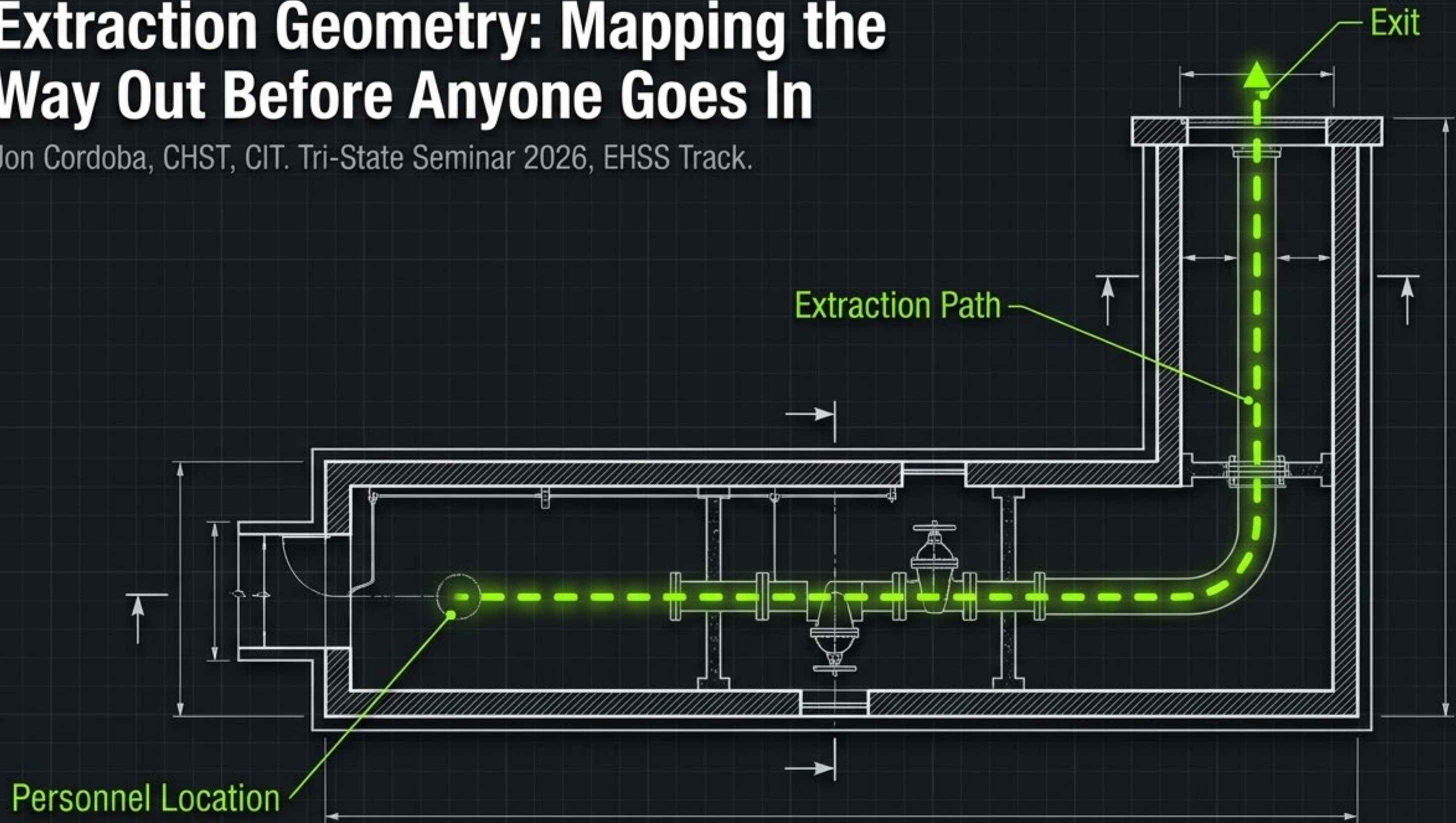


Extraction Geometry: Mapping the Way Out Before Anyone Goes In

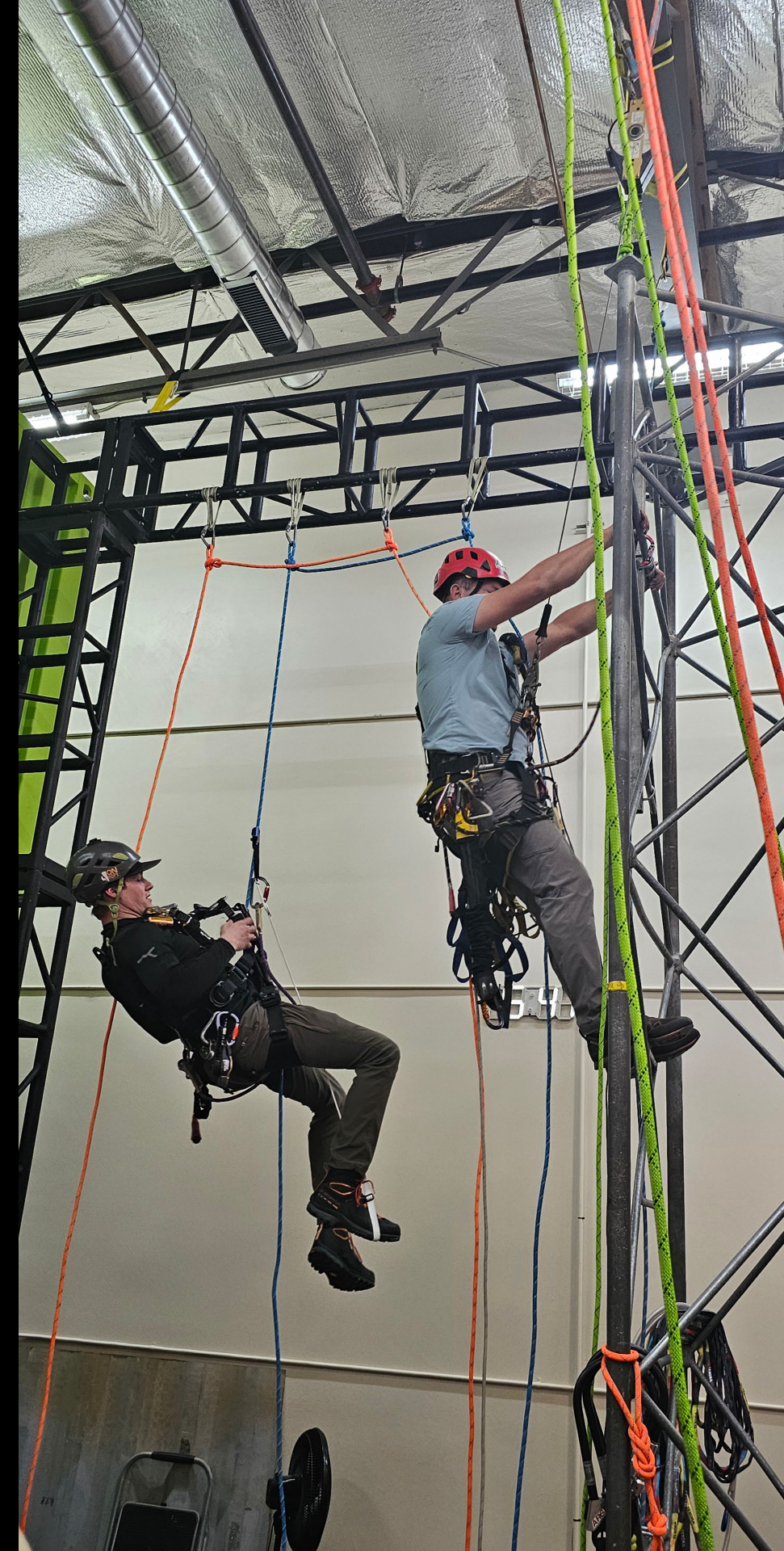
Jon Cordoba, CHST, CIT. Tri-State Seminar 2026, EHSS Track.



Who I Am



- Occupational Safety Consultant
- SPRAT Level 1 PADI Dive Instructor
- Founder, P3 Safety Solutions
- 25+ years in construction, telecom & infrastructure Safety



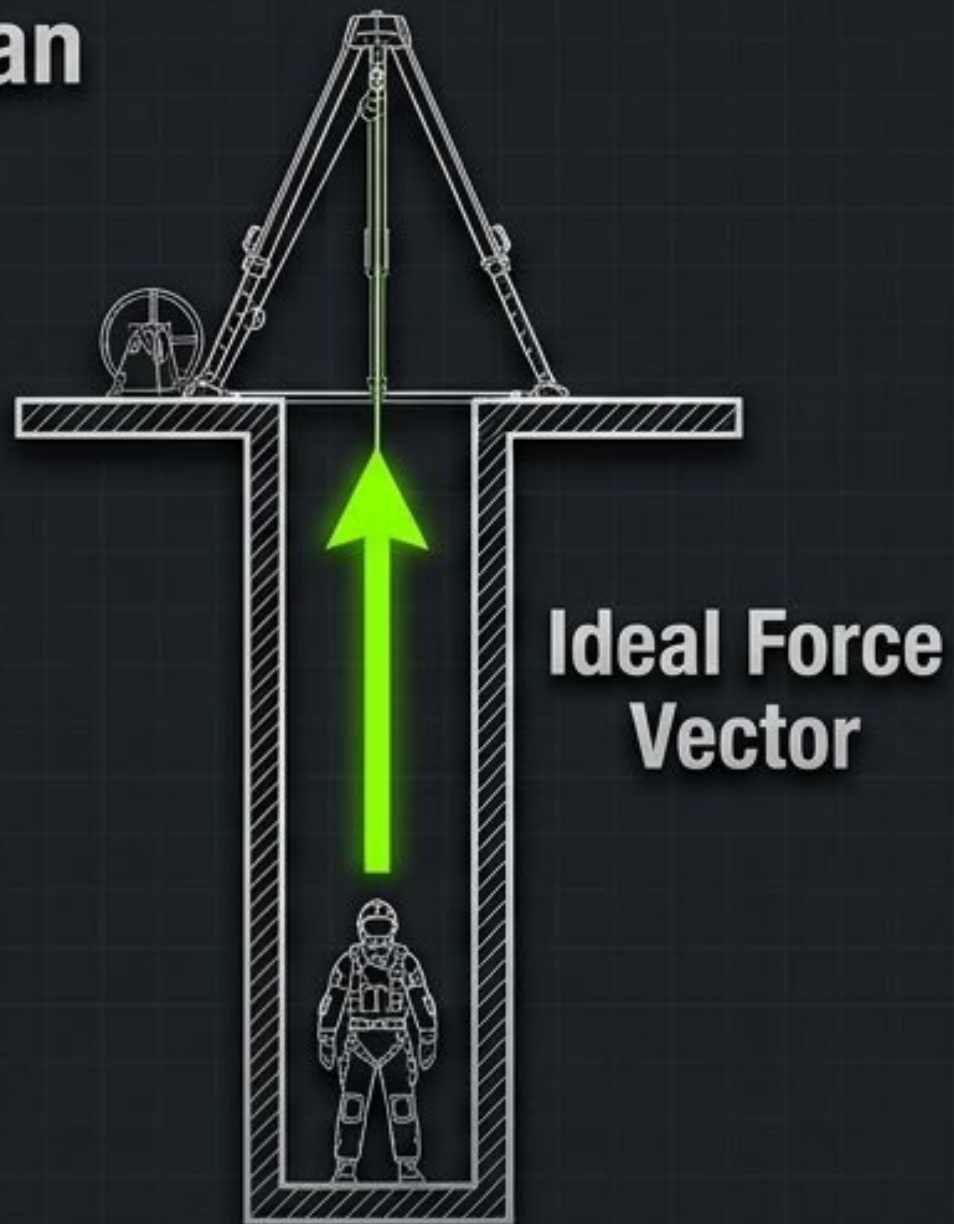
What I do

- Hands-on safety training in real-world, high-risk environments
- Focused on practical, applicable fall protection
- “Working with workers, not just writing programs.”

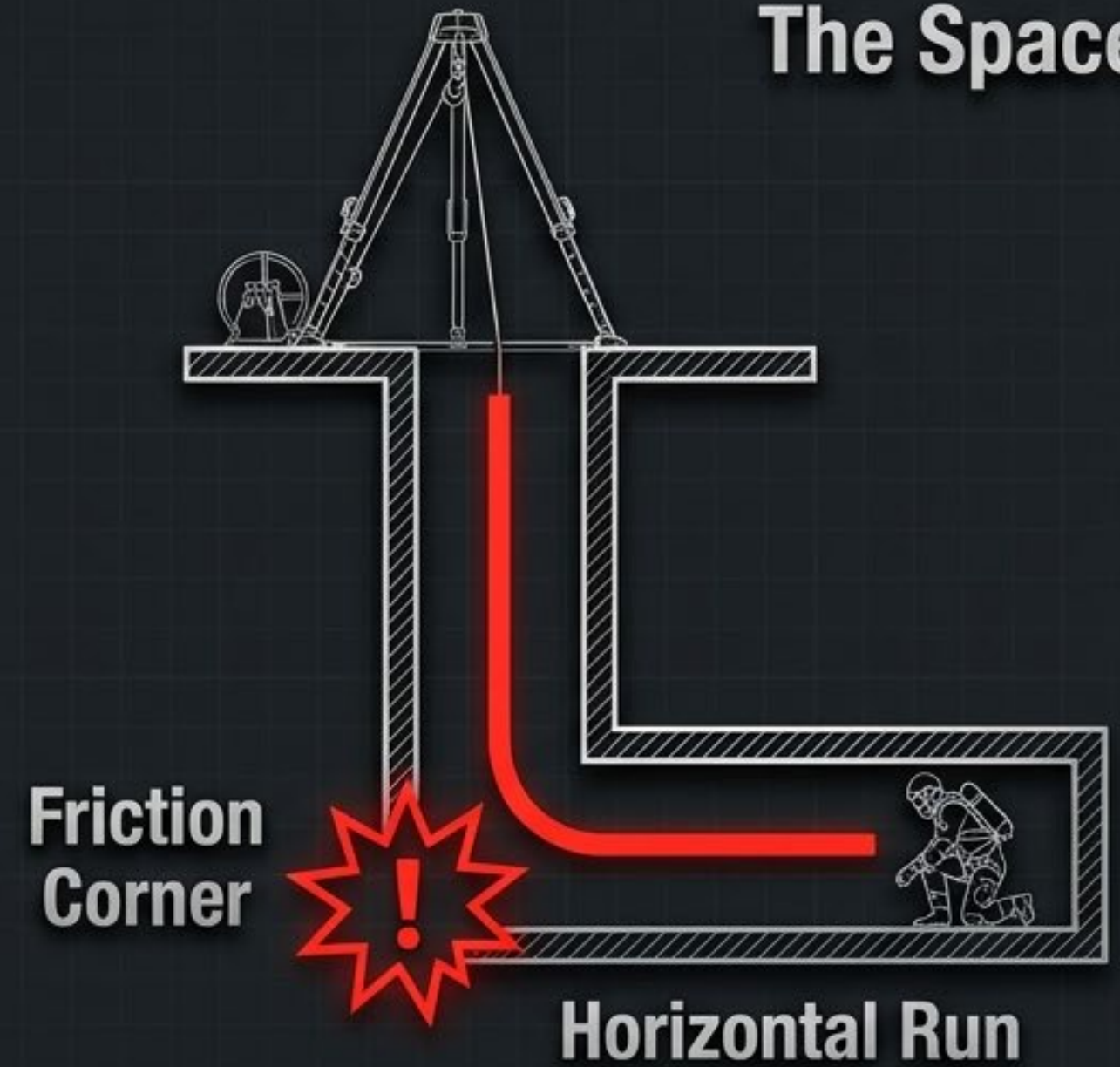


We plan the entry. We assume the exit.

The Plan



The Space



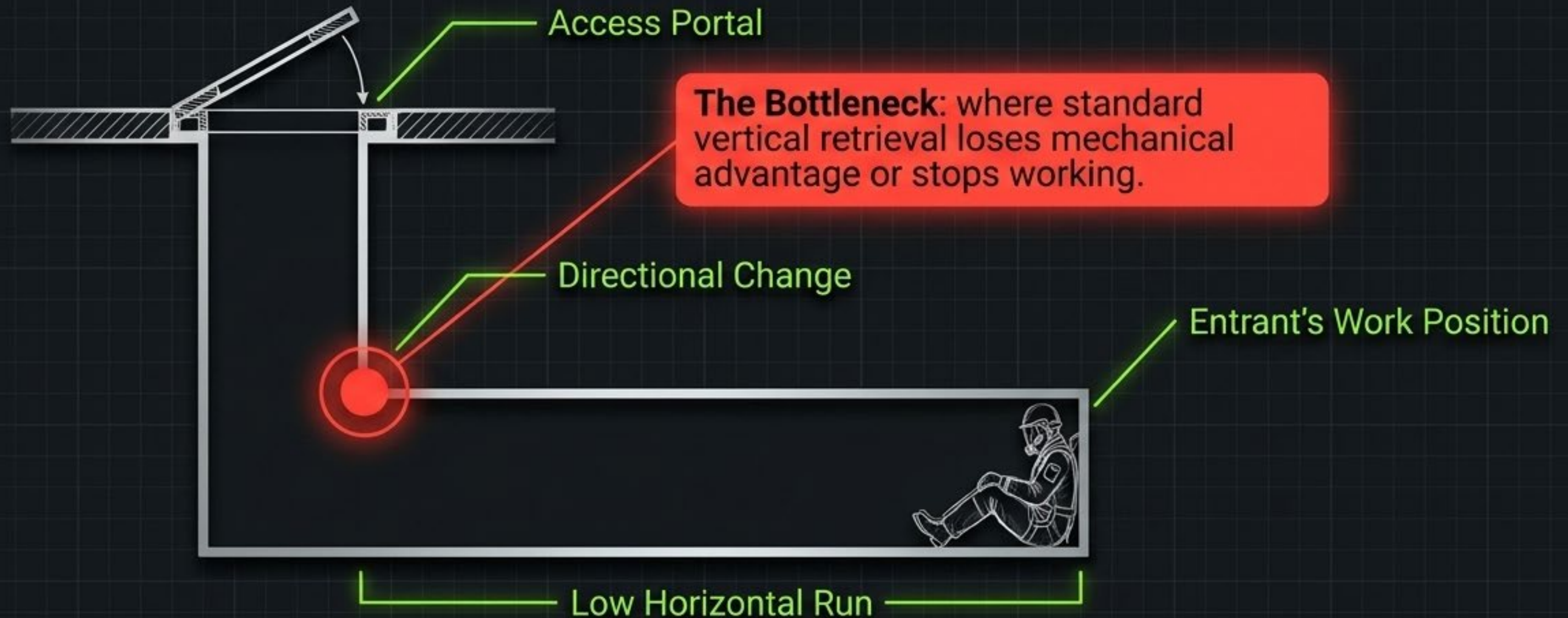
Standard retrieval assumes
a straight vertical lift.

Real permit spaces rarely
provide straight vertical access.

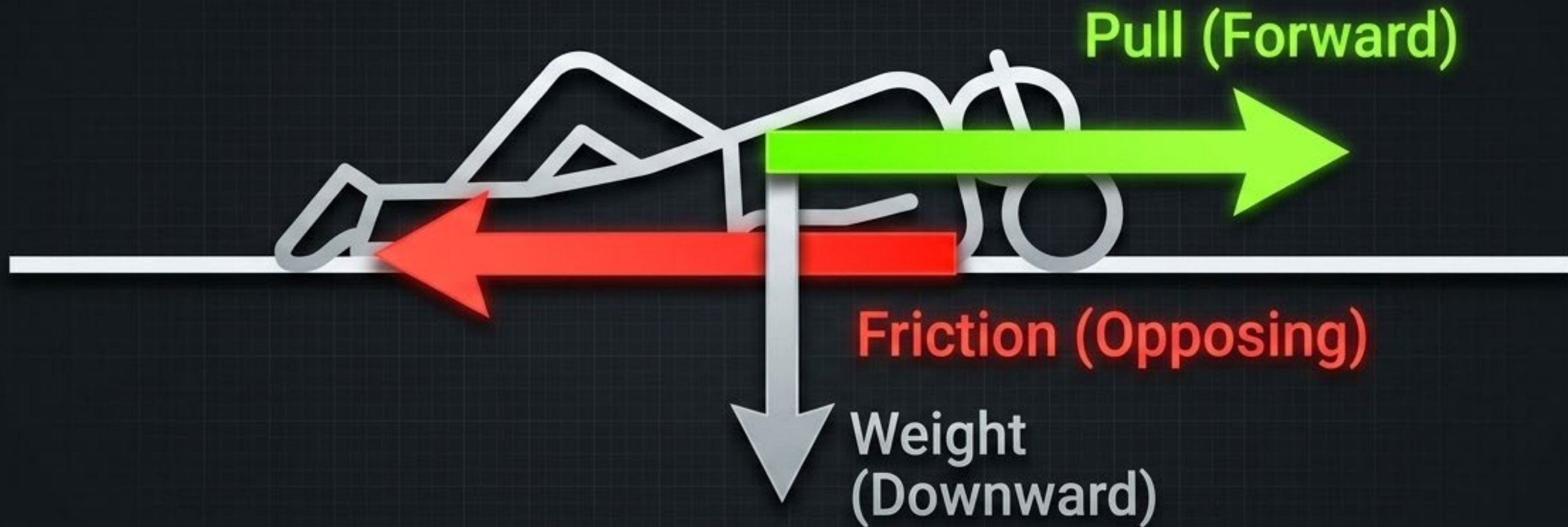
Calling the fire department
is not a retrieval plan.

Defining Extraction Geometry

The internal architecture of a confined space, evaluated for whether an incapacitated entrant can actually be removed.

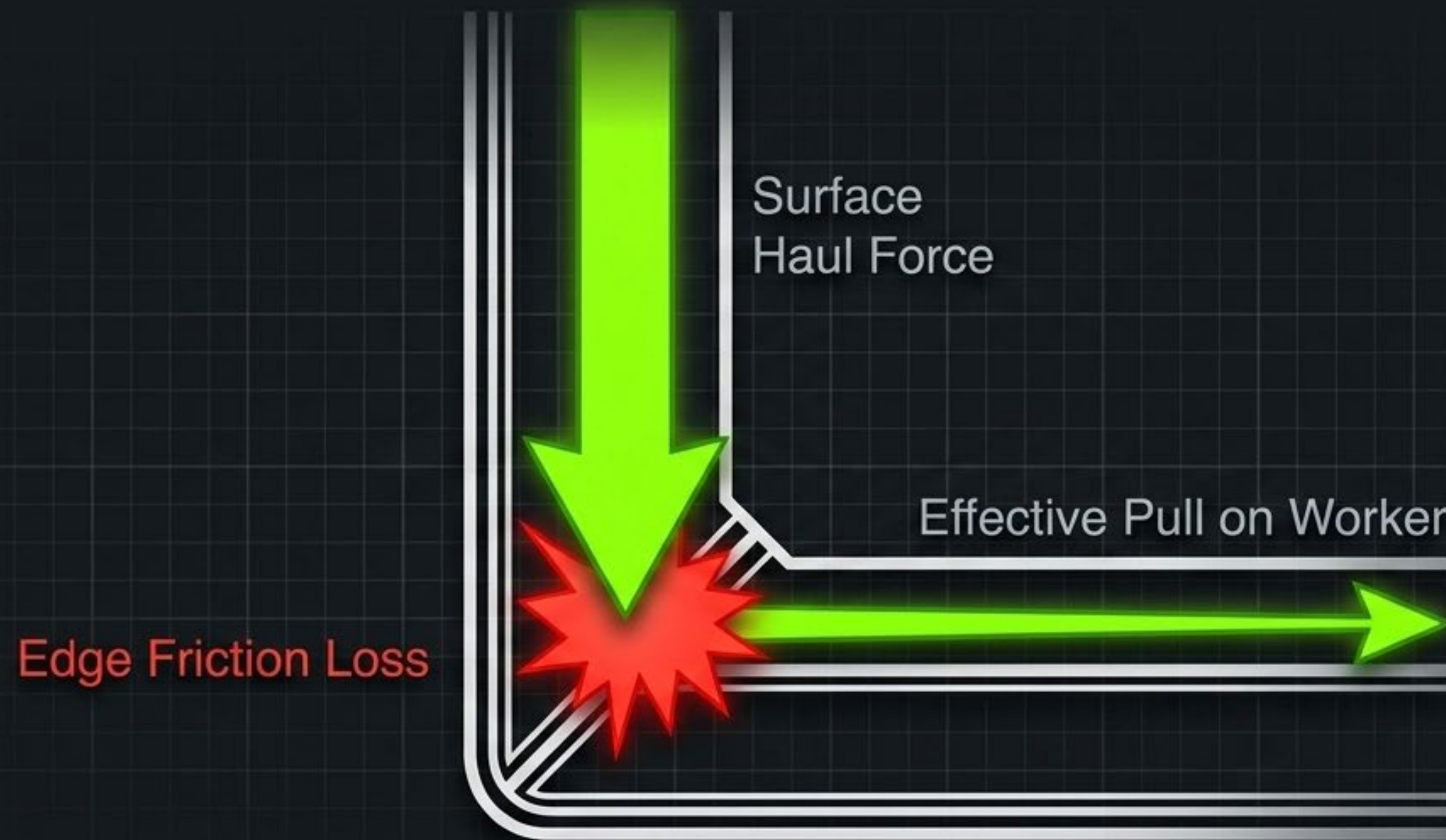


The Dead-Weight Drag



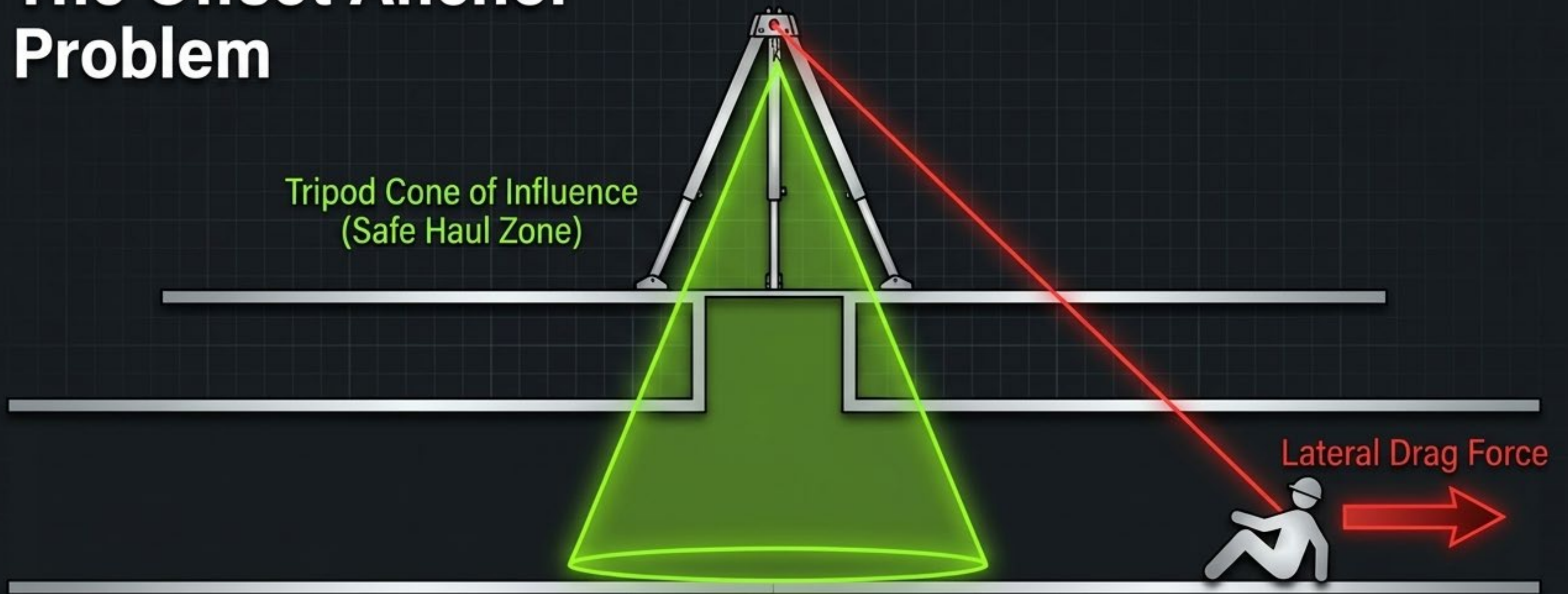
A conscious worker climbs. An incapacitated worker is a dead-weight load. Friction sets the force required, not just body weight.

The Edge Defeat



A 90-degree directional change transfers line load into the structure and collapses effective mechanical advantage.

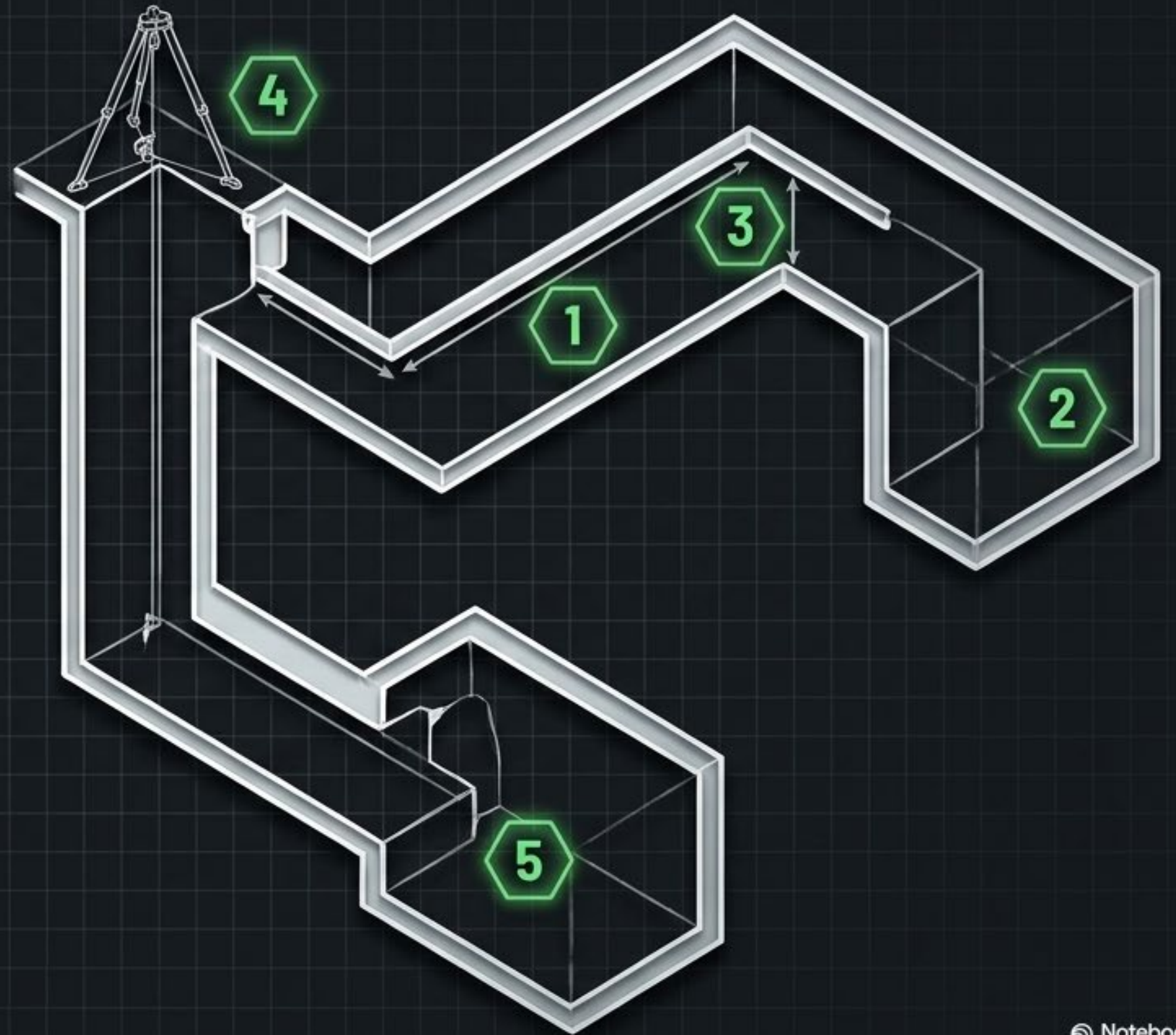
The Offset Anchor Problem



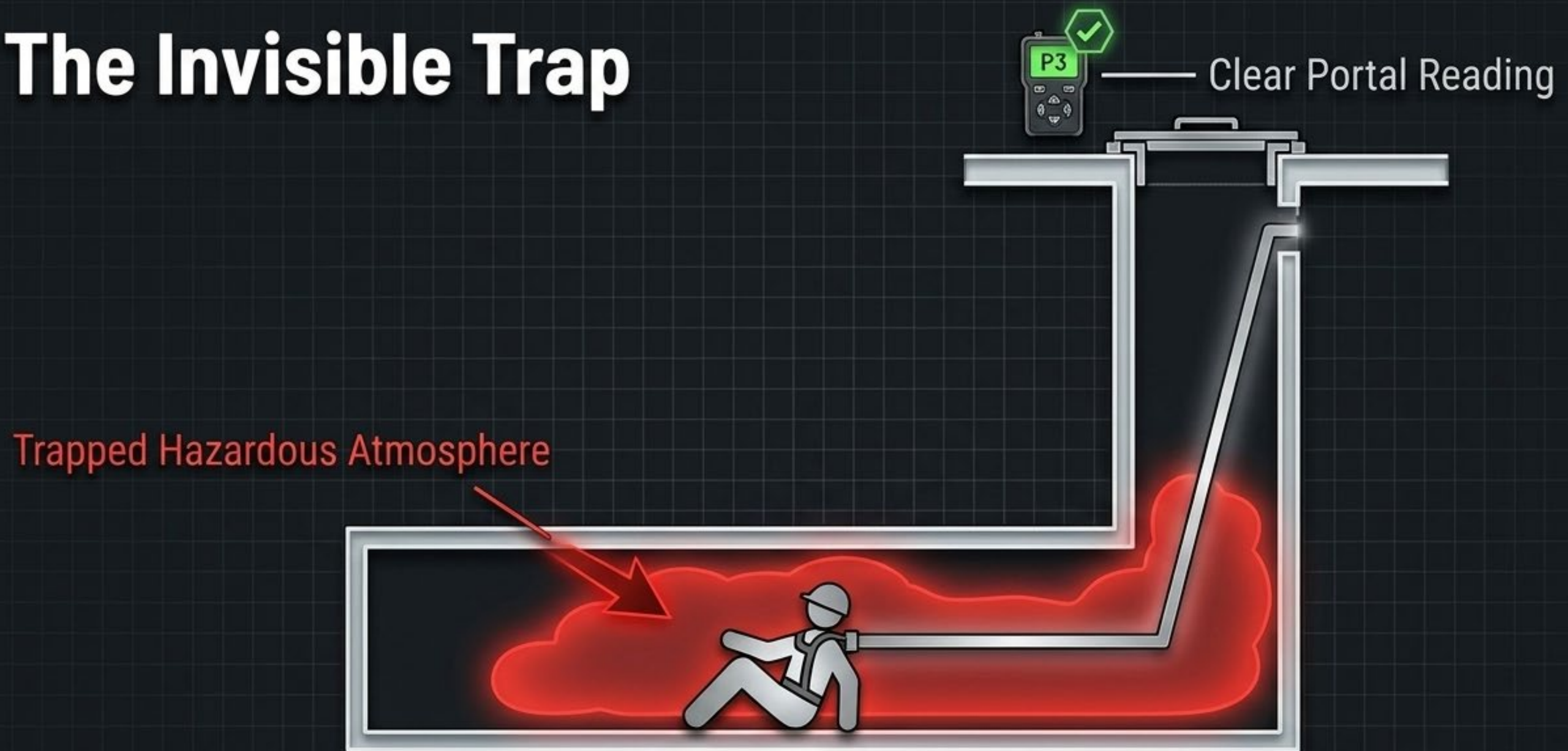
An anchor centered over the portal is compromised if the entrant is laterally offset.
The line of pull is wrong before rescue even begins.

The Five Geometry Factors

1. Horizontal Drag Distance
2. Directional Changes
3. Vertical Clearance
4. Anchor Placement
5. Atmospheric Dead-Zones



The Invisible Trap



Complex geometry traps hazardous gas in low corners and dead legs. Extraction paths pull the entrant directly through unmonitored zones.

Regulatory Reality: 1910.146(k)

What 1910.146(k) Requires

- Retrieval used whenever an entrant enters, unless it increases risk or would not aid rescue.
- A chest or full-body harness with the retrieval line attached.
- A mechanical retrieval device for vertical spaces more than 5 feet deep.

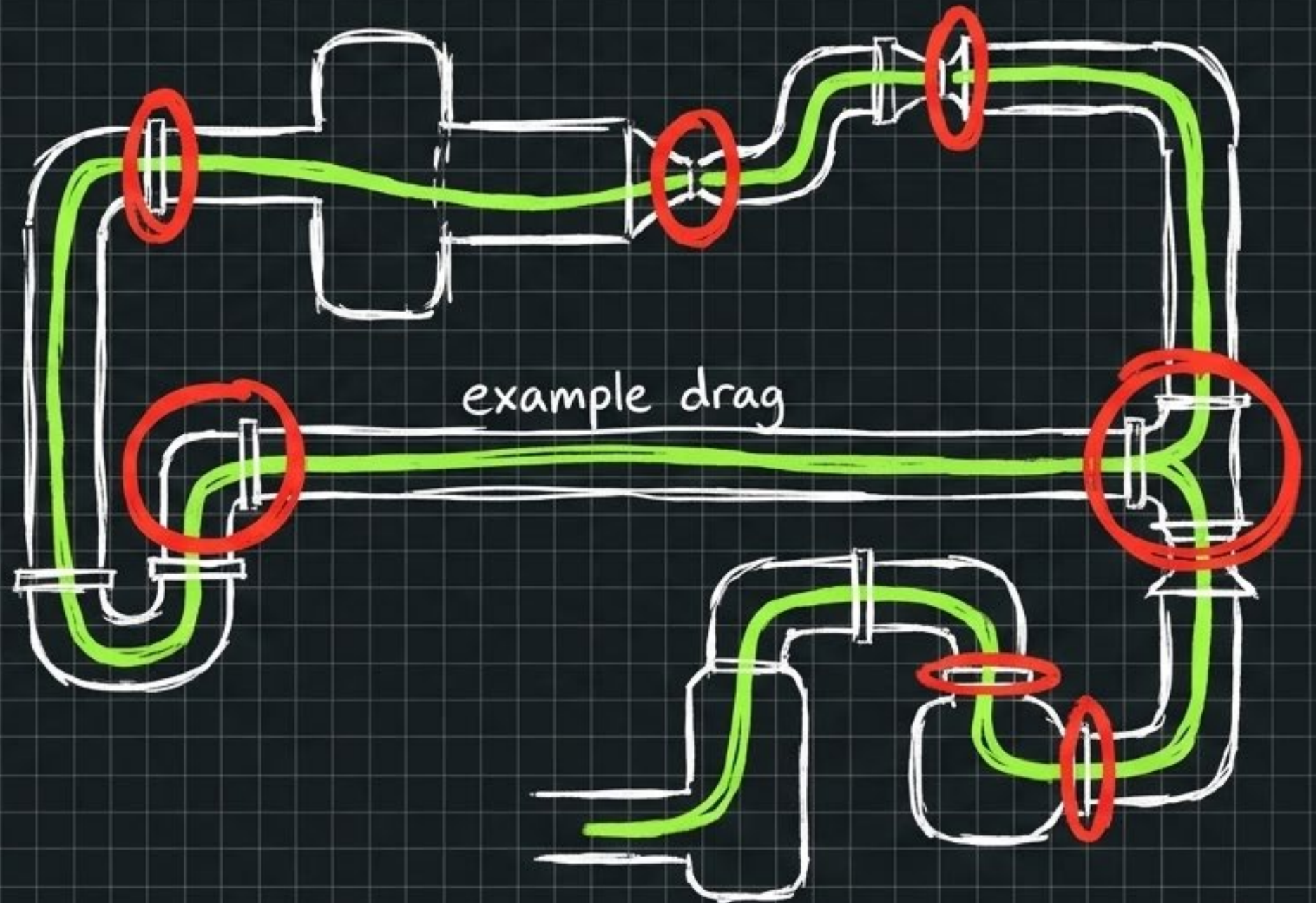
What the Standard Leaves to Your Judgment

- Evaluating directional friction loss.
- Designing horizontal haul systems.
- Deciding when standard retrieval adds risk.

Reading the Space

Pre-entry actions:

- Sketch the internal configuration.
- Measure horizontal runs and clearances.
- Locate anchor positions relative to the entrant.
- Mark the extraction bottlenecks.



The Field Checklist

One page. Complete it before the permit is signed.

Extraction Geometry Field Checklist

Pre-entry retrieval-feasibility check. Complete before the permit is signed.



Retrieval is the weakest part of most confined space plans. Use this to read the way out **before** anyone goes in. If the geometry defeats a standard vertical system, change access, equipment, or staffing now, while you still can.

SPACE / ID

DATE

ENTRY SUPERVISOR

STEP 1 — SKETCH AND MEASURE THE SPACE

- ☐ **Sketch the space in plan and section**
Include the portal, all runs, and the entrant's work position.
- ☐ **Measure horizontal drag distance**
Portal to the farthest work position, in feet.
- ☐ **Measure vertical clearance / headroom**
Can the entrant be kept upright, or is it a crawl-and-drag?

STEP 2 — ANALYZE THE EXTRACTION PATH

- ☐ **Count directional changes**
Every corner adds an edge, an efficiency loss, and a snag point.
- ☐ **Locate anchors relative to the entrant**
Anchor over the portal is not the same as over the entrant.
- ☐ **Identify atmospheric dead-zones**
Low corners and dead legs trap gas the portal monitor can miss.
- ☐ **Mark the extraction bottleneck**
The point where a standard vertical haul loses advantage or stops.

STEP 3 — MATCH THE METHOD TO THE GEOMETRY

- ☐ **Confirm the retrieval system fits the actual path**
Not just the opening. A tripod over the portal may not reach around the corner.
- ☐ **Verify retrieval meets 1910.146 provisions**
Retrieval line, full-body harness, and a system that will actually move the entrant out.

STOP if any of these are true: there is a directional change between the entrant and the exit, a long horizontal drag, low clearance that prevents a favorable line angle, or an anchor offset from the entrant. A standard vertical system alone is **not** adequate. Resolve it below before signing.

Change ACCESS

Enter through a closer or better-aligned opening to shorten the drag and straighten the pull.

Change EQUIPMENT

Add a horizontal haul / mechanical-advantage system, edge protection, or repositioned anchors.

Change STAFFING

Add rescuers or upgrade the rescue arrangement to match the real extraction load.

STEP 1

Sketch and measure

Plan and section. Drag distance. Headroom.

STEP 2

Analyze the path

Directional changes. Anchors. Dead-zones. The bottleneck.

STEP 3

Match method to geometry

Does the system fit the actual path, not just the opening?

STOP GATE

A directional change, a long drag, low clearance, or an offset anchor.

A vertical system alone is not adequate.

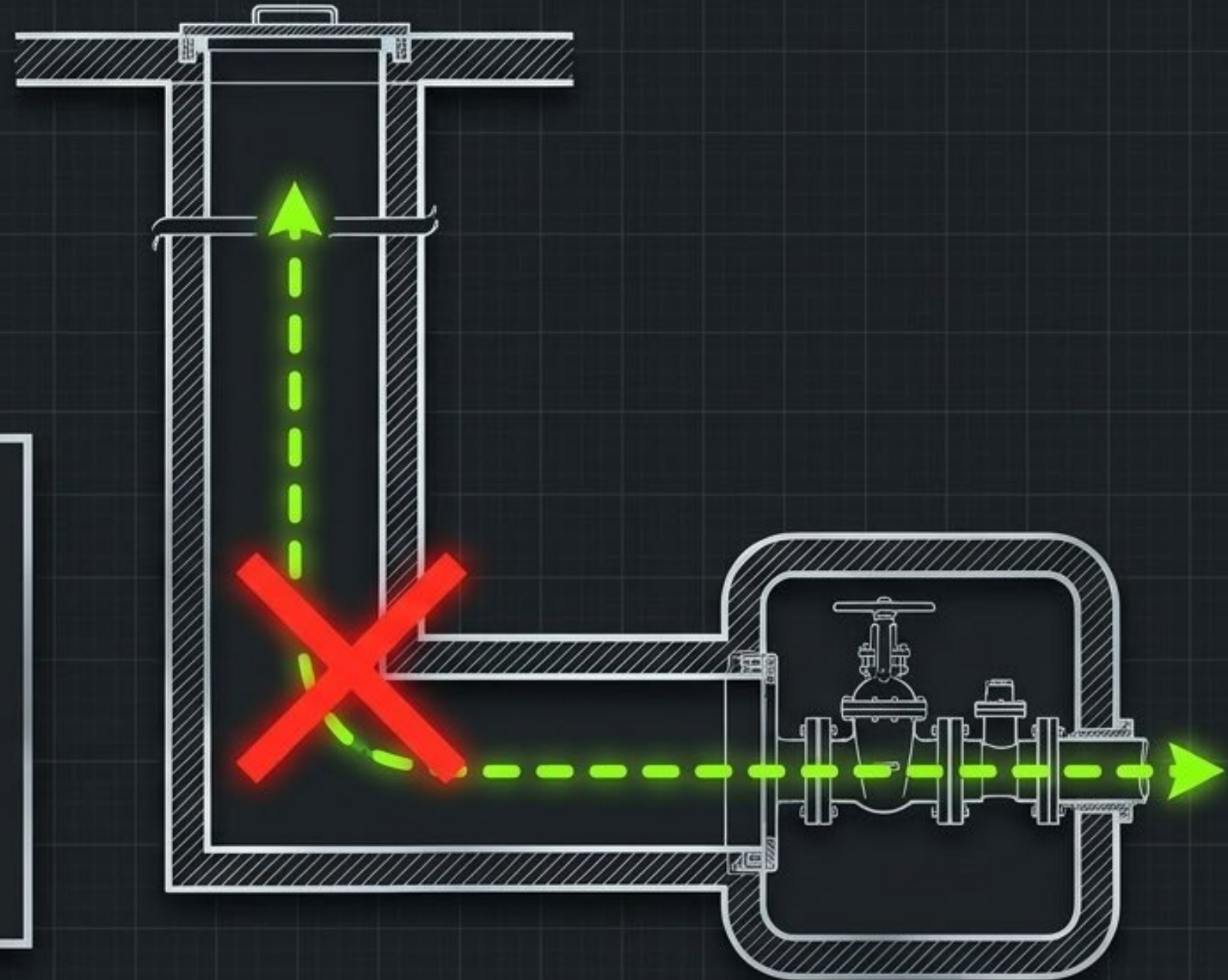
Case 1: L-Shaped Valve Vault

Geometry Breakdown

Vertical drop, 90-degree turn, horizontal run.

Pre-Entry Decision

Standard tripod fails at the corner. Fix: relocate the access point or rig a horizontal mechanical-advantage haul system before entry.



Case 2: Deep Wet Well

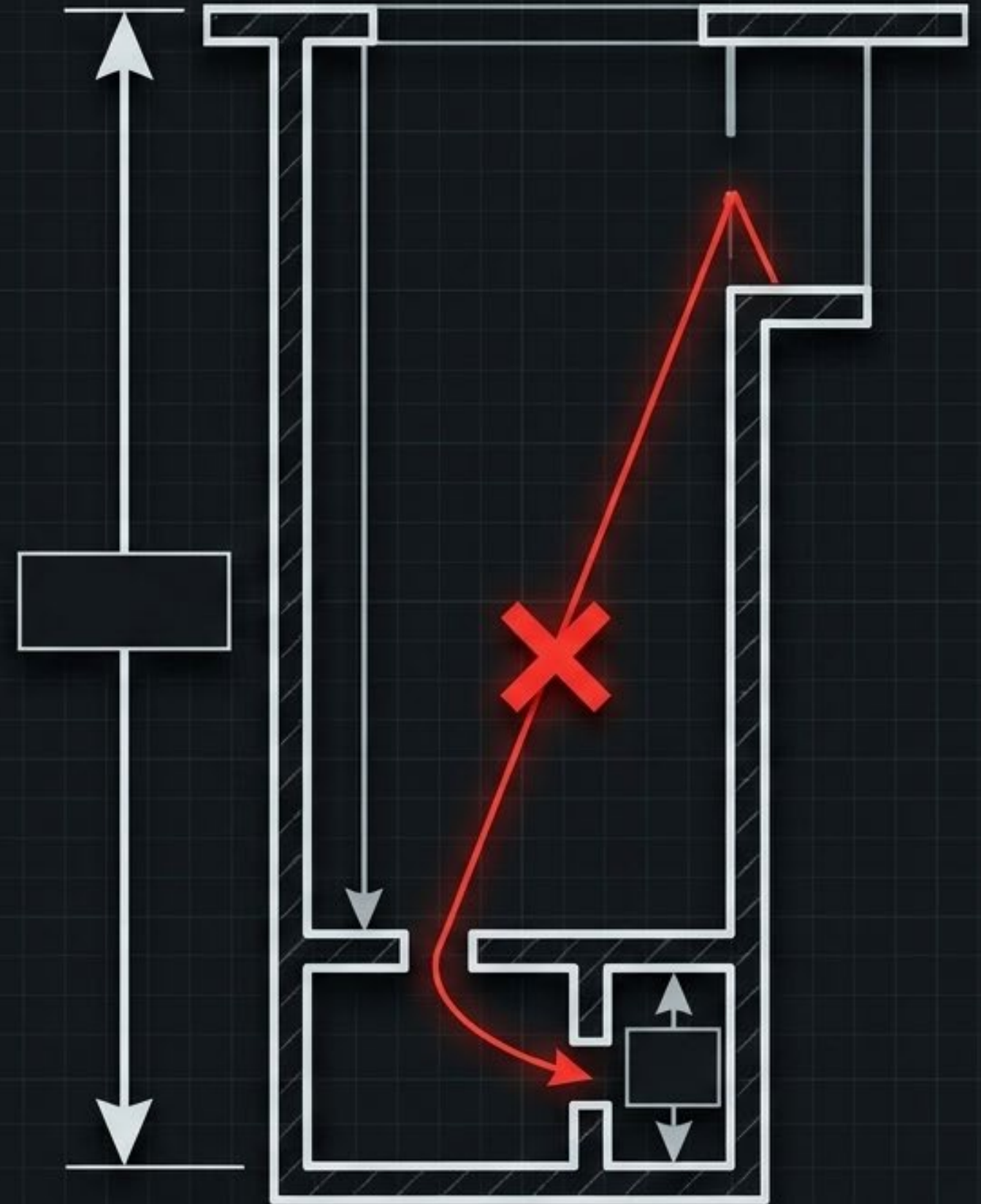
Geometry Breakdown

Deep vertical drop, limited headroom, slick surfaces.

Pre-Entry Decision

You cannot keep the entrant upright during the haul.

Fix: reposition the anchor and use a rescue litter suited to the space.



Case 3: Lift Station

Geometry Breakdown

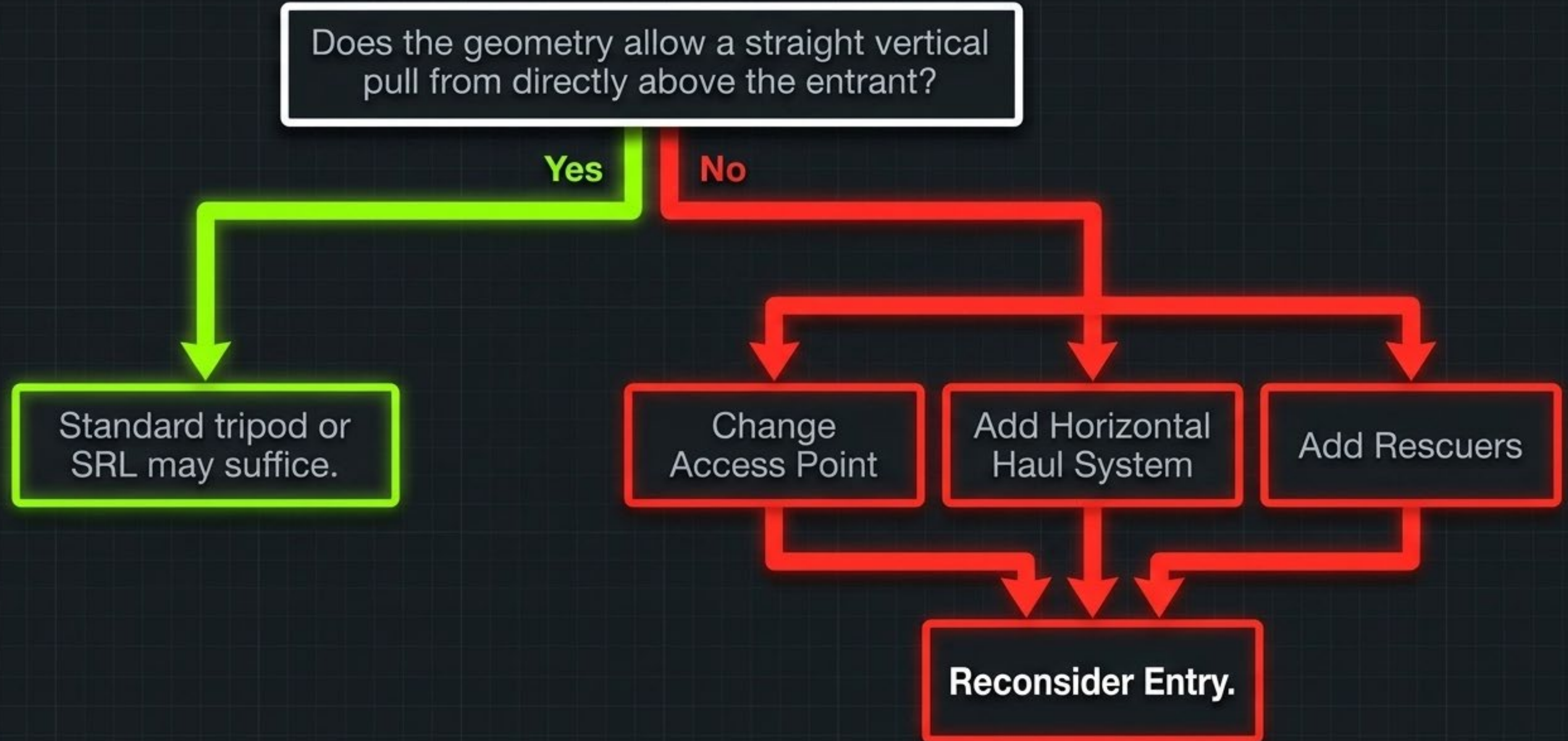
Low horizontal run with an extended drag distance.

Pre-Entry Decision

Friction can exceed standard winch capacity.
Fix: add rescuers or pre-rig inline hauling pulleys.



When Vertical Retrieval Fails



Fix It Before the Permit Is Signed



- Measure runs.
- Count directional changes.
- Locate anchors.
- Check dead-zones.
- Confirm retrieval matches geometry.



Access



Equipment



Staffing



**Permit Signed.
Geometry Locked.**

Read the way out before anyone goes in.

| TAKE THE FIELD CHECKLIST WITH YOU

One page. Use it before the permit is signed. Printed copies at the front.

Jon Cordoba, CHST, CIT · 602-730-0422 · jcordoba@p3safety.com