IMPACT REPORT 2026

SHAPING SUSTAINABLE HERITAGE FUTURE

NUS-Architectural Conservation Laboratory

NUS ArCLab

CONTENTS

PRINCIPAL INVESTIGATOR'S FOREWORD

Shaping heritage futures in a changing Singapore

Dr. Nikhil Joshi
Principal Investigator, NUS-ArCLab

As the city-state continues to evolve rapidly under pressures of redevelopment, climate change, and technological transformation, the NUS-Architectural Conservation Laboratory (ArCLab) has emerged as a critical platform for advancing heritage conservation research, capacity building, and professional practice. In a relatively short period, it has established itself as a leading hub that bridges scholarship, policy, and on-the-ground conservation work in Singapore and the wider region.

One of the NUS-ArCLab's most significant impacts lies in its research agenda, which is explicitly grounded in the realities of a dense, tropical, and highly urbanised context. Moving beyond conventional preservation models, the ArCLab has advanced interdisciplinary research that integrates architectural history, materials science, environmental performance, digital documentation, and urban studies. Its projects address pressing questions such as how traditional building materials perform under intensifying heat and humidity, how historic structures can be adapted to meet contemporary sustainability standards, and how heritage value can be retained amid large-scale urban renewal. By situating conservation within broader debates on resilience and sustainability, the ArCLab has helped reposition heritage as a forward-looking asset rather than a constraint on development.

The NUS-ArCLab has also played a key role in strengthening technical knowledge and evidence-based practice. Through systematic material analysis, condition assessment, and conservation diagnostics, it has generated data that informs more precise and durable interventions in historic buildings. This emphasis on scientific rigour has contributed to raising professional standards in conservation practice in Singapore, supporting decisions that balance authenticity, longevity, and environmental performance. Importantly, the ArCLab work demonstrates how research outcomes can directly inform policy and guidelines for conservation projects, reinforcing the relevance of academic research to real-world applications.

Education and training form a second major pillar of impact. Since its establishment, the NUS-ArCLab has supported the training of students, early-career professionals, and mid-career practitioners through studio-based learning, workshops, seminars, and hands-on laboratory work. These programmes expose participants to conservation challenges that are specific to Singapore and South-east Asia, such as adaptive reuse in high-density settings and the conservation of post-war modern architecture. By embedding research into teaching, the ArCLab has helped cultivate a new generation of architects, planners, and conservation specialists who are analytically rigorous, technologically adept, and sensitive to cultural context.

Beyond the university, the NUS-ArCLab has actively engaged with government agencies, professional bodies, and industry partners. These collaborations have strengthened links between research, regulation, and practice, enabling knowledge exchange across sectors. The ArCLab has contributed expert input to conservation-related discussions, offering research-backed perspectives on issues ranging from materials performance to heritage impact assessment. Such engagement has reinforced the role of the university as a trusted knowledge partner in shaping Singapore's conservation landscape.

By embedding research into teaching, the ArCLab has helped cultivate a new generation of architects, planners, and conservation specialists who are analytically rigorous, technologically adept, and sensitive to cultural context.

Public engagement and outreach further extend the NUS-ArCLab influence. Through lectures, exhibitions, and public-facing publications, it has helped broaden understanding of architectural heritage among non-specialist audiences. By communicating complex research findings in accessible ways, the ArCLab has contributed to fostering a more informed public discourse on heritage and identity. This is particularly important in a rapidly changing city, where public support and awareness are essential for sustaining long-term conservation efforts.

Regionally, the NUS-ArCLab has begun to position Singapore as a centre for conservation research and training in Southeast Asia. By addressing issues common to tropical and post-colonial contexts, its work resonates beyond national boundaries. Partnerships and knowledge exchange with regional institutions have laid the groundwork for future collaboration, enhancing Singapore's contribution to global conservation discourse while learning from diverse regional practices.

Looking ahead, the NUS-ArCLab remains committed to heritage conservation research, education, and practice in Singapore by combining scientific rigour, interdisciplinary inquiry, and strong stakeholder engagement. As Singapore continues to transform, the ArCLab is well positioned to play an even more influential role in shaping how the past is understood, valued, and responsibly integrated into the nation's future.

INTRODUCTION

In November 2022, the NUS-Architectural Conservation Laboratory (ArCLab) was inaugurated as a laboratory dedicated to advancing research, education, and practice in architectural conservation within the Department of Architecture at the National University of Singapore. The laboratory is housed in a 1880s historic townhouse acquired by the Portabella family in 2020, and generously donated to support heritage conservation and sustainable stewardship of the built environment.

The laboratory stands along Neil Road, a one-way street lined with historic shophouses and townhouses that reflect Singapore's late 1800s urban residential fabric. It is located within the Blair Plain conservation area, which was officially gazetted in October 1991.

Inauguration of NUS-ArCLab on 14 November 2022.

Since its inception, NUS-ArCLab has endeavoured to strengthen capacity within the architectural conservation sector, advance research and technological solutions to address climate change in historic buildings, and bridge the divide between professional expertise and public understanding.

The contributions of NUS-ArCLab are assessed against the United Nations Sustainable Development Goals (SDGs), with the impacted goals outlined below.

NUS-ArCLab has established an international presence, engaging partners, researchers, and practitioners across 22 countries through research, collaboration, and knowledge exchange.

Global Footprint

22 Countries Engaged

1. Australia
2. Bangladesh
3. Canada
4. China
5. France
6. Hong Kong SAR, PRC
7. India
8. Indonesia
9. Italy
10. Japan
11. Kenya
12. Malaysia
13. New Zealand
14. Pakistan
15. Portugal
16. Republic of Korea
17. Sri Lanka
18. Thailand
19. The Netherlands
20. The Philippines
21. USA
22. UK

NUS-ArCLab's impact was measured across three key themes aligned with its goals.

RESEARCH & COLLABORATIONS

31 Research Publications Dissertations

39 Collaborations

OUTREACH

463 Activities

EDUCATION & TRAINING

274 Individuals trained

RESEARCH AND COLLABORATIONS

01

At NUS-ArCLab, impactful heritage conservation begins with rigorous research and meaningful collaborations. Our approach is rooted in interdisciplinary inquiry, where traditional knowledge intersects with emerging technologies such as digital documentation, materials science, and climate resilience studies.

We engage with local and international partners, including academic institutions, government agencies, NGOs, and practitioners, to develop frameworks that are both contextually relevant and globally informed. These collaborations enrich our understanding of historic environments and contribute to shaping policies and practices in conservation.

By prioritising research that addresses real-world challenges, such as climate change and material degradation, NUS-ArCLab ensures that conservation solutions are sustainable, inclusive, and future-facing. The lab also supports student and faculty-led research initiatives, encouraging a culture of critical inquiry. Through these efforts, ArCLab not only generates new knowledge but also nurtures a collaborative ecosystem that advances the theory and practice of heritage conservation in Singapore and the region.

Singapore currently has over 7,000 conserved buildings and 77 national monuments, forming a significant component of the nation's built heritage. These buildings operate under stricter regulatory controls and typically incur higher maintenance and retrofit costs than the wider building stock. As Singapore advances its net-zero ambitions and climate mitigation targets, retrofitting heritage buildings must become a strategic priority. This requires a holistic and integrated approach that moves beyond compliance-driven upgrades to consider user behaviour, adaptive comfort, and occupant well-being, areas often overlooked in energy studies that focus predominantly on new construction.

The “Material & Materiality” project addresses this gap by advancing climate-responsive conservation practice for old buildings through a hybrid experimental–computational framework. Conducted between 2023 and 2025 at the NUS-ArCLab within the Blair Plain Conservation Area, the research developed and evaluated a lightweight, permeable clay roof tile and tile-fixing methods, in collaboration with Kansai University (Osaka, Japan) and Kamedani Ceramics (Hamada, Japan). The innovation directly addresses the thermal limitations of dense imported clay tiles that exacerbate solar heat gain in Singapore’s hot-humid climate.

Discussion with NUS-ArCLab, Kansai University, and a local roofing contractor.

Sensors on the existing roof and a full-scale, sensor-instrumented roof mock-up in the backyard of NUS-ArCLab generated empirical data on temperature, humidity, and airflow, which are used to validate Computational Fluid Dynamics simulations and whole-building energy models. Findings identify the roof as the principal source of thermal heat gain, underscoring the importance of targeted roof optimisation. Parametric studies examining tile geometry, permeability, ventilation strategies, and solar reflectance establish an evidence-based, low-risk retrofit methodology that enhances thermal performance while safeguarding historic fabric. The project provides a scalable model for climate-adaptive conservation across tropical historic contexts.

NUS-ArCLab’s conservation project represents a pioneering effort to demonstrate that deep decarbonisation is achievable within Singapore’s historic building stock. Located within the Blair Plain Conservation Area, the ArCLab is being retrofitted to achieve a net-zero operational energy target while pursuing Building and Construction Authority (BCA) Green Mark Platinum Zero Energy certification, the highest tier of national sustainability recognition.

Weather station that monitors air flow, humidity, temperature, solar radiation and air pollution concentration.

This initiative is particularly significant given that conserved buildings operate under stricter regulatory controls, material compatibility requirements, and cost constraints compared to new developments. By targeting net-zero performance within these limitations, the project establishes a credible and transferable pathway for aligning heritage conservation with Singapore’s national climate commitments. Developed in collaboration with Liu & Wo Architects and Ramboll, the retrofit strategy integrates passive design optimisation — such as roof permeability enhancement, improved natural ventilation, and reduction of solar heat gain — with high-efficiency building systems, intelligent energy management, and on-site renewable energy solutions.

> “ArCLab exemplifies the fusion of conservation and environmental congruency; a synthesis essential to the regeneration of the natural world and to the harmonious alignment of the built and natural environments.”
>
> **Dr. Hossein Rezai-Jorabi**
> Global Design Director, Ramboll & Milan Research Lab

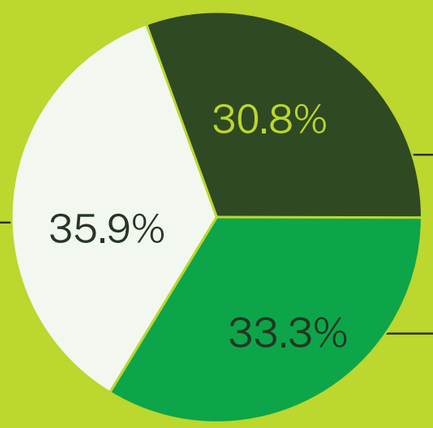
Study by Ramboll for the potential photovoltaic panel locations in NUS-ArCLab.

Beyond technical metrics, the project incorporates continuous monitoring and verification systems to track real-time energy consumption, thermal comfort, and indoor environmental quality. This ensures that decarbonisation outcomes are evaluated holistically, balancing performance targets with occupant well-being and adaptive comfort. As a living laboratory, NUS-ArCLab translates research into demonstrable practice, informing policy development, conservation guidelines, and professional training. Its impact extends beyond a single site, offering a scalable model for climate-adaptive retrofitting across Singapore’s extensive portfolio of conserved buildings and national monuments.

Research Supported

- **6** PhD Candidates
- **19** Dissertation Projects
- **5** Research Publications

Collaborations



- 12 LOCAL ORGANISATIONS
- 14 FOREIGN ORGANISATIONS
- 13 EDUCATIONAL INSTITUTIONS

Total Partners: 39 Institutions

Sustainable Development Goals (SGDs) Addressed

IMPACT

Generating Research Data

As an intact historic townhouse retaining key architectural features and passive environmental strategies, the site produces primary data supporting research on tropical heritage conservation, materials performance, and adaptive reuse.

Testing and Applying Conservation Research

Operating as a live testing environment, the laboratory enables evaluation of conservation methodologies, innovations, repair strategies, material compatibility, and long-term maintenance approaches within an authentic historic structure.

Supporting Singapore Green Plan 2030 through Historic Buildings

Research and innovations advance Singapore's climate resilience goals by reducing the environmental impacts and improving the sustainability of heritage buildings in the built environment.

Promoting Responsible Consumption and Production in the Built Environment

By highlighting the environmental value of conserving and adapting existing buildings, the laboratory shows how retaining embodied carbon and improving resource efficiency can offer sustainable alternatives to demolition and reconstruction.

Enriching International Heritage Conservation Discourse and Practice

Interdisciplinary collaboration across heritage conservation and related fields brings together diverse cultural and disciplinary perspectives, enriching debate and contributing to regional and international discussions on conservation practice.

EDUCATION AND TRAINING

3D laser scanning workshop for historic building documentation

02

The NUS–Architectural Conservation Laboratory (ArCLab) serves as a national and regional platform for capacity building in architectural conservation, strategically bridging research, professional practice, and public policy.

Conceived as a hands-on training and demonstration facility, NUS-ArCLab equips building professionals such as contractors, consultants, and government officers with applied technical competencies in traditional materials, conservation science, building pathology, and diagnostic methodologies tailored to tropical climates. Its practice-oriented pedagogy integrates laboratory analysis, on-site investigation, material testing, and heritage management through short-term training programmes — Executive Programmes. The programmes equip participants in making evidence-based decisions in the repair, retrofit, and adaptive reuse of historic buildings.

Building pathology seminar with non-destructive testing methods.

Hands-on cut-and paste porcelain shard work workshop

NUS-ArCLab also trains students from the Master of Arts in Architectural Conservation (MAArC) programme offered by the NUS Department of Architecture, providing a rigorous academic foundation combined with immersive, practice-based learning. With a strong emphasis on interdisciplinary learning and mentorship, ArCLab fosters a new generation of conservation leaders who are critically engaged, ethically grounded, and technically equipped to steward cultural heritage into the future.

In 2026, NUS-ArCLab significantly expanded its international footprint through a strategic collaboration with The Commonwealth Heritage Forum, UK, to co-host the Introduction to Heritage Skills and Technology for Conservation: Commonwealth Field School (24 June – 7 July 2026). This two-week intensive programme convenes emerging conservation practitioners from across the Commonwealth for immersive, field-based training in heritage craft skills, digital documentation techniques, condition assessment protocols, and sustainable retrofit strategies. By combining traditional craftsmanship with contemporary conservation technologies, the Field School advances cross-cultural knowledge exchange and reinforces Singapore's position as a hub for conservation education within the Global South.

Hands-on lime plastering workshop.

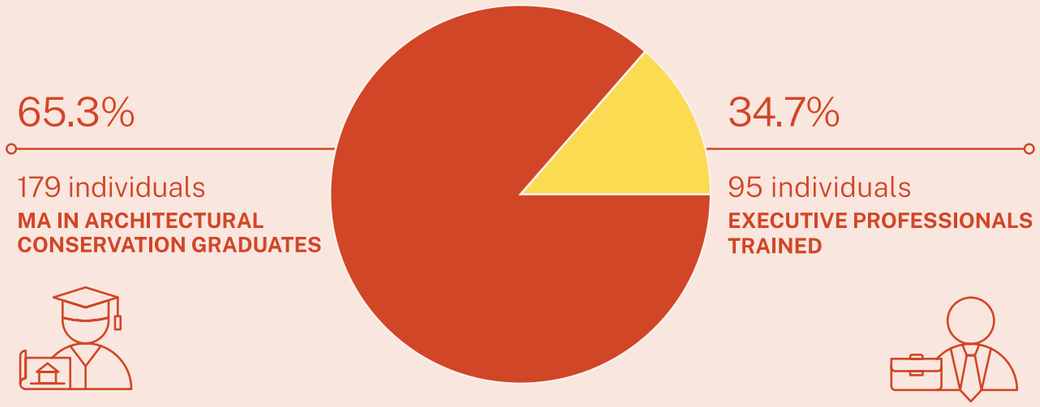
Through its workshops, certification courses, applied research demonstrations, and international field training initiatives, NUS-ArCLab strengthens professional standards and enhances regulatory literacy in key heritage management instruments, including Heritage Impact Assessment (HIA) and Conservation Management Plans (CMP). Collectively, these initiatives build institutional capacity across sectors, promote low-carbon and resource-sensitive conservation approaches, and contribute to the long-term stewardship and resilience of historic environments within rapidly urbanising contexts.

"The training of Singapore's building professionals in heritage conservation is essential to safeguarding our architectural legacy while meeting latest standards. NUS-ArCLab plays a pivotal role in bridging research, practice and multidisciplinary collaboration, equipping practitioners with the technical depth and critical thinking required for meaningful conservation."

Ar. Wo Mei Lan
Director, Liu & Wo Architects Pte Ltd

Executive Programmes.

274 Total Individuals Trained



Sustainable Development Goals (SGDs) Addressed

IMPACT

Preserving Building Fabric Craftsmanship

Hands-on workshops with skilled craftsmen enable students and professionals to learn directly from traditional construction techniques, strengthening the transmission of specialised craft knowledge and safeguarding practices that are increasingly at risk of disappearing.

Advancing Technical Professional Development

Through a living laboratory for architectural conservation, students and practitioners engage directly with historic materials, construction systems, and building pathologies, strengthening applied skills in diagnostics, conservation decision-making, and site management.

Supporting the Care of Historic Buildings

Technical advice notes developed in collaboration with local authorities provide historic building owners with accessible guidance on maintenance and repair, helping safeguard the long-term physical condition of conserved buildings.

Building Professional Capacity

Teaching and training initiatives equip approving authorities, consultants, contractors, and architects with knowledge of conservation principles and methodologies, strengthening professional capacity across disciplines involved in historic building conservation in Singapore.

Informing Heritage Policy and Regulatory Frameworks

Evidence generated through research and practice supports technical waivers and context-sensitive solutions, contributing to more nuanced procurement, approval, and compliance processes for the conservation of historic buildings in Singapore.

OUTREACH

Guided tour of NUS-ArCLab and the Blair Plain for Singapore Heritage Festival.

03

The NUS–Architectural Conservation Laboratory (ArCLab) plays a significant public-facing role in advancing awareness and appreciation of heritage conservation in Singapore, to extend its impact beyond academia and the industry, into the heart of communities.

Recognising that heritage conservation is deeply rooted in people and place, NUS-ArCLab actively engages diverse audiences through a sustained programme of outreach events, public education initiatives, and cross-sector dialogues that connect conservation practice with broader societal and environmental concerns.

NUS-ArCLab regularly hosts curated heritage walks, hands-on workshops on traditional building skills and materials, and demonstrations on the application of digital technologies in heritage conservation (HeriTech), including digital documentation and diagnostic tools. These activities demystify conservation processes for the wider community by translating technical knowledge into accessible, experiential learning formats.

Since 2024, NUS-ArCLab has been an active programme partner of Singapore HeritageFest, contributing public programmes that foreground conservation science, craft practices, and sustainable retrofit strategies. Events at ArCLab are regularly featured in print media and on social media platforms, amplifying outreach and expanding public awareness of heritage conservation issues.

The laboratory has welcomed official delegations, including representatives from the Building and Construction Authority (BCA) and the Singapore Green Building Council (SGBC), who visited to better understand ongoing research in low-carbon conservation, materials performance, and adaptive reuse methodologies. These engagements reinforce NUS-ArCLab's role as a knowledge intermediary between academia, industry, and regulatory agencies.

Since its launch in 2022, NUS-ArCLab has consistently hosted students from local schools, polytechnics, and universities, nurturing early interest in heritage and sustainable construction. Public lectures, exhibitions, and book launches further position the laboratory as a vibrant intellectual and cultural platform. Collectively, these initiatives broaden stakeholder engagement, cultivate the next generation of conservation professionals, and embed heritage stewardship within Singapore's evolving discourse on the built environment.

463 Total Activities Delivered

51.8%

240 sessions

PUBLIC LECTURES & WORKSHOPS

36.7%

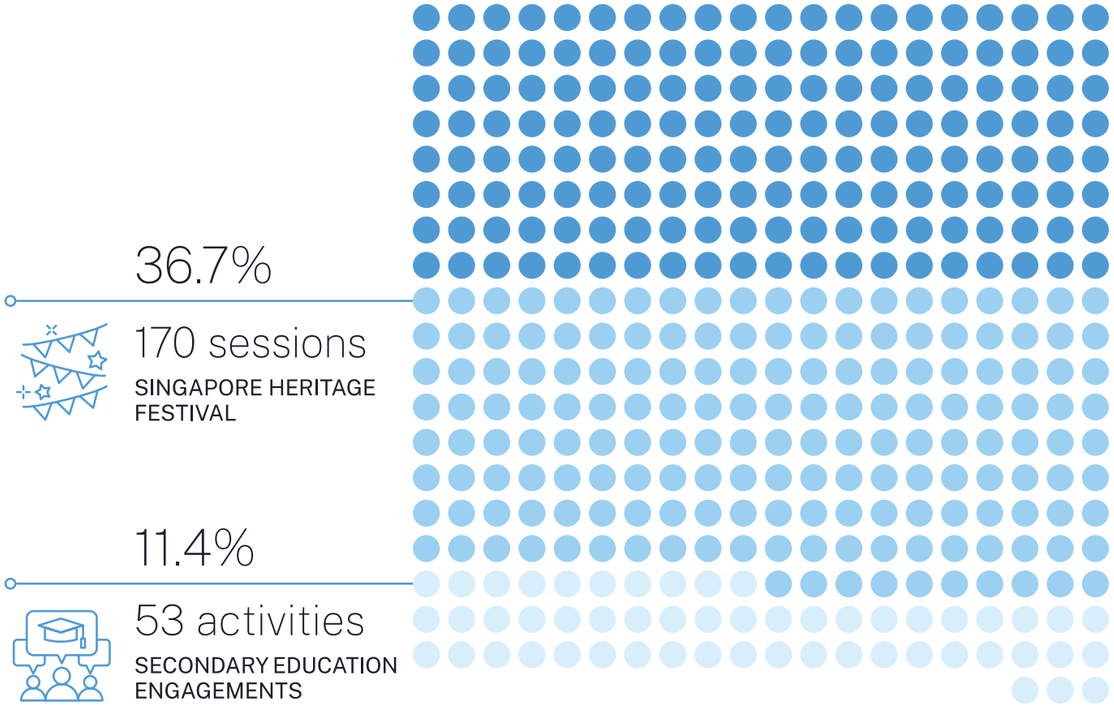
170 sessions

SINGAPORE HERITAGE FESTIVAL

11.4%

53 activities

SECONDARY EDUCATION ENGAGEMENTS



Sustainable Development Goals (SGDs) Addressed

IMPACT

Strengthening Appreciation of Singapore's Heritage

Preserving a representative example of Singapore's late nineteenth-century urban fabric reinforces continuity within a rapidly transforming city, retaining authenticity, material integrity, and historical layering within the historic built environment.

Highlighting the Value of Everyday Heritage Buildings

Interpretation of the townhouse strengthens national narratives around adaptive reuse and demonstrates the relevance of everyday heritage buildings — not only monuments — as meaningful parts of Singapore's evolving urban future.

Expanding Access to Architectural Conservation

Public programmes and engagement with the building's fabric introduce lay audiences to conservation principles and techniques, enabling direct understanding of values-based heritage conservation through discussion with practitioners and industry professionals.

Raising Awareness of Architectural Conservation Careers

Exposure to the diverse professions involved in architectural conservation highlights the knowledge-intensive nature of the field and introduces young audiences to potential career pathways within the heritage and built environment sectors.

Fostering Understanding of Sustainable Heritage

Public education and interpretive programmes build awareness of environmental sustainability in historic structures, explaining how climate change affects heritage buildings and districts and how conservation can improve environmental performance while preserving cultural significance.

“I would like to congratulate the NUS-ArCLab on this next stage of supporting Singapore’s growth in building local capacity to restore and maintain our heritage buildings.

Since the 1970s, URA has pioneered the incorporation of over 7000 heritage buildings for adaptive reuse as part of sustainable city planning, good urban design and nation building. Their continuation as places of high social, cultural, enterprise and economic value will depend on there being more who are trained to properly care for them – using a combination of scientific and artistic skills – for the many decades to come.

The ArCLab’s work will no doubt be a critical element in up-lifting the built-environment sector’s capacity to carry out an important and specialised area of high-value ‘head, hand and heart’ work.”

Ms. Fun Siew Leng
Chief Urban Designer, Urban Redevelopment Authority

We would like to thank our collaborators and our wider network for the progress and impact we have made thus far.

URBAN REDEVELOPMENT AUTHORITY

National Heritage Board

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Architectural Heritage Conservation and Management in Asia
National University of Singapore

NUS National University of Singapore | Department of Architecture
College of Design and Engineering

NUS-ArCLab
141 Neil Road
Singapore 088870

NUS-ArCLab Website:
https://cde.nus.edu.sg/arch/arclab/