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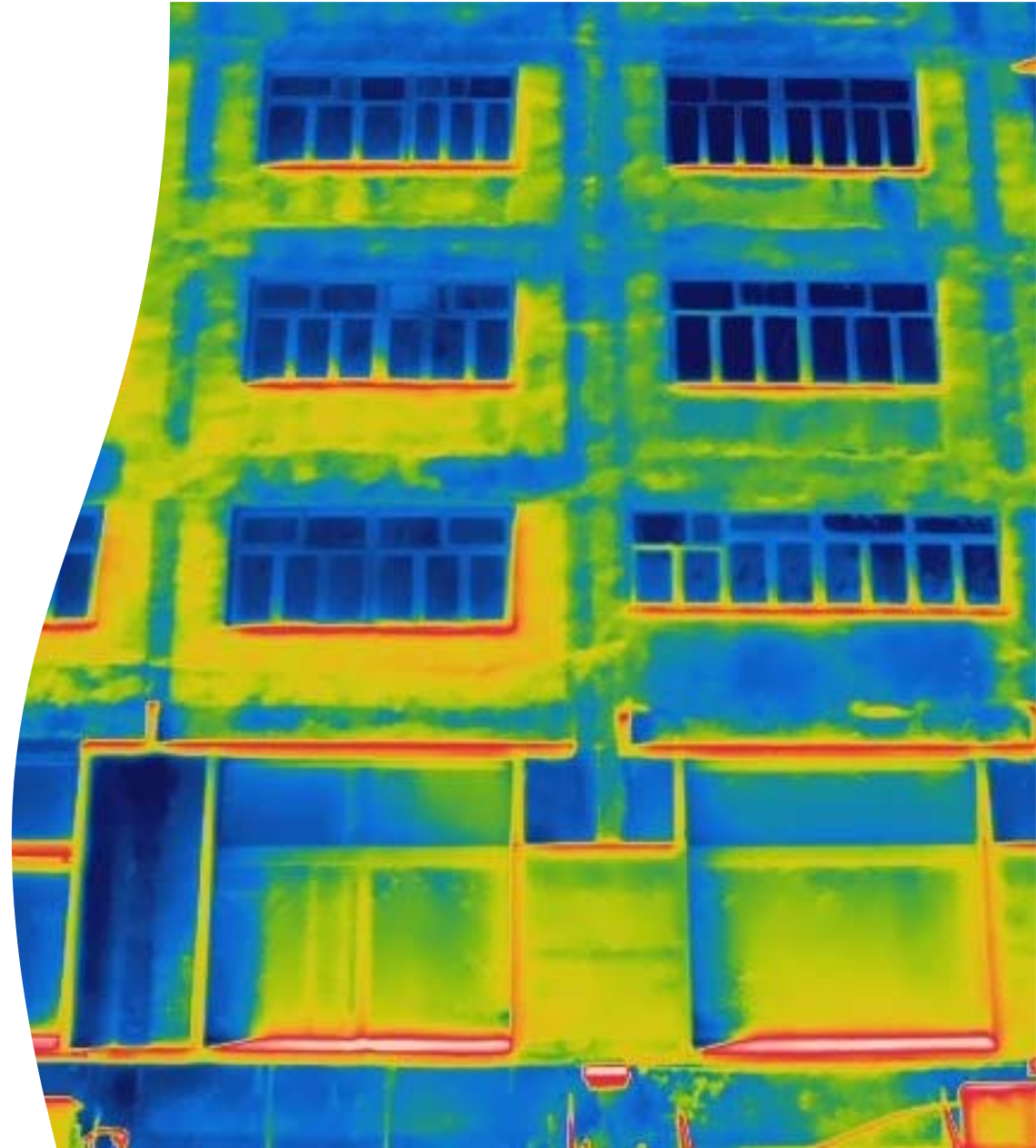
# Common FAQs of Infrared thermography on building envelop inspections: 紅外線外牆檢測的常見問題

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# Background

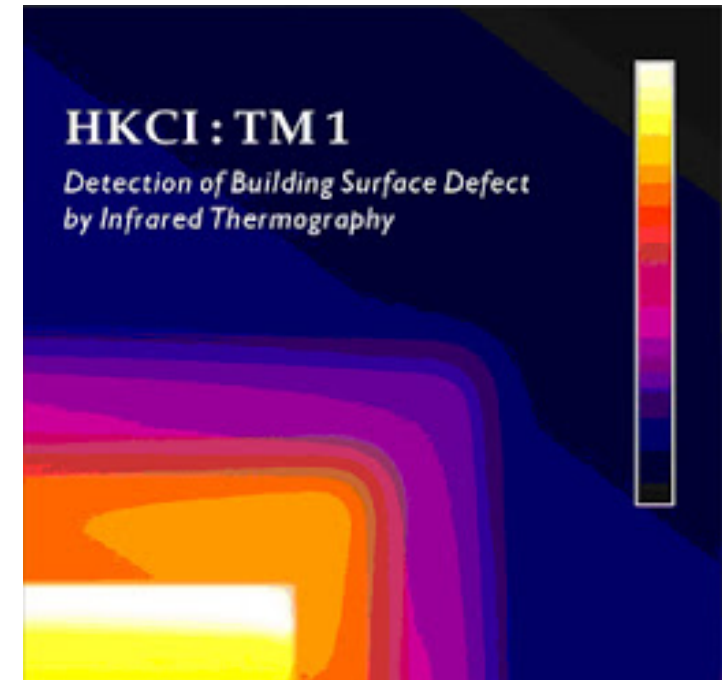
## Mandatory Building Inspection Scheme (MBIS)

Building Department (2005)

- Buildings aged **30 years** or above require to carry regular inspection

## Specifications for IR inspection

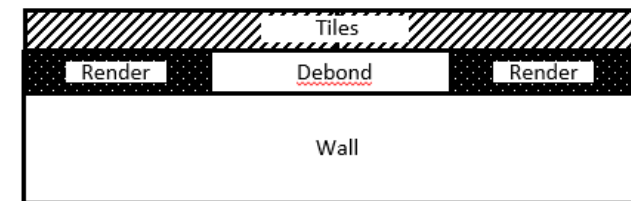
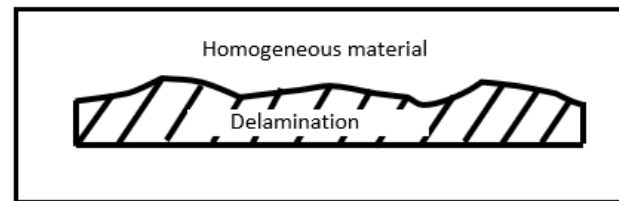
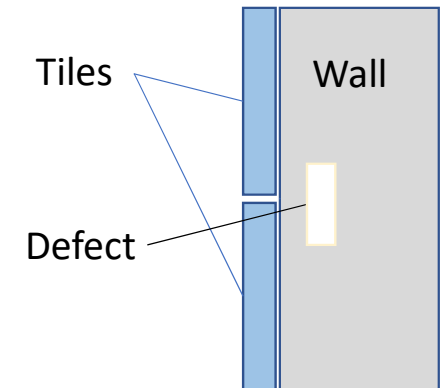
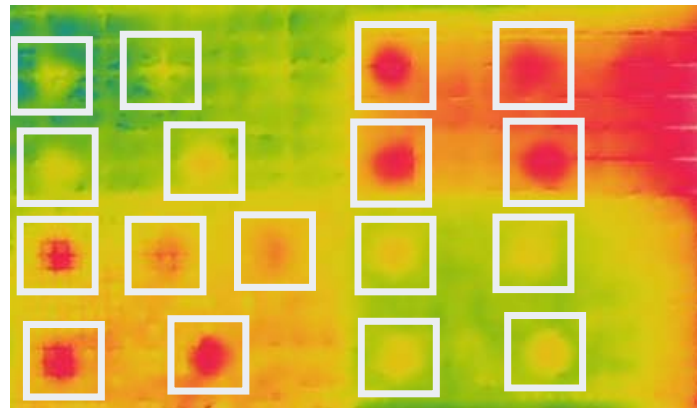
- HKCI TM1 (currently under review)



# Background

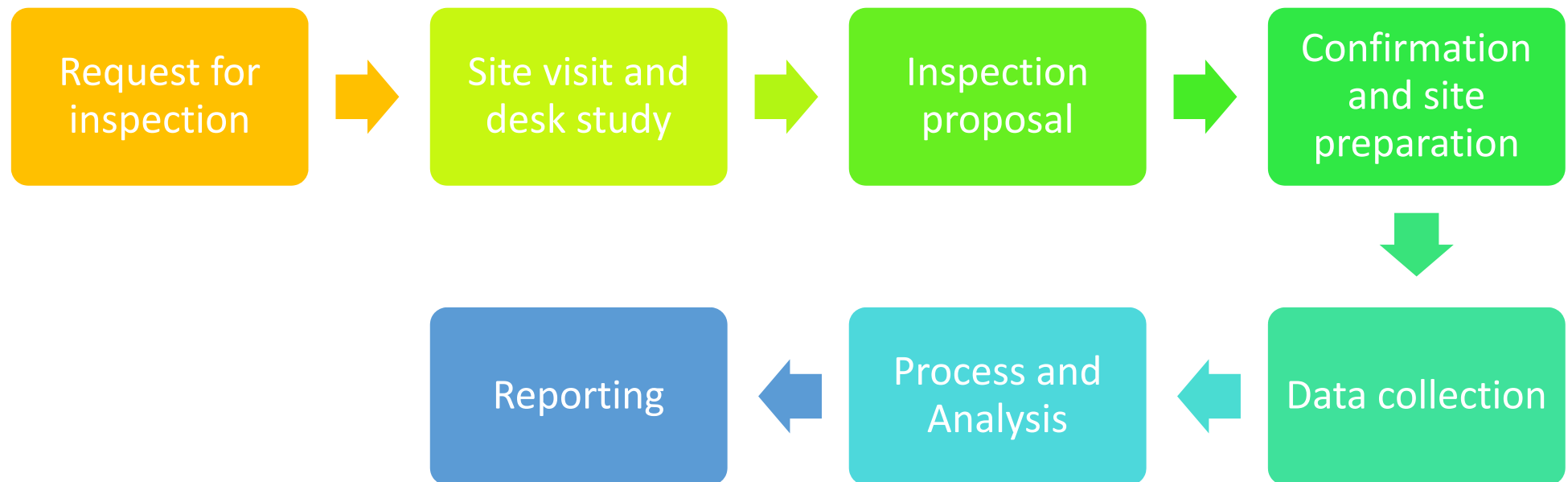
## IRT Inspection

- Looks for defects
  - Delamination
  - Debond
- Defects appear in region of hot temperature



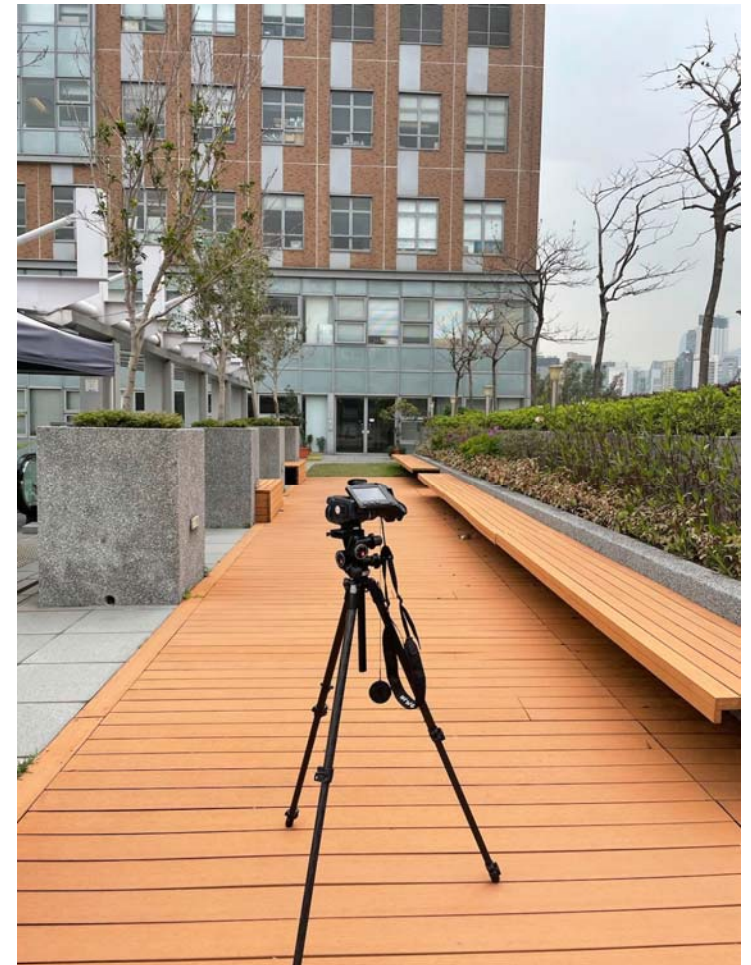
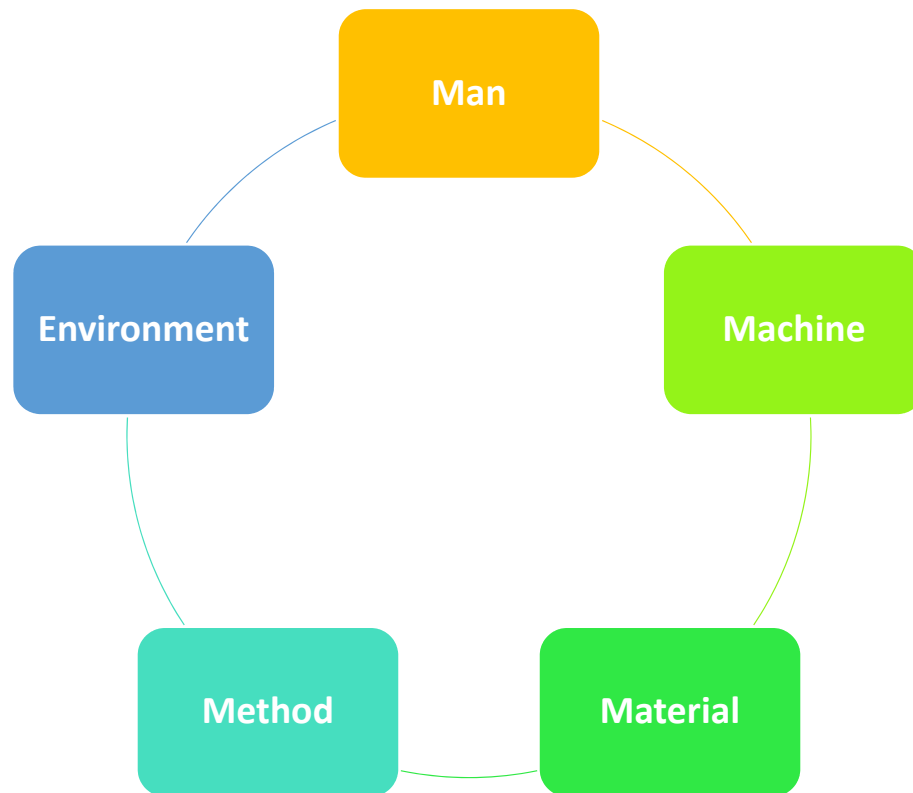


# General Workflow





# Factors affecting IRT Inspection



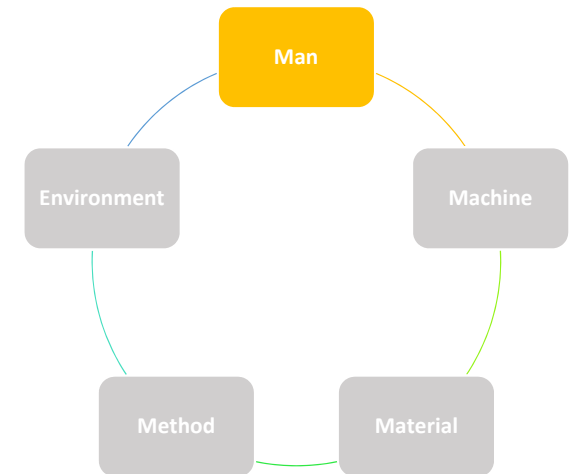
# Factors affecting IRT Inspection

## *Man – Personnel*

HKCI TM1 (2<sup>nd</sup> Edition – under review)

Personnel Qualifications of **signatories** and  
**testing personnel** are updated according to

HOKLAS SC No.19



### Signatories

- Level **2**  
Thermography  
or
- Other  
equivalent  
qualifications

### Testing personnel

- Level **1**  
Thermography  
or
- Other  
equivalent  
qualifications

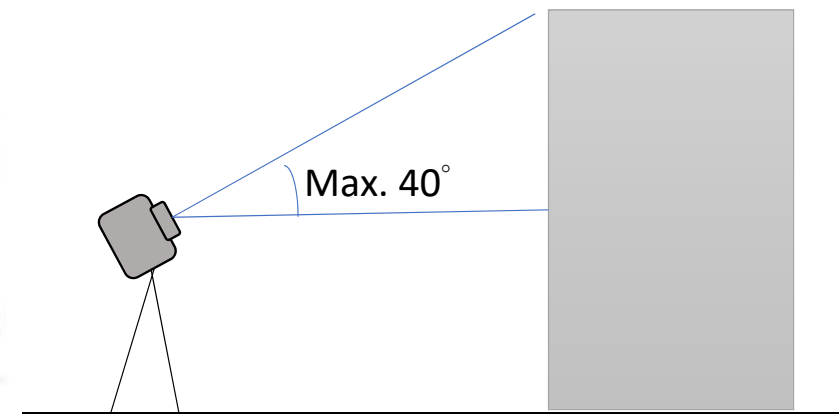
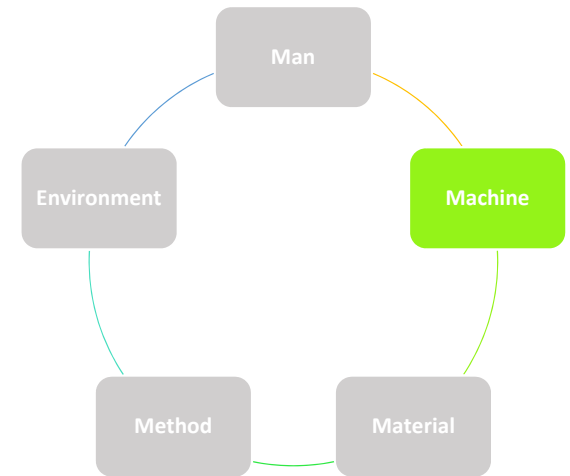
# Factors affecting IRT Inspection

## *Machine – Instrument*

HKCI TM1 (2<sup>nd</sup> Edition – under review)

Angle of incidence should be  $< 40^\circ$

- For high-rise buildings, robotic device (e.g. UAV) equipped with radiometric IR camera could be used





# Factors affecting IRT Inspection

## *Machine – Instrument*

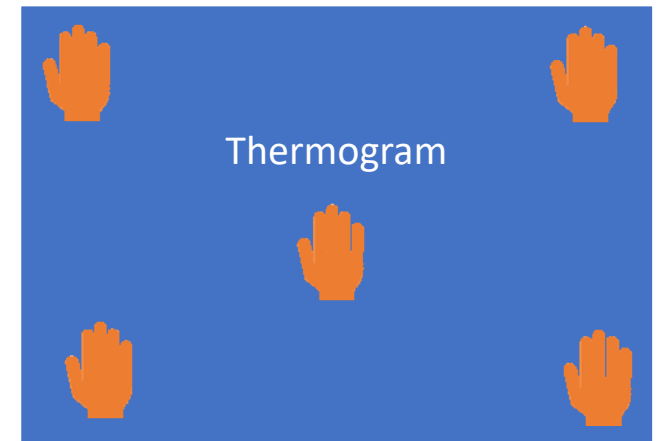
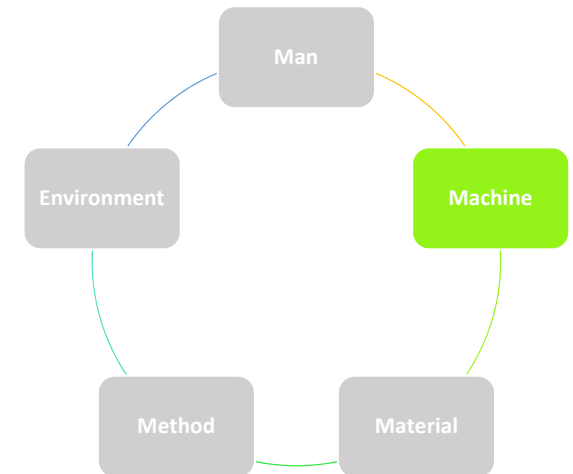
HKCI TM1 (2<sup>nd</sup> Edition – under review)

On-site functionality test

*Original:* 3-point test comparing IR-measured temperature and thermocouple-measured temperature. If difference < 2 degC, okay.



*Reviewed:* recognizing a distinct object (e.g. fingers) clearly at five locations



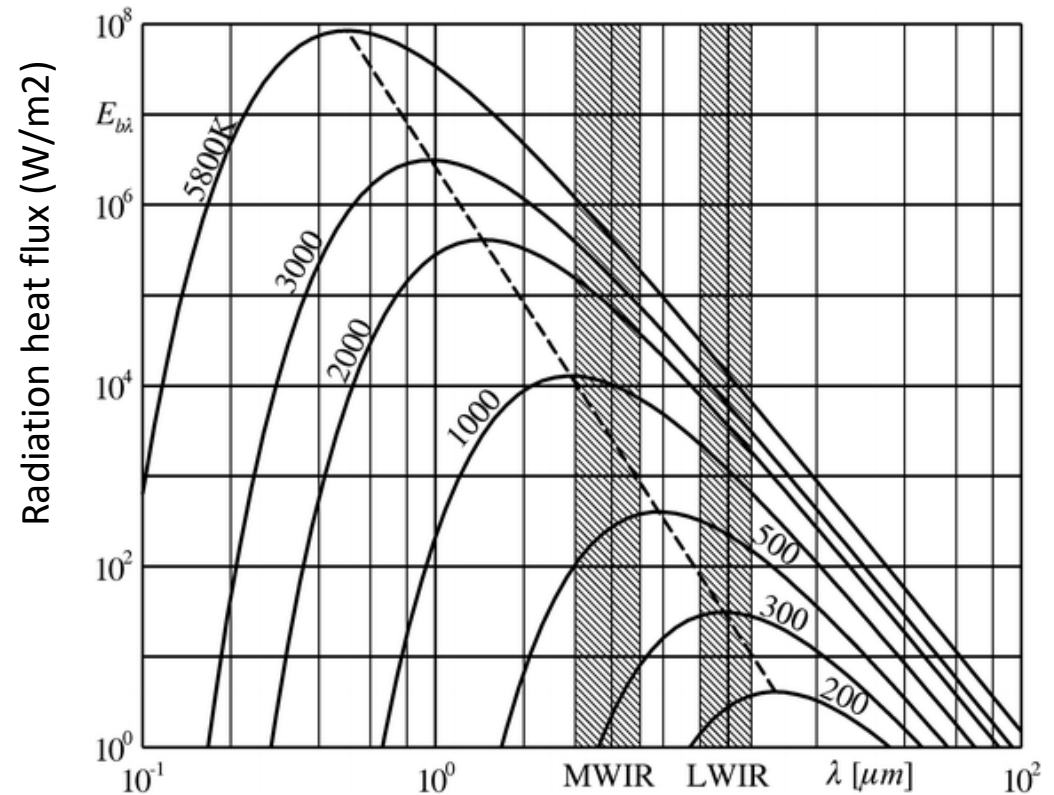
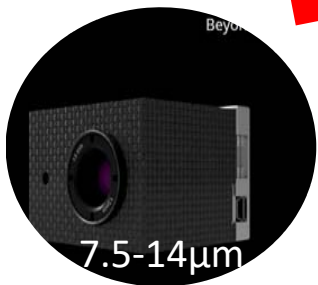


# Heat transfer by Radiation (Planck's law) captured by IR cameras

Influence of partial reflection:

- Disturbing background radiation from a 3000 K hot lamp
- Radiated power in MWIR is 13 times higher than in LWIR
- Primary signal (difference between 300K and 295K) is significantly smaller in MWIR.

**Why are we concerned about the 300K?**

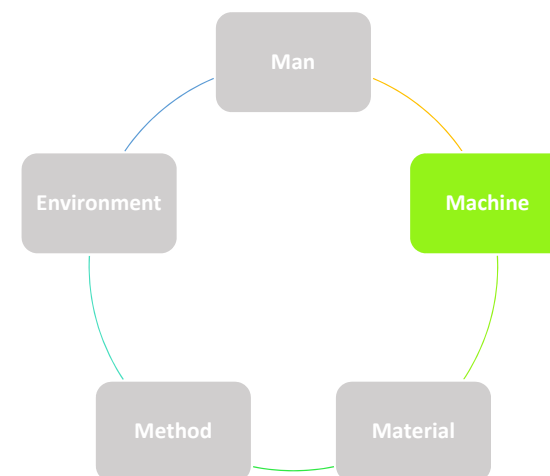


# Factors affecting IRT Inspection

## *Machine – Instrument*

HKCI TM1 (2<sup>nd</sup> Edition – under review)

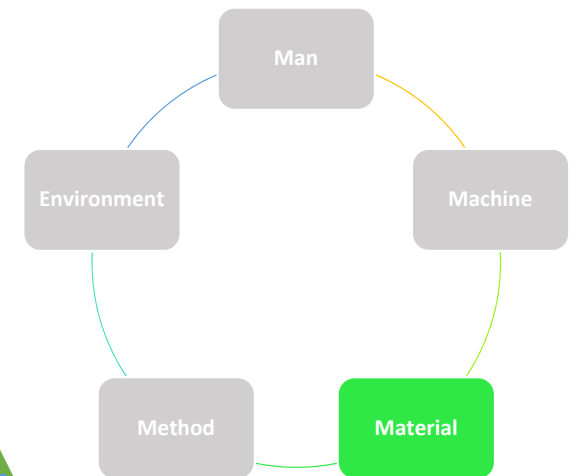
Calibration



Type of equipment	Recommended maximum period between successive calibration/verification	Recommended calibration/verification procedure
Infrared imaging device	5 years	<ul style="list-style-type: none"> <li>Calibrate using reference black bodies</li> </ul>
	1 year	<ul style="list-style-type: none"> <li>Carry out the uniformity check on a flat target with a high emissivity (at least 0.9)</li> </ul>
	Before each test	<ul style="list-style-type: none"> <li>Check the working performance, e.g. fingerprint test</li> </ul>

# Factors affecting IRT Inspection

## *Material – Target*

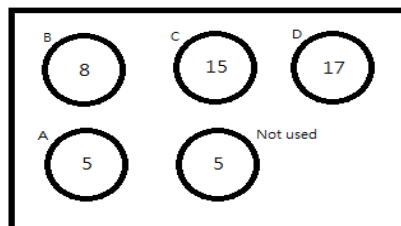


Depends on the emissivity of the material



# Factors affecting IRT Inspection

## *Material – Target*

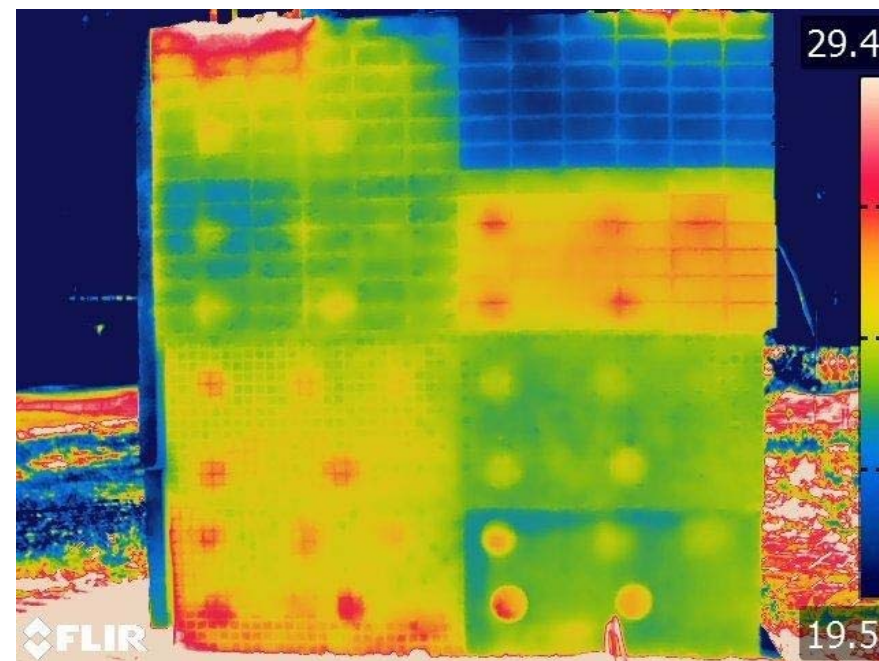
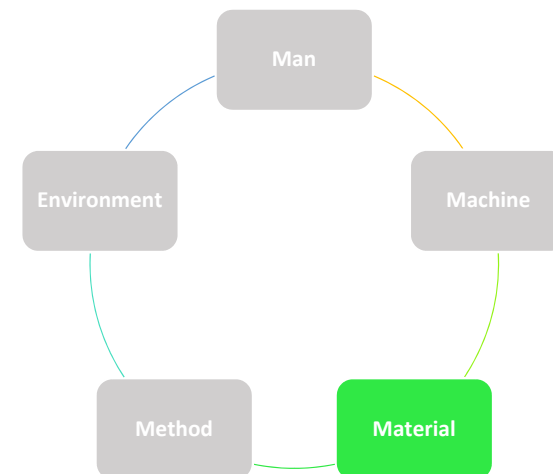


8 demonstrates the depth of debond (in mm)

- Tile: Matt Black  
Size: 95mm x 45mm
- Tile: Grey Ceramic  
Size: 95mm x 45mm
- Tile: Blue Mosaic  
Size: 19mm x 19mm
- Tile: Mixed-color Mosaic  
Size: 19mm x 19mm



- Tile: Reflective White  
Size: 95mm x 45 mm
- Tile: Smooth Black  
Size: 95mm x 45 mm
- Tile: White Mosaic  
Size: 19mm x 19 mm
- Tile: Fair-face Concrete  
Size: N/A





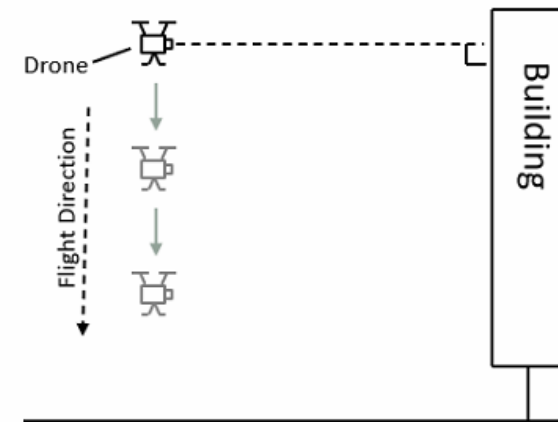
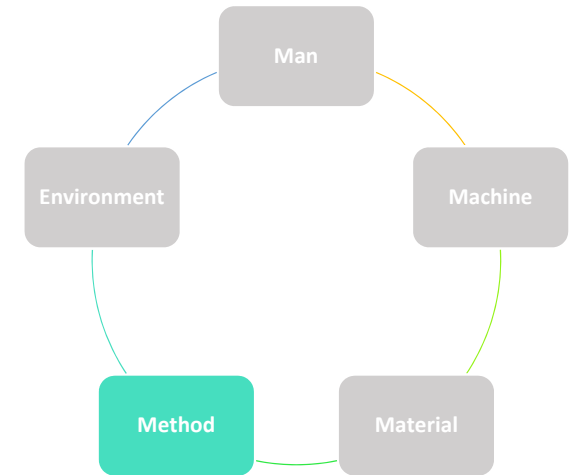
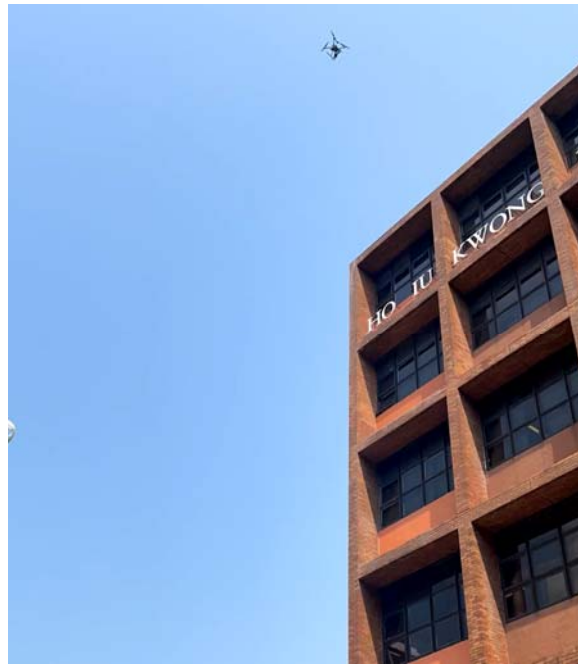
# Factors affecting IRT Inspection

## *Method*

Normal case – ground-based



High-rise buildings – with UAV

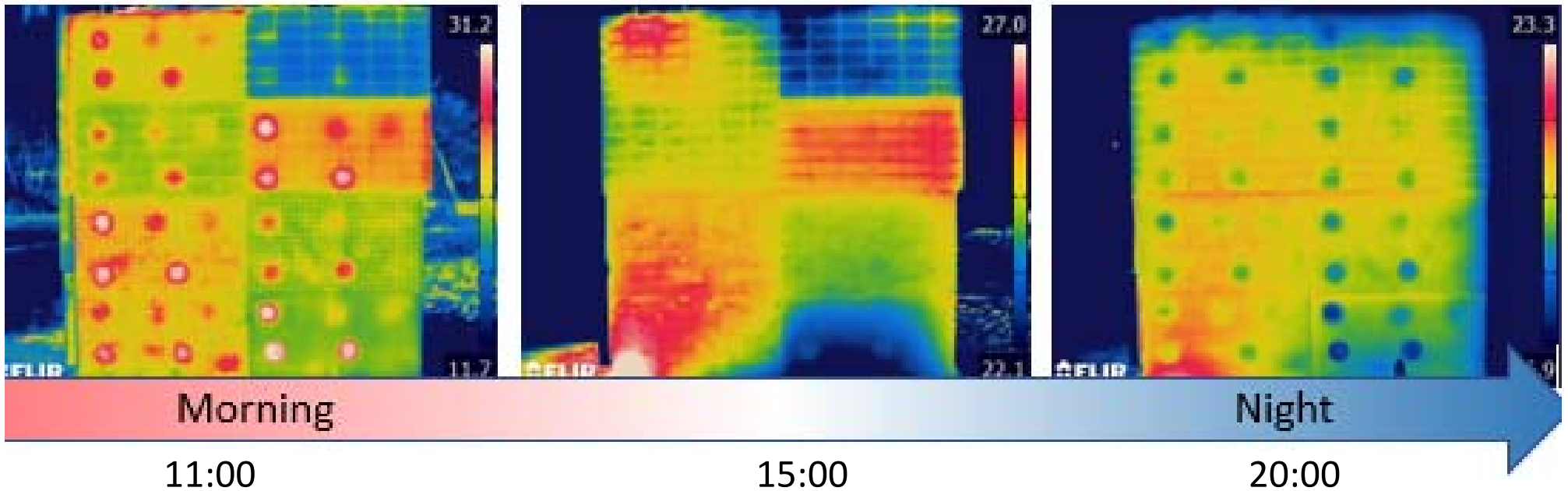
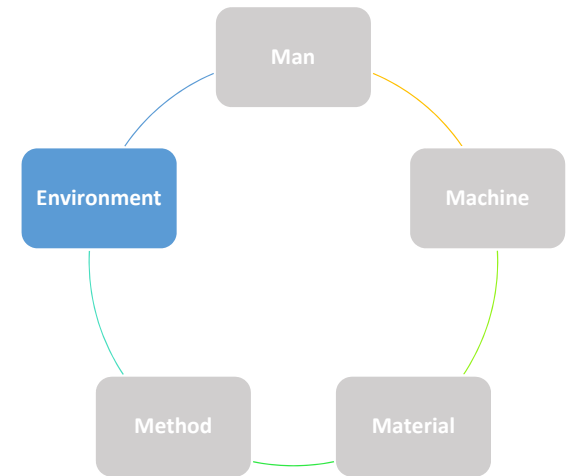




# Factors affecting IRT Inspection

## *Environment*

Time Factor

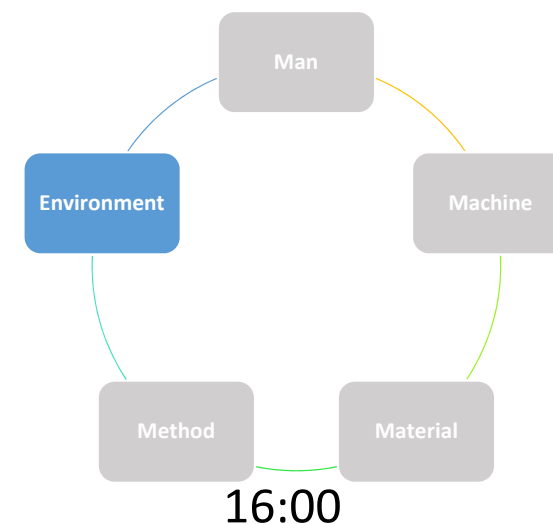




# Factors affecting IRT Inspection

## *Environment*

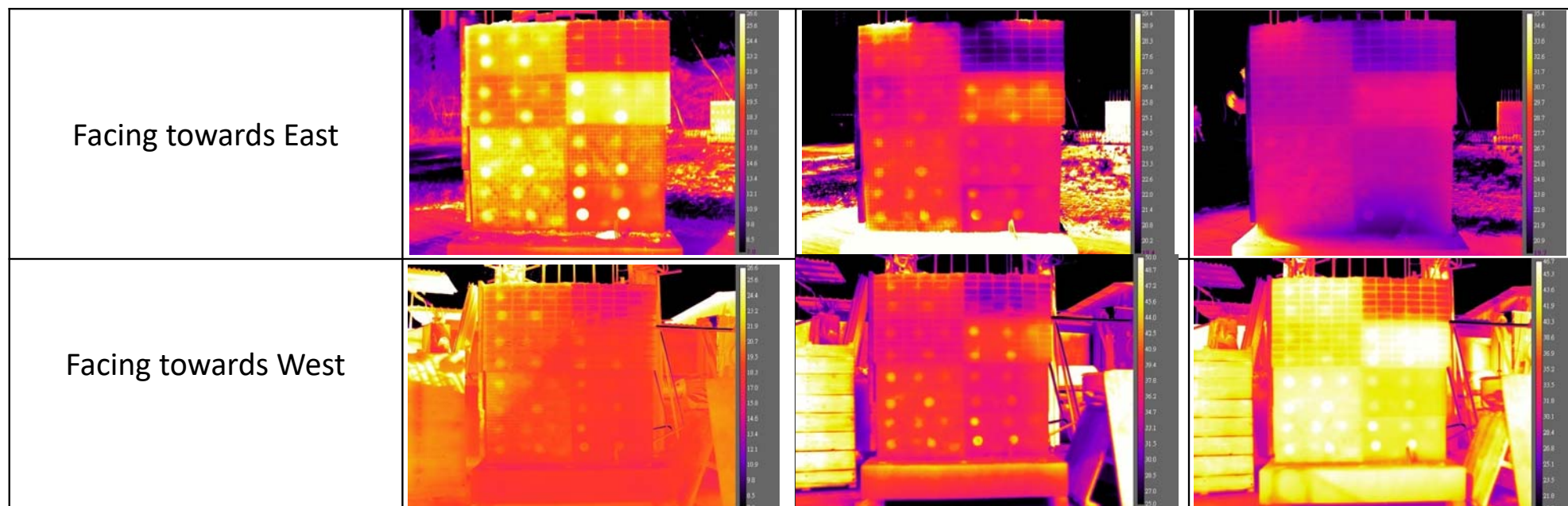
Orientational Factor



10:00

13:00

16:00



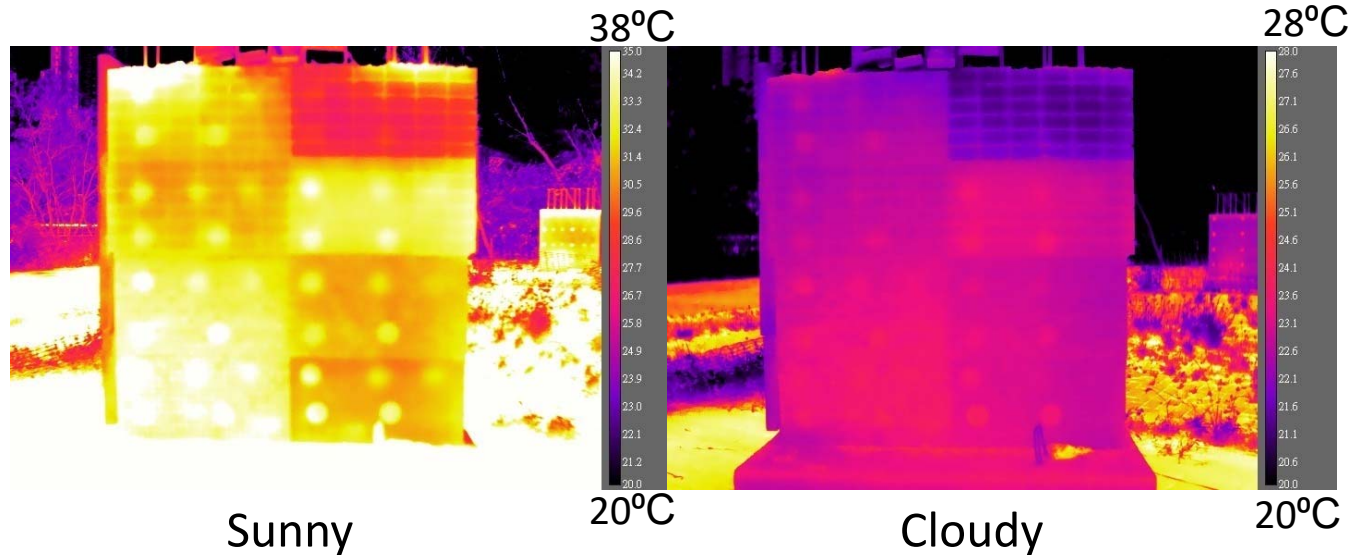
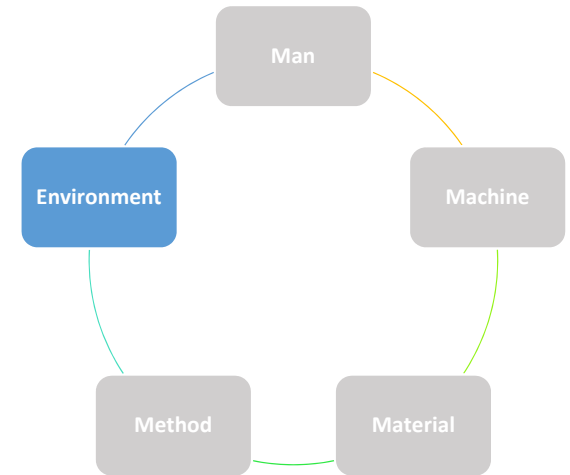


# Factors affecting IRT Inspection

## *Environment*

### Fine Weather

- Cloud coverage:  $< 6/8$
  - Wind speed:  $< 6.5 \text{ m/s}$
  - 2-3 days prior to survey
- **at least 12 hours** prior to survey

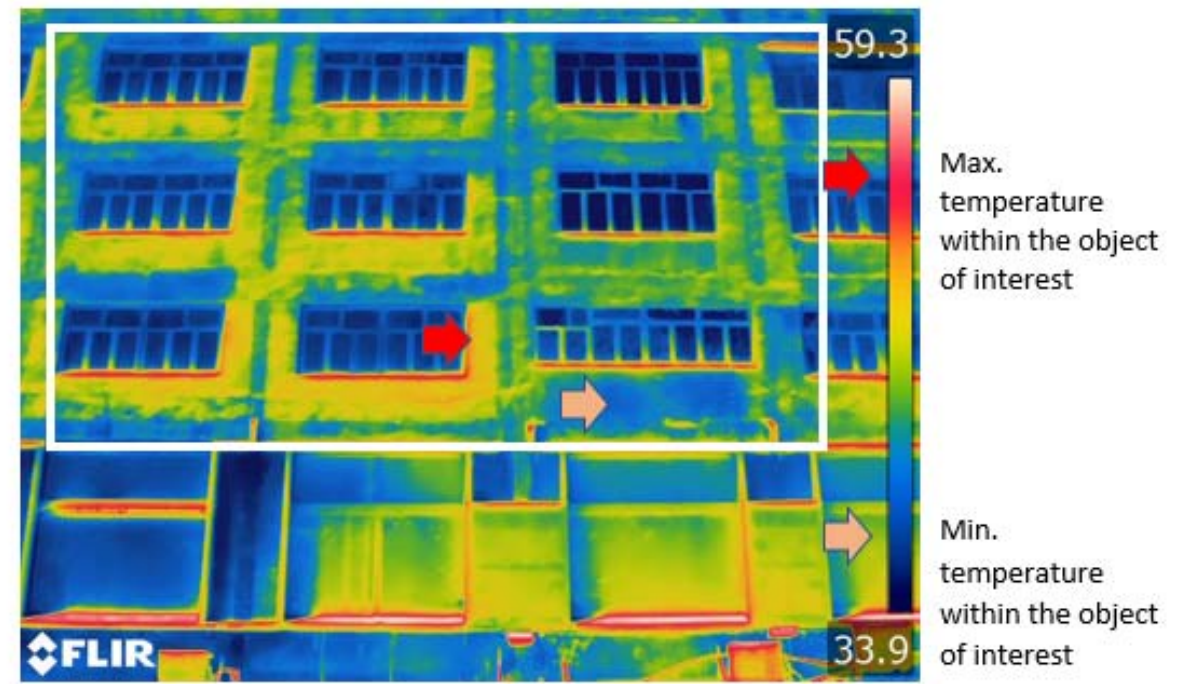




# Processing

## *Infrared Image Interpretation*

- Temperature span: max. and min. temperature within objects of interest
- Evenly/linearly distributed colour palette



# Reporting - Limitations

HKCI TM1 (2<sup>nd</sup> Edition – under review)

Commonly found limitations

Limitations	Reasons of declaring 'Survey Unreliable'	Reasons of declaring 'Survey not successful'
A. Reflections from other sources	Applicable	Applicable
B. Insufficient thermal contrast	Applicable	Applicable
C. Unable to gain access	Not Applicable	Applicable
D. Angle of inclination	Not Applicable	Applicable





*Thank You!*

*Q & A?*



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