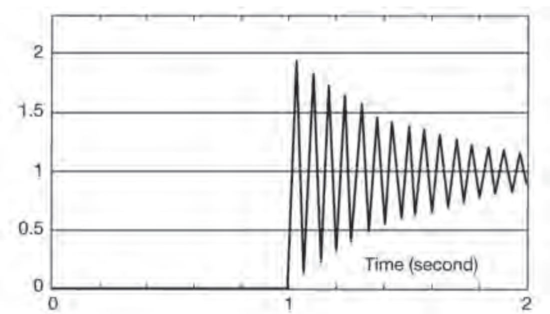

Fig. 20.11 Entry impact of first second.

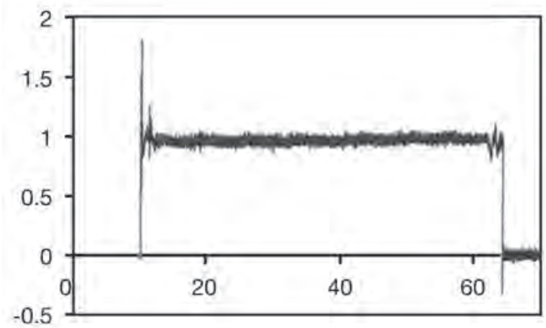

Fig. 20.12 Field test result.

1.75) higher than the static load at the given damping ratio. Similar to the entry impact, which results from a sudden applied load, the exit impact, caused by sudden removal of the load at the rolls, is also not negligible to the transmission system. Stock entry impact has been commonly recognized. However, the stock exit impact or the negative impact, in most cases, is ignored. Considering the fatigue effects of the negative impact on the machine parts, it is also an important factor for the design of such a system because the periodic stock entry and exit is the normal operating condition for a rod or bar mill.

After the system reaches the steady state, the dynamic load is low and the static load dominates the system. The variation of the dynamic loads at the steady state is essentially made of noise and other high-frequency responses.

The detailed dynamic response at one roll, the first second of response by a stock entry impact, is shown in Fig. 20.11.

20.1.7 Field Test and Results Comparison

To verify the dynamic model and the analysis, field tests were performed on a rod mill. Strain gauges were installed on the motor shaft and a cordless data acquisition system was installed on the rolling stand. One example of several test results is shown in Fig. 20.12. The analysis results are consistent with the test results. Both stock entry impact and exit impact are apparent. A close examination of the chart shows the second impact immediately after the entry impact, which is caused by the stock entering the next stand. Before the stock exits the stand, the tail-end impact appears because of the tail-end exiting the previous stand. At the tail-end exit of the current stand, the negative impact or tail impact appears, because of the sudden removal of the rolling load.

20.1.8 Conclusions

System torsion oscillation occurs at a sudden change of load, at both sudden application and removal of the load.

In this study, no significant excitation factor from the rolling load is found.

Because all billets are essentially the same size and the rolling stock impacts each stand periodically, the transient vibration should be considered for the power train.

The consistency of the test results with the analysis results verified the validation of the dynamic model and the simulation method.

20.1.9 Summary

Vibration can be a serious problem with rolling mill equipment. To avoid vibration problems, it is important to predict system characteristics and dynamic performance at the design stage. This prediction can be achieved through vibration modeling and rolling process simulation. A new method of simulating torsional vibration for the power transmission system of a typical mill stand is described. System natural frequencies and vibration mode shapes are evaluated. Vibration responses and dynamic load factors are predicted. Predicted performance and field test results are consistent.

20.2 Prevention of Vibrations and Chatter in Hot Strip Mills

Quality and productivity are major requirements for any rolling mill. Physical and metallurgical properties and surface appearance of the finished product are goals shared by both operating and maintenance personnel. All equipment must function properly to achieve these goals.

In both hot and cold rolling processes, mechanical vibrations called chatter can be observed under certain conditions, in most cases audibly. As a result of this chatter, transverse marks covering the strip