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Steel manufacturers, reverse roughing stands, and condition monitoring

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In 1480, Leonardo da Vinci sketched the first "rolling mill" machine. Although the intent was to roll lead for stained glass windows, da Vinci's rolling mill concept is akin to the rolling mills used in steel manufacturing today.

In metal forming, rolling is a vital and widely used process. Simply put, the rolling process compresses a sheet of steel to reduce its thickness—consistently and uniformly—by passing the steel through a series of high compression rollers.

Rolling mills: The same, only different

Rolling mills consist of different configurations, sizes, speeds, and capacities. They may include two, three, four, or more stacked rollers. In addition, rolling mills can be used for cold rolling and hot rolling material properties. Configuration types include cross country, reversing, semi-continuous, and continuous. In addition, rolling mill operation can entail any combination of manual, mechanical, electro-mechanical, pneumatic, or hydraulic function. There are many potential differences across rolling mill design and deployment.

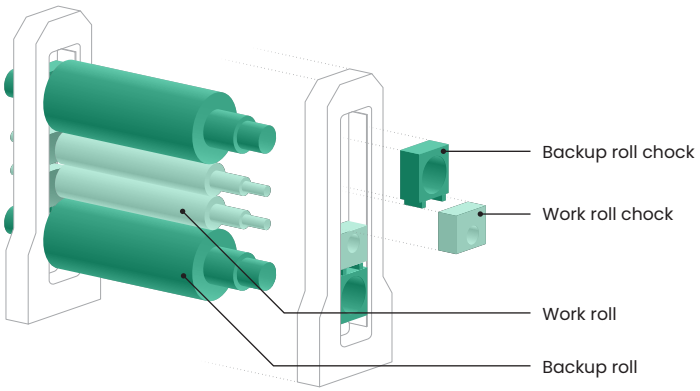
Despite the vast array of rolling mill parameters, however, the basic technologies and operating principles of roller equipment are common across rolling mills. This is most relevant in the application of condition monitoring solutions—a crucial capability to preserve uptime. Mill stands, which hold the rollers in specific configurations, are the most crucial assets in the rolling mill process, utilizing rollers to compress the steel and reduce its thickness. One such configuration is the reverse roughing stand.

Reverse roughing stand vulnerabilities

Steel manufacturers use reverse roughing stands to hot roll the steel slab back and forth several times, compressing it into a thinner, longer shape. The roughing stands employ a series of sequential roller passes, often using multiple mill stand stations in succession, to transform the steel's material and physical properties. However, since reverse roughing stands operate in the harsh, high-demand environments of steel manufacturing, they also have several potential points of failure. In the event of a full failure, the reverse roughing stand can spiral a continuous steel operation into a costly, high-impact, unplanned downtime event.

The potential points of failure in reverse roughing stands include the roller's main bearings, the gearbox, and the motor connected to the gearbox. Any bearing defects or gear defects, for example, can lead to halted operations. The chock rolls are of particular operational concern as they are changed out multiple times a shift. Mitigating the risk of unplanned downtime is a top goal for steel manufacturers. Condition monitoring answers that need.

Work rolls, backup rolls, and chocks



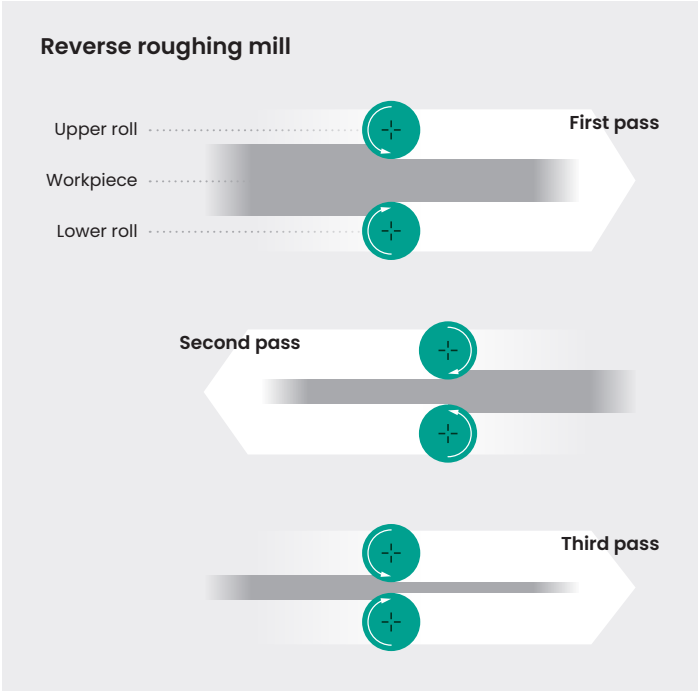
Condition monitoring vibration data

Although reverse roughing mills are one of the most important operational areas in steel manufacturing, they are also one of the most challenging. Condition monitoring solutions that measure the vibrational patterns of rotating assets, can be used to help proactively detect impending failures before they occur and when the cost to repair is at the lower possible cost and the timing is most flexible.

Condition monitoring is based on vibrational change analysis by detecting anomalies compared to a consistent, repeatable operating state. Sufficient data must be collected over time to "establish" the pattern for that typical operating state. Therefore, portable data collection, which is based on sporadic checkpoints and data gathering, does not work well for reverse roughing stands. Permanently installed condition monitoring solutions are needed.

In reverse roughing stands using permanent condition monitoring, vibration data must be collected during the period of longest operation with unchanging conditions that are consistent and repeatable (i.e. a consistent roller speed). That's because vibration data is not a one-time snapshot; rather, it is a collection of data points that are measured over time. Investing that time will produce the best vibrational pattern resolution and the most effective condition monitoring outcomes. Thus, the longest operation with unchanging conditions provides that required volume of data most effectively. In reverse roughing mills, the operation with the longest duration is the final pass—such as pass three of a three-pass process—within a mill stand.

Innovative condition monitoring solutions are equipped with automatic state-based control that can recognize the operating state of the machine. When these solutions are used on a reverse roughing stand, they can be programmed to start collecting data as soon as, and only when, the final pass begins and continue until the final pass is complete. Collecting this data continuously over time supports a more accurate recognition of true operational patterns and anomalies and helps with the root-cause analysis of approaching failures.



Proactive maintenance pays off

Because downtime is the bane of every steel manufacturer, the insights that detect impending failures or data anomalies are extremely valuable. Knowledge facilitates more effective preparation and planning. For example, during periodic planned shutdowns, steel manufacturers must know everything that needs to be addressed before the shutdown so that the replacement parts and repair priorities are in place and shutdown time can be optimized.

Condition monitoring enhances steel manufacturing by proactively tracking the vibration levels in reverse roughing stands to detect failures before they occur. That way, the root cause issues can be repaired at the best time and lowest possible cost. The right condition monitoring solution—simple yet sophisticated—can transform a steel manufacturer's operations. Leonardo da Vinci who foretold the rolling mill concept said, "simplicity is the ultimate sophistication."

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