KONECRANES

Rail-to-girder eccentricity matters

White paper

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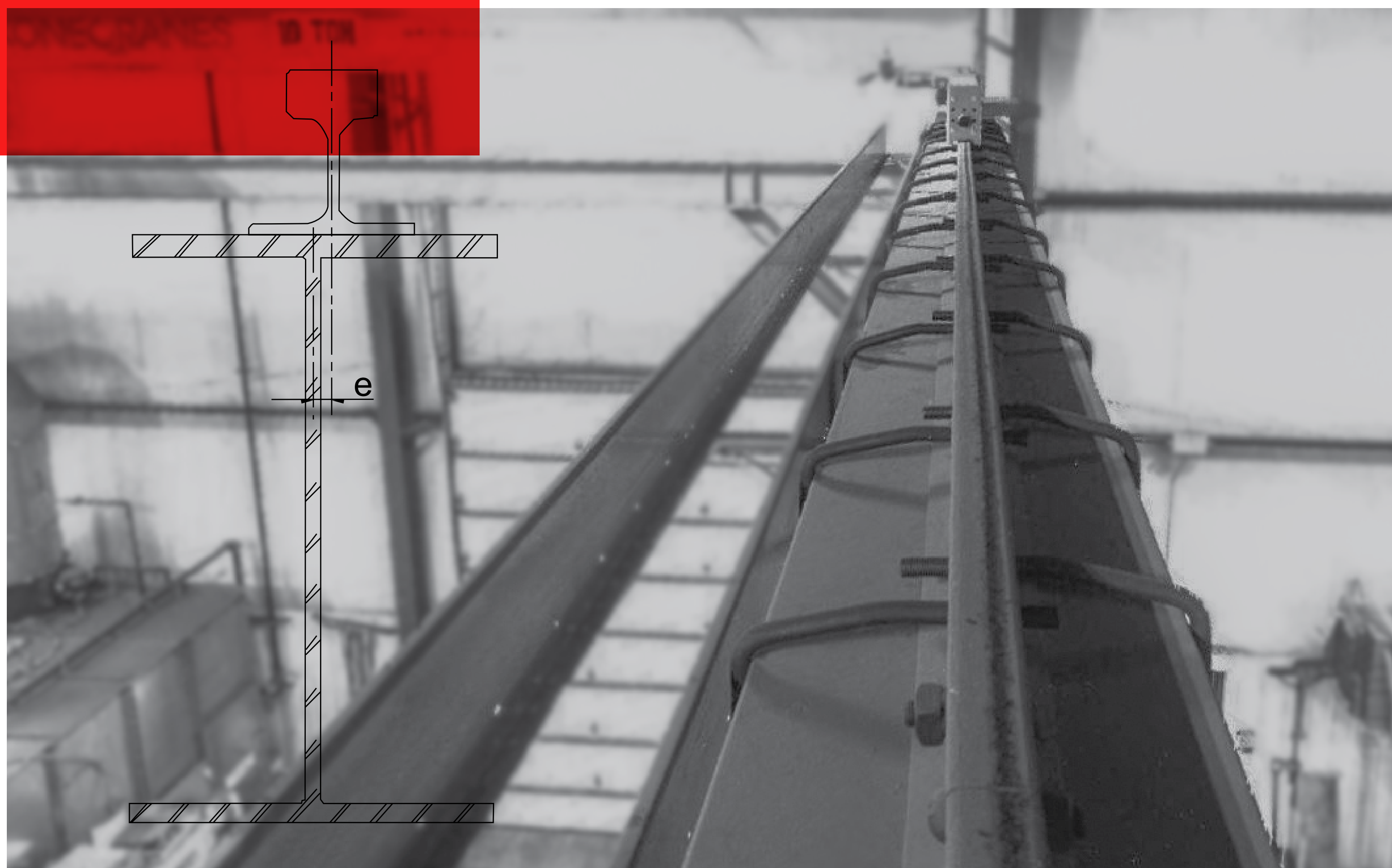

Crane runway rail and girders play vital role in the health of your crane

The crane runway rail and girders are a sometimes-forgotten element in the overall health of your crane—until there is a problem. Runway issues can have a substantial effect on the condition of the driving elements of the crane and an improperly functioning runway can lead to major repair costs.

Obvious tolerances such as rail span, elevation and straightness are easy-to-understand concepts and have an immediate effect on the performance of the crane runway. However, there is another element that plays a critical role in the longevity of the runway, especially in cases where the crane is used in heavy production applications such as steel making, automotive die handling and coke handling. This is the eccentricity between the runway rail and the runway girders.

Controlling the rail-to-girder eccentricity of the runway improves the fatigue resistance of the runway girders. This is particularly critical in cases where the runway girders are fabricated plates welded together to form a girder.

What is rail-to-girder eccentricity?

Rail-to-girder eccentricity (e)—or what is commonly referred to as rail eccentricity—is the difference in the central plane of the runway rail and the central plane of the runway girder (beam), Fig 1.

International building codes along with professional industry focus groups such as the Association for Iron & Steel Technology (AIST) define an acceptable amount of rail eccentricity. For example, the American Institute of Steel Construction (AISC) suggests that the maximum eccentricity should be three-quarter (3/4) of the girder web thickness.[1] Using this specification, runway and building engineers can properly design the runway girders and support structure to guard against fatigue.

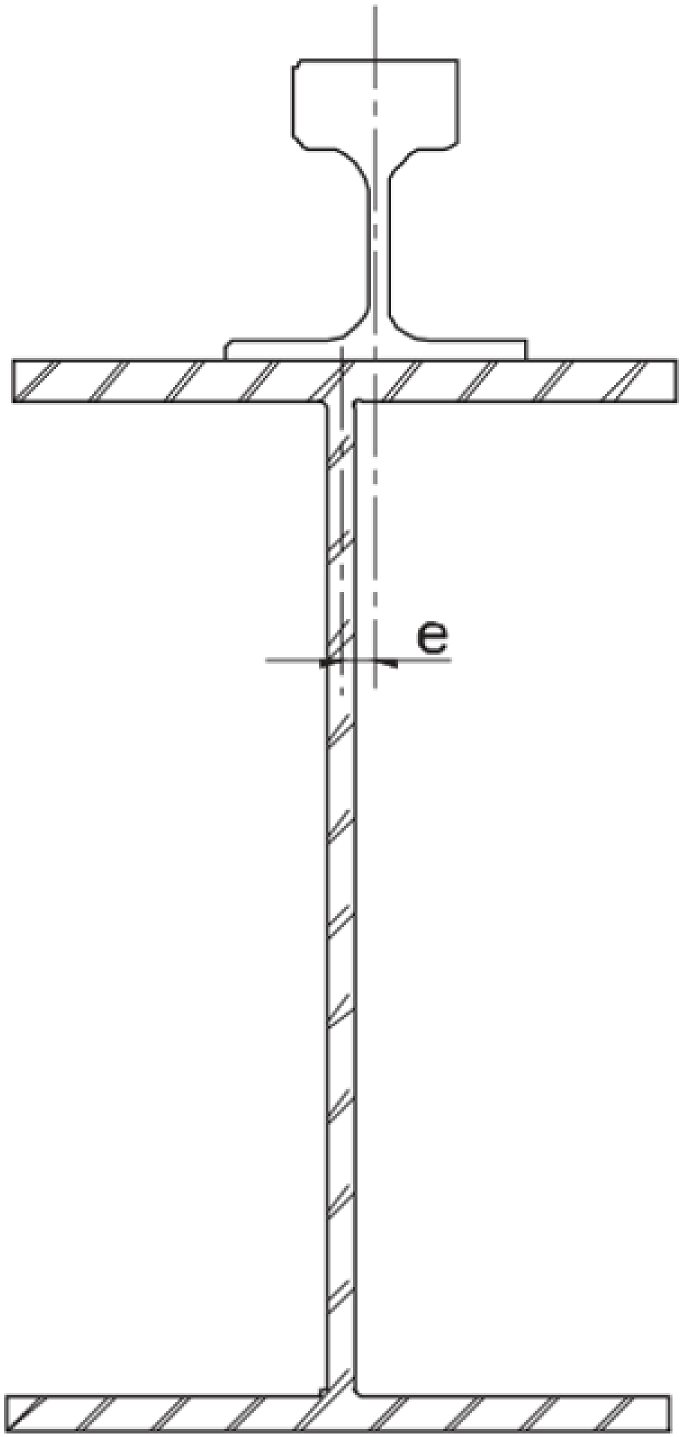

Fig. 1, rail-to-girder eccentricity, From AISC DG 7

[1]American Institution of Steel Construction, Design Guide 7 / Industrial Buildings - Roofs to Anchor Rods (2004)

Why is it critical to evaluate rail eccentricity?

Imagine a crane passing over a single area of runway which has some value of rail eccentricity and assume that no other transverse load is directly applied. Since the rail is positioned off the center of the girder the vertical load transfer from the rail to the girder will be off center from the girder's axis. This induces a bending load on the girder's top flange and a bending moment on the girder web.

A torsional moment is transferred from the rail through the girder flange creating a bending moment to the top of the girder web. Intermediate flange stiffeners may help with this, but the benefit dissipates as the wheel moves away from the immediate plane of the stiffener and has little support for torsional deflection.

While this has a substantial effect on the heat affected zone of the plate girders welds; the cyclical loading conditions are the same on the rolled section girders.

These bending loads happen as each wheel passes over the subject area, each causing a load cycle. Over time the cyclic loading causes fatigue stresses to build up in the flange-to-web weld. Specifically, the toe of the weld is vulnerable to cracking due to these fatigue stresses.

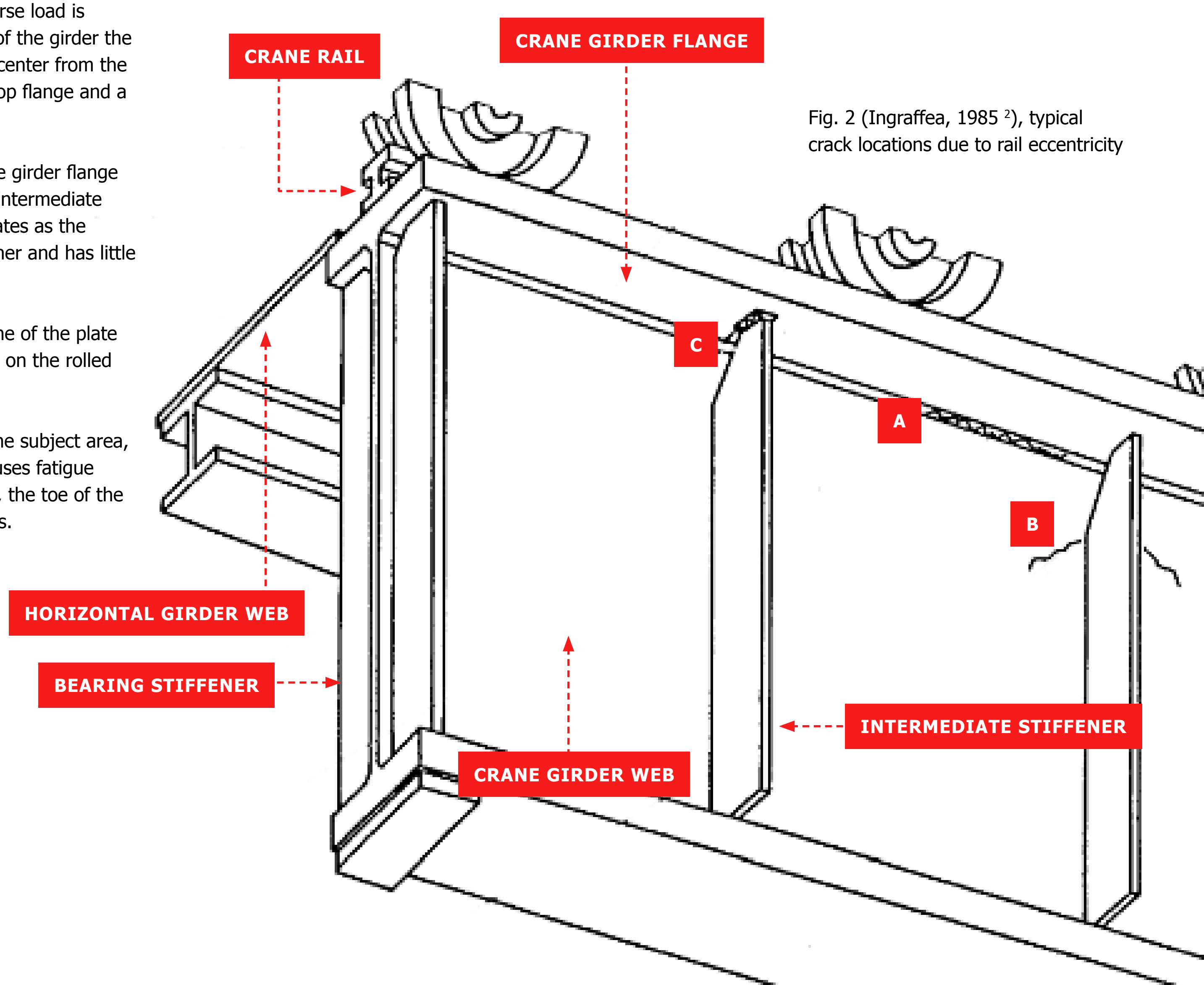

Fig. 2 (Ingraffea, 1985 [2]), typical crack locations due to rail eccentricity

[2] Cracking of Welded Crane Runway Girders: Physical Testing and Computer Simulation, Ingraffea, Anthony R, Iron and Steel Engineer (1985)

How to avoid issues

For new runway installations it is recommended to follow the latest guidance from local standards organizations and industry focus groups such as ISO, AISC and AIST. Ensuring that the steel designers are taking fatigue loading into the sizing and design of the structure is also recommended.

Konecranes offers engineering and inspection services that can be used to identify cracking of the runway girders. To remedy rail-to-girder eccentricity, the first step is to survey the runway rails and girders. Konecranes RailQ 3D Runway Survey should be used for this task as it has been specifically developed to focus on the relationship of the rails to the girders.

RailQ 3D can also be paired with a structural inspection to determine the overall health of the runway. Performing these surveys at regular intervals allows owners to trend the health of the runway over time and identify areas of concern. The ability to monitor the health of the runway is critical in applications where the cranes are in critical use.

SYMPTOMS THAT MAY INDICATE THE NEED FOR A RUNWAY SURVEY

- **Crane tracking and skewing issues**
- **Excessive wear on wheels and rails**
- **Loose rail fasteners**
- **Abnormal noises during bridge travel**
- **Frequently replacing bridge couplings, rail splices, rail sections and crane wheel axles**
- **Broken wheel flanges, etc.**

WHEN RAILQ 3D IS RECOMMENDED

- **A crane has experienced or is planned to have a significant increase in usage or duty class**
- **Planning a modernization of the crane structure or driving machineries**
- **Planning to increase the lifting capacity of the crane(s)**
- **A new runway or runway rail have recently been installed**
- **Before a new crane will be installed on an existing runway**
- **An additional crane is being added to an existing runway**
- **Replacing end trucks or driving machineries**
- **Before and after an engineered or critical lift is performed**
- **Limited information on how the existing cranes were used in the past**

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