Vibration Control System at High Speed Elevator

Banyan Garden Phase II

Banyan Garden, a prestigious residential development located nearby Laichikok MTR station. It is made up of seven towers with height between 46 to 56 storeys. The development was divided into two construction phases and completed in April, 2004.

Banyan Garden is a high-rise development, traveling speed for some of the elevators in this development are high speed elevator and reaching **4.5m/s at speed**. As noise and vibration generation due to operation of elevators is proportional to their speed, nuisance to the residences at building is a concern at the very beginning of design stage.

Fig1. Banyan Garden at Lai Chi Kok

The Problem

Figure 2 is a typical layout for Block 8 of the captioned development. Lift shaft wall is the partition wall between elevators and residential premises adjacent to it. Space saving concept has driven the architect to trim shaft wall thickness to maximize the usable area at adjacent dwellings.

As thinner walls and lighter concrete structure are more effective in transmission of vibration and noise energy, consequent re-radiation of noise to sensitive zones, e.g. bedrooms, would be an inherent problem. From our measurement at past cases, for elevator moving at some **2.5m/s speed**, the re-radiated noise at shaft walls to sensitive zone would be as high as **40dB(A) to 45dB(A)** that may caused tremendous complaints.

Fig2. Typical Floor Layout at Block 8

System Employed

Basically the system could be divided into two parts, **(1) Elevator Machine Vibration Isolation**; and **(2) Guide Rails Vibration Isolation.**

(1) Elevator Machine Vibration Isolation

Figure 3 shows the use of 50mm thickness **Sylomer®** material at lift machine base support.

Sylomer® is a mixed cell PUR-Elastomer that offers Quasi-Static Load Deflection characteristic. When the material is subjected to load higher or lower to design range, its mechanical behavior become stiffer that exhibit smaller deflection, i.e. higher stability. While at design load range, the material become softer and yields a higher efficiency in vibration control.

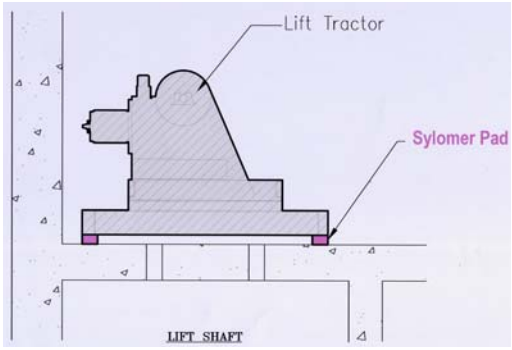

Fig3. Sylomer® Special PUR Pad at Lift Tractor Machine Base

Fig4. Close view on Sylomer® Special PUR Pad at Lift Tractor Machine Base

(2) Guide Rails Vibration Isolation

The higher the elevator speed, the more vibration generated at lift guide rails. For lift speed upto 4.5m/s, guide rail vibration becomes a significant factor to the noise generated due to vibration transmitted at lift shaft walls. The **Sylomer®** PUR-Elastomer pad again is used at rail support bracket, it decouples the mechanical contacts between upper and lower brackets and for the reduction of high frequency vibration transmission onto inner lift shaft walls. Figure 5 shows how this pad is inserted.

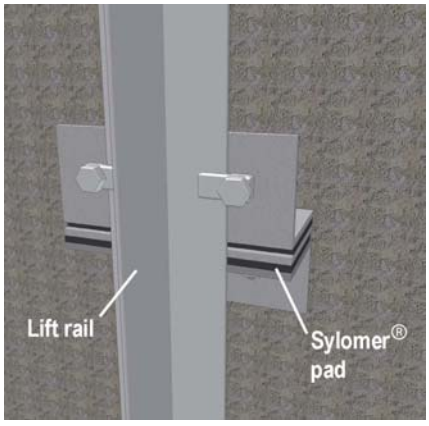

Fig5. Sylomer® Special PUR Pad at Lift Rail Brackets

System Performance

We have enaged the **Wilson, Ihrig and Associate- Hong Kong Limited (WIAHK)** to conduct vibration measurement at lift machine rooms and at residential premises adjacent to lift shaft on 47th Floor at Block 8.

The significant reduction in vibration levels between the measurement on base support and on floor of lift machine room has given us a proof for the effectiveness of **Sylomer®** PUR-Elastomer.

Base Support Pads

Significant reduction was recorded at frequency higher than 12Hz. At most critical frequency, the reduction was almost 40dBV re µin/s (over 98% vibration isolation) for the lift machine base isolation (See Figure 6 for measured vibration level various check points).

Measured Vibration Level :

Location	1/3 Oct. Freq	Measured Vibration Level
At machine base	80 Hz	82dBV R.M.S. (0.32mm/s)
On Lift room floor	80 Hz	45dBV R.M.S. (4.52×10^{-3}mm/s)

Measurement position

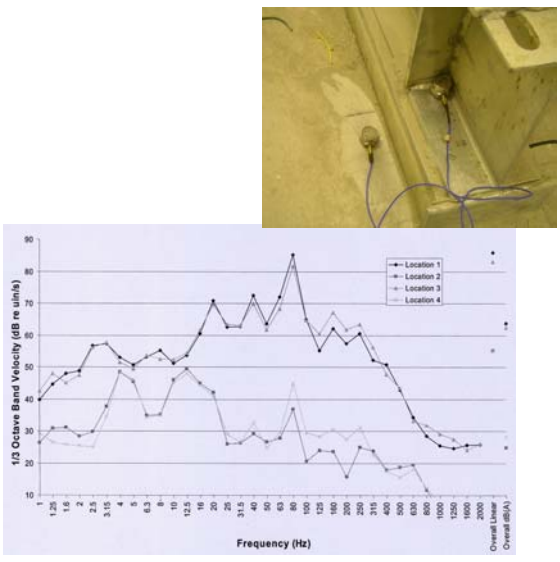

Fig6. Measurement Results at Lift machine Room

Guide Rail Pads

Measured Vibration Level :

< 50dBV R.M.S. (max.)
from 1Hz to 2000Hz

(< 8.03×10^{-3} mm/s R.M.S.)

Measured Noise Level :
Less than 40dB(A) at residential premises

Measurement position

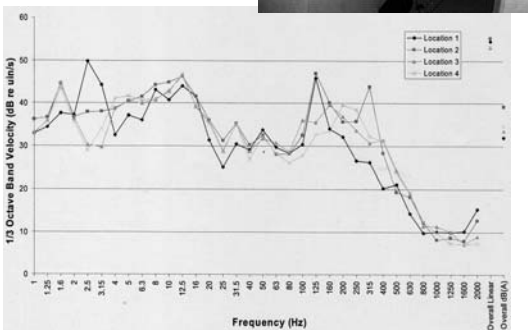

Fig7. Measurement Results at Vertical Wall 47/F