

Structural Health Monitoring of century-old structure—an initiative for heritage conservation

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Contents

- Brief significance of SMAPC
- Importance of cultural heritage conservation
- Issues and concerns
- Gameplan
 - (a) Evaluate microclimatic parameters*
 - (b) Recognize crack image patterns*
- Baby steps towards our initiative



(a)

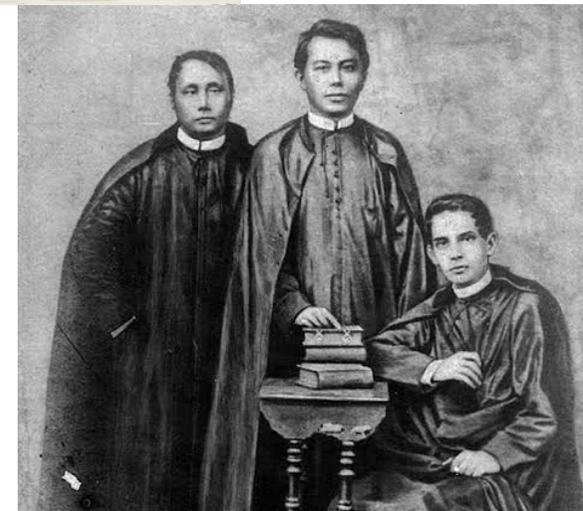


(b)

(a) Façade and **(b)** interior structures of St. Michael, the Archangel Parish Church, Bacoor City, Cavite, PH

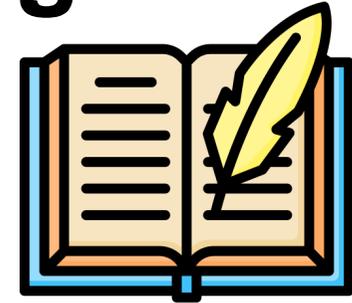
Brief significance of the structure

- Built in 1752, St. Michael, the Archangel Parish Church was one of the oldest churches in the Province of Cavite.¹
- It was declared by National Museum of the Philippines as an important cultural property.¹
- It was served by Fr. Mariano Gomez, a Filipino secular priest and one of the triumvirates of GomBurZa who were sentenced to death by garrote in 1872.²



Importance of cultural heritage conservation

- Access to historical and educational value
- Preserve the cultural identity and sense of belonging
- Promote economic tourism and sustainable development



| | |
|---|---|
| 11 SUSTAINABLE CITIES AND COMMUNITIES  | Make cities and human settlements inclusive, safe, resilient and sustainable |
| | Target 11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage |

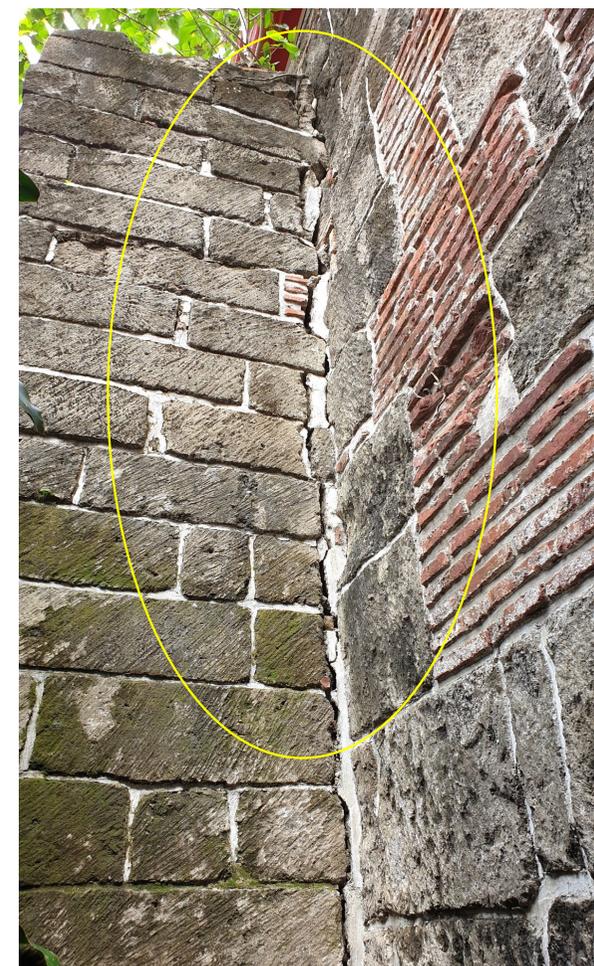
Issues and concerns (1/3)



Issues and concerns (2/3)



Issues and concerns (3/3)



Gameplan

SHM of concrete

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graph TD; A[SHM of concrete] --- B[Evaluation of microclimatic parameters]; A --- C[Image pattern recognition of cracks];
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Evaluation of microclimatic parameters

Image pattern recognition of cracks

Evaluate microclimatic parameters

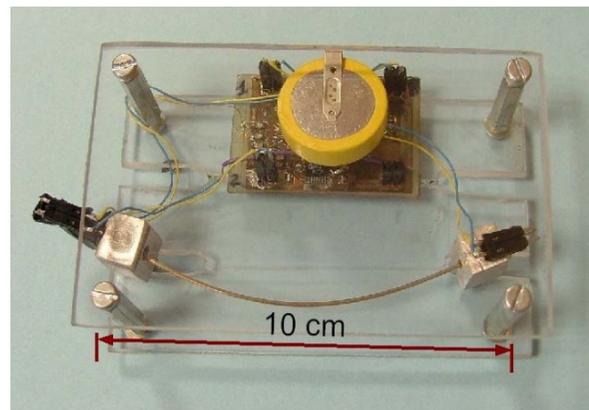
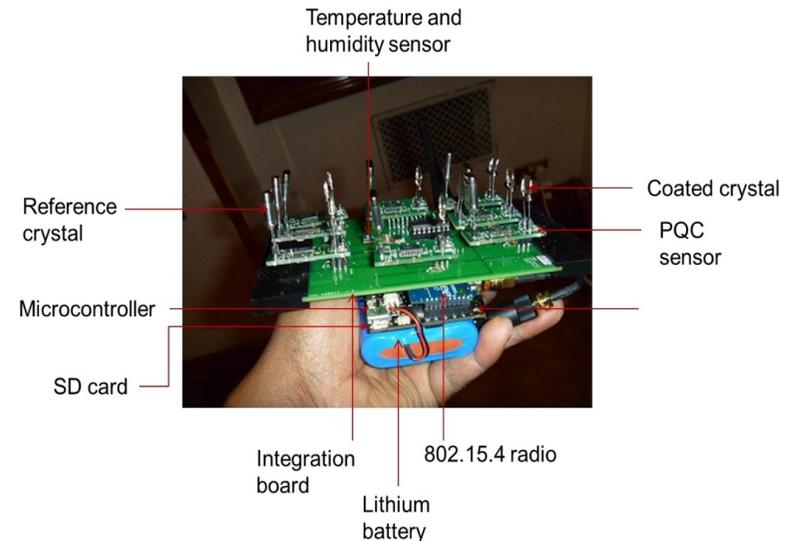
• *Parameters to be measured:*

1) Temperature^{3, 4}

2) Relative humidity^{3, 4}

3) Pollutants & gas sensing^{5, 6}

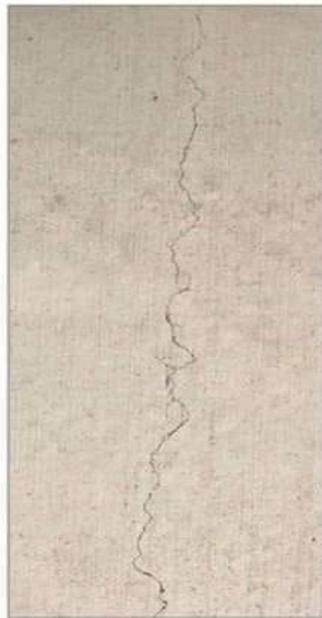
4) Angle of inclination⁷



Recognize cracks image pattern (1/2)

TYPES OF CONCRETE CRACKS

Some concrete cracks are more concerning than others but they're all considered bad and unnecessary. Here's an overview of different types of cracks that are common in concrete work.



HAIRLINE

Minor surface level cracks caused by a variety of reasons.



SHRINKAGE

Minor surface level cracks caused from shrinking concrete.



SETTLEMENT

Medium cracks caused when the ground below concrete settles.

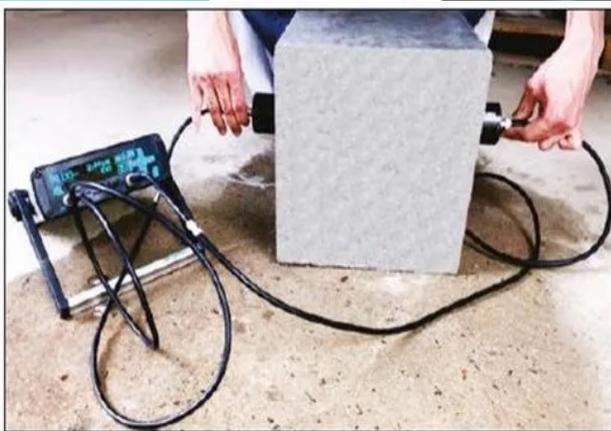
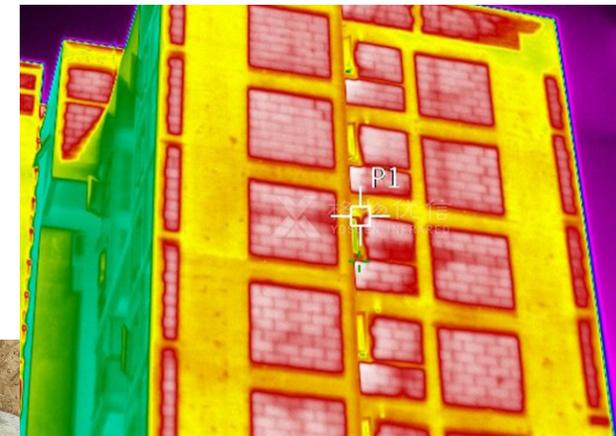
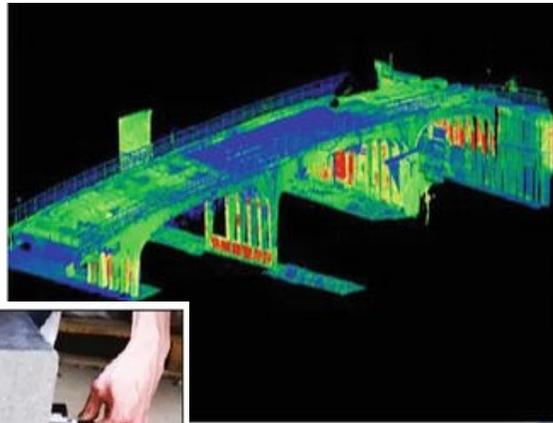


STRUCTURAL

Large more serious concrete cracks.

Recognize cracks image pattern (1/2)

- Methods of data gathering are usually carried out by UAV, ultrasonic pulses, terrestrial laser scanning, ground penetrating radar, and IR thermal cameras.



Baby steps towards our initiative



Initial inspection of NHCP on 23 Feb 2024



References

- ¹ Simbahan ng Bacoor. (2024). <https://bacoor.gov.ph/tourism/st-michael-the-archangel-church/>
- ² Remembering the GOMBURZA throughout the Years. (2022). <https://nhcp.gov.ph/remembering-the-gomburza-throughout-the-years/>
- ³ Mesas-Carrascosas, et al. (2016). Monitoring Heritage Buildings with Open Source Hardware Sensors: A Case Study of the Mosque-Cathedral of Córdoba. *Sensors*. **16**, 1620.
- ⁴ Varas-Muriel and Fort. (2018). Microclimatic monitoring in an historic church fitted with modern heating: Implications for the preventive conservation of its cultural heritage. *Building and Environment*. **145**, 290-307.
- ⁵ Odlyha, et al. (2005). Microclimate indoor monitoring: damage assessment for cultural heritage preservation. *14th Triennial Meeting The Hague Preprints*. **2**, 670-676.
- ⁶ Neri, et al. (2009). Environmental Monitoring of Heritage Buildings. *2009 IEEE Workshop on Environmental, Energy, and Structural Monitoring Systems*, Crema, Italy, 93-97.
- ⁷ Bezas, et al. (2020). Structural Health Monitoring in Historical Buildings: A Network Approach. *Heritage*. **3**, 796-818.



Thank You!

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