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EVALUATING FUNCTIONALITY OF PORTA CABIN OFFICE FACILITIES IN LAGOS STATE, NIGERIA

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ABSTRACT

This study examined the functional and environmental performance of portal cabin office facilities in Lagos State, Nigeria, with emphasis on spatial organisation, thermal comfort, natural ventilation, lighting, and overall environmental quality. A mixed-method research approach involving field observations and structured questionnaire surveys was adopted. Data were collected from users of selected portal cabin office facilities, comprising a study population of 505 users, from which a sample size of 223 respondents was determined using Slovin's formula. The data were analysed using descriptive statistics, including frequencies, percentages, and Mean Weighted Values (MWV). The findings revealed that the overall functional and environmental performance of the selected porta cabin office facilities was satisfactory, with a grand MWV of 3.52. Rainy-season performance recorded the highest rating (MWV = 3.76), indicating that the facilities adequately protected occupants from rainfall and moisture. However, natural ventilation (MWV = 3.09) and thermal comfort (MWV = 3.32) recorded the lowest ratings, suggesting that excessive heat and inadequate airflow remain the principal environmental challenges affecting occupants. The study concludes that while porta cabins provide functional office accommodation for construction and industrial operations, improvements in passive environmental design strategies, particularly ventilation, thermal insulation, solar shading, and daylight optimisation, are necessary to enhance occupant comfort and workplace performance in the tropical climate of Lagos State.

Keywords: Porta cabins, modular offices, environmental performance, thermal comfort, natural ventilation, office functionality, Lagos State

I. INTRODUCTION

The growing demand for flexible, rapidly deployable, and cost-effective office accommodation has increased the use of prefabricated and modular building systems across different sectors. porta cabins are among the most visible forms of modular accommodation because they can be manufactured off-site, transported to the required location, installed within a short period, and expanded or relocated as operational needs change (Lawson, Ogden, and Goodier, 2014). Although they were originally associated with temporary site facilities, porta cabins now support administrative, technical, commercial, educational, and institutional activities.

Office environments are expected to support concentration, communication, decision-making, documentation, meetings, and collaboration. Their effectiveness therefore depends not only on the availability of floor area, but also on spatial organisation, circulation, privacy, thermal comfort, ventilation, lighting, and indoor air quality (Duffy, 1997). These requirements become especially important in porta cabins because their standardised dimensions and lightweight envelopes can influence workspace arrangement and environmental control.

In tropical climates, the environmental performance of lightweight modular structures is a major concern. High ambient temperatures, elevated humidity, strong solar radiation, and seasonal rainfall can increase heat gain, restrict comfort, accelerate material deterioration, and create moisture-related problems where the envelope and site are inadequately designed (Olesen, 2007; Oladapo, and Oginni, 2022). Steel-framed cabins may respond quickly to external temperature changes because they possess less thermal mass than conventional masonry buildings. Their compact interiors may also experience poor airflow where windows and other openings are not deliberately arranged for cross-ventilation.

Lagos State provides an important setting for evaluating these conditions. As Nigeria's principal commercial and industrial centre, the state contains numerous construction yards, manufacturing complexes, logistics bases, and large-scale development sites where porta cabins are used as temporary or semi-permanent offices. Lagos also has a humid tropical climate characterised by high temperatures, significant humidity, and heavy seasonal rainfall (Nigerian Meteorological Agency NIMET, 2021). Consequently, porta cabin offices in the state must simultaneously protect occupants from rain and water ingress while controlling heat, providing adequate airflow, and supporting prolonged office use.

Existing studies on modular construction have largely emphasised speed, cost, waste reduction, portability, and life-cycle benefits (Lawson,Ogden, and Goodier,2014; Aye, Ngo, Crawford, Gammampila, and Mendis, 2012; Kamali, Hewage, 2017). Comparatively less attention has been given to the day-to-day functional and environmental performance of porta cabins used specifically as office facilities in Nigeria. This gap is important because a structure may be efficient to manufacture and install while still providing unsatisfactory indoor conditions for its users.

Against this background, the study examined the functional and environmental performance of porta cabins as office environments in Lagos State in terms of spatial organisation, thermal comfort, ventilation, and lighting. The findings are intended to identify the strengths and weaknesses of existing facilities and provide evidence-based architectural strategies for improved modular office design in southwestern Nigeria.

II. REVIEW OF RELATED LITERATURE

Porta cabins are factory-fabricated or substantially pre-assembled modular units designed for transportation and rapid installation. They may function as single self-contained cabins or as multiple units connected horizontally or vertically to form larger facilities. Their structural systems commonly combine lightweight steel frames with insulated wall and roof panels, while electrical, plumbing, and mechanical services may be incorporated before delivery (Lawson, Ogden, and Goodier, 2014, Olawale, and Okorie, 2021).

The principal functional advantage of porta cabins is adaptability. Units can be combined, separated, relocated, or repurposed as organisational requirements change. This makes them suitable for project offices, staff workspaces, meeting rooms, administrative units, customer-service areas, and other functions that require quick accommodation (Smith, 2016). However, the compact and predetermined dimensions of modular units can limit layout options unless circulation, furniture, equipment, and service zones are coordinated at the design stage.

Functional office performance concerns the ability of a space to support work activities efficiently and comfortably. It includes adequate workspace, logical circulation, appropriate furniture arrangement, access to support facilities, privacy, flexibility, and the ability to accommodate different modes of work (Duffy, 1997; Neufert, and Neufert, 2012). In porta cabin offices, these qualities are influenced by module width and length, internal height, the number and position of openings, the arrangement of connected units, and the placement of partitions and services.

Multiple connected modules can overcome some limitations of single-unit cabins by providing larger floor plates and allowing functions to be separated. Conversely, poorly coordinated connections may produce narrow circulation zones, awkward furniture arrangements, or interior areas that are distant from windows. Functional evaluation should therefore consider how the cabin supports daily work rather than relying solely on its nominal dimensions.

Thermal comfort describes occupants' satisfaction with the thermal conditions of an indoor environment. It is affected by air temperature, radiant temperature, humidity, air movement, clothing, and activity level (Olesen,2007). In office settings, prolonged exposure to excessive heat can reduce concentration, increase fatigue, and lower satisfaction. These concerns are pronounced in tropical regions where high temperature and humidity persist for much of the year (Oladapo, and Oginni, 2022; Szokolay, 2014).

Effective thermal performance therefore requires an integrated response involving building orientation, insulated wall and roof panels, external shading, reflective finishes, reduced direct solar exposure, and adequate air movement. Ventilation supplies fresh air and removes heat, moisture, odours, and indoor pollutants. Natural ventilation depends on pressure differences and the size, placement, and operability of openings, while mechanical ventilation uses fans or air-conditioning systems to control indoor conditions (Awbi, 2003). Cross-ventilation is particularly relevant in tropical office buildings because openings on opposing or adjacent facades can create continuous airflow and reduce heat accumulation.

Porta cabins frequently rely on air-conditioning because of their compact form and restricted openings. Mechanical cooling can improve immediate comfort, but exclusive dependence on it increases energy demand and may conceal deficiencies in passive design. A mixed-mode approach, in which natural ventilation is supported by mechanical systems when conditions require it, provides a more resilient response for tropical office use.

Lighting is another component of environmental and functional performance. Adequate daylight supports visual comfort and reduces dependence on electric lighting, but window

size and placement must be balanced against glare and solar heat gain (Boyce, 2014). Standardised panel construction may restrict the number and location of windows in portal cabins. Window design, shading, interior surface reflectance, and furniture placement must therefore be considered together to provide useful daylight without worsening thermal discomfort.

Rainfall, Moisture, and Tropical Durability

Tropical modular buildings must respond to both heat and water. Heavy rainfall requires durable roof coverings, sealed joints, waterproof wall systems, elevated floors, and effective site drainage. In low-lying or poorly drained areas of Lagos, water accumulation may expose floor assemblies and external panels to prolonged moisture. (Olotuah, and Adesiji, 2018). Corrosion-resistant materials, protective coatings, maintained seals, and well-detailed junctions are essential to sustaining the service life of porta cabins (Adewale, and Olatunji, 2020).

The simultaneous evaluation of heat, airflow, lighting, and moisture protection provides a more complete understanding of environmental performance. A porta cabin may perform well during rainy periods but remain uncomfortable during hot working hours. The present study therefore assessed both the strengths and weaknesses of existing office cabins under the climatic and operational conditions of Lagos State.

III. RESEARCH METHODOLOGY

Study Area and Population

The study was conducted in Lagos State, Nigeria. Five industrial and construction facilities with operational porta cabin offices were investigated. The combined estimated population of porta cabin office users in the selected facilities was 505.

Research Design and Sampling

A mixed-method descriptive survey design was adopted. Quantitative data were obtained from users of the selected offices, while qualitative evidence was gathered through direct observation and photographic documentation. A multistage procedure was used to identify facilities in Lagos State where porta cabins functioned as offices and to select the five study locations from the compiled sampling frame.

The sample size was determined using Slovin's formula, $n = N/[1 + N(e)^2]$, where N represented the study population of 505 and e represented a 0.05 margin of error. This produced a sample of 223 respondents, equivalent to approximately 44% of the population. The sample was allocated proportionately.

Data Collection

Primary data were collected with a structured questionnaire comprising socio-demographic items, office-profile questions, five-point Likert-scale statements, multiple-response questions, and short open-ended items. The questionnaire assessed spatial adequacy, circulation, window provision, thermal comfort, ventilation, indoor air quality, heat protection, weather resistance, and related aspects of office performance. Field observation sheets were used to document the physical and environmental characteristics of the cabins, and photographs provided supporting visual records. All 223 administered questionnaires were retrieved and included in the analysis.

Data Analysis

The responses were coded and analysed using SPSS and Microsoft Excel. Frequencies and percentages were used for socio-demographic, office-profile, and challenge data. Likert-scale items were scored from 5 for Strongly Agree to 1 for Strongly Disagree. The Total Weighted Value (TWV) was obtained by summing the products of each response frequency and its assigned weight, while the Mean Weighted Value (MWV) was computed by dividing the TWV by the number of respondents. A criterion mean of 3.00 was adopted: values above 3.00 indicated a generally favourable assessment, while values close to the criterion mean indicated moderate performance requiring improvement. Variables were ranked by MWV.

IV. RESULTS AND DISCUSSION

(i) Respondent and Office Profile

The 223 respondents provided a balanced and technically informed basis for assessing the selected facilities. Male respondents accounted for 50.2% and female respondents for 49.8%. Engineers constituted 56.1% of the sample, architects 27.4%, and administrative staff 16.6%. Most respondents had substantial experience of the facilities: 42.2% had used their offices for one to three years, 34.1% for more than three years, and 64.1% used the offices daily. These characteristics indicate that the responses were obtained largely from regular users familiar with the performance of the cabins.

Table 1: Socioeconomic Characteristics of Respondents (n = 223)

S/N	Variable	Category	Frequency	Percentage (%)
1.	Gender	Male	112	50.20
		Female	111	49.80
2.	Age Group	21–30	83	37.20
		31–40	126	56.50
		Above 50	14	6.30
3.	Occupation	Architect	61	27.40
		Engineer	125	56.10
		Administrative staff	37	16.60
4.	Facility	Dangote Refinery & Petrochemical Complex	66	29.60
		LADOL - Lagos Deep Offshore Logistics Base	53	23.80
		Julius Berger Nigeria Plc Construction Yard	40	17.90
		Lagos Free Zone Industrial Park	35	15.70
		Mikano International Limited	29	13.00
5.	Duration of Use	Less than 6 months	27	12.10
		6 months–1 year	26	11.70
		1–3 years	94	42.20
		Above 3 years	76	34.10
6.	Frequency of Use	Daily	143	64.10
		Weekly	25	11.20
		Occasionally	55	24.70

Source: Author's Field Survey (2026)

The offices themselves were predominantly multi-unit arrangements: 54.3% of respondents worked in multiple connected cabins, while 45.7% used single-unit cabins. Most users described their office size as moderate (60.5%). The spaces were also multifunctional. Staff workspace was reported by 70.4% of respondents, meeting space by 51.6%,

administrative work by 48.4%, and customer service by 20.6%. This pattern confirms that the cabins were not used merely as temporary shelters; they supported overlapping technical, administrative, and collaborative functions.

(ii) Functional and Spatial Performance

The functional and spatial indicators relevant to Objective Two were generally favourable. Adequate internal height recorded the highest MWV of 3.97. Arrangement of spaces for efficient movement and circulation recorded 3.73, while adequacy of space for office activities recorded 3.72. These results indicate that the basic dimensions and configuration of many of the cabins supported routine office activities.

However, performance reduced for variables that depended on detailed internal planning and openings. Furniture and equipment arrangement recorded an MWV of 3.49, support facilities recorded 3.48, and building orientation in relation to thermal comfort and daylighting recorded 3.45. Window number and placement recorded a comparatively low MWV of 3.24. The results suggest that the main functional weakness was not the existence of the modular space itself, but the refinement of openings, support areas, and layout elements needed to sustain diverse office functions.

Table 2: Selected Functional and Spatial Performance Indicators (n = 223)

S/N	Indicator	TWV	MWV	Rank
1	Internal height is adequate for comfortable office activities	886	3.97	1st
2	Arrangement of spaces promotes efficient movement and circulation	831	3.73	2nd
3	Cabin has adequate space for office activities	830	3.72	3rd
4	Office arrangement allows efficient use of furniture and equipment	778	3.49	4th
5	Adequate support facilities are available	775	3.48	5th
6	Building orientation contributes positively to comfort and daylighting	770	3.45	6th
7	Number and placement of windows are adequate	722	3.24	7th

Source: Author's Field Survey (2026)

(iii) Environmental Performance of PortaCabin Offices

Table 3 presents the assessment of seven environmental and functional performance variables. All variables recorded MWVs above the criterion mean of 3.00, producing a grand mean of 3.52. This indicates that respondents considered the cabins generally functional, although the spread of scores reveals clear differences between weather protection, active environmental control, and passive comfort.

Table 3: Users' Perception of Architectural and Spatial Characteristics of Porta Cabin Offices (n = 223)

S/N	Variable	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	TWV	MWV	Rank
1	Internal height is adequate for comfortable office activities	67	107	30	14	5	886	3.97	1st
2	Arrangement of spaces promotes efficient movement and circulation	64	81	38	33	7	831	3.73	2nd
3	Cabin has adequate space for office activities	62	92	20	43	6	830	3.72	3rd
4	Construction materials appear durable and suitable for office use	34	129	35	10	15	826	3.70	4th
5	Internal layout supports easy movement and circulation	50	83	68	17	5	825	3.70	4th
6	Width and length provide sufficient workspace	45	102	34	31	11	808	3.62	6th
7	Roofing material provides adequate protection against heat and rainfall	26	103	63	26	5	788	3.53	7th
8	Office arrangement allows efficient use of furniture and equipment	35	95	44	42	7	778	3.49	8th
9	Adequate support facilities (storage, toilet access, waiting area)	23	114	42	34	10	775	3.48	9th
10	Building orientation contributes positively to thermal comfort and daylighting	31	96	50	35	11	770	3.45	10th
11	Office is flexible enough to accommodate changes in use/arrangement	46	80	32	51	14	762	3.42	11th
12	Number and placement of windows are adequate	23	85	61	30	24	722	3.24	12th
13	Facility provides adequate privacy for office tasks	26	90	37	48	22	719	3.22	13th

Source: Author's Field Survey (2026)

Rainy-Season and Moisture Performance

Performance during rainy periods ranked first with an MWV of 3.76, while protection against water leakage or flooding ranked second with an MWV of 3.72. The scores indicate that the selected cabins generally provided effective enclosure against Lagos State's seasonal rainfall. The finding is consistent with the use of profiled metal roofing, sealed modular panels, and elevated or prepared sites in industrial facilities. It also shows that the weatherproofing function of the cabins was more successful than their passive thermal response.

The challenge data support this interpretation. Water leakage was reported by 23.8% of respondents and flooding around the cabin by 24.2%, considerably lower than the proportions reporting ventilation and heat problems. These issues remain important for a minority of users, but they were not the dominant weaknesses across the five facilities.

Mechanical Ventilation and Indoor Air Quality

Adequate artificial or mechanical ventilation ranked third with an MWV of 3.66. Indoor air quality also received a favourable MWV of 3.57. These scores suggest that air-conditioning units, fans, or other mechanical systems were available in many of the offices and helped users maintain acceptable working conditions. The result demonstrates the functional value of active systems in compact modular offices, particularly during hot and humid periods.

However, the favourable rating for mechanical ventilation should not be interpreted as evidence of strong passive performance. Where acceptable indoor conditions depend heavily on air-conditioning, comfort becomes vulnerable to power interruption, equipment failure, and operating cost. The result therefore points to a need for mixed-mode design rather than the continued substitution of mechanical cooling for effective natural airflow.

(iii) Heat Protection and Thermal Comfort

Protection from excessive heat gain recorded an MWV of 3.49, while thermal comfort during working hours recorded 3.32. Both scores remained above the criterion mean but were lower than the ratings for weather protection, mechanical ventilation, and indoor air quality. The difference indicates that the envelope and cooling systems limited heat to some extent but did not provide consistently comfortable conditions throughout working hours.

This finding reflects the thermal behaviour of lightweight modular construction in tropical climates. Metal roofs and wall skins can absorb and transmit solar heat rapidly, especially where insulation continuity, reflective finishes, shading, roof ventilation, and orientation are inadequate (Lawson,Ogden, and Goodier, 2014). The result also shows that perceived indoor air quality may be satisfactory while occupants still experience thermal discomfort, since air freshness and temperature satisfaction are related but distinct components of indoor environmental quality.

(iv) Natural Ventilation and Lighting

Natural ventilation ranked last with an MWV of 3.09, only slightly above the criterion mean. The response distribution shows the weakness more clearly: 83 respondents disagreed or strongly disagreed that natural ventilation was adequate, compared with 104 who agreed or strongly agreed. The result identifies insufficient passive airflow as the most critical environmental issue in the assessed cabins.

The finding is consistent with the compact configuration of the units, the standardised placement of openings, and the comparatively low rating for window number and placement (MWV = 3.24). Where windows are limited to one facade, blocked by internal partitions, or positioned without reference to prevailing winds, cross-ventilation is restricted. The

widespread use of multiple connected modules may also create deeper interior areas that depend on mechanical cooling.

Lighting performance was not among the seven variables in Table 3, but related results indicate room for improvement. Poor lighting was reported as a challenge by 37.2% of respondents, while building orientation in relation to thermal comfort and daylighting recorded 3.45 and window adequacy recorded 3.24. The combination suggests that daylight provision is acceptable in some cabins but inconsistent across the facilities. Increasing window area alone would be inadequate; windows must be positioned and shaded to improve daylight and airflow without increasing glare and solar heat gain.

(iv) Supporting Evidence from Reported Challenges

The multiple-response challenge data reinforced the MWV analysis. Poor ventilation was the most frequently reported challenge, selected by 47.1% of respondents, followed by excessive heat at 44.4%. Poor lighting was selected by 37.2%. In contrast, water leakage and poor durability were reported by 23.8% and 22.9% respectively. The consistency between the Likert-scale results and the challenge data strengthens the conclusion that environmental comfort, rather than basic structural durability, is the principal limitation of porta cabin offices in the study area.

Table 4: Environment-Related Challenges Reported by Respondents (n = 223)

S/N	Challenge	Frequency	Percentage (%)
1	Poor ventilation	105	47.1
2	Excessive heat	99	44.4
3	Poor lighting	83	37.2
4	Flooding around the cabin	54	24.2
5	Water leakage	53	23.8
6	Poor durability	51	22.9

Source: Author's Field Survey (2026). Multiple responses were permitted.

(v) Discussion of the Combined Performance Pattern

The combined findings reveal a distinct performance pattern. porta cabins were positively assessed for rapid functional accommodation, internal height, circulation, workspace provision, rainy-season performance, and protection from water ingress. These qualities explain their continued use in large industrial and construction facilities where offices must be installed quickly and modified as projects develop.

The weaker ratings were concentrated around the passive environmental systems: natural ventilation, thermal comfort, window placement, orientation, and lighting. Mechanical ventilation partly compensated for these weaknesses, producing acceptable ratings for air quality and active ventilation, but the challenge data show that this compensation was incomplete. The offices therefore functioned effectively as operational spaces while remaining environmentally dependent on cooling equipment.

This pattern confirms the literature on modular buildings in hot-humid climates. The benefits of off-site manufacture and lightweight construction do not automatically translate into satisfactory indoor comfort (Lawson, Ogden, and Goodier, 2014; Oladapo, and Oginni, 2022; Kamali, and Hewage, 2017). Climate-responsive performance must be deliberately designed through envelope specification, orientation, opening design, shading, drainage, and an appropriate relationship between passive and mechanical systems.

V. ARCHITECTURAL DESIGN IMPLICATIONS

The findings provide clear architectural directions for improving porta cabin offices in Lagos State and similar tropical settings. The recommended strategies are not intended to replace the modular character of the system; rather, they adapt its envelope, openings, spatial arrangement, and site relationship to local climatic conditions.

Table 5: Design Implications Derived from the Findings

S/N	Observed finding	Design implication
1.	Natural ventilation recorded the lowest MWV (3.09).	Provide operable openings on opposing or adjacent facades; orient units to prevailing winds; avoid partitions that block airflow; use high- and low-level vents where security or privacy limits window opening.
2.	Thermal comfort was moderate (MWV = 3.32) and excessive heat was reported by 44.4%.	Specify continuous roof and wall insulation, reflective external finishes, ventilated roof cavities, generous overhangs, external shading devices, and reduced east-west solar exposure.
3.	Mechanical ventilation was rated more favourably than natural ventilation.	Adopt mixed-mode operation: passive ventilation during suitable periods, supported by efficient fans or split air-conditioning for peak heat and humidity.
4.	Window placement recorded a comparatively low MWV (3.24), while poor lighting affected 37.2%.	Coordinate window size, sill height, shading, glazing, interior reflectance, and furniture layout to improve daylight distribution without increasing glare or solar heat.
5.	Rainy-season performance was strong, but flooding and leakage affected a minority of users.	Maintain sealed roof and panel joints, raise finished floor levels, provide perimeter drains, slope sites away from cabins, and establish routine maintenance for roofs, seals, and drainage channels.
	Cabins supported multiple office functions.	Use connected modules, demountable partitions, modular furniture, and planned service zones to separate staff work, meetings, administration, and customer-facing activities while retaining flexibility.

Source: Developed from the findings of the study (2026)

VI. CONCLUSION AND RECOMMENDATIONS

Conclusion

The study examined the functional and environmental performance of porta cabin office facilities across five industrial and construction locations in Lagos State. The results show that the facilities provided useful and adaptable office accommodation. Their internal height, circulation, workspace provision, multi-unit configurations, and ability to support staff work, meetings, and administrative functions were generally favourable. The cabins also performed strongly during rainy periods and were largely protected against water leakage and flooding.

Environmental performance was less consistent. Mechanical ventilation and indoor air quality were rated favourably, but natural ventilation and thermal comfort were the weakest variables. The supporting challenge data, in which poor ventilation and excessive heat ranked

highest, confirm that occupants continued to experience inadequate airflow and heat stress despite the presence of active cooling systems. Window placement, orientation, and lighting also require improvement.

It is therefore concluded that the principal weakness of porta cabin offices in Lagos State is not their ability to provide immediate functional space or weather protection, but their passive environmental response to the hot-humid climate. Their long-term suitability as office facilities depends on integrating climate-responsive design measures at the planning, manufacturing, installation, and maintenance stages.

Recommendations

1. Porta cabin offices should be oriented and configured to support cross-ventilation, with operable openings located on opposing or adjacent facades and positioned in relation to prevailing wind direction.
2. Roof and wall assemblies should incorporate continuous thermal insulation, reflective finishes, and well-detailed joints. Ventilated roof cavities, overhangs, and external shading should be used to reduce solar heat gain.
3. Mechanical ventilation and air-conditioning should supplement rather than replace passive design. Efficient fans and split systems should be provided for periods when outdoor temperature and humidity prevent natural ventilation from maintaining comfort.
4. Window number, size, position, and shading should be determined together to improve daylight and airflow without creating glare or excessive heat gain. Interior layouts should keep major work areas within useful daylight zones.
5. Finished floor levels should be raised above surrounding ground, and perimeter drainage should be provided to sustain the favourable rainy-season performance and reduce localised flooding.
6. Connected modules and demountable partitions should be used to accommodate staff workspaces, meeting rooms, administrative areas, and support spaces while allowing future reconfiguration.
7. Facility managers should implement scheduled maintenance of roofing sheets, panel joints, seals, coatings, air-conditioning equipment, and drainage systems to preserve environmental performance over the service life of the cabins.

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