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Concrete reinforcement assembled al the workshop. A specific information management system.

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Summary: First of all, introducing the topic we would like to describe how information management system for reinforcement of structural concrete has changed since the beginning as a solution for public works, till the last improvement of Schnell and Iproin. Both of them oriented towards building structure with reinforcement assembled on the workshop instead of site.
We give details of the machines allowing to adapt Optibat, Idea and Optipocket machines to the building construction, along with the technical information management system Ferrocad.
Finally workshops become co-ordinated as a whole.
Future looks bright with the electronic Assistant. This software tool permits to have a total control of the production and a precise forecast of the expedition time considering not only the cutting and bending but also the assembling.

REINFORCEMENT. THE HIDDEN CLUE.

Reinforcement has always been seen, from outside,as a lot of persons involved in placing little pieces of corrugated steel on the shuttering and assembling them witht wire. When this task is finished concrete is thrown and all that work becomes hidden.

On the oposite, the usual form of industrial processing has been the prefabrication in which reinforcement is placed inside the structure except some outside little buts that are put when the structure in finished "in situ."

Due to the fact that a structure can't be seen from outside it is quite difficult to control the strenth of steel according to the rules of ISO 9002.

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STEEL FOR REINFORCEMENT.

Reinforcement is made with corrugated steel; and the steel like the concrete, can be made through industrial processes giving the guarantee of satifying different geometrical and mechanical features with quality levels easily over 3σ.

Corrugated steel usualy comes from the factory in bars of a length right for the transport, usualy 12-mt. long or even longer in special cases. But reinforcement normaly needs lower lengths and then bars have to be cut giving scraps of no use with the consequence that usually three percent of steel gets easily lost.

Steel can also be made in coiled wire of small diameters and this permits avoiding to loose steel during the cutting because there are no scraps.

Obviously it requires a special machine to straigthen and cut (sometimes also bend) thus causing a damage to the ribs that are neccesary to avoid displacements between concrete and steel.

It is not possible to use coiled wires for larger diameters and for job in site. The interest of selecting one or another form (straight or coiled) depends on several factors which not allow a general answer.

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ASSEMBLED REINFORCEMENT.

Another feature of reinforcement is that cut and bent bars work in the final structure in such a co-ordinated way that not only dimensions and forms are important but perhaps mostly the relative position between them and with the shuttering.

In order to get the right position, bars are fixed by using assembling wire and with spacers that maintain the right distance to the surface to avoid future damages to the steel protected by concrete.

This assembling is temporary and resistance is not concerned except for what is transport, placing and concreting. It is necessary that parts remained fixed without losing theirs relative position.

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ASSEMBLING REINFORCEMENT ON THE WORKSHOP

Assemblig reinforcement on the job-site has often been changed by assemblig it on a workshop, this is to say, in an industrial permanent installation. This is not a minor change in reinforcement technique.

First at all, it deeply reduces the work that has to be done in a place, the job-site, where there is neither room nor means, machinery and central control; on the contrary, all this is available on the workshop and allows increasing outputs.

Transport charge is quite expensive since products have a very low apparent density. Besides, if the assembling is not good enough, products could break down before reaching the site and it is not to forget that there is still much work to be finished in the site.

Of course, when we come to Public Works, this way of working is not possible because of the big element dimensions. The usual way of enhancing the outputs is by using prefabrication, as we stated.

In Building construction it makes sense to assemble in the workshops because the high quantity of the elements and the small dimensions of those permits that a high percentage of work can be carried out in the workshop.

This radical transformation in the way of working is quite old and involves an enormous change in the mentality of the operators, specially in the technological mentality.

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MACHINERY FOR REINFORCEMENT

The use of machinery to process the corrugated steel (cut and bend it) either from straigth or coiled bars, is very old and it is thought for Public Works and with information management systems oriented to this market.

As stated above, bars for Publics Works are of big dimensions and diameters so it is not possible to cut and bend them with reasonable output but with using the right machines.

A simple economic analysis is the following one: if we suppose a cost of steel of 0,3 e. (Euro)/kg a cost of 15 e./man-hour and a yield of 500 kg/h using the right machine we come to a ratio 1/10 between the cost of the labour and cost of steel. So the important factor is the capacity of the machine (outputs).

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MACHINERY FOR ASSEMBLED REINFORCEMENT

Is it possible to work in Building construction with the same mentality as in Public works?. Certainly not, even if till now a lot of people thought so. This mistake comes for a simple reason: there were neither machines nor information systems able to cope with the new mentality.

A common labour can assemble a yield of 100 kg/h; when the ratio between cost of labour/raw material is up to 1/2 labour becomes a significant factor.

The lot of people that before was in the job site is now partially employed in the workshop and theirs output are extremely important. Any machine in the workshop can not be considered, as in the Public works, only from the amount of kg that it produces per hour but also for the reduction of manual work.

Given a five years depreciation of the machine so that after five years its residual valour is zero-an exaggerated hypothesis justified only by the machine obsolocence- supposing that in five years a labour costs one hundred thousand euros, we can easily admit that, from the cost point of view, it is the same either to buy this machine or to employ one labour more in the staff.

It is important to know that we are not speaking about big workshops as in Public works, but of small ones, the ones that we can find in Spain and Europe, with an annual output of 3.000 to 4.000 tons which corresponds to what a big workshop can produce in less than one month or, in some cases, even in one week.

Considered as a whole, they produce about half a millon tons per year in a country like Spain that counts an annual consumption of two millions tons of corrugated steel.

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TWO PROBLEMS...

As we said before, to get less scraps, we have to cut together the largest number of bars. In this way, with a simple software optimizing the list, we can do it (having the software and, of course, the machine able to receive it).

After obtaining a huge amount of bars and a little quantity of scraps, the following step is to classify those.

In the Building construction the elements (beams, for instance...) have few bars but with many different diameters and lengths. The only way to finish the work is to classify the big amount of bars...

A hard tribute to pay for reducing the heap of scraps.

That is why workshops have decided to process elements one by one and to forget, till now, any kind of optimization. Scraps stay there waiting for a new use and consequently labour cost has overcome the cost of raw materials.

All the standard machines, so useful in Public works, cannot solve this problem. They even worsen it because of the handling operations not neccesary when cutting by means of a simple knife shear.

Why to have a lot of tons... if we just need few of them, but precisely classified?.

This was a problem. Another one is the assembling process. Till few years ago there were not machines for assembling, with the sole exception of the welding machines; but the number of points to be fixed were the same as the ones tying with wire.

The machines were thought for cuttig and bending, but not for assembling. Just the most expensive part of the work.

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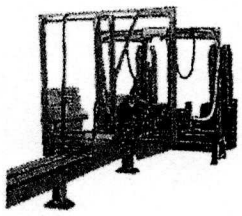
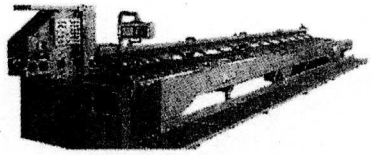
... SOLVED.

All this has changed. SCHNELL, a reinforcement equipment manufacturer, and IPROIN, a service-oriented Company in the same market, have joined together theirs efforts to find solutions; and they have now given a new standar of working for the reiforcement.

An important change has come with "IDEA", a SCHNELL's machine that, thanks to an auxiliar automatic wielding tool, allows to reduce more than a half the assembling points thus cutting down costs. In Spain this way of assembling has been included in the new rules for reinforced concrete and is used in tenths of workshops.



Another important change is given by the software developped by IPROIN, which permits to classify by elements while cutting with a minimum scrap. Moreover, the OPTIBAT and OPTIPOCKET machines manufactured by SCHNELL that understand and execute the orders from that software.



So they contribute to improve the industry.

One worker gives the bars to be cut (the software can choose between several commercial lengths -12,14,16, for example- and the useful scrap from former cutting) and then the necessary work to cut and classify is made by the machine according to the instructions received from the software. When a channel is finished and unloaded, several elements, with all their components - every diameter, every lenght-, come to the following task, which usually is the bending one.

And, last but not least, the system allows using the scraps (coming from a cutting) that anyway have been laid up in the previous cuttings, to be introduced as bars to be cut in the subsequent ones. An automatic "recycling" of scraps that is, in itself, a real great innovation.

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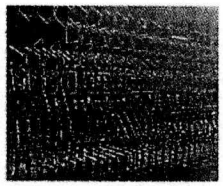

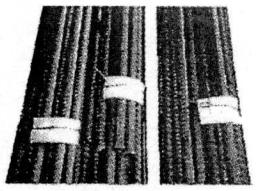

INTELLIGENT SOLUTIONS

Those two changes are but examples that show the way in which workshop-assembled reinforcement is developping. At present, the main principle is that the machine is not only a tool able to cut and (sometimes) to bend but also a system to classify (while cutting) and to fix (parcially) taking upon it an important part of the work traditionally assigned to men.

No more and more powerful machines... but more and more inteligent ones.

Talking about intelligence referring to machines means talking about the three information technology levels leading it:

On the machine itself, the PLC is now able to carry out several functions usualy performed by men (to classify bars and to process cages).

The "aim" of the job for every machine is to get the best from it and to co-ordinate it with the other machines. All is process performed by the computer connected to the others by serial interface or bar-code-supported connections.

Finally, taking into account every detail concerning the industrial management, the computer supported planning satisfies a "just in time" demand based on an interactive system in permanent attention to the changing orders in the sites and the resources (men and machines) avalaible on the workshop.

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DIMENSION OF THE SOLVED PROBLEM

Perhaps the most important thing in this solution is the dimension for which it has been conceived. As already stated, we speak about small workshops having an insignificant annual production compared to the traditional workshops for Public Works reinforcement (for which many solutions have been found).

But it was almost impossible to "export" these solutions to the small workshops not only because of the different dimension and therfore the investiment capacity but also because they were "wide variety of" problems to be solved, as we have explained here.

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FUTURE

In the next future, taking into consideration the interactive system we have previously talked about, called "Electronic Assistant", which allows to know in real time the output from the machines and from the men we can expect a fixed dispatching time for every order even if, as usual, orders change according to the needs on sites. And not only for the traditional operations such as cutting and bending but also for assembling, the real critical path in Building structures.

All this can be achieved ONLY because the production by these machines is so regular and industrialised that all the people involved in this field have a precise working rhythm and an aim always under control.

This job planning is recorded in a computer that drives the machines. The IDEA machine controls the assembling work in the same way as OPTIBAT or OPTIPOCKET do in cutting, bendig and classifying bars.

In conclusion we can affirm that in the next future, beginning from this year, thanks to Internet, a small workshop for Building Jobs will be closer to the site reality. In a virtual way it will be able to meet its "just in time" needs.