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UNIVERSAL DESIGN: FROM DESIGN PHILOSOPHY TO APPLIED SCIENCE

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***Abstract*:** Universal Design (UD) philosophy is inspired by the social responsibility that no discrimination is present in the use of the built environment. During recent decades UD philosophy led to a systematic development of design guidelines for architectural and urban projects aimed at rendering the built environment accessible to all. In Malta, such guidelines are endorsed by central and local government entities and non-governmental organizations and they are covered by legislation which is actively enforced. Moreover, the law stipulates that the planning regulator makes it mandatory that a given development permission complies with these guidelines. This ensures that no barriers can hinder the usage of a given development. The objective of this paper is to demonstrate that UD is not only a legal requisite emerging from a socially sensitive design philosophy and grounded in official design standards that ensure legal compliance, but an applied science aimed at ensuring mobility for all. Using a case study from this European Union Member State, this paper argues that setting the focus on technical specifications relating to access for all falls short of addressing the inherent interdependencies; consequently, it does not tackle UD issues. UD goes beyond the prescriptive requirement established by law and underpins a performance-based design, thereby intrinsically enhancing the quality of any given element, whether a space or a product. UD is an applied scientific discipline; it is a multifaceted, interdisciplinary branch of learning. It involves the application of current

formal scientific knowledge to pragmatic scenarios in order to attain contextual specific solutions. UD is not just an applied design philosophy; it is an applied science integrating anthropometrics, medicine and design; it is universal design science.

Keywords: Universal design, universal design science, design for all, inclusive design, accessibility, heritage design, floating pontoon, Malta.

Introduction

Terminology

A widely used working definition of the term Universal Design (UD) adopted by the Committee on the Rehabilitation and Integration of People with disabilities (CD-P-RR) (Ginnerup, 2009) recommended the endorsement of Resolution ResAP(2007)3 by all Member States of the European Union. This resolution (Council of Europe, 2007) states:

"Universal Design is a strategy which aims to make the design and composition of different environments, products, communication, information technology and services accessible and understandable to, as well as usable by, everyone, to the greatest extent in the most independent and natural manner possible, preferably without the need for adaptation or specialized solutions."

This resolution builds upon Council of Europe Resolution ResAP(2001)1 (Council of Europe, 2001), known as the 'Tomar Resolution' (Council of Europe, 2007), which was adopted in 2001. Resolution ResAP(2007)3 is echoed in the introductory paragraph of the executive summary of the report drawn up by Søren Ginnerup in co-operation with the Committee of Experts on Universal Design (Ginnerup, 2009). The term UD is used in this report as a broader label to include other terms used with respect to access for all design, namely, 'design for all', 'integral accessibility', 'accessible

design', 'inclusive design', 'barrier-free design', 'transgenerational design' and 'accessibility for all'. Likewise, the term UD was used in this article.

Accessible design need not be UD. "At a basic level, accessibility operates on an 'access' scale (from not difficult to access through degrees of difficulty to impossible to access, with the defined group including everyone). UD has several roots, including usability, which tends to operate on a 'use' scale (from easy to hard to use by a collective group that includes as many people as possible within this group)" (Erlandson, Enderle, & Winters, 2006).

A fundamental principle of UD is equity. One should not differentiate between users; any given element should be appealing and usable by all. A ramp is required for wheelchair access and individuals with restricted mobility, but consideration is to be given to its aesthetic quality and/or stigmatizing effect (Erlandson, Enderle, & Winters, 2006). Christopher Day, an architect by profession and author of several seminal publications with a foreword by H.R.H. The Prince of Wales, published an inspirational humorous book about access for all soon after he was diagnosed with Motor Neurone Disease, one of the most severe degenerative diseases (Day, 2007). This publication is a critique of his personal experience of accessibility in cities, on mode of transport and access for all ranging from walking sticks to wheelchairs, an experience which he termed "non-accessible accessibility".

Within the context of UD, and other terms falling under its umbrella as noted above, official bodies such as the Council of Europe, particularly the cited resolutions, repeatedly referred to people with disabilities. Although describing such individuals as disabled was the prevalent established discourse, the *Regional Socio-Economic Plan for the South of Malta*, published years before Council of Europe Resolution ResAP(2001)1, makes use of the term 'people with special needs' (Planning Council, 1998). The author, then the Chairperson of the Planning Council responsible for initiating research as the basis for the drafting and completion of this publication, considered references and allusions to people as being disabled and/or handicapped as insensitive, humiliating and degrading. In fact, the

Volume 10, Issue 1. (CC) JACCES, 2020. ISSN: 2013-7087

Planning Council's over-reaching philosophy was that such people were individuals with diverse abilities rather than disabilities.

Historical Backdrop

Since the European Convention for the Protection of Human Rights and Fundamental Freedoms, which was drafted in 1950 and came into effect in 1953, there is a growing awareness of UD supported by legislation and guidelines both within European Union Member States and also in other countries. The major milestones in the development of UD were tabulated in a publication of the Council of Europe issued a decade ago (Ginnerup, 2009). These included landmark conventions, declarations and resolutions, international events, national legislation, action plans, research and other initiatives. All are grounded in, and implicitly reinforce, the conviction that people with permanent and temporary special needs should not be discriminated against since they are entitled to enjoy their full rights and freedoms as the rest of society. Although qualitative research undertaken by Ginnerup (2009) concluded that most of the above mentioned events and resolutions had been incorporated into national, regional and local initiatives, UD in practice is still read as a mere application of technical specifications imposed by enacted legislation. Therefore, it needs to be complied with for given design proposals.

The principles of UD were developed at the Centre for Universal Design at North Carolina State University (Table 1) (Connel et al., 1997) although the first pioneering publication was by Goldsmith (1963) followed by others, such as Farrant and Subiotto (1969), and Boswell and Wingrove (1974). This centre, formerly known as the Center for Accessible Housing, was established in 1989 by Ronald Mace together with North Carolina State University, his alma mater. Wheelchair user since the age of 9 after contracted polio, Mace was instrumental in getting the accessibility-focused building code mandatory in North Carolina in 1973, the first in the United States. Some of his key publications include Mace (1980) and Barrier Free Environments Incorporated (1991), the latter being a consulting firm which

Volume 10, Issue 1. (CC) JACCES, 2020. ISSN: 2013-7087

Mace directed. Together with Story, Mace had co-edited an issue on UD for the authoritative academic journal Assistive Technology (Story & Mace, 1998). In this issue he published a seminal, comprehensive paper on UD in housing (Mace, 1998) whereby he argued that UD goes beyond the threshold for accessible design and do lead to homes that are usable and marketable.

Table 1. The Principles of Universal Design (Connel et al., 1997)

No.	Design Principle	Objective
1	Equitable Use	The design is useful and marketable for people with diverse abilities.
2	Flexibility in Use	The design accommodates a wide range of individual preferences and abilities.
3	Simple and Intuitive Use	Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4	Perceptible Information	The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
5	Tolerance for Error	The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6	Low Physical Effort	The design can be used efficiently and comfortably and with a minimum of fatigue.
7	Size and Space for Approach and Use	Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

The British Standards Institution issued its first code of practice addressing accessibility for disabled people, namely the British Standard Code of Practice CP96 (BS CP 96, 1967) in 1967. Despite these principles, which are

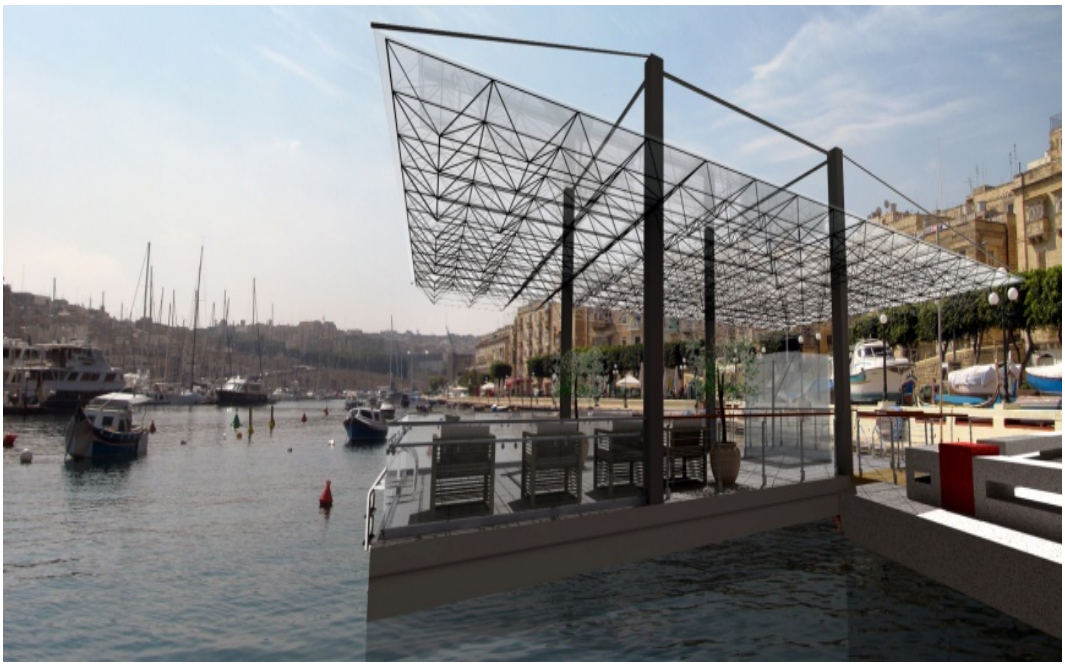
Volume 10, Issue 1. (CC) JACCES, 2020. ISSN: 2013-7087

essentially guidelines, the 1999 project of the Royal Institute of British Architects culminating with the publication of the first handbook on design indicators for special needs by Harker and King (2002), and other seminal publications notably by Imrie and Hall (2001), ease of mobility and full accessibility are still an issue around and within buildings (Carvalho de Souza & Duarte de Oliveira Post, 2016; Mustaquim, 2015).

Aim of the study

This article presents a case study which illustrates UD beyond merely conceptual design philosophy. It involves a design proposal within a sensitive cultural and maritime heritage context, namely a floating sea terminal and other pontoons for the traditional 'dgħajsa tal-pass' (translated as 'passage boat' in the Laws of Malta, 2009), a passenger-carrying small boat, in the Grand Harbour, Malta (Figure 1).

Figure 1. Artistic Impression of the proposed floating Sea Terminus which illustrates UD beyond merely conceptual design philosophy. Source: Lino Bianco and Associates (2011)



This case study is not merely an investigation regarding accessibility to sea craft from floating structures for persons with disability. It can be considered as offering a unique solution which symbiotically merges an

architectural concept with access for all requirements not just from a prescriptive adhesion at law but as an applied science. It was included in the Grand Harbour Network Initiative, part of the SeaToLand project of the Foundation Temi Zammit. The architectural brief was to develop designs to maintain and sustain the maritime traditional legacy associated with the dgħajsa tal-pass, the traditional water taxi synonymous with this geographical region (Muscat, 1991; Muscat, 1999; Muscat, 2009).

Methodology

Review

The focus of the architectural brief was to create a special assistive technological product design which is inclusive and can be easily replicated in aquatic environments. This study is based on official development planning policies and design guidelines together with consultations with the interested parties involved, both governmental and non-governmental agencies. Thus, the designs developed were:

- complementary to the geocultural and maritime heritage legacy of the Grand Harbour region,
- compliant with approved policies included in the *Structure Plan of the Maltese Islands* (Planning Services Division, 1990) and the relative local plan (Planning Authority, 2002);
- in consultation with the relevant stakeholders, namely, the barklori (the boatsmen), the Local Councils of the various cities within the Cottonera Region, and government authorities and agencies; and
- compliant with the *Access for All Design Guidelines* (AADG) (Spiteri, 2011).

The anthropometric dimensions for the proposed sea terminus were obtained from:

- AADG,
- interviews with the key players including

  - Lawrence Ancilleri from the Koperattiva tal-Barklori (Boatsmen's Cooperative),
  - Ahar family, notably Walter then secretary of the Koperattiva, who has been associated with the operations of water taxis for several decades, and
  - Abela family, notably Alfred,

- technical measurements and observations of water taxis in use.

Access for All Design Guidelines (AADG)

The AADG (Spiteri, 2011) is a practical, concise publication and provides all-round information on UD. It is an enforceable legal document as it is the official publication of the National Commission Persons with Disability (KNPD), Malta, a commission legally established through Act I of 2000 entitled 'Equal Opportunities (Persons with Disability) Act' (Laws of Malta, 2000). Unlike the case of the United States whereby accessible design has a specific legal definition and Access Board accessibility guidelines specifically cover architecture, transportation and communication as related to electronic and information technologies (Erlandson, Enderle, & Winters, 2006), the Maltese framework is less specific. Although there are aspects which need to be addressed, these guidelines are a document aimed at maximizing accessibility through architecture and urban design specifications. Compliance with the access for all guidelines is legally binding, and they are consciously integrated by practising architects and civil engineers in their architectural and infrastructural projects. Students reading courses in the built environment studies at undergraduate level at the University of Malta are introduced to AADG guidelines through design workshops whereby they have to apply and integrate them into their design coursework. Such architectural education in UD falls short of the model proposed by Sungar Ergenoglu (2015) which proposes six teaching modules: the first four at undergraduate level (UL) while the last two at postgraduate level (PL). The former introduces students to the background and the

Volume 10, Issue 1. (CC) JACCES, 2020. ISSN: 2013-7087

significance of UD concluding with a case study whilst the last two, a continuation of the former, aim to review and share best practices (Table 2).

Table 2. Teaching modules for UD teaching in architectural education (after Sungar Ergenoglu, 2015)

Module	Level	Title	Aim
1	UG	Pre-evaluation	Introduction to the understanding of UD
2	UG	Basic disability and diversity information and case study	From a theoretical background and awareness building to disability issues
3	UG	The relationship between the UD concept and architectural design	Introduction to UD concepts, assistive technologies, anthropometrical dimensions and physical barriers in built projects
4	UG	Case study	Identifying UD issues and resolving them
5	PG	Review	Review modules 1 to 4 and introduction to best practices
6	PG	Searching and sharing (being up-to-date)	Searching and sharing best practices and trends in UD issues and generation of innovative ideas

Case Study

The Context

The Maltese archipelago, the smallest-in-size and most densely populated Member State of the European Union, is located in the middle of the Mediterranean Sea, 93 km south of Sicily and 333 km north of Libya. It consists of three major islands: the largest and the seat of government is Malta with Valletta as its Capital. Malta has several natural harbours; the largest being the Port of Valletta also known as the Grand Harbour (Figure 2).

Figure 2. The Maltese Islands. The location of the Grand Harbour and the main cities within the area relevant to the Grand Harbour Network Initiative is indicated in red (1: Valletta, 2: Isla, 3: Birgu, 4: Bormla and 5: Kalkara). Baseline photo: Google Earth

Utilised since the dawn of prehistory, this harbour was the operating base of the Hospitaller Order of St John which was essentially a naval power. The maritime heritage associated with this harbour includes the historical timber rowing boat, known as dgħajsa tal-pass, which commuted within the harbour and cut across its creeks, ferrying passengers and small luggage to and from ships (Muscat, 1991; Muscat, 1999). At the turn of the twentieth century about 2,000 such crafts operated in the Grand Harbour (Muscat, 1991). The

Vilhena Code and the De Rohan Code issued in 1724 and in 1784 respectively, specifically refer to the use of this boat within the harbour (Muscat, 1991). The latest subsidiary legislation in Malta still defines "passage boat" as "the traditional Maltese dgħajsa licensed for the conveyance of … passengers within the Grand Harbour …" (Laws of Malta, 2009). The dgħajsa tal-pass, the Maltese version of the Venetian gondola and theme of a 20-minute film directed by Narcy Calamatta (Calamatta, 2013), survived for centuries although the original design was modified particularly during British rule (Muscat, 1991). The Foundation Temi Zammit, chaired by the former rector of the University of Malta and Malta's leading philosopher Peter Serracino Inglott, in 2011 had launched the Grand Harbour Network Initiative in order to sustain this mode of transport and the heritage associated with it.

Grand Harbour Network Initiative

The ultimate aim of the Grand Harbour Network Initiative was the sustainable safeguard of the maritime culture synonymous with the Grand Harbour region. Several tangible and intangible aspects were identified with respect to the legacy associated with the dgħajsa tal-pass (Lino Bianco & Associates, 2011), namely, the traditional trades involved in the building and maintenance of such boats and the skills of their boatsmen, the 'barklori' (the plural of the Maltese word 'barklor') (Table 3). The barklor traditionally stood facing forward, making use of two oars to propel the dgħajsa tal-pass frontward.

The three tangible aspects identified were: fabric, activity and memory. Fabric conservation relates to the restoration and maintenance of the boat building material, normally white deal (Muscat, 2009), with red pine for frames, floors and planking (Muscat, 1991). A substantial number of the remaining small fleet of circa a dozen crafts, mostly dating to the first decades of the twentieth century, require restoration while others have been damaged beyond repair. The oldest, now restored, is the Palomba which is attributed to the second half of the nineteenth century (Oldest 'dgħajsa', 2014).

Volume 10, Issue 1. (CC) JACCES, 2020. ISSN: 2013-7087

These boats have several decorative elements which are worth restoring and conserving for their particular merit. These include the tablet-sculptures representing saints and patrons and the high stem and stern which vary from craft to craft. Activity conservation refers to the revival of the dgħajsa tal-pass as a means of sea transport within the Grand Harbour. Although it is still prevalently used ferrying tourists visiting the Grand Harbour, its use is marginal with locals. Further to this cultural heritage implication, such a mode of transport has logistic and environmental benefits as vehicular traffic in the region, notable from the south to the central part of the island, is substantially significant especially during peak hours. The cultural significance of the dgħajsa tal-pass, in terms of both aesthetics and historic integrity, is the memory which this initiative aimed to conserve.

Table 3. Tangible (1 to 3) and Intangible (4 to 6) Cultural Heritage Characteristics of the Grand Harbour Network Initiative

Cultural Heritage	Conservation Aspects	Characteristics
1	Fabric	Restoration and maintenance of the boat building material
2	Activity	Revive the use of dgħajsa tal-pass as a mode of transport
3	Memory	Cultural significance of the dgħajsa tal-pass
4	Trade	Boat construction skills
5	Skill	Handling skills to propel and manoeuvre manually the dgħajsa tal-pass
6	Identity	The dgħajsa tal-pass was included in the Coat of Arms of Malta; a modified version is used annually in the traditional regattas held on national days

Concerning the intangible aspects, the following were identified: trade, skill and identity. The construction of a dgħajsa requires a high level of craftsmanship (Muscat, 1991). The knowledge and ability to building such timber sea crafts were passed on through generations via master artisans, mostly coming from the Cottonera area, a trade which nowadays approaches extinction. The gradual decline in the construction of the dgħajsa can be traced back to the socio-political and cultural changes precipitated by the rundown of the British services after Malta's Independence in 1964. In fact, the decrease in the number of warships and auxiliary naval vessels in the Grand Harbour rendered the employment prospects of the boatsmen bleak (Muscat, 1991). Permits issued by the Malta Maritime Authority in 2007 for fibreglass replicas or high-speed water taxis exacerbated this trend (Ahar, 2007; Save The dghajsa, 2007). A master craftsman, Joseph Mallia, had called for the revival of the timber boat building tradition some years earlier (Cini, 2003). Furthermore, the barklor as a form of employment was also disappearing. Only a few still retain the skills to steer, maintain and manoeuvre a dgħajsa tal-pass.

All this notwithstanding, the national identity is still strongly associated with this boat. It was included in the Coat of Arms of Malta used from 1975 to 1988. A modified, lighter version of this craft, known as 'dgħajsa tal-midalji' (literally translated as 'boat of medals') is used for the annual Regatta held on Freedom Day (31 March) and Victory Day (8 September) (Serracino, 2010).

To conserve and sustain the tangible and intangible heritage a polycentric approach was adopted to ensure that the initiative will be socio-economically feasible. This was undertaken through the utilization of existing infrastructural networks while ensuring improved sea-to-land intra-connections. Five sites were identified to launch this initiative, each having a distinctive, respective architectural design intervention. The proposed interventions were the following: a sea terminus, a landing/embarkation point, an interactive experience heritage centre, administrative offices and a restoration/maintenance workshop (Table 4).

Volume 10, Issue 1. (CC) JACCES, 2020. ISSN: 2013-7087

These interventions are all located at Isla, one of the Three Cities (namely: Birgu, Bormla and Isla) which are collectively referred to as Cottonera, except for the landing place located at the Birgu waterfront facing Kalkara (which served as a prototype for any location within the harbour area) and the restoration/maintenance workshop which underlies the incline of Triq Ix-Xatt Juan B. Azzopardo, Bormla (Figure 3).

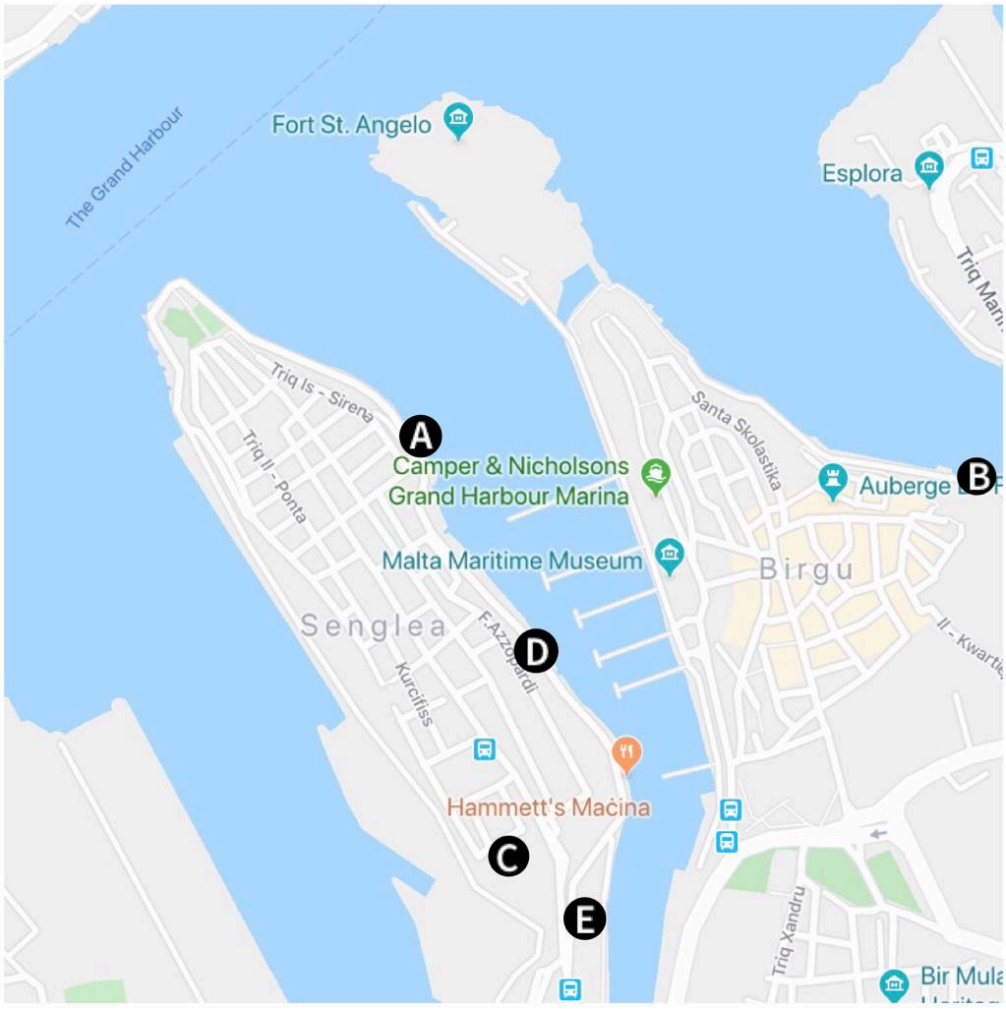
Table 4. Design Interventions included in the Grand Harbour Network Initiative

No.	Proposed Interventions	Location in Isla	Design Interventions
1	Sea Terminal	Waterfront along Triq Ix-Xatt Juan B. Azzopardo, Isla	Designed on the proportions of the dgħajsa tal-pass
2	Landing Place	Prototype for any future location	Designed similar to the terminal but to a smaller footprint; it is a prototype for any location along the quays of the Grand Harbour
3	Interactive heritage centre	St Michael's Ditch, Isla	Restoration of a building dating back to the British Period and its conversion into an interactive experience heritage centre
4	Restoration and Maintenance Workshop	Underlying Triq Ix-Xatt Juan B. Azzopardo, Bormla	Restoration of a former H.M. Naval Dockyard store and its conversion into a boat building/maintenance workshop
5	Administrative Offices	60, Triq San Guzepp, Isla, overlooking Isla foreshore	Upgrading of a substandard dwelling and its conversion into offices

Volume 10, Issue 1. (CC) JACCES, 2020. ISSN: 2013-7087

Given the cultural heritage significance of the Grand Harbour region in general, and Isla in particular, two of the key design decisions of this project were adaptability and reversibility. Thus, all proposed interventions respect the historical-aesthetic character of the environs. While the restoration and conservation of built heritage are minimal on the exterior of the building envelopes, the interventions in the interior are, wherever required, the least possible to permit the new adapted use of the space within. The sea terminus, which has a stainless steel space-frame to support the glazed roof, was designed on the geometrical proportions of the dgħajsa tal-pass (Figures 1 and 4). The transparent and reversible nature of the design is sensitive and does not hinder the present views of the Grand Harbour (Figure 5).

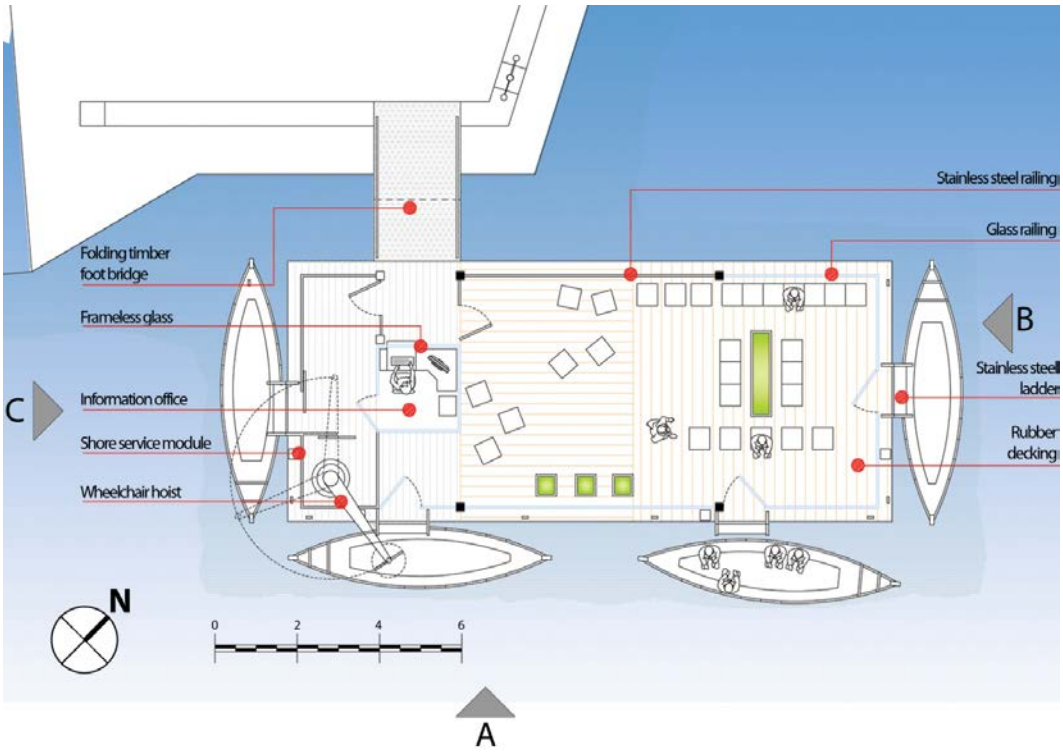
Figure 3. Site plan showing the location of the proposed historical-aesthetic interventions (A: sea terminus, B: landing place; C: interactive heritage experience centre, D: administrative offices and E: a restoration and maintenance workshop). Baseline photo: Google Street View



The landing place, a prototype for other locations within the harbour, is also a floating pontoon designed similar to the sea terminal but on a smaller footprint. Such pontoons are easier to relocate or remove as circumstances dictate, e.g. to accommodate third party projects/interventions/demands.

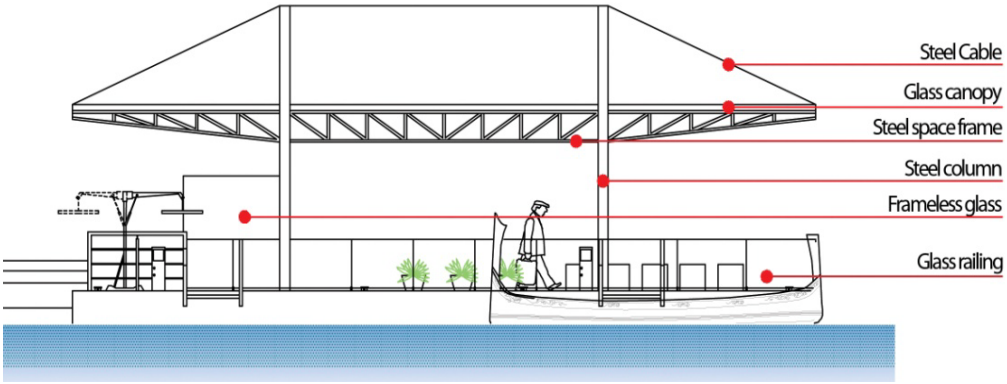
The twentieth-century building dating to the British naval period, located within St Michael's Ditch, was designated as an interactive heritage experience centre.

Figure 4. The geometrical proportions of the plan of the Sea Terminus are based on the dgħajsa tal-pass. Source: Lino Bianco and Associates (2011)

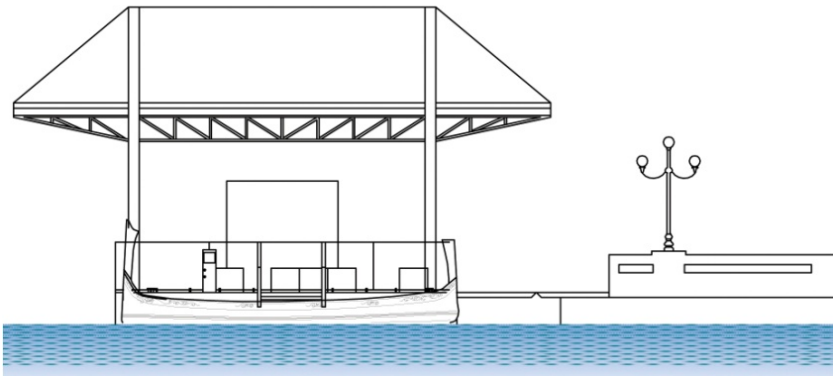


One of the former stores of H.M. Naval Dockyard, facing Birgu waterfront, was selected to be converted into a restoration and maintenance workshop for the dgħajsa tal-pass and could also support the building of such vessels. A substandard residential apartment, accessed from Triq San Guzepp and overlooking the waterfront along Triq Ix-Xatt Juan B. Azzopardo, was projected to be restored and converted into offices housing the management and administrative units of the project.

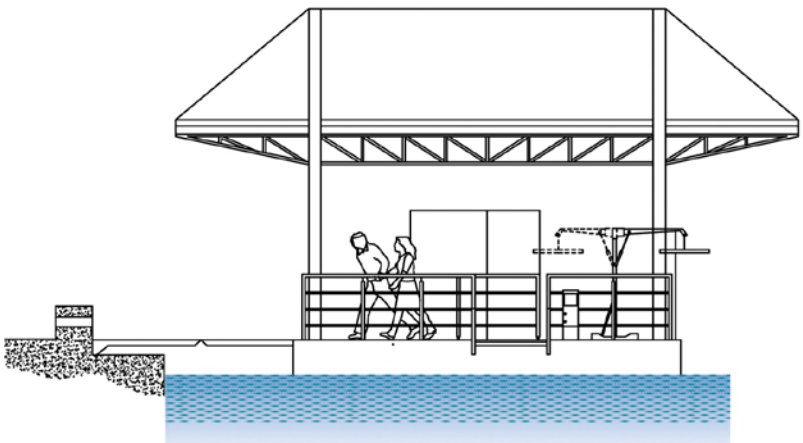
Figure 5. Elevations of Sea Terminus indicated in Figure 4 showing the stainless steel space-frame to support the glazed roof. The transparent and reversible nature of the design is sensitive and does not hinder the present views of the Grand Harbour . Source: Lino Bianco and Associates (2011)



Elevation A



Elevation B



Elevation C

Volume 10, Issue 1. (CC) JACCES, 2020. ISSN: 2013-7087

Results

Anthropometric Dimensions

The individuality of a given dgħajsa tal-pass is constituted by its painted parts, typically chosen from an established colour scheme which included green, red, yellow and white. The dimensions of the craft have standard specifications: the length, beam and depth should be 6.3 metres, 1.55 metres and 0.45 metres respectively. With a length of 0.52 metres for each passenger, the carrying capacity of the boat was set at 10 passengers and 2 rowers (Muscat, 1991). These specifications have to be adhered to as any failure to comply with these standards precluded the granting of a licence to operate such a craft by the competent authority (Muscat, 1991).

The technical measurements relating to the craft have been confirmed by the author who had measured some dgħajjes (plural of dgħajsa) propped up on land for maintenance works. The average dimensions and the variations from the standard are tabulated below (Table 5). It is confirmed that strict adherence to the standard has been maintained in the building construction of the crafts studied.

Table 5. Variations between technical measurements and standard specifications for the dgħajsa tal-pass

Parameter	Measurements	Standard	% Variation
	6.40 metres	6.30 metres	
Beam	1.53 metres	1.55 metres	- 1.30

The floating sea terminal is subject to swells. Thus, the pivoted folding timber footbridge (see Figure 4) is adjustable in length to take into account wave action. The maximum permissible gradients of the footbridge vary with the vertical movements of the water, which are given in Table 6. The width

Volume 10, Issue 1. (CC) JACCES, 2020. ISSN: 2013-7087

of this bridge is 2m, that is over the 1.2m width required for wheelchair users.

Table 6. Permissible gradients to accommodate swells

Swell	Maximum gradient of footbridge	Foldable footbridge length
< 10 cm	1 : 10	< 5 m
< 25 cm	1 : 12	< 6 m
< 50 cm	1 : 16	< 8 m
⩾ 50 m	1 : 20	≥ 10 m; ≤ 12 m

Analysis

The accessibility audit on behalf of the National Commission Persons with Disability was undertaken by Joseph Spiteri, the lead academic and expert in the field of access for all design guidelines in Malta. The drawings for the floating sea terminal, vetted in terms of the AADG, were deemed compliant provided that the comments included in the assessment were addressed (Spiteri, 2012). Table 7 includes the considerations undertaken when auditing the design from AADG perspective.

Discussion

The sea terminal proposed at part of the Grand Harbour Network Initiative, a floating raft for the traditional water taxi, is an essay in anthropometric science applied to a UD compliant floating pontoon. The design philosophy is grounded in the spirit of place, namely the Grand Harbour, one of the largest, heritage-rich, natural occurring harbours in the world. As a traditional passenger boat, the dgħajsa tal-pass is strongly associated with Malta's national identity and with the Grand Harbour in particular, a historical fact acknowledged in contemporary legislation (Laws of Malta, 2009). The tangible and intangible heritage associated with this craft

Volume 10, Issue 1. (CC) JACCES, 2020. ISSN: 2013-7087

factually formed an integral part of the operations within the harbour. The call of the accessibility audit for details of the area around the access to the pontoon (Table 7) is legitimate. UD calls for the holistic planning of the urban infrastructure in the area around the proposed development. For example, kerb heights should comply with the required dimensions, while surfaces should be regular and finished in a non-slip material.

The design of the sea terminal is barrier-free and inclusive, the main notions underlying UD, as people with permanent or temporary special needs can access the dgħajsa tal-pass thus contributing to the integration of such individuals into social life. Furthermore, this design proposal is not merely a conceptual UD philosophy applied to architecture but an actual holistic UD. It is not only congruent with the resolution put forward by the Committee of Ministers (Council of Europe, 2007) whereby it recommended to all its Member States to accept UD as a philosophy and strategy aimed at supporting "full citizenship and independent living" for all including those with special needs in terms of Resolution ResAP (2007)3 but one whereby UD is effectively applied science.

Table 7. Accessibility Audit. Based on: Spiteri (2012)

Location of Access	**Design Considerations**
Around the building	Details (such as kerb heights) concerning the area around the building have not been submitted. Thus conformity, or otherwise, to the AADG could not be ascertained. Any approval of the design is on condition that the areas around the building do conform to the AADG
Into the building	The entrance is indicated as 2100 mm wide and level
Within the building	A wheelchair hoist is indicated in the submitted drawings. Also, the proposed floor material is timber and rubber decking. These materials are approved on condition that the ground is level and smooth.

Volume 10, Issue 1. (CC) JACCES, 2020. ISSN: 2013-7087

UD is not a privilege but a right, a right to access at all times a given place and/or space with ease. Persons with physical and cognitive impairments require accessible, usable and safe design. Permanent or temporary disability, the former accounting for circa 15% of the population of the western world (Björk, 2009), is a deficiency in human ability implying that accessibility will be an issue unless one thinks holistically about such a reality. No limitations should be present as they hamper access. Ignoring UD is socio-economically expensive (Björk, 2009). While legislation and guidelines are effective if abided, UD forms an integral part of the basic design concept, thus rendering it an applied science underpinning a product which is socio-economically efficient. A product or design element may be suitable in terms of accessible design guidelines, but unsuitable as it is unsafe. A ramp may comply with the design guidelines in terms of dimensions and gradient but may constitute bad design, effectively hazardous to users if it is facing a street rather than a sidewalk.

The disclaimer included in the audit report for the floating pontoon states that the applicant is responsible for ensuring that the development complies with the AADG and "any approval given herewith does not exonerate the applicant from adhering fully to all the recommendations set in the said guidelines, notwithstanding the contents of this report" (Spiteri. 2012). Nevertheless, the onus of a design within the built environment is on its creators, architects and urban engineers (Ochieng, Onyango, & Wagah, 2017). Enhancing accessibility awareness in society falls within the social responsibility of architects (Sungur Ergenoglu, 2015). An architect and product designer who had worked determinedly for such an objective was Mace, cited above, who had coined the term UD. He was indeed the pioneer for user-friendly, all-inclusive, design environs and head of the firm Barrier Free Environments which had undertaken ground-breaking work in the sphere of accessibility.

Volume 10, Issue 1. (CC) JACCES, 2020. ISSN: 2013-7087

Limitations

This case study was assessed and analysed based on the AADG. These guidelines are specific, yet they fail to address the various degrees of capacity and limitations imposed by various active disabilities. For example, while the elderly are placed in the category of adults without disabilities (Kroemer, 2006), they are physically and psychologically undergoing gradual transformations such as a decrease in anthropometric size (Hasiholan, Susilowati, & Satrya, 2019) and cognition (World Health Organisation, 2018).

Conclusion

Design philosophy relating to UD broadly adopts a prescriptive approach whereby the focus is compliance with legislation/s, directive/s and guidelines which may not necessarily meet all the needs of the users (Froyen, 2012; Sanford, 2012). A recent study departed from the prescriptive to a descriptive approach to UD (Mosca et al., 2019b). It focused on methods to inspire architects on official design guidelines through information gathering and advice. Moreover, it proposed criteria to translate design requirements arising from the ultimate users of a given space into design strategies. Citing several studies (Froyen, 2012; Sanford, 2012; Mosca et al., 2019a), Mosca et al. (2019b) argue that "it is performance-based and requires an individual understanding, which is necessary for critically analysing the situation and considering the requirements of a range of individuals with different ability levels". They further argued that "if the prescriptive approach brings to the fore a mechanical application of codes and norms, the latter allows designers to find a proper solution for their own individual projects". Adopting a performance-based approach is what UD as an applied science involves. It leads to designs with inclusive environs beyond the prescriptive requirements at law.

The foremost aim of UD is to create spaces, products, technologies and services that are accessible to all without need for modification. The design and layout of such elements impinge on the independence of the users. UD is

Volume 10, Issue 1. (CC) JACCES, 2020. ISSN: 2013-7087

not merely about compliance with guidelines since there are instances when there are logistical and health hazards associated with particular guidelines-compliant features and designed spaces. Focusing solely on technical specifications falls short of addressing the inherent interdependencies and does not solve UD issues. While design philosophy is effective to ensure that a given project conforms to UD, as an applied science UD intrinsically enhances the quality of an undertaking. It goes beyond finding a design solution to meet design specifications. UD is a multi- and inter-disciplinary branch of learning whereby design guidelines are analysed and applied in the overall design approach; concepts and methods of accessibility are integrated to address particular requirements of users within given social, economic and urban contexts. It involves the application of current formal scientific knowledge to pragmatic scenarios in order to attain an explicit specific solution. It is an applied scientific discipline and not merely an applied design philosophy. It is universal design science applying anthropometrics, medicine and design.

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Disclosure

Following a bid for the architectural services to develop the Grand Harbour Network Initiative, the designs were entrusted to Lino Bianco & Associates which was set up by author in 1997 to render architecture and environmental planning consultancy.

The Foundation Temi Zammit subsequently applied to the Malta Environment and Planning Authority to obtain planning consent through five development planning applications, one for each proposed intervention. Following the demise of Serracino Inglott the applications were systematically refused planning consent thus rendering the Grand Harbour Network Initiative not eligible for EU funding. Also, in due course, the site for the interactive centre was handed over to a local non-governmental organization unrelated to Foundation Temi Zammit.

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Journal of Accessibility and Design for All

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