt	pt min.	Check Min pt
LIFT	出力なし	出力なし	2	12	2-12φ 2×113 ＝226㎟	75	75	75mm	226/(300*75) =0.0100 →1.00%	1.00%	1.00%

Y Direction – Vertical max spacing and reinforcing steel ratio checks

Wall No	ϕ Vc [kN]	ϕ Vc/2 [kN]	Number of Layers	Bar Diameter [mm	Avv [mm2]	sv [mm]	Sv max. [mm]	Check Max Spacing 109 ?	pl	pl min.	Check Min pl
LIFT	出力なし	出力なし	2	16, 22	2-20φ 2×314 ＝628㎟ 2-16φ 2×201 ＝402㎟	20φ 150仮定 16φ 170仮定	170	170	402/(300*170) =0.0079 →0.79%	0.79%	0.79%

Y Direction – In-Plane Shear Checks

Wall No	Vu < ϕ Vc/2 [kN]	Vu < ϕ Vc [kN]	Vs [kN]	Vn [kN]	Vn. Max	Vn < Vn. Max	ϕ Vn [kN]	Vu < ϕ Vn
LIFT	出力なし	出力なし	出力なし	出力なし	出力なし	出力なし	出力なし	出力なし

Y Direction – Tension Steel Check

Wall No	Hw [m]	Lw [m]	Vu[kN]	MOT [kN-m]	Pu [Dead Load ,kN]	MR [kN-m]	Tu [Tension, kN]	110 AS_Required [mm2]	111 AS_Provided [mm2]	112 Tension Steel Check
LIFT	一番上と同じ？		出力なし	出力なし	出力なし	出力なし	出力なし	28311	33964	Adequate