Lesson Two

Proto Type Passive Dampers

Classification of Dampers

- Type one: Passive dampers

  Do not change damping property once they are manufactured
- Type two: Active dampers
- Type three: Semi-active dampers

  Can change damping property

In which part of the building can we install dampers?

Dampers have to be installed not to interfere with the beauties and the functions of buildings where we live.

Four possible places to install dampers

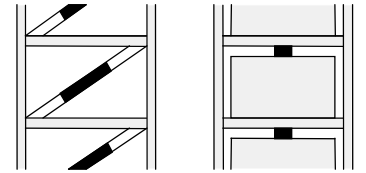
1)Mass dampers on the roof

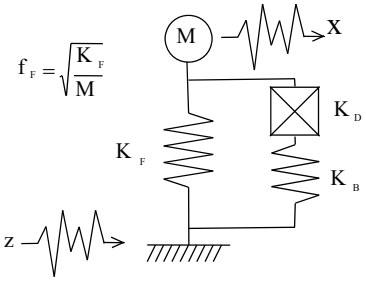
2)Inter story dampers between the two stories

3)Coupling dampers between the separated structures

4)Distribute dozens of small dampers

Inter story damper





Analytical model to take into considerations the stiffness of the damper supporting members.

small dampers

In the case we can not find out enough room for large scale dampers, numbers of small dampers are assembled and installed

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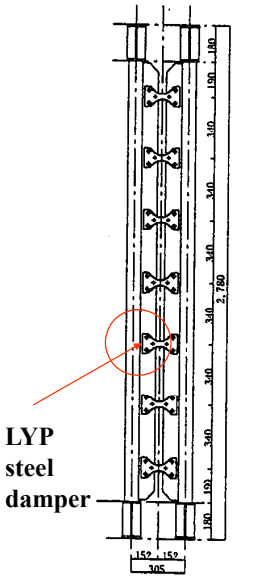
Joint VED for wooden house

20_30__damper.wmv

Joint oil damper for wooden house

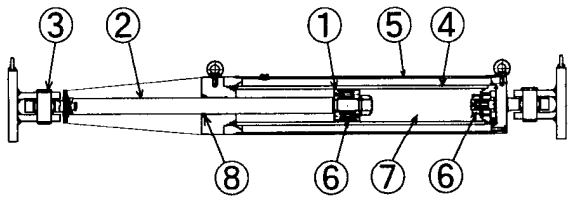


Sub panel damper for steel house

Proto Type Passive Dampers

1)Oil damper
2)Visco elastic damper
3)Steel bar damper
4)Steel panel damper
5)Friction damper

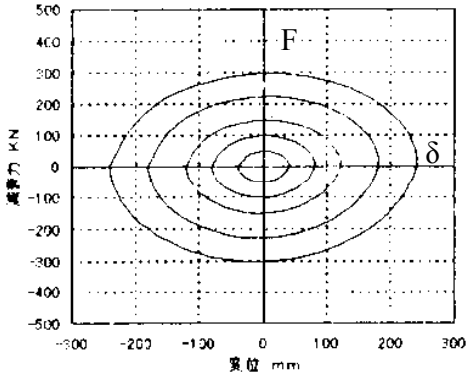
1) Oil Damper



①	piston
②	piston rod
③	pin
④	inner cylinder
⑤	outer cylinder
⑥	orrifice
⑦	oil
⑧	packing

Structure of Oil Damper

Mechanical properties of a linear oil damper



$$F = Cv$$

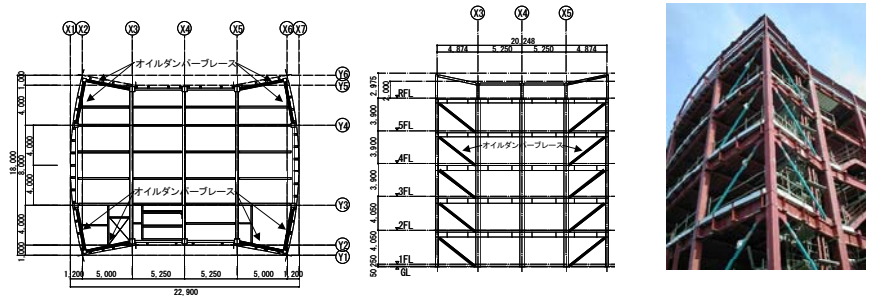
F :resistance

C :viscous oefficient

V :velocity

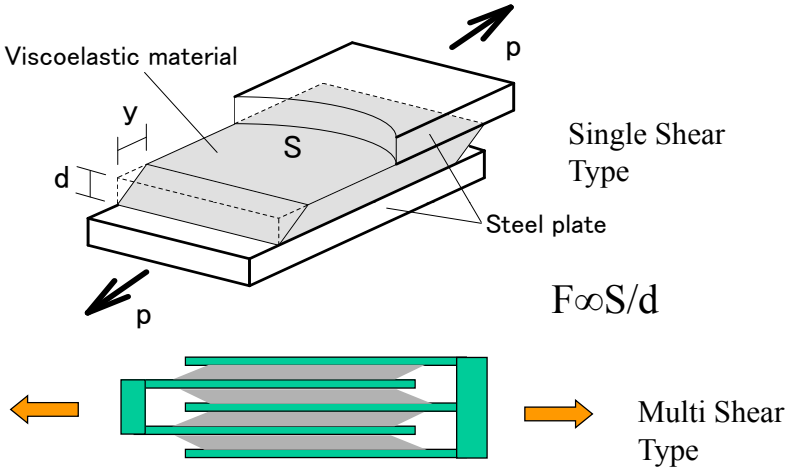
δ:displacement

Installment of oil dampers into steel frame office building



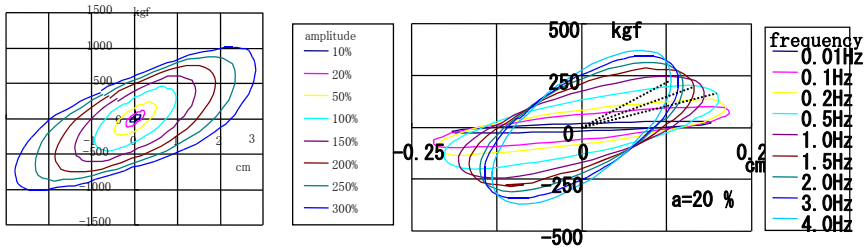
According to on site measurement,
no dampers: h_1=1% → with dampers: h_1=5%

2) Visco-Elastic Damper (VED)



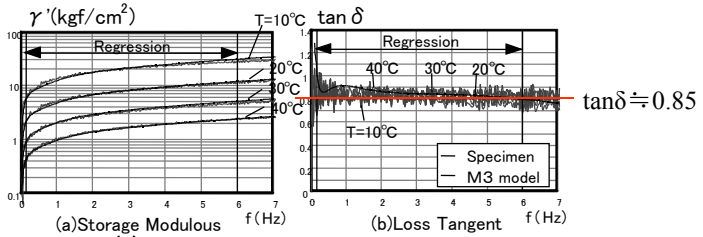
Basic Structure

Mechanical properties of VED



(a) linear type Diene elastomer

(b) Frequency dependency

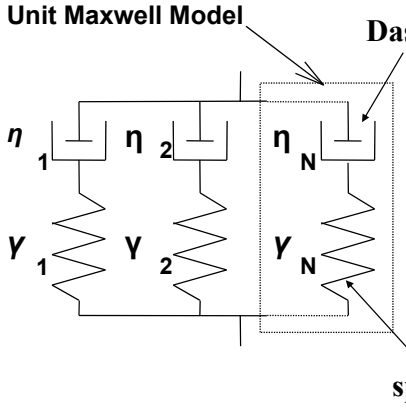


(a)Storage Modulous (b)Loss Tangent

tanδ≒0.85

(b) Temperature dependency

Generalized Maxwell Model

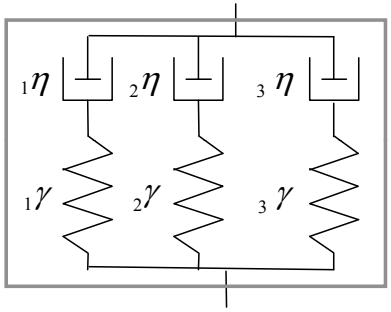


$$\gamma'(f) = \sum_{k=1}^{N} \gamma_k \frac{(2\pi f)^2 \tau_{M,k}^2}{1+(2\pi f)^2 \tau_{M,k}^2}$$

$$\gamma''(f) = \sum_{k=1}^{N} \gamma_k \frac{2\pi f \tau_{M,k}}{1+(2\pi f)^2 \tau_{M,k}^2}$$

$\tau_{Mk} = \eta_k / \gamma_k$ to be fitted

Six-Element Model for a Dien Elastomer VED



$_1\eta$ =4.2(kgf･s/cm^2)

$_2\eta$ =0.52(kgf･s/cm^2)

$_3\eta$ =0.28(kgf･s/cm^2)

$_1\gamma$ =3.0(kgf/cm^2)

$_2\gamma$ =4.6(kgf/cm^2)

$_3\gamma$ =20.0(kgf/cm^2)

$$\lambda_T = \left(\frac{80}{T+60}\right)^{7.13}$$ Temperature correction factor

横置き告示波100mm.wmv

Applications of VED

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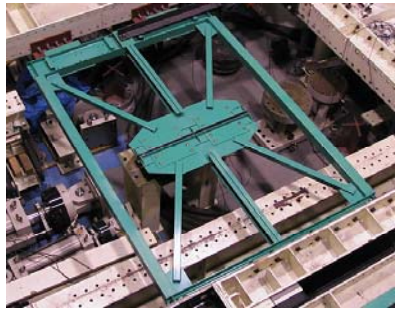
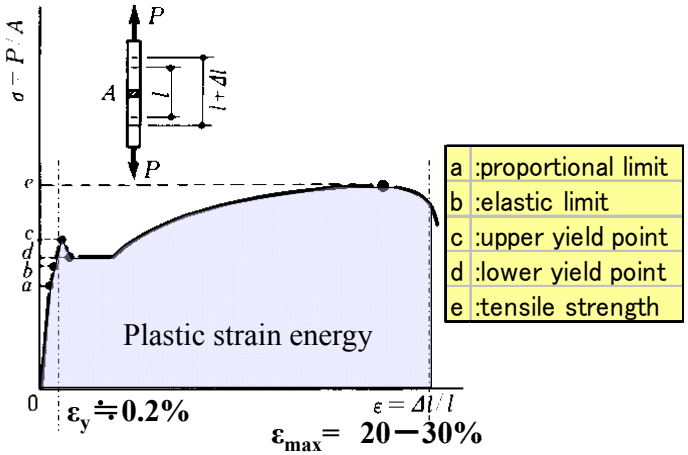


Panel Type VED in steel frame

Stud column VED in RC Frame

bbc.avi

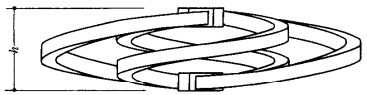
3) Steel Dampers



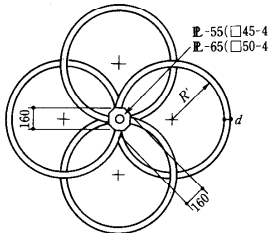
a	:proportional limit
b	:elastic limit
c	:upper yield point
d	:lower yield point
e	:tensile strength

σ－ε relation of steel

Steel loop damper

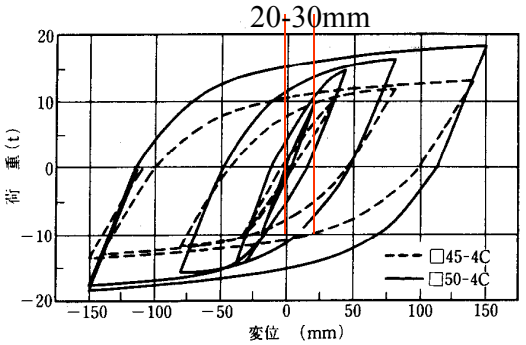


elevation



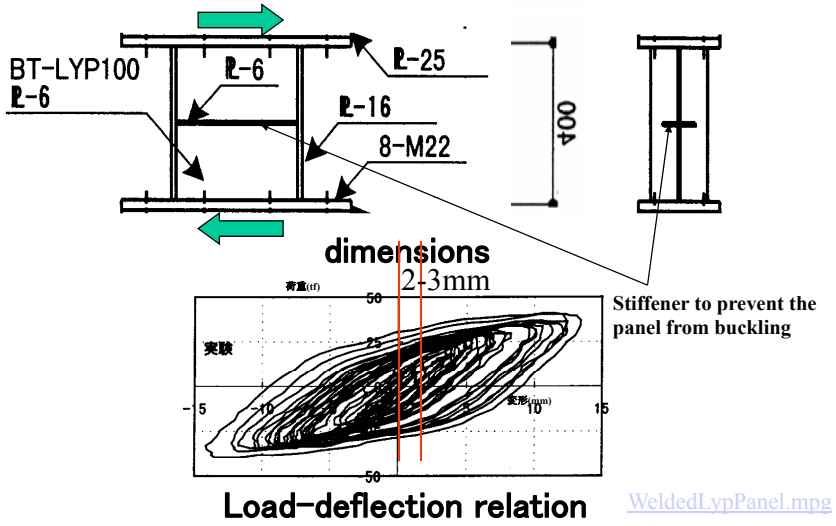
plan

型	d(mm)	R'(mm)	h(mm)
□45-SS41	45	250	250
□50-SS41	50	250	250



Load-deflection relation

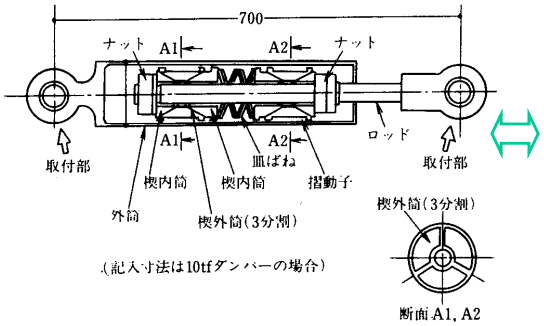
LYP steel shear panel damper

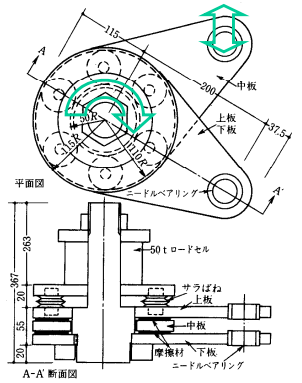


Load-deflection relation

WeldedLypPanel.mpg

4) Friction Dampers





one way sliding type

rotating disk type

Conclusions for Lesson Two

- There are already many passive dampers that have large amount of energy absorbing capacity
- Some dampers work only when the ground motion is quite strong.
- Some dampers yield energy loss at the sacrifice of accumulation of damage
- Some dampers are frequency dependent or temperature dependent
- Smart passive dampers are required

END of Lesson Two