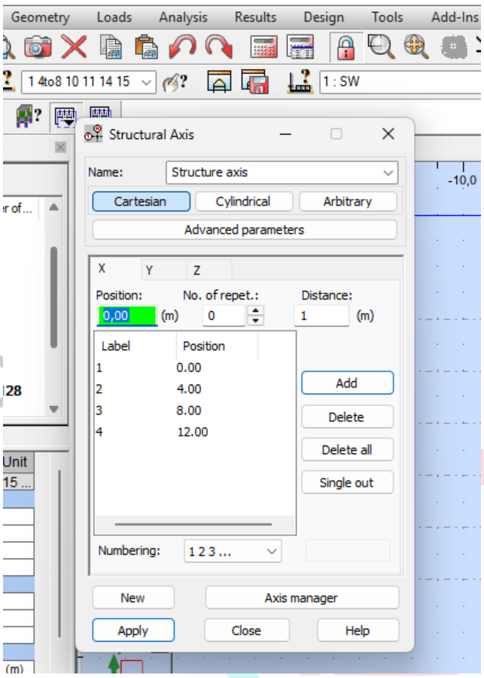
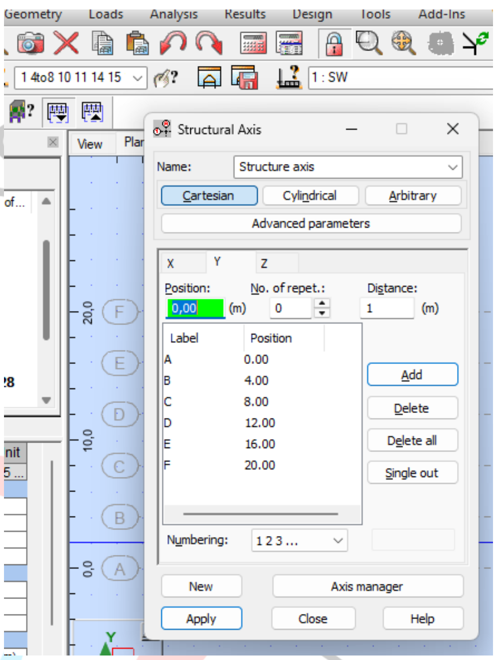
LAMPIRAN

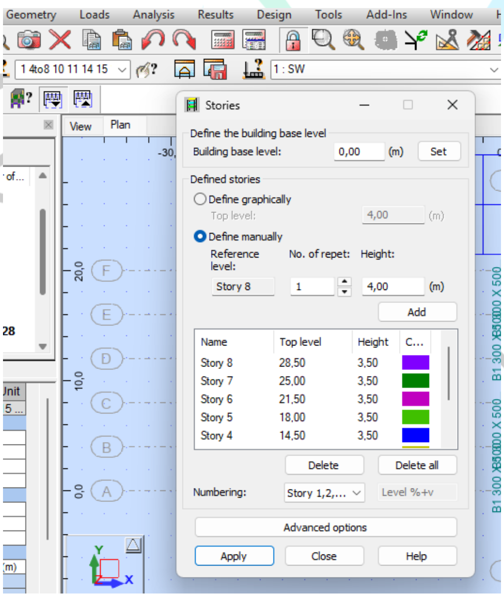
Lampiran 1 Tahapan Permodelan pada *Robot Strructural Analysis Professional* (RSAP)

Lampiran 1 Tahapan Permodelan Pada RSAP 2025

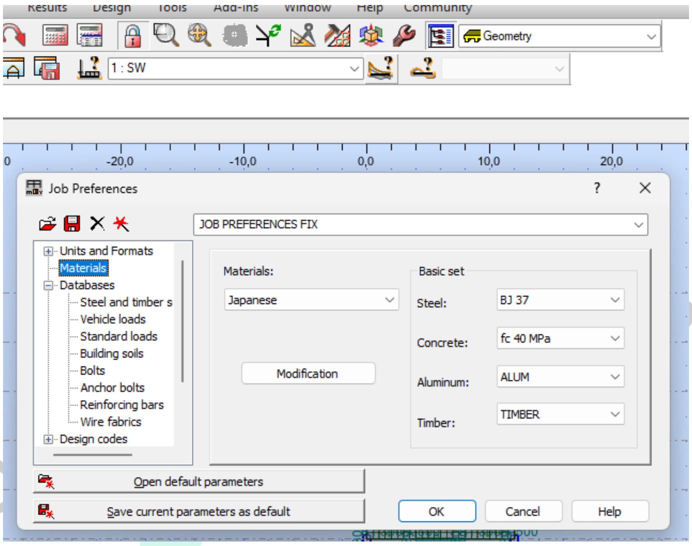
1. Mengatur *Grid*, dan Menambahkan *Stories*



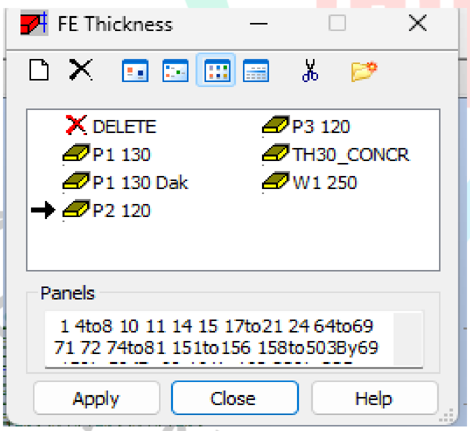


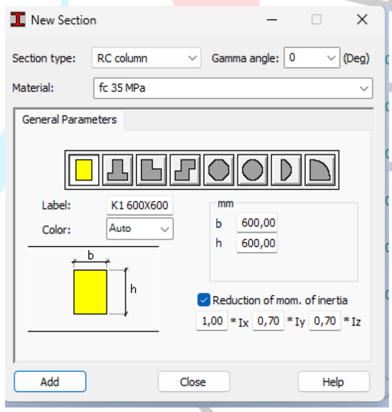


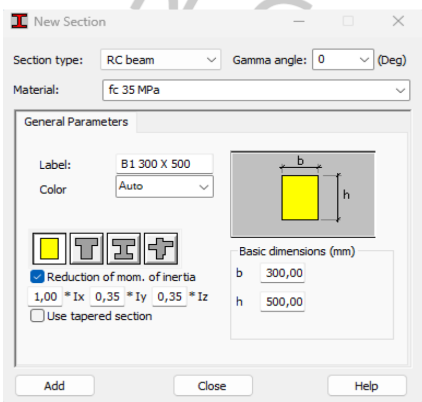
2. Define Material dan Standar parameter

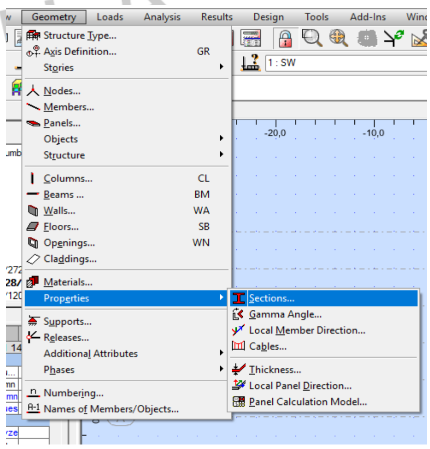


3. Membuat definisi penampang

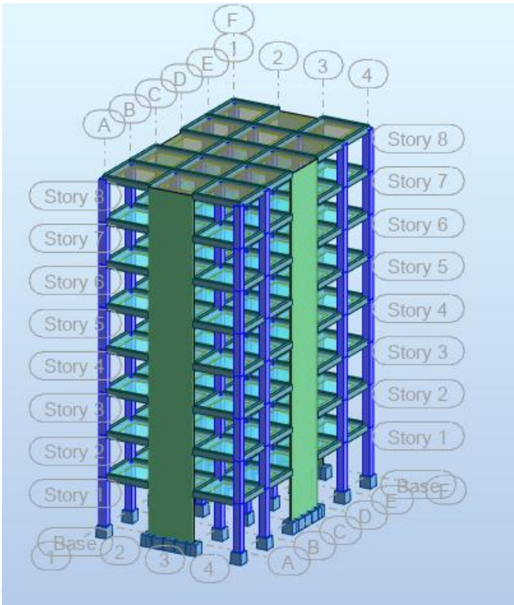


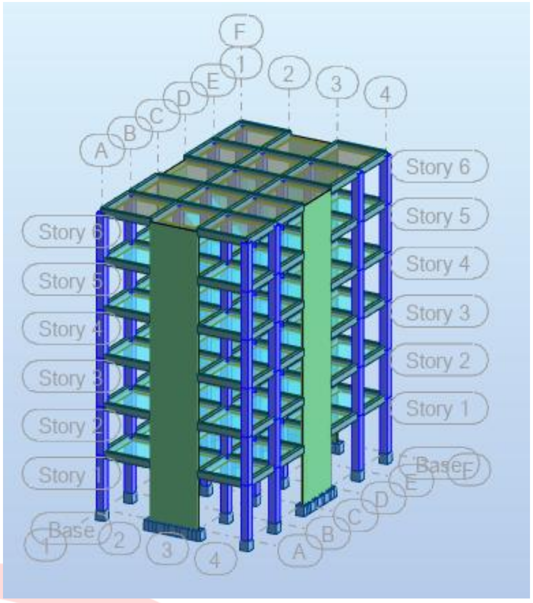


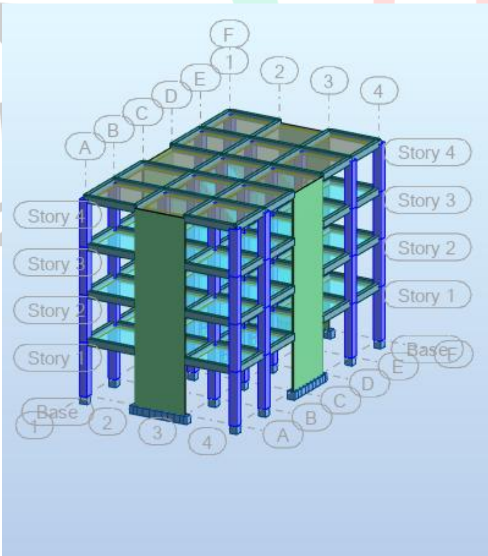




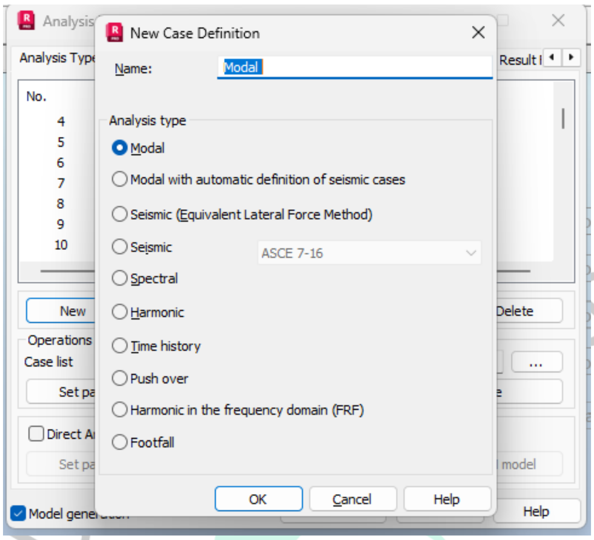
4. 3D Modelling struktur bangunan

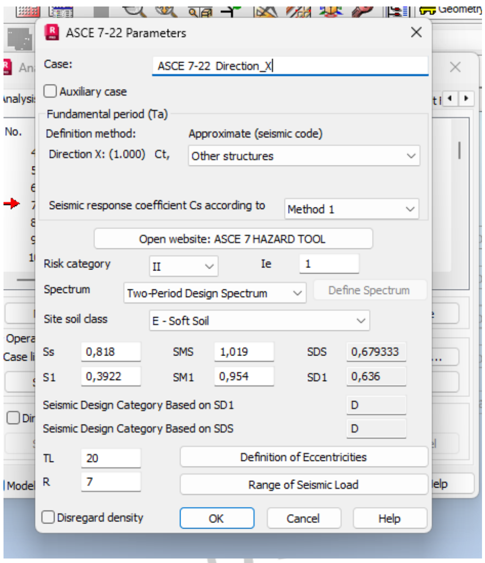




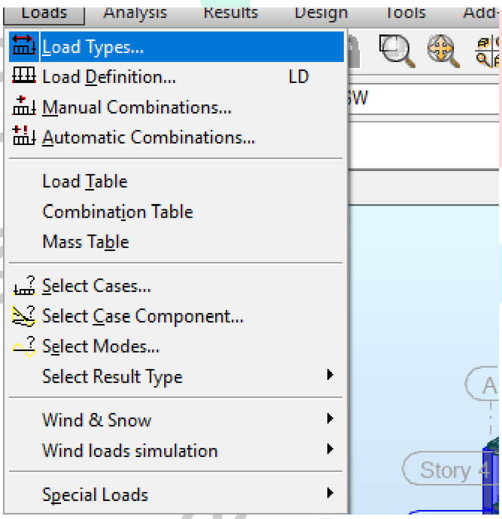


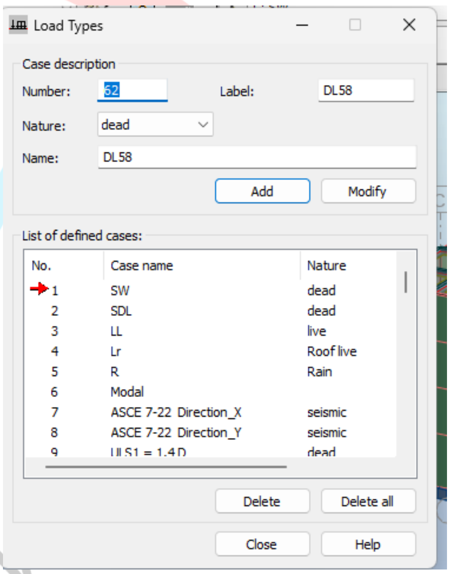
5. Input Modal & Parameter Gempa statik



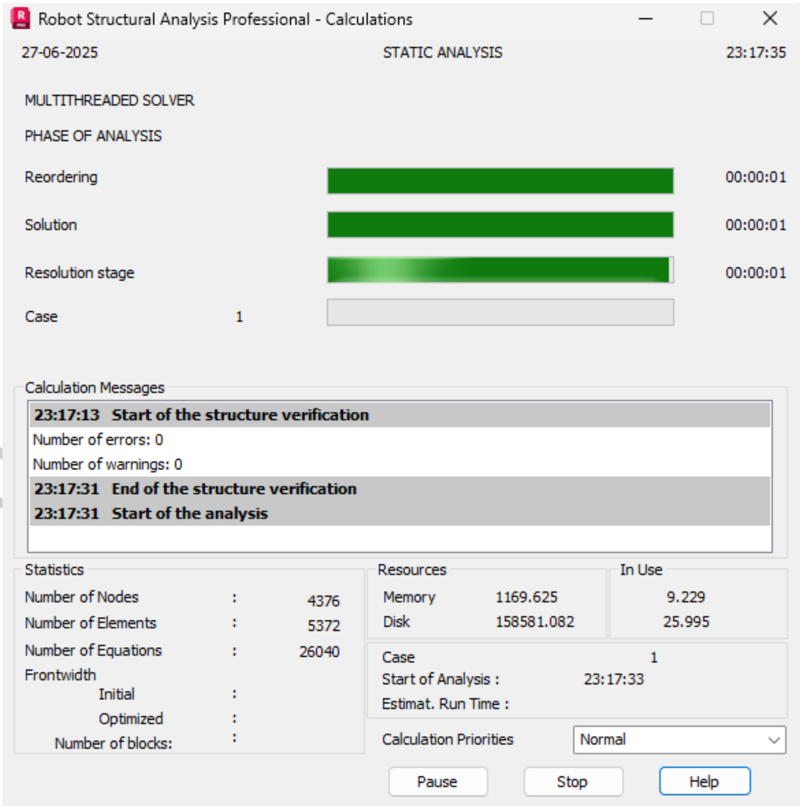


6. Input Pembebabanan dan Kombinasi Pembebanan





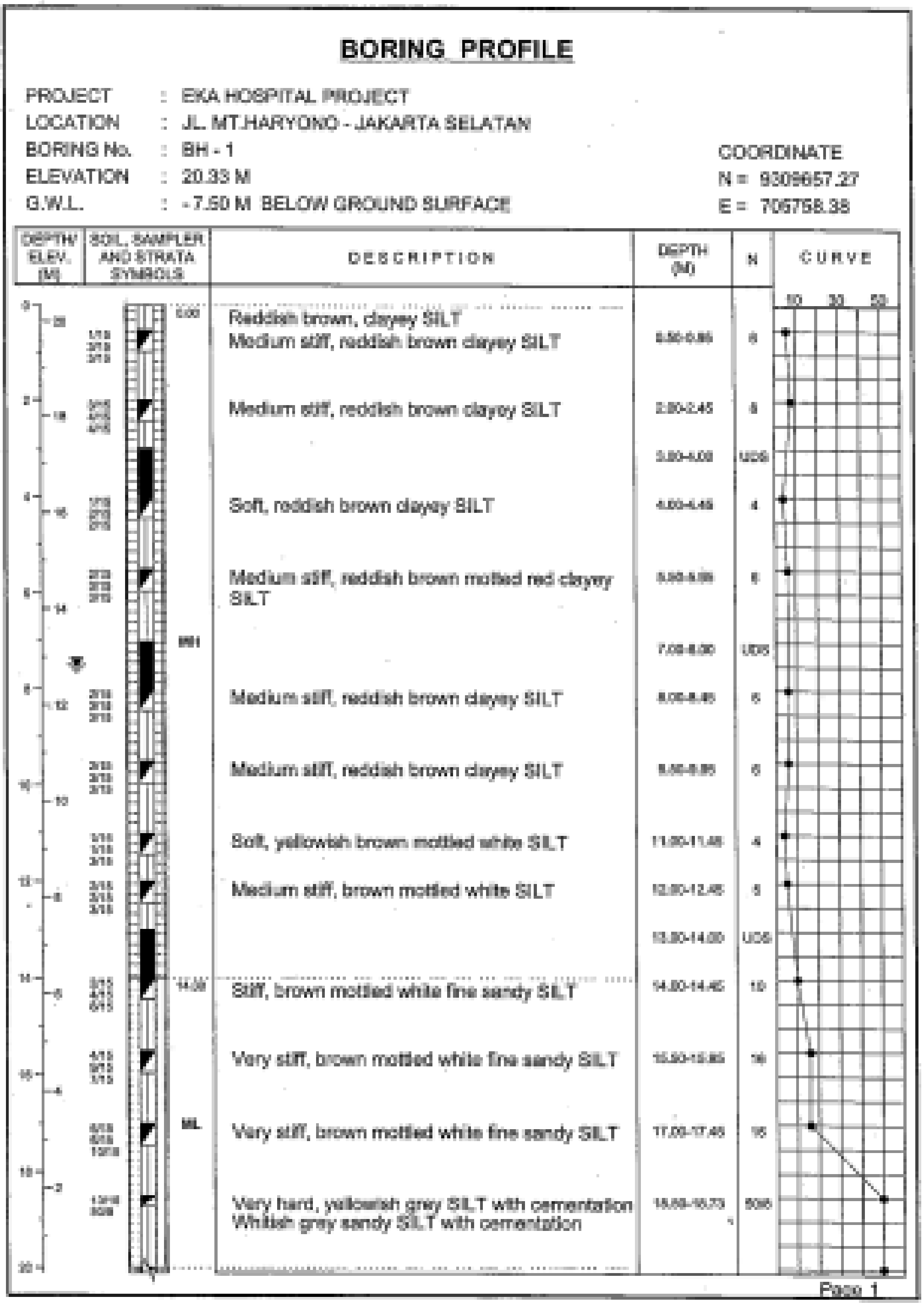
7. Running Analysis Calculation



Lampiran 2 Data Uji Sondir di Kec. Tebet, Kota Jakarta Selatan

Lampiran 2 Data Uji Sondir di Kec. Tebet, Kota Jakarta Selatan

1. Titik BH-1



BORING PROFILE

PROJECT : EKA HOSPITAL PROJECT
LOCATION : JL. MT.HARYONO - JAKARTA SELATAN
BORING No. : BH - 1
ELEVATION : 20.33 M
G.W.L. : - 7.50 M BELOW GROUND SURFACE

COORDINATE
N = 9309657.27
E = 706758.38

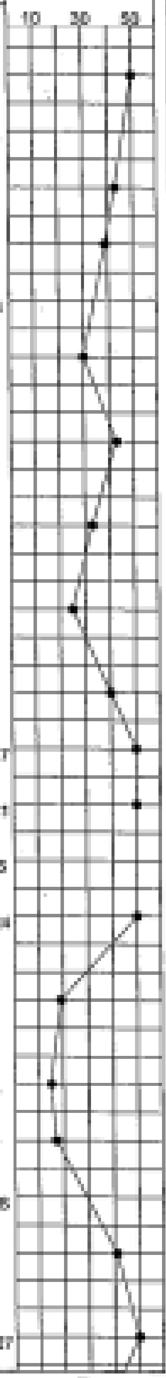
DESCRIPTION	DEPTH (M)	N
Reddish brown, clayey SILT		
Medium stiff, reddish brown clayey SILT	0.50-0.95	6
Medium stiff, reddish brown clayey SILT	2.00-2.45	8
	3.50-4.00	UDS
Soft, reddish brown clayey SILT	4.00-4.45	4
Medium stiff, reddish brown motted red clayey SILT	5.50-5.95	6
	7.00-8.00	UDS
Medium stiff, reddish brown clayey SILT	8.00-8.45	6
Medium stiff, reddish brown clayey SILT	9.50-9.95	6
Soft, yellowish brown mottled white SILT	11.00-11.45	4
Medium stiff, brown mottled white SILT	12.00-12.45	5
	13.50-14.00	UDS
Stiff, brown mottled white fine sandy SILT	14.00-14.45	10
Very stiff, brown mottled white fine sandy SILT	15.50-15.95	16
Very stiff, brown mottled white fine sandy SILT	17.00-17.45	16
Very hard, yellowish grey SILT with cementation Whitish grey sandy SILT with cementation	18.50-18.73	50/8

Page 1

PROJECT : EKA HOSPITAL PROJECT — BORING No. : BH - 1

DEPTH/ ELEV. (M)	SOIL, SAMPLER AND STRATA SYMBOLS	DESCRIPTION	DEPTH (M)	N
	SM	Very dense, brown silty SAND	20.00-20.21	50/6
		Brown mottled yellow clayey SILT and fine sand		
	21.05 SP	Very dense, brown fine sand stone	21.00-21.06	50/6
			22.00-22.30	DNS
	22.30 ML	Brown, SILT with cementation		
		Hard, brown fine sandy SILT with cementation	23.00-23.45	43
		Brown and dark grey fine sandy SILT with silty sand		
	24.00 SM	Dense, dark grey mottled white silty SAND	24.00-24.45	38
			25.00-25.50	DNS
	25.80 ML	Grey, SILT with trace of cementation		
		Hard,Grey, SILT with trace of cementation	26.00-26.45	30
	27.50 SM	Hard, dark grey silty fine SAND	27.50-27.95	45
	29.00 ML	Hard, dark grey fine sandy SILT	29.00-29.45	33
		Very stiff, grey to dark grey fine sandy SILT with trace of cementation	30.50-30.95	25
		Hard, grey to dark grey fine sandy SILT with trace of cementation	32.00-32.45	40
		Hard, grey to dark grey fine sandy SILT with trace of cementation	33.00-33.42	50/27
		Very hard, Dark grey mottled white SILT	34.00-34.36	50/21
			35.00-35.50	DNS
		Very hard, dark grey SILT with cementation	36.00-36.39	50/24
	36.50 MH	Grey and dark grey clayey SILT with trace of cementation		
	37.50 CH	Very stiff, light grey and yellowish grey silty CLAY	37.50-37.95	19
		Stiff, light grey and yellowish grey silty CLAY	39.00-39.45	15
		Grey, reddish brown and yellowish grey silty CLAY	40.00-40.45	17
			41.00-42.00	UDS
	42.00 ML	Hard, light grey and yellowish brown sandy SILT	42.00-42.45	41
		Very hard, brown sandy SILT with cementation	43.50-43.82	50/27
	43.82			

CURVE

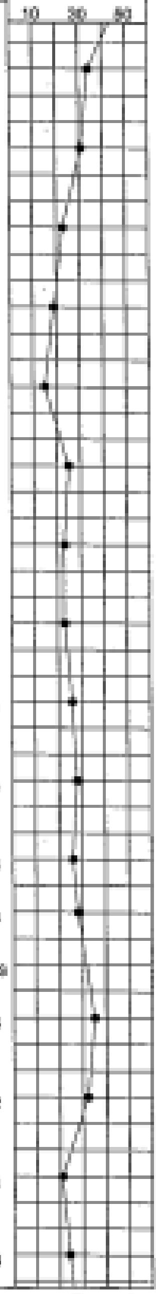


Page 2

SOFOCO

PROJECT : EKA HOSPITAL PROJECT — BORING No. : BH - 1

DESCRIPTION	DEPTH (M)	N
Brown, yellowish brown and grey clayey SILT with cementation		
Hard, grey and yellowish brown mottled white clayey SILT with trace of cementation	45.00-45.45	34
Hard, grey and yellowish brown mottled white clayey SILT with trace of cementation (MH)	46.50-46.95	31
Very stiff, grey, brown and yellowish brown clayey SILT with cementation	48.00-48.45	23
Very stiff, yellowish brown grey silty CLAY	49.50-49.95	15
Stiff, greenish grey and brown silty CLAY	51.00-51.45	15
Very stiff, grey and brown silty CLAY	52.50-52.95	20
Very stiff, grey, red and yellow silty CLAY	54.00-54.45	23
Very stiff, grey, yellowish brown silty CLAY	55.50-55.95	23
Very stiff, grey, yellowish brown silty CLAY	57.00-57.45	28
Very stiff, yellowish brown silty CLAY with cementation	58.50-58.95	28
Very stiff, brown and light grey silty CLAY with cementation	60.00-60.45	26
Very stiff, brown and light grey silty CLAY with cementation	61.00-61.45	28
	62.00-63.00	DNS
Hard, yellowish brown and grey silty CLAY	63.00-63.45	35
Hard, yellowish brown and grey silty CLAY	64.50-64.95	32
Very stiff, yellowish grey silty CLAY with cemntation (OH)	66.00-66.45	21
Very stiff, yellowish grey silty CLAY with	67.50-67.95	24



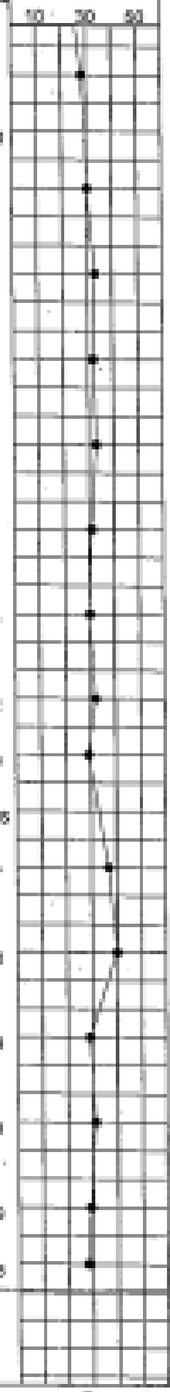
Page 3

SOFOCO

PROJECT : EKA HOSPITAL PROJECT — BORING No. : BH - 1

DEPTH/ELEV. (M)	SOIL, SAMPLER AND STRATA SYMBOLS	DESCRIPTION	DEPTH (M)	N
		cemntation		
		Very stiff, grey and yellowish brown silty CLAY	69.00-69.45	28
			70.00-71.00	UDS
		Very stiff, yellowish brown and grey silty CLAY	71.00-71.45	30
		Hard, yellowish brown and grey silty CLAY	72.50-72.95	33
		Hard, yellowish brown and grey silty CLAY	74.00-74.45	32
		Hard, yellowish grey silty CLAY with cementation	75.50-75.95	33
		Hard, yellowish grey silty CLAY with cementation	77.00-77.45	31
		Very stiff, yellowish grey silty CLAY with cementation	78.50-78.95	30
		Hard, grey and dark grey Silty CLAY	80.00-80.45	32
		Light brown, grey and dark grey silty CLAY		
		Very stiff, yellow grey and dark grey silty CLAY	81.00-81.45	29
			82.00-83.00	UDS
		Hard, grey, yellow and dark grey silty CLAY	83.00-83.45	37
	MH	Hard, grey and greyish brown clayey SILT	84.50-84.95	40
		Yellowish brown and dark grey silty CLAY		
		Very stiff, yellowish brown and dark grey silty CLAY	86.00-86.45	29
	CH	Hard, grey and dark grey silty CLAY with cementation	87.50-87.95	34
		Very stiff, grey and dark grey silty CLAY	89.00-89.45	29
		Very stiff, grey and dark grey silty CLAY	90.00-90.45	28
		Boring terminated at a depth of 90.45 M On July 24 - Agustus 9, 2029		

CURVE



Page 4

SOFOCO

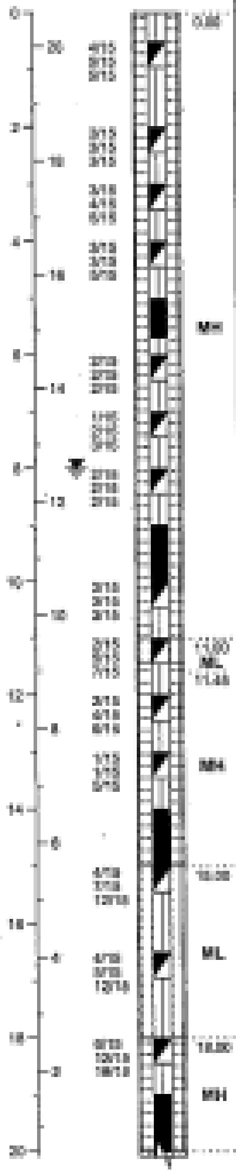
2. Titik BH-2

BORING PROFILE

PROJECT : EKA HOSPITAL PROJECT
LOCATION : JL. MT.HARYONO - JAKARTA SELATAN
BORING No. : BH - 2
ELEVATION : 20.59 M
G.W.L. : - 8.00 M BELOW GROUND SURFACE

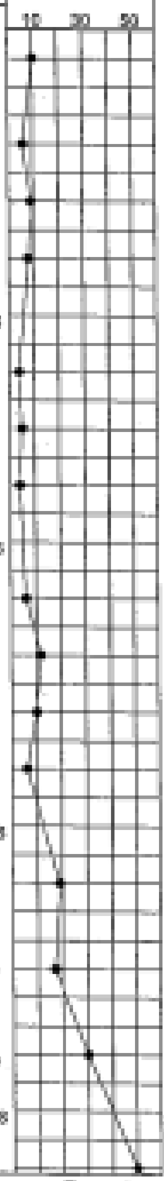
COORDINATE
N = 9309658.32
E = 705731.89

DEPTH/ ELEV. (M) — SOIL, SAMPLER AND STRATA SYMBOLS



DESCRIPTION	DEPTH (M)	N
Brown, clayey SILT Stiff, brown clayey SILT	0.50-0.95	10
Medium stiff, brown clayey SILT	2.00-2.45	6
Stiff, brown clayey SILT	3.00-3.45	9
Medium stiff, brown clayey SILT	4.00-4.45	8
	5.00-5.70	UDS
Soft, reddish brown clayey SILT Reddish brown mottled whitish grey clayey SILT	6.00-6.45	4
Medium stiff,reddish brown mottled whitish grey clayey SILT	7.00-7.45	5
Soft, Reddish brown mottled whitish grey clayey SILT	8.00-8.45	4
	9.00-10.00	UDS
Stiff, reddish brown and whitish grey clayey SILT	10.00-10.45	6
Stiff, brown mottled white fine sandy SILT	11.00-11.45	12
Reddish brown, yellowish brown and grey clayey SILT	12.00-12.45	10
Stiff,reddish brown yellowish brown and grey clayey SILT Medium stiff, brown to dark brown mottled white clayey SILT	13.00-13.45	8
	14.00-15.00	UDS
Very stiff, brown mottled white sandy SILT	15.00-15.45	19
Very stiff, brown mottled white fine sandy SILT	16.50-16.95	17
Very stiff, brown and grey clayey SILT	18.00-18.45	30
Whitish grey and brown clayey SILT with cementation	19.00-20.00	DNS

CURVE



Page 1

SOFOCO

PROJECT : EKA HOSPITAL PROJECT BORING No. : BH - 2

STRATA	DESCRIPTION	DEPTH (M)	N
20.00 SM	Very dense, yellowish brown silty fine SAND stone	20.00-20.15	50/15
21.00 ML	Very hard, brown, cemented SILT Brown, cemented silt and sand stone	21.00-21.30	50/15
22.00 SP	Very dense, dark grey and black fine SAND with trace of cementation	22.00-22.28	50/13
23.00	Very hard, light brown SILT with cementation and silty sand	23.00-23.33	50/18
		24.00-25.00	DNS
ML	Very hard, greyish brown SILT with cementation	25.00-25.20	50/20
	Very hard, brownish grey SILT with cementation	26.00-26.45	50
27.50	Yellowish brown and dark grey SILT with cementation	27.50-27.95	45
SM	Dense, black silty fine SAND		
29.00	Very hard, dark grey SILT with cementation	29.00-29.32	50/17
	Very stiff, dark grey sandy SILT with cementation	30.00-30.45	25
ML		31.00-31.50	DNS
	Very hard, dark grey silt with cementation	32.00-32.34	50/19
	Very hard, dark grey silt with cementation	33.00-33.30	50/15
34.00 SM	Dense, dark grey and black silty fine SAND	34.00-34.45	45
35.00	Very hard, grey to dark grey cemented SILT	35.00-35.15	50/15
ML	Hard, grey and dark grey SILT with trace of cementation	36.00-36.45	37
37.50 CH-MH	Grey, dark grey and yellowish grey clayey SILT with silty clay	37.50-37.95	33
37.95	Very stiff, grey, dark grey and yellowish grey clayey SILT with silty clay		
	Stiff, yellowish grey silty CLAY	39.00-39.45	15
CH	Very stiff, yellowish grey and grey silty CLAY	40.00-40.45	20
	Very stiff, yellowish grey and grey silty CLAY	41.00-41.45	28
42.00 MH	Very hard, grey and reddish brown clayey SILT	42.00-42.43	50/28
43.50	Very hard, grey and reddish brown sandy clayey	43.50-43.82	50/17

Page 2

SOFOCO

PROJECT : EKA HOSPITAL PROJECT — BORING No. : BH - 2

DEPTH/ ELEV. (M)	SOIL, SAMPLER AND STRATA SYMBOLS	DESCRIPTION	DEPTH (M)	N
	CL-ML	SILT		
	45.00	Very hard, grey clayey SILT	45.00-45.45	50
		Very hard, yellowish grey and grey clayey SILT with cementation	46.50-46.90	50/25
	MH	Very stiff, yeloowish grey and grey clayey SILT with cementation	48.00-48.45	28
		Very stiff, grey and yellowish brown clayey SILT with trace of cementation	49.50-49.95	24
			51.00-52.00	UDS
	52.00 MH	Very stiff, light grey yellowish brown clayey SILT	52.00-52.45	22
	53.00	Greyish brown and dark grey silty CLAY with cementation Hard, dark grey and brown silty CLAY	53.50-53.95	37
		Very stiff, grey silty CLAY with cementation	55.00-55.45	28
	CH	Very stiff, grey silty CLAY with cementation	56.50-56.95	30
		Hard, grey and whitish grey silty CLAY with cementation	58.00-58.45	42
		Hard, grey whitish grey silty CLAY with cementation	59.50-59.95	44

Boring terminated at a depth of 59,45 M
On July 24 - Augustus 4, 2020

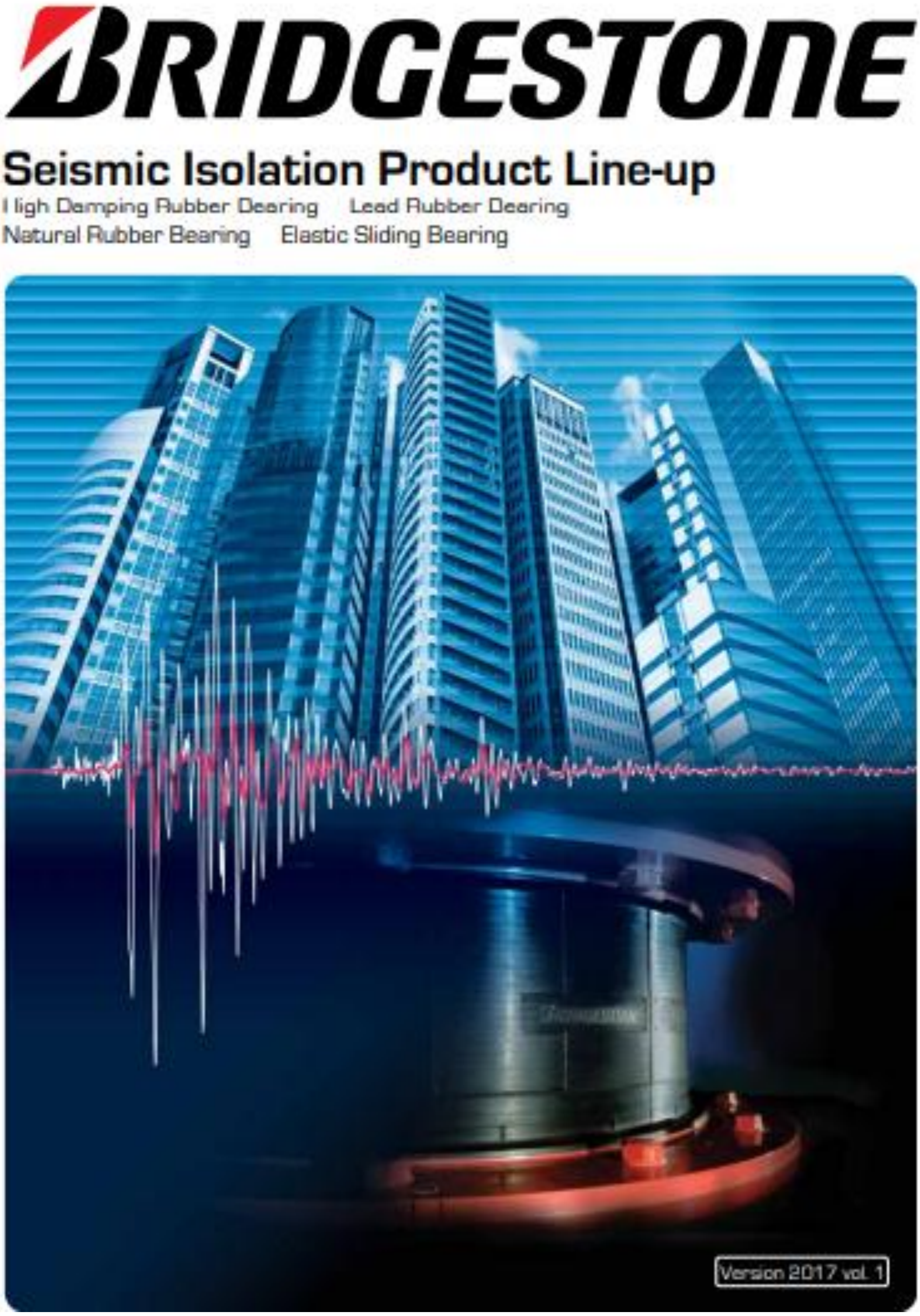
CURVE: 10 30 50

Page 3

SOFOCO

Lampiran 3 Katalog *Base Islation* (Bridgestone)

Lampiran 3 Katalog *Base Islation* (Bridgestone)



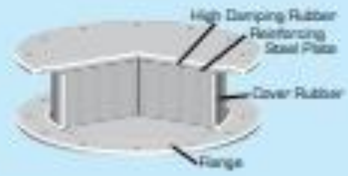
Bridgestone Seismic Isolation Product Line-up

We will meet the customer needs with our new product line-up

Features | **Sectional View**

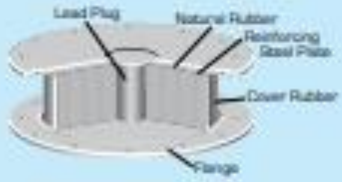
HDR
High Damping Rubber Bearing

High damping rubber includes both spring and damping characteristics. Generally, a separate damper is not required, making it an excellent choice for areas with space constraints. Since its hysteresis curves are relatively smooth, seismic isolation can also be extended to the equipment inside the building.There are 3 different elastic moduli are available (X0.3R, X0.4S, X0.6R). From light column loads until high rise building can be accommodated.



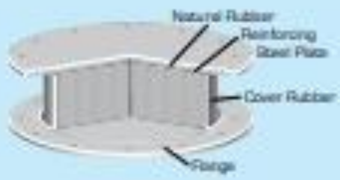
LRB
Lead Rubber Bearing

This bearing includes a lead plug embedded at the centre of a laminated natural rubber structure, where the rubber incorporates the spring capability and the lead plug provides the damping capability. Generally, a separate damper is not required making it a good choice for areas with space constraints. Its hysteresis resembles elasto-plastic materials. The attenuation can be tuned by varying the lead plug diameter. One type of rubber material is available (G0.40).



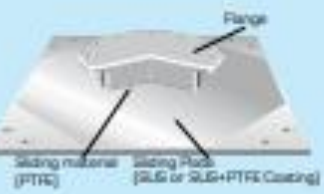
NRB
Natural Rubber Bearing

This bearing uses natural rubber, which inherently has a low damping ratio (about 2~3% equivalent damping ratio), excellent linearity, and a stable restoring force.
A separate damper is required, but the overall isolation design has much greater flexibility. Four different kinds of elastic moduli are available (G0.30 , G0.35 , G0.40 , G0.45) to support a wide range of column loads.



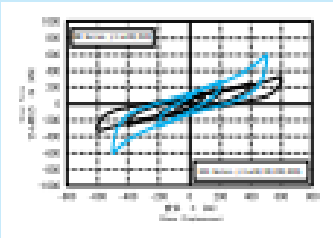
Elastic Sliding Bearing

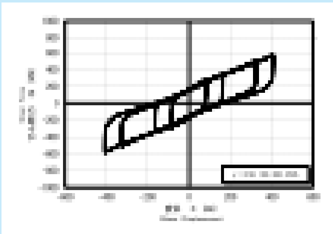
This bearing consists of 2 pieces: 1) a natural rubber bearing bonded with PTFE (Teflon) material and 2) a stainless steel slide plate. Small displacements are absorbed by the rubber itself, while large displacements cause the rubber bearing to slide on the plate. Since there is no restoring force, the slide bearing is normally used in combination with NRB, LRB or HDR. Two different coefficients of friction are available to suit the damping requirements.

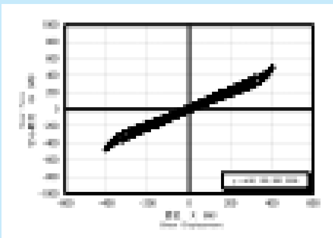


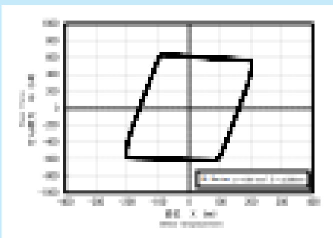
Note: The above diagram and hysteretic loop are for illustrative purpose only.

Hysteretic Loop









Content

Product & System Introduction

High Damping Rubber Bearing X Series

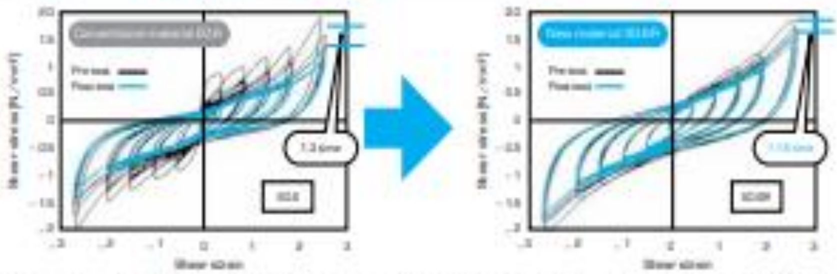
Features of High Damping Rubber Bearing X Series

High damping rubber bearing is a laminated rubber structure that includes a special filler compound in the rubber itself to provide energy absorption performance. It combines damping and spring charateristics and is widely adopted as a seismic isolator.

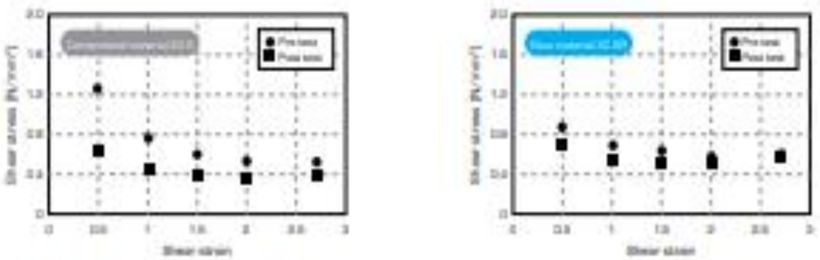
However, the conventional high damping rubber shows loading hysteresis dependency, where its rate of change of stiffness has become reduced and restoration becomes progressively worse after repeated loading under increasing deformation.

With Bridgestone's next-generation of high damping rubber X series, the effect of loading hysteresis dependency is greatly reduced and the properties become much simpler to manage. Furthermore, it is also more accommodating to the reduction in ultimate properties caused by bi-directional loading.

● Reduction in Loading Hysteresis Dependency



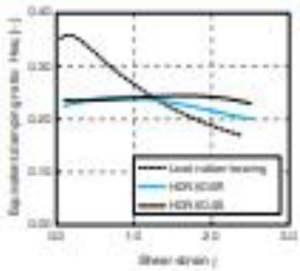
Compared to conventional high damping rubber, the change of equivalent shear stiffness (1cycle/3cycle) in repeated loading is greatly reduced. The properties of seismic isolation bearings are defined by the 3rd cycle and it is able to reduce the load variation during initial deformation.



Conventional high damping rubber shows shear stress reduction after large deformation due to the effect of loading hysteresis dependency, but the next-generation high damping rubber is able to minimize the change in properties before and after large deformation. By reducing the effect of loading hysteresis dependency, the accuracy of the overall seismic isolation design can be improved.

● Increasing of Equivalent Damping Ratio

Compared to conventional high damping rubber, the equivalent damping ratio (at shear strain $\gamma = \pm 100\%$) of high damping rubber XO.45, XO.6R are increased (XO.45:0.220 → 0.240, XO.6R:0.225 → 0.240). Furthermore, compared to the same diameter of lead rubber bearing (lead diameter/outer diameter = 0.2), a higher damping ratio can be obtained in the range of $\gamma \geq 130\%$.



3

Ultimate Properties of High Damping Rubber Bearings by Horizontal Bi-directional Loading

Outline

The ultimate deformation of high-damping rubber is degraded by applying bi-directional loading compared to unidirectional loading. Through a horizontal bi-directional loading test with a full scale model high-damping rubber bearing, torsional deformation can be seen in the side view of the rubber. Compared with unidirectional loading, the phenomenon of breaking at early stage by bi-directional loading has been identified. The standard value of the ultimate properties, influenced by bi-directional loading is shown below and the ultimate compressive stress is confirmed.

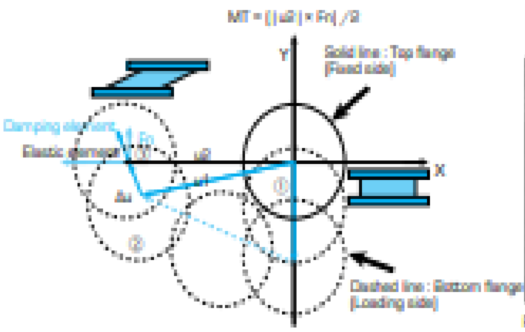


Figure 1: The mechanism of torsional deformation

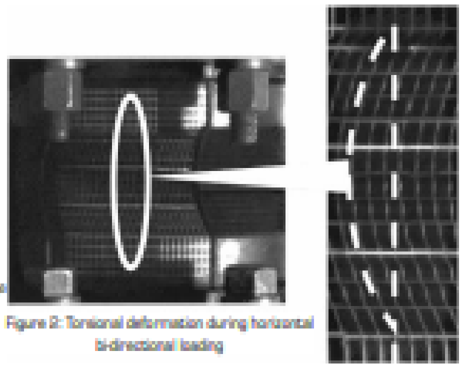


Figure 2: Torsional deformation during horizontal bi-directional loading

As shown in Figure 1, when the bi-directional loading is applied on a high damping rubber bearing, the elastic force occurs in the shear deformation direction, while the damping force occurs in the tangential direction of the deformation trajectory. The torsional moment created by the damping elements and the shear deformation is present at each rubber layer of the laminated structure. The additional shear strain γ_{t} caused by torsional deformation is added to the shear strain caused by the rubber shear deformation itself. Thus, it will rupture relatively early compared to the unidirectional loading test. However, the torsional deformation caused by bi-directional loading does not affect the bucking ultimate strain, as verified experimentally.

Ultimate Property of Horizontal Bi-directional Loading

According to the Japan Society of Seismic Isolation (JSSI) guidelines, the final ultimate strain is determined by the minimum of the ultimate strain γ_u by unidirectional loading and the ultimate strain γ_{bu} by bi-directional loading.

- Ultimate strain by unidirectional loading
  Ultimate strain by unidirectional loading is defined as shown in Table 1.

Table 1: Standard value of ultimate strain by unidirectional loading

Compound	Ultimate strain by unidirectional loading γ_u
X0.4S	$S_2 \times 0.9 \times 100\%$ $(0.9 \times S_2 < 4)$ 400% $(0.9 \times S_2 \geqq 4)$
X0.6R	$S_2 \times 0.9 \times 100\%$ $(S_2 < 4.5)$ 400% $(S_2 \geqq 4.5)$

S₂: Second shape factor

- Ultimate strain by bi-directional loading
  Ultimate strain by bi-directional loading is defined as shown in Table 2.

Table 2: Standard value of ultimate strain by bi-directional loading

Compound	Formula of ultimate strain by bi-directional loading γ_{bu}
X0.4S	$\gamma_{bu} = (5.80 \times S_2 + 9.05) / (S_2 + 4.49)$
X0.6R	$\gamma_{bu} = (5.00 \times S_2 + 9.05) / (S_2 + 4.49)$

S₂: Second shape factor

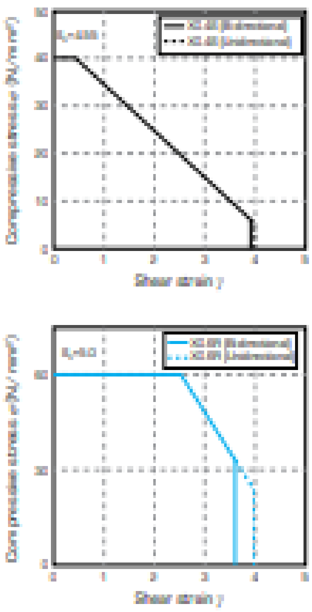


Figure 3: Comparison example of ultimate property diagram

4

LAP² + t.Ver2 (Layout Planning Assistance Program for Seismic Isolation Device)

LAP² + t.Ver2 is a program that supports layout planning of Bridgestone seismic isolation bearing for seismically isolated building.
The ideal seismic isolation bearing (in terms of size) can be determined from the column axial force (nominal long term column load) and the selections of seismic isolation bearing's series based on the layout of the seismic isolation interface. In addition to Bridgestone made seismic isolation bearings, hysteresis type dampers or oil dampers which are typically used in Japan can be specified in the program.
The selections can be changed (or specified) interactively on the GUI (Graphic User Interface) screen by the click of a mouse and the notification calculation for that bearing arrangement can be carried out as well.
Besides, regarding to the bearing layout planning, the mathematical process which is using genetic algorithm could produce an optimization function whereby by satisfying the notification calculation and at the same time reduce as much as possible the shear force for the layout plan,or by satisfying the notification calculation and at the same time reduce as much as possible the response displacement for the layout plan that could meet the criterias. In addition to being able to verify by the notification calculation, the Lap² +t.Ver2 software allows response calculation for seismic response analysis.

●Simple Input

From the data-input and modification of the seismic isolation interface, seismic response analysis can be conducted easily. Also, Lap² + t.Ver2 is compatible software that can capture or transfer structural calculation data from the "Super Build / SS3" software which is developed by Union System.
•"Super Build / SS3" is a registered trademark of Union System Inc.

●Seismic Isolation Devices

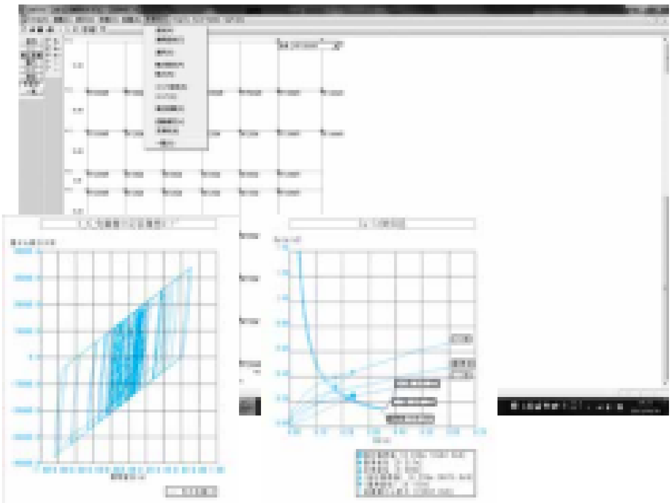
Bridgestone natural rubber bearing, lead rubber bearing, high damping rubber bearing, elastic sliding bearing, other standard hysteretic dampers and oil dampers can be adopted.

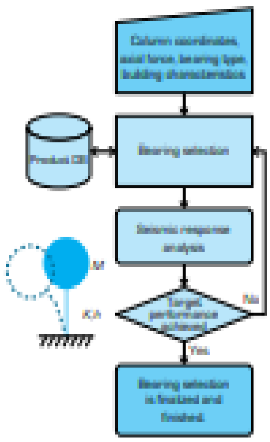
●2 Calculation Functions of Seismically Isolated Structure

● "Seismic Response calculation by seismic isolation notification※1 "......the results of the calculation can be printed in a reporting style.
● "Seismic response calculation by time history analysis"......the calculation can be conducted for various earthquake waves. Also, Lap² +t.Ver2 can work together with the structural calculation software "Super Dynamic Pro" from Union System.
※1 The structural calculation method is based on the "Technical standards required for safety which relates to the structural method for seismically-isolated buildings" as stated in the notification No.2009 of the Ministry of Construction, in the year 2000.

●Layout Planning of Seismic Isolation Devices

The software helps you to choose the appropriate seismic isolation devices and its placement in the building to satisfy the target performance.





Product Specification & Description of Performance Characteristics

High Damping Rubber Bearing (HDR)

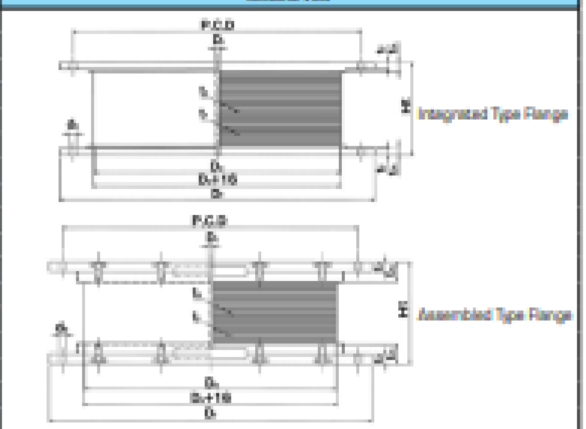
Seismic isolation material certification number by Ministry of Land, Infrastructure and Transport, Japan

MVBR-0516 (X0.3R Series)	**Acquired in December 2014**
MVBR-0510/MVBR-0519 (X0.4S Series)	**Acquired in December 2014**
MVBR-0514/MVBR-0520 (X0.6R Series)	**Acquired in December 2014**

●Product Dimension

Characteristics		
Physical Dimensions	Outer diameter	: D_o (mm)
	Inner diameter	: D_i (mm)
	Number of inner diameter	: n
	Effective plane area	: A (× 10^3mm²)
	Thickness of one rubber layer	: t_r (mm)
	Number of rubber layers	: n
	Total rubber thickness	: $H = n \cdot t_r$ (mm)
	First shape factor $S_1 = (D_o^2 - n \cdot D_i^2) / \{4 \cdot t_r \cdot (D_o + n \cdot D_i)\}$	
	Second shape factor $S_2 = D_o / (n \cdot t_r)$	
	Diameter of flange	: D_f (mm)
	Thickness of flange edge/center	: t_e / t_c (mm)
	Connecting bolt PCD	: PCD (mm)
	Diameter of connecting bolt hole × qty	: d_b (mm) × qty
	Bolt size (assumption)	: M (d_b −3)
	Thickness of each reinforced steel plate	: t_s (mm)
	Total height	: H_t (mm)
	Total weight 1 (kN) = 1 / 9.80665 (tonf)	

Sectional View



●Rubber Material

Notation of rubber kind (standard temperature 20°C, standard strain γ = 100%)

Compound name	Rubber code	Shear modulus G_{eq} (N/mm²)	Equivalent damping ratio H_{eq}
X3R	X0.3R	0.300	0.17
X4S	X0.4S	0.392	0.24
X6R	X0.6R	0.620	0.24

Composition of rubber materials (weight ratio %)

Rubber code		Natural rubber Synthetic rubber	Filler, Reinforcement agent	Vulcanization agent and others
Inner Rubber	X0.3R	35 and above	15 and above	50 and below
	X0.4S	35 and above	20 and above	45 and below
	X0.6R	35 and above	25 and above	40 and below
Cover rubber		40 and above	15 and above	40 and below

Properties of rubber materials

Item		Tensile strength (N/mm²)	Elongation at Break (%)	Hardness (JIS A)	100% modulus (N/mm²)	Young's modulus E (N/mm²)	Bulk modulus E_∞ (N/mm²)	Correction factor for apparent Young's modulus according to hardness, k
Test Standard		JIS K6251	JIS K6251	JIS K6253	JIS K6251	−	−	−
Inner Rubber	X0.3R	7 and above	700 and above	36 ± 8	0.53 ± 0.2	4.0	1150	1.0
	X0.4S	7 and above	600 and above	37 ± 8	0.43 ± 0.2	6.2	1300	1.0
	X0.6R	8.5 and above	780 and above	50 ± 5	0.73 ± 0.2	7.6	1500	1.0
Cover rubber		10 and above	600 and above	−	−			

●Steel Material

Steel material for each part

	Material
Reinforced steel plate	SS400 (JIS G 3101)
Flange*1*2	SS400 (JIS G 3101)
Connecting plate*1	SS400 (JIS G 3101)

*1: Optionally SM490A (JIS G 3106).
*2: Optionally special thickness other than standard thickness.

Anti-rust treatment of flange

Preparation	Remove rust up to blasting quality of SSPC-SP 10 (ISO Sa 2 1/2)
Primer	Zinc-rich paint 75μm × 1 coat
Middle coat	Epoxy resin paint 60μm × 1 coat
Finishing	Epoxy resin paint 35μm × 1 coat
Total film thickness	170μm and above

*1: Standard color is gray.
*2: Other kinds of anti-rust treatment are also available. Please contact us for more details.

●Precautions

- For mid-storey isolation, fire resistant cover is necessary (according to JSSI provision, HS1100X4S cannot apply any fire resistant cover). Please contact fire resistant cover manufacturer who are listed in the JSSI manufacturer list for more details. (http://www.jssi.or.jp/bussiness/kigyou_detail/to-si-base.htm)
- There are two certification numbers for X0.4S, X0.6R due to difference of some manufacturing process. Although their properties values are the same, please fill the certification number as shown in the table on the right in the design documents.

	Rubber size ∅1000 and below	Rubber size ∅1100 and above
X0.4S	Both MVBR-0510/MVBR-0519	MVBR-0510 only
X0.6R	Both MVBR-0514/MVBR-0520	MVBR-0514 only

●Shear Properties

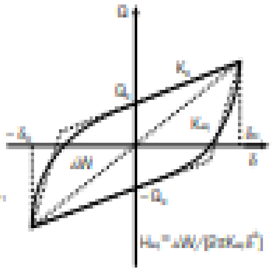
Equivalent shear stiffness K_{eq}, equivalent damping ratio H_{eq}, initial stiffness K_1, post-yield stiffness K_2, characteristic strength Q_d, Function giving ratio of characteristic strength to maximum shear force of a loop u

Shear properties of HDR is dependent on shear strain amplitude. The shear strain dependency of each property is expressed by the following equations.

●Rubber material X0.3R $(0.1 \leq \gamma \leq 3.0)$	$G_{eq}(\gamma) = 0.0355\,\gamma^4 - 0.2913\,\gamma^3 + 0.7980\,\gamma^2 - 1.1099\,\gamma + 0.8703$
	$H_{eq}(\gamma) = -0.005\,\gamma^3 + 0.075\,\gamma^2 - 0.096\,\gamma + 0.196$
	$u(\gamma) = -0.0087\,\gamma^3 + 0.0262\,\gamma^2 - 0.0105\,\gamma + 0.0720$
●Rubber material X0.4S $(0.1 \leq \gamma \leq 2.7)$	$G_{eq}(\gamma) = 0.034\,\gamma^4 - 0.419\,\gamma^3 + 1.192\,\gamma^2 - 1.580\,\gamma + 1.165$
	$H_{eq}(\gamma) = -0.007\,\gamma^3 + 0.080\,\gamma^2 - 0.009\,\gamma + 0.208$
	$u(\gamma) = -0.0139\,\gamma^3 + 0.0801\,\gamma^2 - 0.0190\,\gamma + 0.4001$
●Rubber material X0.6R $(0.1 \leq \gamma \leq 2.7)$	$G_{eq}(\gamma) = 0.600 \times (0.1064\,\gamma^4 - 1.076\,\gamma^3 + 3.900\,\gamma^2 - 3.878\,\gamma + 3.855)$
	$H_{eq}(\gamma) = 0.340 \times (0.02803\,\gamma^3 - 0.1804\,\gamma^2 + 0.2084\,\gamma + 0.9150)$
	$u(\gamma) = 0.408 \times (0.03401\,\gamma^3 - 0.2080\,\gamma^2 + 0.2711\,\gamma + 0.8089)$

Based on above equations, each shear properties shall be determined by the following equations.*1

Equivalent shear stiffness	: $K_{eq} = G_{eq} \cdot A_r / H$	Equivalent damping ratio	: $H_{eq} = \Delta W / (2\pi \cdot K_{eq}\,\delta^2)$
Initial stiffness	: $K_1 = 10 \times K_2$		
Post-yield stiffness	: $K_2 = K_{eq}(1 - u)$		
Characteristic strength	: $Q_d = u \cdot K_{eq} \cdot H \cdot \gamma$		



*1: At standard condition only and shall be excluded when considering the properties variation.

Temperature dependency

Each shear properties shall be corrected to the value at standard temperature of 20°C by the following equations.
(Applicable range: $-10 \leq T \leq 40$°C) (T : Temperature during inspection)

●Rubber material X0.3R	: $K_{eq}(T°C) = K_{eq}$ (standard value at 20°C) $\times (1.139 - 9.853 \times 10^{-3} \cdot T + 1.701 \times 10^{-4} \cdot T^2 - 1.867 \times 10^{-6} \cdot T^3)$
	: $H_{eq}(T°C) = H_{eq}$ (standard value at 20°C) $\times (1.050 - 2.780 \times 10^{-3} \cdot T + 4.678 \times 10^{-5} \cdot T^2 - 1.813 \times 10^{-6} \cdot T^3)$
●Rubber material X0.4S/X0.6R	: $K_{eq}(T°C) = K_{eq}$ (standard value at 20°C) $\times (1.205 - 1.862 \times 10^{-2} \cdot T + 5.881 \times 10^{-4} \cdot T^2 - 8.881 \times 10^{-6} \cdot T^3)$
	: $H_{eq}(T°C) = H_{eq}$ (standard value at 20°C) $\times (1.065 - 4.134 \times 10^{-3} \cdot T + 1.098 \times 10^{-4} \cdot T^2 - 2.109 \times 10^{-6} \cdot T^3)$

●Standard value of temperature dependency (Standard temperature (20°C))

Properties values	Equivalent shear stiffness K_{eq}				Equivalent damping ratio H_{eq}			
	-10°C	0°C	30°C	40°C	-10°C	0°C	30°C	40°C
X0.3R	within +25%	within +14%	within −5%	within −9%	within +8%	within +5%	within −3%	within −9%
X0.4S	within +38%	within +21%	within −6%	within −16%	within +13%	within +7%	within −3%	within −13%
X0.6R	within +38%	within +21%	within −6%	within −16%	within +13%	within +7%	within −5%	within −13%

Performance variation

The rate of change of main causes (manufacturing variation, aging, temperature change) which affect shear properties as shown below.

Rubber materials		X0.3R		X0.4S		X0.6R	
		Equivalent shear stiffness, K_{eq}	Equivalent damping ratio, Heq Function giving ratio of characteristic strength to maximum shear force, u	Equivalent shear stiffness, K_{eq}	Equivalent damping ratio, Heq Function giving ratio of characteristic strength to maximum shear force, u	Equivalent shear stiffness, K_{eq}	Equivalent damping ratio, Heq Function giving ratio of characteristic strength to maximum shear force, u
Manufacturing variation*1		±10%	∓10%	±10%	∓10%	±10%	∓10%
Aging*2		+10%	−10%	+10%	−10%	+10%	−10%
Ambient temperature variation 20°C ± 20°C	(+) side	+14%	+5%	+21%	+7%	+21%	+7%
	(−) side	−9%	−9%	−16%	−13%	−16%	−13%
Total	(+) side*3	+34%	−15%	+41%	−13%	+41%	−13%
	(−) side*3	−19%	+1%	−26%	−3%	−26%	−3%

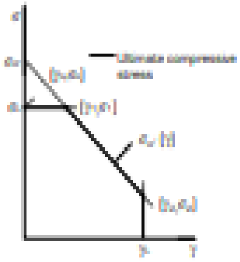
*1 : The variation of each product (standard value) shall be within ±20% and variation of total units of products per project (total of standard values) shall be within ±10%.
However, if the total units of products is less than 8 units per project, the variation (total of standard values) shall be within ±15%.
(For H_{eq}, $\Sigma(H_{eq} \times K_{eq}) / \Sigma K_{eq}$ shall be within ±15% from the standard value)
Note: For compressive stiffness Kv variation of each product (standard value) shall be within ±30%.
*2 : Predicted rate of change after 60 years at 20°C standard temperature.
*3 : The equivalent shear stiffness Keq and equivalent damping ratio Heq is dependent to each other. The indicated rate of change of Heq are corresponding to both maximum and minimum rate of change of Keq respectively.
*4 : Above list shows the combination example.

●Compressive Properties

Compressive stiffness K_V

●Compressive stiffness Kv is determined by the following equation.

$$K_V = E_C \cdot \frac{A}{H} \qquad E_C = \frac{E(1+2\kappa S_1^2)}{1+E(1+2\kappa S_1^2)/E_\infty}$$



Ultimate compressive stress

●Critical stress σ_{cr} at zero shear strain is determined by the following equation.

$$\sigma_{cr} = \alpha_c \cdot \frac{\pi}{4}(G_{eq} \cdot E_r)^{1/2} \cdot S_2$$

However, $E_r = E_0\,[1 + 2/3 \cdot \kappa \cdot S_1^2] / [1 + E_0\,[1 + 2/3 \cdot \kappa \cdot S_1^2] / E_\infty]$

(Note) S_1 is defined as 35.0 (for X0.4S, X0.6R) and 28.0 (for X0.3R) as standard value.

α_c : Correction factor determined from our test data

Rubber material X0.3R : $\alpha_c = 1.0$ (if $S_2 \geqq 5$) $\alpha_c = \{1 - 0.2\,(5 - S_2)\}$ (if $5 > S_2$)

Rubber material X0.4S : $\alpha_c = 0.88$ (if $S_2 \geqq 5$) $\alpha_c = 0.88\,\{1 - 0.07\,(5 - S_2)\}$ (if $5 > S_2$)

Rubber material X0.6R : $\alpha_c = 1.45$ (if $S_2 \geqq 5$) $\alpha_c = 1.45 - 0.3\,(5 - S_2)$ (if $5 > S_2$)

$E_0 = 3 \times G_{eq}$ (for X0.4S, X0.6R) $E_0 = 2.2$ (for X0.3R)

●Ultimate compressive stress at any shear strain $\sigma_{cr}'(\gamma)$ is determined by σ_{cr} by the following equation.

$$\sigma_{cr}'(\gamma) = \sigma_{cr} \cdot \left(1 - \frac{\gamma}{S_2}\right)$$

●The ultimate compressive stress shall not exceed the upper limit σ_L determined as below and the strain region corresponding to the ultimate strain γ_L at 0 compressive stress.

Rubber material X0.3R : $\sigma_L = 40$ (if $S_2 \geqq 5.0$) $\sigma_L = 40 + 10\,(S_2 - 5)$ $(5.0 > S_2 \geqq 3.0)$

γ_L is defined as minimum value among $\lceil 400\% \rfloor$, $\lceil S_2 \times 0.9 \times 100\% \rfloor$, $\lceil (5.80 \times S_2 + 7.10)/(S_2 + 3.45) \times 100\% \rfloor$

Rubber material X0.4S : $\sigma_L = 45$ (if $S_2 \geqq 4.9$) $\sigma_L = 45 + 10\,(S_2 - 5)$ (if $4.9 > S_2 \geqq 4.0$) $\sigma_L = 40 + 10\,(S_2 - 5)$ (if $4.0 > S_2 \geqq 3.0$)

γ_L is defined as minimum value among $\lceil 400\% \rfloor$, $\lceil S_2 \times 0.9 \times 100\% \rfloor$, $\lceil (5.80 \times S_2 + 9.05)/(S_2 + 4.49) \times 100\% \rfloor$

Rubber material X0.6R : $\sigma_L = 60$ (if $S_2 \geqq 4.9$) $\sigma_L = 48 + 14\,(S_2 - 4)$ (if $4.9 > S_2 \geqq 4.0$)

$\sigma_L = 24 + 24\,(S_2 - 3)$ (if $4.0 > S_2 \geqq 3.5$) $\sigma_L = 22 + 28\,(S_2 - 3)$ (if $3.5 > S_2 \geqq 3.0$)

γ_L is defined as minimum value among $\lceil 400\% \rfloor$, $\lceil S_2 \times 0.9 \times 100\% \rfloor$, $\lceil (5.00 \times S_2 + 9.05)/(S_2 + 4.49) \times 100\% \rfloor$

Product Specification

(Please contact us if you require more information regarding the specification)

High Damping Rubber Bearing (HDR)

Certification Number MVBR-0516 (X0.3R)

Code

Compound name	Rubber code	Shear modulus (N/mm²)	Equivalent damping ratio
X0R	X0.3R	[illegible]	0.170

●HM Series (Total Rubber Thickness 16cm)

	Characteristics		HM060X3R	HM070X3R	HM080X3R
Physical Dimensions	Outer diameter	(mm)	600	700	800
	Inner diameter	(mm)	15	15	20
	Effective plane area	($\times 10^2$ mm²)	2826	3847	5023
	Thickness of one rubber layer	(mm)	5.0	5.9	6.8
	Number of rubber layers	(−)	32	27	23
	Total rubber thickness	(mm)	160.0	159.3	156.4
	First shape factor	(−)	29.3	29.0	28.7
	Second shape factor	(−)	3.75	4.39	5.12
	Diameter of flange	(mm)	800	900	1000
	Thickness of flange*1	(mm)	19	19	19
	Connecting bolt PCD	(mm)	825	925	1025
	Diameter of connecting bolt hole × qty	(mm)	Ø 33 × 8	Ø 33 × 8	Ø 33 × 8
	Bolt size (assumption)	(−)	M30	M30	M30
	Thickness of each reinforced steel plate	(mm)	3.1	3.1	3.1
	Total height	(mm)	**294.1**	**277.9**	**262.6**
	Total weight	(tonf)	**0.44**	**0.54**	**0.64**
	Total weight	(kN)	**4.4**	**5.3**	**6.3**
Compression Properties	Critical stress (N/mm²)	σ_{cr} when $\gamma = 0$	28	34	40
	Ultimate compressive stress (N/mm²)	(γ_1, σ_1)	(0.00,28)	(0.00,34)	(0.00,40)
		(γ_2, σ_2)	(0.20,28)	(0.65,34)	(1.24,40)
		(γ_3, σ_3)	(3.33,3)	(3.95,4)	(4.00,12)
	Compressive stiffness	($\times 10^3$kN/m)	1760	2370	3140
	Nominal long term compressive stress*2	(N/mm²)	5.0	5.0	5.0
	Nominal long term column load	(kN)	1410	1920	2510
	Allowable tensile stress	(N/mm²)	1.0	1.0	1.0
Shear Properties (γ = 100%)	Initial stiffness	($\times 10^4$kN/m)	3.82	5.22	6.85
	Post yield stiffness	($\times 10^3$kN/m)	0.382	0.522	0.685
	Characteristic Strength	(kN)	23.7	32.2	42.0
	Equivalent shear stiffness	($\times 10^3$kN/m)	0.530	0.724	0.964
	Equivalent damping ratio	(−)	0.170	0.170	0.170

*1 Special thickness for flange is available. Please contact us for more details.
*2 Nominal long term compressive stress is referred as long term upper limit of compressive stress.

Description of the product designation

H N 080 X3R

- X3R — Compound name (refer to shear modulus)
- 080 — Outer diameter (cm)
- N — Series (Shape)
- H — Type of bearing (High damping rubber)

Certification Number MVBR-0516 (X0.3R)

●HN Series (Total Rubber Thickness 20cm)

Code

Compound name	Rubber code	Shear modulus (N/mm²)	Equivalent damping ratio
X3R	X0.3R	0.300	0.170

Characteristics			HN060X3R	HN070X3R	HN080X3R
Physical Dimensions	Outer diameter	(mm)	600	700	800
	Inner diameter	(mm)	15	15	20
	Effective plane area	(×10² mm²)	2826	3847	5023
	Thickness of one rubber layer	(mm)	5.0	5.9	6.8
	Number of rubber layers	(-)	40	34	29
	Total rubber thickness	(mm)	200.0	200.6	197.2
	First shape factor	(-)	29.3	29.0	28.7
	Second shape factor	(-)	3.00	3.49	4.06
	Diameter of flange	(mm)	800	900	1000
	Thickness of flange※1	(mm)	19	19	19
	Connecting bolt PCD	(mm)	825	925	1025
	Diameter of connecting bolt hole × qty	(mm)	Ø 33 × 8	Ø 33 × 8	Ø 33 × 8
	Bolt size (assumption)	(-)	M30	M30	M30
	Thickness of each reinforced steel plate	(mm)	3.1	3.1	3.1
	Total height	(mm)	**358.9**	**340.9**	**332.0**
	Total weight	(tonf)	**0.51**	**0.62**	**0.74**
	Total weight	(kN)	**5.0**	**6.1**	**7.2**
Compression Properties	Critical stress (N/mm²)	σ_{cr} when $\gamma = 0$	19	25	31
	Ultimate compressive stress (N/mm²)	(γ_1, σ_1)	(0.00,19)	(0.00,25)	(0.00,31)
		(γ_2, σ_2)	–	(0.03,25)	(0.41,31)
		(γ_3, σ_3)	(2.70,2)	(2.14,3)	(2.05,3)
	Compressive stiffness	(×10³kN/m)	1390	1890	2490
	Nominal long term compressive stress※2	(N/mm²)	5.0	5.0	5.0
	Nominal long term column load	(kN)	1410	1920	2510
	Allowable tensile stress	(N/mm²)	1.0	1.0	1.0
Shear Properties (γ = 100 %)	Initial stiffness	(×10³kN/m)	3.06	4.15	5.51
	Post yield stiffness	(×10³kN/m)	0.306	0.415	0.551
	Characteristic Strength	(kN)	23.7	32.2	42.0
	Equivalent shear stiffness	(×10³kN/m)	0.424	0.575	0.764
	Equivalent damping ratio	(-)	0.170	0.170	0.170

※1 Special thickness for flange is available. Please contact us for more details.
※2 Nominal long term compressive stress is selected as long term upper limit of compressive stress.

High Damping Rubber Bearing (HDR)

MVBR-0510/MVBR-0519 (X0.4S)

Note: There are 2 certification numbers due to difference of some manufacturing process.
Please refer to "Precautions" in page 8 for the certificate number that used for design document.

Code

Compound name	Rubber code	Shear modulus (N/mm²)	Equivalent damping ratio
X4S	X0.4S	0.392	0.240

●HH Series (Total Rubber Thickness 20cm)

	Characteristics		HH060X4S	HH065X4S	HH070X4S	HH075X4S	HH080X4S	HH085X4S	HH090X4S	HH095X4S	HH100X4S	HH110X4S	HH120X4S	HH130X4S	HH140X4S	HH150X4S	HH160X4S
Physical Dimensions	Outer diameter	(mm)	600	650	700	750	800	850	900	950	1000	1100	1200	1300	1400	1500	1600
	Inner diameter	(mm)	15	15	15	15	20	20	20	20	25	55	55	55	65	65	80
	Effective plane area	(×10² mm²)	2826	3317	3847	4416	5023	5671	6359	7085	7849	9480	11286	13249	15361	17638	20056
	Thickness of one rubber layer	(mm)	4.0	4.4	4.7	5.0	5.4	5.7	6.0	6.4	6.7	7.4	8.0	8.7	9.5	10.0	10.4
	Number of rubber layers	(−)	50	45	43	40	37	35	33	31	30	27	25	23	21	20	19
	Total rubber thickness	(mm)	200	198	202	200	200	200	198	198	201	200	200	200	200	200	198
	First shape factor	(−)	36.6	36.1	36.4	36.8	36.1	36.4	36.7	36.3	36.4	35.3	35.8	35.8	35.1	35.8	36.5
	Second shape factor	(−)	3.00	3.28	3.46	3.75	4.00	4.26	4.55	4.79	4.98	5.51	6.00	6.50	7.02	7.50	8.10
	Diameter of flange	(mm)	900	950	1000	1100	1150	1200	1250	1300	1400	1500	1600	1700	1800	1900	2000
	Thickness of flange*1 (edge/center)	(mm)	22/28	22/28	22/28	22/28	24/32	24/32	28/36	28/36	28/36	32/38	32/40	32/40	37/45	40/50	50/110
	Connecting bolt PCD	(mm)	775	825	875	950	1000	1050	1100	1150	1250	1350	1450	1550	1650	1750	1800
	Diameter of connecting bolt hole × qty	(mm)	φ33×12	φ33×12	φ33×12	φ33×12	φ33×12	φ33×12	φ33×12	φ33×12	φ39×12	φ39×12	φ39×12	φ39×12	φ42×12	φ42×16	φ45×16
	Bolt size (assumption)	(−)	M30	M30	M30	M30	M30	M30	M30	M30	M36	M36	M36	M36	M39	M39	M42
	Thickness of each reinforced steel plate	(mm)	3.1	3.1	3.1	3.1	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	5.8	5.8	5.8
	Total height	(mm)	407.9	380.4	388.3	376.8	422.2	413.1	410.8	402.4	402.8	380.2	385.6	376.8	425.5	410.2	520.0
	Total weight	(tonf)	0.66	0.72	0.80	0.90	1.21	1.31	1.49	1.58	1.77	2.05	2.38	2.65	3.46	4.05	6.64
	Total weight	(kN)	6.5	7.0	7.8	8.8	11.8	12.8	14.6	15.6	17.3	20.1	23.3	26.0	33.9	39.7	65.1
Compression Properties	Critical stress (N/mm²)	σ_{cr} when $\gamma = 0$	26	29	31	35	38	41	45	48	51	56	61	66	71	76	82
	Ultimate compressive stress (N/mm²)	(γ_1, σ_1)	(0.20)	(0.20)	(0.25)	(0.28)	(0.33)	(0.38)	(0.40)	(0.43)	(0.45)	(0.45)	(0.45)	(0.45)	(0.45)	(0.45)	(0.45)
		(γ_2, σ_2)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		(γ_3, σ_3)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Compressive stiffness	(×10³kN/m)	1700	2030	2380	2660	3030	3430	3870	4300	4700	5690	6760	7980	9030	10600	12000
	Nominal long term compressive stress*2	(N/mm²)	4.6	5.5	6.1	7.0	8.4	10.4	11.5	12.4	13.0	13.0	13.0	13.0	13.0	13.0	13.0
	Nominal long term column load	(kN)	1300	1830	2340	3080	4710	5880	7280	8780	10200	12300	14700	17200	20000	22900	26100
	Allowable tensile stress (γ = 100%)	(N/mm²)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Shear Properties (γ = 100%)	Initial stiffness	(×10³kN/m)	3.28	3.89	4.42	5.12	5.83	6.60	7.45	8.29	9.26	11.0	13.1	15.4	17.9	20.5	23.3
	Post yield stiffness (γ = 100%)	(×10³kN/m)	0.328	0.389	0.442	0.512	0.583	0.660	0.745	0.829	0.926	1.10	1.31	1.54	1.79	2.05	2.33
	Characteristic Strength	(kN)	45.2	53.0	61.5	70.6	80.3	90.7	102	113	126	152	181	212	246	282	321
	Equivalent shear stiffness	(×10³kN/m)	0.554	0.657	0.756	0.866	0.986	1.11	1.25	1.40	1.53	1.86	2.21	2.60	3.02	3.46	3.93
	Equivalent damping ratio	(−)	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240

*1 Special thickness for flange is available. Please refer to the table on the next page (upper top table) for more details.
*2 Nominal long term compressive stress is referred as long term upper limit of compressive stress.

Specification of flange (edge thickness / center thickness)

Outer diameter of rubber bearing (ø)[*2]	(600)	(650)	700	750	800	850	900	950	1000	1100	1200	1300
Standard thickness	22/28	22/28	22/28	22/28	26/32	26/32	28/36	28/36	28/36	30/38	32/40	32/40
Special thickness (option)	(26/32)	(26/32)	26/32	30/36	32/40	32/40	37/45	37/45	42/50	42/50	42/50	42/50

*1 [illegible]
*2 [illegible]
*3 [illegible]

MVBR-0514/MVBR-0520 (X0.6R)

Note: There are 2 certification numbers due to difference of some manufacturing process.
Please refer to "Precautions" in page 6 for the certificate number that used for design document.

Code

Compound name	Rubber code	Shear modulus (N/mm²)	Equivalent damping ratio
X6R	X0.6R	0.620	0.240

●HH Series (Total Rubber Thickness 20cm)

	Characteristics		HH060X6R	HH065X6R	HH070X6R	HH075X6R	HH080X6R	HH085X6R	HH090X6R	HH095X6R	HH100X6R	HH110X6R	HH120X6R	HH130X6R	HH140X6R	HH150X6R	HH160X6R
Physical Dimensions	Outer diameter	(mm)	600	650	700	750	800	850	900	950	1000	1100	1200	1300	1400	1500	1600
	Inner diameter	(mm)	15	15	15	15	20	20	20	20	25	55	55	55	65	65	80
	Effective plane area	(×10² mm²)	2826	3317	3847	4416	5023	5671	6359	7085	7849	9480	11286	13249	15361	17638	20056
	Thickness of one rubber layer	(mm)	4.0	4.4	4.7	5.0	5.4	5.7	6.0	6.4	6.7	7.4	8.0	8.7	9.5	10.0	10.4
	Number of rubber layers	(−)	50	45	43	40	37	35	33	31	30	27	25	23	21	20	19
	Total rubber thickness	(mm)	200	198	202	200	200	200	198	198	201	200	200	200	200	200	198
	First shape factor	(−)	36.6	36.1	36.4	36.8	36.1	36.4	36.7	36.3	36.4	35.3	35.8	35.8	35.1	35.9	36.5
	Second shape factor	(−)	3.00	3.28	3.48	3.75	4.00	4.29	4.55	4.79	4.98	5.50	6.00	6.50	7.02	7.50	8.10
	Diameter of flange	(mm)	900	950	1000	1100	1150	1200	1250	1300	1400	1500	1600	1700	1800	1900	2000
	Thickness of flange[*1] (edge/center)	(mm)	22/28	22/28	22/28	22/28	24/32	24/32	26/36	26/36	26/36	30/38	32/40	32/40	37/45	42/50	50/60
	Connecting bolt PCD	(mm)	775	825	875	950	1000	1050	1100	1150	1250	1350	1450	1550	1650	1750	1800
	Diameter of connecting bolt hole × qty	(mm)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bolt size (assumption)	(−)	M30	M30	M30	M30	M30	M30	M30	M30	M36	M36	M36	M36	M39	M39	M42
	Thickness of each reinforced steel plate	(mm)	3.1	3.1	3.1	3.1	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.6	5.8	5.8	5.8
	Total height	(mm)	407.9	380.4	388.3	376.9	422.2	413.1	410.8	402.4	400.8	380.2	385.6	376.9	405.5	410.2	520.0
	Total weight	(tonf)	0.66	0.72	0.80	0.92	1.21	1.31	1.49	1.58	1.77	2.05	2.38	2.65	3.46	4.05	6.64
	Total weight	(kN)	6.5	7.0	7.8	8.9	11.9	12.9	14.6	15.5	17.3	20.1	23.3	26.0	33.9	39.7	65.1
Compression Properties	Critical stress (N/mm²)	σ_{cr} when $\gamma = 0$	43	52	58	66	76	86	100	113	120	136	149	160	173	185	200
	Ultimate compressive stress (N/mm²)	(γ, σ)	(0.29)	(0.33)	(0.35)	(0.42)	(0.48)	(0.52)	(0.56)	(0.58)	(0.60)	(0.60)	(0.60)	(0.60)	(0.60)	(0.60)	(0.60)
		(γ, σ)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		(γ, σ)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	–	–	–	–
	Compressive stiffness	(×10³kN/m)	1970	2040	2660	3080	3510	3970	4490	4860	5450	6560	7660	8280	10700	12300	14200
	Nominal long term compressive stress	(N/mm²)	6.6	8.1	9.1	10.7	12.0	13.4	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	Nominal long term column load	(kN)	1860	2690	3500	4710	6050	7600	9540	10600	11800	14200	16900	19900	23000	26500	30100
	Allowable tensile stress (γ = 100%)	(N/mm²)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Shear Properties (γ = 100%)	Initial stiffness	(×10³kN/m)	5.19	6.15	6.89	8.10	9.23	10.4	11.6	13.1	14.3	17.4	20.7	24.3	28.3	32.4	37.3
	Post yield stiffness (γ = 100%)	(×10³kN/m)	0.519	0.615	0.689	0.810	0.923	1.04	1.16	1.31	1.43	1.74	2.07	2.43	2.83	3.24	3.73
	Characteristic Strength	(kN)	71.5	83.9	97.3	112	127	143	161	179	199	240	285	335	389	446	507
	Equivalent shear stiffness	(×10³kN/m)	0.876	1.04	1.18	1.37	1.56	1.76	1.98	2.21	2.42	2.94	3.50	4.11	4.77	5.47	6.28
	Equivalent damping ratio	(−)	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240

*1 Special thickness for flange is available. Please refer to the table above for more details.

Others

Compact Flange Type

●Characteristic

Installation space improvement

It could save space during installation because the flange size has been minimized in compact shape. Reduction of footing size is possible especially in the retrofit project, edge parts placement & etc.

Round shape of rubber bearing

Because of round-shape of rubber bearing, there is no change of shear characteristics due to direction.

Supports many types of seismic isolation rubber bearing

Any size can be selected from Bridgestone's product range.

※Compared to round-shape flange, compact flange has some limitations in the strength of the flange, displacement of rubber bearing & etc. Please contact us for more details.

●Line-up

Line-up is for the flange-integrated seismic isolation bearing.
Please contact us for any size that isn't listed in the table below.

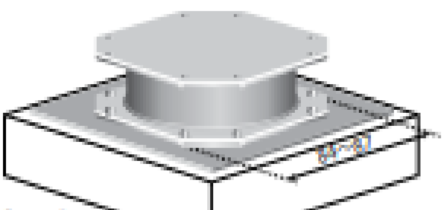
Certification Number	Series	Size (diameter of rubber bearing)	Type of Rubber	Performance
MVBR-0510/MVBR-0519 MVBR-0514/MVBR-0520	HDR	Ø600 – Ø1300	X4S X6R	Equivalent to Bridgestone seismic isolation rubber (round-shape flange)
MVBR-0509/MVBR-0518 MVBR-0295	NRB	Ø600 – Ø1300	G4 N3, G3, G5	
MVBR-0517	LRB	Ø600 – Ø1300	G4	

※ For Ø1400 and above, assembled type flange will be used.

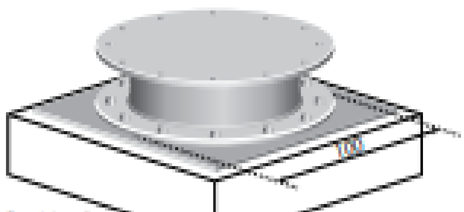
●Flange Size Table

Diameter of rubber bearing	600	650	700	750	800	850	900	950	1000	1100	1200	1300
Diameter of round-shape flange [D]	900	950	1000	1100	1150	1200	1250	1300	1400	1500	1600	1700
Length of one side of a compact flange [L]	745	795	845	910	965	1010	1055	1100	1200	1290	1380	1470
D – L	155	155	155	190	185	190	195	200	200	210	220	230

Comparison Between Compact Flange and Round-shape Flange

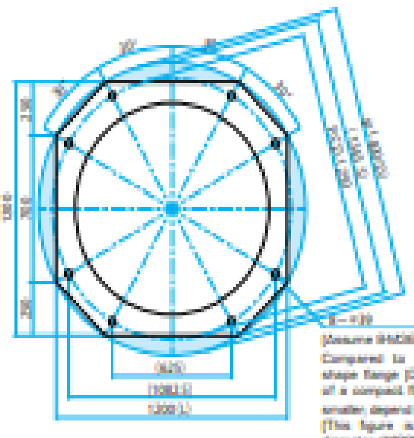


Compact flange



Round-shape flange

●Comparison of flange's dimension

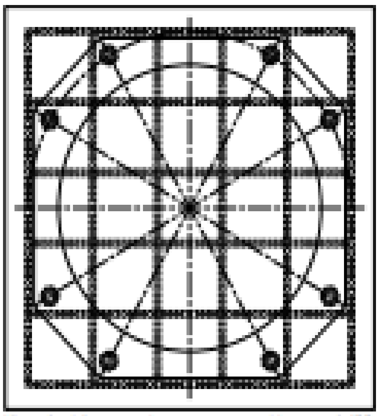


[Assume 8-M30]

Compared to the diameter of round-shape flange [D], the length of one side of a compact flange [L] is about 13-19% smaller, depend on sizes.

[This figure is an example of rubber diameter Ø1000]

●View of reinforcement bar arrangement



View of reinforcement bar arrangement with span of 180-200mm.

Dustproof Cover for Elastic Sliding Bearing

●Characteristic

Superior workability

It is composed of 2.0mm thick polyvinyl chloride and base fabric only, easy to carry and excellent workability including easily detach during maintenance.

Flame resistance

With self-extinguishing properties, polyvinyl chloride can prevent the spread of fire in the event of fire.

Other Characteristics

It helps to clean the dirt or dust on the surface since elastic sliding bearing and "dustproof cover SD" move together during earthquake, and it does not affect the sliding surface.

Compared to conventional product, we had shortened the lead time.

Dustproof

"Dustproof cover SD" are arranged to cover the surface of sliding plate without a gap, so that dirt or dust does not deposit on the surface.

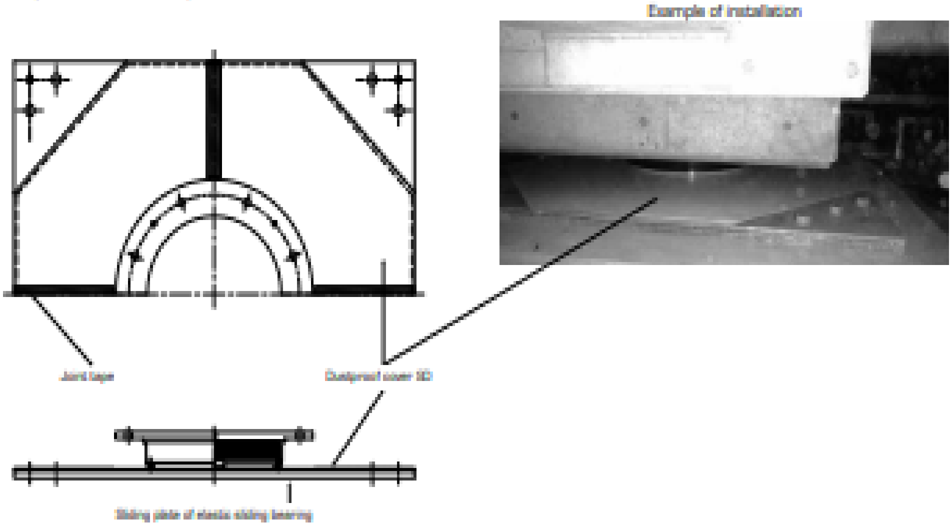
Durability

Polyvinyl chloride is excellent in durability and there is almost no degradation in strength. It can be used for a long period of time with peace of mind.

Precaution

Because of polyvinyl chloride, it requires high-temperature treatment for disposal.

Example of installation



Precautions for Safe Use of Seismic Isolation Bearing (SIB)

- The term "SIB" as used in this precautions means seismic isolation bearing for seismically isolated building, including sliding bearing.

⚠WARNING	Failure to follow these precautions may result in death or serious injury.

SIB is heavy. Falling or rolling SIB may cause death or serious injury.

■ **Always be careful when you move SIB.**

- Transport SIB one by one. If not, it becomes unstable.

■ **When lifting the SIB with a crane or others, observe the followings.**

- Use a crane or a suspending jig (eyebolt or others) corresponding to the product weight of the SIB, and use the bolt hole of SIB flange and hoist at 4 points or more. If not, it becomes unstable.
- Sufficiently check the safety of the surroundings beforehand so that no one enters around the suspended load.

Rubber part of SIB is flammable. Ignition / catch fire on SIB may cause fire or burn.

- Be away from a fire and do not weld the flange part or such like.

NOTICE	Failure to follow these precautions may result in damage to other property, or damage, low performance, malfunction or early deterioration in durability of SIB itself.

- Do not apply large impact (falling, collision, etc.) to SIB. Damaged SIB may cause function deterioration of the SIB and an early deterioration in durability.
- Do not roll the SIB or twist it with iron lever or bar. Damaged SIB may cause function deterioration and an early deterioration in durability.
- Be careful not to damage the SIB with other equipment (such as a cutter when packaging removal). Damaged SIB may cause function deterioration of the SIB and an early deterioration in durability.
- In case of outdoor storage, be sure to take measures against rain. Due to wetting with rainwater, it may cause an early deterioration in durability to the flange antirust coating part.
- Do not expose the SIB to a temporary high temperature condition (about 100 ° C or higher). Due to the influence of heat, the rubber part of the SIB may be damaged, which may cause function deterioration of the SIB and an early deterioration in durability.
- When tightening the bolt in SIB installation work, do not damage the flange antirust coating part with bolt / washer fastening jig or others. It may cause an early deterioration in durability to the flange antirust coating part.
- Install the SIB so that the horizontal inclination of the foundation becomes less than 1/400 in inclination accuracy. (Except when our company acknowledges in advance.) When mounted in an inclined, SIB may not function properly (function deterioration may occur).
- Do not apply or adhere oils, solvents etc. to the rubber part. Due to deterioration, dissolution etc. of the rubber part may cause function deterioration of the SIB and an early deterioration in durability.
- Do not scratch the coating part of the sliding plate when removing the packing of the sliding plate of sliding bearing. Damage of the coating part may cause function deterioration and an early deterioration in durability.
- If the residual displacement after the earthquake is equal to or greater than the preset displacement (standard 5 cm), promptly take measures to restore it to the origin. It may cause function deterioration of the SIB and an early deterioration in durability.
- After installing SIB, consider aeration and ventilation as much as possible inside seismic isolation interface, and remove moisture by condensation as necessary. It may cause an early deterioration in durability to the flange antirust coating part.
- Carry out proper maintenance as prescribed in the design document (building completion inspection · normal inspection · periodical inspection · emergency inspection · detailed inspection etc. by experts). It is necessary to periodically check whether events that may cause function deterioration of the SIB and an early deterioration in durability have occurred.

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- Specification and parameter may vary. Please enquire our company or any group's subsidiary whenever want to use it.
- Content of catalogue is as on January 2017.

Bridgestone Corporation

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Lampiran 4 Formulir Rekap Bimbingan

Lampiran 4 Formulir Rekap Bimbingan

7/29/25, 2:39 PM Rekap Percakapan Bimbingan

UNIVERSITAS PEMBANGUNAN JAYA

Jalan Cendrawasih Raya Blok B7/P, Sawah Baru, Kec. Ciputat, Kota Tangerang Selatan, Banten 15413
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REKAP PERCAKAPAN BIMBINGAN

Judul Proposal : Perbandingan Kinerja Bangunan Gedung Bertingkat Antara Sistem Base Isolation dan Sistem Dinding Struktural di Kota Jakarta Selatan

Sesi / Bahasan : ke-1 / Memmbahas mengenai dimensi dan denah yang digunakan serta memastikan apakah dapat dilakukannya non linear hinges pada pushover

Mahasiswa : 2021091014 - OBAR KHOLID **Pembimbing** : 08.1112.034 - Dr. Ir. Agustinus Agus Setiawan, S.T., M.T.

Pembimbing
Rabu, 4 Juni 2025, 16:06:55 Cari referensi kapabilitas program Robot. Cek kembali konfigurasi struktur yang digunakan

Sesi / Bahasan : ke-2 / membahas dan mencari solusi pada analisis yg bermasalah pada modal di RSAP 2025, serta pergantian metode menjadi analisis statik ekivalen

Mahasiswa : 2021091014 - OBAR KHOLID **Pembimbing** : 08.1112.034 - Dr. Ir. Agustinus Agus Setiawan, S.T., M.T.

Senin, 23 Juni 2025, 16:16:50 Pelajari dengan baik proses modelling bangunan dengan RSAP

Sesi / Bahasan : ke-3 / Memperbaiki typo, Memperbaiki Tabel, dan pencocokan font sesuai dengan ketentuan penulisan.

Mahasiswa : 2021091014 - OBAR KHOLID **Pembimbing** : 08.1112.034 - Dr. Ir. Agustinus Agus Setiawan, S.T., M.T.

Senin, 23 Juni 2025, 16:17:53 Cari literatur pendukung yang dapat digunakan sebagai bahan dalam menjelaskan analisis data dan pembanding hasil. Literatur sebaiknya dari literatur asing dan jurnal

Sesi / Bahasan : ke-4 / - Revisi penulisan - Membuat penulisan kesimpulan sesuai dengan ketentuan skripsi

Mahasiswa : 2021091014 - OBAR KHOLID **Pembimbing** : 08.1112.034 - Dr. Ir. Agustinus Agus Setiawan, S.T., M.T.

Senin, 23 Juni 2025, 16:19:14 Perbaiki editing dokumen, cek kembali keseragaman penulisan, typo, dsb. Hasil analisis belum disajikan/dirangkum dengan baik. Bandingkan antara bangunan tanpa Base I, dan yang memakai Base I. Apa dampaknya pada beda tinggi bangunan

Sesi / Bahasan : ke-5 / Membahas mengenai revisi yang diperlukan pada bab 4 baik penulisan maupun hasil dan output.

Mahasiswa : 2021091014 - OBAR KHOLID **Pembimbing** : 08.1112.034 - Dr. Ir. Agustinus Agus Setiawan, S.T., M.T.

Senin, 30 Juni 2025, 21:57:09

1. Perbaiki bagian abstrak, karena tidak spesifik menyebut berapa penurunan yang terjadi? Apa benar gaya lateral berkurang?
2. Perbaiki gambar 3.3
3. Penulisan notasi masih dijumpai belum tepat, contoh f'c, Mpa (P nya besar) dst, notasi perkalian --> msh pakai huruf 'x' (hal ini sudah bbrp kali diingatkan)
4. Penulisan tabel tidak perlu border, tidak perlu garis vertikal.
5. cek halaman 34 --> beban mati tambahan dan beban hidup tidak ada hitungannya
6. penulisan ribuan --> dipisahkan dg tanda titik
7. no sub bab di bab 3 diperbaiki lagi, mestinya 3.6 dan 3.8 tidak ada
8. Bab 4 di bagian awal harus ditampilkan denah struktur nya sprt apa, dan lokasi2 shear wall dimana saja
9. statement bhw base isolation menurunkan gaya dalam --> perlu dipertanyakan, krn dari balok justru naik. --> sajikan dalam bentuk diagram shingga terlihat nyata turun.naiknya, dan brp persen perbedaannya --> bagian ini yang perlu dieksplorasi
10. Tabel tabel di sub bab 4.7 dan 4.8 kok berulang ya? harusnya di 4.8 sudah lebih tajam ke arah grafik2 pembanding dan analisisnya.
11. lihat komen lain di notes pd file

Sesi / Bahasan : ke-6 / Pengarahan pembuatan kesimpulan dan saran pada bab 5, kesimpulan harus berkaitan erat dengan tujuan penelitian, dan membahas bagaimana tata cara pembuatan saran yang tepat

Mahasiswa : 2021091014 - OBAR KHOLID **Pembimbing** : 08.1112.034 - Dr. Ir. Agustinus Agus Setiawan, S.T., M.T.

Senin, 30 Juni 2025, 21:57:44

1. Gbr 3.3 belum diperbaiki masih mnyebut pushover
2. notasi belum diperbaiki, operator perkalian masih pakai huruf x --> ini sdh beberapa kali disampaikan
3. penulisan ribuan belum diperbaiki
4. sub 3.6 dan 3.7 masih muncul
5. dari gbr 4,34 - 4.36 harusnya terlihat, dan dinyatakan/tulis bhw pada sistem dg base i, gaya dalam cendrung mengecil semakin tinggi lantai tingkatnya, hal berbeda ditunjukkan oleh sistem ddg geser yang cendrung membesar/mencapaik maksimum di tengah ketinggian bangunan
6. semua grafik jangan di copy as picture dari excel, harus berupa excel object
7. bagian abstrak masih terlalu umum penutupnya, mestinya diisi dengan rangkuman kesimpulan dalam 2-3 kalimat.

Sesi / Bahasan : ke-7 / membahas mengenai bagaimana tata cara penulisan daftar pustaka (refrensi) yang tepat dan mudah ditemukan pada web, dan pembuatan abstrak harus meliputi : tujuan penelitian, metode atau cara apa yang dilakukan dan bagimana hasil dari penelitian.

Mahasiswa : 2021091014 - OBAR KHOLID **Pembimbing** : 08.1112.034 - Dr. Ir. Agustinus Agus Setiawan, S.T., M.T.

Senin, 30 Juni 2025, 21:58:45

Lengkapi dengan halaman pendukung seperti kata pengantar, lembar pengesahan dsb

Sesi / Bahasan : ke-8 / Pada bimbingan ke-8 ini membahas mengenai revisi penulisan laporan secara menyeluruh serta pengecekan kembali mengenai ketentuan aturan penulisan.

Mahasiswa : 2021091014 - OBAR KHOLID **Pembimbing** : 08.1112.034 - Dr. Ir. Agustinus Agus Setiawan, S.T., M.T.

Senin, 30 Juni 2025, 21:59:16

Dapat diajukan sidang skripsi