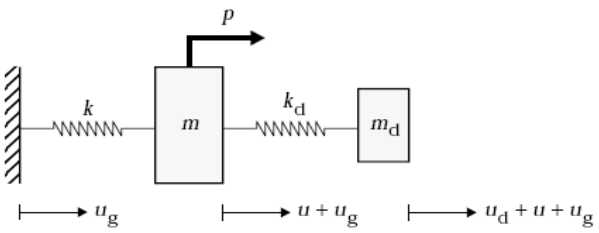
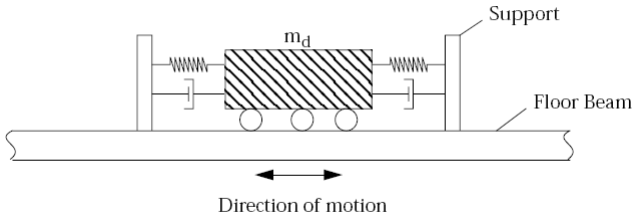
Tuned Mass Dampers



Translational Tuned Mass Dampers



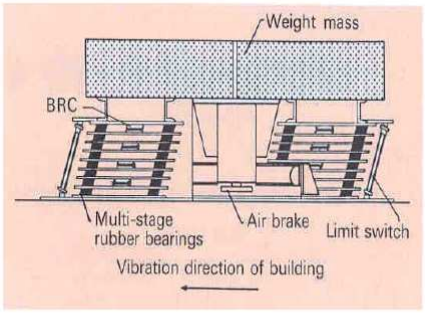


Fig. 4.5: Deformed position - tuned mass damper.

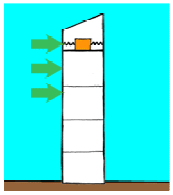
Citicorp, Manhattan

Height: 280 m

Fundamental period: 6.5 sec

Inherent damping: 1%

Citicorp, Manhattan



TMD @ top (63rd floor)

9.1 x 9.1 x 2.6 m concrete block

~360 t (2% of eff. modal mass of fund. mode)

Twelve 60-cm hyd. pressure –balanced bearings

Variable operating period: 6.25 sec +/- 20%

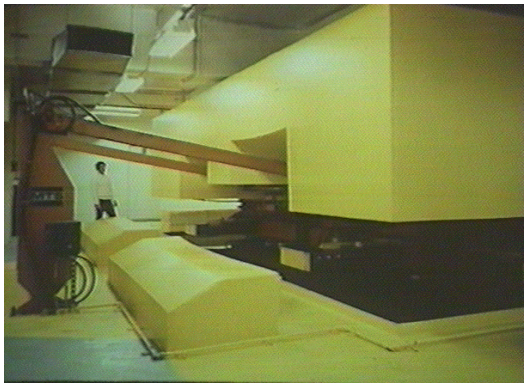
Adjustable linear damping: 8%~14%

Peak relative disp: +/- 1.4 m

Reduce motion by ~50%

Effective damping: 4%

Cost $1.5M. Saved 2,800 t structural steel (~$4M)



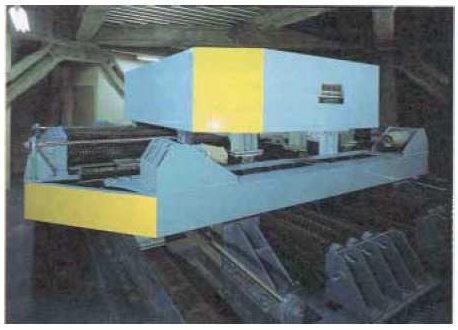
Chiba Port Tower, Japan

First tower in Japan to use TMD

125 m

0.5% damp.

1950 tonnes



Bidirectional

1/120~1/80 of effective mass

15% damp

+/-1m relative disp. max

Roof disp. reduction: 30%-40%

30% reduction in peak bending moment

Canadian National Tower, Toronto

451 m + 102 m

Two lead dampers to prevent antenna deflecting excessively and reduce bending moment in the antenna under wind loads.

At 488 m and 503 m elevations.

Two doughnut-shaped steel rings: 35-cm wide, 30-cm deep, 2.4-m and 3-m in dia.

9 tons of lead in each ring.

Sitting on three steel support structure; four universal joints pivoting in all directions connect the rings to the support beam.

Four separate hydraulically activated fluid dampers between the mast and center of universal joints dissipate energy.

Tuned to 2nd and 4th modes of vibration which are critical for the tower. In 1st and 3rd modes, antenna response was not critical.

Pendulum TMD

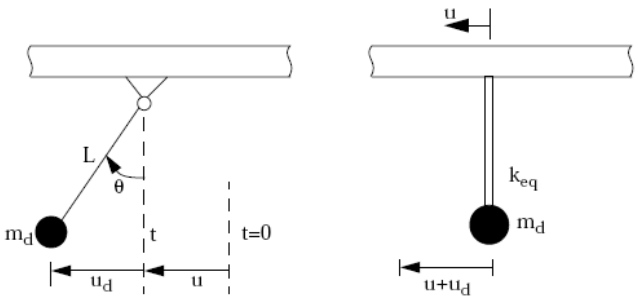
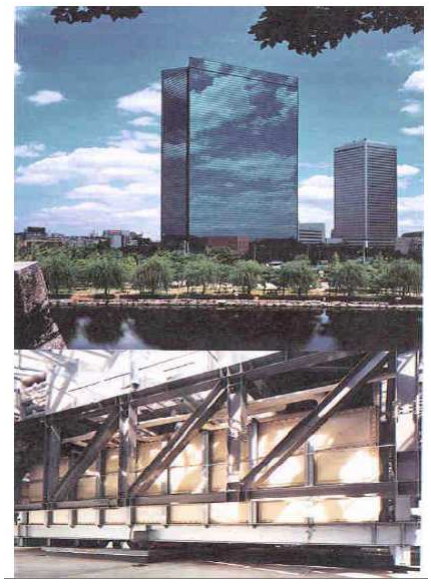


Fig. 4.8: A simple pendulum tuned mass damper.

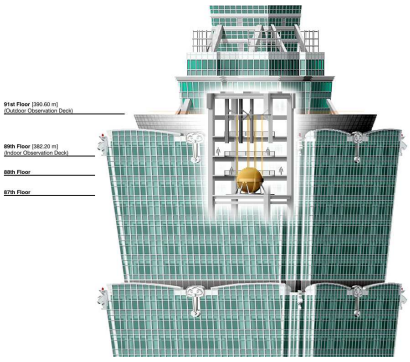
Crystal Tower, Japan



160 m; 44,000 tonnes

6 ice storage tanks;
90 tonnes each

Taipei 101, Taiwan



TUNED MASS DAMPER STATS
Diameter: 18 ft.
Cost: $4 million
Weight: 730 tons
Number of steel plates: 41
Cable thickness: 3 1/2 in.