"THE HOUSE OF THE WORLD'S LONGEST BILLET" THE NEW MICROMILL DANIELI (MI.DA®) AT CMC STEEL ARIZONA .AN INNOVATIVE PROCESS FOR THE MOST COMPETITIVE PRODUCTION OF REBAR PRODUCT [1]

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Abstract
The new state-of-the-art Minimill built by CMC in Mesa, AZ. featuring Endless Casting and rolling (ECR®) technology optimized for achieving the most competitive production of rebar product. The paper will cover the main technological features of the mill and its potential for expansion to roll other products as well as performance achieved during the initial period of operation.
Keywords: Endless casting and rolling; Most competitive production.

Resumo
A Minimill, estado da arte, construída pela CMC Mesa, AZ. caracterizando a tecnologia de Lingotamento e Laminação sem fim (ECR®), otimizada para alcançar a produção mais competitiva em vergalhões. O documento irá abranger as principais características tecnológicas da planta e do seu potencial de expansão para laminar outros produtos, bem como o desempenho obtido durante o período inicial de operação. Produção
Palavras-chave: Lingotamento e laminação sem fim; Produção mais competitiva.

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INTRODUCTION

On September 8, 2009, the first heat was poured at the new Micro-mill Danieli at Commercial Metals Co. - CMC Steel Arizona in Mesa, Arizona. The new steel complex, the first of its kind worldwide, is based on the “regional-mill/product-focused” concept designed to serve a regional market focusing on a specific product range and making extensive use of local scrap supply.

Figure 1. Aerial view of the CMC Mill in Mesa, AZ**.**

PROJECT GENESIS

Since their beginning, Mini-mills had been growing in size to capture the economies of scale and have now reached capacities exceeding 1,000,000 tons per year. However, markets that can serve these volumes are being exhausted. From the early 70’s, CMC had a vision of a highly efficient, low-investment, minimal manning, low-operating cost Mini-mill that can serve specific geographic areas with a good balance of scrap supply and market for finished product. Over the years, CMC’s management has challenged his people and Danieli in order to come up with the right idea to fulfil this vision. In mid 2004 Danieli approached CMC with a design concept that eventually led to the construction of the mill in Arizona. The design capitalizes on CMC’s management and motivational philosophies and employs Danieli’s Endless Casting Rolling (ECR®) process where melting, casting and rolling are carried out in one continuous and uninterrupted production process from scrap to finished product. This eliminates the need for a conventional reheating furnace along with all associated entry/exit equipment, auxiliaries and warehouse resulting in significant savings in the initial investment, utility consumption and running costs. The design also includes the “Direct Rolling & Bundling system”(DRB®), the system enables the cut to final commercial length directly off the last finishing stand. The result is a very compact arrangement of the whole cooling bed/bundle forming and tying station, with significant savings in the initial investment and production costs. The mill also features a Quenching and Tempering system for Bar (QTB) that allows for the production of low-cost billets in the meltshop by using less alloys and therefore reduce the conversion cost.

MAIN DESIGN DATA

The mill has a design capacity of 300,000 short tons (272,000 metric) per year of finished product. The meltshop is 100% scrap-based, 35 short ton nominal heats. The rolling mill produces sizes ranging from #4 to #11 (12 to 36 mm) rebar.

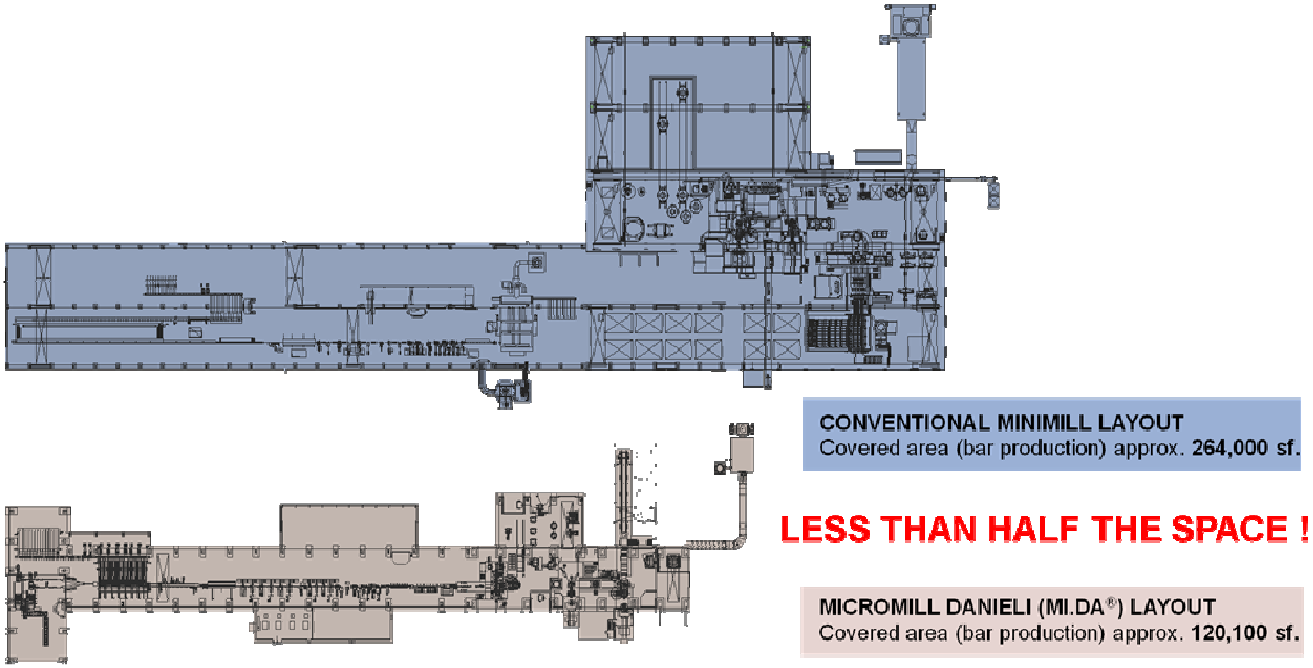

Figure 2. Comparison between conventional mini-mill layout and MI.DA® layout.

MELTSHOP

The very efficient in-line layout features a continuous scrap feeding system that feeds the scrap into the 50 ton total capacity compact EAF (avg. 35 shtons of tapped steel). The system is designed to work at 23MW active power to achieve the design TTT of 45 min. The performances reached so far (summarized in the table below), are clearly proving the soundness of the selected design and technical solution. Thanks to an innovative in-line ladle lifting system, located underneath the ladle Furnace, without the need of any crane lift, the full ladle can be transferred from the tapping car to the LF car, for subsequent treatment. The Ladle Furnace is used essentially to achieve the correct chemistry and guarantee the proper temperature control, both essential for the downstream ultra-high speed casting process.

CASTER (“the thing that made it possible”)

The single strand 9-m nominal radius continuous casting machine features a unique set of tools for unprecedented performances on the market worldwide allowing casting speeds for the 5-1/8” (130mm) square billet up to 251 ipm (6.3 m/min). Besides a properly designed and extended multi-zone system for secondary cooling, it includes a revolutionary all-in-one compact mould oscillator: the Fast-Cast-Cube™ (FCC™).
This one cubic-meter unit includes:

- a maintenance-free oscillator (bearing-less design), for high performances and 50% extended working limits;

- an extremely limited oscillating mass and inertia, resulting in very sensitive control of mould friction, for both process tuning and breakout prediction, to ensure the highest utilization factor (steel in mould);
- a revolutionary cartridge type mould with top performing alignment free copper tubes (POWERMOULD®). This system does not require water jacket assembly and complicated alignment procedures. In addition, it shows extra stiffness and taper stability due to enhanced heat exchange performances and controlled cooling of the corners;
- a radio frequency automatic tracking and monitoring system (RFID) to record any event and critical data for the mould equipment directly stored by the automation system, with no need of human intervention.

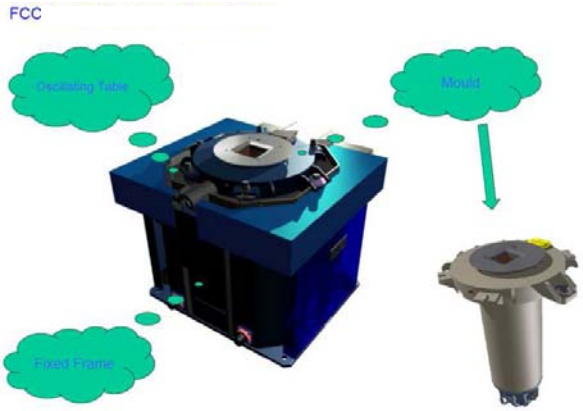

Figure 3. 3D of Fast-Cast-Cube™.

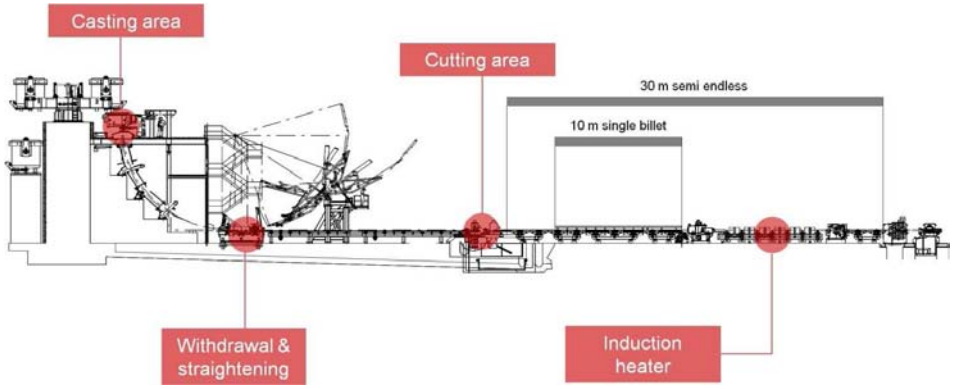

Figure 4. Longitudinal section of caster and link with rolling mill.

A hydraulic shear is located between the caster and the induction heaters essentially for cropping, emergencies and very seldom non-continuous operation.

THE ROLLING MILL

An induction furnace is located between the caster and the rolling mill for temperature equalization prior to entering the first stand. The rolling mill consists of sixteen stands arranged in H/V configuration. The roughing mill consists of eight cantilever type stands. The eight intermediate and finishing stands are of housing-less type and are equipped with quick change car that enables the whole mill to be changed over in less than 15 minutes. HiWEIGHT® gauges are properly located along the mill for on-line measuring of the weight of the stock going thru the mill and monitor groove wear. The intermediate and finishing stands have on-load roll gap

adjustment capability working in closed-loop with the HiWEIGHT® gauges. A Quenching and Tempering system for Bar (QTB) is located at the delivery side of the rolling mill.

	Stand	Type	Arrang.	Roll Size		Roll Face	Motor Power
				Max.	Min.		
Roughing Mill	1	ESS 685	H	685 mm (27 in.)	590 mm (23.22 in.)	300 mm (11.81 in.)	250 kW (335 HP)
	2	ESS 685	V				
	3	ESS 685	H				
	4	ESS 450	V	450 mm (17.71 in.)	385 mm (15.15 in.)	175 mm (6.88 in.)	
	5	ESS 450	H				
	6	ESS 450	V				
	7	ESS 450	H				
	8	ESS 450	V				
	Crop Shear						
Intermediate/finishing Mill	9	GCC 4334	H	480 mm (18.89 in.)	290 mm (11.41 in.)	600 mm (23.62 in.)	350 kW (470 HP)
	10	GCC 4334	V				
	11	GCC 4334	H				
	12	GCC 4334	V				
	13	GCC 4334	H				
	14	GCC 4334	V				
	15	GCC 4334	H				
	16	GCC 4334	V				

Figure 5. Mill configuration.

Figure 6. Induction heating.

Figure 7. Roughing mill.

Figure 8. Intermediate and finishing mill.

Figure 9. QTB system.

THE DIRECT ROLLING AND BUNDLING (DRB®) SYSTEM

The finishing end of the mill incorporates the Direct Rolling and Bundling (DRB®) system that enables the cut to final commercial length of high-tensile rebar product directly off the last finishing stand. The result is a very compact arrangement of the whole cooling bed/bundle forming and tying station, with significant savings in the

initial investment and production costs. After bundling, the bars are run through two wire-tying machines and then collected onto a chain transfer for final removal by fork truck.

Figure 10. DRB® system.

Figure 11. DRB® system.

Figure 12. Bundle forming.

Figure 13. Finished bundles.

PROCESS CONTROL

An ambitious process demands a powerful set of control tools. The automation system provided by Danieli for the CMC mill in Arizona has been a key factor to guarantee the success of the MIDA® process. In order to further enhance the capability to monitor, trend and improve the process, Danieli has also developed an innovative set of tools for data collection called MORE Intelligence. Based on Windows Explorer™, MORE Intelligence is a Multi-dimensional Database Analysis system that transforms the significant amount of production and process data gathered by the automation systems into tangible information for decision-making and improved process knowledge. Virtually, the system can be configured in any form (or dimension), and the various reporting structures can be easily customized in a very lean and user-friendly way.
Dashboard type reports, as an example, are preconfigured and ready-to-use with a single click, assessing the actual status of the shop with useful KPIs and gauges that show the salient parameters of each heat.

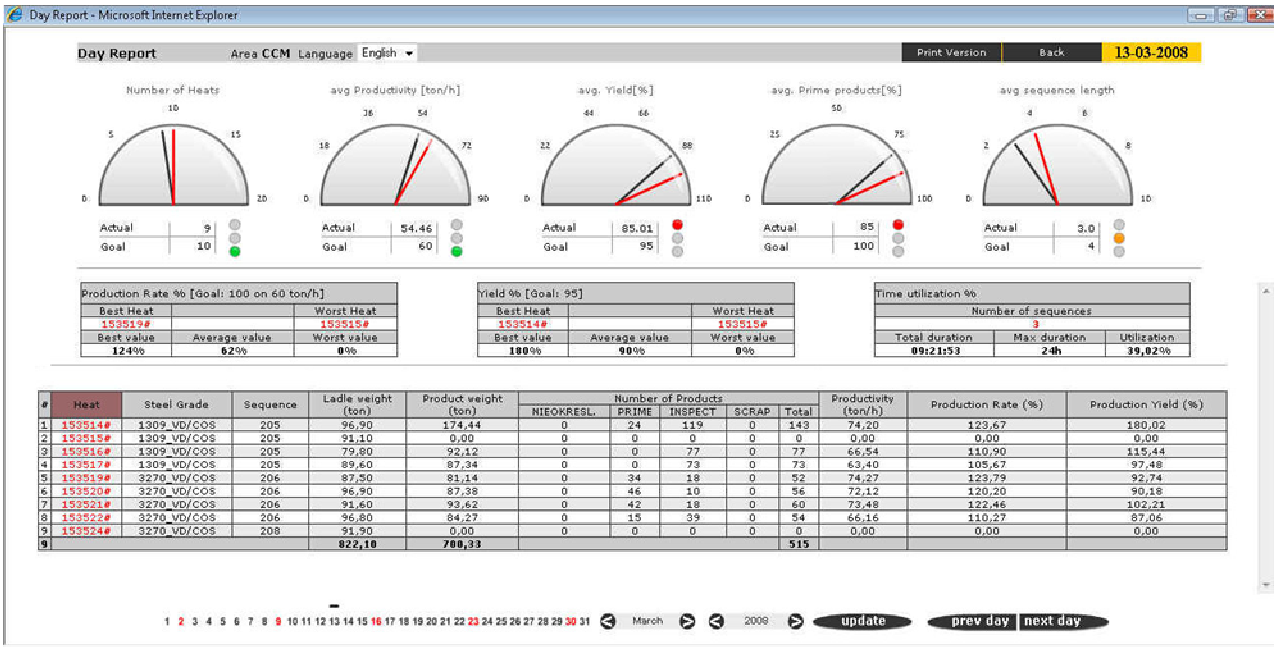

Figure 14. Example of dashboard-type report.

Dynamic reports are the advanced display tool that brings the trends, correlations and cause-and-effect relationships, which are not evident from traditional reports, directly to your desktop.

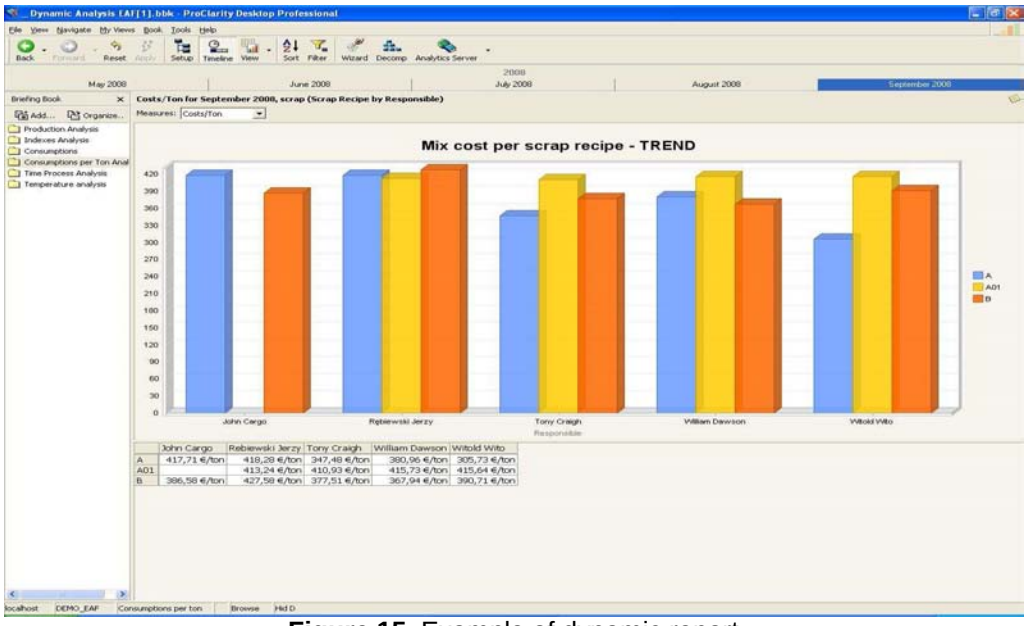

Figure 15. Example of dynamic report.

With the increasing number of variables recorded every second (and milliseconds), the need of special software tools has already become unavoidable in order to carry out an effective analysis of significance. MORE Intelligence is the answer to these needs and was developed and implemented by a team of professionals exclusively dedicated to the steel business.

PROJECT SCHEDULE

CMC and Danieli signed a contract in early 2007 and construction began in August 2008. The first steel was produced from scrap to finished bundle in September of 2009.

Figure 16. Site prior to construction, early 2008.

Figure 17. First concrete pour, late 2008.

Figure 18. Site midpoint thru construction.

Figure 19. Site prior to commissioning.

CONCLUSIONS

The start-up of the new Danieli Micro-mill at CMC Steel, Arizona marks the beginning of a new era in production of commercial steel long products. The new steel complex, the first of its kind worldwide, represents a formidable step forward in technology that makes CMC's MI.DA® the most cost efficient rebar production plant available today in the world and puts CMC Arizona one-step-ahead of the competition.

Figure 20. CMC and Danieli Liquid Process Team.

Figure 21. CMC and Danieli Forming Process Team.