Datum Advisory Limited
Clarity before transformation

Tel: 07486385217
Web: www.datumadvisory.co.uk
Email: contact@datumadvisory.co.uk

Reg No: 16970138

Date: 01/07/2026

Case Study: Racking Risk Intervention

Hidden load paths, structural overload, and decisive engineering action

Executive Summary

Operators had noticed subtle but persistent deterioration in a cantilever racking system used to store long, heavy boxes of strip material. Bolts were repeatedly working loose, deformation was developing slowly, and no one could explain why. The symptoms pointed to a deeper issue: the structure was being used in a way that violated its intended load path.

This case study shows how a simple, physics-based diagnostic uncovered a hidden overload condition and restored structural integrity; while revealing important lessons about governance, ownership, and system discipline.

1. Context — A storage system showing unexplained deterioration

An SME manufacturing site was using cantilever racking to store long boxes of strip material:

- Length: ≈5 m
- Weight: ≈500 kg each
- Up to four boxes per level (≈2 tonnes total)
- Overhangs: 1 m on one side, 1.5 m on the other
- Three support arms per level, with the middle arm centred between the outer two

Operators had noticed that the racking "didn't look right", but no one could explain the cause. Noting that the photo exaggerates the effect, it was less visible to the naked eye. The most visible symptom was subtle but telling:

Single M16 bolts securing the arms were repeatedly working loose.

This indicated torsional loading, a sign that the arms were being twisted rather than simply loaded vertically.

2. Diagnostic Approach — Engineering pattern recognition

Rather than treating the symptoms (tightening bolts), the underlying question was:

"Why is the structure behaving as if it's being twisted?"

Using basic mechanical engineering principles, beam deflection, load paths, and turning moments, the geometry was mapped and insights obtained:

- Overhangs created an eccentric load
- The 5 m boxes behaved as flexible beams, not rigid bodies

- Sagging caused the middle arm to lose contact
- The load was redistributed onto the two outer arms
- The overhang created a moment arm, amplifying the bending moment at the column

This was a classic case of a structure being used in a way that violated its assumed load path.

3. Analysis — Quantifying the hidden overload

A beam-deflection calculation confirmed the suspicion:

Per box

- Weight: ≈4.9 kN
- Middle arm reaction: ≈0 kN (effectively unloaded due to sag)
- Outer arm reactions: ≈2.45 kN each

Per level (four boxes)

- Total load: ≈19.6 kN (≈2 tonnes)
- Each outer arm carried: ≈9.8 kN (≈1 tonne vertical load)
- Nominal arm rating: ≈750 kg

Amplification effect

Because the load was applied 1–1.5 m away from the column:

- The bending moment at the column was significantly higher than the nominal rating assumed
- The single M16 bolt was experiencing cyclic torsional loading, explaining why it was loosening

In short: the racking was quietly overloaded, and the load path was fundamentally wrong. This was a structural failure mode developing in slow motion.

4. Intervention: Eliminating the failure mode

Once the load distribution was understood, corrective action was immediate:

- The racking was repositioned so that all boxes were fully supported across all three arms according to an optimal geometry calculation
- Overhangs were reduced
- Load paths were restored to the manufacturer's design intent
- Torsional loading on the arm brackets was removed
- The M16 bolts stopped loosening

This was a restoration of structural integrity rather than simply a repair.

5. Outcome: Risk removed, system stabilised

After repositioning:

- No further loosening of arm bolts
- No visible deformation
- Load evenly distributed
- Racking returned to safe operating condition
- Operators gained confidence in the system

This intervention avoided:

- Structural failure
- Damage to high-value stock
- Injury to personnel
- Unplanned downtime
- Insurance and compliance consequences

It's been several years since this exercise was carried out, and until the eventual decommissioning of the store area, no further issues were experienced with the racking.

The question that remains, however, is how did the situation arise in the first place and how relevant is that today ?

6. Further Learnings

This intervention demonstrates how physical symptoms often reveal deeper organisational issues:-

Governance	Load ratings, storage configurations, and sign-off processes must be owned and maintained.
Process Ownership	Racking safety and inspection routines require clear accountability.
System Discipline	Geometry rules, SEMA standards, and torque checks must be consistently applied.
Data Standards	Correct load ratings and arm capacities are essential for safe operation.
Capability	Trained operators and competent installers prevent misuse and hidden overloads.
Control	Periodic inspection and validation ensure long-term stability.

For SMEs, this case shows how a straightforward engineering fix can expose wider operating-model gaps, and how addressing those gaps prevents recurrence, reduces risk, and builds organisational resilience.