Transforming our World Through Design, Diversity and Education
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# Universal Access in Heritage Site: A Case Study on Jantar Mantar, Jaipur, India

VARDIA, SHWETA<sup>a1</sup> and KHARE, AJAY<sup>b</sup> and KHARE, RACHNA<sup>c</sup> <sup>a</sup>Assistant Professor, Department of Conservation, School of Planning and Architecture (SPA), Bhopal, India <sup>b</sup>HOD & Professor, Department of Conservation, SPA, Bhopal, India <sup>c</sup>Dean & Professor, Department of Architecture, SPA, Bhopal, India

Abstract. One of the key requirements for an inclusive and sustainable society is that everyone should be able to participate in and enjoy the social, economic and cultural assets of that society. For some people, barriers exist which make visiting and using heritage buildings and places difficult or sometimes impossible. Making the built heritage more accessible in an appropriate and sensitive manner can increase awareness and appreciation of its cultural, social and economic value. The roots of universal access are grounded in equal opportunity, nondiscrimination and designing for diversity. Architects play an important role in creating accessibility awareness in the society. Thus it is important to impart 'universal design' teaching in architecture schools that will bring awareness amongst budding architects and planners who will respond to the need of diverse population and will create awareness in the society. This paper is and outcome of the academic exercise conducted for the Masters in Architectural Conservation Design Studio at the site of Jantar Mantar with diverse users and proposing solutions for physical and intellectual access to the site. The paper aims to develop awareness, sense of responsibility among students through universal design education for a heritage site and further discuss the possible universal design interventions at World Heritage Site of Jantar Mantar, Jaipur.

Keywords. Accessible heritage, universal accessibility, diverse users, accessible tourism , heritage sites and museums

### 1. Introduction

A country is recognized by a range of its significant historical, cultural and natural properties. These properties are generally preserved and maintained either by national administration or by private owners and charitable trusts due to higher value of their cultural inheritance and termed globally as heritage or historic sites. Heritage sites are a significant asset, a unique and irreplaceable resource which reflects a rich and diverse expression of past societies and forms an integral part of local, regional and national cultural identity. Today, heritage sites also play an important role in communication and knowledge exchange. Thus the rapidly increasing heritage tourism industry faces several challenges too. One of the challenges is that there is a segment of society who is not yet able to equally enjoy the visit to historic structures /sites and attractions, facilities and

<sup>&</sup>lt;sup>1</sup> According Author, Department of Conversation, SPA, Bhopal, India; E-Mail: shwetavardia@spabhopal.ac.in

services. The ones who face difficulties are persons with disability, mobility impairment, vision and hearing impaired, elderly, children, women, and families with rural background unfamiliar with urban life, poor and unschooled.

Most of the heritage sites were not originally designed to accommodate people with disabilities and special needs; same is the case with the Jantar Mantar of Jaipur. The Jantar Mantar, Jaipur is an astronomical observation site built in the early 18th century and includes a set of some 20 main fixed instruments. They are monumental examples in masonry of known instruments and designed for the observation of astronomical positions with the naked eye; embody several architectural and instrumental innovations. Today, the site is one of the most popular tourist destinations in Jaipur and is listed as UNESCO World Heritage Site and it is likely that not only able bodied users but persons with physical and sensory limitations should experience the site in the same manner as other users.

Universal Design is concerned with more than just removal of barriers, it seeks to eliminate discrimination by design and support full participation for all members of society [1]. It is a humane approach to design that responds to the diverse needs of all intended users, that adds value and bring dignity to design [2]. Architect's plays an important role in designing the built environment and it is expected that any design interventions should be designed inclusively to accommodate the needs of all diverse users. The inclusive living environment will be the one of the driving factors to raise awareness and develop a sense of responsibility in the society. The architectural institutions and allied disciplines are perfect places for enhancing the knowledge of universal design among professionals and other society members.

#### 2. Universal Design and its education

In present context Universal Design education has made a crucial progress worldwide but still has not been completely accepted among architecture, planning and design schools in India. There are no specialized courses on universal design in the country, this is perhaps because the benefits of designing in a more inclusive way are not immediately apparent and also because there are many other pressing issues that require attention. Universal Design education and research is not quite preferred subject in architectural and design schools in India though Council of Architecture have made it compulsory to include accessibility not to mention Universal Design in the existing curriculum since 2006. Center for Human Centric Research (CHCR) at SPA Bhopal is a multidisciplinary research centre that aims to bring awareness among budding architects and planners to respond to the needs of diverse human population for collective socio-economic and socio cultural development in the country [2].

This study is an outcome of joint effort of Center for Human Centric Research and Masters Conservation program at School of Planning and Architecture Bhopal by conducting a design studio for Masters Conservation student. The studio exercise will help students to understand the significance of historic site and principles of universal design and further integrate universal access plan in developing conservation management plan of Jantar Mantar. The paper aims to develop awareness, sense of responsibility among students through universal design education for a heritage site and further discuss the possible universal design interventions at World Heritage Site of Jantar Mantar, Jaipur. The studio conducted not only provided an intense and experiential universal design understanding to the students, but also provided an opportunity to explore Design studio as a pedagogical tool to meet educational objectives that the school is striving to include in Academic Curricula. The paper presents the academic study in brief and summarizes the lessons learnt for the contextual aptness of Universal Design (UD) and Universal Design Education (UDE). The objectives of the study are:

- To create awareness about Universal Design among budding conservation architects and professionals to support social sustenance.
- To sensitize the conservation students to the needs of the persons with disability and elderly and to enable them with critical thinking towards practical application of universal design in historic sites.
- Develop contextual and model design example through intense Universal Design Education.

The proposed study is focused to investigate, identify and an attempt to find solutions and recommendations for making the spaces more user friendly for all in the heritage structures/sites. The expected outcome of the studio exercise is to develop proposal for Conservation Management Plan along with Universal access Plan for the site of Jantar Mantar, Jaipur. The paper discusses in detail the framework adapted to educate conservation students to create inclusive conservation management plan for heritage site.

# 3. Methodology adopted for Study

Universal design has been described to comprise the following three key elements: User Designer Interaction; Understanding people and Evidence based findings [3]. The Universal Design education involves both theory and practice, besides lecture based on theories, it is essential to apply other methods like discussions, audits and case studies. Based on these aspects the framework of the teaching universal design is formed The framework of the study involved mainly four stages including Theoretical knowledge, User involvement, Evaluation, and Innovative Design solutions for the Jantar Mantar Complex, Jaipur. Refer to the text in Table 1.

Stage	Intention	Activity
1	Gaining theoretical knowledge	Input given to students about the technical aspects of universal design, history, developments, standards, accessibility and design, requirements related to physical space.
2	User involvement	Guest lectures by inviting persons with different needs, learning about lifestyles and user requirements and through simulation exercise experiencing the barriers of daily environment.
3	Evaluation	Evaluation methods, access audits, teaching the systems and tools.
4	Innovative Design Solutions	Possible design interventions to make the premises more accessible for the diverse users.

**Table 1:** Stages explaining the framework

Providing inclusive built environment (exterior and interior) for persons with disabilities in ways that preserve the character of the historic property is a challenge and requires creativity and collaboration The most common method that may be employed to understand the needs of people with disabilities in the site of Jantar Mantar, Jaipur is 'access audit'. The access audit on a site is carried out to understand the needs of users which generally follow the normal journey sequence. It is an important tool in identifying and documenting the barriers which can cause difficulties for people with disabilities. Access audit delivers action plan in detail, and is site specific and case specific, thus retaining the ambiance of the site. It may typically include an assessment of the pre-visit information and the journey to the site. The conservation assessment and access audit are ideally undertaken simultaneously. The access audit delivers action plan in detail, site specific and case specific retaining ambiance of the site [9]. The participatory approach of learning was pursued. Finally, an attempt was made to find solutions for making the spaces more user friendly for all including the elderly and persons with disability in the specified locations. The results can be implemented on site and the process can be used as an exemplary method for similar historic sites and structures.

#### 4. Jantar Mantar Complex, Jaipur

Jaipur is a standout amongst the most socially rich legacy urban areas in India. Established in the year 1727, the city is named after Maharaja Jai Singh II who was the primary organizer of this city and ruled the region from 1699AD and 1744AD. He planned to shift his capital 11 kilometers away from Amer, to Jaipur to accommodate the growing population and increasing scarcity of water. Jai Singh consulted several books on architecture and architects while planning the layout of Jaipur. Under the architectural guidance of Vidyadhar Bhattacharya, Jaipur was planned based on the principles of Vastu shastra and Shilpa Shastra. The construction of the city began in 1726 and took four years to complete the major roads, offices and palaces. The city was divided into nine blocks, two of which contained the state buildings and palaces, with the remaining seven allotted to the public. Huge ramparts were built, pierced by seven fortified gates. Jantar Mantar, Jaipur was built in central sector called as Chowkdi Sarhad in the vicinity of the City Palace, by Maharaja Sawai Jai Singh. Refer Figure 1.



Figure 1. Jantar Mantar and the city of Jaipur (@DRONAH)

The Jantar Mantar Jaipur, Rajasthan is a collection of nineteen architectural astronomical instruments, built by the Rajput king Sawai Jai Singh II, and completed in 1734 century. It features the world's largest stone sundial, and is a UNESCO World Heritage site. The monument features masonry, stone and brass instruments that were built using astronomy and instrument design principles of ancient Hindu Sanskrit texts. The instruments allow the observation of astronomical positions with the naked eye. The monument expresses architectural innovations, as well as the coming together of ideas from different religious and social beliefs in 18th-century India.

The observatory is an example of the Ptolemaic positional astronomy which was shared by many civilizations. The monument features instruments operating in each of the three main classical celestial coordinate systems: the horizon-zenith local system, the equatorial system and the ecliptic system. The KapalaYantraprakara is one that works in two systems and allows transformation of the coordinates directly from one system to the other. At present Jantar Mantar site has an area of approximately 20,000 m sq. and has a high boundary wall around it and is now UNESCO World Heritage Site. Refer Figure 2 & 3. The site is under the protection of Rajasthan State Archeology and is well maintained including the instruments and Some Facilities like Interpretation centre, Canteen, Shop, ticket counter etc are provided.



Figure 2. Section of Jantar Mantar complex (@ M Arch conversation studio 2016)



Figure 3. Site plan of Jantar Mantar complex (@ M Arch conversation studio 2016)

# 5. Universal Design at Jantar Mantar Complex in Jaipur

Like most of the heritage sites, the historic precinct of the Jantar Mantar complex was not originally designed to accommodate people with disabilities and special needs. The site operated as laboratory for the Raja Jai Singh and scholars to observe the movements of celestial bodies, sun dial and astronomical readings. The location of Jantar Mantar was chosen in the close proximity of the city palace complex and on relatively flat site so the orientation of the instruments is precise. Today, the site is a major tourist destination in the city and it is expected that not only able bodied users but persons with physical and sensory limitations visit the sites.

## 5.1. Stage 1: Gaining theoretical knowledge

In the first stage lectures were conducted by Universal Design experts to create awareness and basic background information. The students were taught and trained on the principles of universal design, standards, relationship between accessibility and design and requirements related to physical spaces. The students were made aware about all different type of disability and diversity issues. The students were sensitized about the existing Indian accessibility standards and International Universal design standards. Students also learned about the access audits and accessibility checklist and were asked to apply any tool to assess the universal usability.

#### 5.2. Stage 2: User Involvement;

The stage two focused on participatory approach in understanding the relationship between different conditions of humanity and design. An interactive meeting was arranged with high achievers with disabilities to sensitize students and to understand their role as designer to improve the quality of built environment. The students were instructed for conducting and documenting the simulation exercise (using blind folds, canes, crutches, using wheel chair...) at the Jantar Mantar site to experience the barriers in daily environment. The students had hands on experience by playing the role of differently able users or people with special needs. The idea is to address diverse need by design, including the needs of most vulnerable ones. Also the simulation exercise helped in understanding that accessibility do not only address needs of person with disabilities, but include real life users of all ages, abilities and conditions. *Figure 5* depicts the real life role plays conducted in the Jantar Mantar.



Figure 4. Simulation exercise conducted at the Jantar Mantar complex

#### 5.3. Stage 3: Evaluation;

The Stage 3 focused on the evaluation methods and access audits. Access audit was conducted with the help of existing Indian accessibility checklist to understand the physical barriers existing at the site. The students went around the entire premises and assessed the human conditions and ergonometric setting. With the help of measurements and checklists and trip chain method mapped the entire area right from parking and entrance to the indoor exhibits and instruments via ticket counters and other provisions. Refer figure 5 for the access audit checklist.

The simulation exercise led to understanding the difficulties faced by the diverse users. This led to the identification of contextual problems by the students. Refer Figure 6 Identification of Problems Faced at the site.

INTERNAL ENVIRONMENT					DOORS & DOORWAYS					
NO.	QUESTION		NER	REMARKS	1	NO.	QUESTION	ANS	NER	REMARKS
		Yes	No					Yes	No	
23	Are steps uniform in width and height?			Uniformity observed in some places	1	1	Is the clear width of the door minimally 900mm?			All doors > 900mm
24	is the staircase not circular and sharp?				1	2	Is much energy required to open the doors?			All opened doors
25	Are the stairs continuous without any abrupt breaks and gaps?					3	Is the color of door in contrast with furniture, walk and doorframe?			
26	Is a ramp provided as an alternate route to the stairs?			Not everywhere.		4	Are there any thresholds present on the door? If yes, are they less than 12mm ?			
27	Is the ramp gradient not steeper than 1:12 ¥			At Rashivalaya yantra < 1:12 At Jai Prakash yantra < 1:12		5	Are doors double hinged and swing bothways ?			
28	Is the ramp width is less than 1600mm#			1630mm	1	6	Are the doors have a timed- release spring for shutting?			Only in office
29	Have handrails been provided on the both sides of the ramp and are continuous on the landing?					7	Is there adequate space available to open the door even by a wheelchair user?			NA
30	Have landings, been provided at specified intervals and at the beginning and end of ramp?					8	Is the vision plate on doors, comfortable for wheelchair users?			
31	Have facilie warring blacks been installed 300mm				1	9	Are there door closers?			
	run in external environments?	L	-		TOILETS					
32	Is the ramp illuminated?	<u> </u>	-	Presence of Doylight		1	Are there any accessible tailets provided?			
33	Is there tactile warning tiles provided at the beginning and at the end of each ramp?					2	Are there any unkex accessible toilets provided?			
34	If alternate access route by ramp has not been provided then identify the space and design for the			Refer plans. For instruments not		3	Is there color contrast between floor, wall and sanitary fittings?			
ramp.				ocossible		4	Is there any claim system within easy reach to alert persons outside? If yes, is there any visual alarm?			
FAIRWAYS				5	Can the door be opened from outside if					
1	Is the pathway minimally 1200mm wide?						accidentally locked from inside \$			
2	Are there any protructing objects or barriers on the pathways?						CAPETERIA	_	_	
3	Is there 1500mm x 1500mm space to allow a wheelchair user to turn around at some point on the pathway?			General width = 1600mm	1	1	Is the entrance to cafeteria barrier free?			
						2	Is the floor non slippery and without heavy texture \$			
4	Is the floor finish non slippery and non reflective?					3	Is the handwash area accessible?			
5	Is the pathway well illuminated?					4	Is the staff trained to axist differently abled persons?			
6	Is there a color contrast between the floor and instruments?					4	Do the staff serve food on table to differently abled persons?			

Figure 5. Access Audit checklist



Figure 6. Identification of problems at the Jantar Mantar complex

The problems found in The Jantar Mantar Complex are: the whole complex has astronomical instruments, interpretation centre, cafeteria and offices. The ticket counters are at the entrance gate of the complex and are inaccessible for the specially abled users. The architectural astronomical instruments have series of narrow pathways. There are no designated pathways or paved areas for the movement of wheel chairs around the instruments. Thus the architectural astronomical instruments are mostly inaccessible. There is no designated accessible parking while entering the premise. Lack of proper signage causes confusion for first time visitors. The high risers of the steps are difficult for children, elderly and pregnant women. The staircases have disconnected or no railings. The inappropriate ramp junction and inappropriate ramp height (more steep) at the entrance makes it difficult in terms of accessibility to diverse users and when there are more number of tourists entering the precinct. The landing space is less which is only 1.5 m making it more compact and no spillover space for the tourist as soon as they enter the area. The ramps provided in the outdoor areas are not of the required gradient and are obstructed with planters, leading to compulsory assistance required by wheel chair bound person. The pathways and the outer flooring provided are uneven and are prone to accidents for the usual users also. The indoor exhibit areas have been refurbishing with ramps, low risers, railings, non slippery flooring and signage. But still there are still certain problems which need to be addressed like, provision for drinking water fountains and accessible toilets, the gradient of ramps are steep, missing railings, tactile pavers and missing signage for specially abled users. The entire premises lacks in the availability of tactile pavers, signage's and designated pathway for wheelchair bound persons. Refer figure 6.

## 5.4. Stage 4: Innovative Design Solutions;

The last stage is about searching and sharing best practices, new developments and new approaches in universal design related issues and generating new ideas. The students are expected to suggest some innovative ideas not only are architects but also as an intellectual member of the society. After the conduction the study in the of simulation exercise and access audit the participants identified various problems regarding accessibility at Jantar Mantar, Jaipur. The participants also identified the different expectations and requirements of the users depending on the purpose of their visit. The proposed design solutions are an attempt to make these historic sites/structures users friendly to diverse users. There was several design solutions proposed collectively which are as follows:

**Pre visit Information:** There could be a provision of information in advance of, any visit to Jantar Mantar complex The pre visit information will be help the visitors to decide and plan in advance and to know which all areas are accessible, or no access or limited access. The online websites are useful aid to provide pre-visit information. **Interpretive information:** The interpretive information will facilitate visitors in informing about the place itself or its contents, its architecture or its services. Information should be designed to be accessible to as many people as possible both in terms of sensory and intellectual access. These methods may include: pictorial symbols, annotated maps and models, tactile guides, haptic models: these are 3D models of objects which communicate information about the object through touch to people with vision impairment, audio guides and easy to read leaflets [1].

**Facilities:** There are some of the key facilities which are required to be provided at the historic sites mentioned in the study. There is a need of reception facilities and should be located near the entrance with a clear evenly lit unobtrusive route. The reception desk should have lower level counter top which could be used either by someone in wheel chair or by people of short.

**Sanitary facilities:** the site requires proper accessible toilets with grab bars, easy wheel chair movements, clear signage and clear access route.

There is need for tactile paving to be provided along the routes and should be well designed and harmonies with the adjoining surface and also providing tonal contrast for people with vision impairment. Steps, Ramps and Mechanical Lifts The level changes exist in the study locations are either as a result of the natural topography or as part of the original design and layout. Ramps are generally preferable to mechanical solutions, such as lifts, particularly where level changes are small or where there is sufficient space to integrate a ramp. However, ramps are not suitable for everyone and steps may be required also as an alternative for some users with mobility difficulties [1]. Ramps can be permanent, semi-permanent (or demountable) or temporary (or portable). Handrails are required either on both sides or on one side depending upon the location to facilitate a person going both up and down. Resting places and Signage. The study locations require rest areas along the accessible routes, waiting areas and exhibit areas for all types of users. Proper, well designed and clear signage at the strategic locations without obstructing the views are required all along the site. Refer Figure 7: Proposed design solutions for reception, facilities and signage stature.



Figure 7. Design Proposals and solutions for the Jantar Mantar complex

# 6. Conclusions

The entire methodology adopted is one of the methods to teaching universal design education to students of Masters in conservation studies which is not available as regular academic courses in architectural institutions and colleges in India. Learning by doing should be essential part of Universal Design education. Creating awareness and shaping the perception of budding professionals towards universal accessibility through such exercises proves beneficial pedagogical strategies which can be incorporated to develop multiple design solutions which are practical and universally accessible. A balance need to create between accessibility and maintenance of the ambiance of the site. Accessibility should not threaten or destroy features and materials that convey its significance. However, in the assessment or management of a building or site in respect of access, it is important to recognize that disabled people have a right to expect, where possible, dignified and easy access to and within historic buildings and sites. The majority of visitors with disabilities require facilities which can also have advantages for able bodied visitors and can be an added attraction to other visitors who would generally not be classified as "disabled". The provision of universal design in heritage sites is a win-win solution; it shows sensibility, compassion for the diversity and respect for the vulnerable populations. It expresses responsibility towards the community as well as indicates International excellence. It also enhances the marketability of the heritage site and attracts untapped tourists who have never visited the heritage site due to its inaccessibility.

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