

Goliath Gantry Cranes

Extension of operational life of the structure

First Experiences

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1. Preamble

Early 2005 the author was approached by the owner with a question whether a 37 years old structure of a large capacity Goliath crane could have its operational life extended by another 10 years – and that in a manner that would **guarantee** no disruption, let alone stop of operations.

A budget of approx. 10% of value of a new crane (painting excluded) was offered.

The answer was not easy ; no such project was ever undertaken in this category of cranes, so no previous experience was available.

On hand was first the impression of two previous, short, visual inspections in 1992 and 2000 that went relatively well. Further, the main trolley was practically new, completely rebuilt after major accident in 1998.

On the whole, the proposed exercise represented no less than « sailing in uncharted waters », but the need was pressing and so, in the end, it was agreed to try.

2. The Project

To describe the Project – now in its 8th year – is not the aim of this paper.

Firstly, because of the sheer volume required ; moreover, because details of defects and damages are proprietary to the owner, while the methods of localizing and remedying them, as well as the entire guidance of the Project, are proprietary to us.

Being the ultimate phase in crane refurbishment, the entire approach was already described in ref. 1 (pt. 6) and it is this approach that was applied.

Rather than to drown in details, it is believed that sharing of important experiences would be of optimal benefit to the reader. These can be divided into three groups, all interrelated, and it is of interest that, contrary to expectations, it was not the technical one that carried most of the « weight ».

These groups are :

2.1 Technical

Inevitably, the project commenced with inspections. These were visual, accompanied by an NDT team using MP, US, ACFM and radiography methods, as required by individual situations. The same team equally conducted plate thickness measurements, if and when required.

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In parallel, the entire structure was recalculated using finite elements method to help to localize points of interest, but on the whole (and as expected) it brought no indication of particular problems in place **as per this analysis**.

The inspection itself brought a very uncomfortable fact in that substantial backlog of work not related to the Project was discovered, this being result of insufficient past maintenance. As degree of urgency of these items varied, it was necessary to include some into the Project immediately, others then gradually according to priorities between new and old work.

This provides the first of explanations why all works are still not completed today, 8 years after the starting date.

Turning to groups of defects, it will not surprise anyone that the most dangerous ones were those of the hidden type ; the word « hidden » having multiple meanings as will be demonstrated later.

To list these groups by volume or frequencies, we have to commence with :

2.1.1 Corrosion :

Largely as a result of extended neglect in maintenance, it involved both external and internal (due to water ingress) areas. As important example are to be mentioned most of bolted joints, together with particularly severe cases found in the hook blocks and on the service crane, where the jib and counterweight suspension were deeply affected ; all the cases providing hazardous situations.

Lesson No 1 : do not underestimate corrosion, far too often considered just a matter of « cosmetics ».

2.1.2 Fabrication shortcomings :

represent the second group in importance and confirmation of inadequate original supervision.

As examples we can quote full penetration welds executed with partial penetration or variable quality of oxy-cut free edges in tension areas. Our particular interest was drawn to residues of U-type temporary supports welded to bottom flanges and adjacent web areas of the girders. The role of these brackets was evidently to stabilize the narrow and high girders during fabrication. After that they were cut off in an improper manner leaving scars, particularly on the webs, with development of cracks in consequence.

2.1.3 Erection shortcomings :

similarly to previous case, heavy brackets were welded to tension areas of girder webs serving as lifting attachments for individual girder sections (bolted together in the air.)

Also here their removal by oxy-cutting was particularly brutal, leaving scarred areas behind with cracks to follow ; all hidden behind paint, as is so often the case.

2.1.4 Unauthorized interventions :

a very common phenomenon that most of cranes owe to electricians : welding and drilling without a thought to possible consequences, if applied in sensitive areas.

As a less common example should serve a case of M24 fitted bolts in various connections of the girders and of the fixed leg.

It is understood that just a few years after erection of the crane all these bolts were « reviewed » by torquing them up. Whoever did this was surely guided by the grade (8.8), but forgot the bolts did not have the geometry for it. As a result, all of them show shallow crack between the threaded part and the conical part of the shank.

Having considered that thousands of bolts were involved, all extremely difficult to remove, that without exception they were subject to pure shear (and that the torque must have introduced some, however minor, friction into the mating surfaces), we decided to keep the bolts in place, taking into account reduced safety factor due to induced tension from the torque.

Lesson No 2 : to track serious problems, look for the unexpected.

2.2 Organizational

Realization of the project was a matter of tri-partite arrangement between the owner and two consultants, us being one of them .

The intellectual leadership came from us, project management by the owner, analytical support by the other consultant who took care of recalculation of the structure and of drafting of the Special Assessment (to ISO) based on our findings.

Apart from project management the owner controlled

- availability of the crane for investigations and all works, including means of access
- all labour
- the NDT team
- the certification organization to carry out legal tests.

Relations between the groups employed were excellent with the exception of labour, where insufficient numbers, variable quality and far too often poor productivity gave rise to many problems.

Further exception were relations with the certification body, that were non-existent due to sharp difference in evaluation of a need, way of execution and potential consequences of frequent overload tests.

(Note : this conflict, still unresolved, finally came into the open mid 2012 and it is here that our consulting partners played a highly constructive role.)

However, the excellent relations mentioned previously could not change the fact that progress and cost of the Project – the first 3 years apart – developed in a less than satisfactory manner and that for the reasons listed below :

- 2.2.1 insufficient availability of the crane for Project activities ; when crane available, refusal to install 2nd shift and to work on Saturdays.
- 2.2.2 having within the first 3 years dispensed with virtually all of his maintenance personnel, the owner found himself entirely dependent on subcontractors who brought with them all problems mentioned previously. Moreover, they had no experience with this kind of equipment, be it in historicity or quality of work.
- 2.2.3 we, as the consultants, were there to indicate what to do, how to do it and what quality standards were to apply, but had no control over the labour in any other sense. That was responsibility of the Project Manager who was unable to delegate his staff to direct / supervise the labour for the simple reason that he did not have it – and the productivity looked accordingly.
- 2.2.4 The Project Manager himself, being in addition responsible for a very large installation, was too occupied with other work to be able to devote the required degree of attention to his duties stemming from the Project. This slowed any decision-making process.

Apart from inclement weather always present in the region, this is the summary of all the other explanations of slow progress of works.

Lesson N° 3 (to the owner) : it is not of advantage to be in charge of the Project unless you can secure availability of all factors influencing its optimum performance. Any shortcomings in this regard add to risks to the equipment, to the production and to its personnel, hence to risks that are largely to your own interests and of your responsibility.

2.3 Contractual :

Looking back 8 years since commencement of this Project it is unavoidable to admit that absence of any written contractual agreement between all parties participating directly or indirectly in the Project was the most significant shortcoming detected so far and a sign of lack of experience.

It was based on idealistic point of view that the owner, having initiated the Project and putting himself in charge, would do everything possible for the success because the project was vital for him. But this evaluation overlooked that the owner had many voices and that they were not, as gradually established, speaking in unison. Due to this unacceptable delays a.o. occurred in certain instances leading, as later discovered, to potentially hazardous situations. Moreover, certain aspects, such as frequent overload tests, were neither anticipated nor known to us in the first years, although they may have had influence on the structure. (see also ref. 1, pt. 7)

It is therefore essential and in the interest of all parties to establish a clear-cut agreement about all aspects concerning the Project and that, evidently, before the start. Particular attention should be drawn to resolution of disagreements with a speed each individual situation may require, to a list of technical priorities known (adjusted continually) and to at least a preliminary planning, safeguarding adequate progress of investigations and works. Qualifications and numbers of workforce for each task should equally be known well ahead of their assignment.

Lesson N°4 (to the consultant) : insist on formal agreement before undertaking such project. If conditions are not in compliance with the agreement give a short warning notice and if conditions still do not improve, withdraw.

For remember what was said at the beginning : that the whole exercise will always remain « sailing in uncharted waters ». In case the exercise should « hit a rock », even if you are completely innocent your reputation will be destroyed by association long time before it was proven in courts that you carry no blame.

3. Conclusions

As any reconditioning of a crane structure each project aiming at extension of technical life is bound to include risks. Every consultant worth his name knows that and it is his task to anticipate and to eliminate them before they can cause harm. But in any sensible exercise of such kind these risks must remain related to the structure on its own ; by which is meant that they must remain isolated from any outside influences that in course of such project would put additional risks on top. It is this rule that should guide any decision to undertake such project, or to continue with it or not when on its way.

Finally, with all that was said previously, the Project continues towards its end in a satisfactory manner and it is more than likely that its objectives will be fully achieved.

This confirms that such projects can be conducted in a reliable manner even under difficult circumstances and that – with supplementary measures taken – for periods even longer than presently attempted.

This represents significant advance as there must be dozens of large-capacity Goliath cranes where such potential exercise offers important economies to the owner.

Although a technical review would be required to assess in each individual case the crane suitability for such project, the related cost factor would be insignificant compared with potential benefits to expect.

With all the experience gathered so far we are confident that each new project of such kind will be faster, simpler and more economical, e.g. even more attractive to any future customers. This represents the principal achievement.

References :

1. V. Nevsimal-Weidenhoffer / N. Tsouvalis / V. I. Pagazoglou :
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Their Steel Structure - A Neglected Element
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