Episode Book

EPISODE #5914

Fire Alarms in 40-Story Towers: What Goes Wrong

PUBLISHED	12 October 2026 at 18:39 UTC
DURATION	27:17
LISTEN	myweirdprompts.com/episode/high-rise-fire-alarm-systems-30566/
HOSTS	Corn, Herman, Hilbert
SCRIPT MODEL	deepseek-flash
VOICES	chatterbox-regular (chatterbox-local)
PIPELINE	V5.4
SOURCES	13 cited by the research (listed at the end)
BOOK GENERATED	19 October 2026 at 17:41 UTC

SYNOPSIS

A 28-storey walk down a stairwell because someone burnt toast — that's the everyday failure mode of high-rise fire systems. This episode walks the full chain: ionization vs. photoelectric detection, aspirating smoke detection, the addressable fire alarm control panel, wet/dry/pre-action/deluge sprinklers, stairwell pressurization and stack effect, elevator recall, and phased evacuation. Then the data: 150,000+ automatic alarm call-outs in England in the year ending March 2019, roughly two-thirds false, with cooking and faulty equipment the top causes for eight straight years. The hard tradeoff: the kitchen is both the most likely place for a real fire and the most likely source of a nuisance alarm, so you can't solve both with one sensor. Featuring the UK's "stay put" compartmentation model and what false alarms cost in complacency and blue-light road risk.

TRANSCRIPT



Corn

Jerusalem's skyline has changed. Twenty storeys, thirty, forty plus going up like mushrooms after rain, and every one of those towers is quietly full of machinery nobody who lives in it will ever see.



Herman

And the machinery only becomes interesting to you on the day it goes off.



Corn

Daniel's prompt starts with a specific resident. Man in his sixties, joint trouble, lives high up in one of these buildings. Cooking triggers a false alarm, building-wide, and he starts walking down. Twenty-eight storeys. By the time the alert was stood down, he'd already done almost ten minutes of stairs.



Herman

And the stood-down part is what makes it worse, because he can't un-walk it.



Corn

Daniel's asking how the calibration works. How do you avoid emptying a tower over burnt toast without going soft on a real fire, and how does the chain from a single detector to a building-wide alarm actually run?



Herman

So let's start with what's actually in the walls.



Corn

Please do something about the phrase "in the walls."



Herman

Everything a resident never sees is the short answer. Detection, suppression, smoke control, power redundancy, notification. Five subsystems, one network, and the resident's entire experience of it is a horn and a strobe.



Corn

So it isn't smoke detectors. It's a nervous system.



Herman

It's a nervous system with a brain. The brain is the Fire Alarm Control Panel, the FACP, usually a cabinet somewhere in the basement or the ground floor that nobody has ever opened. Everything reports to it and it decides what the building does.



Corn

And the nerve endings?



Herman

They're different sensors for different fires, because fires don't all burn the same way. Ionization detectors respond fast to flaming fires, the ones with visible flame and quick particle production. Photoelectric detectors are better at smouldering, the sofa that's been cooking quietly for an hour before it lights.



Corn

So a building needs both because it doesn't know which fire it's going to get.



Herman

Exactly that. Then you get the specialised ones. Beam detectors across an atrium or a lobby, because you can't put a hundred point detectors across a ten-metre void. Aspirating smoke detection, ASD, which actively pulls air samples through pipes back to a central unit, and it can catch a fire when it's still at the trace level, before any ordinary detector would stir.



Corn

That's for the rooms with the servers and the priceless things.



Herman

Data centres, museums, telecoms rooms. Then heat detectors in the places where a smoke detector would be a liability, kitchens and boiler rooms. A heat detector will sit through steam and grease all day and only fire on genuine temperature rise.



Corn

Which is the first hint of the calibration problem.



Herman

It's the whole problem in miniature. You've deliberately blinded the sensor in the room most likely to have a fire, because the room most likely to have a fire is also the room most likely to lie about it.



Corn

And manual pull stations.



Herman

Red boxes by the exits on every floor, still required, because a human who sees flame should never have to wait for a sensor to agree with him.



Corn

Now the addressable part. This is where it gets clever.



Herman

Older systems worked in zones. The panel would say something on the fourteenth floor, and a firefighter would walk the whole floor looking for it. Modern systems are addressable, every device has a unique digital address, so the panel reports the exact room. Not floor fourteen. The kitchen of 14B.



Corn

That's the difference between minutes and seconds for the first responder.



Herman

It's the difference between a firefighter arriving at the right door with the right equipment and a firefighter doing a hallway search with a thermal camera while the fire gets another four minutes.



Corn

How many devices are we talking about in a forty-storey tower?



Herman

Easily over a thousand. Detectors, sprinkler flow switches, tamper switches, pull stations, door holders, damper controls, all individually addressed. The panel isn't just reporting, it's sequencing.



Corn

Sequencing what?



Herman

Suppression first. Sprinklers are not one technology. Wet pipe is the common one, water sitting in the pipes right up to the head, ready the instant a head fuses. Dry pipe holds air or nitrogen in the pipe and lets water in only when a head opens, because the pipe runs through an unheated space and you can't have it freezing in January.



Corn

Pre-action.



Herman

Pre-action is the careful one. The pipe stays dry until a separate detection event confirms there's a fire, then it charges. It's for the rooms where a burst head and a flooded floor would be its own disaster. Data centres, museums, archives.



Corn

So the system asks twice before it commits.



Herman

Deluge is the opposite end. All the heads open at once, high hazard, places where you're not defending the room, you're defending the neighbourhood.



Corn

And the sprinkler reports back.



Herman

Waterflow switches tell the panel water is moving in the pipe. Tamper switches tell the panel somebody has closed a valve by hand, which sounds minor and isn't, because a closed valve means a floor of sprinklers that will never open.



Corn

Smoke control next, and I'd argue that's the part that actually saves the building.



Herman

I'd take that argument. Detection wakes you up. Smoke control is what keeps the escape route usable while you're using it. Stairwell and elevator-shaft pressurization pushes air into the stair core so it's at a higher pressure than the fire floor, and smoke physically can't push its way in.



Corn

The stair fills with clean air instead of smoke going up it like a chimney.



Herman

There's a real chimney in every tower, and it's the whole building. Stack effect. Warm air rising through the vertical shafts, drawing air in at the bottom and pushing it out at the top. In a tall building in winter it's strong enough to move smoke upward on its own, against your wishes.



Corn

So the engineering is managing a wind that never stops.



Herman

Exhaust on the fire floor, pressurization in the nearest stairwells, elevator recall to a safe floor, all sequenced by the panel off a single detector going into alarm.



Corn

Give me the concrete version.



Herman

Thirtieth floor, kitchen of 30C. Detector trips, panel identifies the exact device. It exhausts the fire floor to pull smoke out of the corridor. It pressurizes the two nearest stairwells. It recalls every elevator to the lowest occupied floor and stops them answering calls above a certain point, because the one thing you cannot have is a lift opening onto a fire floor full of people.



Corn

And the battery.



Herman

Power redundancy is mandatory. Primary supply, standby batteries rated for a stretch of normal operation plus the alarm load, and a generator connection. The system is designed on the assumption that the mains will fail at exactly the moment a fire starts, which is not unreasonable, because that happens.



Corn

Then notification.



Herman

Horns and strobes in the older and cheaper systems. Voice evacuation in high-rises, and this is a genuine design choice, not a luxury. A horn tells you something is wrong. A voice tells you that you're on the eighteenth floor of a thirty-storey building, the fire is four floors up, the north stairwell is clear, and you should use it.



Corn

A horn panics a building. A voice moves it.



Herman

A voice moves it in a specific direction.



Corn

So the alerting chain is sensor, panel, notification, monitoring station, fire department.



Herman

In that order, with the monitoring station dialling the fire service automatically. And the notification isn't uniform across the building.



Corn

Phased evacuation.



Herman

A twentieth-floor fire sounds the alarm on floors eighteen to twenty-one. Everybody else gets a standby message, "prepare to evacuate, stay tuned." The whole point is that a full simultaneous evacuation of a thirty-storey building on foot is a logistical nightmare, and you don't want two thousand people in one stairwell while a fire is still being fought four floors above them.



Corn

You want the fewest people moving, in the clearest stairwell, in the shortest time.



Herman

And the UK takes the logic further than almost anyone, because the default there in a well-built residential block is "stay put." Your flat is a fire compartment. It's supposed to hold a fire in the flat of origin, so the safest place for you is generally inside it, and the common escape routes stay clear.



Corn

That's a serious bet on the wall between flats.



Herman

It's a bet on the wall between flats, and on the fact that the common means of escape is built to a higher standard than anything else in the building, because it has to stay usable longer than any other part of it.



Corn

So that's the chain. Detection to panel to notification to fire department. But what happens when the thing that triggers it is burnt toast?



Herman

Then you get 2019 in England, which is the cleanest data anyone has. Over a hundred and fifty thousand call-outs to automatic alarms in the year ending March 2019, and about two thirds of all false alarms. Of those, forty thousand eight hundred and thirteen were faulty equipment and thirty-four thousand five hundred and eighty-two were cooking or burnt toast.



Corn

Two categories. Broken nonsense and dinner.



Herman

And those two were the top causes for eight straight years. In London that year, cooking or burnt toast was the single most common cause of an automatic false alarm. Nine thousand one hundred and forty-five times.



Corn

In one city. In one year.



Herman

It's not a rare edge case, is the point. It's the everyday behaviour of the system.



Corn

Why is cooking specifically so bad at tripping these things?



Herman

NIST and the Consumer Product Safety Commission both looked at it, and the finding is intuitive once you see it. Nuisance alarms during cooking get more frequent the closer the detector sits to the cooking equipment. It's a distance problem.



Corn

And the sensor type matters.



Herman

Ionization-only alarms are the most susceptible. They respond to the fine particles you get from a flaming pan or a piece of toast catching, and toast catching is exactly the fire they're designed to detect. Photoelectric and dual-sensor alarms are harder to trip, but they're not immune. Cooking smoke gets them too.



Corn

So you could desensitise the kitchen. You could go heat-only in kitchens.



Herman

And here's the razor. Cooking is the leading cause of actual residential fires. The smoke that sets off the nuisance alarm is the same smoke that precedes the real thing. If you blunt the kitchen sensor, you keep the peace and you lose your earliest possible warning, in the room where the fire is most likely to start.



Corn

So the answer is the wrong answer.



Herman

The answer is that you cannot buy both with one sensor. You buy it with placement, with sensor type, with ventilation, with suppression, with sprinklers in the dwelling, with things that are not the alarm.



Corn

There's also the human cost, which doesn't show up in the false alarm figures.



Herman

There's a line from the National Fire Chiefs Council, from Paul McCourt. False alarms can make people complacent. They also increase the road risk to the public from the crew attending under blue lights.



Corn

So the cost of the false alarm isn't only the man walking down twenty-eight storeys. It's every additional blue-light run through a city.



Herman

And it compounds in exactly the direction Daniel's resident is pointing at. UK evacuation guidance actually says it out loud, that residents may underestimate risk due to previous experiences of small-scale fires and false alarms.



Corn

Training people to ignore the alarm.



Herman

Training people to ignore the alarm, in a building whose safety model requires them to take it seriously.



Corn

And you can't simply decide to stop responding to automatic alarms, because the whole system is built on the assumption that somebody is coming. If the fire service stops attending, you've decided a mechanical failure is the resident's problem.



Herman

Some places put a price on it to try and deter the volume. Humberside charges a minimum of three hundred and forty-six pounds per false-alarm call-out.



Corn

A fine for the toast.



Herman

Surrey in Canada, the fire service said plainly that of the nuisance alarms they respond to, typically less than one percent turn out to be actual fires.



Corn

Ninety-nine out of a hundred trips up a ladder for nothing.



Herman

That's the ratio the system is operating on and there's no sensor on the market that fixes it, because the sensor doesn't know intent. Smoke is smoke.



Corn

That's the calibration problem in theory. Let's look at what happens when the calibration fails and what it cost.



Herman

Fourteenth of June, 2017. Grenfell Tower, west London. The fire started in the kitchen of Flat 16.



Corn

A kitchen.



Herman

A kitchen in a building whose model, like every residential block in the country, was stay put. Your neighbours' fire is contained in your neighbours' flat. It did not stay contained, because it got out into the external cladding and ran up the outside of the building faster than anyone inside could have imagined. Seventy-two people died.



Corn

And the lesson isn't "stay put is wrong."



Herman

The lesson is that stay put is a bet, and the bet is on compartmentation. The whole model only holds if the box you're sitting in is actually a box. If cladding turns the outside of the building into a chimney, the model inverts, because staying put is now the worst possible choice and nobody has told the residents.



Corn

And the residents found out in real time.



Herman

The Phase 2 inquiry ran to a final report in September 2024. Seventeen hundred pages. It found systematic dishonesty by the cladding and insulation manufacturers about how their products performed in fire. It found persistent indifference to fire safety on the part of the council and the tenant management organisation. It found a serious failure of leadership during a drive to cut regulation.



Corn

The chair, Moore-Bick, said the failings were mostly incompetence but some were dishonesty and greed.



Herman

And the inquiry's line on deregulation is the one I keep coming back to, because it's not about one building. Pressure to cut red tape was so strong that civil servants felt the need to put it at the forefront of every decision, such that even matters affecting the safety of life were ignored, delayed or disregarded.



Corn

That's a sentence written after seventy-two deaths.



Herman

And it's not the first warning in London. Lakanal House, 2009, six people died in a tower fire in Southwark, and the finding was that it should have alerted the London Fire Brigade to the shortcomings of its ability to fight fires in high-rise buildings. The same capability gap that Grenfell exposed eight years later had been flagged, and the lessons weren't carried far enough.



Corn

So the wake-up calls were rung and not answered.



Herman

And the post-Grenfell rules are the answer to that. Metal composite materials with unmodified polyethylene cores banned on external walls of any height. Materials not classed as A2 or better banned on buildings over eighteen metres. A Building Safety Regulator established as its own legal entity at the start of this year, moved out of the Health and Safety Executive to arm's-length status so it can act as a regulator rather than an internal team.



Corn

And evacuation plans?



Herman

The Fire Safety (Residential Evacuation Plans) Regulations were laid in July 2025 and came into force in April this year. They mandate residential personal emergency evacuation plans, PEEPs, for high-rise residential buildings of at least seven storeys or eighteen metres, and for eleven to eighteen metre buildings where the evacuation is simultaneous.



Corn

Which is a direct answer to the man in his sixties with joint trouble. Somebody has to have thought about him before the alarm goes off.



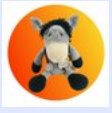
Herman

Somebody has to have a plan on file for him. That is the change. The building has to know who needs help and what the help is. It cannot rely on the assumption that everybody walks.



Corn

And that gets us back to the ten minutes.



Herman

Let's put a number on it. NIST measured stair descent speeds in a six-storey assisted-living facility, elderly residents and residents with mobility impairments, self-evacuating, using a cane, being assisted, or being carried in a stair chair.



Corn

And the speed?



Herman

Zero point one one to zero point two nine metres per second. That's the range across all of those groups.



Corn

What does that look like in a building?



Herman

A stair descent that a fit adult does in a couple of minutes takes an order of magnitude longer. That number, in a thirty or forty storey building, is the whole problem in one figure.



Corn

Give me the full-building trials.



Herman

The Home Office ran live evacuation trials with the University of Central Lancashire. A full ten-floor evacuation took nineteen minutes and fifteen seconds with an evacuation alert system in the building, versus twenty-eight minutes and thirty-eight seconds with firefighters going door to door.



Corn

Nine minutes of difference over ten floors, from the alerting alone.



Herman

And the same trials found something I think is the most striking finding in the whole batch. If one of the two staircases is dedicated solely to firefighters, so the residents have the other one to themselves, total evacuation time drops by up to fifty-three percent. Nineteen fifteen becomes nine oh two.



Corn

Halved by giving the firefighters their own stairs.



Herman

Halved by removing the collision at the door. Two-way traffic in a stairwell is doing something very expensive to everybody in it, and the fix is architectural, not procedural.



Corn

So the design question becomes: how do you build a tower that has the stair capacity for a full evacuation that probably never happens?



Herman

At least two fire-resistant staircases. Fire elevators with independent power and protected lobbies, so a lift can still be used for evacuation when the ordinary lifts have been recalled and shut down. Refuge floors or refuge areas, at intermediate points where somebody can stop and still be protected.



Corn

Where does the assumption come from?



Herman

BS EN 81-76 recommends designing on the basis that ten percent of a building's population has a disability and may be unable to use stairs. That's the planning figure. And a scoping review published last year, looking at a hundred and fifty-six articles going back to 2000, found that the research literature overwhelmingly studies able-bodied occupants.



Corn

So we've built a regulatory assumption of ten percent and a research base of roughly zero percent.



Herman

People with functional limitations have longer pre-evacuation times, so they take longer to start moving, and they move more slowly when they do. And stairs remain the primary evacuation facility, which makes them the primary problem, because they are the one thing that assumes you can walk.



Corn

And the numbers you mentioned earlier, about stair widths and refuge floors. Different countries answer this differently.



Herman

Staircase widths are a good proxy for how seriously a jurisdiction takes this. The US minimum is one point one metres under the IBC and NFPA 101. The UK is one point two metres. Germany is one point five.



Corn

Half a metre difference is a whole other person side by side.



Herman

It's whether two people can pass without turning sideways, which is the whole question in an evacuation. Refugee floors are the same story. The US typically puts them every fifth floor. China puts them every fifteen floors or forty-five metres of height, with a minimum of six square metres per person.



Corn

Every fifth floor versus every fifteenth. That's a different theory of what a refuge floor is for.



Herman

One is a resting point on the way down. The other is a temporary safe haven if you can't complete the descent at all.



Corn

And the stay put versus evacuate tension.



Herman

Grenfell exposed the danger of stay put when compartmentation fails. But the guidance itself warns that false alarms erode the trust that stay put depends on, and that's the knot. Stay put only works if people believe it, and people stop believing it after the third time a pan of onions empties their evening.



Corn

So the calibration problem and the evacuation problem are the same problem.



Herman

They're the same problem, and they meet in the person walking down twenty-eight storeys, because he didn't choose to walk. The system told him to.



Corn

What's your read on all this?



Hilbert

I agree with both of you, mostly. And I'd like to talk about the panel.



Hilbert

The one I know best is a Notifier NFS-3030, head end in a riser cupboard on the ground floor of a thirty-two storey tower in Petah Tikva. I didn't install it. I was there for a fortnight putting the address list in order, which is a job nobody ever notices and everybody depends on.



Corn

The address list.



Hilbert

Every device on that panel has a label typed by a human being. Somebody has to type it. Loops one through six, two hundred and twelve devices, and if a label says "kitchen 22B" and the detector is physically over the corridor outside 22B, then the first firefighter up the stairs gets sent to the wrong door. It's not a hardware problem. It's a filing problem.



Herman

That's a underrated point. The addressable system is only as good as its commissioning database.



Hilbert

They never updated it. The building changed hands twice. Units were merged, kitchens moved, and the labels stayed as they were. So the panel is telling the truth about a building that no longer exists.



Corn

You filed a complaint.



Hilbert

I filed a complaint about a false alarm at eleven at night on a Friday, and it was the twenty-third such complaint from that address in eleven months. The committee wrote back. They said the panel was working as designed.



Herman

Which it was, technically.



Hilbert

Which it was. The panel was working as designed. Design was the problem.



Corn

What did you actually want?



Hilbert

I wanted the label on detector four-one-nine changed from "kitchen 22B" to "corridor north 22B," and I wanted a line of text added to the event log so that when the alarm went off at eleven at night, the person looking at the screen knew it was the corridor not the kitchen. One line of typing. It took fourteen months and a written escalation to the management company's lawyer.



Corn

Fourteen months for one line.



Hilbert

Fourteen months. And then the fire marshal visited the building for something unrelated and told them to do it anyway, which took him about four minutes.



Herman

The panel was doing what it was told.



Hilbert

The panel was doing what it was told in language from another decade. That's the thing about these systems. The automation isn't wrong. The map is wrong. And the map is a person's job, and the person who was supposed to be doing it left or was never told, and the whole chain inherits that.



Corn

The addressable system that was supposed to save minutes is being undermined by a typo.



Hilbert

Not a typo. A decision. Somebody looked at that label and decided it was close enough. And close enough is fine until the night it isn't.



Herman

The address database is the building's memory of itself. If it's stale, the building has forgotten what it is.



Hilbert

I'll take that. That's better than how the committee said it.



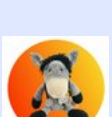
Corn

Which is exactly the thing your panel install catches. The detection is fine, the panel is fine, the notification is fine, and the human layer is running on four-year-old paperwork.



Hilbert

The stairwell pressurization fan on that building had a manufacturer's service interval of twelve months and had last been serviced in a year I'm not going to say out loud. That's not the panel's problem. That's nobody's problem, which means it's everyone's.



Herman

Nobody reads the log.



Hilbert

Nobody reads the log. Two thousand events a year and the only person who ever looked at it was me, because I was putting the addresses in, and I was only there because the last address list had to be replaced.



Corn

Where did you keep it?



Hilbert

The address list? A laminated card in my breast pocket, an index card, handwritten, one card per loop. I still have loop three in the car. Six years later. If you ever need to know which detector is over the north corridor of the twenty-second floor of a building in Petah Tikva, I can tell you.



Herman

What we're taking from this is that the invisible infrastructure is only as good as the paperwork behind it.



Hilbert

Yes.



Corn

The person we don't see is the one who typed the label.



Hilbert

The person you don't see is always the one who typed the label. And they left the building the year after.



Herman

Right, which means the whole system has this fragility sitting underneath the sensors and the panel and the voice evacuation and the recall, and nobody in the design process owns it.



Corn

The glue that holds the important things together.



Herman

Which is the one part of the system that no regulator has managed to write a standard for, because it's not a device. It's a habit.



Corn

That's why the PEEPs regulation is interesting, because for the first time it forces a building to have a document that describes a person, not a floor.



Herman

It forces the building to know who needs help and what help looks like. It moves the human being from the category of "should be able to walk" into the category of "we've written it down."



Corn

What's the cutting-room floor on this one?



Herman

The thing I can't fit is just how big the gap is between what the research knows and what the buildings are built for. One point three billion people worldwide experience significant disability. The building codes are starting to catch up.



Corn

What I'm left with is a question the research couldn't answer. The Israeli detail wasn't in anything I could find, and I'd like to know what the Israeli code requires for residential towers of that height, because the buildings are going up faster than the framework around them.



Herman

The calibration question doesn't have a clean answer. You can't desensitise the kitchen without losing your warning in the room most likely to burn. You can't cry wolf without training people not to listen. You can't stay put if the wall between you and the fire isn't a wall.



Corn

Which means the person walking down twenty-eight storeys isn't the problem the system is solving. He's the problem the system is producing, and the fix has to happen before the alarm goes off.



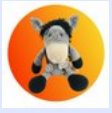
Herman

Before the alarm, and while he's still sitting down.



Corn

Our producer Hilbert Flumingtop, who keeps a laminated index card from six years ago in his car.



Herman

If this was your kind of episode, go back for episode eighteen sixty-one, Emergency Prep You Can Sing To; episode fourteen oh eight, Israel Wartime Readiness Field Guide; and episode four fifty-five, When Your Neighbor's Fire Is Your Fire. This has been My Weird Prompts, the human-AI collaboration podcast. You can find everything at my weird prompts dot com, or send us your own prompt on Telegram at t dot me slash MWP listener bot.



Corn

We'll be back soon.



Herman

See you then.

SOURCES

What the research for this episode read before the script was written. Primary sources first.

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https://www.surrey.ca/sites/default/files/media/documents/preventing-false-fire-alarms.pdf