

Design Considerations Iron Bench in the Gardens

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Abstract - Iron benches play an important role in public garden where it is strong, has long age and beautiful form. So they are used in public garden, where they improve this garden. Public garden can be important things to many people such as the elderly and small children to rest their feet. Iron benches in this garden must be safely in finishing, design and weather conditions. They need sequences maintenance program, so design for them must be save easily maintenance. The great problem is in complex design of iron benches which make maintenance is difficult. This is due to neglect and then makes generalizations that influence their perceptions or feelings about the gardens. And benches are sometimes left derelict and broken benches are left in disrepair. So the research aim to study the design of iron bench in public garden and put selection criteria for the design of iron bench which make then comfort and easy maintenance. Therefore, research studied Bench location and Distribution in gardens, Materials & benches supporting, Design & ergonomic iron benches in garden and Bench & Vandal-resistant. Then the research clear that, it must be takes main requirements when design benches for public garden. These requirements are location, easy maintenance, safety, comfortable, psychological factories, aesthetics, easy for use and efficiency.

Key words: *General Garden - Iron Bench - Design Consideration - Maintenance.*

1. INTRODUCTION

Iron benches in garden are very much a part of the urban landscape that facilitates public activities. The benches are in general use in City Gardens and many other public and private gardens. It is makes a comfortable district friendlier and provides visitors with a spot to chat with friends. (1)

Iron benches in garden are situated to provide a comfortable means of enjoying the contemplation of a beautiful landscape. Therefore, shape and form design of them affect on the ways of sitting. (2)

Places where several activities occur, that have opportunities for people watching from different directions, or where people like to take advantage of front and back views are better suited to benches that have adjustable backs or no backs. Allowing users to choose the direction they would like to face. The requirement provides people with a level of social comfort by giving them the opportunity to choose. (3)

Good public spaces provide different types of benches options different places or locations within the same area, such as in the sun, in the shade, in groups, alone, close to activity, or somewhat removed from activity.

2. FIRST: THEORETICAL AND ANALYTICAL STUDIES

2.1. Bench location and Distribution in gardens.

Of particular concern are the physical challenges inherent in the aging process. A range of abilities need to be accommodated, including individuals requiring benches and those that may need assistance with activities. So benches should be plentiful but carefully placed to encourage walking in the garden. Time spent in a garden plays a critical role in the maintenance and restoration of health. This is true for the young and old, for the healthy as well as the frail. Depend in Beautification the urban environment poorly designed in iron benches especially in public garden, It due to poor view and affect on psychological case of human society. (4)

In order to plan the design of iron benches in garden , one must plan establish and define the type of space under consideration:- as who are the potential users of the space, for what purpose, at what times will it be used and how will it serve users when they arrive there. (5)

Typically, installations iron benches in garden have been planned and coordinated as part of a broader. Design concept are more successful than those where they have been selected piecemeal without taking account of users, needs, or the architectural character or weather conditions at the site. (6)

Public garden design integrates the elements of bench that are used for various designated purposes. This is creating a sense of place, garden areas and enables them to shape spaces that can succeed in achieving their aims over the long term.(7)

In areas where disabled people are likely to sit, benches should be spaced so that wheelchairs can be accommodated on the side or in front of the bench. The iron benches in garden should not be hazardous for pedestrians; if it is used along a walking area it should be aligned to make passage easier, rather than staggered.

Avoid causing obstruction to main lines of movement consider any possible security implications for adjoining property. In high-activity areas such as garden there should be access to benches there should also be rest facilities at regular intervals of 100-200m, with the needs of the disabled kept in mind. (8)

The open space character of the broader area, with good benches ensuring that a reasonable range of consistency is achieved across the various landscapes character types. (10)

When introducing new benches, try to match to existing benches styles or materials, otherwise choose a style that suits the architectural heritage of the garden. Benches should be located where it must not cause obstruction to the footway

The most important decision that needs to be made in selecting a bench, or any other type of public space amenity, is whether it is needed and whether it will be used. This requires visiting the area and noting the types of benches that already exist; the types of garden; and the potential users (in the area who would be likely to use the benches. Locations where people already sit (on steps, ledges, etc.) should also be noted.

2.2. Materials & benches supporting

Benches come in a variety of different materials, but there are some standards that account for use, durability, and maintenance patterns. Wrought iron benches are often found in garden. The material is lightweight and economical option for indoor or garden settings. It is often featured on strap metal benches because of its anti-corrosive qualities and ability to strongly bond to heavy duty iron constructions.

Cast-iron benches for garden use enjoyed great popularity, especially for furnishing gardens, and public squares. Benches can be made of iron, iron, concrete, wood and fiberglass. The classic iron benches of the nineteenth century, cast iron, are famous for its ability to resist weathering, and, in normal situations in the external environment. (11)

The iron benches in garden were used first introduced in New York City in the mid to late 1800's. This bench has cast iron armrests and feet as fig. (1). (12)

Benches were connected and bolted together. Not using the rough edges and were filed away, it protect the user's clothing. The benches were painted several times to prevent rust from forming as fig. (2). Construction is in cast iron with timber slats and supports feature a well-detailed naturalistic design incorporating branches, leaves and fruit.(13)



Figure (1) bench made from cast iron and wood

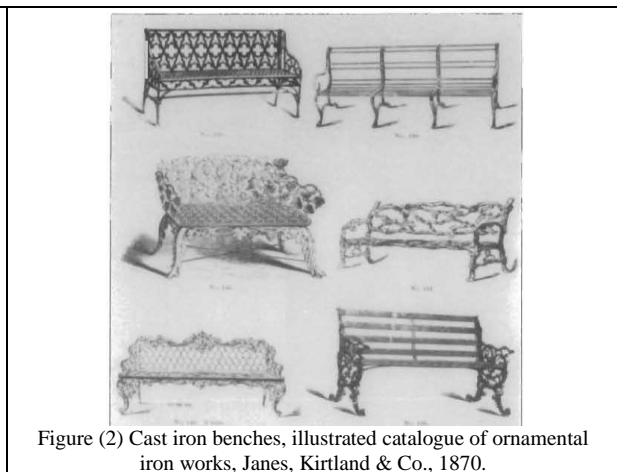


Figure (2) Cast iron benches, illustrated catalogue of ornamental iron works, Janes, Kirtland & Co., 1870.

Iron elements are often used to support a bench, helping prevent it from moving under load. Benches can come under considerable stress from swaying or twisting. If bracing fails, there is a significant risk of harm being caused to user. It is therefore important to inspect any bracing of a bench to ensure there has not been any excessive structural movement. Warped, cracked or damaged bracing elements fixings that are coming loose or deteriorating. Cracked or rusted welds

For example, in an area where teenagers may sit on the backs of the benches, a bench with large slats, which is stronger, even though for sitting large slats is less comfortable than smaller ones.

Person's loads benches are an important aspect to consider when you are establishing the stability and integrity of a bench. It is often easy to overlook the load that the combined weight of a number of people sitting on the bench.

Structural order reveals the structural relations between different structural elements for a specific load case: it shows which element is supported by which other elements. It brings to the fore the path(s) a load follows throughout the system of structural elements to its supports

Bracing is often used to support a bench, helping prevent it from moving under load. Bench can come under considerable stress from swaying or twisting.

Understanding the structural logic of a form metal bench garden allows altering this form bench through structurally sound rules. (14)

Consider a simply supported sitting surface (that is, a sitting surface that simply rests on supports at its two ends) subjected to a central point load. The sitting surface

will tend to bend, as shown in Fig (.3). The extent to which the sitting surface bends will depend on four things:-

- (1) The material from which the sitting surface is made.
- (2) The cross-sectional characteristics of the sitting surface.
- (3) The span of the sitting surface.
- (4) The load to which the sitting surface is subjected.

Clearly, the stronger the material, the more difficult it is to break. A timber ruler is quite easy to break by bending. An iron ruler of similar dimensions might bend quite readily but it's unlikely that you would manage to break it with hands. Sitting surface must be designed so that they do not fail in this way.

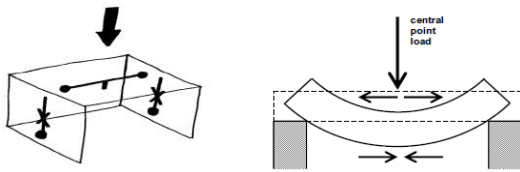


Figure (3) the effect central point load on bench

The traditional form of cast iron, known as 'grey iron' is, however notable for its brittleness, and must be used with care very low tensile strength.(15)






Iron members in bench tension have to be made of wrought iron because cast iron is suitable only for compressive loads. However, iron members in compression could be of either cast iron or wrought iron, whichever was more economical and convenient for the iron shop to fabricate. (16)

Iron benches should combine the ones of composite construction - stiffness, robustness, durability, easy erection and large spans - leading to high flexibility including the verification of the vibration comfort. The bench always made timber slats and iron pack bench. The iron benches are a popular choice of material, because it is versatile, has a high strength, weight ratio and can be shaped to fit almost any design aesthetic. It is durable, resistant to corrosion and impact, and requires no maintenance. It is also cheap compared to all the other materials in terms of life-cycle cost, and is fully recyclable.

Iron benches in garden to use timber slats materials where people are likely to be benches for some time. The timber slats it is a natural material that feels warmer in cold weather and cooler in hot weather, unlike metals. Its disadvantages are that it dries more slowly than metals after rain, needs more maintenance, and is easier to burn, break, carve graffiti into, or otherwise vandalize. Timber slats may be inexpensive, but the type of timber slats selected should depend on the location and frequency of use of the bench. For example bench is inexpensive and quite durable, but loses its color and longevity if it is not treated and maintained; the cost of maintaining or replacing it may outweigh the initial cost of purchasing it. Also timber slats in hardwood impregnated with anti-fungus and anti-woodworm chemical. (17)

When space is available, iron benches is occasionally used in circular or curved forms to give an organic feel to an area table (1) which show some metal bench garden pattern.

Table (1) properties and form of iron bench in public garden

properties of iron bench	Form
<ul style="list-style-type: none"> - The benches feature a crafted wrought iron frame with a hand chamfered slatted benches in well seasoned wood. - It is manufactured angle Iron frame using robust welded flat iron bar with 55 mm wide wooden slats. - Striking a balance between simplicity and strength, the bench combines profiled timber slats with wrought iron ends and supports. - Iron benches in garden with classic appeal, the iron frame with black powder-coated finish supports hardwood slats in a natural-looking finish. 	
<ul style="list-style-type: none"> - The iron benches in garden straight and articulating rail configurations, optional intermediate armrests, and backed or backless. - The structure consists of a tube and wooden benches. Legs welded at a 15 degree inclination to bench. 	
<ul style="list-style-type: none"> - The heavy duty benches standards of the form range of benches are cast iron and painted black, with the lion's head and other details highlighted in gold as standard. - Cast iron adorning a powder-coated iron frame, natural wood bench on a cast iron frame. 	
<ul style="list-style-type: none"> - Iron bench is sometimes used in circular or curved form where space allows. - This bench is made entirely from iron with angle iron support frame and strap iron welded to the frame. - The use of shaped iron slats allows us to construct circular tree benches. 	
<ul style="list-style-type: none"> - Iron benches in garden supports laser cut and linked together by iron fixed to the supports with screws. - Ribs in solid wood treated with natural waterproof oils and then assembled together with the supports through M6 screws. - On the base of the structure there are two sheet iron sheet plates. 	

3.2. Design & ergonomic iron benches in garden

Ergonomic comfort is an important factor in designing a bench. But how comfortable a bench needs to be depends on how it will be used. Where people will stop briefly with packages, comfort is important as in a park or main street where people may spend an entire afternoon. Concern for comfort must be combined with other considerations. (18)

- The most comfortable encasing surface is wood, which is resilient and does not readily conduct heat or cold.
- Small bench slats (2 inches) spaced closely together and following a contoured form are generally more comfortable than larger slats (8 inches).
- However, in areas where vandalism is a factor a larger size (3 inches x 8 inches) should be used.

Table (2) Elements specification ergonomic that effected design iron bench in garden

Elements	Specification
Depth benches	The depth of the benches should be 30 to 45 cm
The Back	The height of the backrest should be 50 cm to provide support for people's backs and shoulders. Benches backs that slope back slightly and have a slight curve are the most comfortable.
The Legs	The legs should not extend out past the benches; otherwise people may trip on them. If a large, solid leg is used, a kick space (3 inches minimum) under the benches is needed.
Benches height	For benches, the recommended height of the benches surface is 45cm, with a width of 35-40cm
Arm rest	The edge of the arm rest should extend out to the edge of the benches, and it should have a firm, rounded gripping surface Arm rest are useful both to help people to get out of the benches, and to divide a bench so that more people can fit along it. Segmenting the bench into sections through the use of armrests can provide a sense of privacy among groups as well as encourage people to sit closer together.
Angle between the benches and the back,	To be comfortable, there should be a 95-105 degree angle between the benches and the back, and the benches should be between 2 and 10 degrees off of horizontal. Benches with arm and back rests provide support to users' bodies; to provide appropriate back support for users, the back rests should be 32.5-37.5cm in height.
Benches length	The length of the benches should allow for 60 cm per person. However, people will sit closer to each other if there is an armrest separating them.

Arm rest and back support are normal features of benches; these provide assistance to the elderly. Back supports, contoured benches and arm rests provide comfort when sitting and support when getting up and down; these are important design elements, especially in areas where people sit for longer periods of time. Adding armrests in the center of a bench should be considered in cases where it is desirable to prevent people from sleeping on benches.

Iron benches in garden are consistency mixing and matching of colours and styles of main street metal bench garden on long streets and public garden. The consistent use and repetition of color, materials and design of bench elements within any street, park or area helps to unify that space and define and support the preferred character of that area. On the contrary a mix of colours and design styles indicates disorganized management and distorts any attempts to preserve or create a particular character or image. (19)

Consider site context, and the broader urban, landscape and heritage character in the design style and color selection in all new main street and park bench installations.

4.2. Bench & Vandal-resistant

Iron bench is often vandalized by burning, slashing, carving, and spray painting, so this should be taken into account in the planning phase; some materials and styles are more resistant to vandalism. The best solution to vandalism lies in developing an understanding of what types of vandalism occur, at what times, and by what types of people, then trying to develop a program that will prevent it from occurring. Of course, the best deterrent to vandalism is heavy and frequent use by everyone. Proper installation of items will ensure their durability, and damaged materials should be replaced with more sustainable products wherever possible. The bench should be easy to repair, and one way to facilitate this is to design

it as replaceable modular parts, so that it does remain unusable for long periods pending repairs.

The benches must be durable and secure, with finishes and coatings that resist stickers, graffiti and bacteria. Thus while wood may be a cheap and aesthetically appealing choice, it is easy to carve, burn, and spray-paint, so it is not particularly resistant to vandalism compared to other alternatives. Iron is the material most resistant to vandalism, but it is usually the most costly: iron meshes and iron bars cannot be spray-painted, burned or slashed easily, and they also have the advantage of good ventilation so they dry rapidly after rain.

Bench items designed for garden spaces must be constructed of safe materials and designed to prevent injury, without sharp edges or exposed fasteners. When installing Iron benches elements onto existing concrete or asphalt, ensure the fixture and method of installation achieves a solid fix that minimizes capacity for the theft removal or damage to the iron benches. They are usually either attached to the ground with anchor bolts (for example, using surface mounting, i.e. attaching a bench to a concrete slab), or embedded in the ground. Naturally, the technique used for mounting should be decided on in advance, so the bench can be made accordingly. (20)

Bench near the coast can have a higher risk of potential failure. This is due to the harsh environment and corrosive effects of salt, sand and wind. Such corrosion can lead to mechanical or abrasive wear which can cause timber to break down and iron to corrode. One of the best ways to help protect Bench against this type of corrosion is to apply and maintain an oil-based paint on exposed timber surfaces such as bearers, joists and posts. Decking oil alone will generally not provide a sufficient barrier against the corrosive coastal atmosphere. Iron used in coastal areas should be protected by a coat of paint or other protective coating. This protection should be carried out at the time of construction to help prevent initial deterioration. Iron that

is left unprotected and starts to rust or corrode should be dealt with promptly to prevent further deterioration. (21)

Painting slats and supports requires time and funds. Some ways around painting are: using aluminum for supports; galvanizing iron supports before painting; staining instead of painting slats to avoid corrosion or rust. (22)

Installation should be inexpensive, time efficient, and durable as possible. Installation plans should allow for experimentation with location, and bench arrangement. Identify the maintenance standards and regimes applicable to all bench items. (23)

There is no bench that is vandal resistant. However, being aware of the likelihood of vandalism in particular areas can affect the type of bench selected for that area. (24)

The best solution to vandalism lies not in the type of bench used, but in developing an understanding of what types of vandalism occur, at what times, by what types of people, and then in trying to develop a program that will prevent it from occurring. The key to preventing vandalism in a downtown is locating benches where adjacent institution will assume some responsibility for their use and maintenance.

2. RESULTS

The main considerations are identified under the different items of iron bench below:-

- Bench must be carefully studied and selected or designed to maintain the general character of town consider the impact of the bench upon the existing public garden and streetscape character in broader urban context and then separately within a site specific context.
- Understand how benches design could affect the overall character of garden, including variation of treatments and sensitivity and compatibility to architectural conditions.
- If bench is properly integrated in the design of a public space, it creates an identity and develops a sense of place around it.
- Different types of designs are recommended for differing areas to reinforce the individual character of these areas,
- Benches should not face each other directly. People tend to feel uncomfortable when they sit face to face with a stranger, and will twist around or sit sideways to avoid eye contact. Occasionally, pairs of benches should be placed at a 90 to 120 degree angle, which is good both for conversations and for sitting alone.
- The location of benches and their relationship to one another is of prime importance. Normal park benches parallel to walks are a barrier to social contact.
- Benches should be arranged in groups to promote contact and form interesting spaces from which to watch the world go by.
- If too much bench is located in the one area then it becomes cluttered and the bench will be under-utilized, relative to its cost to provide and maintain.

- Appropriately selected and placed iron benches in garden can draw people to garden spaces and add to the pleasure of using these spaces; the main challenge is getting them gardens, with the aim of making they feel welcome, relaxed, and involved.
 - Benches help create a 'sense of place' and are invaluable for increasing mobility among older people by providing places to rest. Benches are also highly desirable near office buildings for worker 'breaks'.
 - The type of iron benches in garden and its arrangement should take into account visibility and sightlines, lighting, and accessibility issues that may be faced by women, children, the elderly and the disabled. Areas which are unsafe or pose risks should be designed taking these factors into consideration.
 - Choose public garden benches to relate to its location and local distinctiveness, and reinforce a sense of place. Should relate to each other in terms of design, sitting and color Avoid causing clutter.
 - Forms Surfaces benches are hard enough to face the challenges of weather and public use, yet refined enough to sit comfortably gardens.
 - New bench is contemporary and simple in design to reflect the design qualities, materials and architectural era that the bench is being manufactured in, and to ensure that the bench is readily distinguishable from the bench in.
 - Their iron benches in garden can be used to create social meeting places, areas of rest and relaxation and comfortable waiting areas.
 - Bench to-foot distance must be present so that the feet can rest easily on the ground and the back of the sitter is supported comfortably.
 - It isn't considered appropriate that one single style can be used in all environments, but that there should be a restricted range related to location.
 - To create eco-friendly bench which is healthy and comfortable, by having a balance between ecological integrity and economic viability, it is aimed to use eco-efficient materials as iron, iron and stainless iron, related with these materials.
 - The iron benches in garden of urban spaces should be designed with the needs of the disabled, children, and the elderly in mind, and also to enable triangulation, i.e. they should be linked together to stimulate social encounters and encourage people to talk.
 - Bench selected to apply specifically in public garden areas with high heritage significance and others only to new growth areas. Some urban public spaces may have different bench and styles that relate to existing site-specific treatments.
 - Bench selection and design should take into account weather effects such as sunlight, expansion and contraction, wind stress, moisture, and in some cases, salt spray and frost. The best designs usually incorporate strong, simple shapes, native materials, and natural finishes, generally in black, grays, and earth tones, accented with bright colors.

- Achieve high quality in innovative and environmental-friendly solutions in details of designs for sustainable design development.
- Gardens must be easily and safely accessible, accommodating individuals with varied and changing interests, abilities and needs. Mobility throughout the garden is achieved by providing spaces that are easy to enter, move through, and exit.
- Benches should be offered in the garden, wide enough for two individuals to sit comfortably together for conversation.

After research studied and deducted the results, the research clears that when design benches for public garden, it must be considered the following requirements:-

Table (3) requirements effected design iron bench in garden

Elements	Requirements
Locations	Locations for bench are places where there are people, especially in areas where people can watch other people. In his research of activities in public plazas in City, the people like to have conversations, or sit..
Color	Color selection in all new main street and garden bench installations therefore needs to be given to balancing color and style, with minimizing local site dominance, and with the overall need to have visual unity on a long streetscape that cuts through different urban character areas.
Cost	If the types of bench and manufacturers involved at a site are consistent, maintaining or replacing worn or damaged benches will be less costly Bench can be more economical by using as few as two different slats in one bench. Slat replacement can be made easier by the way it is attached to the bench structure and tradeoffs may need to be considered between ease of replacement and frequency of replacement.
Durability	given expected usage Concrete base Unbreakable ductile iron legs, with wood slat benches. Use materials from cast iron, wrought iron, stainless iron and wood.
form and appearance	Making sure there a continuity or at least a linkage between the designs of different items
location	Deciding where each item should be places
Function	Seeing how necessary an item is and how it can serve its purpose
paint	The benches and back rest are both manufactured from mahogany mounted on a robust iron frame which is galvanized and powder coated in a standard. Frame in galvanized iron.
Long lasting	Useable all year long – useable everywhere. Resistance and maintain their brightness for years. The bench is strong
Surface treatment	It’s completely protected from rust and corrosion. Highly water-resistant It has no pores for dirt o food to become trapped in. The bench has to withstand years of sunlight and harsh weather conditions. In hardwood impregnated with anti-fungus and anti-woodworm chemical.
health	Odorless Shock-resistant, no splitting and no rupturing. It is highly resistant to UV-rays and odorless even at high temperatures. Everlasting beauty – the UV- resistance
Heat resistant	The material is has high impact resistance and resistant to burning cigarettes
Comfortable	The curved back and arm rest coupled with a flat sitting element make the benches a very comfortable piece of bench. The design of the benches proves to be very comfortable.
The slats	The slats have self-cleaning characteristics, are resistant to water and moisture and have no odor. The slats immediately take on the body temperature without feeling cold. For this reason, sitting down on the bench feels simply cozy.

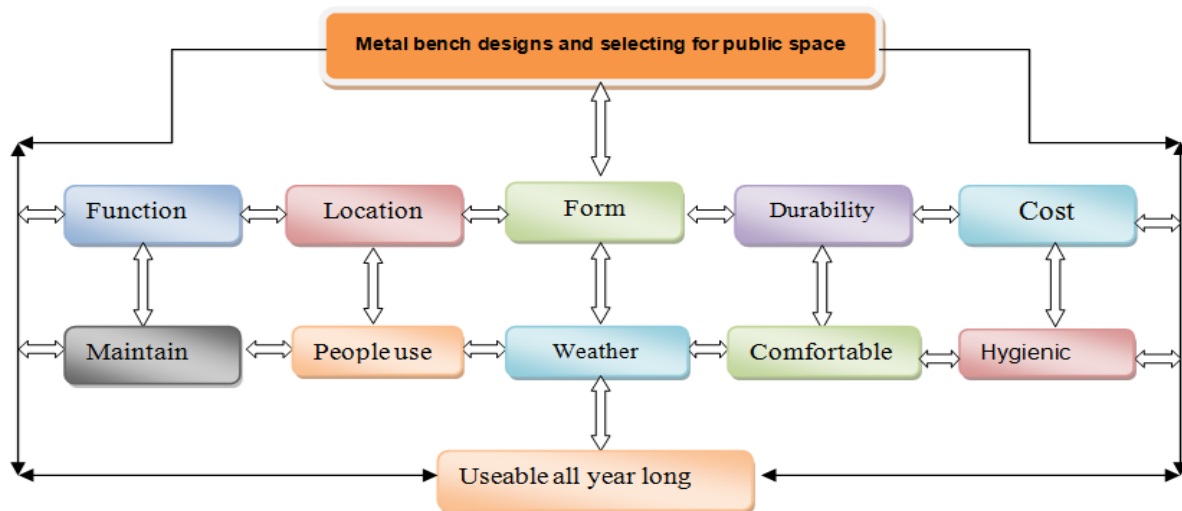


Figure (7) Basics to consider when incorporating moveable bench into your public areas

3- REFERENCES

- [1] J. W. Brown (2013): Site Bench Selection: Context Based Criteria, Natural Resources and Environment, in the University of Michigan, April.
- [2] B. Lesley & others (2012): Living Streets: Strategies for Crafting Public Space, Ltd; p71
- [3] D. Mark & others (2007): Sustainable Urban Development, Volume 2; The Environmental Assessment Methods, Routledge Press; p365.
- [4] J. Daly (2010): Art and Architecture, Landscape Architect, Pechet and Robb, John Wiley & Sons, July.
- [5] M. Bill, H. G. Greet (2010): A Complete Guide to the Planning, Selection, Landscape Bench and Amenities, John Wiley & Sons, p151
- [6] G.F. Yücel (2013): Street Bench and Amenities: Designing the User-Oriented, Urban Landscape, licensee In Tech.
- [7] Ibid, M. Bill, H. G. Greet (2010), P25.
- [8] Street Design Manual (2009), Bench, New York City Department of Transportation; p197.
- [9] L.Hans, B.Stefan (2003): Opening Spaces: Design as Landscape Architecture, Birkhauser Verlag AG; p132.
- [10] Ibid, J.W.Brown (2013).
- [11] A.Davey (2013): Maintenance and repair Techniques for Traditional Cast Ironwork, Historic Scotland Publisher, March.
- [12] H. J. Louw (1987): The Rise of The Metal Window During The Early Industrial Period in Britain, Building Themes in Construction History, Construction History, Vol. 3, p39
- [13] M.Gayle & W.David Look (1992): Metals in America's Historic Buildings, U.S. Department of the Interior National Gardens Service Cultural Resources Preservation Assistance, Washington, D.C.
- [14] P. Garrison (2005): Basic Structures for Engineers and Architects, Blackwell Publishing, Ltd.
- [15] A. Davey (2013): Maintenance and repair techniques for traditional cast ironwork Published, Historic Scotland, March.
- [16] M. Braun & O. Hechler: (2012) Embodied energy optimization by innovative structural system, International Conference Sustainability of Constructions, Towards a better built environment, p117.
- [17] Public Space Design Guidelines (2013): Bench, London Borough of Richmond upon Thames Civic Centre, richmond.gov.uk, psdg, chpt5. pdf (accessed January).
- [18] Ibid, M. Bill, H. G. Greet (2010), p14.
- [19] Ibid, J.W.Brown (2013), April.
- [20] <http://www.urbangreeninc.com/looking-for/site-benches>.
- [21] Y.K.Aktuglu (2011): Iron, steel and Stainless Iron, from the Point of Eco-Efficient Materials and Technologies, International Conference Sustainability of Constructions, Towards a better built environment, p97.
- [22] John G. Waite (1991): Historical Overview by Margot Gayle: The Maintenance and Repair of Architectural Cast Iron, October.
- [23] Urban Design (2013): Urban design manual, City Strategy, City of Ballarat, Version 4.1, September, P7
- [24] Ibid, Gökçen Firdevs Yücel, 2013