ON-LINE PROFILE MEASUREMENT OF SLAB EDGES

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Summary:

LIMAB has developped a non-contact laser based measurement system for slab edge profiling. The system is mounted next to the roller table and measures the slab edges from the side. Data is collected by a PC and presented to the operator both graphical and numerical. Network communication with upper level systems is used for nominal production data downloading and measurement result reporting. The sensors are fixed mounted at each side of the roller table and measures all porduction widths without need for re-positioning or re-calibration.

Keywords:

laser profile measurement

1. Introduction

On-line measurement of slab width during continuous casting is important. By adding a scanning function to the width measurement sensors LIMAB has developped a system that provides complete edge data. This is important both for casting process knowledge and for downstream processing. For casters with adjustable moulds, on-line early warning about slab width and trapezoide cross-sections help reduce size change times and reduces scrap production to a minimum. Other parameters that influence the slab edges are caster speed and cooling. The Hot Strip Mill may suffer from processing slabs that has width measured by fixed single spot or camera based solutions where the maximum (in the camera case) or “any” point will be the absolute width refernce. In these cases there is an obvious risk that expected coil width will not be achieved due to lack of material in the slab.

2. Scanning optical triangulation

The technique has been developped by LIMAB for edge profile measurement of thinner products, such as gypsum boards and fibre cement boards. In these cases it is important to have an acurate early warning if expected edge profiles goes out of tolerances, just as in the case with slab edges. By combining the already proven fixed single spot witdth measurement technology for “hot” material with the edge scanning technology from the gypsum industy application, LIMAB has developped a new concept for measurement of slab edges.

Fig. 2.1, Display of measurment principle.

One of the big problems with on-line slab measurement in the caster is the differences in background radiation. The sensor must in each measurement situation be able to evaluate the ratio between the reflected light from its own laser spot and the background radiation from the hot slab. The background radiation will vary over the edge (from top to bottom) due to temperature differencies. The corners of the edges will be cooler than the center part and will thereby have different ammount of background radiation. The necessary exposure time of the CCD will vary with the background radiation.

To be able to have fixed mounted sensors that covers the entire width range of the caster without need for sensor re-positioning or calibration between slab size changes means that the CCD will have to have sufficient laser light coming back to it even from the far end of the measurement range. In many casters this means a distance between the sensor and the slab edge of 1500 mm. As diffused light spreads with the cube of the distance (r^3), laser power must be sufficient to keep the dynamics of the receiver intact.

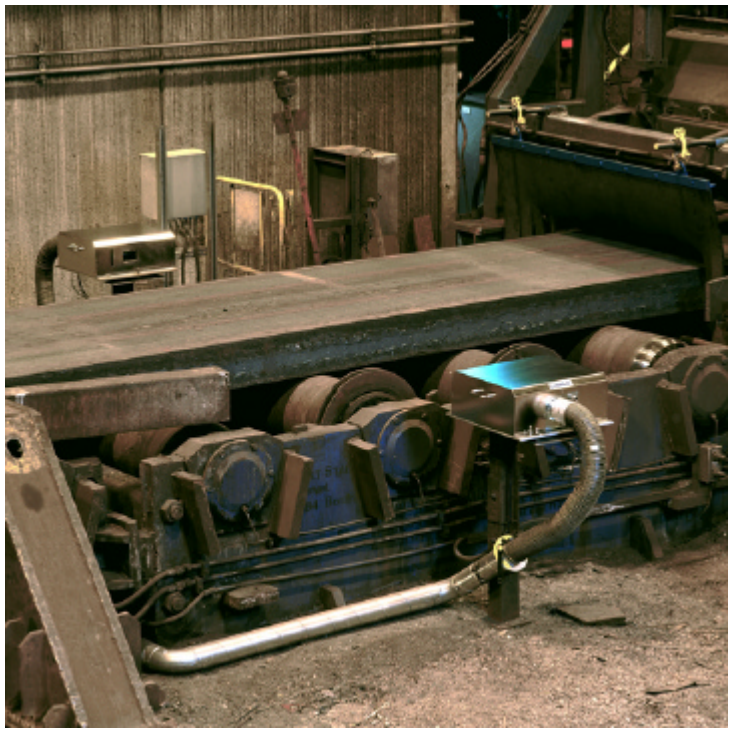


Fig. 2.2, Measurement installation in a Hot Strip Mill, prior to the re-heating furnace.

3. Achievements

The system solution presented today has achieved the following:

Maximum scanning speed:	250 ms / scan
Maximum measurement rate:	2000 Hz
Maximum measurement range (MR):	2000 mm / sensor
Resolution:	
- MR < 650 mm:	0.01 mm
- 650 < MR < 6500 mm:	0.1 mm
Width measurement accuracy, averaged numerical value (1 sec):	< ± 1 mm
Thickness measurement accuracy, averaged numerical value (1 sec): (depending on roller run out, etc.)	< ± 5 mm

The benefits of on-line slab edge profile measurement will be discussed below.

3.A, Monitoring slab edge angles in casters with adjustable moulds.

By continuous monitoring of the slab edge angles, important information about mould behaviour can be extracted. Mould problems that will result in trapezoide slabs are bad adjustment, wear and slag build-up. These problems can be minimized by early warnings from trend logs based on complete slab edge profile data.

3.B, Edge shape will vary with changes in caster parameters such as casting speed, cooling, steel temperature.

An edge shape measurement system will be a powerful tool in monitoring the result of complex changes in the process system. Increase in casting speed may result in concave edge shapes and increased cooling may result in convex edge shapes. Changes in steel temperature will result in concave or convex edge behaviour. When these parameters are combined the resulting edge shape may be difficult to predict.

3.C, Minimum width is more important information than the average width measured at some point on the slab edge for the Hot Strip Mill settings and for selection of slabs for certain jobs.

A slab beeing processed through a Hot Strip Mill will in most cases be run through based on nominal width and thickness data. In some cases the slab will have trapezoide cross sections or may be grinded. At this point the resulting coil will not reach the specified width and may have to be post-processed for substantially narrower widths.

3.D, Quality assurance.

By on-line measurement, 100 % of the slabs will be measured and accurate reports can be created. This reduces need for manual measurements and

reduces risk for slabs beeing processed downstream with wrong presumptions resulting in unneccessary waste production.

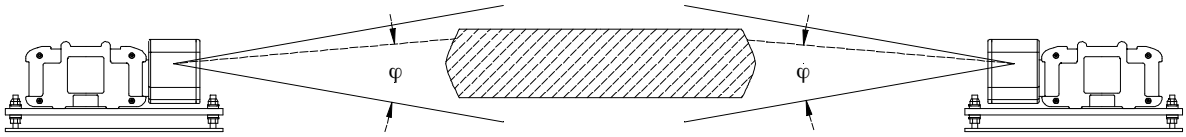
4. System solution

The ProfiCast™ system solution consist of:

2 pcs Accura 35H-2D scanning laser sensors
2 pcs Stainless steel air cooling boxes for the sensors
1 pcs Fan / Filter unit with air hoses for air purging of the sensors
1 pcs Measurement PC with all necessary I/O-cards and ProfiCast software installed
1 pcs Industrial cabinet for the measurement PC
1 set System internal cables

Options inlcude:

Mounting stands for the sensors
Air-conditioning unit if cooling air temperature excceds 25 deg C.



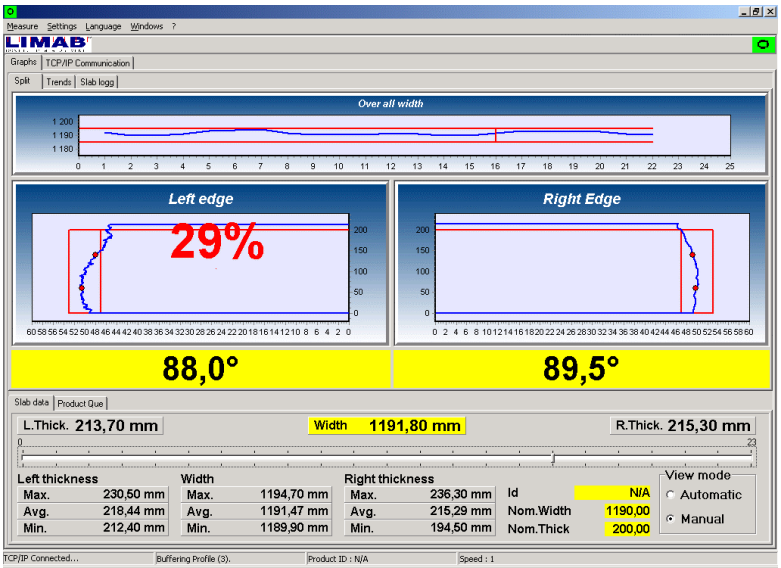


Fig. 4.1, Example of the ProfiCast™ operator screen.