JEDT
24,5

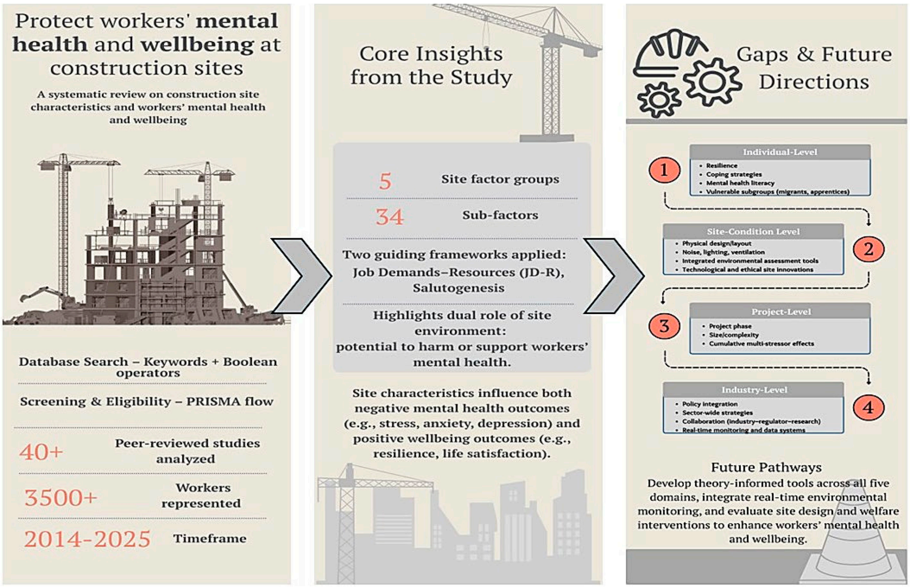
Reframing construction sites as psychosocial work environments: a conceptual framework

1322

Parisa Moshashaei, Hamed Golzad and Henry Liu
School of Design and Built Environment, University of Canberra, Canberra, Australia, and
Nasser Bagheri
Centre for Mental Health Research, Department of Visualization and Decision Analytics (VIDEA) Lab, Research School of Population Health, School of Health, University of Canberra, Canberra, Australia

Received 14 January 2026
Revised 6 March 2026
Accepted 11 April 2026

Graphical abstract



Funding: The first author is supported by the University of Canberra through a UC HDR scholarship.

Journal of Engineering, Design and Technology
Vol. 24 No. 5, 2026
pp. 1322-1346
Emerald Publishing Limited
1726-0531
DOI 10.1108/JEDT-01-2026-0023

Abstract

Purpose – The construction industry is a hazardous sector with a heightened risk to workers' mental health and well-being (MHW). Despite the importance of physical and environmental site characteristics, limited research has examined how construction site conditions shape MHW or developed theory-driven frameworks to explain these effects. This study aims to reconceptualize the construction site as a psychosocial–physical workplace.

Design/methodology/approach – Following Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, this study synthesised evidence from 51 studies published between 2014 and 2025. Guided by the Job Demands–Resources model and the Salutogenesis framework, 34 site-level indicators were identified and classified into five domains: environmental conditions, welfare facilities, safety and security, work settings and physical space design.

Findings – The indicators were mapped to both negative outcomes (e.g. stress, burnout) and positive outcomes (e.g. resilience, engagement). The review shows that construction sites function not only as sources of job demands but also as environments that can strengthen workers' sense of clarity, control and purpose, mechanisms central to improving MHW.

Practical implications – The framework supports practitioners and regulators in prioritising site-level interventions, such as environmental controls, welfare provision and space design, that integrate mental health into safety management and workplace planning.

Originality/value – This study extends prior reviews that emphasised psychosocial or organisational determinants by positioning construction sites as integrated psychosocial–physical workplaces. It provides a theory-informed synthesis linking site conditions to both negative and positive MHW outcomes and proposes a conceptual model to inform site-level safety strategies and environmental design interventions.

Keywords Construction, Mental health, Well-being, Safety, Job demands–resources, Salutogenesis

Paper type Literature review

Highlights

- Systematic review maps site conditions to mental health and wellbeing outcomes
- Integrates JD-R and Salutogenesis to interpret site-related demands/resources
- Identifies 34 indicators grouped into five modifiable site domains
- Presents a new conceptual model for site-level wellbeing interventions
- Highlights how better site design and welfare facilities can reduce safety risks

1. Introduction

The construction industry is a large, fast-paced and technically complex sector that employs approximately 273 million workers (about 7% of the global workforce) and contributes around 13% of global gross domestic product (Global, 2020; Betts *et al.*, 2015; Santamouris and Vasilakopoulou, 2021). Despite its central role in infrastructure development and economic growth, the construction sector has been consistently ranked as one of the most hazardous industries, with persistently high rates of fatalities, occupational diseases and injuries (Waage *et al.*, 2010). These risks are shaped by sector-specific working conditions, including job insecurity, exposure to extreme environmental conditions, and limited welfare provisions, which intensify work demands and generate physical and psychological risks (Kurtzer *et al.*, 2020; Vischer, 2008; Golzad *et al.*, 2023). This combination of physical and psychosocial demands leads to sustained psychological pressures that place construction workers at heightened risk of adverse mental health and well-being (MHW) outcomes (Fayyad *et al.*, 2024; Omer *et al.*, 2025). MHW has consequently emerged as a critical occupational issue, with construction consistently identified as one of the poorest-performing sectors internationally (Chan *et al.*, 2020).

Across the national contexts, construction workers exhibit disproportionately high levels of psychological distress and suicide. Across national contexts, construction workers exhibit disproportionately high levels of psychological distress and suicide. In the UK, the construction sector has been reported to experience some of the highest suicide rates among occupational groups (Office for National Statistics, 2023). In the USA, construction workers experience one of the highest suicide rates across occupational groups, with rates estimated to be several times higher than the national average (Peterson, 2020). Similarly elevated levels of psychological distress have been documented in Australia, where approximately one in four construction workers report symptoms of depression or anxiety (Black Dog Institute, 2023). Evidence from Canada and China also indicates high levels of mental ill-health among construction workers, particularly among migrant labour populations who often face additional psychosocial and environmental stressors (Blair Winkler *et al.*, 2024). Beyond workforce suffering, poor MHW imposes substantial economic costs through reduced productivity, absenteeism, presenteeism and workforce turnover, with workplace-related mental ill-health accounting for billions in annual losses across national economies (Anthony *et al.*, 2024; Carter and Stanford, 2021).

While previous studies have substantially advanced understanding of mental health risks in construction, evidence on site-level conditions remains fragmented. Existing literature predominantly focuses on psychosocial or organisational stressors such as job control, work pressure and organisational justice, often overlooking physical, environmental and workplace spatial design or examining them as isolated factors (Chan *et al.*, 2020; Gómez-Salgado *et al.*, 2023; Tijani *et al.*, 2021). Review papers addressing environmental hazards, including heat exposure or safety systems typically lack integration across multiple site conditions and rarely apply theories rooted in psychology science to explain MHW outcomes (Acharya *et al.*, 2018; Duckworth *et al.*, 2024; Kineber *et al.*, 2023). In addition, studies remain limited in their ability to conceptualise construction sites as environments with both adverse and health-promoting aspects (Malaki *et al.*, 2025; Saraji and Mehany, 2025). A comprehensive review of the literature reveals a clear lack of a coherent, theory-informed synthesis that explicitly positions construction sites as psychosocial–physical work environments and systematically links observable, modifiable site-level characteristics, distinct from organisational or industry-wide influences, to both negative and positive MHW outcomes (Bendak *et al.*, 2022; Xiang *et al.*, 2014).

To address the above deficiencies, this study aims to provide a systematic review of how construction site-level characteristics influence workers' MHW through the lens of established MHW frameworks. To this end, three objectives are formulated:

(1) to identify site-level characteristics influencing workers' MHW;

(2) to interpret these characteristics through established MHW frameworks; and

(3) to map the evidence to both adverse and positive MHW outcomes to inform site-focused research and intervention design.

The remainder of this paper is structured as follows. The theoretical underpinning and research design are first described. The Results section addresses the first objective by collating and categorising site-level construction site characteristics reported in the literature. A subsequent theory-informed interpretation section addresses the second objective by interpreting these characteristics through established MHW frameworks. Finally, the synthesis of adverse and positive MHW outcomes addresses the third objective and informs implications for site-focused research, design and intervention.

2. Theoretical point of departure

This study is anchored in the Job Demands–Resources (JD–R) model and the Salutogenesis framework. Together, these frameworks provide complementary lenses for interpreting both adverse and positive pathways linking the physical work environment to MHW outcomes.

The JD–R model conceptualises work environments in terms of job demands that require sustained physical or psychological effort and job resources that help achieve work goals, reduce demands and support well-being (Bakker and Demerouti, 2017; Demerouti *et al.*, 2001) . The JD–R model was used as a classificatory framework to distinguish site-level characteristics according to their primary functional role. In this study, site conditions were coded as job demands when they represented construction site exposures and work conditions requiring sustained effort and associated with physiological or psychological strain, or as job resources when they functioned to reduce demands, support task performance or recovery, or buffer the negative effects of demands (Bakker and Demerouti, 2017). These classifications were applied during data extraction based on how site characteristics were described, operationalised and interpreted in the original studies, including reported mechanisms and measured variables. This approach enabled a consistent and transparent organisation of heterogeneous evidence while avoiding assumptions beyond the scope of the reported data.

The Salutogenesis framework focuses on factors that support health and well-being rather than solely on disease, emphasising the role of Sense of Coherence (SOC) in shaping how individuals perceive and cope with environmental conditions (Antonovsky, 2002). The Salutogenesis framework complements the JD–R model by providing an interpretive perspective on how work environments may support positive adaptation and well-being through SOC. In this study, SOC was treated as an analytical construct comprising three dimensions, comprehensibility, manageability and meaningfulness, to support interpretation of site-level characteristics linked to positive MHW outcomes. Rather than assuming direct measurement of SOC across all studies, these dimensions were used cautiously as interpretive categories to organise findings where authors explicitly reported mechanisms or outcomes aligned with clarity, coping capacity, control, purpose or perceived value.

Where included studies directly assessed SOC or closely related constructs, findings were mapped to the corresponding SOC dimension. Where SOC was not explicitly measured, mapping was undertaken only when the linkage was supported by clear descriptions, participant accounts or author interpretations consistent with salutogenic theory. To avoid over-interpretation, no causal inferences were drawn beyond the evidence reported in the original studies; instead, SOC was used as a conceptual lens to clarify how site-level conditions may contribute to both adverse and positive MHW outcomes.

Together, the JD–R and Salutogenesis frameworks underpin the conceptual framework of this study (Supplementary Figure S1), enabling systematic classification of construction site characteristics as stressors, resources or coherence-enhancing elements influencing workers' MHW.

3. Research methodology

This study was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page *et al.*, 2021) guidelines and the Joanna Briggs Institute (JBI) methodology (Aromataris and Munn, 2020) to ensure transparency and rigour across search, screening, appraisal and synthesis. The JD-R and Salutogenesis frameworks informed the development of inclusion criteria, data extraction and the categorisation of site-level factors. The methodology includes database searching, study selection, bibliometric mapping and a theory-informed narrative synthesis linking construction site characteristics with MHW outcomes.

3.1 Review design

Using the PRISMA with JBI methods can enable an enhanced appraisal and synthesis. In this stance, a protocol is developed to guide inclusion criteria, search strategies, data extraction, quality appraisal and synthesis in line with the conceptual framework (Figure 1). Methodological quality was assessed using appropriate JBI Critical Appraisal Checklists. Two reviewers independently appraised each study, resolving disagreements through discussion or third-party review. Appraisal outcomes informed interpretation but were not used for exclusion. Appraisal outcomes were not used as exclusion criteria; instead, they informed the interpretive weighting of evidence during synthesis, with findings from methodologically weaker studies treated with greater caution.

3.2 Review process

Following clarification of the study objectives and scope (Step 1), the review process proceeded to evidence identification and selection (Step 2) using predefined inclusion and exclusion criteria. Inclusion criteria were specified *a priori* to capture peer-reviewed

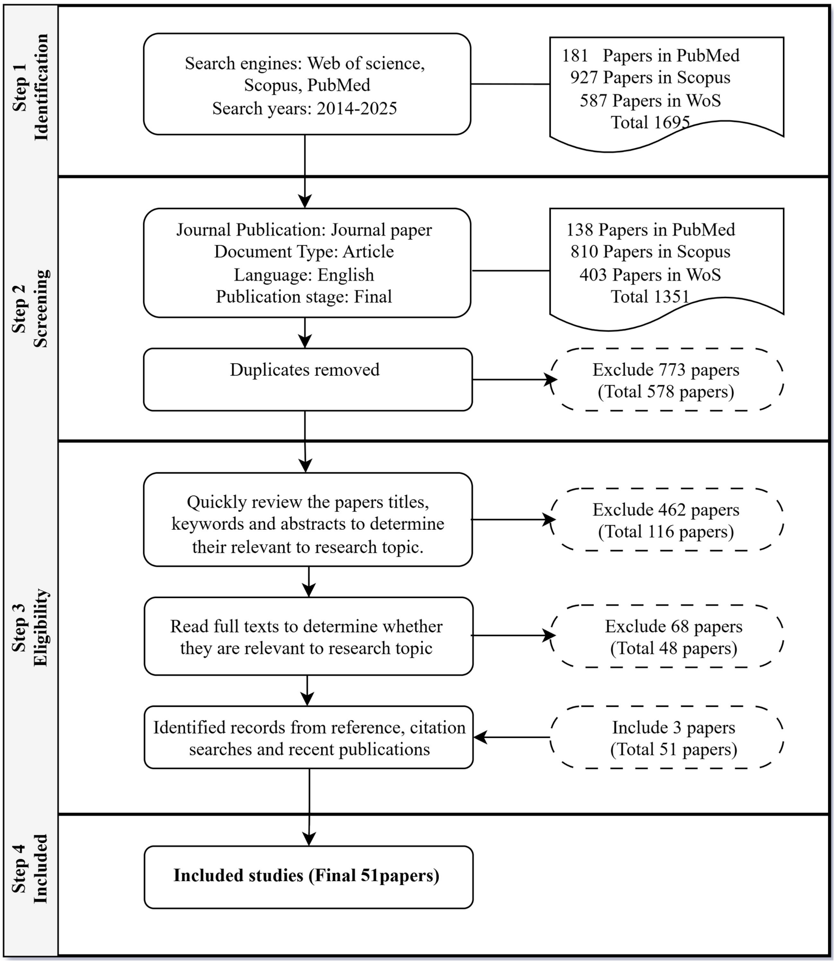


Figure 1. Article screening process following the PRISMA protocol

empirical studies published between 2014 and 2025 that examined how construction site-level physical, environmental, spatial and operational characteristics influence construction workers' MHW. Eligible studies were required to analyse site-level characteristics as job demands, job resources or coherence-enhancing features.

To maintain conceptual and analytical clarity, the study explicitly distinguished site-level factors from broader organisational or managerial determinants. Site-level factors were defined as conditions and arrangements directly within the construction workplace, including physical exposures, environmental controls, site layout, welfare facilities, safety provisions and on-site work practices. Organisational-level factors, such as leadership style, safety culture, human resource policies, contractual arrangements and corporate governance, were considered outside the primary scope of this study. Where included studies incorporated organisational or managerial elements, only findings explicitly linked to site-level conditions or their on-site implementation were extracted and synthesised. Studies in which organisational or managerial factors constituted the primary analytical focus, without a clear connection to site-level characteristics, were excluded. Non-English publications and non-peer-reviewed sources (e.g. conference papers, reports, books, editorials and review articles) were also excluded to ensure methodological consistency and analytical rigour.

Based on these criteria, a systematic literature search was conducted using keywords reflecting the relationship between construction site characteristics and MHW, including "construction site characteristics", "mental health", "well-being", "worker health and safety", "environmental factors", "ergonomics", "safety features", "welfare amenities" and "work settings and practices". These terms were expanded into structured search strings through preliminary scoping, keyword analysis, indexing terms (e.g. MeSH) and expert input to ensure comprehensive coverage. The complete database-specific search strings are provided in Supplementary Table S1.

The search was implemented across three major databases, including Scopus, Web of Science (WoS) and PubMed, selected for their coverage of construction, engineering and health-related research (Chan *et al.*, 2020; Zong *et al.*, 2024). Database-specific keyword adaptations were applied (Supplementary Table S1), and backward and forward citation tracking was undertaken to identify additional relevant studies.

Retrieved records were collated and duplicates were removed using EndNote 21. Study selection followed PRISMA procedures (Figure 1) and was conducted in four stages. The search initially identified 1,695 records, which were reduced to 1,351 following de-duplication. After title and abstract screening, 578 articles were assessed at full-text level, of which 48 were remained eligible. Three additional studies published in 2025 were identified through citation tracking, resulting in a final sample of 51 articles included in the study.

As a complementary analytical step, a bibliometric analysis was conducted to examine the conceptual structure of the literature using keyword co-occurrence analysis in VOSviewer (v1.2.4). Standardised author keywords were analysed using a full-counting method with a minimum occurrence threshold of two, allowing identification of thematic clusters related to construction site characteristics and MHW. Bibliometric analysis was used to contextualise thematic patterns and research emphases within the field, rather than to determine study inclusion, classification or causal interpretation (Zong *et al.*, 2024).

3.3 Data extraction and synthesis

Bibliographic and methodological information (author, year, country, study design and sample size) was extracted alongside variables aligned with the review objectives. Construction site characteristics were identified as observable features of the construction site setting and coded in accordance with the JD-R and Salutogenesis frameworks, as defined in Section 3.2. MHW outcomes were classified as negative (e.g. stress, burnout) or positive (e.g. well-being, engagement), enabling consistent mapping of site-level risks and protective features across studies.

4. Results and thematic synthesis

To strengthen coherence between empirical findings and theoretical interpretation, results are organised across three analytically linked layers:

(1) domain-level evidence on construction site characteristics and associated MHW outcomes;

(2) explicit interpretation of each domain using the JD-R model and Salutogenic mechanisms; and

(3) consolidation of these interpretations within a coherent conceptual framework.

4.1 Descriptive overview of the studies

Publication output shows a steady increase over time, with notable growth from 2020 onwards and continued expansion into 2025. Recent studies (Alruqi *et al.*, 2025; Guo *et al.*, 2025), increasingly integrate psychosocial and environmental site-level factors, reflecting growing recognition of construction environments as determinants of worker's MHW.

Identifying the journals that act as key outlets for publishing studies on a topic is of value to practitioners, directing them towards the best knowledge resources on the topic, and to investigators, identifying the best outlets for publishing (Golizadeh *et al.*, 2018). Across the 51 included studies, publications are distributed across 31 journals. The most frequent outlets are International Journal of Environmental Research and Public Health and Buildings (each $n = 4$; 7.8%), followed by Applied Ergonomics ($n = 3$; 5.9%). Several journals contributed two articles, while the remaining 30 journals each contributed one article (58.8%), indicating substantial disciplinary diversity (Supplementary Table S2).

Regarding geographical distribution, the reviewed studies span 23 countries, with the highest contributions from China (9 studies), followed by Australia (6), Malaysia and Hong Kong (5 each) and Saudi Arabia (3). Moderate contributions were observed from Iran, the United Arab Emirates, India and New Zealand (2 each), while the remaining countries like the USA, UK, Italy and others, contributed one publication each. This global spread (Supplementary Figure S2) underscores the wide-spread international attention to this topic.

The reviewed studies represent diverse participant groups, with most focusing on general construction workers (approximately 70%), rather than specific professions or groups, the remining have focused on safety managers and executives (10%), migrant workers (7%), construction professionals (4%) and site managers (3%). Smaller proportions involve civil engineers, apprentices and technical trades (each $\leq$ 2%). Gender representation has also received increasing attention, and several large-scale studies have included samples exceeding 900 participants, including Omer *et al.* (2024) and Jiang *et al.* (2020).

The co-occurrence network reveals three major thematic clusters (Supplementary Figure S3). The red cluster centres on physical and occupational risks such as heat stress, injury and productivity, reflecting the intersection of environmental hazards and mental health challenges on construction sites. In addition, the green cluster captures broader worksite-related terms such as site, risk and perception, indicating strong links between environmental conditions and perceived health risks. Moreover, the blue cluster encompasses construction site, workplace, environment and safety, representing built environment features and workplace design considerations. These clusters collectively illustrate how site-specific factors are interconnected with both physical and mental well-being outcomes.

An analysis of research methodologies indicates a clear evolution over time (Figure 2). Early studies (2014–2016) primarily relied on field-based measurements, questionnaires and thermal indices (WBGT, TWL). From 2017 onwards, researchers increasingly incorporated physiological monitoring tools (e.g. HRV, EMG) alongside qualitative interviews. The 2022–2024 period marked a shift towards integrated, technology-driven approaches, combining biometric sensors, environmental monitoring and psychosocial assessments. In 2025, emerging studies expanded this integration further, adopting semi-structured and multilingual surveys, EDA-based physiological tracking, CFD-assisted environmental sensors and advanced analytical models (SEM and DEMATEL), to evaluate construction workers' MHW.

4.2 Identification and structuring of site domains

Across the included studies, construction site characteristics were synthesised during the analysis into a set of 34 distinct site-level indicators, which were subsequently organised into five recurring site-level domains: Environmental Conditions, Amenities and Welfare Facilities, Safety and Security, Physical Space Design, and Work Settings and Practices. Together, these domains capture the principal categories through which construction site characteristics have been examined in relation to MHW outcomes across diverse geographical, occupational and study contexts. The full mapping of indicators to these domains is presented in Figure 3.

4.3 Domain-level evidence on mental health and well-being outcomes

This section reports domain-level evidence on construction site characteristics and their associations with workers' MHW outcomes. Findings are presented descriptively, focusing on reported exposures and outcomes without theoretical interpretation.

4.3.1 Environmental conditions. Environmental conditions were the most frequently examined domain across the reviewed studies. Reported site exposures included extreme heat, high humidity, poor ventilation, excessive noise, air contaminants and solar radiation.

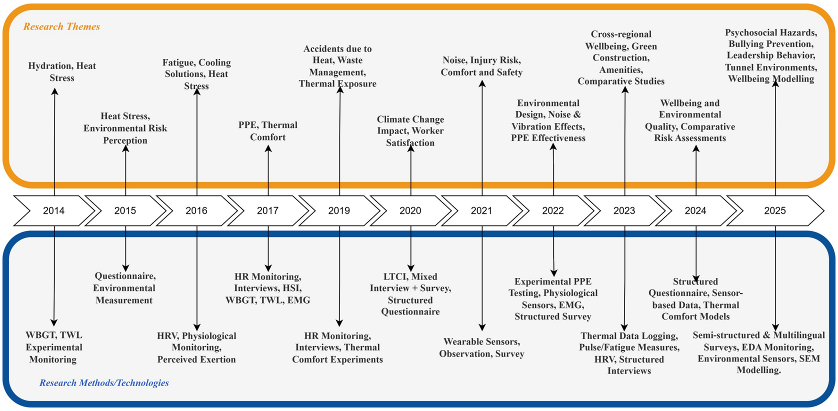


Figure 2. Evolution landscape in research themes and methods/technologies for construction site characteristics

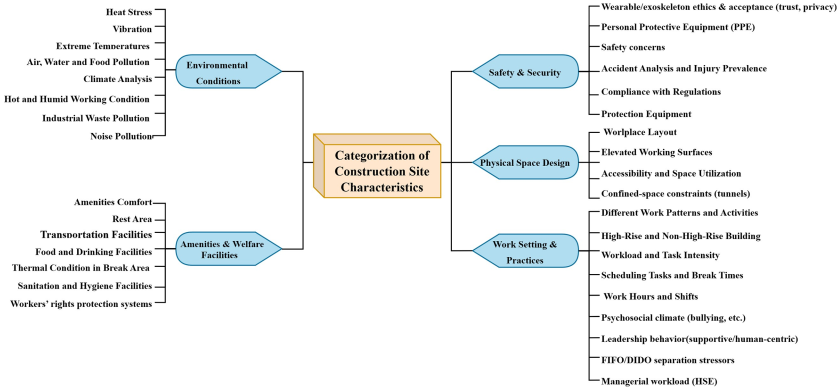


Figure 3. Categorisation of construction site characteristics

Multiple studies documented associations between these exposures and adverse mental health outcomes, including psychological stress, emotional exhaustion, cognitive fatigue and reduced subjective well-being (Al-Bouwarthan *et al.*, 2020; Jiang *et al.*, 2020; Kawakami *et al.*, 2024; Yang *et al.*, 2021).

Heat-related exposures were particularly prominent, with studies reporting increased fatigue, irritability, concentration difficulties and mood disturbances under high thermal load conditions (Ahmed *et al.*, 2020; Omer *et al.*, 2024; Zhao *et al.*, 2017). Noise and air quality issues were also associated with elevated stress levels and diminished perceived comfort and well-being (Chan *et al.*, 2016; Yasmeen *et al.*, 2020).

4.3.2 Amenities and welfare facilities. Amenities and welfare facilities were examined in relation to workers' comfort, recovery and psychological states. Reported site features included the availability and condition of rest areas, shaded spaces, hydration points, sanitation facilities and eating areas. Studies consistently linked inadequate or poorly maintained welfare facilities to increased stress, dissatisfaction and fatigue (Ahmed *et al.*, 2020; Farshad *et al.*, 2014; Irfan *et al.*, 2024).

Conversely, studies documenting access to adequate rest spaces and basic amenities reported associations with lower perceived strain and improved subjective well-being, particularly in physically demanding or hot environments (Umar and Egbu, 2020; Zhang *et al.*, 2023). Welfare-related findings were reported across diverse construction contexts, including large infrastructure projects and smaller site operations.

4.3.3 Safety and security. Safety and security-related site characteristics included hazard control measures, safety infrastructure, site supervision and perceived risk management practices. Several studies reported that inadequate safety controls, overcrowded workspaces and exposure to unmitigated hazards were associated with heightened stress, anxiety and reduced sense of safety (Hsu *et al.*, 2016; Messeri *et al.*, 2019; Radzi *et al.*, 2024)

Studies also highlighted the psychological burden associated with working in environments perceived as unsafe or poorly regulated, particularly where workers felt risks were unavoidable or insufficiently managed (Umar and Egbu, 2020). Associations between safety conditions and mental health outcomes were observed across both short-term and long-duration construction projects.

4.3.4 Physical space design. Physical space design features included site layout, access routes, workspace dimensions, zoning and ergonomic configuration. Evidence indicated that constrained layouts, narrow access points, poor spatial organisation and limited ergonomic consideration were associated with increased frustration, cognitive load and feelings of confinement (Teddlie, 2016; Umar and Egbu, 2020).

Studies examining spatial organisation also reported links between poorly structured layouts and reduced task efficiency, elevated stress and diminished perceived control over the work environment (Yasmeen *et al.*, 2020). These findings were reported across both indoor and outdoor construction environments.

4.3.5 Work settings and practices. Work settings and practices encompassed site-level arrangements such as working hours, task scheduling, workload intensity, rest cycles and on-site coordination. Multiple studies associated long working hours, limited rest opportunities, high physical workload and deadline pressure with psychological strain, fatigue and burnout symptoms (Jia *et al.*, 2019; Liu *et al.*, 2023; Yi and Chan, 2015).

The current study also identified additional site-related stressors, including bullying cultures, FIFO/DIDO arrangements, managerial overload, technological strain and confined or tunnel-based work settings (Biggs *et al.*, 2025; Jia *et al.*, 2016; Ross *et al.*, 2025; Sun *et al.*, 2025). These factors were reported to co-occur with both physical and psychological demands in complex construction sites.

4.4 Theory-Informed interpretation of domains

In line with the analytical approach outlined in Section 4.2, the identified domains were interpreted through the JD-R model and the Salutogenesis framework to clarify how site-level characteristics relate to workers' MHW. This subsection reports the outcome of this interpretive mapping, while detailed findings are provided in Appendix Table A1.

4.4.1 Interpretation through the Job Demands–Resources model. Across the reviewed studies, most site characteristics within the domains of environmental conditions, safety and security, physical space design and work settings and practices were identified as job demands, reflecting conditions that require sustained physical or psychological effort and are associated with strain-related MHW outcomes. Commonly reported demands included thermal exposure, noise, constrained spatial layouts, heavy workloads and time pressure (Bitencourt *et al.*, 2021; Chan *et al.*, 2016; Omer *et al.*, 2024).

In contrast, characteristics within the Amenities and Welfare Facilities domain, along with some features in Safety and Security and Work Settings and Practices, were identified as job resources when they were reported to support task performance, recovery or coping capacity. These included access to rest areas, hydration facilities, ergonomic tools, safety monitoring systems and structured work–rest arrangements (Rani *et al.*, 2022; Techera *et al.*, 2019; Zhao *et al.*, 2017).

4.4.2 Interpretation through the salutogenesis framework. Using the Salutogenesis framework, site characteristics were interpreted in relation to the three dimensions of SOC. Evidence from the reviewed studies indicated that site features influencing clarity, predictability and intelligibility of the work environment were most closely aligned with comprehensibility, particularly within the domains of physical space design and safety and security (Chan *et al.*, 2016; Kawakami *et al.*, 2024).

Features related to access to practical coping resources, recovery opportunities and workload regulation were predominantly aligned with manageability, spanning environmental conditions, amenities and welfare facilities, and work settings and practices (Ahmed *et al.*, 2020; Irfan *et al.*, 2024; Ofori *et al.*, 2025).

Evidence relating to meaningfulness was less frequently explicit but emerged in studies describing site conditions that supported dignity, fairness, recognition and perceived value of work, particularly in relation to welfare provisions and safety practices (Jia *et al.*, 2019;

Ronis *et al.*, 2006). Where SOC dimensions were not directly measured, alignment was based on interpretive consistency with reported mechanisms and outcomes, as documented in Appendix Table A1.

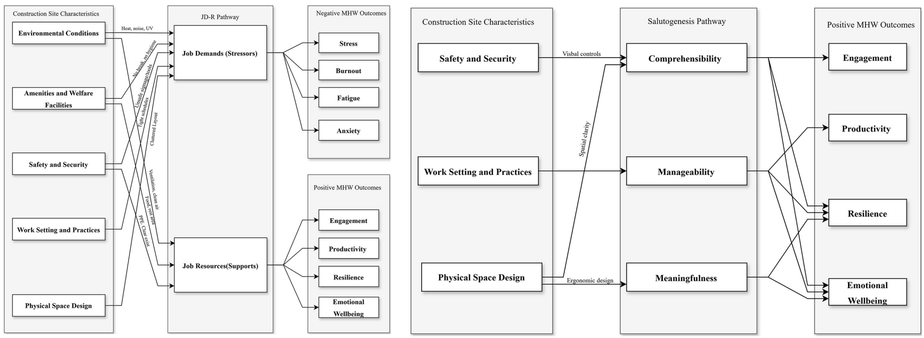
5. Discussion of the findings

5.1 Conceptual model

The integrative conceptual model summarises the synthesis of the reviewed evidence. Figure 4(a) presents the JD-R pathway, while Figure 4(b) presents the Salutogenic pathway, illustrating how construction site characteristics may contribute to both positive and negative MHW outcomes. Together, the two pathways synthesise the empirical and interpretive findings of this study, conceptualising construction sites as environments that shape workers' MHW through both demand–resource dynamics and coherence-related mechanisms. This integrated representation provides a structured foundation for the discussion of implications in the following section.

Beyond synthesising existing evidence, this study makes a distinct conceptual contribution to the construction safety and well-being literature by systematically reframing construction sites as psychosocial–physical workplaces. By consolidating 34 site-level indicators into five analytically coherent domains, the study provides a structured and integrative classification that links environmental safety design with workers' MHW outcomes.

The study further extends established occupational health frameworks, particularly the JD-R model and the Salutogenesis framework, into the built environment domain, which remains underexplored in safety science research. Empirical studies in construction contexts support the relevance of the JD-R perspective in explaining workers' psychological outcomes. For example, Onwuegbuchulam *et al.* (2024) highlight that work characteristics such as workload, leadership practices and peer support significantly influence well-being among construction professionals (Onwuegbuchulam *et al.*, 2024). Similarly, research examining construction workers' health indicates that demanding work conditions increase psycho-physical strain, while resources such as job control and supervisor support play a critical buffering role in mitigating these effects (Sommovigo *et al.*, 2021). Building on this



(a) (b)

Figure 4. (a) Site characteristics mapped to the JD-R framework, showing how demands and resources shape negative and positive mental health outcomes. (b) Salutogenesis-based pathways linking site characteristics to comprehensibility, manageability and meaningfulness, leading to positive well-being outcomes

evidence, the present study demonstrates that construction site characteristics themselves, such as environmental conditions, safety provisions and site organisation, may function as structural job demands or resources shaping workers' MHW.

The findings are also consistent with the Salutogenic perspective, which emphasises the role of resources that enable individuals to maintain health in demanding environments. Central to this framework is the concept of SOC, suggesting that individuals cope more effectively with stress when work environments are perceived as comprehensible, manageable and meaningful. Hansson *et al.* (2022) show that stronger SOC is associated with improved mental health and adaptive coping capacity (Hansson *et al.*, 2022). Complementing this perspective, occupational psychology research further demonstrates that the interaction between job demands and available resources influences workers' well-being through cognitive and coping mechanisms that shape how workplace challenges are interpreted (Fayard and Mayer, 2023). Extending this perspective to construction environments, the present study highlights how site-level characteristics may operate not only as risk factors but also as health-supporting resources that influence workers' capacity to maintain psychological well-being in demanding project settings.

By integrating these theoretical perspectives with site-based evidence, the proposed conceptual model advances current understanding of how construction environments simultaneously generate risk and promote resilience. This contribution provides a defensible theoretical foundation for future empirical testing and for embedding mental health considerations into site design, planning and safety management research.

5.2 Implications for practice

For the project management team, the results suggest that environmental controls (e.g. shading, ventilation, noise mitigation), spatial clarity and ergonomic layout should be treated as core design considerations rather than secondary safety measures (Ahmed *et al.*, 2020; Omer *et al.*, 2024). Similarly, adequate and accessible welfare facilities function as everyday recovery resources, with their quality and proximity influencing stress and fatigue outcomes (Farshad *et al.*, 2014; Irfan *et al.*, 2024).

The findings also indicate that safety management practices shape psychological responses to risk not only through hazard control, but also through predictability, clarity and perceived fairness in site operations (Techera *et al.*, 2019; Zhang *et al.*, 2023). This highlights the importance of integrating environmental management, welfare provision and work organisation within routine site supervision and safety systems.

At a regulatory and policy level, the results support a preventive, site-level approach to MHW that embeds mental health considerations within existing workplace health and safety standards, site requirements, and guidance on environmental controls and welfare infrastructure. Such an approach aligns with contemporary moves towards proactive risk management across high-risk industries such as construction, mining and oil and gas, where regulatory frameworks are increasingly incorporating psychosocial risk management alongside traditional physical hazard control (Chan *et al.*, 2020; Peterson, 2020).

5.3 Gaps in existing research

This study reframes gaps in the literature through the JD-R model and the Salutogenesis framework, revealing limited integration between site-level demands, resources and cognitive-emotional mechanisms that shape MHW (Moon and Ryu, 2024; Onwuegbuchulam *et al.*, 2024). Existing research lacks explanatory depth, causal modelling and theory-informed synthesis of how construction site characteristics simultaneously generate risk and promote resilience. Four interrelated gaps are identified across individual, site, project and industry levels (Figure 5):

(1) Individual Level

At the individual level, research remains narrowly focused on short-term symptoms such as stress and fatigue, with limited examination of chronic mental health conditions (e.g. anxiety, depression, PTSD) and minimal attention to positive well-being, resilience and recovery processes (Hsu *et al.*, 2016; Zhao *et al.*, 2017). This restricts theoretical application of both JD-R (which conceptualises long-term strain–resource dynamics) and Salutogenesis (which emphasises meaningfulness and manageability). Emerging psychosocial stressors, including technological overload, ethical tensions in AI-based monitoring, and fairness in recognition systems, are beginning to be documented but remain weakly theorised in relation to site conditions (Li *et al.*, 2025; Ofori *et al.*, 2025).

(2) Site Conditions Level

At the site level, studies predominantly examine isolated environmental demands (e.g. heat, noise) without analysing cumulative or interacting effects, limiting alignment with JD-R concepts of combined job demands and buffering resources (Yang *et al.*, 2021). Spatial layout, accessibility, ventilation, lighting and environmental coherence, central to manageability and comprehensibility in Salutogenesis, remain insufficiently operationalised (Radzi *et al.*, 2024; Yasmeen *et al.*, 2020). Although welfare amenities, cooling measures and safety infrastructure are frequently reported, they are rarely conceptualised as systematic resources that shape coping capacity or coherence (Kwong *et al.*, 2023). The dominance of cross-sectional designs further restricts understanding of cumulative exposure and long-term psychological adaptation (Liu *et al.*, 2023):

(3) Project Level

At the project level, research documents workload intensity and scheduling pressures but rarely integrates these with physical site design, access constraints or environmental

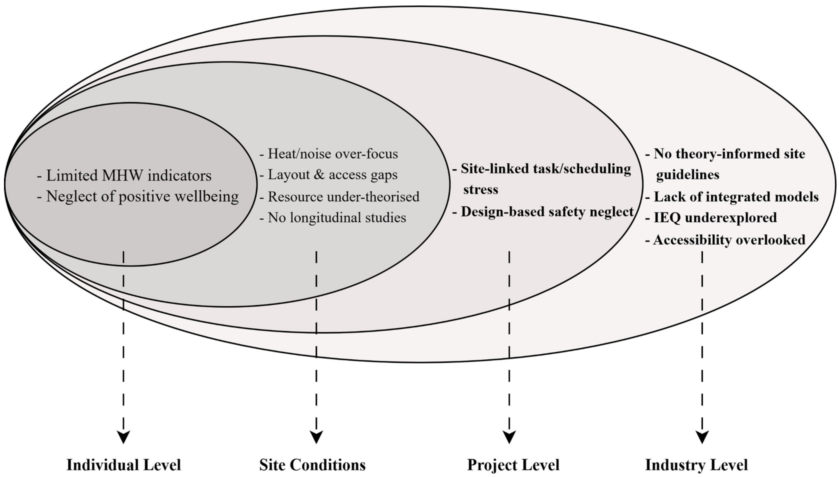


Figure 5. Overview of typical Gaps

exposures that amplify demands and deplete resources (Radzi *et al.*, 2024). Differentiated stress pathways among managers, supervisors and trades are increasingly reported, yet remain weakly embedded within unified site-based analytical frameworks (Biggs *et al.*, 2025; Sun *et al.*, 2025). Moreover, safety research continues to privilege physical protection over psychological dimensions of design, such as wayfinding, visibility and emergency spatial cues, which are critical to perceived control and manageability in both JD-R and Salutogenic perspectives (Yosef *et al.*, 2022).

(4) Industry Level

At the industry level, mental health initiatives remain largely disconnected from theory-informed models of site design. Existing standards prioritise hazard mitigation and productivity, with limited incorporation of JD-R constructs or Salutogenic principles such as demand–resource balance, comprehensibility and meaningfulness (Chan *et al.*, 2016). Integrated predictive frameworks linking multiple site characteristics (e.g. layout, temperature, noise, welfare) to MHW outcomes are scarce (Zhang *et al.*, 2023). Indoor environmental quality, inclusive and accessible design, and equity-oriented planning remain underexplored despite their relevance to manageability and long-term well-being (Imrie and Hall, 2003; Manley, 2016). While industry programs and multidimensional well-being indices show promise, their theoretical consolidation within JD-R and Salutogenic models is still limited (van Heerden *et al.*, 2025).

6. Conclusion

This study demonstrates that construction site characteristics, beyond organisational or individual determinants, play a substantive role in shaping workers' MHW. Synthesising evidence from 51 studies, the findings show that environmental stressors, inadequate amenities, unsafe configurations and poor spatial design are consistently associated with negative outcomes such as stress, fatigue, anxiety and burnout. Framed through the JD-R model and the Salutogenesis framework, the review further identifies how supportive site features, including ergonomic layouts, adequate ventilation, welfare amenities and visible safety controls, function as resources that promote resilience, engagement and emotional well-being.

The conceptual model developed extends existing psychological frameworks into the built-environment domain, providing a structured account of how site-level conditions operate as both demands and resources. By foregrounding modifiable, site-based factors, this study offers a practical foundation for environment-centred safety and well-being interventions in construction. Future research should empirically test the proposed pathways, examine contextual variation across project types, and integrate real-time environmental and psychosocial monitoring to support proactive, preventive approaches to mental health and safety in high-risk work settings.

Limitation

Despite the above contributions, several limitations should be acknowledged. Firstly, the study was limited to English-language publications. Secondly, the search was restricted to studies indexed in major academic databases, which may have excluded relevant research published elsewhere. Finally, the study focused specifically on site-level characteristics, with only limited consideration of broader organisational or industry-level factors that may also influence workers'MHW. These limitations provide opportunities for future research to further expand the evidence base in this area.

Acknowledgements
The authors acknowledge the University of Canberra for supporting this research through the doctoral research program.

References

Acharya, P., Boggess, B. and Zhang, K. (2018), "Assessing heat stress and health among construction workers in a changing climate: a review", *International Journal of Environmental Research and Public Health*, Vol. 15 No. 2, p. 247.

Ahmed, H.O., Bindekhain, J.A., Alshuweihi, M.I., Yunis, M.A. and Matar, N.R. (2020), "Assessment of thermal exposure level among construction workers in UAE using WBGT, HSI and TWL indices", *Industrial Health*, Vol. 58 No. 2, pp. 170-181.

Al-Bouwarthan, M., Quinn, M.M., Kriebel, D. and Wegman, D.H. (2020), "A field evaluation of construction workers' activity, hydration status, and heat strain in the extreme summer heat of Saudi Arabia", *Annals of Work Exposures and Health*, Vol. 64 No. 5, pp. 522-535.

Alruqi, W., Alqahtani, B., Salem, N., Abudayyeh, O., Liu, H. and Ahmed, S. (2025), "Assessing the impact of occupational stress on safety practices in the construction industry: a case study of Saudi Arabia", *Buildings*, Vol. 15 No. 16, p. 2895.

Anthony, B.F., Spencer, L.H., Bryning, L. and Lloyd-Williams, H. (2024), "Well-being of the workforce", *Health Economics of Well-Being and Well-Becoming across the Life-Course*, Vol. 231.

Antonovsky, A. (2002), "Unraveling the mystery of health: how people manage stress and stay well", *The Health Psychology Reader*, SAGE Publications Ltd.

Aromataris, E. and Munn, Z. (2020), *JBI Manual for Evidence Synthesis*, Jbi.

Bakker, A.B. and Demerouti, E. (2017), "Job demands–resources theory: taking stock and looking forward", *Journal of Occupational Health Psychology*, Vol. 22 No. 3, p. 273.

Betts, M., Robinson, G., Burton, C. Leonard, J. Sharda, A. and Whittington, T. (2015), *Global Construction 2030: A Global Forecast for the Construction Industry to 2030*, Global Construction Perspectives and Oxford Economics, London.

Biggs, A., Kellner, A., Robertson, A., Mason, J., Townsend, K., Page, S.J., Thompson, N. and Loudoun, R. (2025), "Managing psychosocial health risks in the Australian construction industry: a holistic hazard management intervention", *Buildings*, Vol. 15 No. 19, p. 3475.

Bitencourt, D.P., Muniz Alves, L., Shibuya, E.K., De Angelo Da Cunha, I. and Estevam De Souza, J.P. (2021), "Climate change impacts on heat stress in Brazil – past, present, and future implications for occupational heat exposure", *International Journal of Climatology*, Vol. 41 No. S1, pp. E2741-E2756.

Black Dog Institute (2023), "Mental health and wellbeing in the construction industry",available at: www.blackdoginstitute.org.au/news/black-dog-institute-turns-to-construction-workers-to-address-mental-health-support/ (accessed 22 May 2026).

Blair Winkler, R., Middleton, C. and Remes, O. (2024), "A review on the prevalence of poor mental health in the construction industry", *Healthcare*, MDPI, p. 570.

Carter, L. and Stanford, J. (2021), "Investing in better mental health in Australian workplaces".

Chan, A.P., Guo, Y., Wong, F.K., Li, Y., Sun, S. and Han, X. (2016), "The development of anti-heat stress clothing for construction workers in hot and humid weather", *Ergonomics*, Vol. 59 No. 4, pp. 479-495.

Chan, A.P., Nwaogu, J.M. and Naslund, J.A. (2020), "Mental ill-health risk factors in the construction industry: systematic review", *Journal of Construction Engineering and Management*, Vol. 146 No. 3, p. 4020004.

Demerouti, E., Bakker, A.B., Nachreiner, F. and Schaufeli, W.B. (2001), "The job demands-resources model of burnout", *Journal of Applied Psychology*, Vol. 86 No. 3, p. 499.

Duckworth, J., Hasan, A. and Kamardeen, I. (2024), “Mental health challenges of manual and trade workers in the construction industry: a systematic review of causes, effects and interventions”, *Engineering, Construction and Architectural Management*, Vol. 31 No. 4, pp. 1497-1516.

Farshad, A., Montazer, S., Monazzam, M.R., Eyvazlou, M. and Mirkazemi, R. (2014), “Heat stress level among construction workers”, *Iranian Journal of Public Health*, Vol. 43 No. 4, p. 492.

Fayard, K. and Mayer, C.-H. (2023), “Male graduates transitioning into the workplace: managing stress through the sense of coherence components”, *Frontiers in Psychology*, Vol. 14, p. 1053173.

Fayyad, N., Lam, B. and Choi, Y. (2024), “Workplace wellbeing and interior design: a systematic literature review”.

Global, A. (2020), “Global status report for buildings and construction”.

Golizadeh, H., Hon, C.K., Drogemuller, R. and Hosseini, M.R. (2018), “Digital engineering potential in addressing causes of construction accidents”, *Automation in Construction*, Vol. 95, pp. 284-295.

Golzad, H., Teimoory, A., Mousavi, S.J., Bayramova, A. and Edwards, D.J. (2023), “Mental health causation in the construction industry: a systematic review employing a psychological safety climate model”, *Buildings*, Vol. 13 No. 10, p. 2442.

Gómez-Salgado, C., Camacho-Vega, J.C., Gómez-Salgado, J., García-Iglesias, J.J., Fagundo-Rivera, J., Allande-Cussó, R., Martín-Pereira, J. and Ruiz-Frutos, C. (2023), “Stress, fear, and anxiety among construction workers: a systematic review”, *Frontiers in Public Health*, Vol. 11, p. 1226914.

Guo, N., Liu, Y., Yu, S., Xia, B. and Cong, W. (2025), “Examining the role of psychological symptoms and safety climate in shaping safety behaviors among construction workers”, *Behavioral Sciences*, Vol. 15 No. 1, p. 66.

Hansson, J., Landstad, B.J., Vinberg, S., Hedlund, M. and Tjulin, Å. (2022), “Small business managers and covid-19 – the role of a sense of coherence and general resistance resources in coping with stressors”, *Plos One*, Vol. 17 No. 3, p. e0265029.

Hsu, F.-W., Lin, C.J., Lee, Y.-H. and Chen, H.-J. (2016), “Effects of elevation change on mental stress in high-voltage transmission tower construction workers”, *Applied Ergonomics*, Vol. 56, pp. 101-107.

Imrie, R. and Hall, P. (2003), *Inclusive Design: designing and Developing Accessible Environments*, Taylor & Francis.

Irfan, M., Jalil, A., Khan, M. and Khan, S. (2024), “Effects of welfare facilities (amenities for well-being) on the satisfaction of civil engineers in construction industry”, *International Journal of Construction Education and Research*, Vol. 20 No. 2, pp. 197-217.

Jia, A.Y., Rowlinson, S., Loosemore, M., Gilbert, D. and Ciccarelli, M. (2019), “Institutional logics of processing safety in production: the case of heat stress management in a megaproject in Australia”, *Safety Science*, Vol. 120, pp. 388-401.

Jia, Y.A., Rowlinson, S. and Ciccarelli, M. (2016), “Climatic and psychosocial risks of heat illness incidents on construction site”, *Applied Ergonomics*, Vol. 53, pp. 25-35.

Jiang, Y., Luo, H. and Yang, F. (2020), “Influences of migrant construction workers’ environmental risk perception on their physical and mental health: evidence from China”, *International Journal of Environmental Research and Public Health*, Vol. 17 No. 20, p. 7424.

Kawakami, R., Hasebe, H., Yamamoto, Y., Yoda, S., Takeuchi, G., Abe, R., Tosaka, Y. and Nomura, Y. (2024), “Cooler break areas: reducing heat stress among construction workers in Japan”, *Building and Environment*, Vol. 262, p. 111821.

Kineber, A.F., Antwi-Afari, M.F., Elghaish, F., Zamil, A.M., Alhusban, M. and Qaralleh, T.J.O. (2023), “Benefits of implementing occupational health and safety management systems for the sustainable construction industry: a systematic literature review”, *Sustainability*, Vol. 15 No. 17, p. 12697.

Kurtzer, D., Blackmore, N., Farrugia, N. and Chileshe, N. (2020), “Productivity enablers and inhibiting health and wellbeing practices of South Australian construction site-based workers: a qualitative study”, *International Journal of Construction Management*, Vol. 20 No. 8, pp. 882-899.

Kwong, Q.J., Terbizi, N., Nordin, N., Marinie, E., Zawawi, A., Abd Razak, A. and Abdullah, J. (2023), "Heat stress and noise exposure levels in a manufacturing plant", *Pertanika Journal of Tropical Agricultural Science*, Vol. 31, pp. 961-975.

Li, X., Li, C., Yanfei, L., Yu, S., Guo, L. and Yang, F. (2025), "Impacts of job stress on the safety management performance of construction safety managers", *International Journal of Civil Engineering*, Vol. 23 No. 7, pp. 1-18.

Liu, Q., Feng, Y., London, K. and Zhang, P. (2023), "Influence of personal characteristics and environmental stressors on mental health for multicultural construction workplaces in Australia", *Construction Management and Economics*, Vol. 41 No. 2, pp. 116-137.

Malaki, M., Shou, W. and Wang, J. (2025), "Psychological distress among male construction workers in Australia: a systematic analysis", *International Journal of Construction Management*, pp. 1-9.

Manley, S. (2016), "Inclusive design in the built environment who do we design For", Training Handbook, available at: https://dcfw.org/inclusive-design-in-the-built-environment

Messeri, A., Morabito, M., Bonafede, M., Bugani, M., Levi, M., Baldasseroni, A., Binazzi, A., Gozzini, B., Orlandini, S., Nybo, L. and Marinaccio, A. (2019), "Heat stress perception among native and migrant workers in italian Industries-Case studies from the construction and agricultural sectors", *International Journal of Environmental Research and Public Health*, Vol. 16 No. 7, p. 1090.

Moon, J.H. and Ryu, H. (2024), "Salutogenesis intervention improves cardio-cerebrovascular health in at-risk office workers: a quasi-experimental study", *Public Health Nursing*, Vol. 41 No. 4, pp. 690-703.

Office for National Statistics (2023), *Suicides by Occupation, England and Wales*, Office for National Statistics.

Ofori, J.N.A., Tomori, M. and Ogunseiju, O. (2025), "Assessing the ethical, social and psychological risks of active and passive exoskeletons in the construction industry: trust, productivity and stress levels", *Smart and Sustainable Built Environment*, Vol. 14 No. 4, pp. 1091-1116.

Omer, M.M., Moyo, T., Al-Otaibi, A., Alawag, A.M., Rizal Alias, A. and Rahman, R.A. (2025), "Critical factors affecting workplace well-being at construction sites across countries with different income levels", *Construction Innovation*, Vol. 25 No. 1, pp. 104-130.

Omer, M.M., Moyo, T., Alias, A.R. and Rahman, R.A. (2024), "Development of workplace well-being indexes at construction sites", *Journal of Engineering, Design and Technology*, Vol. 23 No. 4, pp. 1111-1136.

Onwuegbuchulam, G., Cheung, C.M., Yeow, J. and Manu, P. (2024), "Exploring the interplay of job-related and personal factors in the well-being of construction project professionals: a conceptual framework", *The 40th Annual ARCOM Conference*, *ARCOM*.

Page, M., Mckenzie, J., Bossuyt, P., Boutron, I., Hoffmann, T., Mulrow, C., Shamseer, L., Tetzlaff, J., Akl, E. and Brennan, S. (2021), "The PRISMA 2020 statement", *BMJ*, Vol. 372, p. n71.

Peterson, C. (2020), Suicide rates by industry and occupation – National Violent Death Reporting System, 32 states, 2016. MMWR. Morbidity and mortality weekly report, p. 69.

Radzi, A.R., Ks, A., Alias, A.R., Algahtany, M. and Rahman, R.A. (2024), "Modeling the factors affecting workplace well-being at construction sites: a cross-regional multigroup analysis", *Journal of Engineering, Design and Technology*, Vol. 23 No. 4, pp. 1087-1110.

Rani, H.A., Radzi, A.R., Alias, A.R., Almutairi, S. and Rahman, R.A. (2022), "Factors affecting workplace well-being: building construction projects", *Buildings*, Vol. 12 No. 7, p. 910.

Ronis, D.L., Hong, O. and Lusk, S.L. (2006), "Comparison of the original and revised structures of the health promotion model in predicting construction workers' use of hearing protection", *Research in Nursing and Health*, Vol. 29 No. 1, pp. 3-17.

Ross, V., Waters, A., Wardhani, R., Thompson, N., Waddington, J., Geange, J. and Hamilton, K. (2025), "Assessment of a workplace training intervention targeting bullying and mental health for construction industry apprentices: a three-pillared approach", *BMC Public Health*, Vol. 25 No. 1, p. 2228.

Santamouris, M. and Vasilakopoulou, K. (2021), "Present and future energy consumption of buildings: challenges and opportunities towards decarbonisation", *e-Prime-Advances in Electrical Engineering, Electronics and Energy*, Vol. 1, p. 100002.

Saraji, S. and Mehany, M.S.H.M. (2025), “A comprehensive review of mental health and well-being interventions in the construction industry”, *Proceedings of Associated Schools of Construction*, Vol. 6, pp. 903-913.

Sommovigo, V., Setti, I., Maiolo, M.E. and Argentero, P. (2021), “Tunnel construction workers’ well-being: the role of job control and supervisor support”, *International Journal of Construction Management*, Vol. 21 No. 9, pp. 945-957.

Sun, H., Zhang, S., Jiang, Y., Nie, X., Kuang, M. and Liu, Z. (2025), “The impact of the tunnel micro-environment on workers’ behavior: considering the mediating role of mental health”, *Sustainability*, Vol. 17 No. 6, p. 2631.

Techera, U., Hallowell, M. and Littlejohn, R. (2019), “Worker fatigue in electrical-transmission and distribution-line construction”, *Journal of Construction Engineering and Management*, Vol. 145 No. 1, p. 4018119.

Teddlie, C. (2016), *SAGE Handbook of Mixed Methods in Social and Behavioral Research*, Sage.

Tijani, B., Jin, X. and Osei-Kyei, R. (2021), “A systematic review of mental stressors in the construction industry”, *International Journal of Building Pathology and Adaptation*, Vol. 39 No. 2, pp. 433-460.

Umar, T. and Egbu, C. (2020), “Heat stress, a hidden cause of accidents in construction”, *Proceedings of the Institution of Civil Engineers – Municipal Engineer*, Vol. 173 No. 1, pp. 49-60.

Van Heerden, A., Flemmer, C., Boulic, M. and Mcdonald, B. (2025), “The effect of job status on stressors and stress coping strategies in the New Zealand construction sector”, *International Journal of Construction Education and Research*, Vol. 22 No. 2, pp. 1-22.

Vischer, J.C. (2008), “Towards an environmental psychology of workspace: how people are affected by environments for work”, *Architectural Science Review*, Vol. 51 No. 2, pp. 97-108.

Waage, S., Odeen, M., Bjorvatn, B., Eriksen, H.R., Ursin, H., Hollund, B.E. and Moen, B.E. (2010), “Still healthy after extended work hours? Ten hours shift, twenty-one days working period for tunnel workers”, *Industrial Health*, Vol. 48 No. 6, pp. 804-810.

Xiang, J., Bi, P., Pisaniello, D. and Hansen, A. (2014), “Health impacts of workplace heat exposure: an epidemiological review”, *Industrial Health*, Vol. 52 No. 2, pp. 91-101.

Yang, X., Wang, Y., Zhang, R. and Zhang, Y. (2021), “Physical and psychoacoustic characteristics of typical noise on construction site: ‘how does noise impact construction workers’ experience?”, *Frontiers in Psychology*, Vol. 12, p. 707868.

Yasmeen, S., Liu, H., Wu, Y. and Li, B. (2020), “Physiological responses of acclimatized construction workers during different work patterns in a hot and humid subtropical area of China”, *Journal of Building Engineering*, Vol. 30, p. 101281.

Yi, W. and Chan, A.P.C. (2015), “Which environmental indicator is better able to predict the effects of heat stress on construction workers?”, *Journal of Management in Engineering*, Vol. 31 No. 4, p. 4014063.

Yosef, T., Sineshaw, E. and Shifera, N. (2022), “Occupational injuries and contributing factors among industry park construction workers in northwest Ethiopia”, *Frontiers in Public Health*, Vol. 10, p. 1060755, doi: 10.3389/fpubh.2022.1060755.

Zhang, Y., Li, Y., Xue, X., Dou, Y. and Zhang, R. (2023), “Network analysis of well-being of managerial employees in the construction industry”, *Journal of Building Engineering*, Vol. 80, p. 108011.

Zhao, Y., Yi, W., Chan, A.P.C., Wong, F.K.W. and Yam, M.C.H. (2017), “Evaluating the physiological and perceptual responses of wearing a newly designed cooling vest for construction workers”, *Annals of Work Exposures and Health*, Vol. 61 No. 7, pp. 883-901.

Zong, H., Yi, W., Antwi-Afari, M.F. and Yu, Y. (2024), “Fatigue in construction workers: a systematic review of causes, evaluation methods, and interventions”, *Safety Science*, Vol. 176, p. 106529.

Appendix

Table A1. Mapping construction site characteristics against workers' MHW outcomes using theoretical dimensions

		JDR theory		Salutogenesis theory		
No.	Article (author, year)	Job Demands (JD-R)	Job resources (JD-R)	Comprehensibility	Manageability	Meaningfulness
1	(Omer *et al.*, 2024a)	Workload, long hours, monitoring, poor conditions	Leadership, welfare, communication, transport	Structured workflow, feedback	Timely pay, safety systems	Respect, collaboration, team support
2	(Szer *et al.*, 2022)	Heat, solar radiation, humidity, workload at height	Scaffolding covers, heat index tools (UTCI)	Weather monitoring, risk correlations	Breaks, forecast-based planning, shade/rest areas	Safer work, dignity under extreme heat
3	(Kwong *et al.*, 2023)	Heat, noise, humidity, poor airflow	Fans, PPE, shade, rest breaks	Clear PPE use, routines	Breaks reduced strain	Safety, worker satisfaction
4	(Irfan *et al.*, 2024)	–	Welfare (rest, hygiene, transport, safety)	Welfare improves predictability	Amenities support demand handling	Amenities enhance work value/satisfaction
5	(Radzi *et al.*, 2023)	Workload, hours, deadlines, payment, safety risks	Welfare, food, transport, insurance, leadership, comms	Planning and communication improve task clarity	Leadership, job clarity, and welfare aid control	Leadership and welfare boost value/purpose
6	(Rani *et al.*, 2022)	Long hours, project pressure, performance checks	Welfare facilities, site safety, health monitoring	Project planning, role clarity	Site planning, clear safety procedures	Safety support, adequate site amenities
7	(Radzi *et al.*, 2024)	Long working hours, physical strain, site isolation	Site layout, rest areas, communication tools	Clear roles, signage, site updates	Work planning, break access	Site connection, purpose in physical work
8	(Bitencourt *et al.*, 2021)	Extreme heat, heat waves, outdoor physical labour	–	Climate data and WBGT improve awareness	Limited mitigation mechanisms	General concern for health (policy level)
9	(Messeri *et al.*, 2019)	Heat exposure, physical strain, migrant vulnerability	Training (formal/informal)	Varies by group – clearer for native workers	Migrants adapt despite fewer formal supports	Inferred through reporting of effort
10	(Umar and Egbu, 2020)	Excessive heat, physical strain, hypertension risks	Breaks, hydration, rescheduling, screening (suggested)	Workers aware of heat risks and related incidents	Task rescheduling, lighter clothing, shift planning (partial)	–
11	(Kurtzer *et al.*, 2020)	Heat, weather extremes	Suggestions for environmental adjustments	Awareness of weather-related risks	Limited site-level control	Health linked to work ability
12	(Pogačar *et al.*, 2019)	Heat waves, dehydration, physical exhaustion	Water access, peer discussion	Informal awareness of heat effects on work	Hydration, peer support	–
13	(Chan *et al.*, 2016)	Heat, humidity, clothing discomfort	Cooling clothing, breathable fabrics	Design feedback, discomfort awareness	Prototype testing	Safety, performance
14	(Chinnadurai *et al.*, 2016)	High heat, cardiovascular strain	PMV model, ISO standards, field interviews	Heart rate and PMV data interpretation	Indoor task adaptation	Health protection, climate planning

(*continued*)

Table A1. Continued

No.	Article (author, year)	JDR theory Job Demands (JD-R)	Job resources (JD-R)	Salutogenesis theory Comprehensibility	Manageability	Meaningfulness
15	(Farshad *et al.*, 2014)	Extreme heat, dehydration, solar radiation	No formal OHS, no rest/ hydration system	Awareness via WBGT/ TWL/USG indices	Lack of control, informal setting	Work necessity under poor conditions
16	(Zhang *et al.*, 2023)	Workload, job pressure, physical strain	Welfare, PPE, safe worksite	Wellbeing dimensions, visual tools	Equipment, fair pay, team support	Fairness, support, family balance
17	(Liu *et al.*, 2023)	Workload, task ambiguity	WHS practices	Task clarity	Work planning	–
18	(Onubi *et al.*, 2024)	Site-level green practice requirements	On-site green skills, awareness	Clarity through SEM modeling	Support for green actions	Sustainability-oriented values
19	(Yi and Chan, 2015)	Heat, workload, solar radiation, clothing insulation, ventilation	WBGT model, heart rate data, PPE selection, rest cycle	Heat index model improves risk clarity	Index-based planning and PPE choice	Science-based care supports value of worker role
20	(Yi and Chan, 2017)	Heat, continuous physical labor, physiological strain	Smart work-rest model, WBGT thresholds, workload data	Visual tools and thresholds clarify risks	Real-time schedule adjustments possible	Personalized planning supports health and motivation
21	(Kawakami *et al.*, 2024)	Heat, humidity, physical workload, long hours	Cooling jackets, shaded rest zones, scheduled breaks	Physiological and subjective fatigue assessment	Cooler break areas reduced heat strain	Recovery supports health, but fatigue remained
22	(Guo *et al.*, 2019)	Heat, humidity, physical strain, risk of heat illness	Cooling vest with PCM, fans, UV-protection	Vest performance tested and explained	Reduced heat strain, improved recovery	Comfort and safety supported work performance
23	(Esmaeilifar *et al.*, 2020)	Stress from recycle/reuse tasks, low-carbon pressure	Reduce practice, clear waste management plans	Waste impact modeled via PLS-SEM	Reduce practice easier to apply	Tension between sustainability targets and role meaning
24	(Omer *et al.*, 2024b)	Long working hours, unsafe physical conditions	Rest areas, safety signage, site communication tools	Site-level hazards were observable and documented	Site layout and rest provisions supported control	Physical safety and visible improvements enhanced trust
25	(Carvajal-Arango *et al.*, 2021)	Emotional demands, unsafe conditions, repetitive tasks, lack of recognition	Recognition, social support, growth opportunities, site-level support	Subjective feedback clarified wellbeing influences	Autonomy, interpersonal support, recognition improved control	Recognition and purpose increased connection to work
26	(Techera *et al.*, 2019)	Long shifts, extreme temperatures, physical and mental strain, inter-site travel	Peer support, rest periods, hazard awareness	Task clarity maintained, mental fatigue affects focus	Fatigue limits control, especially during long tasks	Public service creates meaning, but burnout reduces motivation

(*continued*)

Table A1. Continued

		JDR theory		Salutogenesis theory		
No.	Article (author, year)	Job Demands (JD-R)	Job resources (JD-R)	Comprehensibility	Manageability	Meaningfulness
27	(Jia *et al.*, 2019)	Heat stress, deadlines, managerial pressure, productivity push	Cool zones, peer support, union input, site initiatives	Confusing leadership signals, risk awareness	Informal practices, limited formal authority	Peer dignity, blocked by top-down priorities
28	(Ahmed *et al.*, 2020)	Radiant heat, WBGT, physical demand, heat stress risk	Shaded areas, acclimatization zones, shift adjustment	WBGT/HSI/TWL data, acclimatization awareness	Shift rescheduling, shaded rest, worker restriction	Safety concerns, heat impacts performance
29	(Yasmeen *et al.*, 2020)	WBGT 31.5 °C, humidity, solar heat, physical exertion	Acclimatization, rest periods, fan, ventilation	Skin temp, heart rate patterns, physiological insight	Rest scheduling, airflow, short breaks	Endurance, work commitment
30	(Jia *et al.*, 2016)	Heat, no acclimatization, site-induced stress	Engineering controls, symptom control	Risk awareness, hazard identification	On-site infrastructure, physical response measures	Safety concern, survival motivation
31	(Eaves *et al.*, 2016)	Physical strain, age-related demands, musculoskeletal symptoms	Ergonomics, adapted PPE, tool redesign, lifting aids, peer input	High awareness of physical risks	Body strain control through design changes	Empowerment via involvement
32	(Hsu *et al.*, 2016)	Height, narrow space, extreme climate, high-risk tasks	Experience, physiological monitoring (HRV)	Risk awareness with cognitive clarity	Stress harder to control at elevation	Essential, skilled work; stress normalized
33	(Bendak *et al.*, 2022)	High heat, fatigue, impaired performance, accident risk	Task batteries, seasonal data, monitoring	Clear fatigue trends, easy interpretation	Hard to manage summer fatigue	Alertness, safety, performance valued
34	(Yang *et al.*, 2021)	High noise, communication strain, auditory stress	Binaural tools, psychoacoustic analysis, feedback	Noise types understood; long-term risks unclear	Weak control; spatial zoning needed	Mixed: accepted by some; others feel unsafe
35	(Yosef *et al.*, 2022)	High workload, poor PPE, no training, safety risks	Observations, injury prevention advice, analysis	Injury risks known; limited factor awareness	Poor without PPE/ training; risks remain high	Safety perception strongly linked to satisfaction
36	(Jiang *et al.*, 2020)	Air, water, food, waste, noise pollution	Risk perception, proactive orientation	Experience-based interpretation; varies by group	Lower for older/female workers; limited control	Meaning through hazard recognition, esp. young/ males
37	(Kordmiri *et al.*, 2023)	Hand-transmitted vibration, noise, tool repetition, neuromuscular strain	Controlled setup, EMG tools, rest intervals	Exposure and task structure clearly defined	Rest allowed, short tasks, monitored strain	Prevention focus, awareness of dual-exposure risks

(*continued*)

Table A1. Continued

		JDR theory			Salutogenesis theory	
No.	Article (author, year)	Job Demands (JD-R)	Job resources (JD-R)	Comprehensibility	Manageability	Meaningfulness
38	(Al-Bouwarthan *et al.*, 2020)	Outdoor heat, high WBGT, dehydration, cardiovascular strain	Self-pacing, shaded areas, hydration checks, WBGT tools	Risk education, global threshold alignment	Self-pacing helped, but low environmental control	Health study boosted agency, stressed protection needs
39	(Dutta *et al.*, 2015)	High heat, low protection, physical overload	Cooling practices, basic PPE, personal strategies	Recognized symptoms, situational awareness	Self-protection used, low control over workload	Health concerns showed risk awareness and value on safety
40	(Zhao *et al.*, 2017)	Extreme heat, PPE use, physical workload	Cooling vest, hydration, safety monitoring	Clear conditions, relatable outcomes	Passive cooling improved recovery and tolerance	Innovation supports health, safety, and job sustainability
41	(Tennakoon *et al.*, 2025)	Task overload, bullying, macho culture, time pressure	Supportive supervision, communication	Lack of clear communication	Low control and coping capacity	Reduced sense of value under unsupportive culture
42	(Alruqi *et al.*, 2025)	Role pressure, unclear responsibilities, excessive workload	Limited supervision support, job stability	Multicultural and linguistic barriers	Low control due to unstable contracts	Job alienation and reduced safety motivation
43	(Biggs *et al.*, 2025)	Role ambiguity, conflict, isolation in FIFO/DIDO sites	Supervisor support, recognition, consultation (MATES)	Improved clarity via leadership and communication training	Greater access to peer and emotional support	Strengthened belonging and purpose through engagement
44	(Zhang *et al.*, 2025)	Cognitive–emotional load in digitalised Construction 5.0 tasks	Psychosocial support, leadership, emotional resilience	Clearer understanding of safety roles	Better ability to manage tech-driven stress	Enhanced belonging through human-centric culture
45	(Ross *et al.*, 2025)	Bullying, unsupportive work culture	Supervisor training, resilience, toolbox sessions	Awareness of bullying behaviour	Enhanced coping and communication	Inclusion and respect strengthen value perception
46	(Ofori *et al.*, 2025)	Ergonomic and cognitive stress from exoskeleton use	Technological assistive tools, ethical assurance	Understanding of device operation and data use	Moderate control over device comfort	Trust and fairness increase motivation
47	(van Heerden *et al.*, 2025)	Physical workload, interpersonal conflict, long hours	Training, supportive management, career development	Clearer job roles reduce confusion	Organisational support improves coping	Recognition fosters engagement
48	(Li *et al.*, 2025)	High safety accountability, time pressure, uncertainty	Organisational and social support	Ambiguity reduces clarity	Support buffers burnout	Supportive culture enhances role meaning

(*continued*)

Table A1. Continued

No.	Article (author, year)	JDR theory Job Demands (JD-R)	Job resources (JD-R)	Comprehensibility	Salutogenesis theory Manageability	Meaningfulness
49	(Guo *et al.*, 2025)	Psychological distress, isolation, unsafe climate	Safety communication, supportive climate	Unclear risk communication	Improved coping via guidance	Family connection reinforces wellbeing
50	(Sun *et al.*, 2025)	Environmental stress (noise, dust, confinement)	Rest areas, ventilation, exposure controls	Poor understanding of invisible hazards	Limited control in confined tunnels	Comfort and safety perception increase satisfaction
51	(Liu *et al.*, 2025)	Long hours, stress, unsafe or inequitable sites	Income stability, safety assurance, welfare systems	Clear expectations and fair systems	Safety and pay improve stress management	Career growth and recognition enhance purpose

References

Bendak, S., Jouaret, R. and Rashid, H. (2022), "Effects of high ambient temperature on construction workers performance: a longitudinal empirical study", *Journal of Safety Research*, Vol. 81, pp. 197-202.

Carvajal-Arango, D., Vasquez-Hernandez, A. and Botero-Botero, L.F. (2021), "Assessment of subjective workplace well-being of construction workers: a bottom-up approach", *Journal of Building Engineering*, Vol. 36, p. 102154.

Chinnadurai, J., Venugopal, V., Kumaravel, P. and Paramesh, R. (2016), "Influence of occupational heat stress on labour productivity–a case study from chennai, India", *International Journal of Productivity and Performance Management*, Vol. 65 No. 2, pp. 245-255.

Dutta, P., Rajiva, A., Andhare, D., Azhar, G.S., Tiwari, A., Sheffield, P. and Group, C.S. (2015), "Perceived heat stress and health effects on construction workers", *Indian Journal of Occupational and Environmental Medicine*, Vol. 19 No. 3, pp. 151-158.

Eaves, S., Gyi, D.E. and Gibb, A.G. (2016), "Building healthy construction workers: their views on health, wellbeing and better workplace design", *Applied Ergonomics*, Vol. 54, pp. 10-18.

Esmaeilifar, R., Iranmanesh, M., Shafiei, M.W.M. and Hyun, S.S. (2020), "Effects of low carbon waste practices on job satisfaction of site managers through job stress", *Review of Managerial Science*, Vol. 14 No. 1, pp. 115-136.

Guo, Y., Chan, A.P., Wong, F.K., Li, Y., Sun, S. and Han, X. (2019), "Developing a hybrid cooling vest for combating heat stress in the construction industry", *Textile Research Journal*, Vol. 89 No. 3, pp. 254-269.

Kordmiri, S.H.M., Aliabadi, M., Golmohammadi, R., Bovenzi, M. and Farhadian, M. (2023), "Combined effects of noise and hand-transmitted vibration on workers' muscle and mental fatigues in a simulated construction operation", *La Medicina Del Lavoro*, Vol. 114, p. e2023021.

Liu, Q., Zhong, Z. and Li, Y. (2025), "Research on construction workers' job well-being and unsafe state: from the perspective of maslow hierarchy of needs", *Medicine*, Vol. 104 No. 31, p. e43605.

Onubi, H.O., Carpio, M. and Hassan, A.S. (2024), "Job satisfaction in green construction projects: antecedent roles of green work climate, pro-environmental construction practice and green human capital", *Engineering, Construction and Architectural Management*, Vol. 31 No. 5, pp. 1857-1878.

Pogačar, T., Žnidaršič, Z., Kajfež Bogataj, L., Flouris, A.D., Poulianiti, K. and Črepinšek, Z. (2019), "Heat waves occurrence and outdoor workers' self-assessment of heat stress in Slovenia and Greece", *International Journal of Environmental Research and Public Health*, Vol. 16 No. 4, p. 597.

Radzi, A.R., Rahman, R.A., Alias, A.R. and Almutairi, S. (2023), "Validating the impact of psychological, physical, and social factors on workplace Well-Being at construction sites", *International Journal of Integrated Engineering*, Vol. 15, pp. 245-255.

Szer, I., Lipecki, T., Szer, J. and Czarnocki, K. (2022), "Using meteorological data to estimate heat stress of construction workers on scaffolds for improved safety standards", *Automation in Construction*, Vol. 134, p. 104079.

Tennakoon, T.M.M.P., Ranasinghe, U., Samaraweera, A., Rameezdeen, R., Gallage, S., Newman, W.R., White, B.J. and Lim, D.N.T.W. (2025), "Work-related factors affecting mental well-being of young construction workers in South Australia", *Built Environment Project and Asset Management*, Vol. 15 No. 3, pp. 682-698.

Yi, W. and Chan, A.P. (2017), "Effects of heat stress on construction labor productivity in Hong Kong: a case study of rebar workers", *International Journal of Environmental Research and Public Health*, Vol. 14 No. 9, p. 1055.

Zhang, L., Yuan, J., Yin, X., Gu, T., Lu, Y., Liu, P. and Skibniewski, M. (2025), "The emotional equation: how psychosocial support boosts safety practices in the context of construction 5.0", *Frontiers in Psychology*, Vol. 16, p. 1632848.

Supplementary material

The supplementary material for this article can be found online.

Corresponding author

Parisa Moshashaei can be contacted at: parisa.moshashaei@canberra.edu.au