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Educating for DEI in Construction Engineering: Translating Findings on Disability Considerations on Worksites into Pedagogy and Course Content

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Introduction

Accessibility in construction education is most often related to *what* we build, not *how* we build. Construction engineering education typically focuses on the end-user rather than on the people in the industry. Indeed, most of the construction industry recognizes the need for reasonable accommodations for disabilities within health and safety practices but may fail to implement solutions onsite. Traditionally associated with physically demanding and hazardous work, the industry presents a unique challenge for Disabled Workers. But despite these challenging working conditions, many Disabled Workers contribute to the sector yet struggle to participate fully in all work areas. Besides the ethical imperative for justice and inclusivity, the growing labor shortage is an additional spur to better solutions that can both retain and encourage more diversity in the workforce and better educational programs that address inclusive methods in the building process. This paper reports on a review of existing accessibility practices and conditions on four worksites within the UK. The results from this investigation are informing the inclusion of health and safety (H&S) as well as diversity, equity, and inclusion (DEI) topics within a new BSc Construction Management degree being launched in September 2025 at the New Model Institute for Technology and Engineering (NMITE) in Hereford, UK. This program builds on the success of many programs across the UK, the US, and Canada, with a particular focus on practical applications and sustainable building and management techniques. Each course in the degree program links with industry partners to bring current projects, materials, and working conditions into the classroom, better-preparing students for a rapidly evolving construction landscape.

In this paper we use language advocated by the UK's SPECTRUM Centre for Independent Living [1] which explains that "the term 'Disabled People' has been adopted to define a collective identity for the Disability Movement in the UK." We acknowledge that this may not be the preferred language for some groups who instead use the word 'person' or 'people' before the word 'disability', but SPECTRUM notes that people-first language "mixes up the Medical and Social Models of Disability and confuses disability with impairment. Most importantly, it implies that the effects of disability lie with the individual, rather than society. This effectively denies the political and collective meaning of the term 'Disabled People.'" [1].

Literature Review

Literature focusing on curricular content relating to disability (or DEI more broadly) in construction engineering education is very limited. Indeed, searching for scholarship on construction and disability often yields results that focus on construction *as* a disabling industry and how to manage this from a business or personnel management perspective. This includes Quaigrain and Issa's construction disability management maturity model [2] which has been applied to the construction sector in Manitoba and demonstrated as a method to promote awareness and implementation of practices that help organizations manage work-related injuries [3]. However, this focus on disability management obscures approaches and opportunities around access and inclusion and how to educate future professionals so that these can be enacted. To better serve and meet needs within industry, we need a greater focus on retention and reskilling in addition to management and inclusion activities to retain workers who experience disability in the course of the work.

Several studies worldwide describe the integration of workers with disabilities in the construction industry, such as a Bailey et al.'s comprehensive review of inclusive hiring practices in the sector that enable employment of Disabled People [4], or comparative work like Clarke et al.'s which highlights differences in British and Dutch approaches to disability and inclusion in construction [5]. Dapaah Cecilia et al.'s 2024 review of studies on disability inclusion in the construction industry takes a global view and links these efforts to United Nations initiatives such as the Sustainable Development Goals and the Convention on the Rights of Persons with Disabilities [6]. However, links to educational content or pedagogy are not mentioned in these works.

Within engineering education specifically, scholarship around disability has existed for many years, but in the U.S. this initially focused on the practical implications (sometimes characterized as limitations) of the 1990 Americans with Disabilities Act (ADA) operationally, such as on exams, admissions, and provision of accommodations [7]. Recently the focus has moved away from merely discussing compliance to studying educational methods designed to promote accessibility and inclusion, as well as investigating and critiquing the experience of people with disabilities in engineering (both as students and professionals). Cech's [8] and Boda's [9] recent work also situates disability in STEM education within broader dialogue in the Disability Studies discipline around embodiment, ableism, and intersectionality as well as critiques of capitalism and neoliberal theories of work and value.

These theoretical approaches to disability are largely absent from construction education literature, which tends to prioritize the compliance mindset through emphasis on knowledge of codes and regulations such as in Cefali [10] and Ahmed et al. [11]. While the understanding and application of law and policy related to health and safety and DEI is of course critically important to construction practice, critiquing the way that it is taught could be analogous to scholars of engineering ethics education who have shown that when codes are taught but not humanized due to a reliance on cognitivist educational approaches alone, there are real-world implications to students' abilities to empathize, relate emotionally, and reflect on ethical or

inclusive practice [12]. Too, the existence of codes and regulations in construction education almost exclusively focuses on the resulting *building* being inclusive and accessible as in Martel and Paton-Cole [13], rather than on improving conditions for the *workers* doing the building.

There are a few examples in the literature that get closer to uniting teaching with professional practice around disability in construction education. These tend to be descriptions rather than evaluations of educational or curricular interventions and come from other related fields such as architecture. Most pertinent may be Livingston's 2000 article [14] describing a classroom activity that allows students to experience the perspective of Disabled People through an exploration of their campus buildings. Livingston outlines the educational aims of this activity as building awareness, understanding, and sensitivity to Disabled People and their challenges of equal access, but also gestures to the need for built environment professionals to implement practices that do not exclude or discriminate. However, the article's positioning in the journal *Teaching Sociology* alludes to the perception of disability as a sociological rather than a built environment or engineering concern.

Interestingly, the article most relevant to our study's goal was from the field of Sports Management education. Hayes Sauder and DeLuca [15] explicitly outline how academics who design curricular content can influence industry practices around diversity and inclusion—not just in awareness or knowledge, but specifically in "improved skills and attitude." They describe foundational or core courses commonly found in all Sports Management programs that have clear association to Disabled People and then provided case studies of two courses where knowledge and professional skills around disability were integrated, and students were subsequently surveyed about the effect of this learning. They found that the inclusion of educational content on disability in these courses provided the opportunity to not only change student perceptions around DEI, but also how students can operationalize access and inclusion in their future managerial roles [15]. Crucially, they suggest that students benefit from understanding the sociocultural importance of codes and regulations on inclusion rather than "just an emphasis on [their] *application* associated with . . . management," and that educators should incorporate reflection as a means to enhancing student cultural competence around disability as well [15]. We are inspired by Hayes Sauder and DeLuca's work and believe that if applied to the construction engineering education field, it can help close a critical gap in education and practice and enable a more diverse and inclusive construction workforce.

Methodology

This paper reports on a review of existing accessibility practices and conditions on worksites within the UK: a medical facility, an office building, a school, and a manufacturing facility. Four safety audit reports provided by NMITE's industry partners (tier 1 contractors and construction component manufacturers) were systematically reviewed using a document analysis methodology. Such reports are typically completed on a quarterly basis, or on a regular timeline as set by the construction company's internal safety auditor, to determine compliance with

regulations and opportunities for improvement to prevent injury on the job. This is especially important as the worksite transitions through various phases of construction (site work, foundation, structural construction, finish out, and handover). At each of these phases, a report is produced detailing compliance with existing regulations, changes executed due to the evolution of the project, and any needed adjustments to reduce the opportunity for future injury. NMITE's partners provided the researchers with these reports after being invited to participate in this study, and they acknowledged that the anonymized reports would be used to evaluate accessible accommodations on the worksite for educational purposes only.

The written documentation and photographic evidence in the reports were analyzed using a checklist of criteria developed for this study. The checklist focuses on mobility, auditory, visual, and neurodivergent considerations for the construction workforce or for visitors to the site (owners' representatives, owners, engineers, architects, and compliance agents) and is shown in Table 1.

Mobility Concerns	
	Site access minimum 775mm wide
	Site Entrance separate from Vehicle access
	Site Entrance surface is free from trip hazards
	Ramps in place where required to eliminate steps
	Lift access available for multi-story projects
	Lighting to prevent need for torches
	Site pathways free of debris
	Designated refuge areas with assistance in place
Auditory Concerns	
	All signals are visual throughout the site
	Noise filtering hearing protection available
	Designated refuge areas with assistance in place
Visual Concerns	
	Auditory alarms for all signals on site
	Designated paths through vehicle and equipment areas
	Pathways marked for visual impairments
	Consistent lighting levels throughout job site (no dark corridors or spaces)
	Designated refuge areas with assistance in place
Neurodivergent Concerns	
	Signage to indicate risks, including excessive noise, visual stimulus, or other abrupt changes
	Designated area for de-stimulation

	Designated refuge areas with assistance in place

Table 1. Checklist of accessibility considerations in construction worksite safety audit reports.

Besides using the checklist to analyze the content of the reports, special attention was given to each audit's narrative describing conditions and opportunities for improvement. This part of the analysis particularly aimed to evaluate the awareness of and sensitivity to accessibility and accommodations across different construction phases and identify opportunities for improvement.

Results and Discussion

1. Key Findings

Data from and analysis of the site audits suggest that accommodation for Disabled Workers is not part of the typical safety and access plans for most construction sites, with fewer accommodations made early in the building process. After reviewing the data, results can be grouped into four primary areas of focus.

a) Mobility & Physical Limitations

Mobility concerns are the most significant impediment to full participation in work activities. Challenges begin at the site entrances, in most instances, with alternative routes that require assistance to navigate (Figure 1).

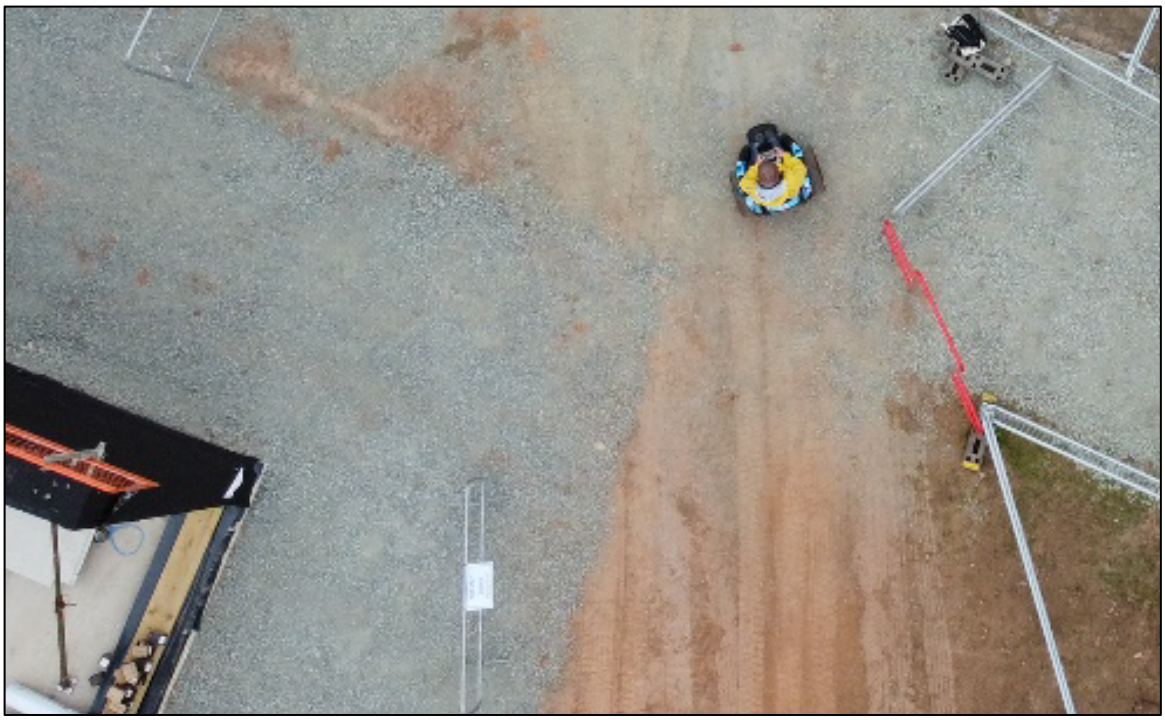

Figure 1 Site Entrance shows the access gate in red, slightly too narrow to accommodate the wheelchair user in the vehicle traffic entrance.

Openings at the perimeter fencing are too narrow, less than 600mm, meaning most assistive devices cannot be accommodated. Entrances also often feature a crossbar at the base that requires workers to step over to enter. The alternative route is through the material delivery gate, which connects pedestrian traffic with vehicle traffic and creates a new safety concern.

While uneven surfaces are unavoidable, the worksites reviewed had steps, gravel, and other surfaces that can inhibit travel across the site for people using different types of assistive devices. Multi-story projects did not have lifting systems approved for human transport as part of the access plan, which limits workers and most visitors with mobility concerns to the ground floor until building systems are completed and activated.

b) Auditory Adjustments

From a health and safety perspective, all site audits indicated measures to protect against further damage to hearing loss through protective requirements. However, worksites lacked warning and signal systems that can accommodate workers with auditory concerns. If an impairment exists among the workforce, those workers will rely on other employees to signal them in an emergency tied to an auditory signal. This is also the case for some workers wearing ear protection that will muffle alarms and potentially increase response time in an emergency.

c) Visual Impairment

The site audits revealed a lack of consideration for individuals with visual impairments, with a few notable exceptions. Onsite signage did meet requirements for high visibility and high contrast to assist with specific access requirements regarding visual impairment, and lighting systems for safety were adequate for walkways and task work. However, low-sighted individuals may struggle with the inconsistency of lighting between areas, which is common during rough stages of construction (Figure 2). No signage exists with alternative communication measures or visibility enhancement.

Figure 2. Extreme variations in lighting within the structure reduces visibility for workers with vision differences.

Visual impairments and mobility concerns overlap in some aspects of safety and accessibility. On staircases and platforms, railing systems met minimum requirements to prevent falls or objects from rolling off surfaces. As these are designed to prevent falls, they are less than ideal to assist with either balance or visual support. Temporary railings do not often have a consistent rail as a handhold, meaning the rail breaks at each transition or change in the structure, making it inadequate as an accessible accommodation. Steps also lack visual markers as they will not be part of the final structure. Steps combined with inconsistent lighting create a significant trip hazard for both visual and mobility impairments.

d) Neurodivergent Considerations

No measures were found in the site audits that accommodate neurodivergence specifically. As awareness of neurodivergence and needed adjustments improves, more can be done to accommodate workers in a safer environment.

2. Study Limitations

This study was limited by the small number of construction worksites reviewed. Safety audit reports are seldom shared outside companies due to potential liability if they are found to be in violation of standards or practices, so authors had to depend on their connections to NMITE's industry partners. The limited sample size is also restricted to the UK, which may affect the generalizability of the findings. In addition, the photographs found in the reports may not have captured all relevant accessibility conditions. This is because these reports do not have the purpose of specifically looking for accessible accommodations, and therefore individual

measures may not be represented. However, this also means that the reports are representative of typical working conditions since site managers had no opportunity to improve site accessibility ahead of the study.

3. Future Work

Intended as an initial study to begin developing an area of construction education that is seldom investigated, this work offers the potential for several avenues of future research.

a) Further site research and analysis

A broader perspective on accessibility on construction sites and its implications for the workforce could be developed in several ways. First, the evaluation of existing conditions could be expanded by analyzing more sites within regions both inside and outside the UK. A comparative study would give insight into different approaches worldwide. This evaluation could be complemented by qualitative studies that focus on interviews with or surveys of workers and managers to understand their direct experiences with accessibility. From this work, a standardized framework for evaluating accessibility on construction sites could be developed and trialled. Finally, an investigation of the practical implementation of suggested changes could be conducted to determine their impact on the sector.

b) Potential for evidence-based curricular integration

A greater focus on inclusive practices in the construction sector is acknowledged as essential for a more sustainable and equitable built environment, as articulated in Sustainable Development Goal (SDG) 9 “Infrastructure and Innovation” [16]. The education of construction managers is also understood to be a key enabler of best practice in project delivery [11]. For these reasons, incorporating disability inclusion into construction management education curriculum can have broad real-world impact.

In the case of NMITE’s new BSc in Construction Management, the curriculum content was informed by two primary inputs: accreditation expectations as required by the UK’s Chartered Institute of Building (CIOB) and skills development needs as defined by both academia and industry [11], [17], [18]. The curriculum development process followed constructive alignment principles to link generic graduate skills with discipline-specific learning [19] and NMITE’s own circular educational delivery model which enables agile collaboration across the sector [20]. This model allowed researchers access to the site surveys and engagement with the companies on this topic.

In addition, all the courses offered at NMITE are rooted in the knowledge, skills, and attitudes required of the modern construction professional. This means that learners must also develop the habits of mind that enable a sustainable and equitable built environment. Competency development in construction education has often focused on skills and abilities but mindset is also a critical aspect of competence [11], [21]. This aligns with the long-recognized demand for

built environment graduates with better "soft skills" in communication, collaboration, leadership, and emotional intelligence [11], [22], [23]. Fostering an inclusive mindset and developing a habit of seeing opportunities for improving inclusive practices is something that can be reinforced throughout the curriculum.

Based on findings from the audit review, embedding real-world examples of worksite accommodations can inform and enhance three key topics found throughout the BSc curriculum: Sustainable Design, Codes and Legislative Requirements, and Construction Processes. We found that these topics link with 14 established learning outcomes found in 7 out of the 11 courses within the BSc Construction Management degree program, providing an excellent opportunity for integrating this content. Table 2 shows how these topics related to disability inclusivity revealed in the site surveys align to the existing learning outcomes in the BSc courses.

BSc Construction Management Course Title	**Related Course Learning Outcome**	**Associated Workplace Inclusivity Topic**
Sustainability and Construction	Interpret sustainability as a concept, terminology, policy, and legislation, in relation to its contribution to social, economic, and environmental pillars.	• Sustainable Design
Introduction to Construction Systems and Processes	Determine the relevant health, safety and wellbeing legal requirements appropriate to a given construction site context.	• Codes & Requirements • Construction Processes
	Define the role of construction manager in relation to professional codes of conduct, competence, and ethics, within the broader construction framework.	• Sustainable Design • Codes & Requirements • Construction Processes
	Compare the various financial, legal, and legislative systems that govern construction and built environment.	• Sustainable Design • Codes & Requirements • Construction Processes
Construction Process and People Management	Appraise and select appropriate options for on-site or off-site technologies, materials, and systems to ensure adherence to building codes relevant to complex new or refurbished buildings.	• Sustainable Design • Codes & Requirements • Construction Processes
	Apply leadership skills to promote work ethic, enhance inclusivity, and manage performance and wellbeing in different contexts.	• Sustainable Design • Codes & Requirements • Construction Processes
	Describe and characterize the legal obligations of the appropriate stakeholders and procedures in relation to the design, construction, and operation stages.	• Sustainable Design • Codes & Requirements • Construction Processes

Industrial Placement	Apply and integrate knowledge and skills acquired during the earlier stages of the program within an industrial organization.	• Sustainable Design • Codes & Requirements • Construction Processes
Regulatory Framework and Professional Practice	Translate regulatory/H&S responsibilities and frameworks into executable management and compliance plans.	• Codes & Requirements • Construction Processes
	Critically evaluate ethical and professional responsibilities related to specific roles within the construction industry, drawing on principles of moral philosophy and codes of conduct.	• Sustainable Design • Codes & Requirements
	Distinguish legal obligations of the different stakeholders in contract specification, delivery, and dispute resolution.	• Codes & Requirements • Construction Processes
	Examine the construction industry's challenges, opportunities, and responsibilities with regards to financial, environmental and social sustainability.	• Sustainable Design
Advanced Leadership and Project Management in Construction	Evaluate and synthesize performance management techniques in complex projects, transforming them into management plans including procurement and contract performance, process improvement, incentivization, best practices and feedback	• Sustainable Design • Codes & Requirements • Construction Processes
Bachelor's Project	Demonstrate awareness of ethical, legal and commercial considerations relevant to the project and evaluate the impact of their work within its/a wider context, including implications for sustainability.	• Sustainable Design • Codes & Requirements • Construction Processes

Table 2. Links between BSc Construction Management Courses, Learning Outcomes, and Workplace Inclusivity Topics.

More work now needs to be done to develop coursework, activities, and assessments that enable students to make the link between the real-world inclusivity needs and the learning outcomes. This process will be completed by July 2025. Having access to example worksites and partner companies that are willing to share and explore with students will be invaluable in this effort.

4. Impact and Broader Implications

Broadening future construction managers' mindsets beyond just compliance and management of disability inclusivity on worksites can create ripple effects across the sector. For instance, in a report on translating inclusive design approaches taken at the 2012 London Olympics and Paralympics into architectural education, Fleck describes how learning about and adopting these principles and practices can spur innovation that supports economic growth, entrepreneurship, and ultimately a built environment that works better for everyone [24].

Neither are the economic implications trivial, given the importance of the construction sector to the broader economy and the numbers of people needed to fill significant workforce shortfalls. In the UK, for example, the Construction Industry Training Board estimates that over a quarter of a million new workers will be needed by 2027 to meet demand [25]. Considering that 23% of working age people in the UK are classed as disabled and of these, only 64.9% of Disabled People with one health condition were in employment in 2022/2023 [26], there is a great opportunity to make an impact on individuals, industry, and society by including more Disabled People in the construction workforce.

The economic benefits of educating and hiring Disabled People are now well understood [27], [28]. However, "in education attainment, disabled people are less likely to have a degree or equivalent qualification than non-disabled people (25.6% for disabled people and 40.0% for non-disabled people), and more likely to have no qualifications (12.9% for disabled people and 5.0% for non-disabled people)" [26]. Might embedding inclusivity topics within construction education also show Disabled Students that they are welcome in the field, encouraging them to pursue degrees and enhancing DEI in programs as well? A survey conducted by Engineering UK shows that just 10.5% of students studying an engineering or technology subject in university has a disability, compared with 15% for students in all other disciplines [29], and Disabled People make up only 9% of the construction workforce [30]. Studies on perceptions of belonging among females in construction education show that addressing the feeling of being included can impact recruitment and retention of more diverse students [31]; this could extend to Disabled Students as well.

But as mentioned earlier, it is not just who and what we teach but how that helps to bridge these gaps. More real-world practice and experiential learning in educational environments are needed to help students develop the skills needed by industry [32]; these approaches are also shown to change understanding and attitudes around inclusivity in built environment students [33]. The challenge-based learning method used at NMITE across the institution and in every course offers many opportunities for students to solve authentic problems, get feedback from industry and stakeholders, and reflect on instead of just learning about processes and how to follow them. But in any construction curriculum, embedding these topics can be done because alignments are often already possible given existing content and outcomes relating to sustainability, codes, and professional practice. Opportunities also exist via technologies like AR/VR, BIM, or offsite manufacturing practices that support sustainability alongside inclusivity efforts.

Conclusion

An investigation into existing accessibility practices and conditions on four UK worksites has revealed the potential for a BSc in Construction Management to demonstrate the opportunities for disability accommodation in the sector, and how design and management decisions relating to this topic can affect goals for sustainability, inclusion, and economic growth. Without significant adjustment to learning outcomes, students can be taught to recognize and

accommodate workforce differences through the topics already featured in the course. Given the well-known exclusionary practices in the sector but also its importance and prevalence globally, this is an opportunity to make significant impact to reduction in inequality and advances in a sustainable built environment for all.

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