Dynamic models for the guide rail lift set Part II

1. INTRODUCTION

This article is the 2nd part of the Research Project entitled “Dynamic models for the guide rail lift set”, which was published in our last edition of STAR NEWS.

In this study, we describe the first practical trials for analysing the aforementioned dynamic models, in which some very interesting conclusions were obtained.

2. DESCRIPTION OF THE TRIALS

The trials consisted of the measurement of a lift’s accelerations and movements during runs upwards and downwards from the fourth floor of the building. To do so, a piezoresistant acceleration meter was installed at point 7 which measures the upward acceleration of the lift box, as well as four piezoelectric acceleration meters located at points 5 and 7 in the box and at point 3 and 9 of the frame, which provide data about horizontal acceleration. For measuring the relative movement between the frame and the guide rail, movement sensors without contact were placed at points 1, 2 and 9 on the frame.

Different runs were carried out upwards and downwards so as to check the possibility of repeating the measurements and the configuration of the data collection channels corresponding toa the movement was changed from DC to AC so as to obtain greater sensitivity in the measurement process. Subsequently, the running speed was changed from normal to slow and the number of people inside the lift was changed in order to study the influence of the mass on the dynamics of the whole unit.

3. RESULTS AND DISCUSSION

This section contains the results of the measurements as well as comments on the most important aspects that have been observed. Firstly, the results of the trials are shown that were obtained at the normal operating speed for the lift. Then the measurements corresponding to the slow speed are shown and finally the results obtained when changing the number of occupants in the lift.

3.1. Normal operating speed (1 m/sec)

The results corresponding to the four measurement channels are to be seen in Figure 1, which correspond to the upward acceleration of the box obtained at point 7, the horizontal acceleration of the box measured at point 5 and the relative horizontal movements between the frame and the guide rail as recorded at points 2 and 1. The measurements correspond to a downward run from the fourth floor of a building to the first floor for a lift in which there are two people.

In the top graph in Figure 1 we can see how, when the start-up of the lift occurs, the box undergoes an acceleration (negative, due to the fact that it involves the downward run) until reaching a running speed of 1 m/sec. Once this speed has been reached, the acceleration is zero until the time that the lift breaks when reaching the first floor. Once the lift has stopped, an increase in the signal from the acceleration meter may be noted due to the opening of the lift door. The maximum reading recorded for the vertical acceleration is around 2 m/sec2. In the second graph in Figure 1 the horizontal accelerations are shown on the top right part of the box, and it may be noted that the highest readings are not those due to the running of the lift, but rather to the effects produced by the door opening. The third and fourth graphs correspond to the channels for measuring the relative movement between the guide rail and the frame taken at the top right and top left parts of the frame. The signals were obtained in the DC mode, thus we were able to record the low frequency phenomena. The maximum reading recorded for these movements is located between 1 and 2 mm.

In the top graph in Figure 2, you can see the vertical acceleration of the box obtained at point 7 (the graph of the vertical acceleration is repeated in all the Figures with the aim of giving a reference point for the signals). In the second graph the horizontal accelerations are shown that were obtained at the bottom right part of the box, it was also observed the same as on the top parts that the highest readings are those due to the effects produced by the opening of the door. The third and fourth graphs correspond to the channels for measuring the horizontal acceleration of the frame taken at the top and bottom parts thereof. Comparing the acceleration levels between the frame and the box, we can see the highest readings in the latter, this fact may be due to the assembly of some silent blocks that are too rigid between the box and the frame. The excessive rigidity of the silent block may make the system enter into the resonance zone in which the accelerations of the box are amplified.

Figures 3 and 4 correspond to another downward run and are similar to Figures 1 and 2 with the exception that in Figure 1 the graphs referring to the movements sensors show the data collection in AC mode. This means that the low frequency movements are filtered. And greater sensitivity is obtained in the transducers. The movement obtained due to the high frequency phenomena is around 100 micra.

World Finance Tower
Shanghai, PRC
6 m/sec. Savera quide rails: Star 127-1/B and Star 140-/B.
GEC - Hong Kong

3.2. Slow operation speed (0.25 m/sec)

A series of runs were also performed at slow speed, at approximately 0.25 m/sec, in order to record the phenomena that are hidden at higher speeds. In Figure 5, we can see in the two top graphs the reduction in the level of the vertical and horizontal accelerations for the box. In the graph corresponding to the vertical acceleration we can note almost exclusively the acceleration produced by the working of the door. The horizontal acceleration in the box is practically uniform until the door is opened. In the two bottom graphs we can clearly see the passing of the lift through the two unions between different stretches of guide rail that are present along the run (t = 18 secs, and t = 38 secs). As they pass through these points a peak in the signal occurs in the transducers that measure the movement between the frame and the guide rail.

In Figure 6, we can see the reduction in the level of the horizontal accelerations, in this case the working of the door is also the cause of the highest readings recorded. In this case the difference in the level of accelerations between the box and the frame is not as noticeable as for the normal lift operating speed.

Conclusions

The maximum lateral accelerations were recorded when people entered and when opening and closing the doors.
Lateral accelerations were also noted when starting and stopping the lift.

In these first practical trials, we were able to confirm the lack of rigidity in the riding path, either due to the unsuitable selection of the guide rail size or because the distance between the supports was too large.

As a follow-up to these two technical articles based on considering the guide rail as a rigid part, in the next issue of STAR NEWS we shall describe the mathematical model considering that the guide rail, since it is supported at both ends, behaves in an elastic manner.