BAB V
KESIMPULAN

5.1 Kesimpulan

Berdasarkan hasil analisa perbandingan struktur yang menggunakan *fixed base* dengan struktur yang menggunakan *base isolator* dengan tipe *High Dumping Rubber Bearing* (HDRB), maka diperoleh kesimpulan sebagai berikut:

1. Berdasarkan gaya aksial kolom terbesar 4878,410 kN, didapatkan spesifikasi *base isolator* tipe *High Dumping Rubber Bearing* (HDRB) HH080X6R dengan diameter 800 mm dan *nominal long term column load* sebesar 6050 kN pada katalog *bridgestone* 2017.
2. Perbandingan periode getar struktur, simpangan dasar, simpangan antar lantai dan gaya geser pada struktur *fixed base* dengan *base isolator* adalah sebagai berikut:
   a. Penggunaan *base isolator* dapat meningkatkan nilai periode getar struktur dibandingkan dengan struktur *fixed base*. Pada *fixed base* periode getar struktur yang dihasilkan sebesar 1,960 detik sedangkan pada *base isolator* menghasilkan periode getar struktur sebesar 3,204 detik. Dengan demikian, periode getar pada struktur yang menggunakan *base isolator* meningkat 1,64 kali dari struktur *fixed base*.
   b. Struktur *base isolator* memiliki simpangan dasar yang lebih besar dibandingkan dengan struktur *fixed base*. Hal ini terjadi karena *base isolator* memiliki kelenturan pada arah horizontal sehingga simpangan yang terjadi lebih besar. Simpangan dasar pada struktur *base isolator* mengalami peningkatan pada arah x sebesar 59% dan pada arah y sebesar 44%.
   c. Penggunaan struktur *base isolator* dapat mereduksi nilai dari simpangan antar lantai dibandingkan dengan struktur *fixed base*. *Base isolator* dapat mereduksi simpangan antar lantai yang terjadi pada arah x sebesar 36% dan arah y sebesar 69%.
   d. Penggunaan struktur *base isolator* dapat mereduksi gaya geser dasar dibandingkan dengan struktur *fixed base*. Terjadi penurunan gaya geser dasar arah x dari 1926,48 kN (*fixed base*) menjadi 1248,068 kN (*base*

isolator) atau sebesar 35% dan pada arah y terjadi penurunan gaya geser dasar sebesar 1248,068 kN (*fixed base*) menjadi 1060,645 kN (*base isolator*) atau sebesar 33%.

3. Penggunaan struktur *base isolator* dapat mereduksi nilai dari gaya momen dan gaya geser dibandingkan dengan menggunakan struktur *fixed base*. Hal ini terjadi karena adanya pengaruh kekakuan pada kedua struktur. Besarnya momen pada struktur *fixed base* yang lebih besar dibandingkan dengan struktur *base isolator* menandakan bahwa dengan beban gempa yang sama struktur *fixed base* lebih kaku dibandingkan dengan struktur *base isolator*.
4. Pengaruh beban *pushover* terhadap penggunaan *base isolator* dan *fixed base* adalah sebagai berikut:
   a. Penggunaan *base isolator* mampu mereduksi *displacement* dan *base shear* yang terjadi akibat beban *pushover* yang diberikan. Pada arah x *displacement* mengalami penurunan dari 0,159 m (*fixed base)* menjadi 0,129 m (*base isolator*) dan *base shear* dasar dari 9768,348 kN (*fixed base*) menjadi 3820,406 kN (*base isolator*). Pada arah y *displacement* mengalami penurunan dari 0,00349 m (*fixed base*) menjadi 0,00342 m (*base isolator*) dan *base shear* dari 12577,77 kN (*fixed base*) menjadi 8307,73 kN (*base isolator*).
   b. Berdasarkan nilai *displacement* yang dihasilkan dari beban *pushover*, didapatkan level kinerja pada kedua struktur setelah dianalisa berdasarkan *Applied Technology Council* 40 (ATC – 40). Pada struktur *fixed base*, nilai *drift max* arah x dan y berturut-turut sebesar 0,0055 m dan 0,00012 m sehingga level kinerjanya termasuk ke dalam kategori *Immediate Occupancy* (IO). Pada struktur *base isolator*, nilai *drift max* arah x dan y berturut-turut sebesar 0,0044 m dan 0,00012 m sehingga level kinerjanya termasuk ke dalam kategori *Immediate Occupancy* (IO). Artinya kerusakan pasca gempa yang terjadi pada struktur sangat sedikit. Risiko adanya korban jiwa sebagai dampak kerusakan struktur sangat sedikit dan bangunan masih aman untuk tetap digunakan dan aktivitas di dalamnya tidak akan terganggu apabila dilakukan perbaikan.

5.2 Saran

Berdasarkan hasil analisis yang dilakukan pada struktur *fixed* base dengan struktur *base isolator* tipe HDRB, terdapat beberapa saran untuk bahan penelitian selanjutnya antara lain:

1. Dalam analisis gempa yang dilakukan pada kedua struktur, sebaiknya dicoba untuk penelitian selanjutnya menggunakan analisis gempa dinamik *time history*.
2. Penelitian selanjutnya dapat membahas tentang perbandingan struktur *base isolator* dengan struktur pemikul momen ganda.
3. Penelitian selanjutnya dapat membahas tentang perbandingan dari kedua struktur mengenai keekonomisan, efisien dan kemudahan dalam pelaksanaannya.
4. Penelitian selanjutnya perlu dicoba dengan menggunakan bangunan yang berbeda, seperti rumah sakit. Karena rumah sakit memiliki resiko yang sangat besar apabila terjadi keruntuhan.

DAFTAR PUSTAKA

Aoyama, (2019), *Lift Penumpang Cermin Etsa Tanpa Ruang Mesin* (Lift Penumpang Cermin Etsa Tanpa Pemasok dan Produsen Ruang Mesin - Pabrik Cina - Lift AOYAMA (aoyama-elevator.jp), diakses pada 15 Maret 2023 pukul 09.46)

Asroni, A, (2010), *Balok Pelat Beton Bertulang*, Surakarta: Graha Ilmu.

ATC-40, (1996), *Seismic Evaluation and Retrofit of Concrete Buildings*, Volume I. California. Applied Tecnology Council.

Badan Standarisasi Nasional, (2019), *Tata Cara Perencanaan Ketahanan Gempa untuk Struktur Bangunan Gedung dan Non Gedung, SNI 1726:2019*, Jakarta: Badan Standarisasi Nasional.

Badan Standarisasi Nasional, (2019), *Persyaratan Beton Struktural Untuk Bangunan Gedung Dan Penjelasan, SNI 2847:2019*, Jakarta: Indonesia.

Badan Standarisasi Nasional, (2017), *Beban minimum untuk perancangan bangunan gedung dan struktur lain, SNI 1727:2017*, Jakarta: Badan Standarisasi Nasional.

Badan Standarisasi Nasional, (2017), *Baja tulangan beton, SNI 2052:2017*, Jakarta: Badan Standarisasi Nasional.

Badan Standarisasi Nasional, (1989), *Pedoman Perencanaan Pembebanan untuk Rumah dan Gedung, SNI 03-1727-19989*, Jakarta, Indonesia.

Lesmana., Y, (2013), *Analisis Prilaku Gedung Tinggi Yang Menggunakan Sistem Base Isolation Akibat Beban Gempa Nonlinier Time History Analysis*, Surabaya: Institut Teknologi Sepuluh Nopember.

Mwafy, Elnasai, (2001), *Static pushover versus dynamic collapse analysis of RC buildings*, Engineering Structures 23, 407–424.

Naeim, F, Kelly, J.M, (1999), *Design of Seismic Isolated Structures*, California: University of California.

Ricky, Vicky, (2013), *Evaluasi Kinerja Gedung Beton Bertulang Dengan Pushover Analysis Akibat Beban Gempa Padang*, Surabaya: Institut Teknologi Sepuluh Nopember.

Trevor E Kelly, (2001), *Base Isolation of Structures-Design Guidelines*, New Zealand: Holmes Consulting Group.

Samsya, I, Tavio & Raka, I.G.P, (2017), *Evaluasi Aplikasi Penggunaan Base Isolation pada Gedung Grand Keisha menggunakan Analisa Pushover*, Surabaya: Institut Teknologi Sepuluh November.

Supartoyo, (2022), *Gempa Bumi Merusak Di Indonesia Tahun 2021*, (Pusat Vulkanologi dan Mitigasi Bencana Geologi - Badan Geologi (esdm.go.id)), diakses pada 10 Mei 2023 pukul 13.04.

Syahnandito, Suryanita, R, Ridwan, (2020), *Pengaruh penggunaan base isolation High Damping Rubber Bearing pada struktur beton bertulang,* SIKLUS: Jurnal Teknik Sipil, Vol. 6, No. 2, Oktober 2020, pp 181-194.

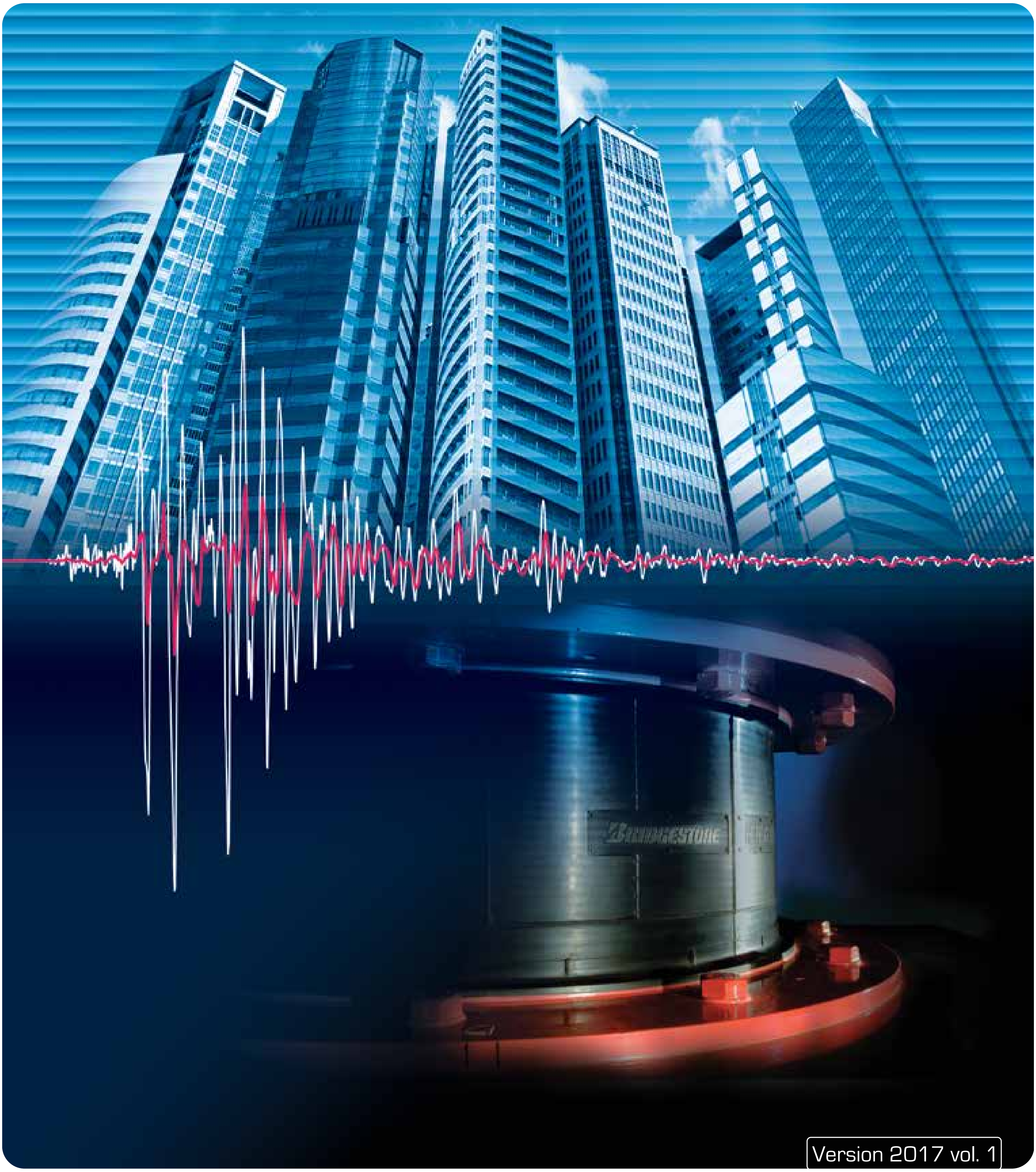
LAMPIRAN I
KATALOG BRIDGESTONE

BRIDGESTONE

Seismic Isolation Product Line-up

High Damping Rubber Bearing   Lead Rubber Bearing

Natural Rubber Bearing   Elastic Sliding Bearing



Version 2017 vol. 1

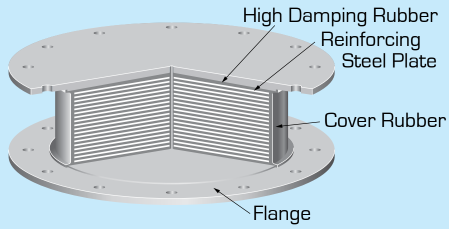
Bridgestone Seismic Isolation Product Line-up

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

Features | **Sectional View**

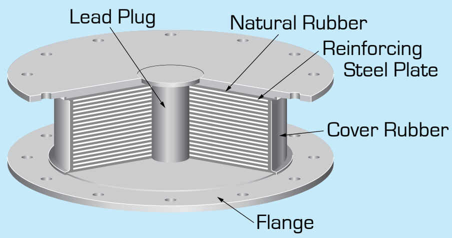
HDR
High Damping Rubber Bearing

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.



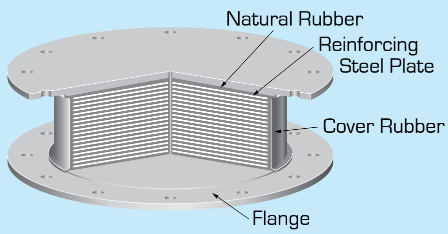
LRB
Lead Rubber Bearing

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).



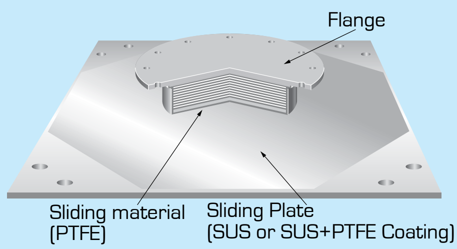
NRB
Natural Rubber Bearing

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.

Product Specification & Description of Performance Characteristics

High Damping Rubber Bearing (HDR)

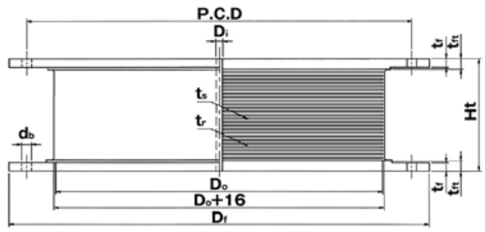
Seismic isolation material certification number by Ministry of Land, Infrastructure and Transport, Japan

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**

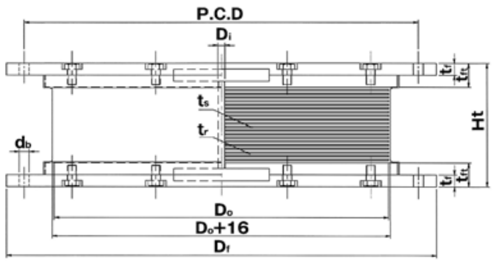
●Product Dimension

	Characteristics	
Physical Dimensions	Outer diameter	: D_o (mm)
	Inner diameter	: D_i (mm)
	Number of inner diameter	: n_i
	Effective plane area	: A (× 10^2mm^2)
	Thickness of one rubber layer	: t_r (mm)
	Number of rubber layers	: n
	Total rubber thickness	: H = n・t_r (mm)
	First shape factor $S_1 = (D_o^2 - n_i \cdot D_i^2) / \{4 \cdot t_r \cdot (D_o + n_i \cdot D_i)\}$	
	Second shape factor $S_2 = D_o / (n \cdot t_r)$	
	Diameter of flange	: D_f (mm)
	Thickness of flange: edge/center	: t_f / t_{fc} (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



Integrated Type Flange



Assembled Type Flange

●Rubber Material

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

Compound name	Rubber code	Shear modulus G_{eq} (N/mm^2)	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/mm^2)	Elongation at Break (%)	Hardness (JIS A)	100% modulus (N/mm^2)	Young's modulus E (N/mm^2)	Bulk modulus E_∞(N/mm^2)	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	34 ± 8	0.53 ± 0.2	4.0	1150	1.0
	X0.4S	7 and above	840 and above	37 ± 8	0.43 ± 0.2	6.2	1300	1.0
	X0.6R	8.5 and above	780 and above	53 ± 5	0.73 ± 0.2	7.6	1500	1.0
Cover rubber		12 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 (SIS 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, HS110X4S 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 $(0.1 \leqq \gamma \leqq 3.0)$

$G_{eq}(\gamma) = 0.0255\,\gamma^4 - 0.2213\,\gamma^3 + 0.7283\,\gamma^2 - 1.1028\,\gamma + 0.8703$

$H_{eq}(\gamma) = -0.005\,\gamma^3 + 0.015\,\gamma^2 - 0.006\,\gamma + 0.166$

$u(\gamma) = -0.0087\,\gamma^3 + 0.0262\,\gamma^2 - 0.0105\,\gamma + 0.2720$

●Rubber material X0.4S $(0.1 \leqq \gamma \leqq 2.7)$

$G_{eq}(\gamma) = 0.054\,\gamma^4 - 0.416\,\gamma^3 + 1.192\,\gamma^2 - 1.583\,\gamma + 1.145$

$H_{eq}(\gamma) = -0.007\,\gamma^3 + 0.020\,\gamma^2 - 0.009\,\gamma + 0.236$

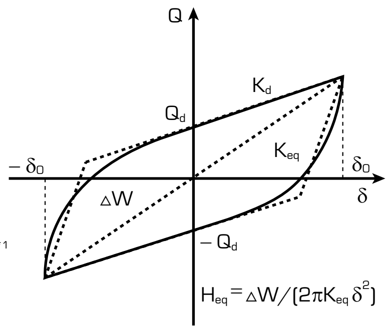
$u(\gamma) = -0.0132\,\gamma^3 + 0.0401\,\gamma^2 - 0.0190\,\gamma + 0.4001$

●Rubber material X0.6R $(0.1 \leqq \gamma \leqq 2.7)$

$G_{eq}(\gamma) = 0.620 \times (0.1364\,\gamma^4 - 1.016\,\gamma^3 + 2.903\,\gamma^2 - 3.878\,\gamma + 2.855)$

$H_{eq}(\gamma) = 0.240 \times (0.02902\,\gamma^3 - 0.1804\,\gamma^2 + 0.2364\,\gamma + 0.9150)$

$u(\gamma) = 0.408 \times (0.03421\,\gamma^3 - 0.2083\,\gamma^2 + 0.2711\,\gamma + 0.9028)$



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

Equivalent shear stiffness : $K_{eq} = G_{eq} \cdot A/H$

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: $-10 \leqq T \leqq 40$°C) (T : Temperature during inspection)

●Rubber material X0.3R

: K_{eq} (T°C) = K_{eq} (standard value at 20°C) × $(1.139 - 9.653 \times 10^{-3} \cdot T + 1.721 \times 10^{-4} \cdot T^2 - 1.847 \times 10^{-6} \cdot T^3)$

: H_{eq} (T°C) = H_{eq} (standard value at 20°C) × $(1.050 - 2.790 \times 10^{-3} \cdot T + 4.678 \times 10^{-5} \cdot T^2 - 1.613 \times 10^{-6} \cdot T^3)$

●Rubber material X0.4S/X0.6R

: K_{eq} (T°C) = K_{eq} (standard value at 20°C) × $(1.205 - 1.862 \times 10^{-2} \cdot T + 5.991 \times 10^{-4} \cdot T^2 - 8.991 \times 10^{-6} \cdot T^3)$

: H_{eq} (T°C) = H_{eq} (standard value at 20°C) × $(1.065 - 4.134 \times 10^{-3} \cdot T + 1.096 \times 10^{-4} \cdot T^2 - 3.102 \times 10^{-6} \cdot T^3)$

●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 −4%	within −9%
X0.4S	within +46%	within +21%	within −6%	within −16%	within +12%	within +7%	within −4%	within −12%
X0.6R	within +46%	within +21%	within −6%	within −16%	within +12%	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%	−12%	−16%	−13%
Total	(+) side*3	+34%	−15%	+41%	−13%	+41%	−13%
	(−) side*3	−19%	+1%	-26%	−2%	−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.

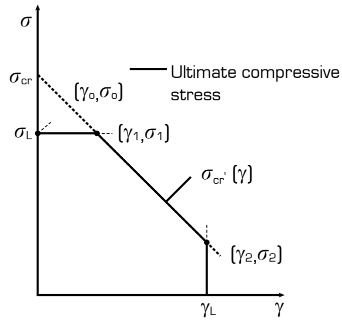
*4 : Above list shows the combination example.

●Compressive Properties

Compressive stiffness K_V

●Compressive stiffness Kv is determined by the following equation.

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



Ultimate compressive stress

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

$$\sigma_{cr} = \alpha_c \cdot \frac{\pi}{4}(G_{eq} \cdot E_b)^{0.5} \cdot S_2$$

However, $E_b = E_{cr}(1 + 2/3 \cdot \kappa \cdot S_1^2) / \{1 + E_{cr}(1 + 2/3 \cdot \kappa \cdot S_1^2) / E_\infty\}$

(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 $5 > S_2$)

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

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

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

●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「400%」,「$S_2 \times 0.9 \times 100\%$」,「$(5.80 \times S_2 + 7.10)/(S_2 + 3.45) \times 100\%$」

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「400%」,「$S_2 \times 0.9 \times 100\%$」,「$(5.80 \times S_2 + 9.05)/(S_2 + 4.49) \times 100\%$」

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「400%」,「$S_2 \times 0.9 \times 100\%$」,「$(5.00 \times S_2 + 9.05)/(S_2 + 4.49) \times 100\%$」

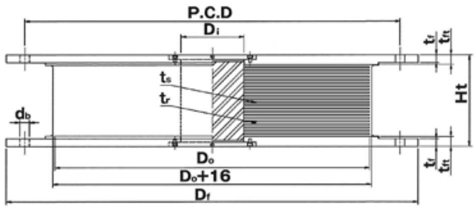
Lead Rubber Bearing (LRB)

Seismic isolation material certification number by Ministry of Land, Infrastructure and Transport, Japan
MVBR-0517 **Acquired in December 2014**

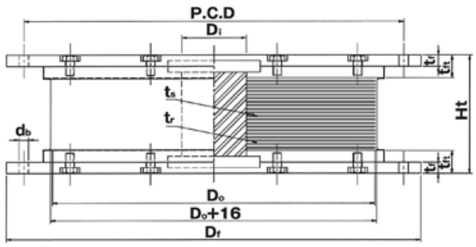
●Product Dimension

	Characteristics	
Physical Dimensions	Outer diameter	: D_o (mm)
	Lead plug diameter	: D_i (mm)
	Number of inner diameter	: A_r (× 10^2mm^2)
	Effective plane area	: t_r (mm)
	Thickness of one rubber layer	: n
	Number of rubber layers	: $H = n \cdot t_r$ (mm)
	First shape factor $S_1 = (D_o) / (4 \cdot t_r)$	
	Second shape factor $S_2 = D_o / (n \cdot t_r)$	
	Diameter of flange	: D_f (mm)
	Thickness of flange: edge/center	: t_f / t_{ft} (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



Integrated Type Flange



Assembled Type Flange

●Rubber Material

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

Compound name	Rubber code	Shear modulus G_{eq} (N/mm^2)
G4	G0.4	0.385

Composition of rubber materials (weight ratio %)

Rubber code	Natural rubber Synthetic rubber	Filler, Reinforcement agent	Vulcanization agent and others
Inner rubber (G0.4)	60 and above	10 and above	25 and below
Cover rubber	40 and above	15 and above	40 and below

Properties of rubber materials

Item	Tensile strength (N/mm^2)	Elongation at Break (%)	Hardness (JIS A)	100% modulus (N/mm^2)	Young's modulus E (N/mm^2)	Bulk modulus E_∞(N/mm^2)	Correction factor for apparent Young's modulus according to hardness, k
Test Standard	JIS K6251	JIS K6251	JIS K6253	JIS K6251	–	–	–
Inner rubber	17 and above	600 and above	37 ± 5	0.8 ± 0.2	2.20	1176	0.85
Cover rubber	12 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)
Lead plug	Pb (JIS H 2105 special)

*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 (SIS 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

- Due to the lead plug embedded in the center of the laminated rubber body, special treatment is required in case the laminated rubber bearing is to be treated as industrial waste, depending on country. Please confirm with the country's regulation.
- For mid-storey isolation, fire resistant cover is necessary. Please check with 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)

●Shear Properties

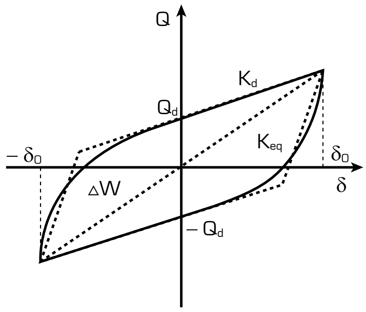
■Equivalent shear stiffness K_{eq}, equivalent damping ratio H_{eq}, initial stiffness K_1, post-yield stiffness K_2, characteristic strength Q_d

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

Post-yield stiffness : $K_2 = K_d = C_{Kd} \cdot (K_r + K_p)$
Shear stiffness of laminated rubber : $K_r = G_r \cdot A_r / H$
Additional shear stiffness by lead plug : $K_p = \alpha_p \cdot A_p / H$

Where, C_{Kd} : post-yield stiffness correction factor due to strain dependency
G_r : shear modulus of rubber 0.385N/mm²
γ : shear strain
α_p : apparent shear modulus of lead 0.583N/mm²

$$C_{Kd}\begin{cases}0.779\,\gamma^{-0.43} & [\gamma < 0.25]\\ \gamma^{-0.25} & [0.25 \leq \gamma < 1.0]\\ \gamma^{-0.12} & [1.0 \leq \gamma < 2.5]\end{cases}$$



Characteristics strength : $Q_d = C_{Qd} \cdot \sigma_{pb} \cdot A_p$

Where, C_{Qd} : characteristic strength correction factor due to strain dependency
σ_{pb} : Shear stress at yield of lead 7.967N/mm²

$$C_{Qd}\begin{cases}2.036\,\gamma^{0.41} & [\gamma \leq 0.1]\\ 1.106\,\gamma^{0.145} & [0.1 < \gamma < 0.5]\\ 1 & [0.5 \leq \gamma]\end{cases}$$

Initial stiffness : $K_1 = \beta \cdot K_d$

Where, β : Ratio of initial stiffness to post-yield stiffness which is between 10~15. (recommended value: 13)

Equivalent shear stiffness K_{eq} Equivalent damping ratio H_{eq}

$$K_{eq} = \frac{Q_d}{\gamma \cdot H} + K_d$$

$$H_{eq} = \frac{2}{\pi} \cdot \frac{Q_d\left\{\gamma \cdot H - \dfrac{Q_d}{(\beta - 1)K_d}\right\}}{K_{eq} \cdot (\gamma \cdot H)^2}$$

■Temperature dependency

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

●Temperature correction equation : K_d (T°C) = K_d (standard value at 20°C) × $(1.052 - 2.955 \times 10^{-3} \cdot T + 1.895 \times 10^{-5} \cdot T^2)$
: Q_d (T°C) = Q_d (standard value at 20°C) × $(1.192 - 1.017 \times 10^{-2} \cdot T + 2.722 \times 10^{-5} \cdot T^2)$

●Standard value of temperature dependency Standard temperature (20°C)*1

Properties values	−10°C	0°C	30°C	40°C
Post-yield stiffness K_d	+10%	+6%	−3%	−5%
Characteristic strength Q_d	+36%	+23%	−11%	−21%

*1 : The standard value takes into account the variation of 20% to the value obtained by the temperature correction equation.

■Performance variation

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

Rubber materials		G0.4	
Properties		Post-yield stiffness K_d	Characteristic strength Q_d
Manufacturing variation*2		Within ±10%	Within ±10%
Aging*3		Within +10%	−
Ambient temperature variation 20°C ± 20°C	(+) side	Within +6%	Within +23%
	(−) side	Within −5%	Within −21%
Total	(+) side	Within +26%	Within +33%
	(−) side	Within −15%	Within −31%

*2 : 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%.
If total units per project are less than 8 units, variation of total units of products per project (total of standard values) shall be within ±15%.
*3 : Predicted rate of change after 60 years at 20°C standard temperature. (20% variation is considered in the rate of change)
*4 : Above list shows the combination example.

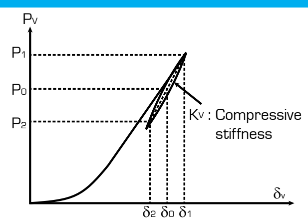
●Compressive Properties

■Compressive stiffness K_v

●Compressive stiffness K_v is determined by the following equation.

$$K_v = \alpha_v \cdot E_c \, \frac{A}{H} \qquad E_c = \frac{E(1+2\kappa S_1^2)}{1+E(1+2\kappa S_1^2)/E_\infty}$$

A : Laminated rubber plane area A_r : Effective plane area A_p : Lead plug plane area
$A = A_r + A_p$
α_v : Young's modulus correction factor = 1.23



■Ultimate compressive stress (refer the figure on the right)

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

$$\sigma_{cr} = \frac{\pi}{4} \cdot 1.26 \cdot \alpha_c \cdot (G_{eq} \cdot E_b)^{0.5} \cdot S_2$$

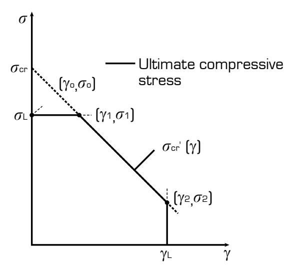
However, $E_b = E\,(1 + 2/3 \cdot \kappa \cdot S_1^2) \,/\, \{1 + E\,(1 + 2/3 \cdot \kappa \cdot S_1^2) \,/\, E_\infty\}$
α_c : Correction factor based on S_2 determined from our test data
If $S_2 \geqq 5$: $\alpha_c = 1$, if $S_2 < 5$: $\alpha_c = 0.25 \cdot (S_2 - 5) + 1$

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

$$\sigma_{cr}'(\gamma) = \sigma_{cr} \cdot \left(1 - 0.9\,\frac{\gamma}{S_2}\right)$$

●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.

$\sigma_L = 60$ (N/mm²)
$\gamma_L = \min(400\%, S_2 \times 100\%)$



Specification of flange (edge thickness / center thickness)

Outer diameter of rubber bearing (∅)※1	(600)	(650)	700	750	800	850	900	950	1000	1100	1200	1300
Standard thickness	22/28	22/28	22/28	22/28	24/32	24/32	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 For adoption of special thickness in regard to those sizes that stated in the ( ), delivery time will be longer due to mold preparation.
※2 For ∅1400 and above, assembled type flange will be used.
※3 Compared to the standard spefication, total height & weight of product for special thickness will be changed.

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.

●HH Series (Total Rubber Thickness 20cm)

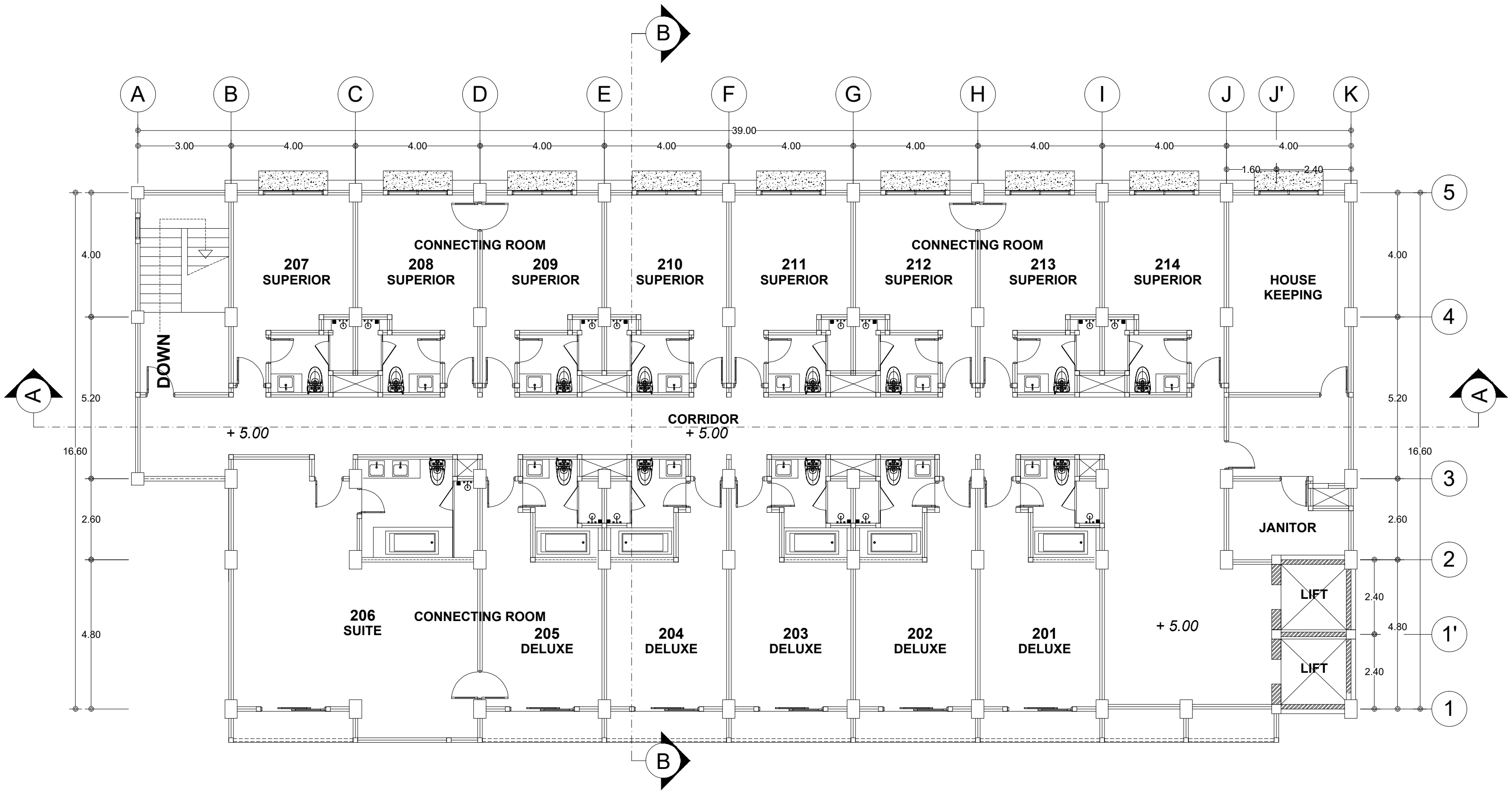
Code

Compound name	Rubber code	Shear modulus (N/mm²)	Equivalent damping ratio

	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	($\times10^2$ 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	3.46	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	30/38	32/40	32/40	37/45	42/50	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)	∅33×12	∅33×12	∅33×12	∅33×12	∅33×12	∅33×12	∅33×12	∅33×12	∅39×12	∅39×12	∅39×12	∅39×12	∅42×12	∅42×16	∅45×12
	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**	**390.4**	**388.3**	**376.9**	**422.2**	**413.1**	**410.8**	**402.4**	**400.6**	**390.2**	**385.6**	**376.9**	**405.5**	**410.2**	**522.0**
	Total weight	(tonf)	**0.66**	**0.72**	**0.80**	**0.90**	**1.21**	**1.31**	**1.49**	**1.59**	**1.77**	**2.05**	**2.38**	**2.65**	**3.46**	**4.05**	**6.64**
	Total weight	(kN)	**6.5**	**7.0**	**7.9**	**8.9**	**11.9**	**12.9**	**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 $\gamma=0$	43	52	58	69	78	89	102	113	122	136	148	160	173	185	200
	Ultimate compressive stress (N/mm²)	(γ_0, σ_0)	(0,22)	(0,30)	(0,35)	(0,42)	(0,48)	(0,52)	(0,56)	(0,59)	(0,60)	(0,60)	(0,60)	(0,60)	(0,60)	(0,60)	(0,60)
		(γ_1, σ_1)	(1.5,22)	(1.4,30)	(1.4,35)	(1.5,42)	(1.6,48)	(1.8,52)	(2.1,56)	(2.3,59)	(2.5,60)	(3.1,60)	(3.6,60)	(3.8,60)	(3.8,60)	(3.9,60)	(3.9,60)
		(γ_2, σ_2)	(2.7,4)	(3.0,5)	(3.1,6)	(3.4,7)	(3.4,11)	(3.5,17)	(3.5,23)	(3.6,29)	(3.6,34)	(3.7,46)	(3.7,56)	–	–	–	–
	Compressive stiffness	($\times10^3$kN/m)	1970	2340	2660	3090	3510	3970	4490	4980	5450	6590	7860	9220	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	7620	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	($\times10^3$kN/m)	5.19	6.15	6.99	8.10	9.23	10.4	11.8	13.1	14.3	17.4	20.7	24.3	28.3	32.4	37.3
	Post yield stiffness (γ = 100%)	($\times10^3$kN/m)	0.519	0.615	0.699	0.810	0.923	1.04	1.18	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	($\times10^3$kN/m)	0.876	1.04	1.18	1.37	1.56	1.76	1.99	2.21	2.42	2.94	3.50	4.11	4.77	5.47	6.29
	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.

LAMPIRAN II
DATA GAMBAR SAPADIA HOTEL



Denah Lt. 1 - 7
Skala 1 : 150

NAMA PEKERJAAN

LOKASI PEKERJAAN

PEMILIK PEKERJAAN

CATATAN

NO	REVISI	PARAF

KONSULTAN PERENCANA

WAHANA MULTI DESAIN

Konsultan Perencana, Perancang, dan Manajemen Konstruksi

DIREKTUR

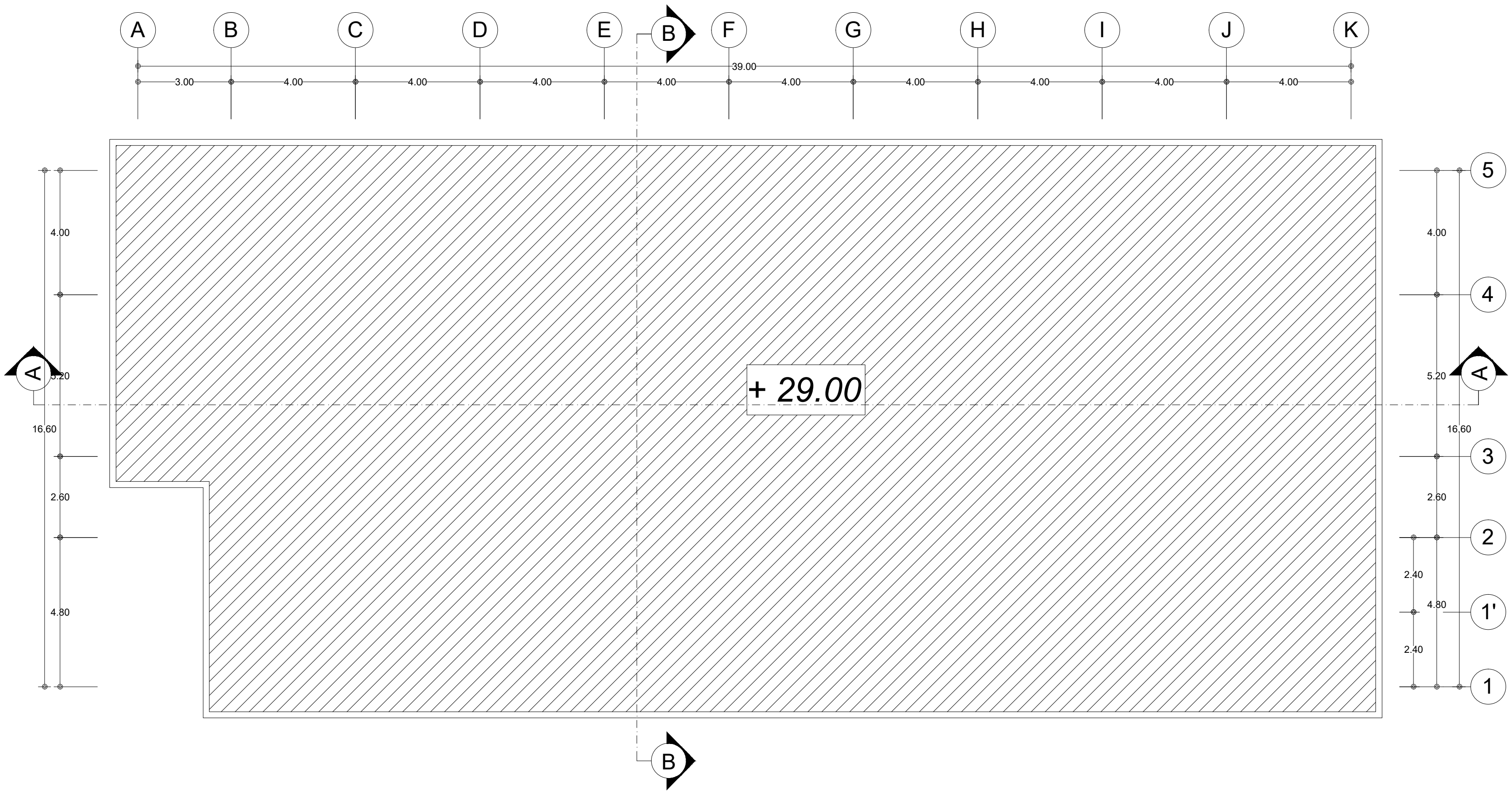
TEAM LEADER

STRUKTUR	DI GAMBAR OLEH
	Western F

JUDUL GAMBAR

DENAH LANTAI 1 - 7

SKALA	TANGGAL
1 : 150	
NO. GAMBAR	KODE
131	ARS
JUMLAH LEMBAR	A4



Denah Pelat Atap
Skala 1 : 150

NAMA PEKERJAAN

LOKASI PEKERJAAN

PEMILIK PEKERJAAN

CATATAN

NO	REVISI	PARAF

KONSULTAN PERENCANA

WAHANA MULTI DESAIN

Konsultan Perencana, Perancang, dan Manajemen Konstruksi

DIREKTUR

TEAM LEADER

STRUKTUR	DI GAMBAR OLEH
	Western F

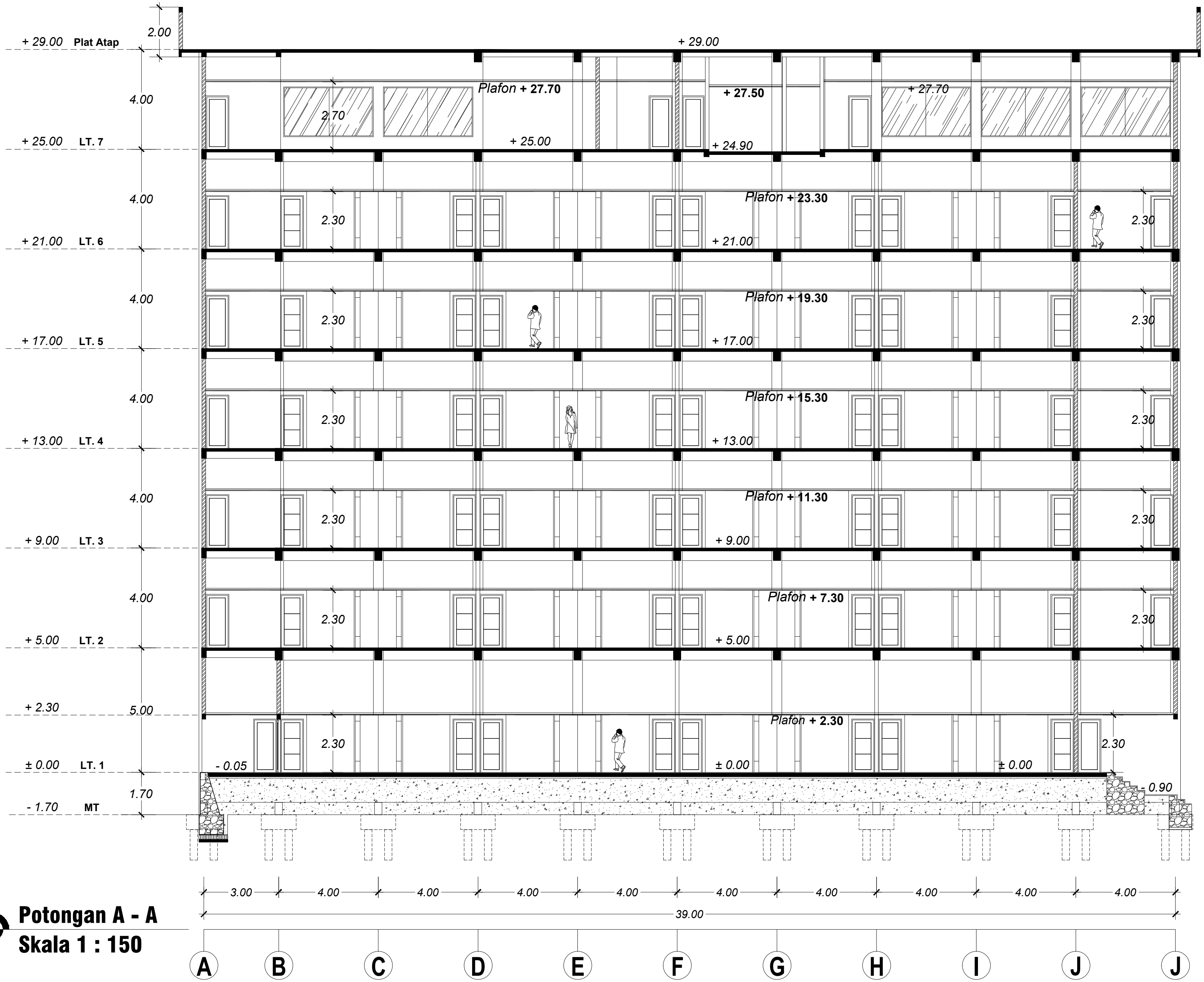
JUDUL GAMBAR

DENAH PELAT ATAP

SKALA	TANGGAL
1 : 150	

NO. GAMBAR	KODE
132	ARS

JUMLAH LEMBAR	
	A4



Potongan A - A
Skala 1 : 150

NAMA PEKERJAAN

LOKASI PEKERJAAN

PEMILIK PEKERJAAN

CATATAN

NO	REVISI	PARAF

KONSULTAN PERENCANA

WAHANA MULTI DESAIN
Konsultan Perencana, Perancang, dan Manajemen Konstruksi

DIREKTUR

TEAM LEADER

STRUKTUR	DI GAMBAR OLEH
	Western F

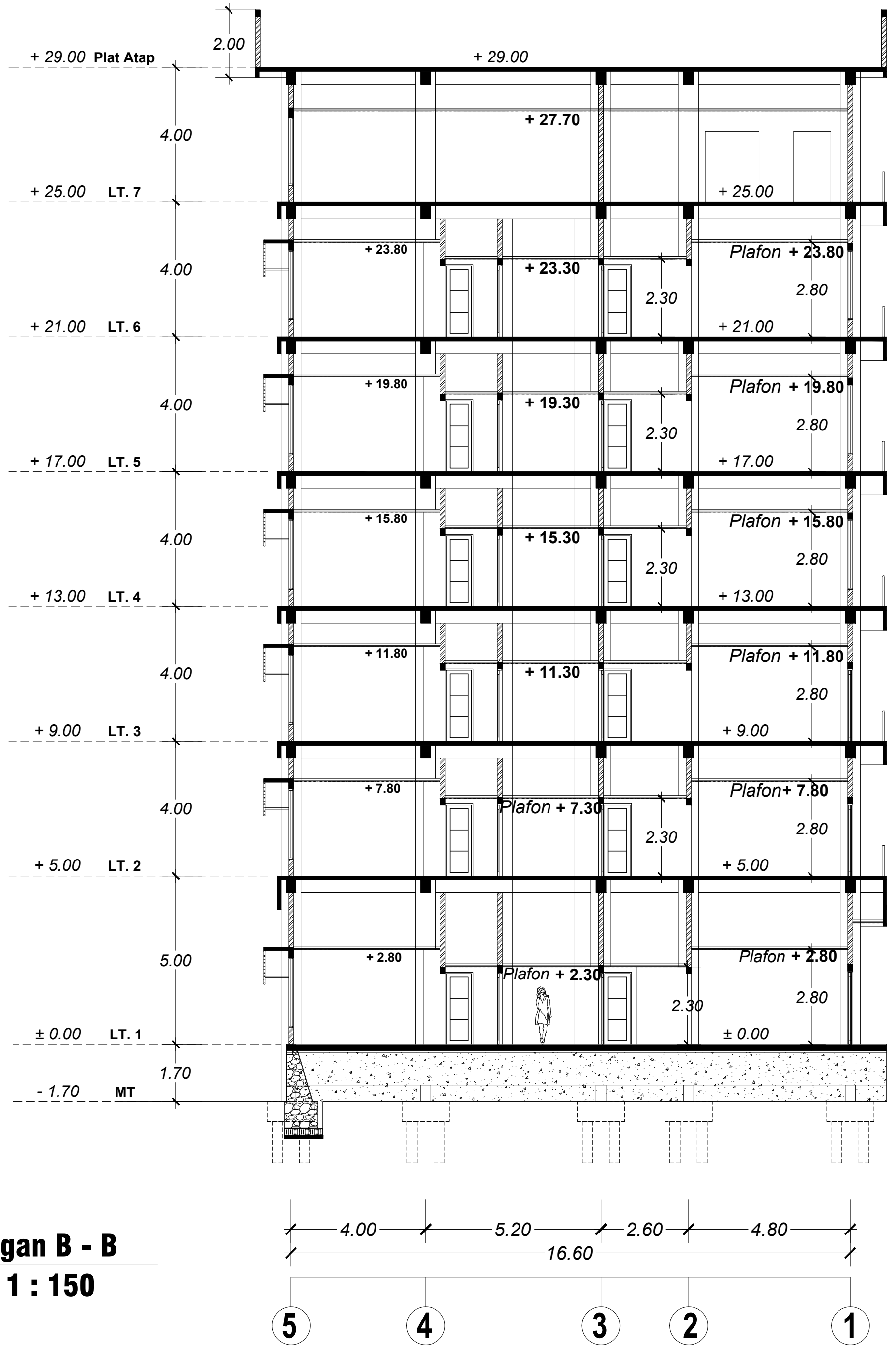
JUDUL GAMBAR

POTONGAN A - A

SKALA	TANGGAL
1 : 150	

NO. GAMBAR	KODE
133	ARS

JUMLAH LEMBAR	
	A4



Potongan B - B
Skala 1 : 150

NAMA PEKERJAAN

LOKASI PEKERJAAN

PEMILIK PEKERJAAN

CATATAN

NO	REVISI	PARAF

KONSULTAN PERENCANA

WAHANA MULTI DESAIN
Konsultan Perencana, Perancang, dan Manajemen Konstruksi

DIREKTUR

TEAM LEADER

STRUKTUR

DI GAMBAR OLEH

Western F

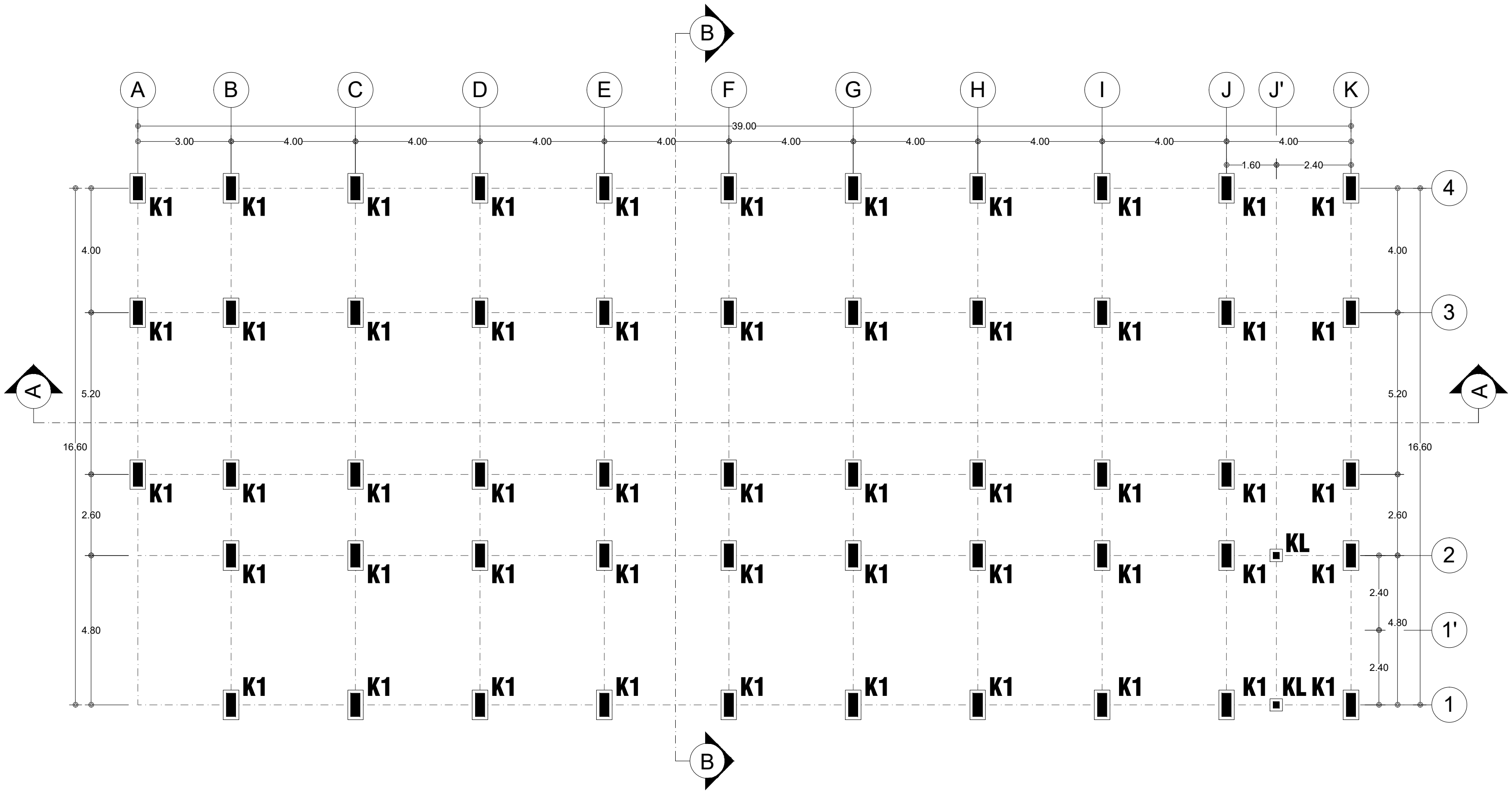
JUDUL GAMBAR

POTONGAN B - B

SKALA	TANGGAL
1 : 150	

NO. GAMBAR	KODE
134	ARS

JUMLAH LEMBAR	
	A4



Denah Kolom Lt. 1
Skala 1 : 150

NAMA PEKERJAAN

LOKASI PEKERJAAN

PEMILIK PEKERJAAN

CATATAN

NO	REVISI	PARAF

KONSULTAN PERENCANA

WAHANA MULTI DESAIN

Konsultan Perencana, Perancang, dan Manajemen Konstruksi

DIREKTUR

TEAM LEADER

STRUKTUR

DI GAMBAR OLEH

Western F

JUDUL GAMBAR

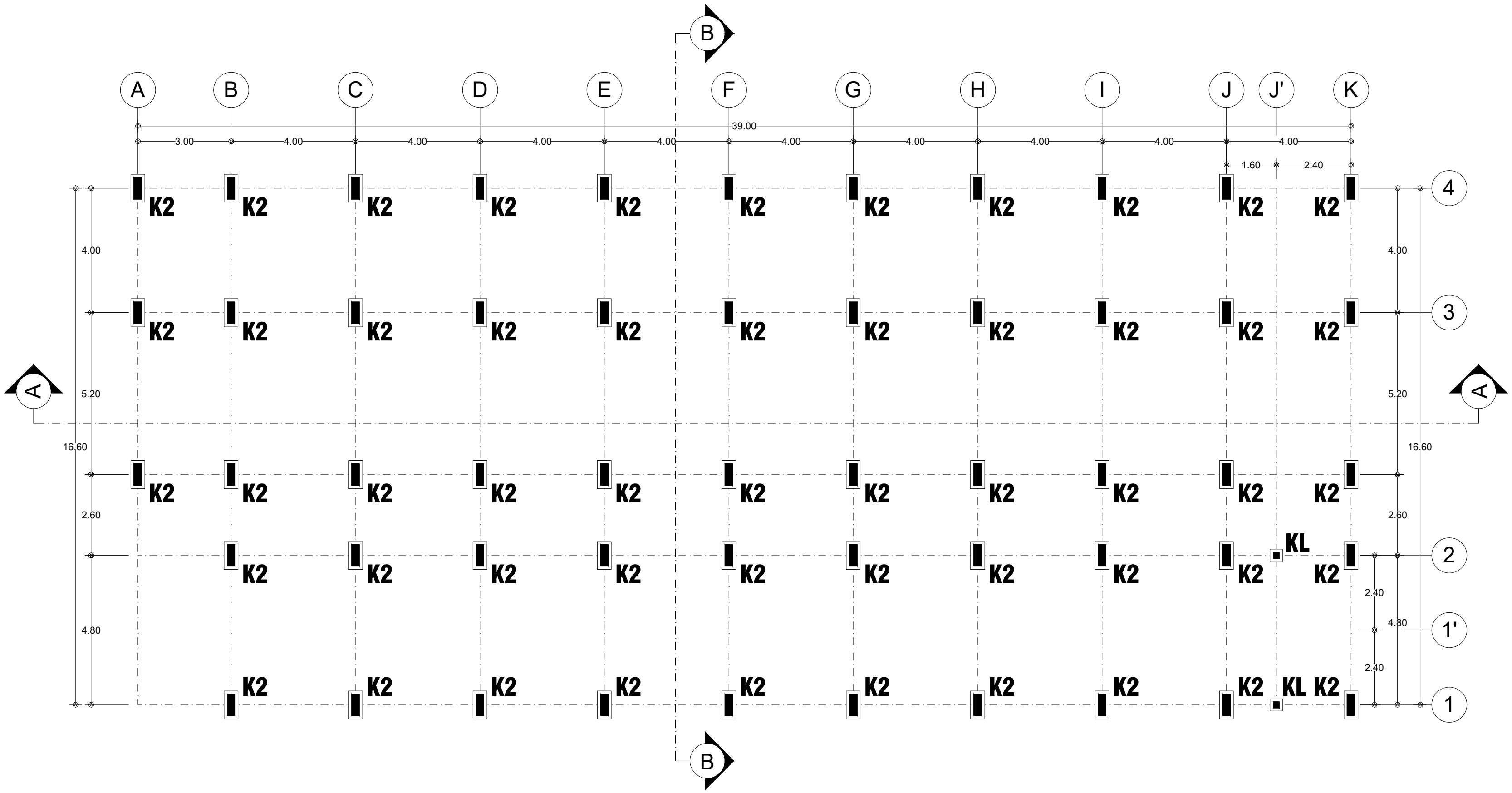
DENAH KOLOM K1

SKALA	TANGGAL
1 : 150	

NO. GAMBAR	KODE
135	ARS

JUMLAH LEMBAR

A4



Denah Kolom Lt. 2 - 4
Skala 1 : 150

NAMA PEKERJAAN

LOKASI PEKERJAAN

PEMILIK PEKERJAAN

CATATAN

NO	REVISI	PARAF

KONSULTAN PERENCANA

WAHANA MULTI DESAIN

Konsultan Perencana, Perancang, dan Manajemen Konstruksi

DIREKTUR

TEAM LEADER

STRUKTUR

DI GAMBAR OLEH

Western F

JUDUL GAMBAR

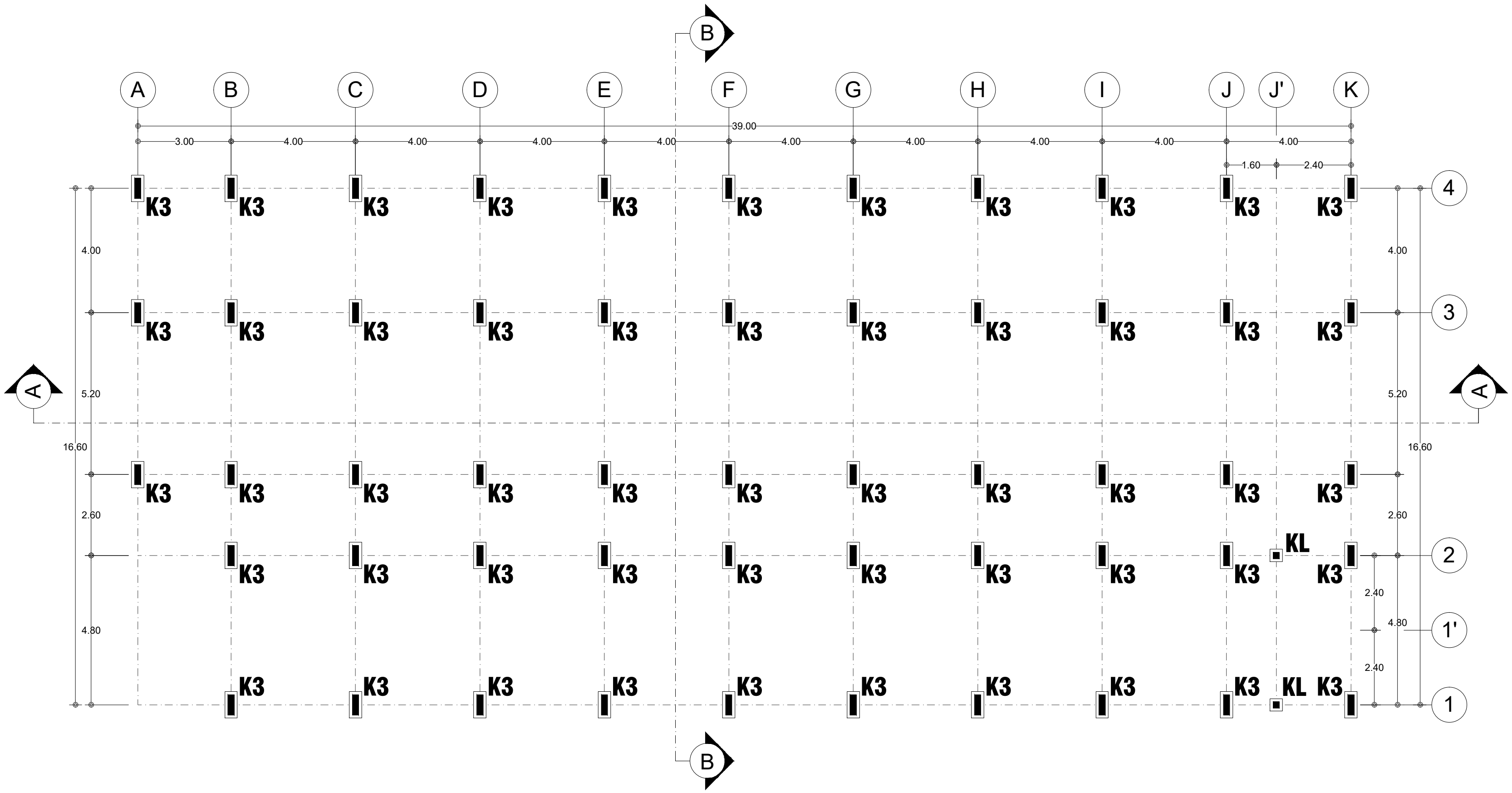
DENAH KOLOM K2

SKALA	TANGGAL
1 : 150	

NO. GAMBAR	KODE
136	ARS

JUMLAH LEMBAR

A4



Denah Kolom Lt. 5 - 7
Skala 1 : 150

NAMA PEKERJAAN

LOKASI PEKERJAAN

PEMILIK PEKERJAAN

CATATAN

NO	REVISI	PARAF

KONSULTAN PERENCANA

WAHANA MULTI DESAIN

Konsultan Perencana, Perancang, dan Manajemen Konstruksi

DIREKTUR

TEAM LEADER

STRUKTUR

DI GAMBAR OLEH

Western F

JUDUL GAMBAR

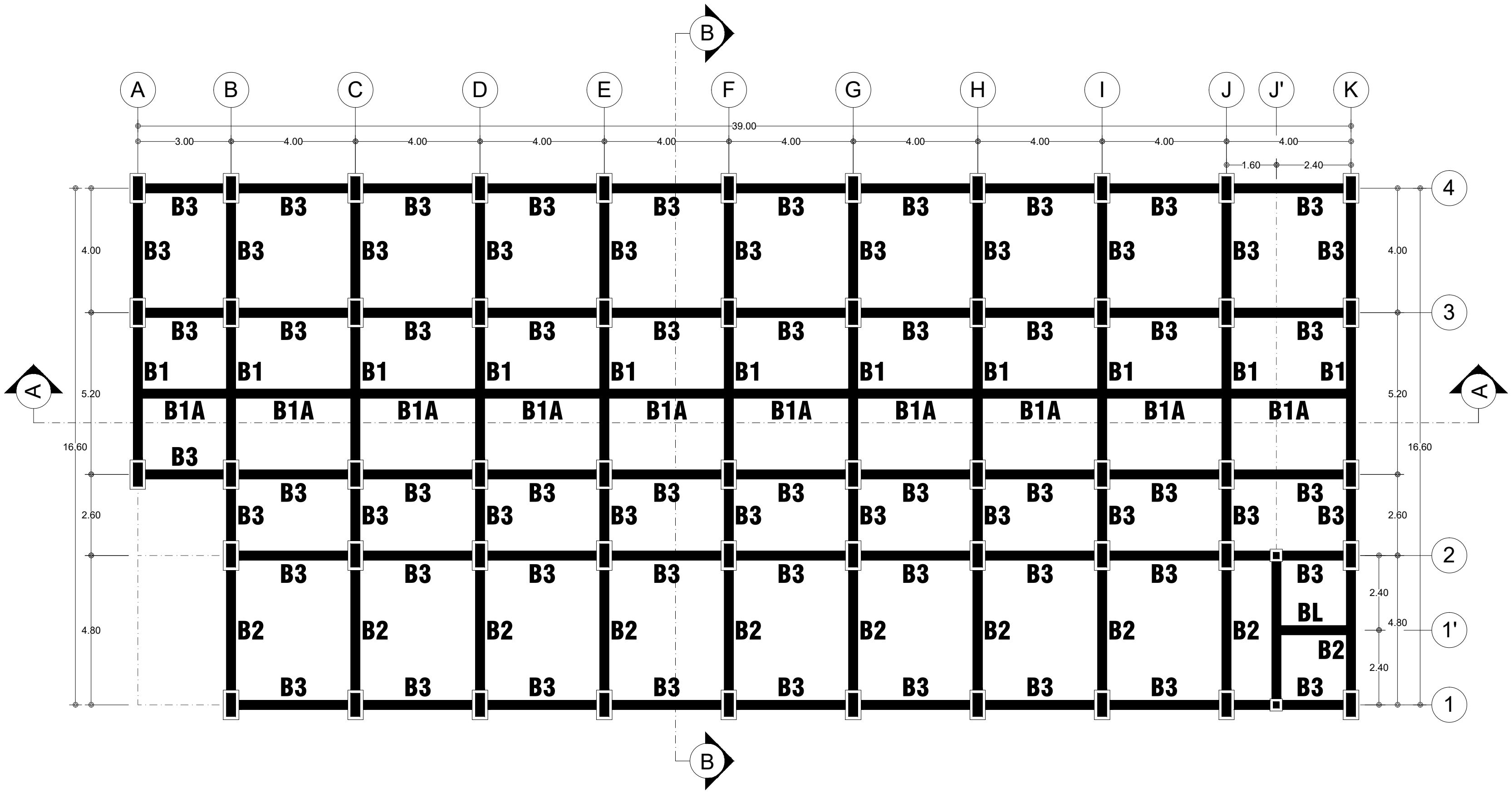
DENAH KOLOM K3

SKALA	TANGGAL
1 : 150	

NO. GAMBAR	KODE
137	ARS

JUMLAH LEMBAR

A4



Denah Balok
Skala 1 : 150

NAMA PEKERJAAN	
LOKASI PEKERJAAN	
PEMILIK PEKERJAAN	
CATATAN	

NO	REVISI	PARAF

KONSULTAN PERENCANA

WAHANA MULTI DESAIN

Konsultan Perencana, Perancang, dan Manajemen Konstruksi

DIREKTUR	
TEAM LEADER	

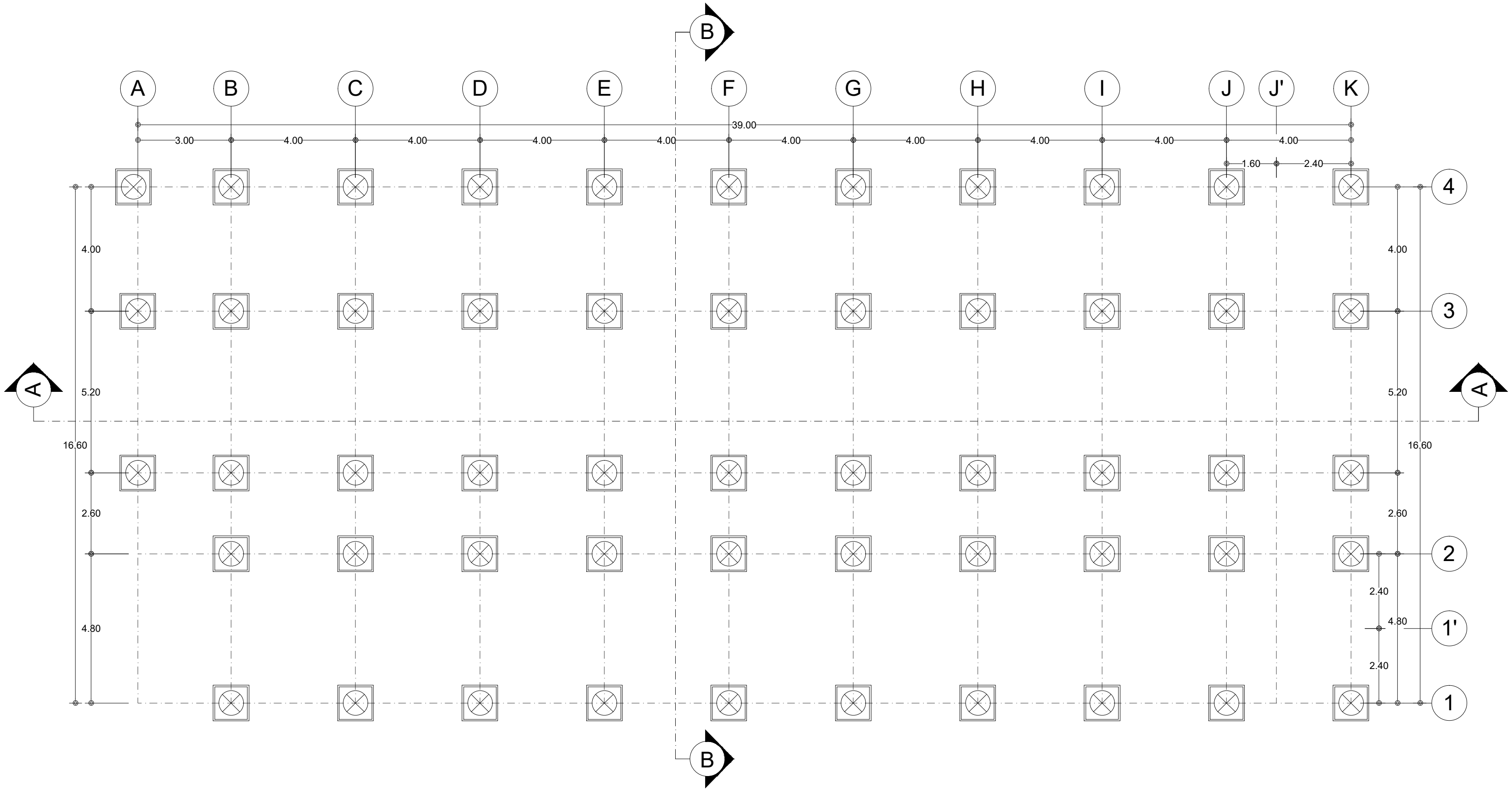
STRUKTUR	DI GAMBAR OLEH
	Western F

JUDUL GAMBAR

DENAH BALOK

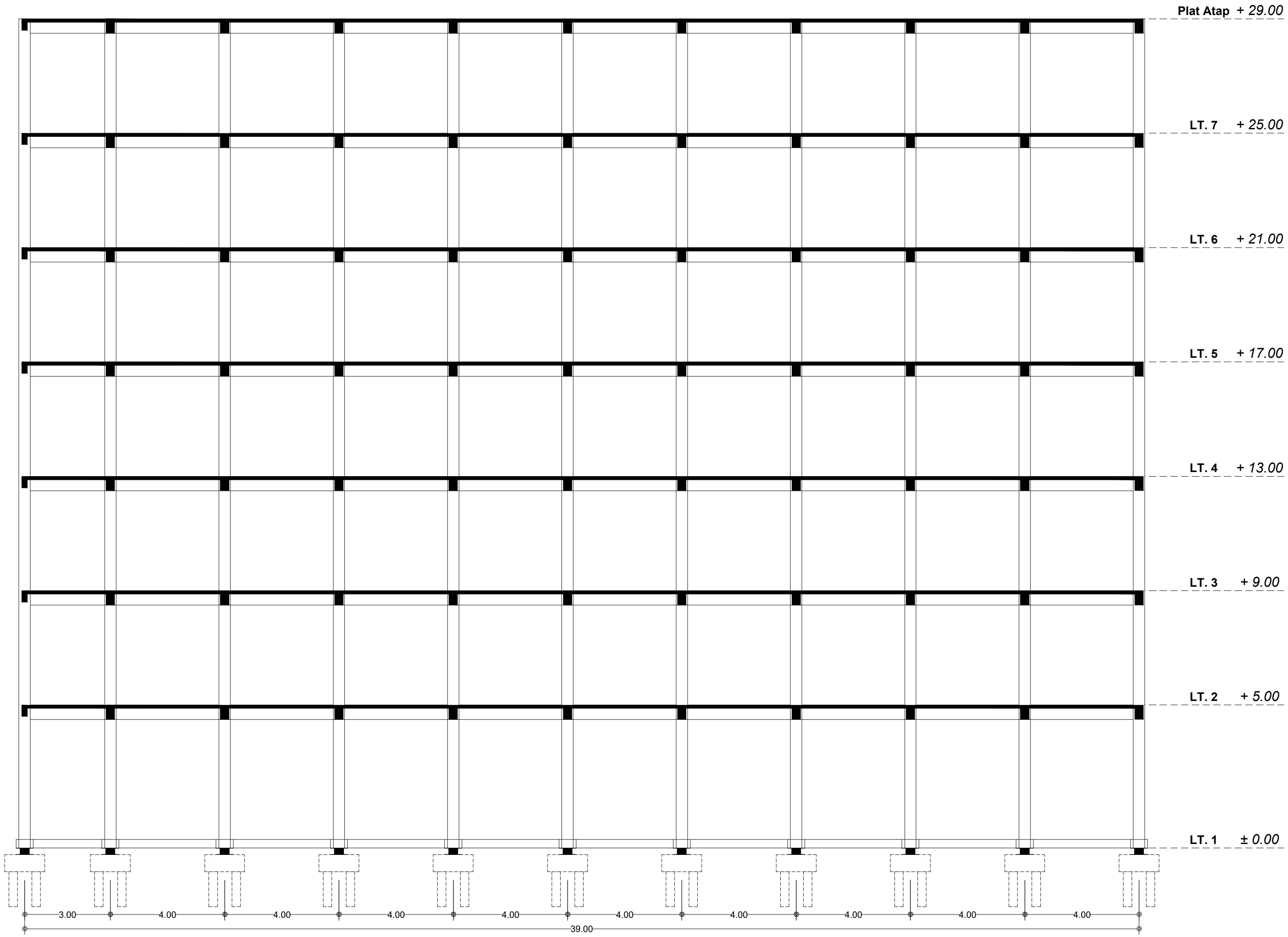
SKALA	TANGGAL
1 : 150	
NO. GAMBAR	KODE
138	ARS
JUMLAH LEMBAR	A4

LAMPIRAN III
DESAIN *BASE ISOLATOR* TIPE *HIGH DUMPING RUBBER BEARING*



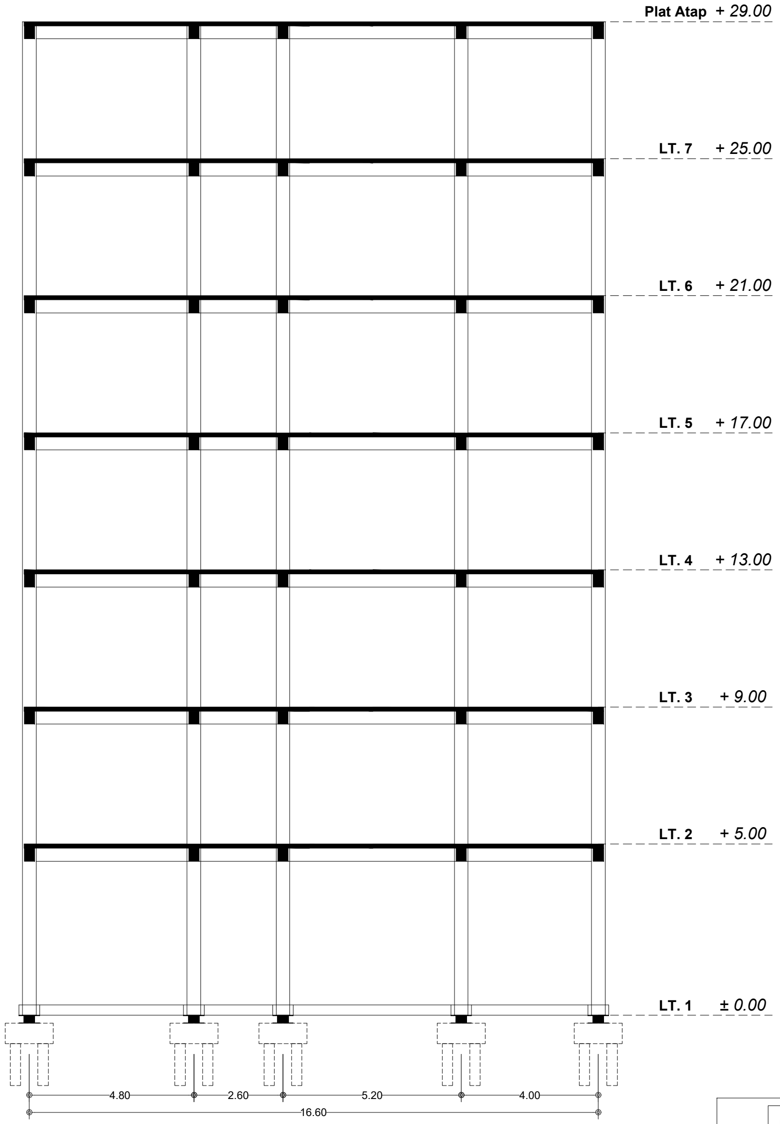
KEMENTERIAN RISET, TEKNOLOGI DAN PENDIDIKAN TINGGI
UNIVERSITAS MUHAMMADIYAH MATARAM
PROGRAM STUDI TEKNIK SIPIL

PEMBIMBING 1: MAYA SARIDEWI PASCANAWATY, ST., MT	JUDUL GAMBAR: DENAH BASE ISOLATOR
PEMBIMBING 2: AHMAD ZARKASI, ST., MT	SKALA: 1 : 150
DIGAMBAR OLEH: M. HERU	NO. GAMBAR: 140



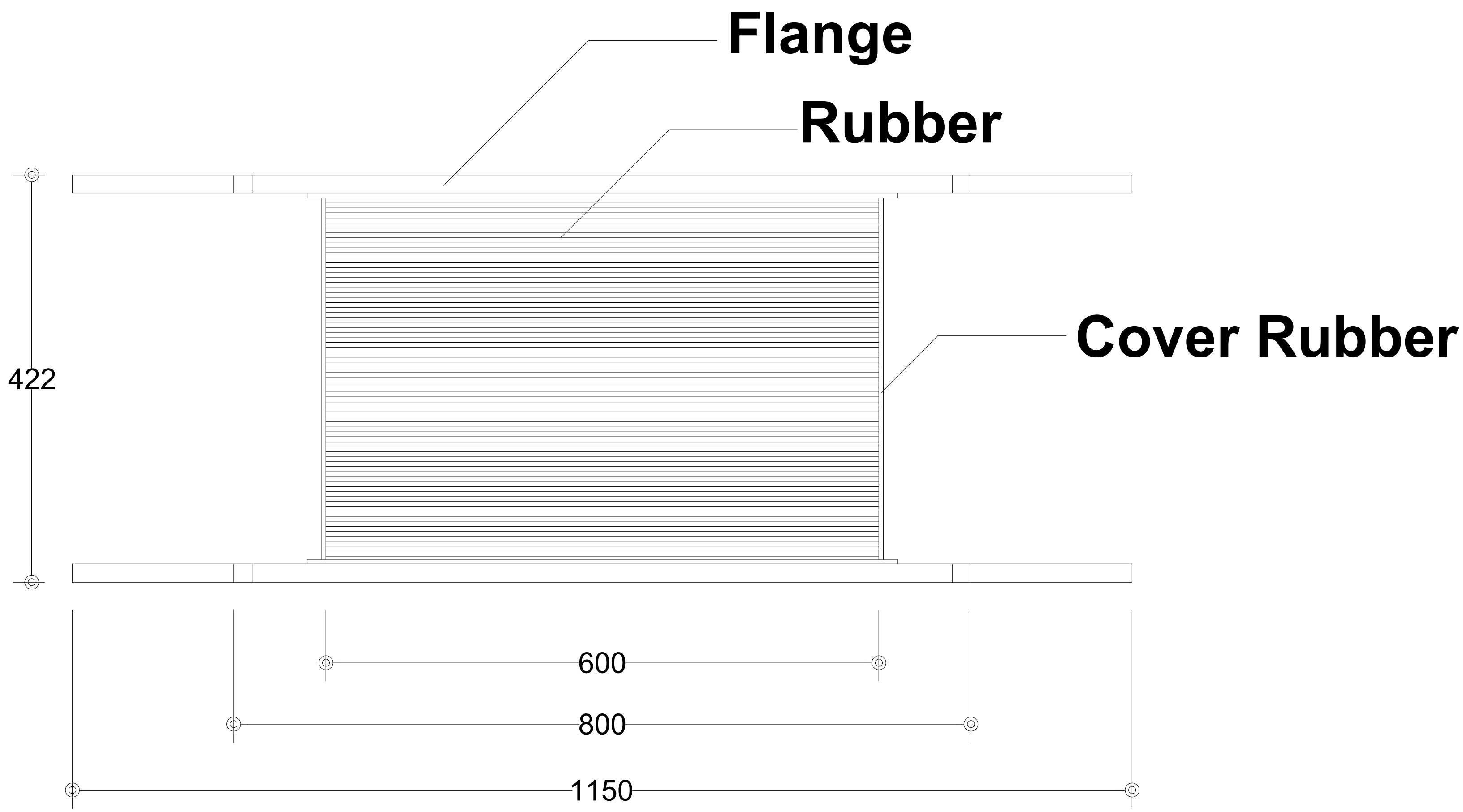
KEMENTERIAN RISET, TEKNOLOGI DAN PENDIDIKAN TINGGI
UNIVERSITAS MUHAMMADIYAH MATARAM
PROGRAM STUDI TEKNIK SIPIL

PEMBIMBING 1: MAYA SARIDEWI PASCANAWATY, ST., MT	JUDUL GAMBAR: POTONGAN A - A
PEMBIMBING 2: AHMAD ZARKASI, ST., MT	SKALA: 1 : 150 / NO. GAMBAR: 141
DIGAMBAR OLEH: M. HERU	



KEMENTERIAN RISET, TEKNOLOGI DAN PENDIDIKAN TINGGI
UNIVERSITAS MUHAMMADIYAH MATARAM
PROGRAM STUDI TEKNIK SIPIL

PEMBIMBING 1: MAYA SARIDEWI PASCANAWATY, ST., MT	JUDUL GAMBAR: POTONGAN B - B
PEMBIMBING 2: AHMAD ZARKASI, ST., MT	SKALA: 1 : 150 — NO. GAMBAR: 142
DIGAMBAR OLEH: M. HERU	



KEMENTERIAN RISET, TEKNOLOGI DAN PENDIDIKAN TINGGI UNIVERSITAS MUHAMMADIYAH MATARAM PROGRAM STUDI TEKNIK SIPIL	
PEMBIMBING 1: MAYA SARIDEWI PASCANAWATY, ST., MT	JUDUL GAMBAR: DETAIL BASE ISOLATOR HH080X6R
PEMBIMBING 2: AHMAD ZARKASI, ST., MT	SKALA: 1 : 50
DIGAMBAR OLEH: M. HERU	NO. GAMBAR: 143

LAMPIRAN IV
SPESIFIKASI *LIFT*

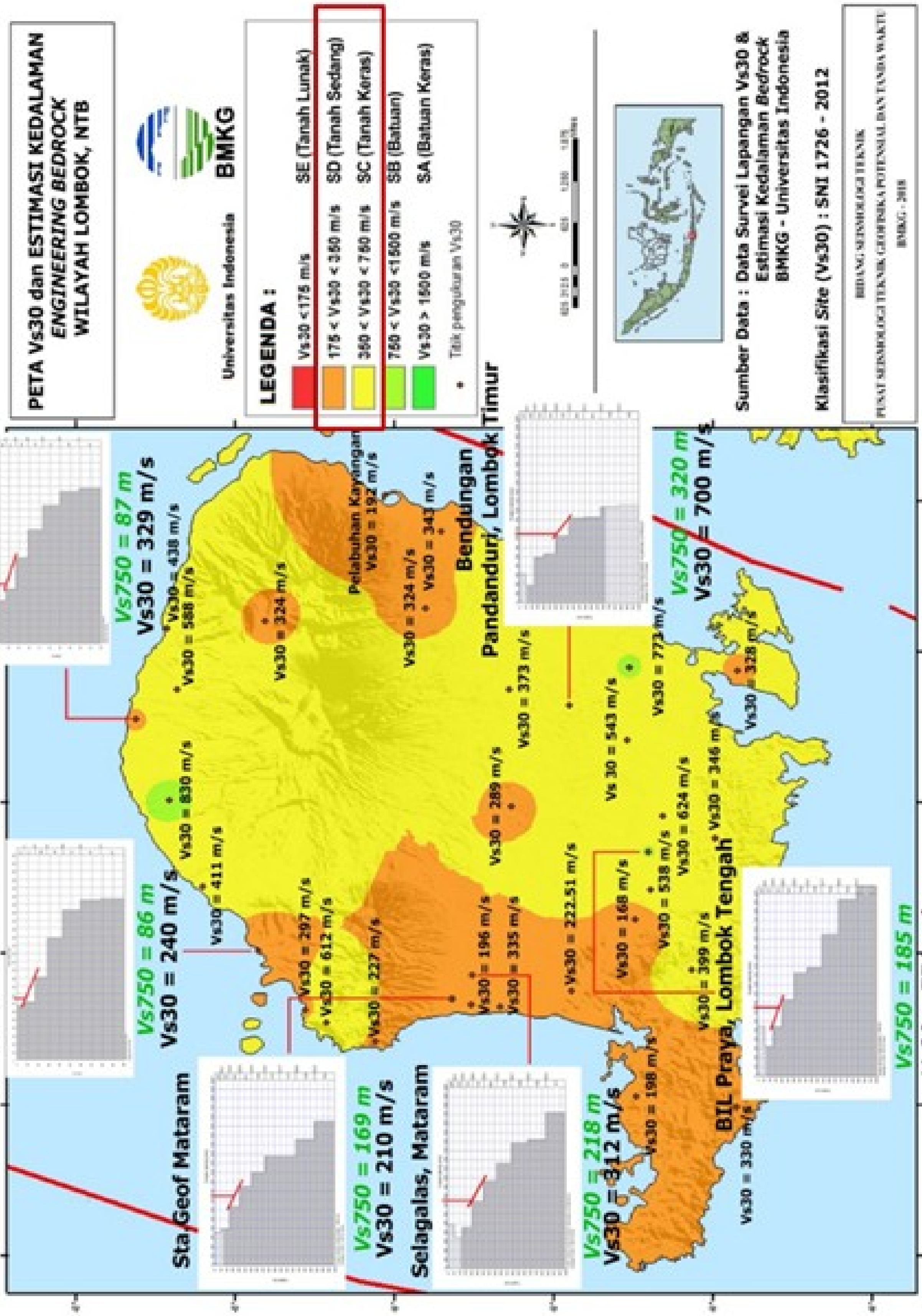
Specifications of passenger elevator without machine room

Note: Standard first floor height 4m, other floors 3m

KG Load	m/s Speed	Car size mm			Opening size mm		Hoistway size mm				Highest floors	Highest rise height m
		CW	CD	CH	OP	OPH	HW	HD	K	S		
630	1				700		1750		4150	1400	15	50
	1.5	1100	1400	2380		2100		1800	4300	1500	24	80
	1.75				800		1850		4400	1550	24	80
800	1								4150	1400	15	50
	1.5	1400	1400	2380	800	2100	2050	1800	4300	1500	24	80
	1.75								4400	1550	24	80
1000	1								4150	1400	15	50
	1.5	1600	1400	2380	900	2100	2250	1800	4300	1500	24	80
	1.75								4400	1550	24	80
1150	1								4250	1550	15	50
	1.5	1600	1600	2500	900	2100	2400	2000	4400	1700	24	80
	1.75								4500	1700	32	95
1350	1								4550	1700	15	50
	1.5	2000	1500	2500	1100	2100	3000	2100	4650	1750	24	80
	1.75								4700	1800	32	95
1600	1								4550	1700	15	50
	1.5	2000	1700	2500	1100	2100	3000	2200	4650	1750	24	80
	1.75								4700	1800	32	95

Note: The drawings and specifications are only for your reference, final order please confirm with LARSSON

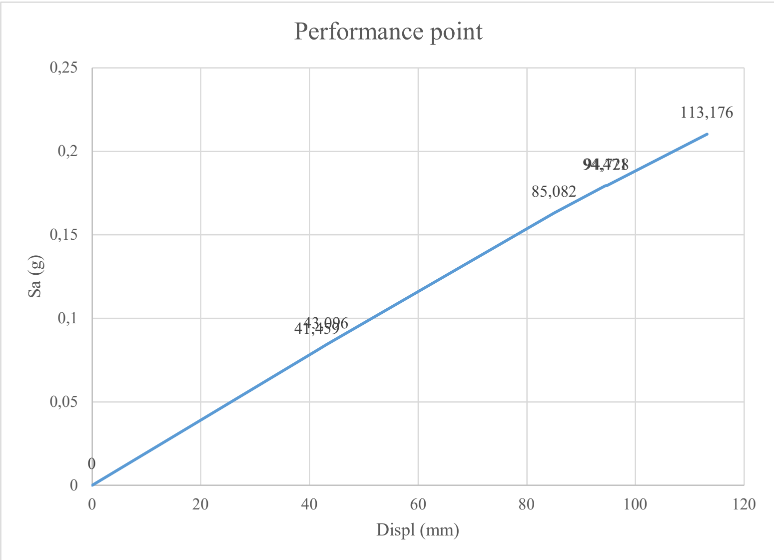
LAMPIRAN V
KELAS TANAH



Peta Jenis Tanah Pulau Lombok Berdasarkan Pergeseran Lapisan Tanah
Sumber : Kajian Rangkaian Gempa Lombok Provinsi Nusa Tenggara Barat, 2018

LAMPIRAN VI
TABEL PUSHOVER *FIXED BASE* ARAH X

TABLE: Base Shear vs Monitored Displacement													
Step	nitored D	Base Forc	A-B	B-C	C-D	D-E	>E	A-IO	IO-LS	LS-CP	>CP	Total
	mm	kN										
0	0	0	4380	0	0	0	0	4380	0	0	0	4380
1	58	3739,05	4380	0	0	0	0	4380	0	0	0	4380
2	60,289	3892,37	4378	2	0	0	0	4380	0	0	0	4380
3	118,794	7553,88	4264	116	0	0	0	4380	2	0	0	4380
4	131,769	8289,33	4070	310	0	0	0	4374	4	0	0	4380
5	132,105	8285,07	4046	334	0	0	0	4374	6	0	2	4380
6	157,493	9727,98	3708	672	0	0	0	4368	10	0	2	4380
7	157,61	9715,91	3708	672	0	0	0	4366	11	0	6	4380
8	158,53	9768,35	3690	690	0	0	0	4366	13	0	6	4380

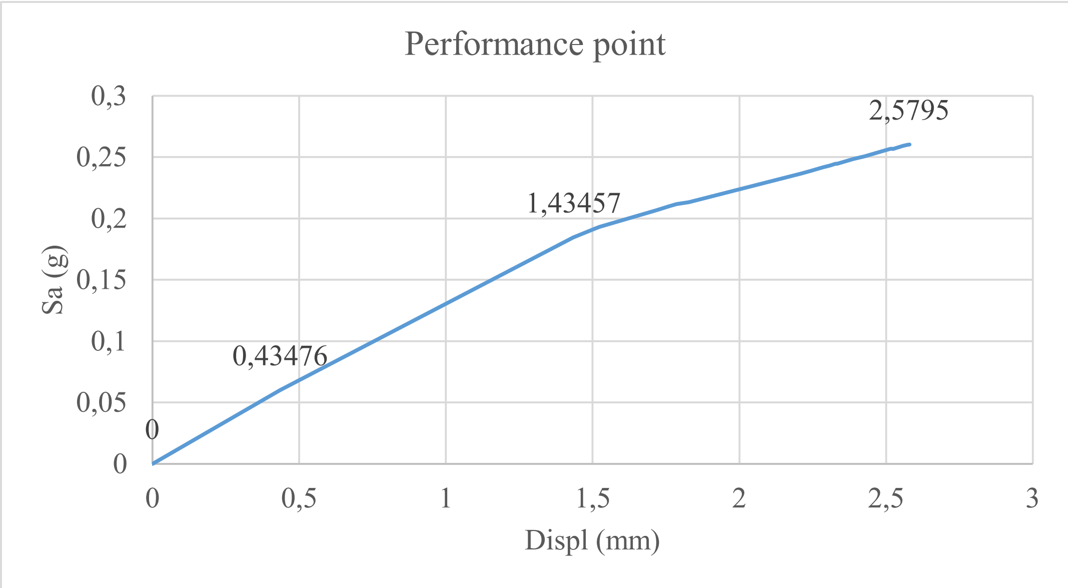


Nilai Performance point *fixed base* arah x

LAMPIRAN VII

TABEL PUSHOVER *FIXED BASE* ARAH Y

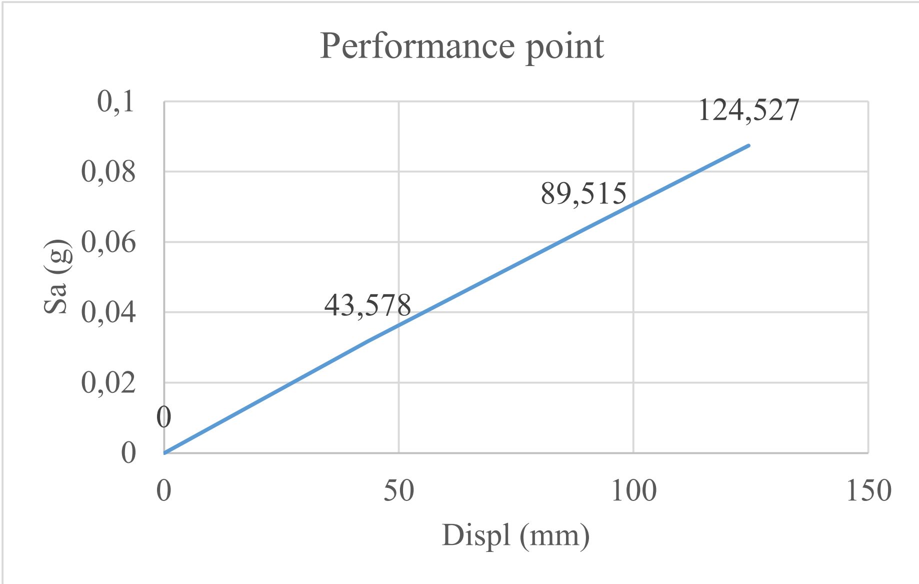
TABLE: Base Shear vs Monitored Displacement												
Step	Monitored Displ	Base Force	A-B	B-C	C-D	D-E	>E	A-IO	IO-LS	LS-CP	>CP	Total
	mm	kN										
0	0	0	4380	0	0	0	0	4380	0	0	0	4380
1	0,573	2964,135	4378	2	0	0	0	4380	0	0	0	4380
2	2,148	9521,491	3596	784	0	0	0	4369	0	0	0	4380
3	2,164	9694,816	3544	836	0	0	0	4368	0	0	0	4380
4	2,19	9798,667	3536	844	0	0	0	4367	0	0	0	4380
5	2,222	9977,647	3480	900	0	0	0	4355	0	0	0	4380
6	2,338	10374,44	3476	904	0	0	0	4354	0	0	0	4380
7	2,451	10540,54	3470	910	0	0	0	4354	0	0	0	4380
8	2,468	10622,82	3466	914	0	0	0	4354	0	0	0	4380
9	2,488	10943,13	3414	965	1	0	0	4319	0	0	0	4380
10	2,528	11045,65	3412	967	1	0	0	4311	0	0	0	4380
11	2,614	11170,95	3410	968	2	0	0	4303	9	0	0	4380
12	2,621	11209,71	3408	970	2	0	0	4300	10	0	2	4380
13	2,623	11194,04	3404	974	2	0	0	4295	11	0	2	4380
14	3,104	11730,17	3404	974	2	0	0	4293	18	0	2	4380
15	3,217	12063,32	3398	979	3	0	0	4284	19	3	4	4380
16	3,232	12073,45	3398	979	3	0	0	4277	18	3	4	4380
17	3,26	12158,48	3378	998	4	0	0	4261	17	4	4	4380
18	3,373	12345,49	3378	998	4	0	0	4260	47	4	5	4380
19	3,384	12376,89	3378	998	4	0	0	4260	55	4	10	4380
20	3,387	12367,03	3376	1000	4	0	0	4252	62	4	10	4380
21	3,465	12499,75	3376	999	5	0	0	4251	65	4	11	4380
22	3,487	12569,8	3376	999	5	0	0	4251	70	4	11	4380
23	3,491	12577,77	3400	978	2	0	0	4299	72	4	11	4380



Nilai Performance point *fixed base* arah y

LAMPIRAN VIII
TABEL PUSHOVER *BASE ISOLATOR* ARAH X

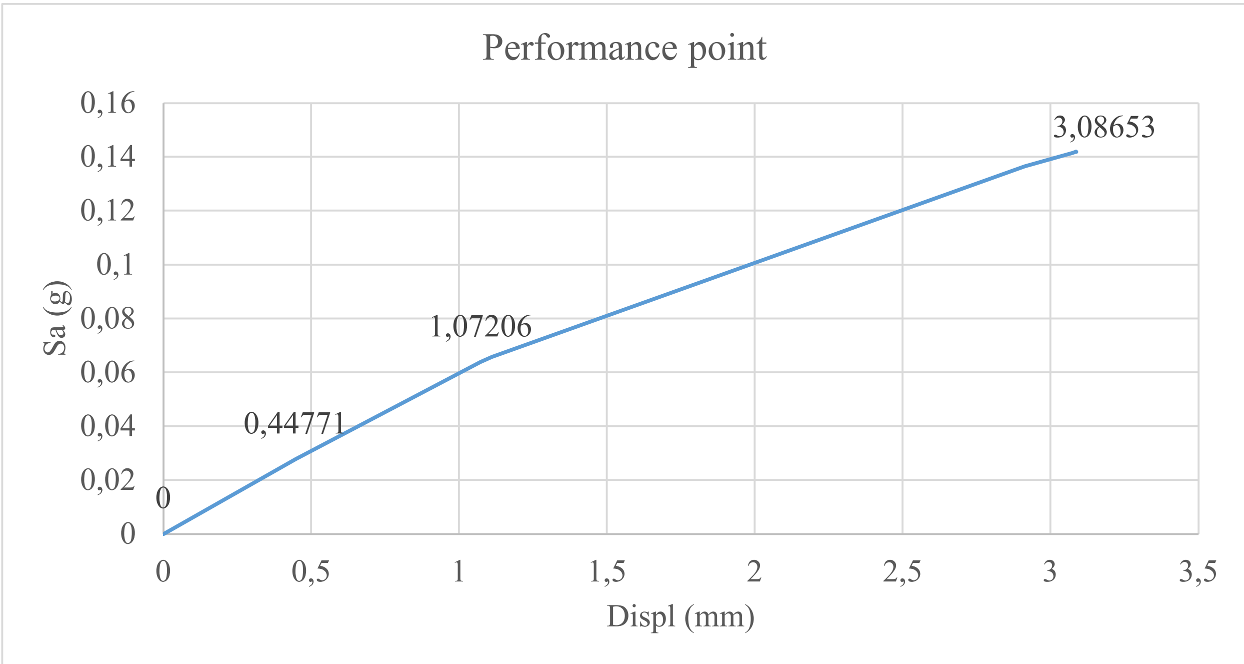
TABLE: Base Shear vs Monitored Displacement													
Step	lonitored Dis	ase For	A-B	B-C	C-D	D-E	>E	A-IO	IO-LS	LS-CP	>CP	Total
	mm	kN										
0	0	0	4380	0	0	0	0	4380	0	0	0	4380
1	-56	1730	4378	2	0	0	0	4380	0	0	0	4380
2	-115	3458	4272	108	0	0	0	4380	0	0	0	4380
3	-129	3820	3962	418	0	0	0	4372	6	0	0	4380



Nilai performance point

LAMPIRAN IX
TABEL PUSHOVER *BASE ISOLATOR* ARAH Y

TABLE: Base Shear vs Monitored Displacement												
Step	Monitored Displ	Base Force	A-B	B-C	C-D	D-E	>E	A-IO	IO-LS	LS-CP	>CP	Total
	mm	kN										
0	0	0	4380	0	0	0	0	4380	0	0	0	4380
1	0,626	1552,1115	4378	2	0	0	0	4380	0	0	0	4380
2	1,496	3586,4221	4108	272	0	0	0	4380	0	0	0	4380
3	1,521	3694,1907	4098	282	0	0	0	4380	0	0	0	4380
4	3,307	7799,8237	3688	692	0	0	0	4360	5	0	0	4380
5	3,422	8307,7299	3661	717	2	0	0	4359	5	0	2	4380
6	3,422	8307,7268	3660	718	2	0	0	4359	13	3	7	4380



Nilai performance point