Ostermann Rail Consult

advice - calculation - support

System comparison of crane rail fastening systems

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1. Introduction

This report is based on my years of (practical) experience in the fields of crane tracks and industrial tracks.
I began working for Railbouw Leerdam, in the crane track department, in 1977. Since then, an increasing number of goods were transhipped in containers. The transhipment of mixed cargo became less and less. Bigger and heavier cranes appeared on the quays, with increasingly higher wheel loads.
Among other things, I was involved in the design and construction of the ECT Delta Terminal at Maasvlakte 1.
My most recent major project was the design and construction of the RWG terminal at Maasvlakte 2.

edilon)(sedra has asked my company to conduct a comparative study into 2 types of crane rail systems.

2. Question

a. What are the characteristic differences between and advantages of the different crane track systems?

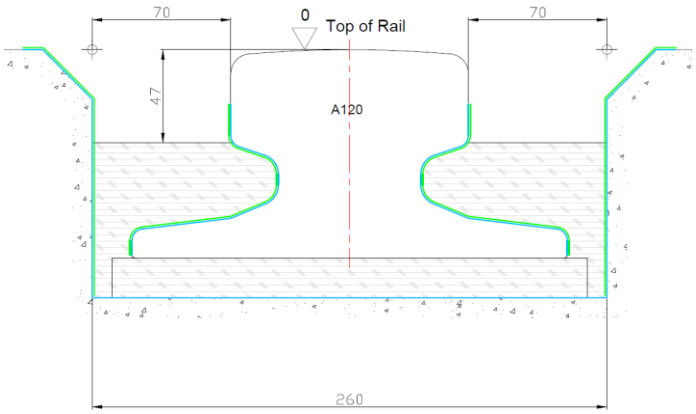
b. What are the differences in realisation costs for both crane track systems?

c. What is the cost comparison between both crane track systems for a period of use of 30 years?

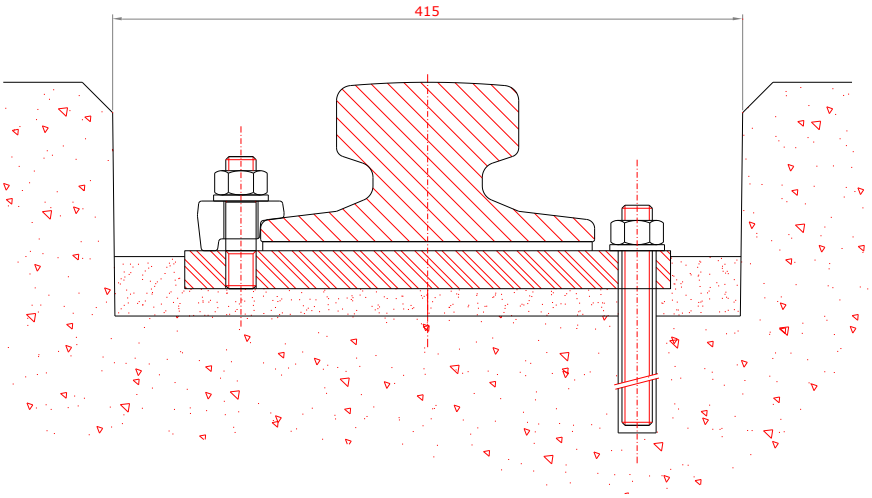
3. Response to the questions

3.1. General system description

a. In the edilon)(sedra CRS (Crane Rail System) crane track - a fully cast system - the rail is fixed in a channel (made of concrete) entirely free from steel mounting components. This is achieved by means of a 2-component elastomeric cast mass of edilon)(sedra Corkelast M-95. A cross-section of this system is shown below. Thanks to the Corkelast's initial castability, every type of rail can be implemented.



b. The conventional solution (e.g. the Gantrex/Gantry system) with laterally adjustable flexible rail clamps, and as alternative the simpler system with non-adjustable, fixed rail clamps. The composition of such a system is shown in the image below. It image relates to a system (separated from the centre line) near the mounting clamp and near the system cross-section. The rail is fastened between 2 clamps, often at a centre-to-centre distance of between 600 and 750 mm, and fixated with anchors that connect the continuous base plate with the underlying concrete.



3.2. Characteristic differences between and advantages of the different crane track systems.

a. Number of processes during realisation:

The aforementioned work descriptions show that the number of actions during construction of the edilon)(sedra system are considerably lower.

As an example, we assume the construction of a 300-metre crane track (2 x 300 metres of crane rail). Roughly speaking, the standard completion time is:

- The edilon)(sedra CRS crane track 2 weeks
- The conventional solution 5 weeks

b. Weather influences during construction:

During the execution of construction, the edilon)(sedra system is slightly more sensitive to weather influences (rain and temperature).
However, professional resources are available that reduce the risk of the time schedule being overrun.
Note: if the lower cast of the conventional system is made of epoxy, steps must be taken during wet weather.

c. Drilling of anchors:

With the conventional system, the anchor holes are/were as a standard, drilled into the concrete using pneumatic equipment.
There is a realistic chance that diamond drills are required (if they hit concrete reinforcement), which may result in the time schedule being overrun and increasing costs for the client.
Furthermore, specific measures must be taken in the near future with regard to the fine dust particles that are released when using pneumatic drilling equipment. An alternative is to use electric drilling equipment fitted with extraction. This takes additional time compared to the use of pneumatic equipment.

d. Installation flexibility:

The required width of the concrete channel is considerably smaller for the edilon)(sedra system. Regardless of the type of rail to be used, the gutter can be approx. 155 mm narrower.
This increases safety when the crane track is in use.
Another important advantage is that these features allow other (heavy) traffic to drive across the structure. This can offer major practical logistical advantages in relation to site use and layout.

h. Repair method:

Previously, repairs to the edilon)(sedra system were regarded as highly time-consuming, but edilon)(sedra has now developed a professional method to carry out repairs swiftly and professionally.

This is implemented through the use of high-pressure water jets.

e. Crane rail damage:

With the narrower channel of the edilon)(sedra CRS crane track, the risk of damage to the crane rail caused by support of the terminal trucks getting caught is virtually zero.

This is in contrast with the conventional system which with a wider channel and the fact that it is possible that the position of the rail becomes raised during the years (due to a reduced performance of the flexible rail clamps).

f. Sound absorption:

Thanks to the cushioning effect of the edilon)(sedra system, moving cranes produce fewer vibrations and less noise.
The crane rail is embedded into an elastic mass, as a result of which the rail surface that can emit noise is limited.
Furthermore because of the elastomeric mass, there is no direct contact between rail base noise and concrete substructure.
Relevant figures are not available, but the phenomenon is clearly noticeable in practice.

g. Repairs in the event of rail breakage:

In the event of rail breakage (for that matter, does not occur very often with a solidly designed crane track), in the case of the edilon)(sedra system there would be no immediate requirement to make repairs, as the rail is fully embedded, and would not create space at the spot of the breakage.
Another important aspect is that at the spot of the breakage, the alignment remains intact.
This allows the crane to continue to be operated until a downtime can be scheduled in by the crane rail authority.

i. Sustainability and maintenance:

Thanks to the embedded edilon)(sedra system, maintenance will hardly be required. Due to a lack of steel mounting fixations, corrosion is excluded.
This is in contrast with the conventional system, where dirt, dust, litter and (salt) water affect the steel structure. This requires that the system must be maintained on a regular basis. Not only does this affect the client's maintenance budget, it also disrupts business operations.

j. Indirect wear and tear:

In practice, cranes sometime demonstrate different operating behaviour than the theoretic calculation.
Indirect wear and tear (for instance, caused by the crane jack-knifing) does at times occur.
It is important to properly align the crane's wheels and to combine this with proper parallel settings.

If indirect rail wear and tear does occur, (preventive) grinding work on the rail head is possible in both systems.
However, if after years of use the rail is truly worn (for most crane tracks that is a minimum of 30 to 35 years of use), changing the rails of the edilon)(sedra system will take more time than with the conventional system.

In our experience, (excessive) rail wear and tear mainly occurs in:

- Overhead crane tracks in (production) halls. Those rails are often mounted in steel structure.
- Crane tracks for stacking cranes. Those are often fast-running cranes that run on rails installed on sleepers in a ballast bed.
- Crane tracks on which cranes move very often and fast. Example: the Rail Service Center railway terminal in Rotterdam

3.4. Realisation and costs of the specified crane track systems.

The edilon)(sedra CRS crane track (example rail A120 > channel width *approx. 260 mm):*

- Blasting the concrete gutter and applying a primer
- Blasting the rail and applying a primer
- Accurately measuring the gutter bottom and establish future height of the rail.
- Laying out the rail and preparing the welds
- Sorting according to correct thickness and laying out of the height adjustment spacers on the channel floor; centre-to-centre 1,500 mm
- Fitting rail in the gutter
- Fine-tuning the rail within the required standards
- Casting the structure with Corkelast

The **conventional system** (example rail A120 > channel width *at least approx. 415 mm):*

- Blasting the channel floor (with pressurised water)
- Accurately measuring the channel floor and establish future height of the rail.
- Laying out continuous steel base plates 5,980 x 365 x 25 mm.
  When the plates arrive at the worksite, they are already blasted and coated.
- Laying out a continuous (steel-reinforced) flexible base material
- Laying out the crane rail
- Making welds to create a continuous rail
- Securing the rail on the base plates by means of (flexible) rail clamps, centre-to-centre 600 or 750 mm.
- Accurately aligning the entire composed structure in terms of height and direction by means of adjustable bolts in the base plates.
- Drilling holes in the concrete using pneumatic equipment (the base plate serves as matrix) and gluing the anchors M20 x 250 / M20 x 300
- Fine-tuning the structure within the required standards
- Casting the base plates with casting mortar. This can be non-shrink mortar on the basis of cement or epoxy.

- After the mortar has hardened, the anchors have to be checked for the correct torque.

The table below provides a cost indication for the end user for the construction of 2 x 300 metres of crane rail A120 in a concrete gutter.

a. Gantrex system on the basis of non-shrink mortar	€ 270,000
b. Fixed clamp system on the basis of non-shrink mortar	€ 260,000
c. Gantrex system on the basis of epoxy mortar	€ 310,000
d. Fixed clamp system on the basis of epoxy mortar	€ 300,000
e. edilon)(sedra system	€ 300,000

3.5. Cost comparison between both crane track systems for a period of use of 30 years

For conventional systems this requires:

- cleaning the channel and removing (dumping included) resulting litter every year or every 2 years
- conducting a visual inspection every year or every 2 years
- Carrying our minor repairs (clamps that have snapped off, bent anchors, retouch coating) every 4 years

Also, the experience with crane track lower channels with non-shrink mortar is that entire sections have to be replaced within approx. 15 to 20 years (the mortar has cracked or pulverised).
Examples include BCTN in Den Bosch, Nijmegen and Wansum. It also occurred at the Transhipment Unit in the city of Oss. On average, 25% of the track has to be repaired; this often takes place during weekends on account of the client's operational service.

In the case of crane track with lower channel and epoxy mortar, the lifespan is at least 30 years (in terms of the lower cast).

Taking the above into account, the total costs for construction, including maintenance and repairs, for a period of 30 years are approx.:

	construction	maintenance	total
a. Gantrex system non-shrink mortar	€ 270,000	€ 107,000	€ 377,000
b. Fixed clamp system non-shrink mortar	€ 260,000	€ 107,000	€ 367,000
c. Gantrex system epoxy mortar	€ 310,000	€ 72,000	€ 382,000
d. Fixed clamp system epoxy mortar	€ 300,000	€ 72,000	€ 372,000
e. edilon)(sedra system	€ 300,000	€ 8,000	€ 308,000

On page 9, the costs are further specified in order to gain an insight into the differences between the various solutions.

4. Conclusions

Both systems have specific pros and cons, as shown by the above.

The important issues are set out below:

a. Implementation period

Advantage of the edilon)(sedra system compared to the Gantrex system: on average, the implementation period will be lower by a factor 2.5.

b. Investment and maintenance costs

Based on quality (plastic lower cast / cast rail), the investment costs for both systems are virtually the same. If the client opts for a Gantrex system with vulnerable lower cast material (non-shrink mortar on the basis of cement), the initial investment costs will be 12% lower compared to the edilon)(sedra system or a system with an epoxy lower cast.

On the basis of the anticipated repair and maintenance costs however, the edilon)(sedra system is by far the most economical.

c. Downtime during repairs / maintenance

Non or hardly any maintenance is anticipated for the edilon)(sedra system; this is a big advantage in terms of the client's operational services.

d. Risk of time schedule being exceeded / mounting costs for the client

With the Gantrex system, the anchor holes have to be drilled using diamond equipment in the case of reinforcement steel. This takes more time and involves contract extras for the client.

In rainy conditions, the edilon)(sedra system requires more measures in order to be able to continue to work.

e. Flexibility of the rail structure

The fact that the rail channel for the edilon)(sedra system can be approx. 155 mm smaller, is a big advantage with regard to (heavy) crossing traffic.
The risk of damage to the rail, which occurs when a support of the terminal truck hangs too low, is nil with the edilon)(sedra system.

f. Replacing rail in the event of complete wear and tear

If this occurs, the traditional system is better.
This is because the work can be carried out must faster and at lower costs.

Appendix 1.

Breakdown of costs for realisation and maintenance for a 30-year period

a. Gantrex system on the basis of non-shrink mortar
b. Fixed clamp system on the basis of non-shrink mortar
c. Gantrex system on the basis of epoxy mortar
d. Fixed clamp system on the basis of epoxy mortar
e. edilon)(sedra system

Indication of realisation costs for 2 x 300 metres of crane rail A120

	materials	wages	other costs	total
a	€ 174,000	€ 73,000	€ 23,000	€ 270,000
b	€ 164,000	€ 73,000	€ 23,000	€ 260,000
c	€ 210,000	€ 77,000	€ 23,000	€ 310,000
d	€ 200,000	€ 77,000	€ 23,000	€ 300,000
e	€ 260,000 *	€ 27,000	€ 13,000	€ 300,000

* The price includes the processing of the Corkelast and blasting/coating of rail and gutter.

Indication of the maintenance costs for a 30-year period:

	inspections	cleaning gutter	minor rep.	sched. rep.	total
a	€ 8,000	€ 50,000	€ 14,000	€ 35,000	€ 107,000
b	€ 8,000	€ 50,000	€ 14,000	€ 35,000	€ 107,000
c	€ 8,000	€ 50,000	€ 14,000	nil	€ 72,000
d	€ 8,000	€ 50,000	€ 14,000	nil	€ 72,000
e	€ 8,000	nil	nil	nil	€ 8,000

For both the (visual) inspections and the cleaning of the gutters / removal of dirt, the basic principle is: at least once every 1.5 years.

The basic principle of minor repairs is: 7 repairs of approx. € 2,000

The basic principle of scheduled repairs is: approx. 150 - 200 metres to be disassembled, reconstructed and recast in their entirety.

Note: indexations have not been taken into account!

Culemborg, 12 March 2015