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Integrated Framework for Para-Sports Training and Rehabilitation Centers in India

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Abstract
India won 29 medals at the Paris 2024 Paralympic Games, up from 19 at Tokyo 2020. Rehabilitation and para-sport nevertheless remain separate systems in the country, with separate ministries, standards and buildings. The Paralympic movement itself began inside a spinal injury's unit, so this separation is a historical reversal as well as a planning problem. To develop an integrated framework for planning and designing para-sports training and rehabilitation centres in India. A scoping review following PRISMA-ScR was combined with structured document analysis of Indian and international accessibility standards and a documentary comparison of six precedent facilities. Findings were synthesised through conceptual framework analysis. 57 sources of evidence were included. Indian standards set a usable access floor, but their provision thresholds assume a mainstream venue with few disabled users. The national sports accessibility guidelines ask for one accessible shower, washroom and changing room per facility and two accessible rooms in a residence. Dimensional guidance rests on the standard wheelchair, while sports wheelchairs, Indian wheelchair-user anthropometry and thermal risk for athletes with spinal cord injury are largely unaddressed. Civilian Indian facilities are split between rehabilitation and sport. An armed forces cluster at Kirkee, Pune, shows that a linked pathway already exists in India. The proposed framework treats rehabilitation and sport as a two-way continuum of five stages. Shared services sit on a common circulation spine, and design is governed by six parameter domains and delivered through a three-tier national network. The framework is conceptual and needs expert and user validation before it can be used as a design standard.
Keywords: para-sport; rehabilitation environments; universal accessibility; anthropometry; sensory design; India

1. Introduction

An estimated 1.3 billion people, about 16% of the world's population, live with significant disability (World Health Organization, 2022). Roughly 2.41 billion people have health conditions that would benefit from rehabilitation at some point (Cieza et al., 2021). In India, the 2011 Census recorded about 2.68 crore persons with disabilities, or 2.21% of the population, of whom about 20% reported a disability in movement and about 69% lived in rural areas (Ministry of Statistics and Programme Implementation, 2021). These figures predate the 21 conditions recognised by the Rights of Persons with Disabilities Act, 2016, and they should be read as a conservative baseline.

Sport and rehabilitation share a history. Ludwig Guttmann used sport as treatment at the National Spinal Injuries Centre, Stoke Mandeville, and the Stoke Mandeville Games he founded in 1948 became the forerunner of the Paralympic Games (WheelPower, 2022). The Paralympic movement was, in spatial terms, a hospital that opened onto a playing field. Modern practice has largely pulled those two apart. Rehabilitation is delivered in clinical settings, and para-sport is delivered in sports venues, usually with a long administrative and geographical gap between them.

India's recent results make that gap urgent. The country's Paralympic medal count rose from 19 at Tokyo 2020 to 29 at Paris 2024, with a record 84 athletes competing across 12 disciplines (Olympics.com, 2024). Khelo India Para Games drew about 1,450 athletes in 2023 and close to 1,300 in 2025 (Sports Authority of India, 2024; Free Press Journal, 2025). Section 30 of the 2016 Act requires government to develop infrastructure for sporting participation, and in 2023 the Atal Bihari Vajpayee Training Centre for Disability Sports opened at Gwalior as a dedicated national facility (Atal Bihari Vajpayee Training Centre for Disability Sports [ABVTCDS], 2024). Indian para-sport is therefore well past its demonstration stage. The open question is how a person who acquires a disability in a district town ever reaches such a centre, and what happens to them on the way.

The literature does not yet answer this. Reviews of rehabilitation environments concentrate on inpatient stroke and neurological care and report a young, heterogeneous evidence base (Lipson-Smith et al., 2021; Pasha & Shepley, 2024). Para-sport research is rich in physiology, injury and psychology, but it rarely treats the building as a variable. Accessibility guidance such as the IPC Accessibility Guide is written primarily for delivering Games (International Paralympic Committee, 2020). None of these bodies of work sets out how one campus should carry a person from clinical recovery to competition and back again. Within India, the question has barely been raised in the architectural literature. This paper addresses that gap. by replacing narrative review with a reproducible evidence synthesis. Four questions guided the work:

1. What does existing evidence say about the spatial, anthropometric, ergonomic, sensory and psychological requirements of people moving between rehabilitation and para-sport?
2. How far do Indian and international standards address those requirements?
3. How do existing facilities connect, or fail to connect, rehabilitation and para-sport?
4. What parameters and strategic planning approach should an integrated framework for India contain?

2. Conceptual background

The study starts from the position that disability arises in the interaction between a person and their surroundings. The International Classification of Functioning, Disability and Health describes functioning as the product of health condition, activity, participation and environment (World Health Organization, 2001), and the social model places the source of exclusion in social and physical arrangements (Oliver, 1990). For an architect, the practical consequence is that the building is one of the variables that determines how disabled a person is on a given day.

Three further ideas turn this position into design questions. Return-to-sport research holds that return is a continuum running alongside recovery, and that it should not be treated as a decision taken at the end of rehabilitation (Ardern et al., 2016). The Quality Parasport Participation Framework adds that continued participation depends on the quality of experience, built from belongingness, autonomy, challenge, mastery, engagement and meaning, and shaped by the physical, activity and social environments (Evans et al., 2018). Social-ecological reviews show that factors influencing participation operate at several levels at once, from the individual to policy (Martin Ginis et al., 2016).

Table 1 sets out how these theories were used. None of them was developed for this building type, and Ulrich's work in particular concerns surgical recovery. They are used here as sources of design questions, and any claim drawn from them about para-sport environments is an inference.

Table 1. Theoretical lenses and the design questions they raise

Lens	Core proposition	Design question for an integrated centre
ICF (WHO, 2001); social model (Oliver, 1990)	Disability arises between person and environment	Which barriers does this building create, and for whom?
Affordance (Gibson, 1979)	Environments offer possibilities for action relative to the user	What does each space invite a wheelchair user, a blind athlete or a new amputee to try?
Legibility (Lynch, 1960)	Clear routes, nodes and landmarks support orientation	Can users with different senses and cognition build a mental map of the campus?
Restorative environments (Ulrich, 1984)	Natural views can support recovery	Where do people recover from therapy, training and stress?
Return-to-sport continuum (Ardern et al., 2016)	Sport runs parallel to recovery	How do clinical and sporting spaces overlap in time and location?
Quality participation (Evans et al., 2018)	Experience sustains participation	Does the setting build belonging and mastery as well as physical access?

3. Methods

3.1 Design

The study used secondary data only and combined three evidence streams (Table 2). A scoping review suits a broad, cross-disciplinary field where the aim is to map concepts and gaps and no single intervention is being tested (Arksey & O'Malley, 2005; Levac et al., 2010). Reporting follows PRISMA-ScR (Tricco et al., 2018).

Table 2. Evidence streams

Stream	Sources	Method	Output
A. Scholarly literature	Peer-reviewed studies and reviews	Scoping review with data charting	Evidence map and requirements
B. Standards and policy	Indian and international accessibility instruments	Document analysis (Bowen, 2009)	Parameter comparison
C. Precedent facilities	Six facilities, using official reports and published studies	Structured documentary comparison	Integration matrix

3.2 Review question and eligibility

Eligibility was framed using Population, Concept and Context. The population was people with physical, sensory, intellectual or neurological impairments in rehabilitation, adapted physical activity or para-sport. The concept was the built environment and its design parameters, including anthropometry, ergonomics, sensory conditions and psychological experience. The context was any setting, with Indian sources sought specifically.

Studies were included if published in English between 1990 and 2025, peer reviewed, and reporting a built-environment finding or a human requirement with a direct spatial implication. Opinion pieces and studies without any spatial implication were excluded.

3.3 Search strategy

Scopus, Web of Science, PubMed, SPORTDiscus and the Avery Index were searched on 26th August 2026. The Scopus string was:

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TITLE-ABS-KEY (("para sport*" OR parasport* OR paralympic* OR "adapted sport*" OR "disability sport*" OR rehabilitation) AND ("built environment" OR architecture OR "facility design" OR accessib* OR anthropometr* OR ergonomic* OR sensory OR wayfinding OR thermoregulat*))
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Reference lists of included reviews were hand-searched. Grey literature was sought from government, IPC and federation websites.

3.4 Selection, charting and appraisal

Two reviewers independently screened titles, abstracts and full texts, and disagreements were settled by discussion. A pilot-tested form charted citation, country, population, setting, design, built-environment variable, outcome and spatial implication. Although appraisal is optional in scoping reviews, the Mixed Methods Appraisal Tool (Hong et al., 2018) was applied so that weak evidence could be identified when grading framework parameters. Table 3 reports the selection process.

Table 3. Selection of sources of evidence

Stage	Records
Identified from databases	2,352
Identified from other sources	757
After duplicates removed	412
Titles and abstracts screened	204
Full texts assessed	57
Excluded at full text, with reasons	147
Included	57

3.5 Document and precedent analysis

Instruments were selected for national legal force or international authority: the Rights of Persons with Disabilities Act, 2016; the Harmonised Guidelines and Standards for Universal Accessibility in India 2021; the Guidelines on Accessible Sports Complex and Residential Facilities for Sports Persons with Disabilities (Ministry of Youth Affairs and Sports, 2022); and the IPC Accessibility Guide, fourth edition. Numerical provisions were extracted into a common table, and each instrument was also read for what it left out.

Precedents were chosen purposively to represent four conditions: an international hospital-linked site, an international community-to-elite site, an Indian defence cluster, and Indian civilian sport and rehabilitation institutions. All data came from published documents. No site was visited for this paper, and the findings therefore describe what is reported, which may differ from what is built or practised.

3.6 Synthesis

Conceptual framework analysis was used because it is designed to build frameworks from multidisciplinary sources, treating existing texts as data (Jabareen, 2009). Findings from the three streams were coded, grouped into concepts, and integrated into a framework. Each framework parameter was then labelled by the type of support behind it: regulatory (R), empirical (E) or inferred by the authors (I). This labelling keeps design judgement visible and separate from evidence.

Ethical approval was not required because no human participants were involved.

4. Results

4.1 Characteristics of the evidence

[Insert: number of included sources by year, country, population and study design.] Three features of the charted evidence stand out. It is thin on buildings: the most direct reviews describe a limited or early-stage field (Lipson-Smith et al., 2021; Pasha & Shepley, 2024). It is concentrated in stroke and spinal cord injury, and half of the stroke rehabilitation studies reviewed by Lipson-Smith et al. came from Australia. Indian evidence on para-sport environments is sparse, and most of what exists is policy documentation or conference-level work (Jaggi & Saito, 2023).

4.2 The rehabilitation-to-sport journey

Sport participation after injury is well supported as a health and identity resource. A thematic synthesis of 14 qualitative studies found that sport helps people with spinal cord injury progress towards an enriching life, with reported gains in fitness, independence, confidence and community (Cheung et al., 2023). In a sample of 1,034 people with spinal cord injury, being able to practise a favoured sport was associated with better psychological adjustment, and team sport participants reported better adjustment than individual sport participants (Tasiemski & Brewer, 2011).

The same synthesis shows where the pathway breaks. People were introduced to sport by family, peers and, in only two studies, by rehabilitation facilities that offered it. Barriers included coming to terms with disability, discouraging or absent advice from healthcare staff, travel, inaccessible venues and cost (Cheung et al., 2023). Reviews of physical disability report the same environmental barriers of facilities, transport and accessibility, with social contact as a key facilitator (Jaarsma et al., 2014). A 2026 systematic review distinguishes entry, maintenance and withdrawal as separate processes (Burmaoğlu & Abakay, 2026), which suggests that a facility should be judged on whether it sustains participation as well as whether it admits people.

The journey also runs backwards. A meta-analysis of 42 studies put the prevalence of musculoskeletal injury in para-athletes at 40.8%, with an incidence of 14.3 injuries per 1,000 athlete-days. Evidence quality was low to very low. Shoulder injuries dominated in non-ambulant athletes and lower-limb injuries in ambulant athletes (Pinheiro et al., 2021). Across the London 2012 and Rio 2016 Games, injury incidence was highest in athletes with visual impairment and neuromuscular disorders (Adam et al., 2024). For a wheelchair user, a shoulder injury threatens daily transfers and mobility as well as a training block. High-performance athletes therefore need clinical rehabilitation repeatedly, and this is the strongest clinical argument for co-location.

4.3 Standards and policy

The legal position is unsettled and has to be stated carefully. The sports guidelines were notified by the Department of Sports on 13 October 2022 and brought under Rule 15(1)(e) of the 2017 Rules on 17 July 2023 (Department of Empowerment of Persons with Disabilities, 2023). In *Rajive Raturi v. Union of India* (2024), however, the Supreme Court held Rule 15(1) ultra vires because it offered persuasive guidelines where the Act requires a compulsory floor, and it directed the Union to frame mandatory rules. Draft amendments published in July 2026 address information and communication technology (Ministry of Social Justice and Empowerment, 2026). We found no final non-negotiable rules for sports buildings at the time of writing. The numbers in Table 4 are therefore best read as the current professional benchmark, with their binding status pending.

Table 4. Selected provisions in Indian and international instruments, with framework proposals (mm unless stated)

Parameter	Harmonised Guidelines 2021	Sports Guidelines 2022	IPC Guide 2020	Framework proposal
Primary route width	1500 person and wheelchair; 1800 two wheelchairs	1800 recommended; 1200 minimum; corridors 1500–1800	1800 mid traffic; 2000 high traffic	2000 on the shared spine
Corridor turning space	1500	1800 × 1800 at intervals	1500 × 1500 in rooms	1800 × 1800 at every junction
Ramp gradient	1:12 up to 6 m run	1:15 maximum	1:20 best; 1:14 for secondary routes	1:20 main routes; 1:15 maximum
Ramp clear width	1200	1500; 1800 preferred	1500	1800
Door clear width	Not extracted	900	950 best; 1000 for athlete preparation with competition chairs	1000 in all athlete and therapy zones
Lift car	Not extracted	1500 × 1500	1700 × 1500 minimum; 2100 × 1500 best for sport	2100 × 1500
Accessible toilet	Not extracted	2000 × 2200	2200 × 1800 clear	2200 × 2200
Provision of accessible wet facilities	Not extracted	At least one shower, washroom and changing room per facility	1 toilet per 15 athletes with mobility impairment	IPC ratio or better at every hall and therapy cluster
Accessible lockers	Not extracted	Minimum 1:10	Design criteria only	All lockers in para zones within accessible reach
Residential rooms	Not extracted	At least two wheelchair-accessible rooms	1500 × 1500 turning space	All rooms wheelchair-usable

Sources: Ministry of Housing and Urban Affairs (2021), figures as reproduced in Jayasuriya (2026) and Pension Fund Regulatory and Development Authority (2024); Ministry of Youth Affairs and Sports (2022); International Paralympic Committee (2020). Framework proposals are the authors' and are unvalidated.

The comparison yields four findings. First, the sports guidelines improve on general guidance on several points, for example the 1:15 ramp, and they go further than building dimensions by addressing staff training, sign language, adapted equipment and a quiet sensory room. Second, their provision thresholds assume a mainstream venue. One accessible shower is a reasonable minimum for a stadium with occasional disabled users. It fails in a para-sports centre, where most users of the changing room may be wheelchair users arriving at the same time. Third, the guidelines list the 2016 Harmonised Guidelines among their sources, and those were superseded in 2021 (Ministry of Housing and Urban Affairs, 2021), so the two national references need reconciling. Their ramp figures also vary internally: the text sets a 1500 mm minimum width while one figure caption shows 1200 mm. Fourth, rehabilitation is almost absent. The guidelines ask that medical and treatment areas be accessible and close to training grounds, but they do not address therapy spaces, assessment, prosthetic or wheelchair workshops, or progression between clinical and sporting use. Healthcare accessibility is covered by a separate instrument from a different ministry, notified on 9 August 2023.

4.4 Anthropometry and ergonomics

The dimensional basis of accessibility guidance is weaker than its precise numbers imply. A systematic review of 41 articles found anthropometric data on wheelchair users to be limited and inconsistent in measures, samples and methods, which makes population comparison and design use difficult (Bragança et al., 2020). Early three-dimensional work measured 121 adult wheelchair users in the United States and reported differences by chair type and sex for only some dimensions (Paquet & Feathers, 2004). This review found no published anthropometric dataset for Indian wheelchair athletes.

A para-sports campus also has to accommodate equipment that the standards do not model. The IPC guide states that competition chairs may require wider doors, up to 1000 mm in athlete preparation areas. Wheelchair rugby sets no maximum chair width and limits only the distance from the rear wheel to the front of the chair (World Wheelchair Rugby, 2021), and manufacturers report that overall width grows with camber (REHADAT, n.d.). The Rio 2016 technical guidelines allowed 2.00 m for a sports chair passing an everyday chair (Rio 2016 Organising Committee, 2013). Athletes also arrive with two mobility systems: a daily chair, and a sports chair, racing chair or running prosthesis. Equipment storage and changeover therefore become planning problems.

A useful ergonomic finding emerges when provisions are read together. The sports guidelines set bed height at 450–480 mm, WC seat height at 450–480 mm and bench height at 480 mm, and the IPC guide sets WC and shower seat heights at 440–460 mm. These values converge on a common transfer plane of about 450–480 mm. A centre could treat this as a continuous design datum across therapy plinths, changing benches, beds, pool transfer edges and gym seats. The approach follows the logic of the standards, although no study has tested it as an integrated strategy. Reach zones for storage (380–1200 mm forward reach) and the shoulder injury evidence above point the same way, since each avoidable overhead reach and each awkward transfer adds load to a joint that wheelchair users cannot rest.

4.5 Sensory environment

Sensory requirements conflict between user groups, and this is where a generic "accessible" brief is least useful. Blind and low-vision athletes depend on sound and touch. Goalball is played on an 18 m × 9 m court with tactile lines, using a ball containing bells, and silence during play is essential (Paralympics Australia, n.d.; Canadian Paralympic Committee, n.d.). Deaf users depend on vision. DeafSpace guidance organises design around space and proximity, sensory reach including visual cues and vibration,

and colour that supports signing (Bauman, 2010). Autistic users and others with sensory sensitivity may need reduced stimulation. The ASPECTSS index proposes acoustics, spatial sequencing, escape spaces, compartmentalisation, transition spaces, sensory zoning and safety (Mostafa, 2014), and the sports guidelines now ask for a sensory room. A hall tuned for goalball; a corridor designed for signed conversation and a low-arousal retreat cannot be the same room. The response has to be zoning.

The Indian guidelines provide useful baselines: a minimum 26-point light reflectance difference between critical surfaces, 250–300 lux in activity areas, tactile guiding and warning pavers, induction loops, and audible and visual alarms (Ministry of Youth Affairs and Sports, 2022). The higher injury rates among athletes with visual impairment (Adam et al., 2024) give a further reason to treat run-off zones, obstacle-free edges and contrast as safety issues.

4.6 Thermal environment

Thermal comfort is the clearest omission from accessibility guidance in this review, and it matters more in India than in the countries that wrote most of it. Spinal cord injury impairs sweating and skin blood flow below the lesion, and the impairment increases with lesion height (Griggs, 2017; Lackner et al., 2024). Athletes with tetraplegia showed greater thermal strain than athletes with paraplegia during intermittent exercise in conditions typical of an indoor hall, at about 21°C and 40% relative humidity (Griggs, 2017). Even a moderately conditioned sports hall can therefore be a clinical risk. Heat acclimation has been studied in a chamber at 30°C and 75% relative humidity with elite handcyclists, although in only five athletes (Lackner et al., 2024).

Outdoor temperature in much of India routinely exceeds such test conditions in summer. The Gwalior centre's pools are covered but open at the edges, and its 2023–24 report lists pool temperature regulation as still in the pipeline (ABVTCDS, 2024). Neither the sports guidelines nor the sections of the IPC guide reviewed set thermal criteria for training spaces.

4.7 Psychological environment

Pasha and Shepley (2024) identify patient confidence and motivation as mediators between environment and rehabilitation, and propose that a balance between privacy and social interaction supports them. The stroke rehabilitation evidence is consistent with this. Attractive, accessible communal areas were linked with activity and well-being, a higher share of single rooms was associated with lower activity, and hard-to-find spaces went unused (Lipson-Smith et al., 2021). Corridors too narrow for self-propelled wheelchairs and long distances between spaces acted as barriers. This matters for a campus model: walking or wheeling to therapy is itself practice.

Staff and culture carry as much weight as form. In a doctoral case study of Lakeshore Foundation, accessible facilities built the organisation's reputation, but Paralympic teams chose to train there mainly because of the attention staff paid to them and their focus on Paralympic sport (Pate, 2012). The dignity principle in the IPC guide points the same way, asking that people choose their preferred way of using a space at their own pace (International Paralympic Committee, 2020). The evidence does not, however, tell us how a person in early rehabilitation feels when watched by elite athletes, or how athletes feel when training beside patients. Visibility may inspire or may humiliate, and both are plausible readings of the qualitative work on identity (Cheung et al., 2023).

4.8 Precedents

Table 5 compares six facilities, and the pattern is clear. The two strongest international cases grew out of hospitals. Stoke Mandeville Stadium sits beside the hospital that houses the National Spinal Injuries Centre, and WheelPower now plans a Centre of Excellence for Rehabilitation and Sport with the local NHS trust. Lakeshore grew from a rehabilitation hospital into a community and Paralympic training site.

The Indian civilian institutions are split. Gwalior offers elite sports infrastructure with physiotherapy, sports science and health support, but the reports consulted show no rehabilitation or prosthetic pathway. NIEPMD and NIPMR offer deep rehabilitation, including prosthetics and orthotics, but sport is not among their reported core services.

The most instructive case comes from outside the civilian system. The armed forces cluster at Kirkee, Pune, links a spinal cord injury centre at the Military Hospital, the residential Paraplegic Rehabilitation Centre established in 1974, the Artificial Limb Centre and the Army Paralympic Node. Published accounts describe protocol-based rehabilitation followed by focused training at the Node, and specialised running prostheses fitted at the limb centre (Millennium Post, 2019; Punekar News, 2022; Press Information Bureau, 2022). India therefore does have an integrated pathway. It exists for soldiers. The planning gap is one of civilian access and replication.

Table 5. Documentary comparison of precedents

Facility	Operator and origin	Rehabilitation	Sport	Reported link between the two
Stoke Mandeville Stadium, Aylesbury, UK	WheelPower; opened 1969 beside the hospital	At adjacent hospital spinal centre	Stadium, sports hall, pool, fitness, accommodation	Strong; work with spinal units, joint centre planned (WheelPower, 2022)
Lakeshore Foundation, Birmingham, USA	Non-profit grown from a rehabilitation hospital; foundation formed 1984	Historic hospital link	Pool, gym, sports science; US Olympic and Paralympic Training Site since 2003	Strong; community users and elite teams share a campus (Pate, 2012)
Kirkee cluster, Pune, India	Indian Armed Forces; from 1974	Spinal centre, residential centre, limb centre	Army Paralympic Node, pool, courts	Strong; sequential pathway, limited to service personnel
ABVTCDS, Gwalior, India	DEPwD; inaugurated 2023; 34 acres	Physiotherapy and health centre for athletes	Track, pools, indoor complex, hostel for 208	Weak; no rehabilitation entry route reported (ABVTCDS, 2024)
NIEPMD, Chennai, India	DEPwD; established 2005	Physiotherapy, gait, hydrotherapy, multisensory,	Not among reported core services	Weak (NIEPMD, 2025)

		prosthetics and orthotics		
NIPMR, Thrissur, India	Government of Kerala; from 2013	Multidisciplinary assessment and therapy, prosthetics and orthotics	Not among reported core services	Weak (NIPMR, n.d.)

Compiled from published documents only. "Not reported" does not establish that a service is absent.

5. Gap analysis

Seven gaps separate what the evidence asks for from what Indian standards and practice provide. Table 6 links each one to the framework domain that responds to it.

Table 6. Gaps between evidence, standards and Indian practice

Gap	Evidence position	Indian position	Framework response
1. Continuity	Return to sport runs alongside recovery; injured athletes re-enter care	Clinical and sporting institutions are separate, except in the defence cluster	Two-way continuum and shared spine
2. Provision thresholds	Para-sport venues need ratios based on the number of disabled users	Minimums of one wet facility and two accessible rooms	Ratios based on users
3. Equipment and body data	Sports chairs exceed everyday chair dimensions; data on users are limited	Guidance models a standard chair; no Indian athlete data located	Anthropometric domain and a measurement agenda
4. Sensory conflict	Needs differ and can conflict between user groups	Good baselines, with no zoning logic	Sensory zoning
5. Thermal safety	Spinal cord injury impairs heat loss	No thermal criteria in the guidelines reviewed	Thermal domain
6. Psychological experience	Confidence, motivation, privacy and community mediate outcomes	Addressed through staff sensitisation and a sensory room	Graded privacy and staff model
7. Governance and reach	Barriers include transport, cost and absent referral	Sport and rehabilitation sit under different departments; binding rules pending; about 69% of disabled people are rural	Three-tier network and joint governance

6. The Rehabilitation-to-Performance Continuum Framework

The framework proposes that an integrated centre is planned as one continuum with a return path, and that it is not a hospital with a sports hall attached. It has four layers: a user journey, a spatial structure, a set of design parameters and a delivery strategy.

6.1 User journey

Five stages describe the journey: clinical rehabilitation, functional independence, adapted activity, sport development and high performance. Three rules govern movement between them. People may enter at any stage. Nobody is expected to progress, because for most users' independence or recreation is a complete outcome. Movement runs both ways, so an elite athlete with a shoulder injury returns to clinical care without leaving the campus or their team.

6.2 Spatial structure

Five zones correspond to the journey: a clinical zone, a transition zone, a performance zone, a residential zone and a community edge. The transition zone is the framework's main spatial proposition. Neither the rehabilitation institutions nor the sports institutions studied reported a dedicated setting for it. It holds therapy-grade practice courts, a hydrotherapy-to-swimming pool sequence, a gym used by both patients and athletes, and low-pressure "try a sport" sessions.

A shared spine connects the zones and carries the services that users at every stage need: assessment, the assistive technology and sports equipment workshop, recovery, counselling, nutrition, and family and carer facilities. The spine is more than a corridor. Lipson-Smith et al.'s (2021) findings suggest that the distance a person travels and the legibility of that route shape how active they are, so the spine is designed as therapeutic ground in its own right, with rest points, gradients of known difficulty, views and social nodes.

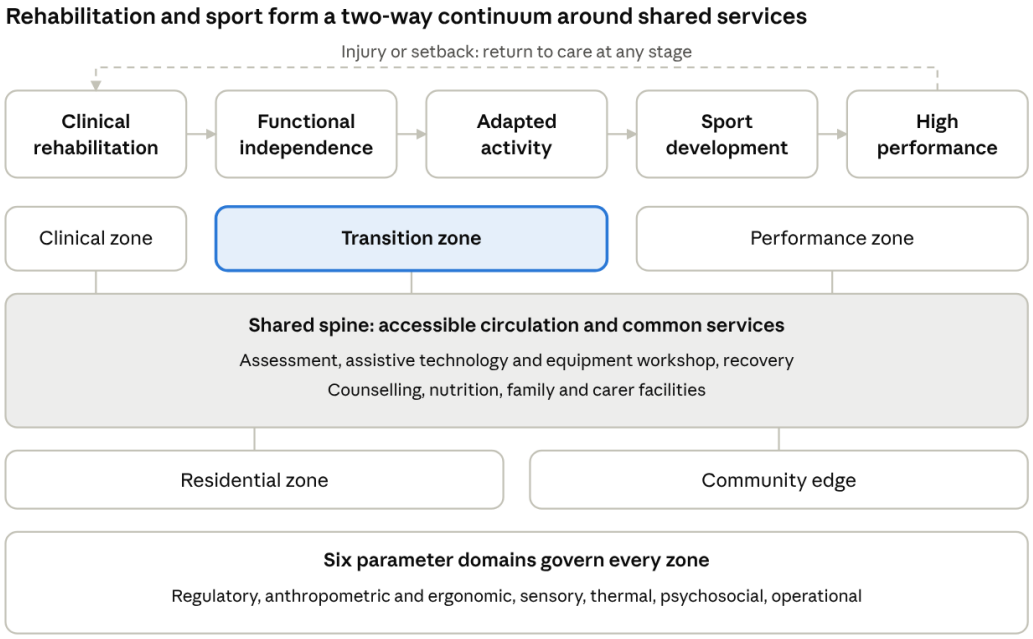

Figure 1. The Rehabilitation-to-Performance Continuum Framework

Figure 1 shows the five stages above their zones. Solid arrows show forward movement, and the dashed line shows return to care. The transition zone is highlighted because it is the framework's main spatial addition.

6.3 Design parameters

Table 7 sets out six parameter domains. The support column separates regulatory provisions (R), empirical evidence (E) and the authors' inference (I), so that readers can see which proposals are firm and which still need testing.

Table 7. Framework parameters

Domain	Parameter	Design response	Support
1. Regulatory	Access floor	Meet the stricter of the Harmonised Guidelines, sports guidelines and healthcare standards; design to the IPC guide in athlete zones	R
1. Regulatory	Provision	Base wet facility, locker and room numbers on expected disabled users, with no fixed minimum count	R, I
2. Anthropometric and ergonomic	Sports chairs	2000 mm spine, 1000 mm doors, 2100 × 1500 mm lifts, per Table 4	R, I
2. Anthropometric and ergonomic	Transfer plane	Common 450–480 mm datum across plinths, benches, beds, WCs, gym seats and pool edges	R, I
2. Anthropometric and ergonomic	Dual mobility	Changeover bays, charging, secure storage for daily and sports chairs at each hall	R, I
2. Anthropometric and ergonomic	Shoulder load	Minimise manual doors, long steep ramps and overhead reach; provide hoists	E, I
3. Sensory	Zoning	Separate acoustic, visual and low-stimulation zones; keep goalball and blind football halls away from plant noise and public routes	E, I
3. Sensory	Multi-sensory wayfinding	Tactile, audible and visual cues on the same route; sightlines for signers; visual and vibrating alarms	R, E
3. Sensory	Contrast and safety	26-point light reflectance difference, glare control, clear run-offs	R, E
4. Thermal	Heat safety	Conditioned halls, shaded and cooled rest stations, water spray points, thermal monitoring, optional heat chamber	E, I
5. Psychosocial	Graded privacy	Sequence from private therapy to semi-private practice to public court; users choose exposure	E, I
5. Psychosocial	Community	Informal seating, shared dining and family spaces near training	E
5. Psychosocial	Restoration	Gardens and views from therapy and recovery spaces	E, I
6. Operational	Workforce	Rehabilitation and coaching staff working jointly; disability training for all staff	R, E
6. Operational	Assistive technology	On-site repair, fitting and adaptation of prostheses and chairs	R, E

6. Operational	Co-design	Persons with disabilities involved at briefing, design and audit	R

6.4 Strategic planning approach

A single national campus cannot serve a population of whom about 69% are rural. Table 8 therefore proposes a three-tier network, so that the first encounter with sport happens close to home.

Table 8. Proposed three-tier network

Tier	Role	Typical host	Core provision
1. National	High performance, research, training of professionals	Existing national centres such as Gwalior, linked to a national rehabilitation institute	All five zones, residential
2. Regional	Sport development and full rehabilitation	National institutes, regional sports centres, medical colleges	Clinical, transition and performance zones, short-stay housing
3. Local	Sport introduction and maintenance	District hospitals, schools, community sports grounds	Transition space, equipment loan, referral link

Six planning steps follow from this. Retrofit should come before new construction, by adding transition zones to institutions that already hold half of the pathway. A rehabilitation institute gains the most from courts and a pool, and a sports centre gains the most from clinical and assistive technology units. Sites should be close to a hospital with spinal or rehabilitation services, and on accessible public transport. Referral needs a formal protocol, so that discharge planning routinely offers sport. Governance should be joint across the departments responsible for disability, sport and health. Staffing and equipment should be budgeted as capital items at the design stage. Post-occupancy evaluation should be built in from the outset, covering referral numbers, retention, injury re-entry, thermal incidents and user-reported dignity.

7. Discussion

This review set out to find how a para-sports centre and a rehabilitation centre might work as one. Its main contribution is to shift the framing of the problem. Indian debate on para-sports facilities has centred on whether buildings are accessible. The evidence suggests that the harder question concerns continuity: whether a person can move between recovery, activity and competition without falling out of the system, and return when the body demands it.

The injury data give that argument a clinical footing, and the Kirkee cluster gives it an Indian precedent. Both qualify the common account of rehabilitation and sport in India as simply separate. The separation holds for civilians. Defence provision shows that the model can work under Indian conditions, and it also shows who is currently left out. Stoke Mandeville and Lakeshore suggest that integration tends to grow from a rehabilitation institution outward. This has a practical implication for India, where strategy may be better directed at extending existing rehabilitation institutes than at building new sports complexes alone.

The framework also departs from the current standards in substance. The Indian sports guidelines are a significant step and their breadth deserves recognition. Their thresholds, however, were written for inclusion within mainstream venues. A centre where disabled users are the majority inverts this assumption, and numerical minimums need to give way to ratios based on users. Thermal safety deserves direct attention from standard-setters, given India's climate and the physiological evidence. If non-negotiable rules are now to be drafted for the built environment following *Rajive Raturi,* this is a timely moment to raise both issues.

There is a real objection to integration, and it should be stated plainly. Para-sport has spent decades escaping the assumption that disabled athletes are patients. The social model and the identity literature warn against any arrangement that re-medicalises elite sport, and a para-athlete's training base that looks like a hospital would send the wrong message. Conversely, a recently injured person may not wish to rehabilitate in full view of Paralympians. The framework responds through its zoning, its graded privacy and the rule that progression is never expected. Whether these measures are enough is an empirical question. It is the question most in need of being asked of disabled people themselves.

Cost is the other tension. A full campus is expensive, and high-performance provision can absorb resources that a larger number of people need at local level. The tiered model tries to hold both, but this paper offers no cost analysis, and one is needed before any policy conclusion can be drawn.

7.1 Limitations

The framework is conceptual. It rests on secondary data and has not been validated by experts, athletes or rehabilitation users. Precedents were analysed from documents, so absence of a reported service does not prove absence in practice, and accessibility as built was not audited. Much of the evidence comes from high-income countries and from spinal cord injury or stroke, so its transfer to other impairments, to children and to Indian settings is uncertain. Women with disabilities and people with intellectual disabilities are under-represented in the sources reviewed. English-language restriction may have excluded Indian regional sources. The numerical proposals in Tables 4 and 7 are the authors' judgement and should not be used as standards.

7.2 Future research

Four studies would move this work forward. A Delphi study with athletes, coaches, clinicians, architects and administrators could validate and weight the parameters. An anthropometric and equipment survey of Indian para-athletes could replace borrowed dimensions with measured ones. Thermal monitoring in Indian training halls could establish the real exposure of athletes with spinal cord injury. Post-occupancy evaluation at Gwalior, Kirkee and a rehabilitation institute could test the framework against lived use.

8. Conclusion

India's para-sport success has outgrown the institutional arrangements behind it. This review found that existing standards offer a workable access floor, but they assume disabled people are a small minority of a venue's users, say little about rehabilitation, and overlook sports equipment and thermal risk. Civilian facilities are divided between treatment and sport, while a defence cluster at Kirkee shows that a linked pathway is achievable in India.

The Rehabilitation-to-Performance Continuum Framework responds with a two-way journey of five stages, a transition zone and shared spine, six parameter domains and a three-tier network. Its central claim is that the most valuable space in such a centre lies

between the clinic and the court. The framework is offered as a structured starting point for planners, designers and policy makers, and its next test must come from the people who will use these buildings.

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AUTHOR CONTRIBUTIONS

Narasimman R and Jayasurya: conceptualization, methodology, document analysis, writing – original draft; Narasimman R: supervision, validation, writing – review and editing.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DECLARATION OF ARTIFICIAL INTELLIGENCE (AI) ASSISTANCE

During the preparation of this manuscript, the authors used Claude (Anthropic) to assist with locating and summarising policy documents, structuring the analysis, drafting and language editing, checking reference details and drawing Figures 1 and 2. The coding of instruments was reviewed and finalised by the authors, who take full responsibility for the content of the published article.

ETHICS APPROVAL

Not applicable. The study is based on published documents and did not involve human participants.

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