INDEPENDENT INVESTIGATION

SAFETY CASE

Independent Third-Party Industrial Accident Investigation

Fatal Lifting Failure During Roof Steel-Beam Erection

Sequential Failure of Two Suspended-Load Slings

Module 3 — Gas Turbine GT31, Combined-Cycle Power Plant (Under Construction)

Subject of report	Fatal lifting failure: suspended two-section steel roof beam fell after sequential failure of both supporting slings
Nature of injury	Fatal crush injuries to a worker in a MEWP basket positioned beneath the suspended load; one further minor injury
Standards engaged	LOLER 1998; PUWER 1998; Work at Height Regs 2005; BS 7121 / EN 280; EN 1492-1; Machinery Directive 2006/42/EC
Report type	Independent third-party industrial accident investigation / safety case
Prepared by	Independent Accident Investigation Team, assisted by a lifting & rigging specialist
Status	Final — Version 2.0; supersedes the Consortium internal investigation v1.0; inferences identified as such
Confidentiality	Confidential — for accident-prevention, root-cause determination and remedial action

Anonymisation note: All personal names, nationalities, company and brand names and identifying reference numbers have been removed or reduced to generic role and organisational descriptors. The parties are referred to by function only — for example the Consortium, the Client, the Appointed Person, and the individuals by their job roles (Supervisor, Crane Operator, Rigger, Fixer, MEWP Operator). The deceased is referred to as Fixer 1 out of respect and is not named.

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1. Investigation Declaration & Scope

1.1 Basis of Instruction

An independent Accident Investigation Team was appointed to conduct a third-party investigation into a fatal lifting failure at a combined-cycle power plant then under construction. During the erection of pre-assembled steel roof beams, a two-section beam of approximately 5.70 tonnes, held suspended by a tower crane at a height of about 17.5 metres, fell after both supporting slings failed in sequence. A steel fixer standing in the basket of a mobile elevated working platform (MEWP) directly beneath the load sustained fatal crush injuries; a second fixer in the same basket escaped with minor injuries.

The investigation team is functionally and organisationally separate from those who planned, supervised or carried out the work. In examining the technical aspects of the lift — the crane, the MEWP, the rigging and the slings — the team was assisted by a consulting lifting and rigging specialist. The engineering findings reported in Section 6, and the engineering opinions identified as such elsewhere in this report, were formed with that assistance; the investigation, its conduct, and the overall findings and conclusions are those of the independent team.

This safety case sets out the facts as established from the evidence, the engineering and procedural failures identified, an analysis of causation, and the conclusions reached as to the root and contributing causes. It concludes with a corrective action plan addressed to each accountable party. It is issued without prejudice and solely to identify causes and prevent recurrence; it does not apportion individual blame or determine civil or criminal liability.

1.2 Scope of the Investigation

The investigation addressed the following matters:

- The planning, method and supervision of the lifting operation and the system of work in force at the time.
- The positioning and movement of the occupied MEWP basket relative to the suspended load.
- The rigging and slinging technique used to attach the beam to the crane.
- The conformity, certification and true capacity of the slings, and the procurement controls that admitted them to service.
- The operation of the MEWP, in particular the use of ground-level controls for an occupied basket.
- The competence, authority and communication arrangements of the personnel involved.
- The adequacy of the controls against the recognised UK/EU legal and good-practice framework for lifting operations.

1.3 Material Examined

This investigation is founded on the physical evidence recorded at the scene (slide marks along the beam, paint transfer on the adjacent girder, rub-marks beneath the basket, the fractured sling ends, the cracked basket handrail and the deformed MEWP knuckle boom and pin housing), witness statements, the lifting plan, method statement and risk assessment, crane and sling certification, competency records, and the government and manufacturer sling-test

evidence. The physical assessment of the rigging, the MEWP and the slings was carried out with the assistance of the consulting lifting and rigging specialist.

Caveat on the evidence. *This safety case re-examines the incident to the standard expected of an independent third-party investigation and supersedes the Consortium internal report. Access to the GT31 area was restricted pending the civil-police investigation, preventing a complete physical re-examination. The written government sling-test report and the police file were outstanding at the date of issue, and the ground MEWP operator provided no statement. Conclusions therefore rest on preliminary test figures, the physical evidence recorded before access was restricted, and witness accounts, and may be revised should further evidence become available. The account of the platform's operation, and the precise mechanism by which the first sling slid and failed, are reconstructed from the other witnesses and the physical evidence and are identified as inference where relevant.*

2. Executive Summary

Two companies engaged as a Consortium were constructing a large combined-cycle power plant. On the day of the incident, a work group at Module 3, GT31 was erecting and bolting pre-assembled steel roof beams. A two-section beam of approximately 5.70 tonnes and 16 metres in length was being held suspended by a tower crane at a working height of about 17.5 metres while two fixers in a MEWP basket prepared to bolt it into its final position. The lifting plan required the basket to approach the beam from the side and expressly prohibited it from being positioned beneath the suspended load. Instead, the basket was positioned directly underneath the beam and was being raised towards it.

The MEWP was not being operated from the basket. It was being driven from the ground-level controls by a separate operator standing on the ground, recorded as the standard practice on the project. Ground controls are provided for emergency recovery of the platform, not for routine positioning of an occupied basket. The ground operator continued to raise the basket towards the descending beam until the moment the first sling was heard to snap, accompanied by the sound of the basket handrail steel cracking under the load.

As the basket pressed up and the crane simultaneously lowered the load, tension was lost in the slings; the rigging — a simple wrap around the beam, not a choke, and without protection against the beam's sharp edges — slid along the steel and the first sling failed. The beam came to rest on, and then broke through, the basket handrails, fatally crushing Fixer 1 against the basket controls. The entire load then transferred to the single remaining sling on the heavier section, which became overloaded as the beam swung towards its centre of gravity and also failed. The beam fell approximately 17.5 metres to the ground. Fixer 2 freed himself and climbed onto adjacent steelwork; the site physician pronounced Fixer 1 dead a short time later.

2.1 Principal Conclusion

Root cause. *The fatality resulted from the coincidence of two failures, neither of which alone would likely have killed: a person was placed and held in the line of fire beneath a suspended load, and the load was then released by a rigging and sling failure. The single most important barrier — keeping people out from under suspended loads — was absent. Operation of the MEWP from the ground (emergency) controls placed control with a remote operator who could neither perceive nor arrest the entrapment; an unchoked, unprotected sling wrap provided the load-release mechanism; and the converging motions of a lowering crane and a rising basket were neither sequenced nor under single command. Compounding these, the slings were of unproven conformity — Chinese-manufactured, no CE or Kitemark, no valid Declaration of Conformity — so their marked capacity could not be relied upon. The dominant failures are systemic, sitting in the planning, supervision and procurement systems above the individuals.*

2.2 Summary of Findings

Domain	Key finding
Line of fire	A person was positioned and held in a MEWP basket directly beneath the suspended load, contrary to the lifting plan's no-load-overhead rule.
MEWP operation	Occupied basket operated routinely from the ground (emergency) controls; the remote operator continued raising it into the beam until the first sling snapped.
Rigging method	A simple unchoked wrap with a bow shackle and no edge protection; the slings slid along the beam and were cut on sharp steel edges once tension was lost.
Simultaneous operations	A lowering crane and a rising basket converged with no sequencing, no hold-point and no single-point command.
Sling conformity	Chinese-manufactured slings, no CE/Kitemark, no valid Declaration of Conformity — only an A5 “factory test” sheet; conformity unproven.
Sling capacity	Government tests failed at 11.6 t and 13.3 t against an implied ~35 t minimum break force — true capacity far below the 5 t WLL marking.
Communication	Conflicting accounts (radio vs hand signal); no single mandated protocol and ambiguous authority to stop the lift.
What worked	Hard barricading kept others clear; a pre-positioned rescue MEWP and prompt medical response enabled recovery of both workers.

The principal established facts are summarised below.

Item	Established fact
What happened	A suspended two-section steel roof beam fell ~17.5 m after the sequential failure of both slings; a worker in the MEWP basket beneath it was fatally crushed.
Consequence	One fatality (Fixer 1); one minor injury (Fixer 2).
The load	Two-section bolted roof beam — Beam A 3.529 t + Beam B 2.172 t = 5.701 t; approx. 16 m long.
Lifting equipment	Tower crane (third-party certified, no issues); two 6 m nylon slings marked 5 t WLL each (EN 1492-1, 7:1 factor).
Rigging method	Simple single wrap with a bow shackle — not a choke hitch; no edge protection against the beam's sharp edges.
MEWP operation	Operated from ground (emergency) controls as routine; basket positioned beneath the load and raised towards it until the first sling snapped.

Item	Established fact
Primary breach	A person was positioned and held in the line of fire beneath a suspended load, contrary to the lifting plan.
Equipment integrity	Slings non-conforming; government test failures at 11.6 t and 13.3 t against an implied ~35 t; capacity unreliable.
Local statutory outcome	Civil police investigation — no charges, no criminal intent. Labour Office — accident, no party to blame.

3. Background & Context

3.1 The Project

The facility is a large multi-unit combined-cycle power plant which, at the time of the incident, was under construction. Two companies were engaged as a Consortium to deliver the works. The work group at Module 3, GT31 comprised a supervisor, two steel fixers, two riggers, a tower crane operator, a MEWP operator and two standby emergency-response personnel. The task was the erection and bolting of pre-assembled steel roof beams into their final positions at height.

3.2 The Lifting Arrangement

The roof beam was a two-section unit, pre-assembled and bolted together at ground level, and was attached to the tower crane hook by two 6-metre nylon slings and a bow shackle. The crane lifted the beam and held it suspended at a working height of approximately 17.5 metres while the steel-fixing crew, working from a MEWP basket, prepared to bolt it into position. A second MEWP was correctly positioned to one side as the dedicated rescue-from-height platform.

3.3 The Equipment

The tower crane had been third-party certified shortly before the incident with no issues recorded, and the morning pre-start inspection found no defects. The two nylon slings carried tags indicating EN 1492-1, a 5-tonne working load limit and a 7:1 design factor, and were in date against the project inspection regime. As discussed in Section 6, however, the slings could not be shown to conform to the marking they carried — a critical point at which a non-conforming lifting accessory entered service and was never caught.

3.4 The Deceased

Role	Steel fixer (referred to throughout as Fixer 1), standing inside the MEWP basket at the time of the incident
Position at time	At the basket controls, a second fixer (Fixer 2) was kneeling in the same basket collecting bolts
Competency status	Competencies assessed through the HR process; had received the site-specific induction
Treatment in report	Out of respect for the deceased and his family, he is not named; individuals are referred to by role only

4. Sequence of Events

The following narrative is reconstructed from witness statements and the physical evidence. The mechanism of sling slide and failure, and the operation of the platform from the ground, are reconstructed as noted in Section 1.3. All persons are referred to by role only.

4.1 Incident Timeline

Time	Event
08:00	Work pre-start: pre-task risk briefing completed, and equipment checks carried out.
09:00	Task commences — beam rigged and lifted towards position at GT31.
~11:45	Beam held suspended at approx. 17.5 m; MEWP basket moves into position to bolt the beam.
~11:48	Incident: basket beneath and rising into the lowering beam; beam contacts basket; first sling slides and fails (snap heard) as the handrail cracks; beam crushes Fixer 1; load transfers; second sling fails; beam falls approx. 17.5 m.
11:50	Emergency response commences; senior HSE on site as first responder.
11:51	Site clinic receives emergency call; ambulance and nurse dispatched, physician attends.
12:15	Site physician pronounces death of Fixer 1; body directed to the governmental hospital mortuary.
13:00	Labour office informed; police informed.
13:30 – 18:00	Consortium management meeting: investigation team appointed; fact-collection commences; initial notification submitted.

4.2 Reconstructed Failure Sequence

The physical evidence and witness accounts converge on the following ordered sequence:

- The MEWP basket was positioned beneath the suspended beam and raised towards it from the ground controls, while the crane was lowering the beam the final distance — two converging motions controlled by two different people, neither commanding the other.
- The beam contacted the top of the basket; the upward reaction of the rising basket against the descending beam reduced the tension in the slings.
- With tension lost, the unchoked, unprotected slings slid along the beam, the loaded webbing abrading against the sharp steel edges; the first sling failed.
- The ground operator continued raising the basket until the first sling was heard to snap, coincident with the basket handrail steel cracking under the beam; the beam settled onto and through the handrails, crushing Fixer 1 against the controls.
- The full load transferred to the single remaining sling on the heavier section; the beam swung towards its centre of gravity, driving the basket and arm down and striking a girder.
- Fixer 2 stripped out of his harness and climbed clear onto adjacent steel.

- The overloaded second sling failed; the beam fell approximately 17.5 m to the ground. The failure sequence elapsed over an estimated 60–90 seconds.

Consistency of the evidence. *One rigger reported hearing three distinct sounds in sequence — a crushing metallic sound, then steel-on-steel, then an impact on concrete — matching the reconstructed sequence (basket crush, beam-on-girder, ground impact). The crane operator independently reported feeling no abnormal crane movement until the first sling snapped, then felt the jib move as the second sling failed seconds later. The coincidence of the snap of the first sling with the cracking of the handrail steel confirms that the basket was being driven up against the beam at the moment the rigging let go. These independent accounts corroborate the reconstruction.*

5. Nature of the Injuries

The clinical findings are material to the severity of the hazard and to the inadequacy of the controls protecting the worker beneath the load.

Finding	Description
Mechanism	Crush injury from a suspended ~5.70 t beam bearing down on and through the MEWP basket handrails onto the occupant.
Fixer 1 (deceased)	On examination: no carotid pulse, no spontaneous respiration, fixed and non-reacting dilated pupils, absent corneal reflex, no response to pressure, no circulation.
Principal trauma	Catastrophic abdominal trauma consistent with a severe crushing mechanism; death pronounced by the senior site physician at 12:15 hrs.
Fixer 2 (survivor)	Minor injuries only; freed himself from his harness and climbed clear onto adjacent steelwork before the beam fell.

Engineering significance of the injury pattern. *The crushing mechanism is consistent with a person held in the line of fire of a suspended load that was then released. No personal protective equipment can protect against a multi-tonne load bearing onto an occupied platform; the only effective barrier is to ensure that no person is positioned beneath a suspended load. The fatal trauma to Fixer 1 and the escape of Fixer 2 — who was able to climb clear in the seconds before the final fall — together underline that the decisive control is positional (keeping people out from under the load), not protective.*

6. Technical & Engineering Findings

6.1 The Load

The roof beam consisted of two sections pre-assembled and bolted at ground level. The combined mass was within the crane's capacity and within the marked rated capacity of the rigging.

Component	Mass	Note
Beam A	3.529 t	Heavier section
Beam B	2.172 t	Lighter section
Total assembled load	**5.701 t**	**Approx. 16 m long**

6.2 Rigging & Slinging — the Critical Technical Failure

The beam was attached to the hook by two 6-metre nylon slings and a bow shackle, arranged as a simple wrap around each lifting point. It was not a choke hitch, and no effective edge protection was fitted where the slings bore on the steel. The corrected facts differ materially from the original report, which had described a single-choke configuration with nylon packing; that description was wrong, and the difference is central to the failure.

Why an unchoked wrap and absent edge protection were decisive. *A choke (reeved) hitch tightens onto the load as tension is applied and grips it, resisting any tendency of the sling to slide along the member. A simple wrap relies only on geometry and continuous tension to stay in place; it provides no positive grip. When the rising basket contacted the descending beam and momentarily relieved the tension, there was nothing to stop the slings migrating along the beam. Soft nylon slings are highly vulnerable to cutting where they pass over the sharp arris of structural steel. Recognised practice requires the sling to be protected from any cutting edge over the whole contact length and throughout any movement. Here the slings were not adequately protected; once the wrap began to slide under partial load, the webbing was abraded and cut, and the first sling failed.*

The slinging arrangement was assessed against recognised good practice, in particular the LEEA codes of practice for the safe use of lifting equipment and for the selection and use of slings. The principal departures were:

Good-practice requirement (LEEA / EN)	What was found
Select a hitch appropriate to the load; use a choke or double-choke to secure long/asymmetric members against sliding.	A simple single wrap was used; the slings were free to slide once tension was lost.
Protect soft slings from sharp edges over the full bearing length and through any movement, using adequate corner protection.	No effective edge protection: the original report's “packing” was absent or inadequate on the failed leg.
Maintain sling tension and control the load through the lift; avoid relieving tension while personnel are exposed.	Tension was deliberately relieved by raising the basket up into the load while the crane lowered.

Good-practice requirement (LEEA / EN)	What was found
Verify capacity, marking, conformity (CE/UKCA, valid Declaration of Conformity) and suitability before use; reject unverified imports and A5 “test” sheets.	Slings were tag-marked 5 t WLL (EN 1492-1, 7:1) but had no CE/Kitemark and no valid Declaration of Conformity; conformity unproven and capacity later shown unreliable.
Use a competent slinger and ensure the lift is planned and supervised by a competent appointed person.	The technique applied was incorrect for the load, indicating a competence and supervision gap.

6.3 MEWP — Operation from Ground Controls

The MEWP carried two workers: Fixer 1 at the basket controls and Fixer 2 kneeling to collect bolts. There is no evidence of mechanical MEWP failure prior to the incident. The condition of the knuckle boom, pin housing and hydraulic arm is consistent with a downward force applied to the top of the basket — the descending beam — and the cracked handrail is consistent with the beam bearing down on it.

Ground controls are for emergency use, not routine operation. *A MEWP has two sets of controls. The upper (basket) controls are the normal means of operating the machine: the operator stands in the basket, moves with it, and has the immediate first-person sight-line and feel needed to position the platform safely and stop instantly. The lower (ground) controls are provided for emergency recovery — principally to lower a basket whose occupant is incapacitated — and for testing and maintenance. They are not intended for routine positioning of an occupied basket during production work. On this project, operating the MEWP from the ground controls was recorded as standard practice. That practice is contrary to the design intent of the machine, to the manufacturer's instructions for use, and to recognised guidance, and is a fundamental defect in the safe system of work. Because the platform was driven from the ground, the person controlling its motion was remote from the basket, looking up at a converging beam and basket from an oblique position, without the occupants' close view of the contact or their immediate feel for the movement. The ground operator continued to raise the basket into the beam until the first sling snapped. Had the platform been operated from the basket — or had the operation simply stopped short of the load as the plan required — the entrapment would in all likelihood have been perceived and arrested before the slings were unloaded and slid.*

6.4 Sling Conformity & Testing

Beyond the slinging technique, the investigation established a more fundamental concern: the conformity of the slings could not be substantiated by valid documentation. The slings were manufactured in China and bore no CE marking and no Kitemark. No Declaration of Conformity was provided. The only supporting paperwork was a single A5 document presented as a factory test certificate. After the failure, slings from the same batch were sent for independent tensile testing, revealing a significant and unresolved discrepancy:

Source	Result	Status
Government facility — sling 1	Failed at 13.3 t	Preliminary; written report inconclusive
Government facility — sling 2	Failed at 11.6 t	Preliminary; written report inconclusive
Manufacturer destructive-test certificate	Peak ~35 t	Certificate supplied with the batch
Discrepancy	**~20 t**	**Unresolved — quality verification required**

Why the documentation was invalid. *A valid Declaration of Conformity for a textile lifting sling must identify the manufacturer, the unique serial numbers of those exact slings, the specific standard against which they were made (for example BS EN 1492-1), and a legal signature from the responsible person. A generic A5 flyer or an unverified "factory test report" meets none of these requirements. Compliant textile slings are engineered to a strict 7:1 safety factor, so a 5-t working load limit corresponds to a minimum break force of the order of 35-t. Unbranded or unverified imports frequently lack the quality control that underpins that factor, meaning the actual breaking point may be far lower than marked. The government tensile results (failures at 11.6-t and 13.3-t against an implied ~35-t) are consistent with a sling whose true safety factor was a small fraction of the assumed 7:1 — precisely the failure mode that conformity assurance is intended to prevent. The procurement and goods-inwards controls that should have rejected non-conforming accessories before they reached site did not do so. Even so, a fully compliant sling would likely also have failed once it began sliding across an unprotected sharp edge under partial load — so sling non-conformity is a serious contributing cause, not the sole or primary cause.*

6.5 Tower Crane & Steel-Fixing Activity

The tower crane was third-party certified shortly before the incident with no issues recorded, and the pre-start inspection recorded no defects. The crane operator reported no abnormal crane behaviour until the first sling snapped, then felt the jib move as the second sling failed seconds later; he was questioned and released without charge. No evidence was found that the crane caused or contributed to the failure. Its continued, controlled lowering did, however, form one of the two converging motions that should have been sequenced and commanded as a single operation. Bolting of the beam had not commenced, the chain block in the basket was not in use and no tagline was being worked, so no additional applied force other than the converging crane and MEWP motions acted on the beam at the moment of contact.

7. Procedural & Human-Factors Findings

7.1 Lifting Plan & the Line-of-Fire Rule

The lifting plan and risk assessment required the two fixers to approach in the MEWP basket from the side of the beam, with the basket never positioned beneath the suspended load. In the event, the basket was positioned directly underneath the beam and was being raised towards it. The “no load overhead” rule existed on paper but was not enforced by any hold-point, and no independent spotter verified the basket position before the approach. The investigation concludes that the decisive barrier — keeping a person out from under a suspended load — was absent in practice.

7.2 Simultaneous Operations & Command

The crane was lowering the beam the final distance while the basket was being raised towards it. These two converging motions were controlled by two different people, with neither commanding the other and no single appointed person holding sole authority to command and to stop the combined operation. The method did not sequence the operations or establish single-point command for the combined crane/MEWP activity.

7.3 Competence

All personnel had their competencies assessed through the HR process and had received the site-specific induction, and the crew was long-standing and experienced. Notwithstanding documented competence, the incident demonstrates that records alone did not prevent either the line-of-fire breach or the defective slinging technique. The use of an unchoked, unprotected wrap and the routine operation from ground controls indicate that the practical standard applied on the day fell short — reinforcing the need for engineered hold-points and verified practical assessment rather than reliance on individual judgement.

7.4 Communication & Authority to Stop

The crane operator and riggers communicated by handheld radio and reported no radio issues. However, the surviving fixer stated he was in radio contact with one rigger, which that rigger denied, stating that hand and verbal signals were used. The position of the ground MEWP operator within the communication chain was unclear and uncorroborated. This inconsistency indicates that no single communication protocol was mandated for the combined lift, and that the authority to stop the lift was not unambiguous and exercisable by any team member who perceived danger.

7.5 Procurement & Goods-Inwards Control

Non-conforming lifting accessories — slings with no CE or Kitemark and no valid Declaration of Conformity — were accepted into service. The procurement and goods-inwards controls that should have verified conformity (manufacturer, serial numbers, standard and responsible signature) and rejected unverified imports and generic “factory test” flyers did not operate. This is a serious systemic failing in its own right, independent of the slinging technique.

7.6 Emergency Response

The emergency response functioned promptly and broadly as planned: rapid notification, a first responder on scene within minutes, medical attendance, controlled crowd management, and use of the pre-positioned rescue MEWP, which brought Fixer 1 down to the paramedic stretcher and then recovered Fixer 2 from the steelwork. The hard barricading kept others clear of the drop zone and prevented additional casualties. These response strengths limited the harm but did not, and could not, prevent the fatal contact.

8. Root-Cause Analysis

8.1 Analytical Approach

Given the severity of the outcome, the causation was examined using four complementary, internationally recognised techniques rather than a single method. Each looks at the event from a different angle, and the findings are triangulated so that no causal branch is overlooked, and no single method's blind spot determines the conclusion:

- **Barrier analysis —** identifies each control that was intended to prevent the harm or limit its consequences, and records whether it was present, effective, degraded or absent at the moment of the incident.
- **Bow-tie analysis —** places the single hazardous top event at the centre, maps the threats that could release it (left side) and the consequences that follow (right side), and arranges the preventive and mitigative barriers across each pathway.
- **TapRooT-style causal / root-cause tree —** traces each causal factor down through its human-performance and management-system origins, distinguishing the causal factor, its near-root cause and its systemic root cause.
- **Fault Tree Analysis (FTA) —** decomposes the top event through Boolean logic gates (AND / OR) to the basic events, making explicit which failures had to occur together and which were individually sufficient.

The four methods converge on the same conclusion, set out in Section 8.6. The analysis is benchmarked throughout against the UK/EU legal framework and codes of practice in Section 11.

8.2 Barrier Analysis

Each barrier that should have prevented the fatal contact or limited its consequences is listed below with its status at the moment of the incident and the reason for that status. The barriers are ordered from the earliest opportunity to prevent the event through to consequence-mitigation.

#	Intended barrier	Status	Why it failed / held
1	“No load overhead” rule in the lifting plan (keep people from under the load).	**FAILED**	Present on paper but not enforced; the basket was positioned and raised directly beneath the suspended beam.
2	Independent spotter / pre-lift hold-point to verify basket position before approach.	**ABSENT**	No hold-point existed, and no independent spotter verified the position before the basket approached the load.
3	Operation of the MEWP from the basket controls, keeping control with the occupants.	**ABSENT**	The platform was driven from the ground (emergency) controls as routine; the remote operator could not perceive or arrest the entrapment.

#	Intended barrier	Status	Why it failed / held
4	Single-point command and sequencing of the combined crane / MEWP operation.	**FAILED**	Two converging motions (crane lowering, basket rising) were controlled by two people, neither commanding the other.
5	Correct, secured, edge-protected rigging (choke hitch with corner protection).	**FAILED**	An unchoked simple wrap with no edge protection slid and was cut on the sharp steel arris once tension was lost.
6	Sling rated capacity with a verified 7:1 safety factor.	**UNRELIABLE**	No CE/Kitemark and no valid Declaration of Conformity; true capacity (gov. test 11.6–13.3 t) far below the implied ~35 t.
7	Authority to stop the lift, exercisable by any team member who perceives danger.	**DEGRADED**	Stop authority was ambiguous and no single communication protocol was mandated; the raise continued until the sling snapped.
8	Barricaded drop zone to exclude other personnel.	**EFFECTIVE**	Hard barricading kept others clear and prevented additional casualties.
9	Pre-positioned rescue MEWP and prompt medical response.	**EFFECTIVE**	The standby platform recovered both workers and medical attendance was rapid; consequence-mitigation worked.

Barrier analysis — finding. *Of the nine barriers, only the last three (the barricade, the rescue platform and the prompt response) functioned as intended, and those are consequence-mitigating barriers — they limited the harm but could not prevent the fatal contact. Every preventive barrier that stood between the work group and the fatality had failed, was absent, or was degraded before the engineer was ever placed beneath the load. A single restored preventive barrier — an enforced hold-point, basket-control operation, single-point command, or correct edge-protected rigging — would most likely have broken the sequence.*

8.3 Bow-Tie Analysis

The bow-tie places the hazardous top event at the centre. On the left are the threats that could release it and the preventive barriers that should have stopped each threat; on the right are the consequences and the mitigative barriers that should have limited them. The status of each barrier (from Section 8.2) is shown in brackets.

Threats & preventive barriers (left side)	Consequences & mitigative barriers (right side)
Hazard: a suspended ~5.70-t beam at ~17.5 m with people working at height beneath it.	**Consequence 1 — worker crushed in the basket.**

Threats & preventive barriers (left side)	Consequences & mitigative barriers (right side)
Top event: uncontrolled release of / contact with the suspended load over a person. **Threat 1 — person beneath the load.** • Preventive: no-load-overhead rule [FAILED]; spotter / hold-point [ABSENT]. **Threat 2 — basket driven into the load.** • Preventive: basket-control operation [ABSENT]; single-point command & sequencing [FAILED]. **Threat 3 — rigging releases the load.** • Preventive: correct edge-protected hitch [FAILED]; conforming, verified slings [UNRELIABLE].	• Mitigative: stop authority to arrest the raise [DEGRADED] — did not prevent contact. **Consequence 2 — falling beam strikes others.** • Mitigative: barricaded drop zone [EFFECTIVE] — no additional casualties. **Consequence 3 — delayed or failed rescue.** • Mitigative: pre-positioned rescue MEWP [EFFECTIVE]; prompt medical response [EFFECTIVE] — both workers recovered.

Bow-tie — finding. *All three preventive pathways on the left of the bow-tie were breached: a person was under the load, the basket was driven into the load, and the rigging released the load. The right side held in part — the barricade and rescue arrangements contained the consequences and saved the second worker — but mitigative barriers cannot substitute for the preventive ones. The bow-tie shows visually that the defences clustered on the consequence side of the event, while the preventive side, which is where a fatality of this kind must be stopped, was effectively open.*

8.4 TapRooT™-style Causal & Root-Cause Tree

Each causal factor identified from the reconstructed sequence is traced below from the observed condition or action, through the near-root cause (the immediate human-performance or equipment reason), to the systemic root cause (the management-system origin which, if corrected, prevents recurrence). This mirrors the TapRooT approach of moving past “who erred” to “why the system permitted the error to cause harm.”

CF	Causal factor (observed)	Near-root cause	Systemic root cause
CF1	MEWP basket positioned directly beneath the suspended load.	No verification step before approach; reliance on individual judgement.	Work control: the no-load-overhead rule was not enforced by a hold-point or independent check.
CF2	Occupied basket operated from the ground (emergency) controls.	Routine practice contrary to the machine's design intent and instructions.	Equipment-use management: selection and use of work equipment not controlled to the manufacturer's instructions (PUWER).

CF	Causal factor (observed)	Near-root cause	Systemic root cause
CF3	Crane lowering and basket raising performed simultaneously, converging, under two controllers.	No defined sequence and no single person commanding the combined operation.	Lift planning: no procedure for simultaneous operations and no appointed-person command (LOLER, BS 7121).
CF4	Slings rigged as an unprotected simple wrap; slid when tension was lost.	Wrong hitch for the load; no edge protection fitted.	Competence & procedure for slinging: practical standard and supervision did not match recognised slinging codes (LEEA).
CF5	Sling failed below its marked capacity.	Non-conforming sling of unproven provenance accepted into service.	Procurement / goods-inwards control: no verification of CE/UKCA marking or valid Declaration of Conformity.
CF6	Unsafe position and movement not stopped before contact.	Stop authority ambiguous; ground operator continued raising.	Supervision & oversight: authority to halt the lift not unambiguous; high-risk lift insufficiently supervised.
CF7	Conflicting accounts of the communication method (radio vs hand signal).	No agreed protocol between crane, riggers, ground operator and basket crew.	Communication standard not set or not enforced for combined lifts.

8.5 Fault Tree Analysis

The fault tree decomposes the top event through logic gates to the basic events. It shows that the fatality required two independent branches to be true at the same time (an AND relationship): a mechanism that released the load, and a person positioned in the line of fire. Either branch alone would not have produced the outcome.

Branch A — load is released (OR gate)	Branch B — worker in the line of fire (AND combination)
Top event: suspended beam falls ~17.5 m and fatally strikes a worker. The two branches combine via an AND gate. • Slings rigged as a simple wrap, not choked — no grip on the load. • No edge protection — loaded webbing slid across sharp steel edges and was cut.	All of the following had to coincide to place and hold a person under the load: • MEWP basket positioned under the suspended load. • Basket raised towards the beam while the beam was still lowering.

Branch A — load is released (OR gate)	Branch B — worker in the line of fire (AND combination)
• Basket contact reduced sling tension, allowing the wrap to slide. • Sling conformity unproven; capacity unreliable (gov. test 11.6–13.3-t). • Second sling overloaded at the centre of gravity after the first failed.	• MEWP driven from ground (emergency) controls — operator remote, poor sight-line. • Raising continued until the first sling snapped — no timely arrest. • No hold-point enforcing “no load overhead”; converging motions not under single command.

Minimal cut sets. A minimal cut set is the smallest combination of basic events that, together, cause the top event:

- **Cut set 1 (primary):** {basket under the load AND raised into the lowering beam from the ground controls} AND {basket contact reduces sling tension → unchoked, unprotected sling slides and is cut → sling fails}. This is the path the evidence supports as having actually occurred.
- **Cut set 2 (contributory):** {worker under the load} AND {sling fails due to compromised integrity / overload at the centre of gravity}. This reinforces that sling reliability was a real contributor, not the sole cause.

Both cut sets share the common term “worker under the load.” Eliminating that single condition defeats every cut set simultaneously, which is why it is the highest-leverage control.

8.6 Convergence of Methods & Statement of Root Cause

The four methods agree. Barrier analysis shows every preventive barrier failed or absent; the bow-tie shows all three preventive pathways breached while only the mitigative side held; the causal/root-cause tree traces each causal factor to a management-system origin in planning, equipment-use, supervision and procurement; and the fault tree shows the fatality required both a load-release mechanism and a person in the line of fire, with “worker under the load” the common term across every cut set. The decisive, highest-leverage control common to all four analyses is the elimination of the line of fire.

Opinion as to root cause. *A worker was placed and held in the line of fire beneath a suspended load, and the load was then released by a rigging and sling failure. The unsafe condition: an occupied MEWP basket positioned and raised directly beneath a suspended beam, with the platform driven from the ground (emergency) controls by a remote operator. The unsafe mechanism: an unchoked, unprotected sling wrap that slid and was cut on sharp steel edges once the basket relieved the tension, on slings of unproven conformity whose true capacity was far below the marking. Why it reached the worker: no hold-point enforced the no-load-overhead rule; the converging crane and basket motions were neither sequenced nor under single command; and procurement controls admitted non-conforming accessories — a planning, supervision and procurement system that did not enforce the critical barriers.*

9. Contributing Factors

The factors below, grouped by category, each removed or weakened a defence. No single factor caused the death; their accumulation did.

Line of Fire / Position

- MEWP basket positioned directly beneath the suspended load, contrary to the lifting plan.
- Basket raised towards the beam while the beam was still being lowered.
- No hold-point enforcing the “no load overhead” rule and no independent spotter to verify basket position.

Equipment Use / MEWP

- Occupied basket operated routinely from the ground (emergency) controls, contrary to design intent and manufacturer's instructions.
- Remote ground operator with an inferior sight-line continued to raise the basket until the first sling snapped.

Rigging / Procurement

- Unchoked simple wrap with no positive grip on the load.
- No edge protection where the soft slings bore on sharp steel arris.
- Non-conforming slings — no CE/Kitemark, no valid Declaration of Conformity, only an A5 “factory test” sheet.
- True capacity far below the marked rating (government failures at 11.6-t and 13.3-t against an implied ~35-t).

Planning / Supervision / Communication

- Simultaneous, converging crane and basket motions neither sequenced nor under single-point command.
- Ambiguous authority to stop the lift; no protocol allowing any team member to halt it.
- Conflicting communication accounts (radio vs hand signals); no single mandated protocol.
- Reliance on documented competence without engineered hold-points or verified practical assessment.

10. System Failures by Accountable Party

Party	Where the layer failed
Consortium / Project Management	No enforced hold-point for the no-load-overhead rule; combined crane/MEWP operations not sequenced or placed under single-point command; oversight of a high-risk lift insufficient.
Site HSE / Appointed Person	Lifting plan's no-load-overhead rule not enforced in practice; no independent spotter; authority to stop the lift not unambiguous.
Lifting / Rigging Supervision	Incorrect hitch for the load (unchoked wrap), no edge protection; routine operation of an occupied MEWP from the ground controls left unchallenged.
Procurement / Quality	Non-conforming slings (no CE/Kitemark, no valid Declaration of Conformity) accepted into service; goods-inwards verification did not reject unverified imports.
Individuals	Carried out the lift with the basket under the load and an incorrect hitch — though enabled and directed by the planning, supervision and procurement failures above.

Apportionment note. *Although the immediate acts were carried out by the work group, the investigation finds individual culpability heavily mitigated. The crew worked within a system that did not enforce the no-load-overhead rule, permitted routine ground-control operation of an occupied platform, did not sequence converging motions under single command, and admitted non-conforming slings into service. The dominant failures lie with the planning, supervision, quality and procurement systems above the individuals. This report does not apportion individual blame or determine legal liability.*

11. Legal & Good-Practice Framework (UK/EU Benchmark)

The incident has been benchmarked against the framework that represents recognised good practice for lifting operations in the United Kingdom and the European Union. Where the project operates under another national jurisdiction, this framework is adopted as the duty holders' own internal standard.

11.1 Principal Legislation & Standards

Instrument	Relevance to this incident
Health and Safety at Work etc. Act 1974 (general duties); EU Framework Directive 89/391/EEC	Overarching duty to provide safe systems of work, competent supervision and adequate instruction. Engaged by the unsafe system of work and the failure to keep people from under the load.
Management of Health and Safety at Work Regulations 1999	Duty to carry out and act on a suitable and sufficient risk assessment following the principles of prevention. Engaged by the failure to control the line-of-fire and simultaneous-operations risks.
Lifting Operations and Lifting Equipment Regulations 1998 (LOLER)	Lifting operations must be planned by a competent person, supervised and carried out safely; loads must not be suspended over persons unless unavoidable and controlled; accessories must be of adequate strength, marked and thoroughly examined. Directly engaged.
Provision and Use of Work Equipment Regulations 1998 (PUWER); EU Directive 2009/104/EC	Work equipment (the MEWP) must be suitable, used only under conditions for which it is suitable, and in accordance with manufacturer's instructions. Directly engaged by routine use of the ground (emergency) controls.
Work at Height Regulations 2005	Work at height must be planned and supervised, with equipment selected and used appropriately and the risk of being struck minimised. Engaged by the MEWP operation and basket positioning.
BS 7121 (cranes); EN 280 (MEWPs)	Recognised standards for planning crane lifts and the safe use of MEWPs, including the appointed person, lift planning and control from the platform.
EN 1492-1 (textile slings)	Product and marking standard underpinning the 5-t WLL / 7:1 marking. The failed slings were tag-marked to this standard but lacked the valid Declaration of Conformity its conformity route requires.
Supply of Machinery (Safety) Regulations / Machinery Directive 2006/42/EC; CE/UKCA conformity regime	Lifting accessories placed on the market must conform, carry CE/UKCA marking and be accompanied by a valid Declaration of Conformity. Directly engaged: the slings bore no CE/Kitemark and had no valid Declaration of Conformity.

11.2 LEEA Codes of Practice & Slinging Guidance

The Lifting Equipment Engineers Association (LEEA) codes of practice for the safe use of lifting equipment and for slinging are directly relevant. The following requirements were not met:

- Plan the lift and select accessories appropriate to the load; a long, asymmetric, two-section beam requires a secured hitch (choke or double-choke), not a simple wrap.
- Protect soft slings from cutting at every point where they bear on a sharp edge, for the full bearing length and throughout any movement of the load.
- Maintain control and tension of the load throughout the lift; never bring a load down onto, or a platform up into, an occupied position beneath the load.
- Use competent slingers and a competent appointed person; verify conformity (CE/UKCA, valid Declaration of Conformity) before use and reject unbranded imports and generic “factory test” flyers.
- Establish clear, single-point communication and unambiguous authority to stop the lift, exercisable by any team member who perceives danger.

Summary legal assessment. *Measured against this framework, the operation departed from recognised good practice in five principal respects, each independently significant: a person was positioned and held beneath a suspended load; the MEWP was operated from its emergency controls for routine production work, contrary to its instructions for use; the load was slung with an incorrect, unprotected hitch contrary to slinging codes of practice; non-conforming lifting accessories with no valid Declaration of Conformity were accepted into service; and the combined crane/MEWP operation was neither properly planned and sequenced nor placed under competent single-point command. The corrective action plan is framed to close each of these gaps.*

12. Corrective Action Plan

Actions are in two parts: immediate actions taken on the day, and corrective actions targeting the root and contributing causes, ordered by the hierarchy of control with elimination of the line-of-fire hazard given priority.

12.1 Immediate Actions (taken on the day)

- GT31 accident area secured and closed to all personnel except the investigation team; site work stopped for the day.
- Local authorities (police and labour office) informed; the deceased's family contacted; investigation task force established.
- All lifting operations using nylon slings stopped pending review; the incident batch quarantined and sent for government testing; information shared with other sites.
- Tower crane withdrawn from use pending inspection; all rigging equipment, including subcontractor slings and chains, checked for certification.
- Third-party rigging trainer brought to site; rigging personnel to be reassessed (theory and practical) before resuming work.
- Workforce briefed at pre-start and via toolbox talks before any work restarted.

12.2 Corrective Actions (targeting root & contributing causes)

Priority key: P1 = critical / immediate; P2 = high; P3 = medium.

#	Corrective action	Priority	Owner / reference
1	ELIMINATE the line of fire: enforceable rule prohibiting any person or MEWP basket beneath a suspended load; mandatory pre-lift hold-point requiring positive confirmation that no one is under the load before it is moved or approached.	P1	Project HSE / Appointed Person (LOLER)
2	PROHIBIT routine operation of MEWPs from ground (emergency) controls: mandate basket-control operation by a trained occupant; restrict ground controls to emergency recovery, testing and maintenance; re-train and re-assess all MEWP operators.	P1	Plant Manager / HSE (PUWER, EN 280)
3	PROHIBIT simultaneous crane-lowering and basket-raising: define a strict sequence and appoint a single competent Appointed Person with sole authority to command and to stop the combined operation.	P1	Appointed Person / Construction Manager (LOLER, BS 7121)
4	CORRECT the slinging method: mandate a secured hitch (choke / double-choke) for long or asymmetric members and purpose-made edge protection wherever soft slings bear on steel; prohibit simple unprotected wraps for such loads.	P1	Rigging Foreman / 3rd-party trainer (LEEA COP)

#	Corrective action	Priority	Owner / reference
5	Independent spotter / banksman with explicit stop authority for every elevated suspended-load lift, obligated to halt the lift if the basket approaches under the load.	P1	HSE — competency verified
6	REJECT and replace non-conforming slings: permit only accessories carrying CE/UKCA marking and a valid Declaration of Conformity (manufacturer, serial numbers, standard, responsible signatory); reject A5 flyers at goods-inwards; quarantine the incident batch and audit all slings in service.	P1	Quality Management (EN 1492)
7	Verify competencies on site for all MEWP operators, riggers and slingers (theory + practical), focused on suspended-load awareness, slinging technique, edge protection and basket-control operation.	P2	HR / HSE / 3rd-party trainer
8	Mandate a single communication protocol (radio, with agreed hand signals as backup) for all combined lifts, including the basket crew; confirm channel and call signs at the pre-lift brief.	P2	Appointed Person
9	Revise the lift plan / method statement / risk assessment to incorporate the hold-point, basket-control operation, motion sequencing, secured edge-protected slinging, spotter and communication protocol; re-brief all crews.	P2	HSE / Engineering
10	Share the lessons and the no-load-overhead and basket-control rules across all worksites via safety alert and toolbox talks; verify uptake.	P3	Group HSE

12.3 Conditions for Resuming Lifting Operations

Lifting operations may resume only when all P1 corrective actions are verified complete, and the following conditions are met:

- Revised lift plan / method statement / risk assessment approved, incorporating the no-load-overhead hold-point, basket-control operation, motion sequencing, secured edge-protected slinging, spotter and communication protocol.
- All rigging equipment re-verified for valid CE/UKCA marking and compliant Declarations of Conformity; the incident batch and any slings lacking valid documentation removed from service and quarantined.
- MEWP operators, riggers and slingers reassessed (theory and practical) and signed off by the third-party trainer.
- Tower crane inspection completed and cleared; workforce briefed on the revised method, the line-of-fire rule and the basket-control rule.

13. Lessons Learned

- **Keeping people out from under suspended loads is the master control.** Equipment can and does fail; the only barrier that protects regardless of equipment behaviour is keeping people out of the line of fire. It must be an enforced hold-point, not a matter of individual judgement.
- **Operate occupied platforms from the basket, not the ground.** Ground controls are for emergency recovery. Routine ground-control operation removed the occupants' ability to perceive and stop their own movement and was decisive here.
- **Slinging technique is not a formality.** A simple unprotected wrap on a long, asymmetric beam allowed the slings to slide and be cut the instant tension was lost. Loads must be secured with the correct hitch and protected at every edge.
- **Simultaneous operations need one commander and a defined sequence.** Two converging motions — a lowering load and a rising basket — created the contact. Combined crane/MEWP work must be sequenced and commanded by one accountable, competent person.
- **Competent crews still need engineered barriers.** An experienced, inducted crew did not prevent the breach. Reliance on competence alone is insufficient for high-risk lifts; practical re-assessment and engineered hold-points are required.
- **Only conforming lifting accessories belong on site.** The failed slings carried no CE or Kitemark and no valid Declaration of Conformity and tested far below their marked capacity. Conformity must be proven by valid documentation before any accessory enters service.
- **Strong response capability proved its worth.** The barricade, the pre-positioned rescue MEWP and the prompt medical response limited the harm and enabled the recovery of both workers. These should be retained as standards.

14. Conclusion & Findings

The work area was established correctly, with a defined lifting zone, hard barricading and a briefed workforce; the crane was certified, and the slings were in date and marked. The barricade and the standby rescue platform performed as intended. These strengths limited the consequences but did not prevent the fatal contact.

On the evidence, this fatality was not the product of misfortune or of a single error. It resulted from the coincidence of two failures: a worker was positioned and held in the line of fire beneath a suspended load — the basket directly underneath the beam and being raised towards it from the ground controls while the crane lowered the load — and the load was then released when the basket relieved the sling tension, the unchoked, unprotected slings slid along the sharp-edged steel and failed in sequence. The fault tree, causal-factor and barrier analyses agree that neither branch alone would have caused the fatality.

Statement of cause. *Immediate cause: a suspended beam fell after the sequential failure of two slings and struck a worker positioned beneath it in a MEWP basket. Root causes: (1) a worker was in the line of fire beneath a suspended load, with no hold-point or independent*

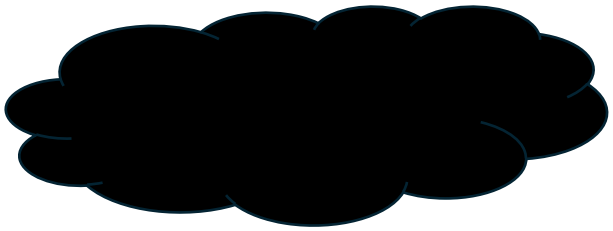
verification to prevent it; (2) the MEWP was operated from its ground (emergency) controls as routine, contrary to its design intent, so that control rested with a remote operator who could not perceive or arrest the entrapment; and (3) the simultaneous crane-lowering and basket-raising operations were neither sequenced nor under single-point command. Contributing causes: an incorrect, unprotected slinging technique that allowed the slings to slide and be cut; the use of non-conforming slings of unproven provenance whose true capacity was far below the marked rating; and the absence of a single mandated communication protocol with clear authority to stop the lift.

Closing statement. *A single working control at any layer — an enforced no-load-overhead hold-point, basket-control operation of the platform, a sequenced lift under single command, a correct edge-protected hitch, or conforming slings — would most likely have prevented this fatality. The duty now is to ensure that no person is ever positioned beneath a suspended load, that platforms carrying people are controlled by their occupants, and that no future lift is allowed to proceed with these defences simultaneously down.*

14.1 Statement of the Investigation Team

We confirm that this investigation was conducted independently and that the findings and conclusions set out in this report are our own. We have endeavoured to be accurate and complete, to set out the substance of all material evidence considered, and to distinguish clearly between fact, established finding and inference. Where the report relies on engineering analysis, that analysis was carried out with the assistance of the consulting lifting and rigging specialist. The findings remain open to revision should the outstanding government test report and police file become available.





Lead Investigator
Independent Accident Investigation Team

Date: [redacted]

Lifting & Rigging Specialist
Specialist Engineering Assistance

Date: [redacted]

End of report. Identities of company, project and individuals have been redacted in accordance with legal obligations. This report has been prepared from evidence supplied and is subject to the caveat at Section 1.3. Issued without prejudice and solely to identify causes and prevent recurrence.