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ANALYSIS OF SUICIDE RATES IN CONSTRUCTION AND HOW LEAN CAN HELP REVERSE THE TRENDS

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ABSTRACT

Suicide rates in Construction are among the highest in the industry, a problem that appears to have been amplified after the COVID-19 pandemic. This paper presents an analysis of data obtained from the United States Centers for Disease Control and Prevention (CDC) from 2003 to 2023, including 27,388 deaths by suicide across the top five occupations where these deaths occurred. The authors present the data and discuss potential solutions based on another study which points out how Lean Construction tools and practices can improve the sense of belonging in construction projects.

KEYWORDS

Construction workers, suicide, belongingness, stress, depression.

INTRODUCTION

The construction industry is one of the largest contributors to the gross domestic product (GDP) in the United States, and usually responsible for the employment of a large number of workers as it relies heavily on manual labor (AGC, 2026). Construction is regarded as an industry where change comes at a slower pace than its counterparts in other sectors (Construction Dive, 2023) and where productivity has remained largely unchanged despite technological advancements (Kacik, 2023). These factors, alongside a combination of long hours of extraneous work in settings that are by nature, and oftentimes, dusty, noisy, and dangerous, contribute to the high levels of stress and depression experienced by construction workers (Alves et al., 2025a). Construction teams are fluid in the sense that specialty trades, construction professionals, suppliers, and regulatory agents, to name a few, join and leave the projects at different points in time, making it difficult for individuals to build long-term professional relationships and develop a sense of belongingness to their teams, the organizations and projects they work for. However, despite the structural challenges to grow their sense of belonging in this environment, construction workers report a high level of belongingness in their projects (Alves et al., 2025a), which could be leveraged to actively bring workers that feel disconnected from their teams to seek help.

Considering the current setting of the construction industry, this paper contributes with an analysis of data obtained from the United States Centers for Disease Control and Prevention (CDC, 2026) to continue to raise awareness about the alarming numbers of deaths by suicide

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in the construction industry and to propose solutions based on the use of Lean Construction tools and practices to improve the sense of belonging of workers as a way to turn the tide on this epidemic. The paper starts with a review of the existing literature considering construction workers' mental health, followed by a discussion of belonging and psychological safety studies in construction. Next, the research method is shared and alongside a discussion of the results obtained from the analysis of the CDC data, and finally recommendations regarding ways to improve construction workers' mental health with the goal of reducing the incidence of deaths by suicide.

CONSTRUCTION WORKERS' MENTAL HEALTH

"*Mental health is a state that enables individuals to cope with life stressors, realize their abilities, learn and work effectively, and contribute to their communities, and extends beyond the absence of mental disorders*" (WHO, 2022). This section reviews existing literature on construction workers' mental health followed by recent studies addressing belongingness and psychological safety in construction projects.

RAISING AWARENESS ACROSS THE INDUSTRY

A growing number of public agencies, industry groups, and private sector partners are taking actions to address mental health issues in the construction workforce. These efforts range from regional policy advocacy to field-level outreach campaigns. For example, the New York State announced a Mental Wellness Program for capital region construction workers in 2024. This program was funded by a five-year, $4.8 million CDC grant to decrease suicides by 10% within the demographic (New York State Office of Mental Health, 2024). The Business Trades Employers' Association has submitted proposals to the New York City legislation to enhance mental health since 2023. It also requested that the Occupational Safety and Health Administration include mental wellness in its 10-hour and 30-hour mandatory safety training programs (Raffetto, 2024). London, Chicago, Sydney, and New York had the out-of-home campaign for Get Construction Talking in 2023. The goal was to destigmatize mental health discussions and encourage industry-wide conversations about well-being (B1M, 2023).

THE IMPACT OF BELONGINGNESS

Sense of belonging is defined as an individual feeling of being accepted, valued, and connected within a group or environment (Dost & Mazzoli Smith, 2023). In the construction industry, belongingness reflects whether workers feel valued as members of their work groups, experience peer and supervisor support, and perceive connection to their teams and projects (Liang et al., 2022). The transient, project-based nature of the construction industry makes belongingness particularly difficult to sustain, as workers frequently change teams and jobsites, limiting opportunities to build lasting relationships (Palaniappan et al., 2023). Certain groups of workers face additional stressors that further undermine their sense of belonging. For ethnic minority and migrant workers, cultural and language barriers isolate them from their teams, directly reducing their sense of connection and group membership (Salami et al., 2019). An entrenched masculine industry culture that emphasizes toughness and self-reliance creates exclusionary norms that weaken belongingness for women and minorities by signaling they do not "fit in" (Howe et al., 2024). Furthermore, workplace discrimination and harassment reduce the perception of being valued and accepted, compounding the challenges these groups face in developing belongingness (Koveshnikov & Lehtonen, 2025). Suicidal ideation or suicide attempts have been negatively correlated with the sense of belonging, individuals who displayed low sense of belonging were more likely to have suicidal thoughts or a history of suicide attempts (Hatcher & Stubbersfield, 2013) and also face greater severity of depression

and hopelessness (Fisher et al., 2015), even after controlling for life stress and perceived social support.

PSYCHOLOGICAL SAFETY

Psychological safety has been defined as individuals feeling safe to speak up without fear of retribution (Edmondson, 1999). Individuals who work in psychologically safe environments are more willing to take risks, raise difficult issues, and engage in open communication, while feeling valued by their teams (Edmondson, 1999; Madrid et al., 2024). Psychological safety is shaped by factors at multiple levels, including organizational, work-related, and personal dimensions (Edmondson & Lei, 2014).

At the organizational level, broader culture, leadership, and systemic structures set the conditions that enable or constrain psychological safety (Volevakha et al., 2021). Supportive organizational cultures advance cohesion and trust, which in turn enhance psychological safety, whereas a climate of silence can inhibit learning and open communication (Khalid & Syed, 2024). Leadership plays a central role in shaping these cultural conditions. McKinsey & Company (2021) identified four leadership qualities that cultivate psychologically safe environments: awareness, vulnerability, empathy, and compassion. Awareness enables leaders to recognize their own internal states and team dynamics, which lays the foundation for vulnerability—the willingness to acknowledge their own limitations, signaling to workers that it is safe to do the same. This vulnerability cultivates empathy, enabling leaders to understand workers' experiences from their perspective, which in turn gives rise to compassion—responsible action to address workers' difficulties.

At the work-related level, psychological safety is shaped by factors inherent to how work is organized and carried out, such as team interaction dynamics, task clarity, and management practices. When workers have clear goals, feel supported by their team, and operate in an environment that encourages open communication, they are more likely to feel psychologically safe (Villanueva et al., 2024). Demirkesen et al. (2021) investigated how Lean principles—including respect for people, trust, communication, lean leadership, problem-solving, continuous improvement, and no blame culture—influence psychological safety in U.S. construction projects through surveys and interviews. Using an adapted version of Edmondson's (1999) psychological safety scale, workers in Lean projects reported higher psychological safety scores (4.10 out of 5) than those in traditional projects (2.71 out of 5), with interviewees attributing this difference primarily to respect for people and no blame culture, which encouraged workers to speak up about errors and safety concerns without fear of negative consequences.

At the personal level, psychological safety is influenced by individual perceptions of control and autonomy; workers who possess a greater sense of control tend to report higher levels of psychological safety. Demirkesen et al. (2021) found that female employees feel more pressure at work, which might be related to the pressures of working in male-dominated workspaces, and that lower status employees feel less psychologically safe than their upper status colleagues, a relationship that likely stems from the power imbalance felt by workers in lower level positions and the fear of "speaking truth to power". Non-native English speakers experience language anxiety leading to withdrawal and lower psychological safety (Aichhorn & Puck, 2017). Additionally, ethnic minority construction workers, often facing language and cultural barriers, face difficulties accessing safety information, further limiting their ability to engage and speak up in the workplace (Lyu et al., 2025).

RESEARCH METHOD

The research method adopted in this study relies on results from two different studies addressing construction workers' mental health. The first study sought to investigate how Lean

Construction practices might potentially impact construction workers' mental health, whereas the second specifically looked at data available from a large dataset obtained from the CDC.

Data was initially collected in a study funded by Lean Construction Institute (LCI), and results were made available in Alves et al. (2025a). The study analyzing the relationship between Lean Construction practices and construction workers' mental health relied on a survey developed by the authors with the support of an industry advisory board and a consultant. The survey instrument used stress, depression, and belongingness as proxies for mental health alongside managerial practices addressing psychological safety, safety climate, collective decision-making, clear direction, as well as practices related to planning and the sharing of information. The survey was deployed in English and Spanish in the United States between August 2024 and March 2025, and 282 valid responses were used in the analyses. Additional details about this study can be found in Alves et al. (2025a). The majority of respondents were white (80.8%) and male (85.1%) and had been in the construction industry for over 20 years (31.9%) or between 1 and 5 years (29.4%). Multiple trades were represented in the data collected including the top three respondent categories: earthwork/highway/road building (20.2%), piping and plumbing (15.6%), and Mechanical/HVAC (11.7%). Data was evaluated using univariate distribution analysis to sort the data into individual questions and, later, multivariate analysis to cross responses related to the mental health measurements (part 2 of the survey) with those related to work environment & psychosocial factors (part 3) and Lean Construction practices (part 4). This paper focuses on results related to the mental health factors (part 2) and how they relate to work environment & psychosocial factors commonly associated with Lean Construction practices.

The second stage of this study comprised the analysis of data obtained from the CDC compiled as part of the National Violent Death Reporting System (NVDRS). The data was obtained via a formal request made to the CDC to have access to the NVDRS data. The NVDRS Web System dataset contains data on a large number of variables collected from 2003 through 2023 including, but not limited to, victim demographics, injury and death, and toxicology variables, to name a few. Once the dataset was obtained, data about deaths by suicide in the construction industry were extracted for further analysis and parsed by occupation categories as defined by Standard Occupational Classification (SOC) 2018—Detailed Occupation Level (BLS, 2018).

Next, the authors focused on the analysis of the top five occupations directly related to working on field tasks, and not including occupations related to supervision, that is, "First-Line Supervisors of Construction Trades and Extraction Workers" and "Construction Managers", which are part of the original top five occupations in Construction for which deaths by suicide were recorded. The decision to include only trades workers directly engaged in field work was made in recognition of the distinct characteristics of trades and managerial roles, as well as the large number of trade occupations represented in the dataset. Results including the top five occupations involving construction workers are reported in the next section of this paper. Finally, the authors isolated the data for a period of time before and after the COVID-19 pandemic to look for changes in trends as the CDC data was analyzed. Considering that the data is available until 2023, the authors used two years prior to the pandemic years, and two years after, where 2020 and 2021 are considered years and when the effects of the pandemic likely had long-lasting impacts on the construction industry.

The final step of the cross analysis includes a discussion of the data collected from both phases previously described and addresses suggestions regarding how to use Lean Construction practices with the goal of supporting the mental health of construction workers and, hopefully, preventing workers from dying by suicide.

DEATHS BY SUICIDE IN CONSTRUCTION

This section reports the staggering number of cases of deaths by suicide in the construction industry. In 2023, the last year for which data is currently available, construction fatalities represented 20% (1,075 out of 5,283) of the total number of fatalities recorded across all industry sectors, taking the top spot across all sectors, and also representing the highest number of fatalities for construction since 2011 (BLS, 2024). This is a warning sign that the industry is moving in the wrong direction regarding workers' mental health, regardless of advancements made in specific construction sub-sectors and across the industry at large.

Data from the NVDRS used for this paper, including records from 2003 to 2023, indicate that 47,791 cases of deaths by suicide (ages 18-67) were recorded across all occupation categories in the construction industry. A closer look at the data available in the years prior and right after the COVID-19 pandemic (2018-2023) for the top five categories analyzed in this study is presented in Figure 1 showing suicide rates per 100,000 cases. Construction Laborers present the highest rates across the five groups, followed by Painters, Construction and Maintenance (hereafter "Painters") and Carpenters, alternating throughout the six years.

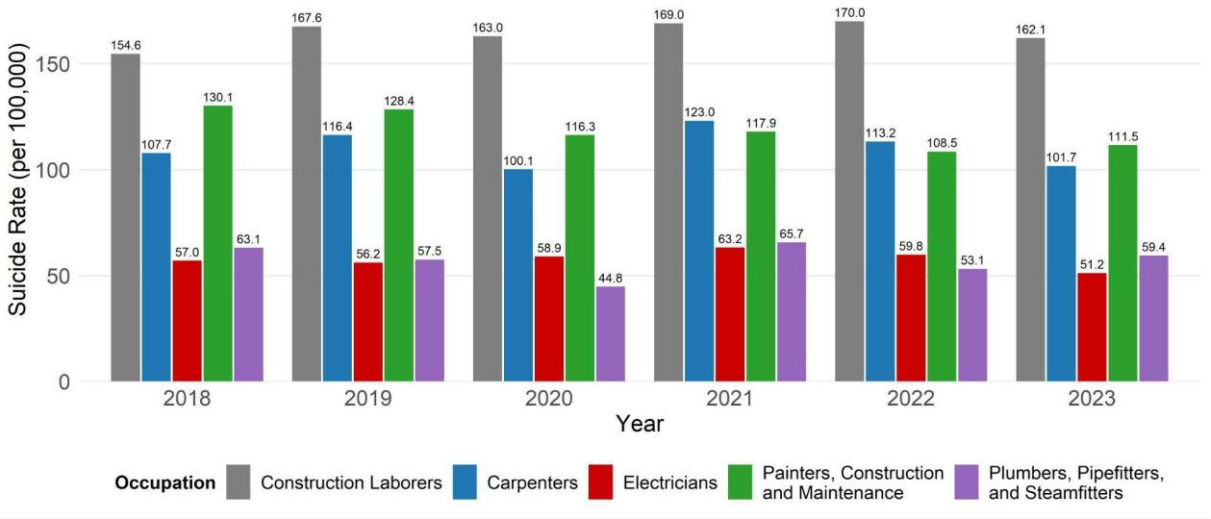

Figure 1: Suicide Rate vs. Occupation from 2018 through 2023

While data is not available to speculate the reasons for the high number of deaths by suicide in these groups, in 2023 Construction Laborers represented 10.78% of all construction employees (BLS, 2023), and this might skew the numbers given the Construction Laborers representation in the industry. In 2023, carpenters accounted for 7.57% of the overall construction workforce, while Electricians made up 7.01%. Painters account for 2.22%, and Plumbers, Pipefitters and Steamfitters are 4.5%. However, considering the total number of deaths by suicide from 2003 through 2023, for the top five categories being analyzed here, Construction Laborers represent 26.6% (12,717) of the cases, followed by Carpenters with 15.1% (7,202), and Electricians with 6.4% (3,065). Considering this time interval, but looking only at the top five occupations involving construction workers, not in managerial positions, 27,388 cases were reported including: Construction Laborers (12,717 cases, 46.4% of the total); Carpenters (7,202, 26.3%); Electricians (3,065, 11.2%); Painters (2,277, 8.3%); and Plumbers, Pipefitters, and Steamfitters (2,127, 7.8%). Whichever way we look at the data, Construction Laborers represent a very high percentage of the cases reported. One might speculate that the tasks performed by these workers are not as specific, with the end result being something less tangible as they support tasks but might not see the final result of their work. Additionally, this group of workers might be less

engaged with crews and the planning of the tasks they develop, which might affect their sense of belonging as discussed in the next section.

Additional analysis of the data for the top five occupations, shown in Figure 2, reveals the top six factors recorded as elements that were present in the cases analyzed. A cutoff of 5% was applied, meaning only factors that appeared in at least 5% of the 47,791 suicide cases (i.e., 2,390 or more cases) were included in the analysis. It is important to note that more than one factor might be listed for a single case. Data reveals that Chronic Substance Abuse, Relationship Problems, and Mental Disorders are prevalent within this group, with numbers that are usually double the next three categories comprising Legal Problems, Physical Illnesses, and Job Problems. These factors manifest themselves in project sites and fabrication shops in the form of absenteeism, presenteeism, and might contribute to safety incidents and low morale of the workers as they struggle to develop their daily tasks.

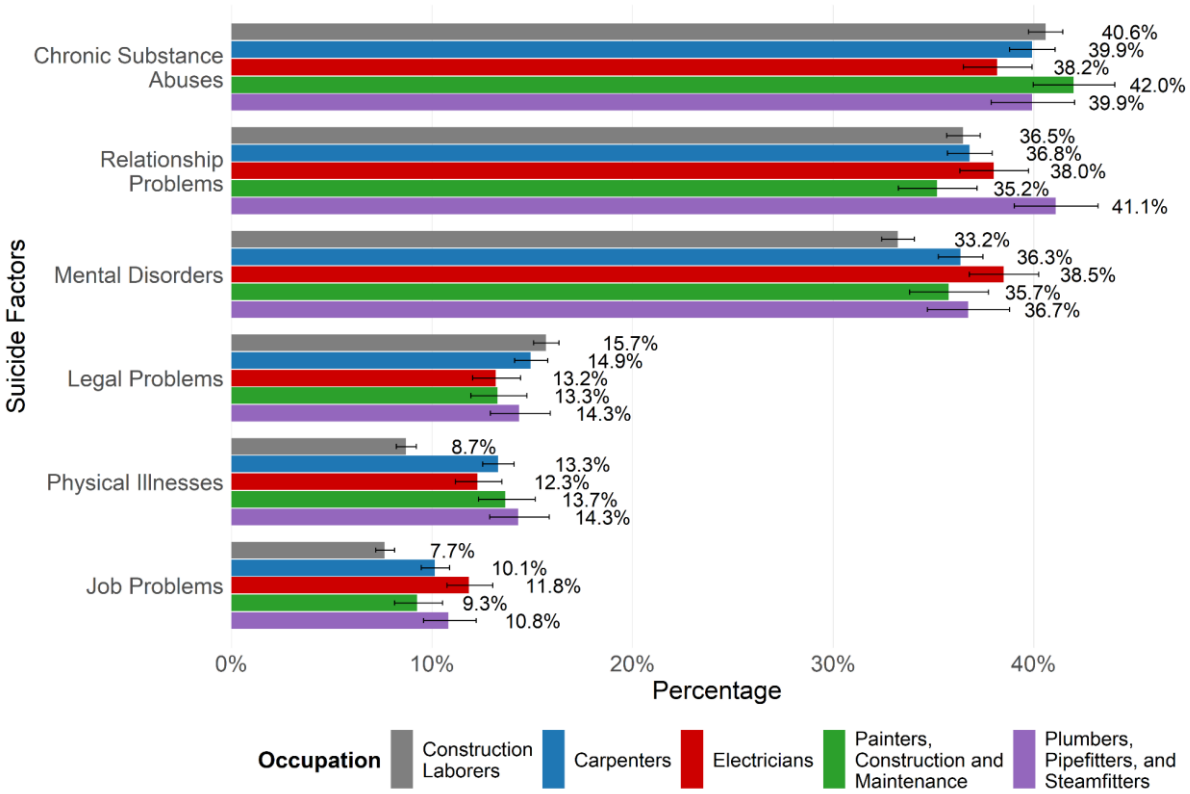

Figure 2: Causes of death by suicide for the top five occupations analyzed (2003-2023)

MENTAL HEALTH INDICATORS IN THE CONSTRUCTION INDUSTRY

The data reported in this section resulted from the work developed by the authors with the support of LCI to investigate potential links between construction workers' mental health and Lean Construction practices. Results and findings are documented in a previous publication (Alves et al., 2025b), and the entirety of the results are documented in a report provided to the project sponsor (Alves et al., 2025a).

Analysis of the 282 completed responses received for the survey deployed in the United States from August 2024 through March 2025 revealed a link between the use of Lean Construction practices and workers' mental health. Three measures of workers' mental health were used: stress, depression, and belonging. Results obtained for these proxies for mental

health were cross analyzed with managerial practices in general and those more closely associated with Lean Construction.

A question related to depression was asked to gauge the "level of interest in doing things over the last month" and the results were cross analyzed with the workers' perception of whether or not they agree that "management places a strong emphasis on workplace health and safety". Figure 3 reveals that out of the workers who strongly agree (91) with the statement related to the management placing emphasis on health and safety, 64% have indicated that they did not feel little interest or pleasure in doing things (not at all), whereas those who agree (109) show a mixed response with 41% not losing interest and 59% have little interest or pleasure in doing things. The results show that management's attitude on workplace health and safety plays an important role in how workers feel and engage. A strong emphasis on workplace health and safety involves proactively identifying and controlling jobsite hazards, integrating safety into planning and operations, and fostering a culture where leadership and workers prioritize prevention and continuous improvement (OSHA, 2016). By placing this emphasis, managers can create conditions that help workers reduce their stress level and have more interest or pleasure in doing things.

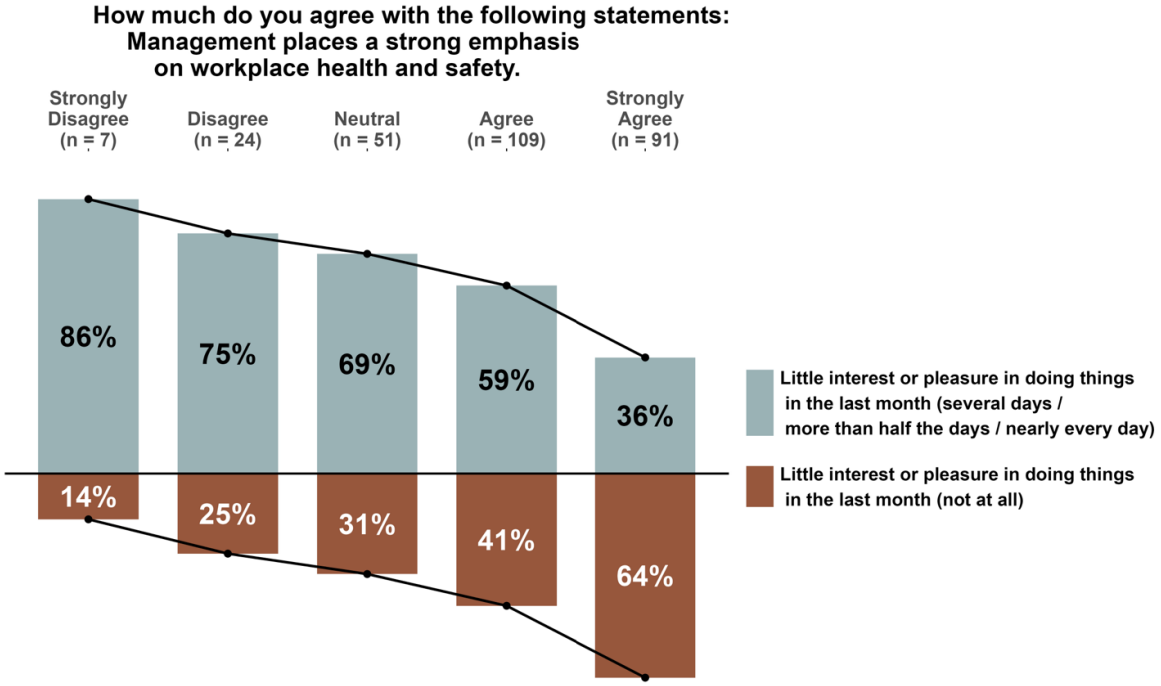

Figure 3: Perceived emphasis on health and safety by management and its relationship with loss of interest in daily activities

The survey also found a pattern between team goal clarity and perceived job stress among construction workers. High team goal clarity is associated with lower levels of stress. Figure 4 shows that all 21 respondents who strongly disagreed that their job is more stressful than expected also reported a clear understanding of the team's goals. However, for the group who strongly agreed that their job is more stressful than expected, only 60% feel that they have a clear understanding of the team's goals. The data shows that lack of clarity regarding team goals is associated with higher levels of job-related stress. Lack of clarity regarding goals causes additional stress to deal with uncertainties, which may lead to additional challenges in dealing with other project members and handling coordination issues. The Lean Construction planning methods and visualization tools such as Last Planner System®, and the use of whiteboards and computer sheds with information, were designed to make the planning process more transparent

and results accessible to everyone. Implementing these methods and tools can be effective to reduce workers' stress level. This finding is consistent with Nawar et al. (2025), who found that Visual Management can effectively reduce stress levels among workers, and Demirkesen et al. (2021), who demonstrated that workers in Lean projects reported lower levels of workload and deadline stress compared to those in traditional projects.

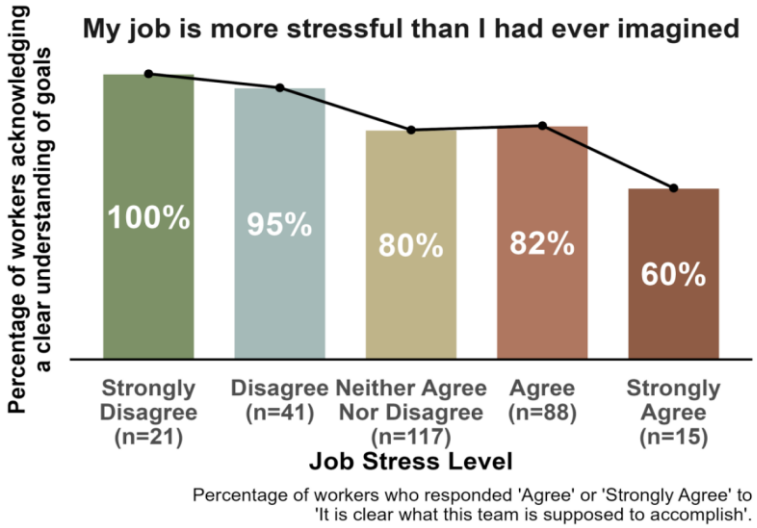

Figure 4: Relationship between team goal clarity and perceived job stress

The survey also found a pattern between unit/work group discussion of work and social aspects and workers' sense of belonging on the job, as shown in Figure 5

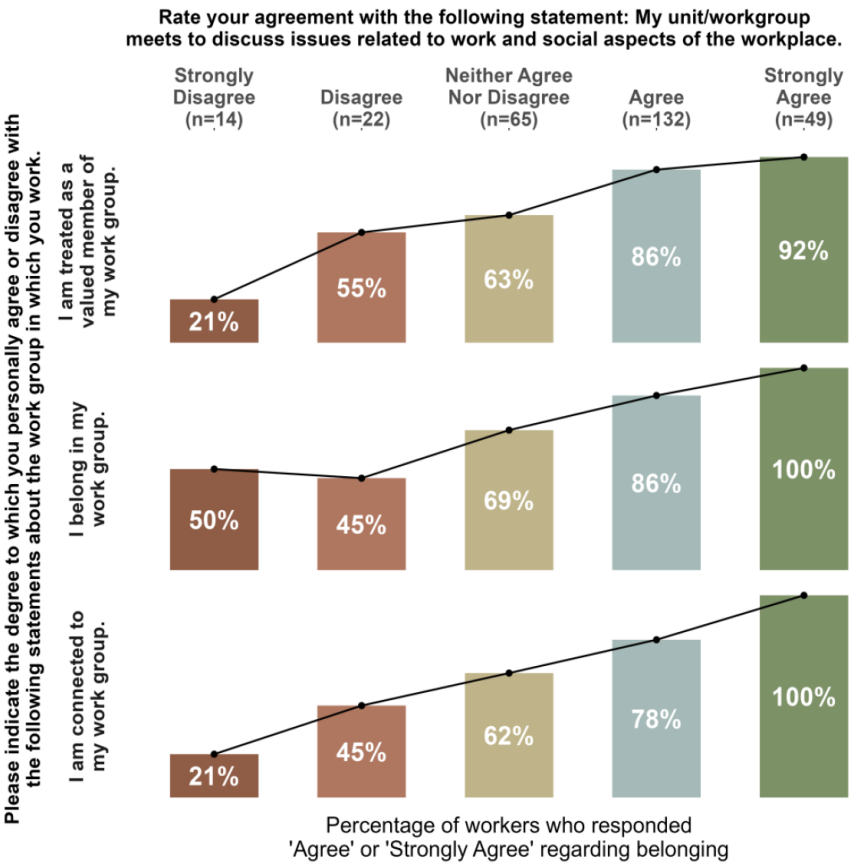

Figure 5: Regular Team Discussions and Workers' Sense of Belonging

In Figure 5, among those who strongly agreed that their unit meets to discuss work and social matters, 92% agreed or strongly agreed that they were treated as valued members, and 100% agreed or strongly agreed that they felt both a sense of belonging and connection to their group. These numbers drop when fewer respondents agree with the statement "my unit/workgroup meets to discuss issues related to work and social aspects of the workplace." Considering respondents who disagreed with the statement, only 55% felt valued, and 45% felt connected, whereas those who strongly disagreed with the statement, only 21% felt they were treated as valued members or felt connected to their work group. Additionally, Figure 5 shows that frequent dialogues at work help workers build relationships and cultivate a strong sense of connection and belonging to their teams, i.e., workers who feel that their contributions are welcomed are more likely to feel valued and connected to their teams.

Figure 6 shows a clear relationship between workers' sense of belonging on the job and the use of lean tools supporting transparent communication, e.g., white boards, stand-up boards, or virtual plans to track completion. Responses indicating the frequent use of these tools were related to a higher percentage of workers who feel valued and connected to their teams.

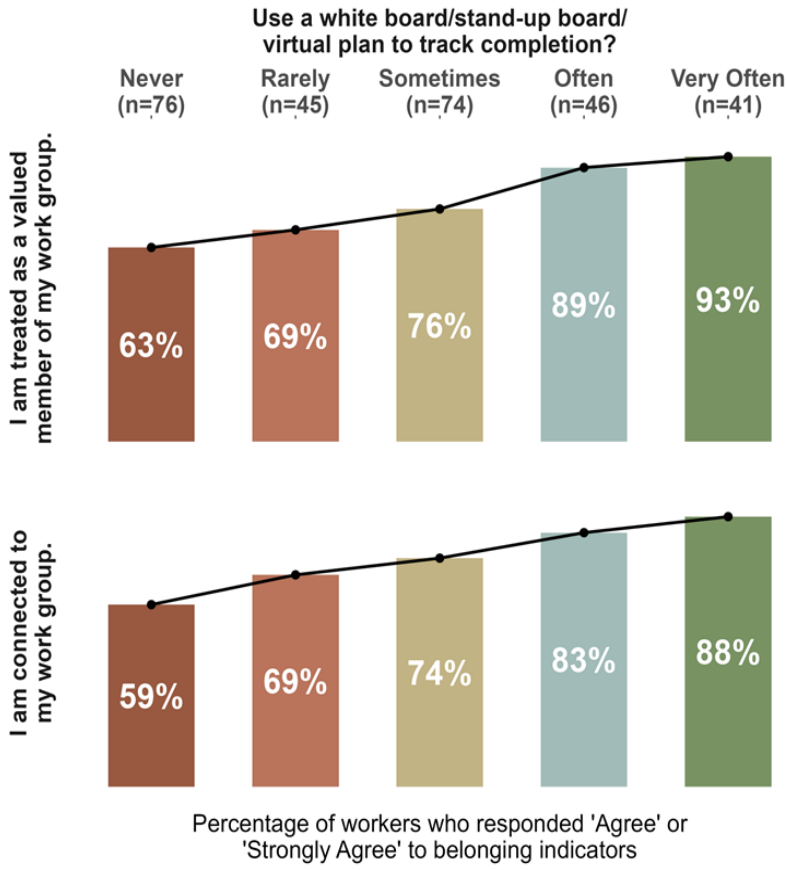

Figure 6: Use of lean visibility tools and Workers' Sense of Belonging

Figure 6 also shows that out of 76 respondents who reported never using visualization tools to track task completion, 63% agreed or strongly agreed with the statement "I am treated as a valued member of my work group," and 59% felt "connected to their work group." Conversely, out of 41 respondents who reported very frequent use of tools supporting transparent communication, 93% said they felt valued, whereas 88% felt connected to their team; a sharp increase in both perception of being valued by their teams and connection with their work group. These numbers suggest that in addition to facilitating coordination, visibility tools are also effective in enhancing social engagement and inclusion within work groups.

FINAL REMARKS AND CALL TO ACTION: HOW LEAN CONSTRUCTION CAN CONTRIBUTE

As the industry with one of the highest death by suicide rates, the construction sector rate was roughly four times the national average and almost six times the rate of all construction fatalities combined (AGC, 2025). Based on NVDRS data for construction suicide cases from 2018 to 2023, the current research identified the top five categories of workers who died by suicide: (1) Construction Laborers; (2) Painters; (3) Carpenters; (4) Electricians and (5) Plumbers, Pipefitters, and Steamfitters. Data reveals that chronic substance abuse, relationship problems, and mental disorders are the prevalent causes, followed by legal problems, physical illness, and job problems.

According to the national survey conducted in 2024 studying construction workers' mental health and its connection with management practices, Lean Construction management principles and methods are associated with better mental health status in terms of stress, belonging, and respect. For example, manager's attitude on workplace health and safety, clear understanding of goals, discussing issues related to work and social aspects are all found to be connected with less stress and higher level of belonging, which are the key contributors of mental health. Using Lean Construction tools such as whiteboards/stand-up boards/virtual plans was also found to be effective in enhancing the sense of belonging and being valued.

While Lean Construction methods and tools have been implemented mainly to improve plan reliability and productivity, it is also important to acknowledge their positive impact on mental health. It is recommended to conduct future research to incorporate them into safety training and everyday practices to enhance the mental health of construction workers. The present study aims to amplify the discussion about how managerial practices, including but not limited to practices associated with Lean Construction, can be used to foster an environment that promotes workers' mental health and helps change the current scenario.

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