MAJED AERIAL SOLUTIONS
ماجد للحلول الجوية · Geospatial Intelligence & Aerial Inspection

AERIAL THERMOGRAPHIC ASSESSMENT

Concrete Curing & Surface Moisture-State Mapping

Radiometric UAV Survey — Capability Demonstration

Client	
Prepared By	Majed Aerial Solutions (MAS)
Survey Date	21 July 2026 · 10:50–10:52 (AST, UTC+3)
Site Location	Residential Development, Riyadh Region, KSA · N, E
Document Ref.	MAS-THERM-2026-07-01
Classification	

Regulatory Credentials

GACA Remote Pilot Certificate UA-38575 · GEOSA Licensed · GAMR Professional Registration No. 646781

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1. Executive Summary

Majed Aerial Solutions conducted a radiometric aerial thermographic survey of an active residential construction site for The survey was flown on 21 July 2026 at approximately 10:50 local time using an integrated radiometric thermal payload. This document is issued as a **capability demonstration** establishing MAS competence in construction-stage thermal assessment, and as a technical record of the surface thermal state observed at time of capture.

The primary objective was **qualitative concrete curing and surface moisture-state mapping** — differentiating freshly placed (wet) concrete from cured or solar-loaded (dry) surfaces across a multi-block villa development spanning three distinct construction stages.

Principal Findings

- **Validated wet/dry thermal signature.** A freshly poured slab confirmed on site by the site team registered a surface temperature of 41.8 °C against adjacent dried/solar-loaded surfaces at 70.7 °C — a differential of approximately 29 °C, with an in-region spread of up to 44 °C. This contrast is consistent with the evaporative and thermal-mass cooling signature of concrete placed within hours of capture, and constitutes a ground-truth–validated result.
- **Construction-stage differentiation.** The dataset resolves three distinct stages — fresh pour, roof-deck preparation (formwork and curing mesh), and cured superstructure — each carrying a characteristic thermal profile under uniform solar load.
- **Curing uniformity is observable.** Within individual slabs, thermal gradients indicate non-uniform moisture retention across the pour surface — a usable indicator for curing-quality QA when supported by ground reference.

Interpretation Boundary

Results are reported as **qualitative and relative**. Absolute surface temperatures are indicative only: acquisition was performed at ~51 m AGL (outside the sensor's rated close-range radiometric envelope) and a single uniform emissivity was applied across mixed materials. The assessment does ***not*** constitute subsurface defect detection, delamination survey, structural evaluation, or any engineering certification of cure completeness or material strength. Findings support site QA decision-making; they do not replace destructive or contact-based verification.

2. Survey Objective & Scope

2.1 Objective

To acquire and interpret radiometric aerial thermal imagery of the site in order to map surface curing / moisture state, differentiate wet from dried concrete, and document the thermal condition of the works at time of capture for construction QA purposes.

2.2 In Scope

- Qualitative surface moisture / curing-state mapping across concrete slabs and roof decks.
- Wet-versus-dried concrete differentiation using relative thermal contrast.
- Detection of intra-slab curing non-uniformity (relative gradients).
- Time-stamped, geo-referenced documentation of surface thermal state across construction stages.

2.3 Explicitly Out of Scope

The following are outside the technical envelope of a single daytime radiometric survey and are excluded from this deliverable:

- **Absolute temperature certification** — values are indicative, not metrologically certified.
- **Quantified moisture content (% w/w)** — requires contact moisture-meter or gravimetric ground-truth.
- **Subsurface void / delamination / honeycomb detection** — not resolvable from a single daytime epoch without diurnal loading analysis.
- **Structural, load-bearing, or cure-completeness engineering conclusions** — require licensed structural assessment and material testing.
- **Building-envelope / thermal-insulation performance** — not applicable to structures at this construction stage.

3. Acquisition & Correction Parameters

All frames were acquired with a single integrated radiometric thermal payload (640 × 512 px, LWIR 8–14 µm; stated radiometric accuracy ±2 °C or ±2 % of reading) in nadir, single-epoch mode, under uniform meteorological conditions within a ~2-minute window — ensuring internal consistency across the dataset.

3.1 Acquisition Geometry

Parameter	Value	Note
Flight altitude	~51 m AGL	Operator-reported
Thermal GSD	≈ 6.7 cm / px	Computed from sensor optical geometry at altitude
Ground footprint / frame	≈ 43 m × 34 m	At 51 m AGL
Capture window	10:50–10:52 AST	Uniform solar load across set
Site coordinates	N, E	Riyadh Region, KSA

3.2 Radiometric Correction Parameters (as logged)

Parameter	Logged Value	Assessment
Emissivity (ε)	0.95	Valid for concrete; over-applied to metal/mesh —

Parameter	Logged Value	Assessment
		see §4
Object distance	25 m (capped)	Field limited to 25 m; true range ~51 m
Relative humidity	6 %	Consistent with arid mid-day conditions
Reflected temp.	25.0 °C	Under-set vs. 39 °C ambient — see §4.3
Ambient air temp.	39 °C	Operator-reported at flight time

4. Methodology & Data-Integrity Framework

Radiometric integrity is governed by emissivity, reflected temperature, atmospheric path, and spatial resolution. Each is addressed below with its effect on the reported values. This section is provided so that findings can be weighted appropriately by the reviewer.

4.1 Emissivity Handling

A single emissivity of 0.95 was applied across the full frame. This value is **defensible for concrete** (cured 0.92–0.95; wet surfaces trend marginally higher toward ~0.96 owing to the surface water film — a sub-degree effect). It is ***not*** valid for the low-emissivity materials present in-frame: bare and oxidised rebar, steel props, and reflective sheeting. Consequently:

- **Concrete / masonry surface readings** — valid within the accuracy envelope.
- **Formwork plywood and green curing-mesh readings** — carry an emissivity offset; treat as relative indicators, not absolute temperatures.
- **Exposed metal (rebar, props, sheeting)** — apparent temperatures are invalid and were not used for interpretation.

4.2 Spatial Resolution (GSD) Constraint

At ~51 m AGL the thermal GSD is ≈ 6.7 cm/px. Features smaller than roughly 3–4 pixels (~20–27 cm) are spatially averaged with their surroundings, suppressing fine-scale thermal anomalies and biasing small hot/cold features toward the local mean. Interpretation therefore relies on area-scale contrast (slab-to-slab, zone-to-zone), not point features.

4.3 Reflected Temperature

Reflected temperature was logged at 25.0 °C against a reported ambient of 39 °C. For the ε = 0.95 concrete surfaces the resulting error is **below 1 °C** (the reflected term is weighted by 1 − ε = 0.05) and lies within the sensor's ±2 °C specification; it does not alter the qualitative conclusions. The effect is larger on lower-emissivity surfaces, reinforcing §4.1. **Recommendation:** re-process with reflected temperature set to measured ambient (~39 °C) prior to any final absolute-value issue.

4.4 Object-Distance Field Cap

The correction field is limited to 25 m while the true slant range was ~51 m. In the LWIR band, atmospheric attenuation is driven primarily by water-vapour path length; at 6 % relative humidity the transmittance difference between 25 m and 51 m is a fraction of one percent — well below the sensor accuracy floor. The cap has negligible effect on reported values. It does, however, place acquisition outside the sensor's rated close-range radiometric envelope, which is why absolute values are reported as indicative.

4.5 Per-Frame Palette Autoscaling

Colour palettes are auto-scaled independently per frame (Frame 0003: 34.8–85.2 °C; 0006: 40.8–90.2 °C; 0007: 45.5–93.2 °C). Identical colours across different frames therefore represent different temperatures. **Cross-frame comparison must use the numeric measurement values, never the colour rendering.**

5. Thermal Interpretation Framework

To maintain inspection-grade discipline, observations are graded on the following ladder. No finding in this report exceeds the "Indicator" tier.

Tier	Definition	Basis Required
Observation	A thermal contrast is present in the data	Radiometric imagery only
Indicator	Contrast correlates with a plausible physical cause	Imagery + RGB / site context
Potential anomaly	Pattern deviates from expected and warrants attention	Imagery + repeat / diurnal data
Confirmed defect	Cause established as a defect	Ground-truth / contact testing
Engineering conclusion	Certified assessment of significance	Licensed structural evaluation

This deliverable reports at the Observation and Indicator tiers only. The wet/dry differentiation reaches the Indicator tier (validated by on-site pour confirmation); all other findings remain Observations pending ground reference.

6. Frame-by-Frame Analysis

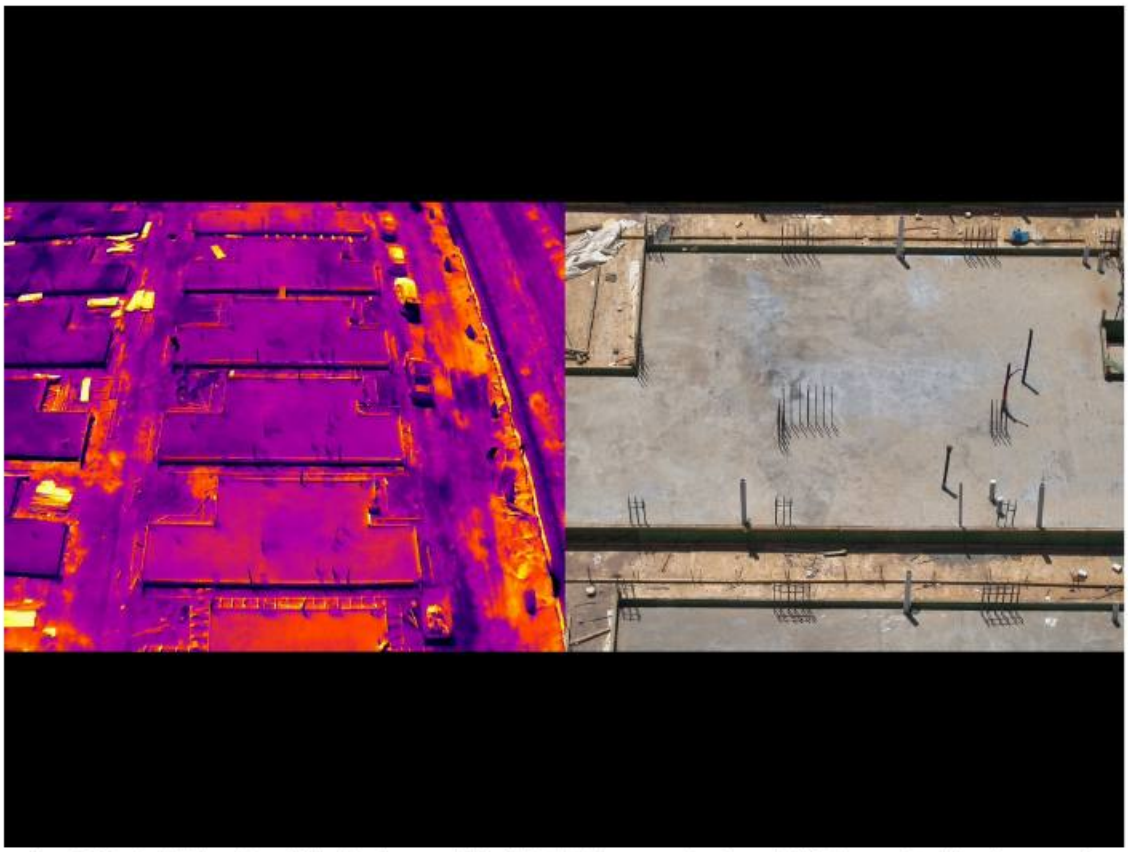


Figure 1 — RGB establishing view of the development. Multi-block villa superstructure at differing construction stages; note green curing mesh / formwork decks and open graded ground.

6.1 Frame 0003 — Wet vs. Dried Concrete (Validated Indicator)

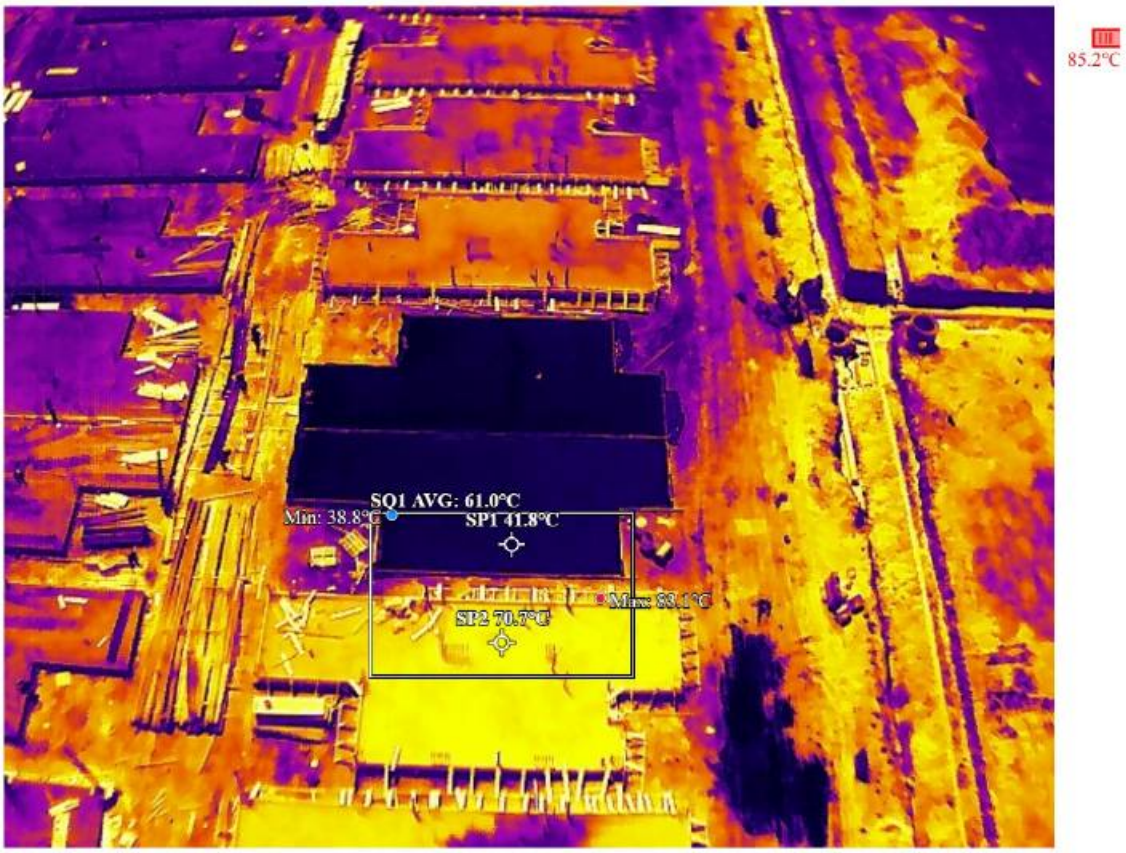


Figure 2 — Frame 0003 radiometric image (palette 34.8–85.2 °C). SP1 41.8 °C on freshly poured slab (cool/purple); SP2 70.7 °C on dried surface; region SQ1 spans 38.8–83.1 °C.

This frame is the anchor result. The site team confirmed on site that the cool (purple) rectangular slabs are **concrete poured within hours of capture**. The thermal data corroborates this directly:

Measurement	Value	Surface (RGB cross-ref)	Validity
SP1	**41.8 °C**	Freshly poured wet slab	Valid (ε-concrete)
SP2	**70.7 °C**	Dried / solar-loaded surface	Valid (ε-concrete)
SQ1 min	**38.8 °C**	Wettest zone in region	Valid
SQ1 avg	**61.0 °C**	Mixed wet+dry region	Context
SQ1 max	**83.1 °C**	Driest zone in region	Valid

Interpretation. The ~29 °C point-pair differential (SP2 − SP1) and up to ~44 °C in-region spread (SQ1 max − min) are consistent with evaporative cooling and the elevated thermal mass of water in a fresh pour, set against dry surfaces in radiative equilibrium with a 39 °C ambient under direct sun. Because the wet zone is independently confirmed, this reaches the **Indicator tier** and demonstrates that the workflow reliably separates fresh from cured concrete.

QA value. Gradients within a single slab map curing uniformity: a slab cooling evenly indicates uniform moisture retention, while isolated warm patches on a slab known to be freshly poured indicate early/localised surface drying. Both are actionable curing-control indicators.

6.2 Frame 0006 — Roof-Deck Preparation Stage (Observation)

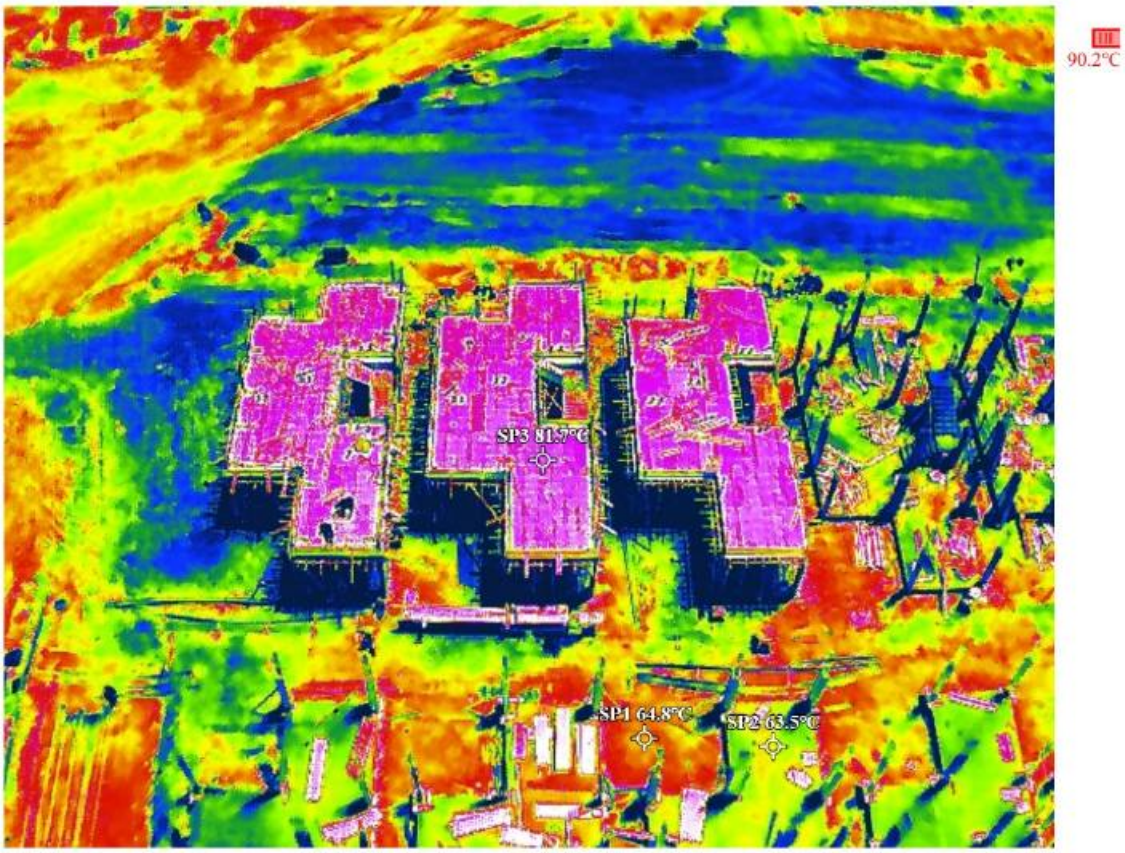


Figure 3 — Frame 0006 radiometric image (palette 40.8–90.2 °C). Roof decks read hottest (SP3 81.7 °C); large cool zone across upper field.

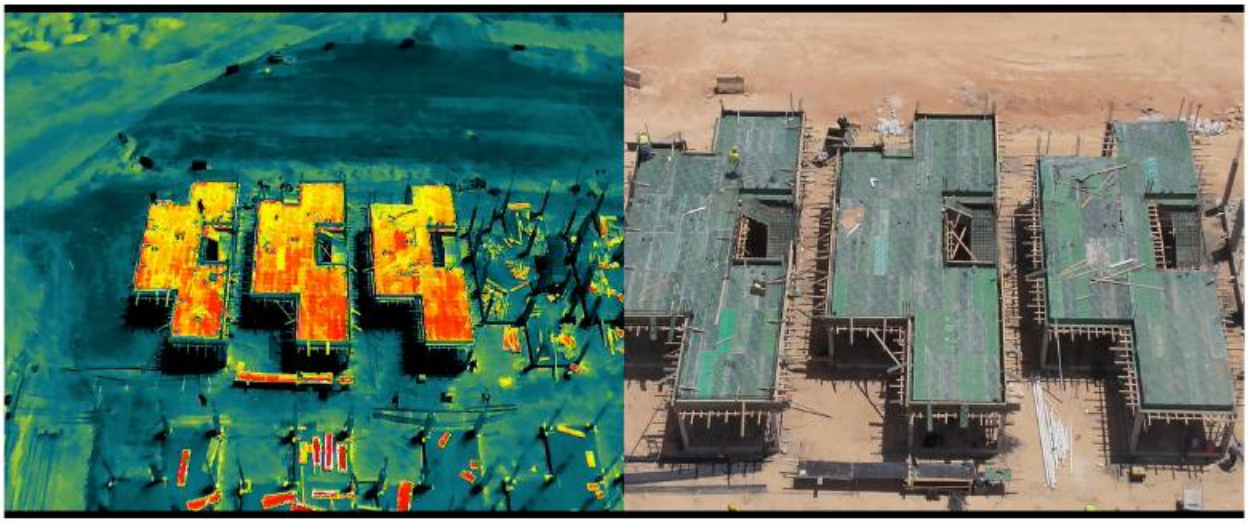


Figure 4 — Thermal / RGB correlation (independent palette). The hot roof-top signatures coincide with green curing mesh and plywood formwork, NOT exposed concrete.

Three villa blocks are captured at the roof-deck preparation stage. The critical interpretive point is the **material of the hot roof signatures**: RGB cross-reference shows these decks are covered in green curing mesh and plywood formwork. SP3 (81.7 °C) is therefore a **formwork / mesh surface temperature carrying an emissivity offset** — it must not be read as a cured-concrete temperature.

Measurement	Value	Surface (RGB cross-ref)	Validity
SP1	64.8 °C	Perimeter grade / surface	Context
SP2	63.5 °C	Perimeter grade / surface	Context
SP3	81.7 °C	Roof deck — mesh / formwork	ε-offset (indicative)

Interpretation. The large cool field surrounding the blocks is consistent with graded / shaded ground or a recently worked (higher-moisture) surface. The blocks read hot because exposed formwork and mesh under direct sun reach high surface temperatures with low thermal inertia. No cured-concrete moisture inference can be drawn for these decks while the formwork is in place. Retained at the Observation tier.

6.3 Frame 0007 — Superstructure & Staging Area (Observation / Context)

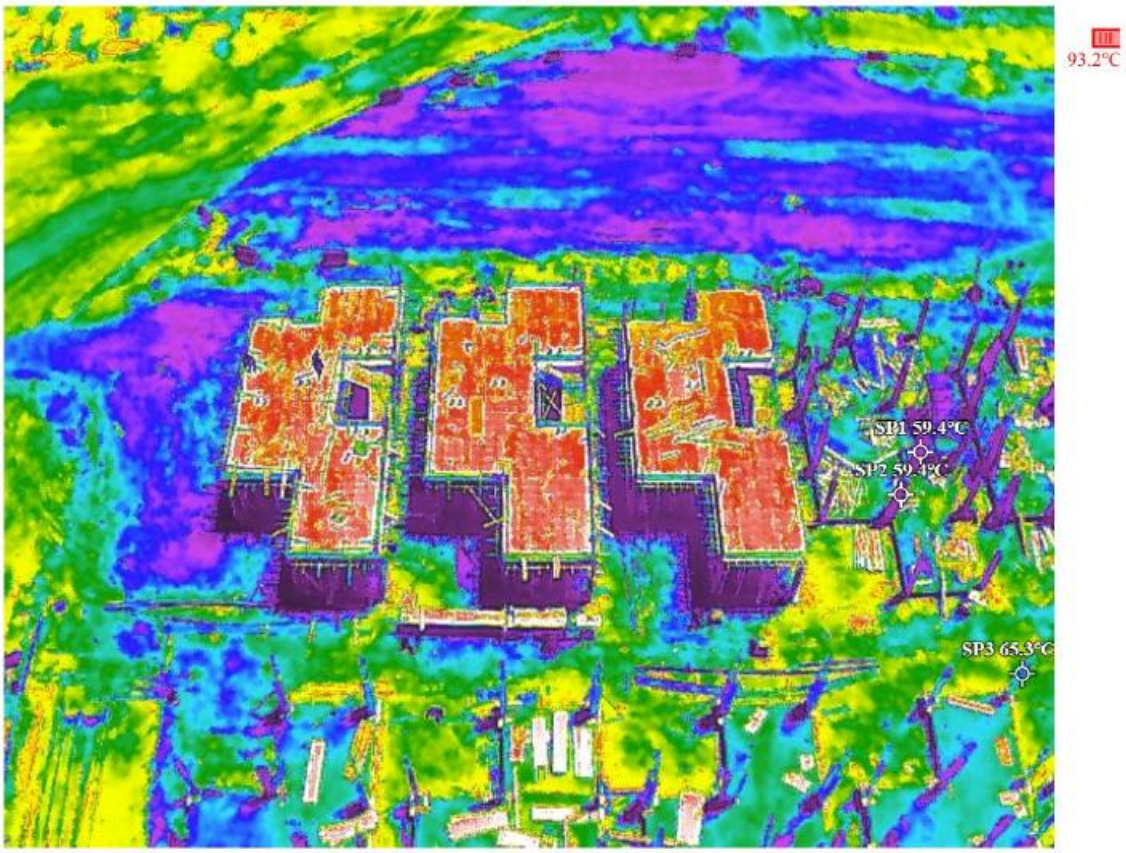


Figure 5 — Frame 0007 radiometric image (palette 45.5–93.2 °C). Point samples SP1/SP2 59.4 °C, SP3 65.3 °C across a mixed-material staging field.

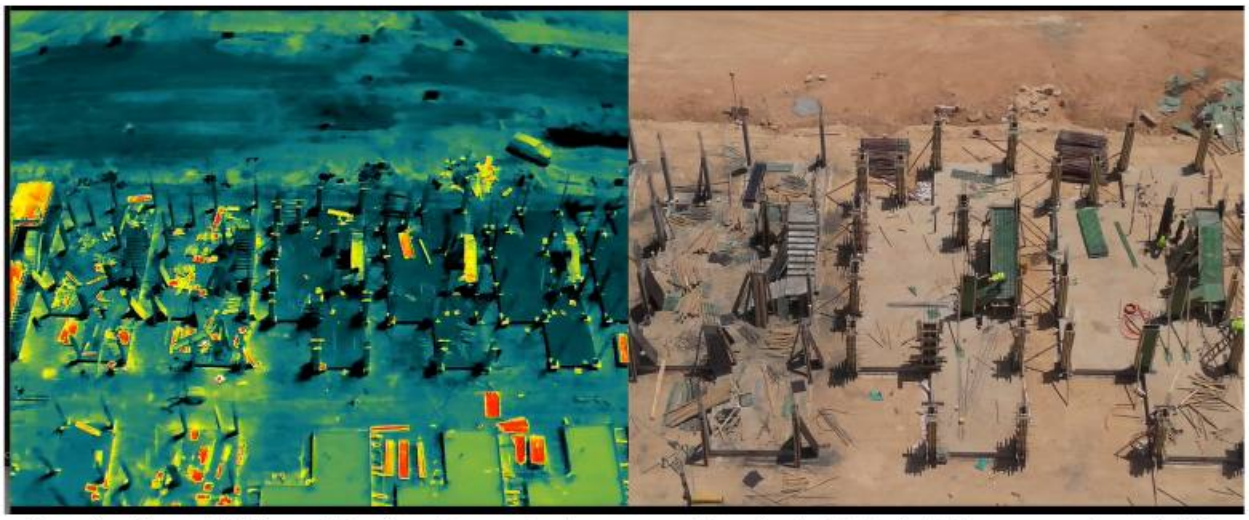


Figure 6 — Thermal / RGB correlation. Dense formwork, rebar, props and staged materials dominate the scene — a low-emissivity mixed field.

This frame captures a superstructure / formwork staging area. The scene is dominated by **mixed low-emissivity materials** — steel rebar, props, timber formwork and staged components — for which the single-ε correction does not hold. Point values (SP1/SP2 59.4 °C, SP3 65.3 °C) are reported for completeness but are **not reliable absolute temperatures** and carry limited moisture-mapping value.

Interpretation. The frame's value is documentary — it records site progress and material staging at the survey epoch. It is retained as context and excluded from quantitative curing interpretation.

7. Findings Summary

#	Finding	Tier	Confidence
1	Fresh-pour concrete is thermally separable from cured/dry surfaces (~29 °C point differential; ~44 °C in-region spread), validated by on-site pour confirmation.	Indicator	High
2	Intra-slab thermal gradients indicate non-uniform surface moisture retention — usable for curing-uniformity QA.	Observation	Moderate
3	Roof-deck hot signatures correspond to formwork / curing mesh, not exposed concrete; no cure inference possible while formwork remains.	Observation	High
4	Staging-area point values are dominated by low-ε mixed materials; retained as documentary context only.	Observation	Low (absolute)

8. Limitations & Confidence Statement

- **Single-epoch daytime capture.** No diurnal loading cycle was acquired; subsurface features requiring day/night differential are not resolvable from this dataset.
- **Absolute values indicative.** Acquisition at ~51 m AGL sits outside the sensor's rated close-range radiometric envelope; absolute temperatures should be treated as indicative, and interpretation rests on relative contrast.
- **Uniform emissivity across mixed materials.** Concrete readings are valid; formwork/mesh readings carry an offset; metal readings are invalid (§4.1).
- **Reflected temperature under-set.** Logged at 25 °C vs. 39 °C ambient; sub-1 °C effect on concrete, correctable by re-processing (§4.3).
- **Limited ground-truth.** One qualitative pour confirmation was available. No moisture-meter, surface-probe, or gravimetric data was supplied; findings are therefore not metrologically validated beyond that single reference.
- **GSD floor.** Features below ~20–27 cm are averaged out; fine anomalies are not detectable at this altitude.

Overall confidence: High for the qualitative wet/dry differentiation and stage differentiation; Low for any absolute-temperature or quantitative-moisture claim. The deliverable is fit for QA screening and progress documentation, not for certification.

9. Recommendations

9.1 To Strengthen This Dataset

- **Re-process with corrected reflected temperature** (~39 °C) before any final absolute-value issue.
- **Apply material-specific emissivity** where absolute readings on non-concrete surfaces are required (mesh/formwork ~0.94; do not attempt metal).
- **Capture at ≤ 25 m AGL** for any future work requiring certified absolute temperatures, bringing acquisition inside the rated radiometric envelope and improving GSD to ~3 cm/px.

9.2 To Convert Screening into Verified QA

- **Pair thermal passes with contact moisture readings** on 3–5 reference slabs to calibrate the wet/dry thermal signature to actual moisture state.

- **Log pour times against capture times** to build a curing-versus-time thermal baseline specific to the site's mix and conditions.

9.3 Recurring Programme Opportunity

The validated wet/dry signature supports a repeatable **curing-QA monitoring service**: scheduled thermal passes over new pours, delivering geo-referenced curing-uniformity documentation per block. Executed as a recurring cadence rather than one-off capture, this provides with a low-cost, non-contact QA record across the programme.

10. MAS Capability Statement

This survey demonstrates end-to-end MAS competence in construction-stage aerial thermography: mission planning under KSA airspace regulation, radiometric acquisition, correction-parameter control, disciplined interpretation, and client-grade reporting.

Domain	MAS Capability
Regulatory	GACA RPC UA-38575 · GEOSA licensed · GAMR Prof. Reg. 646781 — full commercial operating stack
Thermal	Radiometric inspection: curing/moisture, thermal anomaly screening, infrastructure surveys (enterprise thermal payloads)
Geospatial	RTK photogrammetry (±1–3 cm w/ GCP), orthomosaics, DSM/DTM, point cloud, GIS/CAD deliverables
Multispectral	Agricultural / vegetation indexing (multispectral payload)
Fleet	Multi-platform enterprise fleet spanning inspection, survey, and cinematic payloads

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Appendix A — Consolidated Measurement Register

Frame	Time	Point	Value	Palette Range	Validity
0003	10:50:39	**SP1**	41.8 °C	34.8–85.2 °C	Valid
0003	10:50:39	**SP2**	70.7 °C	34.8–85.2 °C	Valid
0003	10:50:39	**SQ1 min**	38.8 °C	34.8–85.2 °C	Valid
0003	10:50:39	**SQ1 avg**	61.0 °C	34.8–85.2 °C	Context
0003	10:50:39	**SQ1 max**	83.1 °C	34.8–85.2 °C	Valid
0006	10:51:11	**SP1**	64.8 °C	40.8–90.2 °C	Context
0006	10:51:11	**SP2**	63.5 °C	40.8–90.2 °C	Context
0006	10:51:11	**SP3**	81.7 °C	40.8–90.2 °C	ε-offset
0007	10:51:38	**SP1**	59.4 °C	45.5–93.2 °C	ε-offset
0007	10:51:38	**SP2**	59.4 °C	45.5–93.2 °C	ε-offset
0007	10:51:38	**SP3**	65.3 °C	45.5–93.2 °C	ε-offset

Appendix B — Emissivity Reference (LWIR)

Applied for interpretation weighting. The survey used a single ε = 0.95; the table below indicates where that value holds and where it does not.

Material	Typical ε (8–14 µm)	This Survey
Concrete (cured)	0.92 – 0.95	**Valid**
Concrete (wet)	~0.96	**Valid (marginal)**
Plywood formwork	0.90 – 0.94	**Slight offset**
Curing mesh (fabric)	~0.90 – 0.95	**Offset**
Soil / graded ground	0.92 – 0.95	**Valid**
Oxidised / weathered steel	0.60 – 0.90	**Unreliable**
Bare / galvanised metal	0.10 – 0.30	**Invalid**

END OF REPORT

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