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Contribution of Solar Energy for Sustainable Urban Development in Rwanda

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Abstract In this century development, some African countries are now still facing a challenge of lack of electricity, because hydropower and thermal fuel are still on a small scale. This problem results in less economic productivity decline of some countries like Rwanda which is among African countries that are at a very high speed in development, and the grid lines are few compared to the need for electricity, especially in rural areas whereby each household needs power usage instead of using local and traditional means of ironing and lighting at home. This issue can be solved using Renewable Energy for rural electrification such as Photovoltaic systems. Therefore, this paper reviews Solar Energy for Sustainable Urban Development in Rural Area (Rwanda). Under this work, case study result will focus on one village in Rwanda named as" Agahozo- Shalom Youth Village (ASYV) located in Rwamagana district in Eastern Rwanda. The project is the first utility-scale, grid-connected, commercial solar field in East Africa. The field is 8.5 MW of grid-connected power to 15,000 homes and it increased Rwanda's generation capacity by 6%. Solar urban design is a phase of sustainable urban planning that will facilitate development and could provide new solutions to the world's energy problem by reducing its consumption and improving the performance of future buildings. The main mission of this article is to care for Rwanda's most vulnerable children, is leasing land to house the solar facility, and the fees from which will help pay for a portion of the Village's charitable.

Keywords Rural Electrification, Renewable Energy, Off-Grid PV Systems, Grid Lines, Sustainable Urban Development

1. Introduction

The application of renewable energies contributes to global warming prevention and as a matter of fact, photovoltaic systems have been increasingly developed in recent years due to the global benefit of natural resources conservation. It is also evident that fossil fuel-based energy sources will be depleted over time since they are finite and consequently, they have been proven to contribute to global climate change[1].To protect our environment and increase electricity access in remote areas, green and clean energy alternatives like solar energy, absorbed by photovoltaic systems can be of great importance. In Rwanda, there is a serious problem of electricity access especially in rural areas, which is very crucial in affecting the sustainable development of the country. The current situation shows that the grid connection is estimated to be around 23%, whereby rural villages that are connected to the national grid account for only 5% and in addition, statistics show that 85% of Rwandan population live in rural areas while only 15% accounts for urban citizens [2]. The most common activity observed in these areas is farming for food provision and other life basic needs security. For the case of Rwanda with many populations in rural areas, there is a challenge of energy extension and development in other economic sectors. The topology of the electric grid in Rwanda is another important aspect. There is presently insufficient electrical power to compensate for electricity demand in Rwanda, most of which produced from different power plants are distributed to urban areas and business centers [3, 4]. The power supply is done using single lines because the transmission network is very radial in nature. Grid extension is affected by economic constraints such as high cost of electricity that is not affordable for rural consumers as well as geographical conditions, and therefore, it's hard for poor people living in far distances from grid lines to get power.

In fact, there is a lack of alternate paths for electricity in transmission network and notably, the power service related to rural areas and this has a negative impact on pushing village residents to move in cities. In this paper vulnerability of rural areas for providing the more reliable and typical solution for rural electrification in Rwanda will be presented and discussed.

2. Materials and Methods

2.1. Basic Operation Mechanism of the Photovoltaic Cell

A complete electricity-management system using PV as its source for power will contain, in addition to the photovoltaic array, one or more of the following:

- Storage device
- Power-conditioning equipment, including devices to limit current and voltage in order to maximize power output.
- Converting direct current to alternating current
- Matching the converted DC electricity to the utility's AC electrical network
- Safeguarding the utility network and its personnel from possible damage caused by the PV system.

There are two basic forms of electricity: alternating current (AC) and direct current (DC). The difference between them is that the alternating current (AC) is made up of electrons alternately flowing in one direction and then in the opposite direction under the influence of a cycling force (voltage) that acts a part of a time in one and then the opposite direction, while for DC electricity, the electrons flow in a single direction and it is generated by devices such as batteries and photovoltaic systems as shown in Fig 1. In a battery, electrons gather at an electrode as the result of a chemical reaction within the battery. In the PV cell, the electrons are generated by light and the ability of the PV cell to move charge carriers to opposite sides of the cell. The electrons move because there is a driving force, a voltage which is characteristic of the electric source, for example, an electrochemical cell (battery) or a PV cell. Direct current is a perfectly useful form of electricity for many applications. At an isolated location, there is no need to do anything more than use PV-generated electricity and perhaps store it for times when there is no daylight to activate the cells. This is possible so long as the devices being powered can use direct current. But some of motors and applications can't be designed for direct current. PV arrays are useful energy producers only when the sun is shining on them and thus are unproductive in a good deal of the time. This extends the availability of electricity through periods when there is no illumination. If a utility grid is convenient to the PV system, then it can be used as a low-cost way to store electricity. Excess electricity from the PV system can be suitably made compatible with grid electricity. When more PV electricity is being generated than is being used, the excess can be metered and fed to the grid. When the PV system is not providing enough power, the extra amount needed can be purchased from the utility grid.

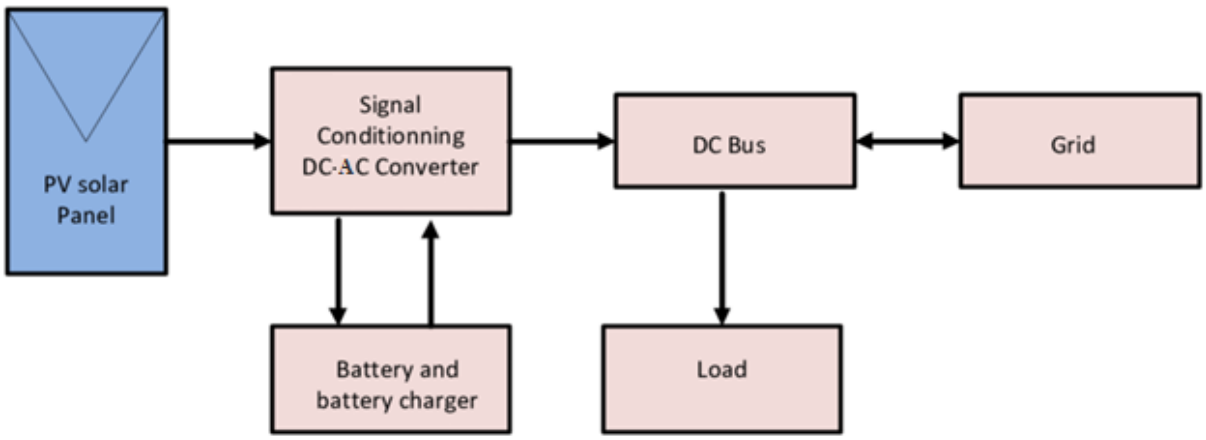

Figure 1. General diagram of the PV system showing the main components

2.2. Methodology

The methodology for Sustainable Solar Urban Planning is based on comparing the existing urban area with the possible gains if the Rural Area is changed in development using the process in sustainable urban planning. The new developments' results will focus on social, economic and governance factors with solar energy use.

This method will guarantee the effectiveness and prosecution of the sustainability principles and accurately predict solar energy production in urban areas subjected to renewal or regeneration processes.

3. Project Description

Rwanda's solar radiation and solar resources were assessed by the U.S. National Air and Space Agency (NASA) as well as the University of Rwanda. Rwanda's Eastern Province has the greatest potential for generating energy from solar resources. Another academic assessment, undertaken in partnership with the MININFRA Department of Meteorology in 2007, used a meteorological data set to estimate monthly averaged global solar radiation. Rwanda's daily solar irradiation ranges from 4 kWh/m² to 5.4 kWh/m². Season to season conditions vary with average daily irradiation in the cloudy reaching about 4.5 kWh/m² and the total annual potential is estimated to be around 66.8 TWh [5].

Rwanda solar energy is very high even during the rainy seasons and there is daily and sufficient sunshine especially in the Eastern province which is known for high irradiance values as it is indicated on the Fig 2. Daily global solar irradiation on the tilted surface has estimated as 5.2 kWh per m^2 per day from Photovoltaic Geography Information System (PVGIS). The long-term average daily global irradiation ranges from 4.8 kWh/m^2 day to 5.8 kWh/m^2 day (Burera, month of May and Nyanza, month of July, respectively) which indicates a high potential for solar energy development.

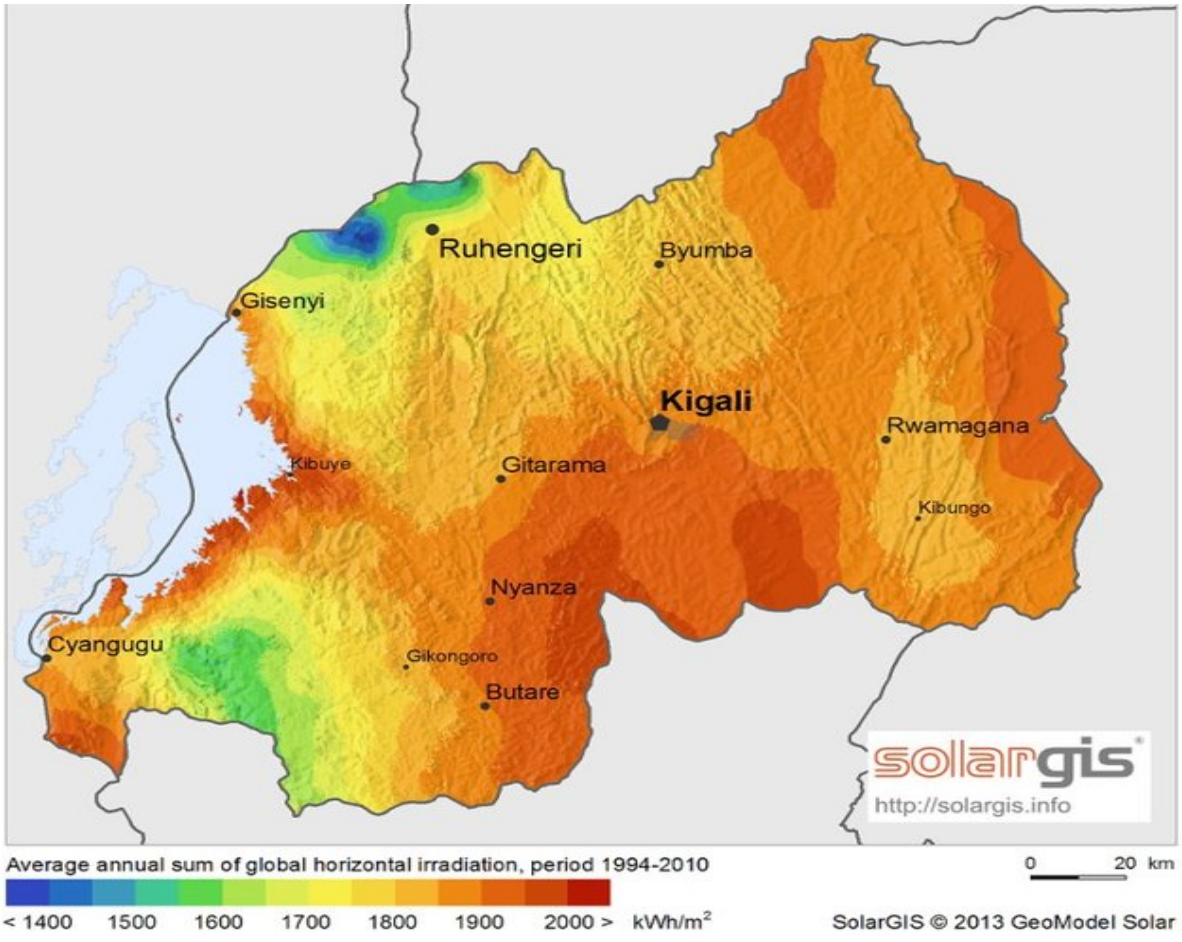

Figure 2. Global horizontal irradiation map for different districts of Rwanda

3.1. Case Study

The Solar PV urban planning project (Gigawatt Global Programme of Activities) was installed renewable solar energy power plant at a site where none existed. The CPP is located in Rwamagana District at the Agahozo-Shalom Youth Village (ASYV). The site is about 80km from Kigali, Rwanda's capital. The CPP used solar photovoltaic (PV) modules with a single-axis tracking system. A not-for-profit village is for orphaned children during and after the 1994 Rwandan genocide. The ASYV is a residential community in Rural Rwanda. The CPP has a peak output capacity of 8.5 MWp consisting of 28,340 solar PV modules and covering 16 hectares. The project had net electricity of 15,275 MWh for the first period and the first year of operation of 15,552 MWh. The solar field at the ASYV in Rwanda embodies a range of causes: it helps the long-term development sustainability, it is good for the environment, it generates local job opportunities employment, education and it empowers the country with access to electricity, which will be the results of benefits for the Rwandan population.

In February 2015, the first utility-scale solar energy project in East Africa was commissioned at the ASYV as shown by the fig.2 taken from Gigawatt global, providing 8.5 MW of grid-connected power to 15,000 homes. This increased the total grid capacity by 6% [6].

The PV Power plant uses 28,360 photovoltaic panels on 20 hectares (49 acres) of land and produces 6% of the total electrical supply of the country. Off-grid renewable energy systems are not only needed to connect a big number of people with a source of electricity, also appropriate due to geographical constraints and costs for grid extension.

In developed countries including Rwanda, mini-grids are increasingly considered an option to improve energy security, power quality, and reliability, as well as to avoid power blackouts due to natural disasters.

Figure 3. Utility-scale of 8.5MW PV power plant constructed in Agahozo-Shalom Youth Village in Rwanda

The project development was partially funded through grants from the Energy and Environment Partnership (EEP), a partnership of the British, Finnish and Austrian governments and the United States Government via the Overseas Private Investment Corporation's (OPIC) Africa Clean Energy Finance Grant. Astrom Technical Advisors, S.L.

(ATA) served as technical adviser, SEDI Labs served as a key project development partner, with Remote Partners assuming the role of the local project manager.

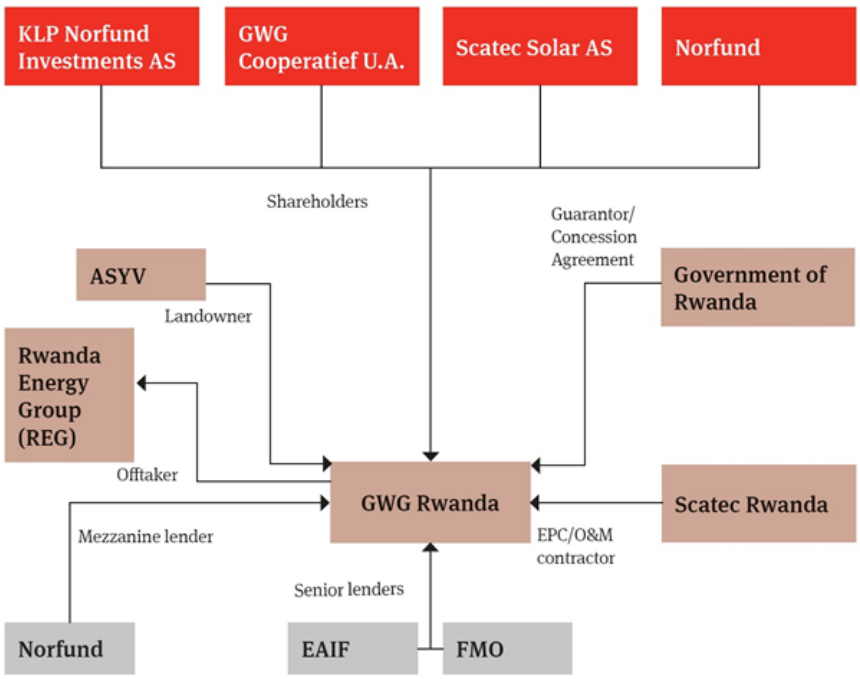

Figure 4. The structure of the transaction

The Rwanda field brought together an international consortium of financing partners. Debt was provided by FMO (Netherlands Development Finance Company) and the London-based EAIF (Emerging Africa Infrastructure Fund); mezzanine debt provided by Norfund (The Norwegian Investment Fund for Developing Countries); equity from Scatec Solar ASA (who also served as EPC contractor and serves as O&M provider), Norfund and KLP Norfund Investments (a vehicle jointly owned by KLP, the largest pension fund in Norway, and Norfund). Grants were received from the United States Government via OPIC's ACEF (Africa Clean Energy Finance) grant and from Finland's EEP (Energy and Environment Partnership). Norton Rose Fulbright from London served as international legal counsel.

3.2. Technical Specifications of the Main Equipment

Polycrystalline silicon PV modules, of the BYD 300P6C-36 type polycrystalline silicon PV modules type, were used in the implementation of CPP. About 28,340 of such modules will be connected in series consisting of 20 PV modules to form 1,417 strings of parallel connections and produce a nominal capacity 8,502 kWp. The angle of incidence between the incoming sunlight and a photovoltaic panel will be minimized by the single-axis tracking system design that is used to minimize thereby increasing the amount of electricity generated per fixed amount of nominal installed capacity. The P50 forecast for electricity generation for the first year of production is 15,552MWh. A degradation factor of 0.60 % is afterward used to approximate the amount of electricity generated in subsequent years.

The table below highlights the solar PV module characteristics:

Table 1. Solar PV module specifications

Parameter	Value
PV Module type	Si-Poly
PV Model	BYD 300P6C-36
Manufacturer	BYD
Rated Nominal Capacity	300Wp
Number of modules	28340
OperatingVoltage	600-850V
Array Efficiency (STC)	15.47%
	8.502 kWp
Array operating characteristics	646 V,11812A
Lifetime	25 years

Direct solar radiation constitutes the major source of solar energy that can be captured by solar Photovoltaic modules.

Since the sun keeps changing its position during the day, the angle by which the direct sun rays hit the solar panels also keeps changing and results in energy losses, especially in the mornings and evenings. Rotating the panels by use of solar trackers helps to minimize the angle of incidence between the incoming sunlight and a photovoltaic panel thereby increasing the amount of energy produced from a fixed amount of installed power generating capacity. A single-axis tracker system, rotating from East to West depending on the position of the sun will be used for this CPP.

4. Sustainable Development

Supplying secure energy resources has good advantages but is not enough for the development of a society or country. Furthermore, development requires a sustainable supply of energy resources in the long-term project and sustainable availability at a reasonable cost, also the use without causing negative societal impacts. Supplies of such energy resources as fossil fuels and uranium are generally acknowledged to be finite. Other energy sources such as sunlight, wind and falling water are considered as renewable and therefore sustainable over the relatively long term. Wastes materials and biomass fuels are also usually viewed as sustainable energy sources. In general, the implementation of these statements is numerous and depends on how sustainable is defined. Clearly, a relation exists between environmental impact and energy efficiency for the same services or products that are less resource utilization and pollution normally associated with increased energy efficiency.

Furthermore, being by nature site-specific, they favor a decentralized power system and locally applicable solutions independent of the national network. It enables people to perceive positive and negative energy consumption. Consequently, the small scale of the equipment often makes the time required from initial design to operation short, providing greater adaptability in responding to unpredictable growth and changes in energy demand.

4.1. Importance of Renewable Energy Resources and Technologies for Sustainable Development

The exploitation of solar energy resources is a key component of sustainable development. There are two significant reasons for it as follows.

1. They have zero environmental impact compared to other sources of energy.
2. Renewable energy resources can provide reliable and sustainable supply energy almost indefinitely and cannot be depleted unlike fossil fuel and uranium resources.

Uranium resources and fossil fuel are finite and can be finished by extraction and consumption. That is why many deferent renewable energy technologies are potentially available for use in urban areas.

4.2. Essential Factors for Sustainable Developments

The main mission of sustainability is to inspire local and national authorities and incorporate environmental considerations in setting energy program, though being given many deferent meanings in deferent contexts, and embodies a long-term perspective.

Such parameters can be described as follows:

Public awareness**:** This is the initial step and very crucial in making a sustainable energy program successful. This should be carried out through the media and by public and/or professional organizations.

Information: important informational input on energy utilization, environmental impacts, renewable energy resources, etc. should be provided to the public through public and government channels.

Environmental education and training: This can be implemented as a completing part of the information. Any approach which an integral education and training do not have is likely to fail. That is why this can be considered as a significant prerequisite for a sustainable energy program. For this reason, a wide scope of specialized agencies and training facilities should be made available to the public.

Innovative energy strategies: These should be provided for an effective sustainable energy program and, therefore, require the efficient dissemination of information, based on new methods and consisting of public relations, training, and counseling.

Promoting renewable energy resources: renewable energy sources should be promoted in every stage, in order to achieve environmentally benign sustainable energy programs, which will create a strong basis for the short- and long-term policies.

Financing: Some countries, e.g., Germany and China apply for the support in a different way and simply exempt the people who use such systems and technologies from some portion of their taxes.

Monitoring and evaluation tools: Monitoring and evaluation tools should be successfully used for the program.

4.3. Analysis of Current Annual Electricity Needs of the Agahozo-Shalom Youth Village

Rwanda's daily solar irradiation ranges from 4 kWh/m² north of the city of Ruhengeri to 5.4 kWh/m² south of the capital, Kigali, in the Southern and Eastern provinces. However, conditions vary from season to season, with average daily irradiation levels in the cloudy reaching about 4.5 kWh/m². Total annual potential is estimated to be around 66.8 TWh. In February 2019, the first utility-scale solar energy project in East Africa was commissioned at the Agahozo-Shalom Youth Village in Rwanda, providing 8.5 MW of grid-connected power to 15,000 homes. This increased total grid capacity by 6%.

5. Conclusions

Sustainable development is related to the utilization of renewable energy resources. Cites and countries should put much effort into discovering sustainable energy resources and environments in terms of renewables. The Solar PV urban planning project (CPP) forms part of the Gigawatt Global Program of Activities, hereinafter "Gigawatt Global PoA" which their purpose is to promote the development that is the sustainability of grid connected renewable energy projects in Rwanda. The CPP is located in Rwamagana District, at the ASYV, approximately nine kilometers from the main Kigali- Kagitumba highway.

The CPP will, therefore, reduce CO_2 emission by replacing Electricity generated by fossil fuel-based power plants connected to the national electricity grid. The project is expected to achieve average annual emission reductions of about 9,470 tCO_2e and a total of 66,289 tCO_2e during the first crediting period.

The implementation of the CPP contributed to sustainable development in the following ways:

- The project is expected to provide reliable electricity to the national electricity grid. This is in line with Rwanda's Vision 2020, which places infrastructural advancement and energy generation as one of the pillars that are necessary for transforming Rwanda to A middle-income earning economy (Rwanda Vision 2020).
- The project is expected to create new local job opportunities during the construction and operation phase.
- The project will balance in improving the hydrocarbon trade through the reduction of oil imports used for electricity generation.
- The project will result in the transfer of state-of-the-art technology in utility-scale power generation from solar PV sources to the Rwandan population. The transfer of technology and know-how will be directly replicable to other future solar PV energy projects.

Appendix

The Socioeconomic Impact:

With an increase of 6% in its electrical capacity Rwanda continues to benefit significantly from improved social welfare in the country, increased economic output and employment conditions, and improved standard of living conditions for residents. The project has also minimized the environmental impact from new energy production.

Figure 5. Rwanda's most vulnerable children, is leasing land to house the solar facility, the fees from which will help pay for a portion of the Village's charitable

Figure 6. Local Job Opportunities

Figure 7. Agahozo-Shalom Youth Village developed

Figure 8. CPP under Construction in the cafeteria at the Agahozo-Shalom Youth Village

Figure 9. The goal of the Village is to restore hope and opportunity to traumatized young lives

Figure 10. A group of Rwandan students return to their dormitories after having lunch

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Statistical Analysis and Corrosion Assessment of Nigeria Steel Rebars: Case Study South-West, Nigeria

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Abstract Corrosion assessment of rebars is very essential to predict the behaviour of reinforced concrete structures in different host environmental conditions. It also highlights the limitations of the local rebars. From the analysis, the severity of aqueous solutions on rebars was in the order $H_2SO_4 > HCl > Na_2SO_4 > H_2O$ for both imported and local bars, whereas the ratio of the severity of local to imported steel rebars in water, Na_2SO_4, H_2SO_4 and HCl were 1.59, 1.26, 1.79 and 1.20 respectively. All the steel bars experienced deterioration due to mass loss, characterized by colour change in all the solutions except NaOH solution where no visible reaction took place as H^+ in the aqueous solution could not react with Na^+ which is higher in the electrochemical series. Also, there is a smaller degree of uncertainty in the imported reinforcing bars size with COV in the range of 0.06 to 0.20 and the local reinforcing bars in the range of 0.25 to 0.75 for the same diameter size range. To end with, the findings would address permissible nominal cover for different host environment to prevent deterioration of steel reinforcement under chemical attack and in water.

Keywords Corrosion, Steel Bars, Lagos, Water, Sodium Sulphate

1. Introduction

Corrosion of reinforcement in concrete structure started from the period little damage occurs, such as diffusion of chlorides towards the reinforcement with a propagation phase which initiated damages, besides progress after the corrosion threshold had been exceeded and corrosion has been initiated (Balogh and Vigh 2013; Bellis 2011). The insidious nature of steel corrosion makes effective repairs expensive if remedial work is only contemplated once significant damage occurs (Castro et al. 2002; Clifton et al. 1999). Clear understanding of mechanics of reinforced concrete structures helps in understanding the intricacy involved with the characterization of rebars (Ede 2010; Erhard 2006; Basu 2004) Moreover, basic knowledge on manufacturing process of steel helps in appreciating various facets of the characterization (Chahrour and Soudki 2005; Kosmtka et al. 2003). Locally manufactured reinforcing steel bars from scrap metal are becoming very common in Nigeria in particular and Africa in general, therefore special attention must be given to the quality of the available reinforcement steel of high yield grades produced and used in the Nigerian construction industry (Harald et al. 2013; Phillips 1998). In developing countries such as Nigeria where imported steel manufacture to world best standards is very expensive, milling companies and private individuals have taken up the challenge to re-cycle obsolete vehicle, machine metal parts and household metal waste for the production of structural and reinforcing steel (Yeon et al. 2007; Kayal and Zhu 2005; Phillips 1998). The typical registered indigenous steel rebar manufacturing industries that use scraps as their major raw materials for producing steel include Continental Iron and Steel Company (CISCO) Ikeja, Lagos, Universal Steel Company Ikeja, Lagos, Sun Flag Nigeria Ltd, Ikorodu, Lagos, Unique Steel Industries, Ltd, Lekki, Lagos, Nigerian Spanish Engineering Ltd, Kano, African Steel Nig. Ltd, Ikorodu, Lagos among several others. In fact, preliminary investigations revealed that there are scores of such local steel companies operating in Nigeria though not registered. Moreover, the steel reinforcing bar required for structural concrete that is partly produced by the country's inland rolling mills while the balance is sourced through import. The importation is carried out mostly by private entrepreneurs and the quality of such imported product is not always sure as they are essentially brought in from different sources without any thorough standardization process regarding their structural properties (Kankam and Adom-Asamoah 2002; Kaushik and Singh 2002; Phillips 1998). Hence, differences are bound to arise in the strengths, and possibly, geometry of steel assumed in

design and those used for actual construction, unless tests are carried out on every batch of imported steel delivered on construction site (Harald et al. 2013; Hashemi 2006; Clifton and Marthey 1983). With the near collapse of the government-owned rolling mills and dwindling performance of the privatized counterparts in an unfriendly economy, influx of steel rebars from questionable sources is the order of the day in Nigerian markets (Alo et al. 2017; Phillips 1998; NIS 1992).

2. Methods

Figure 1. Avery Universal Testing Machine

3. Result and Discussion

High yield reinforcing steel bars were studied throughout the investigation at the Structural Engineering Laboratory of the Department of Civil Engineering, University of Lagos. With the aid of Vernier caliper the diameter of the specimen of 600 mm long was measured at several points along its length in order to determine the real size of specimen. Using the jig and punch, gauge-mark of 100 mm was made on each specimen. The specimen was then inserted into the Avery Universal Testing Machine (UTM) with maximum capacity of 500 kN shown in Figure 1 and a small load applied to take up the slack. A gradually increasing load was applied while taking the readings of load and extension at regular intervals of load using the dividers to measure the extension until the specimen fractures. The maximum load and the fracture load were recorded. The broken specimen will then be removed from the machine and the diameter at the neck measured. The two parts were placed together and the final length over the original gauge length measured with steel rule.

3.1. Statistical Analysis

The data as indicated in Table 1 gives the results during the size distribution survey of rebar in Lagos the foremost commercial city in the southwest. The diameters of all the sample of steel in the market in this area were measured using Vernier caliper. The statistical distribution of steel rebars in each study area is summarized in Table 1. All the parameters that consider for the steel rebars of range 10 mm to 25 mm are the mean ($\bar{x}$), standard deviation (σ), variance ($\sigma 2$) and the coefficient of variation (COV). The coefficient of variation gives the most reasonable consideration, and it shows the percentage of standard deviation to the mean. It is obvious that in Lagos metropolis, the mean bar sizes for the different diameter of rebars considered for the imported are higher in diameter than the corresponding local type, with a very small margin. Also, there is a smaller degree of uncertainty in the imported reinforcing bars size having COV in the range of 0.06 to 0.20 and the local reinforcing bars in the range of 0.25 to 0.75 for the same diameter size range. Therefore, from the analysis, imported bars in relation to the sizes specified by British standard can still be considered for structural purposes, though not without proper assessment of the tensile strength properties.

Table 1. Statistical analysis of size distribution in Lagos city

Steel bars	Mean ($\bar{x}$)				
	Y10	Y12	Y16	Y20	Y25
Local	9.78	11.7	15.6	19.82	24.7
Imported	9.98	11.8	15.8	19.96	24.8
	Standard deviation (σ)				
Local	0.072	0.064	0.096	0.064	0.064
Imported	0.0098	0.032	0.033	0.013	0.033
	Coefficient of variation (%)				
Local	0.76	0.54	0.62	0.33	0.26
Imported	0.10	0.21	0.21	0.07	0.14
Colours	H_2SO_4	Na_2SO_4	HCL	NaOH	H_2O
Initial Colour	Pale green	deep brown	brownish	N/A	Slippery
Final Colour	Brownish	brownish	reddish brown	Slippery	brownish

3.2. Corrosion Effect

Corrosion of high yield steel of both imported and local due to immersion in drinkable water was observed. There are deposits of brown particles at the bottom of the container used at the end of the 6 weeks. Then, there was loss of weight in both imported and local steel. The mean of the weight loss of imported steel was 0.65 g while that of local steel rebars 0.80 g. Also it can be observed that the rate of mass loss was more obvious in local steel rebar than imported steel. The mass loss was more pronounced in local steel after 2nd week while that of imported shows steel increasing after 4th week. The corrosion observed in terms of colour change is summarized in Table 1, while the extent of deterioration due to corrosion in terms of percentage mass loss is summarized in Figures 4 and 7. Weekly durability assessment of the rebar specimens was evaluated to determine the mass loss and the mechanical properties when fully immersed in distilled water, and 5% solution of H_2SO_4, HCl, NaOH, Na_2SO_4 in soluble water over a total period of six weeks. The deterioration due to corrosion expressed as a function of mass loss increased curvilinearly with time of exposure. The severity of aqueous solutions on rebars was in the order H_2SO_4 > HCl > Na_2SO_4 > H_2O for both imported and local bars as shown in Figures 2 - 8. The ratios of the severity of local to imported steel rebars in water, Na_2SO_4, H_2SO_4 and HCl were 1.59, 1.26, 1.79 and 1.20 respectively. Between the third and fifth week, the rate of deterioration of local steel rebars increased at a much higher rate, while those of imported bars increased at a much decreased rate. The average percentage losses in mass were 0.37% and 0.51% for imported and local bars respectively.

3.2.1. Water (H_2O)

The immersion in water value using both local and imported (Ukraine) steel rebars was presented in Figure 2.

Figure 2 reveals changes in mass of both local and imported steel bars immersed in water. Between the third and fifth week, the rate of deterioration of local steel rebars increased at a much higher rate, while those of imported bars increased at a much decreased rate. The average percentage losses in mass were 0.37% and 0.51% for imported and local bars respectively as shown in Figure 4.

3.2.2. Na_2SO_4

The immersion in Na_2SO_4 using both local and imported (Ukraine) steel rebars is presented in Figure 3.

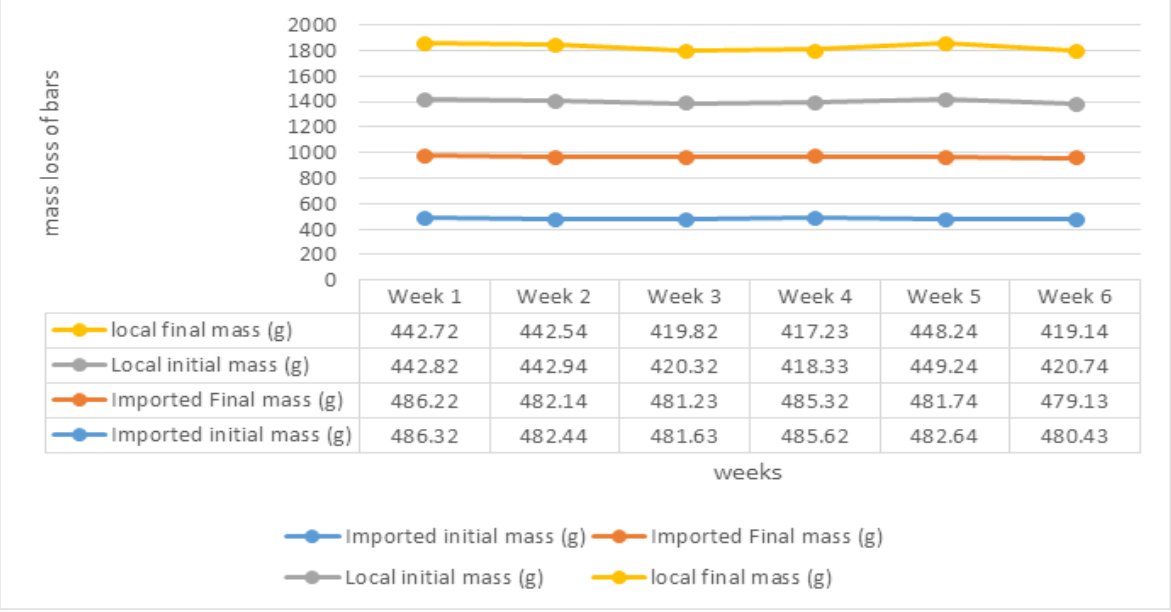

Figure 2. Change in mass of imported and local steel rebar immersed in water

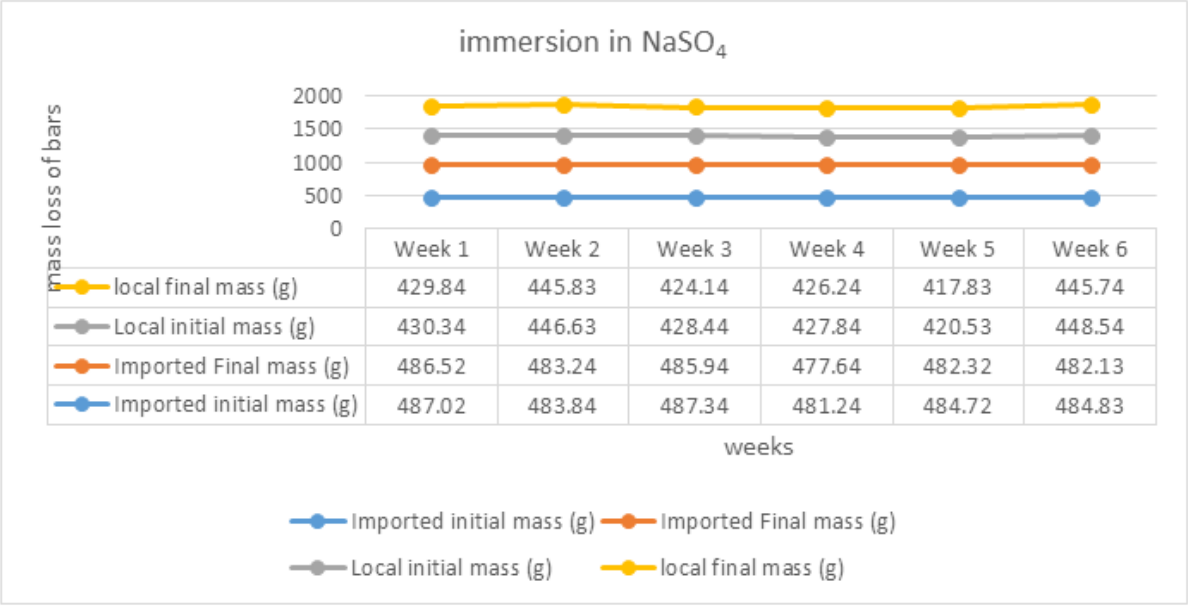

Figure 3. Change in mass of imported and local steel rebar immersed in $NaSO_4$ solution

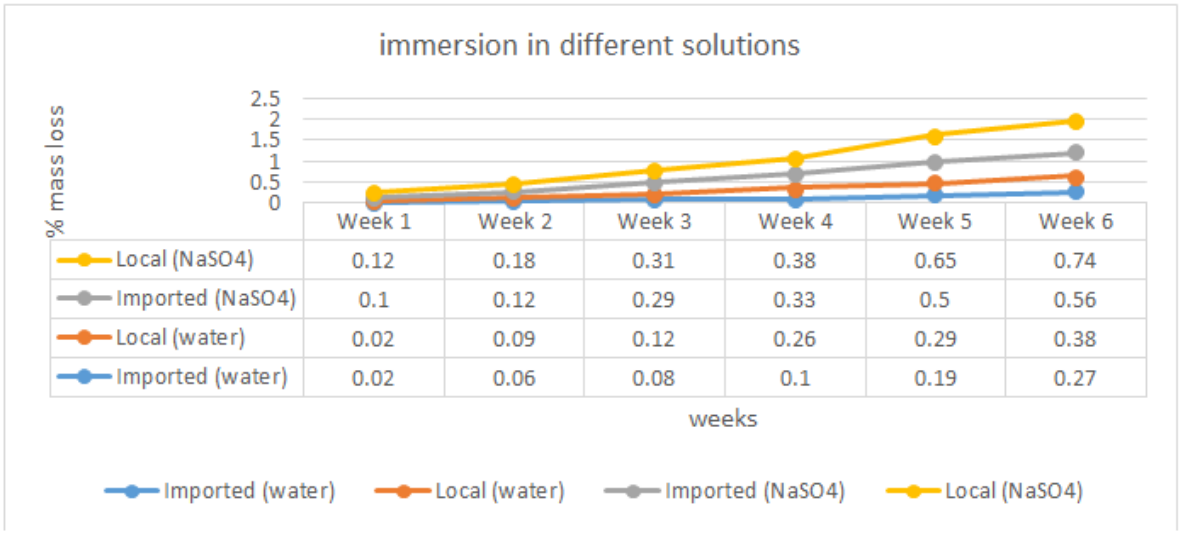

Figure 4. Deterioration patterns of imported and local bars different corrosive environments for water (H_2O) and Na_2SO_4.

Figure 4 discloses changes in mass of both local and imported steel bars immersed in Na_2SO_4. Sodium sulphate solution (Na_2SO_4) had a more pronounced effect on local steel rebars than that of imported steel. The rate of mass loss increases in both imported and local steel after 2 weeks and there is a noticeable deep brown colour, after 24 hour, with deposit of brownish particles at the bottom of container after 6 weeks. Though corrosion effect was almost similar at the 3rd week, the deterioration rate greatly increased much more for local bars than the imported category. At the end of the 6-week study, local bars had over 30% mass loss higher than the imported bars, while colours of steel changes in different solutions after a six-week period of immersion.

3.2.3. H_2SO_4

The immersion in H_2SO_4 values using both local and imported (Ukraine) steel rebars is presented in Figure 5.

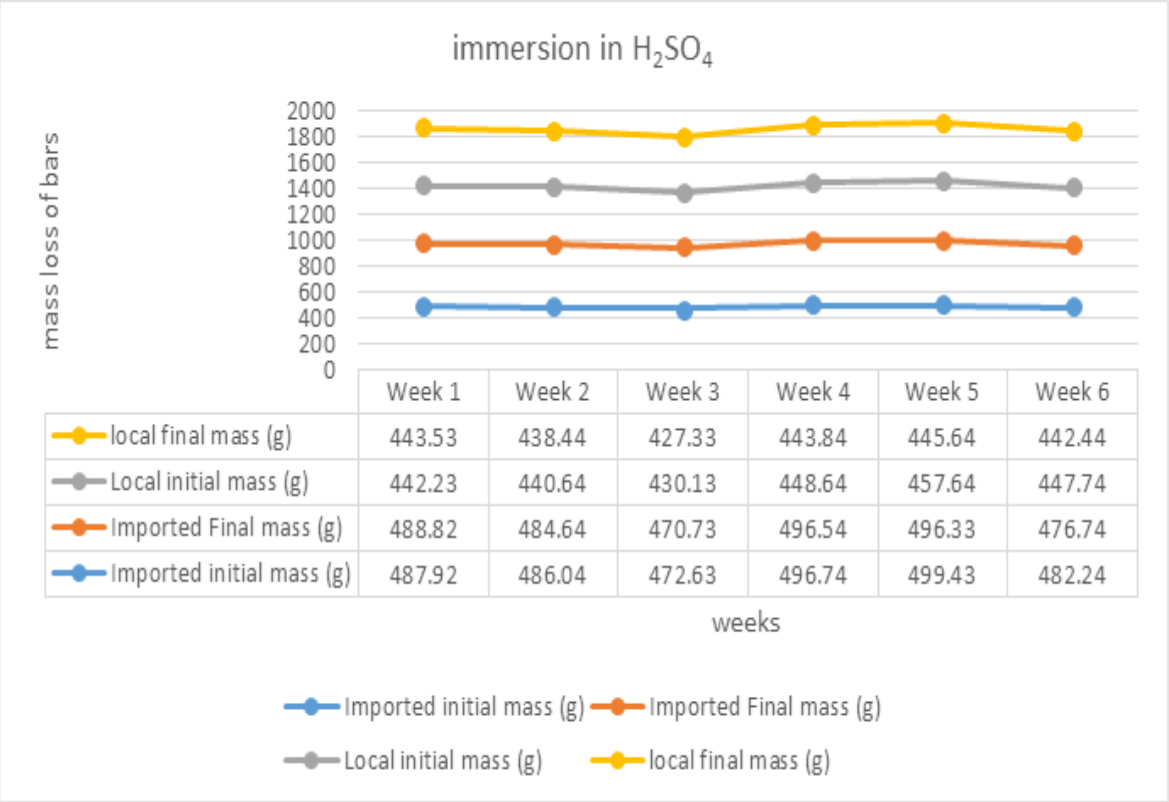

Figure 5. Change in mass of imported and local steel rebar immersed in H_2SO_4 solution.

Figure 5 indicates the trend for changes in mass of both local and imported steel bars immersed in H_2SO_4. The deterioration of steel rebar types in the corrosive environment of H_2SO_4 solution was the most severe of all the exposure environments studied. The solution on imported and local steel rebars shows bubble few hours after immersion, and the local sample appearing pale green while imported became brownish with particles at the bottom of the container. Then, within 72 hours both samples became rusty brown with more residue at the base of the container. Between the fifth and the sixth week, the colour of the solution became slightly yellowish and the specimen became reddish brown, with brownish particles deposited at the bottom of the container. Likewise, physical assessment in terms of mass loss shows a perfectly increasingly linear deterioration pattern with percentage mass loss in local bars about 80% higher than the imported bars. The widest margin was observed at the end of the 4th week when the local bars lost 143% mass higher than the imported bars. However, the margin closed up to about 9% at the end of the 6th week. The mean mass loss for local steel rebars is 3.68g, while the mean mass loss for imported steel rebars is 2.5g. Also, the local steel rebars deteriorated quickly in H_2SO_4 than the imported steel, and the rate of mass loss increases in H_2SO_4 for local and imported steel after 3rd week.

3.2.4. HCl

The HC values using both local and imported (Ukraine) steel rebars are presented in Figure 6.

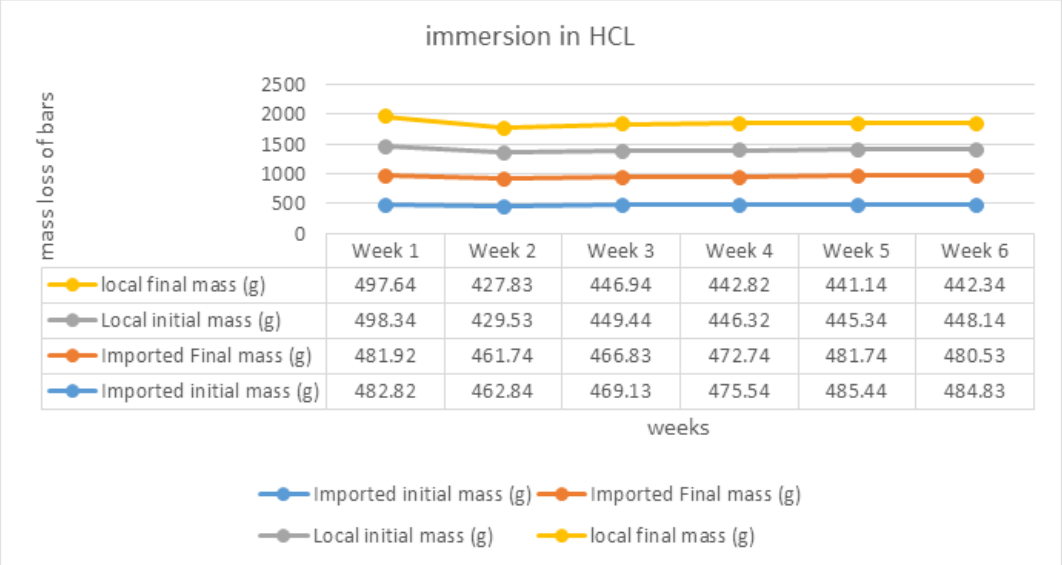

Figure 6. Change in mass of imported and local steel rebar immersed in HCL solution.

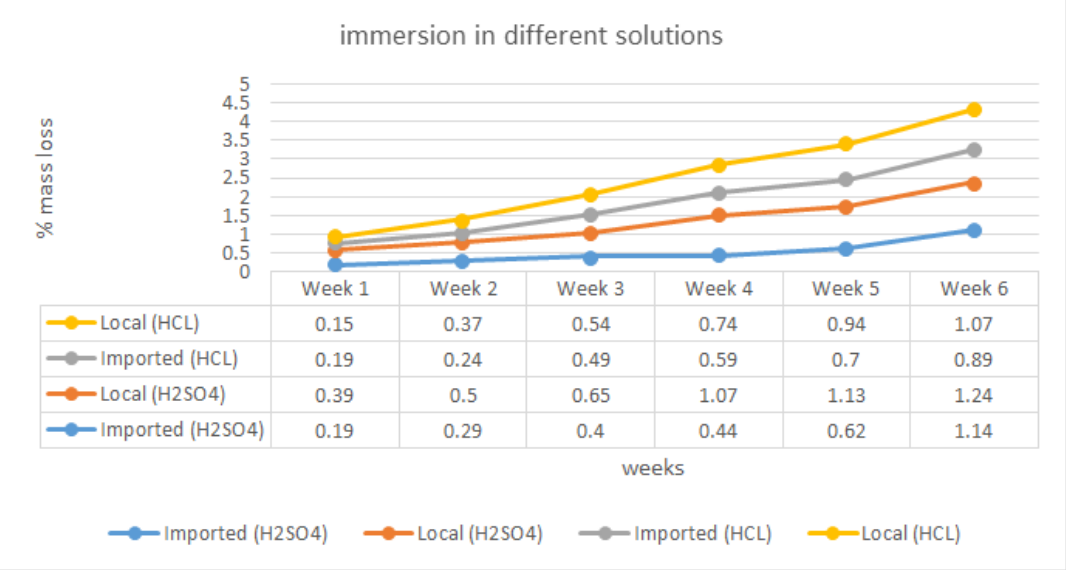

Figure 7. Deterioration patterns of imported and local bars different corrosive environments for H_2SO_4 and HCl

Figure 6 reveals changes in mass of both local and imported steel bars immersed in HCl, while Figure 7 shows deterioration styles for both H_2SO_4 and HCl immersion. The effect of hydrochloric (HCl) acid solution on local steel rebars is more pronounced than the imported steel rebars. There is an indication of brownish colour due to effect or Fe3+ after few days. The colour became more reddish brown, and progressive dark brownish residues were noticed up to the end of the 6-week study. The oxidation of iron gave Fe^{2+} and Fe^{3+} and readily dissolved in HCl solution to form $FeCl_2$. The rate of mass loss increased and more pronounced after the first week in HCl solution for both imported and local steel rebars. Then, it was observed that the local rebars deteriorate quickly in the solution than imported steel. The mean of mass loss for local steel rebars was 2.9 g while the mean mass loss for imported steel was 2.52 g. At the end of the first week of study, the effect of HCl was about 26% more severe on the imported than the local bars in terms of percentage mass loss. However, just after the first week to the end of the 6-week investigation, the local bars increasingly suffered about 20% mass loss than the imported type. In general, the effect of HCl on the studied steel rebar types was the second most severe after the H_2SO_4.

3.2.5. NaOH

The immersion in NaOH values using both local and imported (Ukraine) steel rebars was presented in Figure 8.

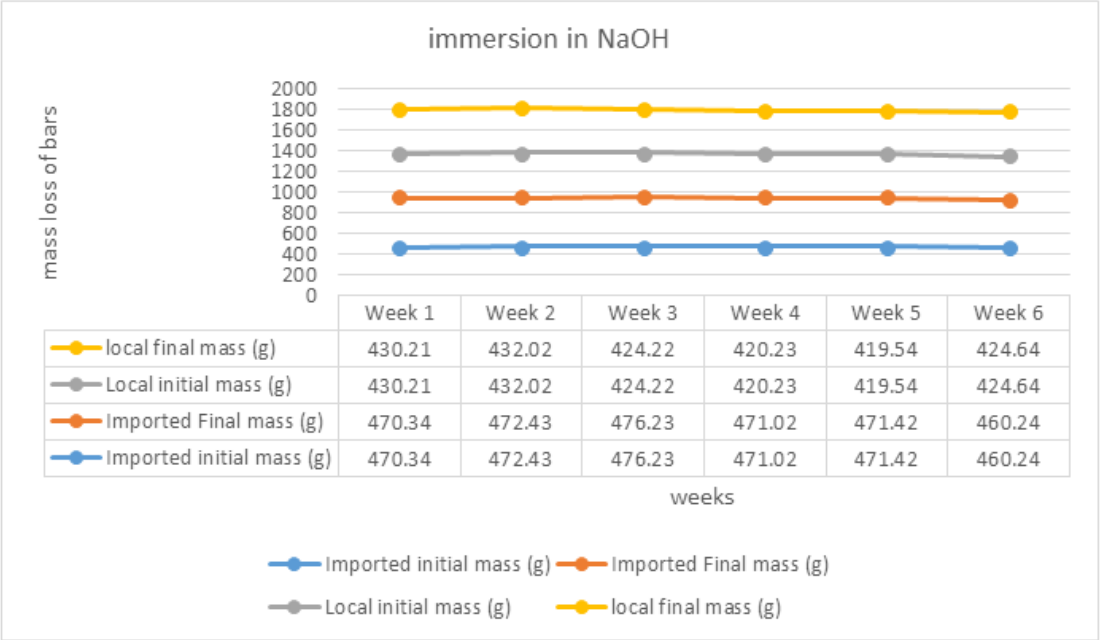

Figure 8. Change in mass of imported and local steel rebar immersed in NaOH solution

Figure 8 shows the trend for changes in mass of both local and imported steel bars immersed in NaOH. The steel rebars were not affected by NaOH solution because no reaction took place as H+ cannot displace Na+ which is higher in the electrochemical series. This was confirmed as there was neither any obvious colour change nor mass loss. It is generally evident from the plots that local bars were more susceptible to corrosion than the imported bars. On the other hand, bars immersed in sodium hydroxide (NaOH) solution maintained a slippery surface after removal from the solution. Conversely, NaOH is a strong base solution that shows no deterioration of steel during the 6 weeks sample study. Therefore, steel is quite safe and durable in an alkaline environment.

4. Conclusions

Weekly durability assessment of the rebar specimens was appraised so as to determine the mass loss and the mechanical properties when fully immersed in distilled water, and 5% solution of H_2SO_4, HCl, NaOH, Na_2SO_4 in soluble water over a total period of six weeks. The severity of aqueous solutions on rebars was in the order H_2SO_4 > HCl > Na_2SO_4 > H_2O for both imported and local bars, whereas the ratios of the severity of local to imported steel rebars in water, Na_2SO_4, H_2SO_4 and HCl were 1.59, 1.26, 1.79 and 1.20 respectively. All the steel bars experienced deterioration due to mass loss characterized by colour change in all the solutions except NaOH solution where no visible reaction took place as H^+ in the aqueous solution could not display Na^+ which is higher in the electrochemical series. The percentage losses in mass for imported were 0.37%, 2.70%, 1.85% and 2.70%, while local bars had 0.51%, 3.0%, 2.17% and 3.0% respectively. The effect of HCl on the studied steel rebar types was the second most severe after the H_2SO_4. The average percentage losses in mass were 0.37% and 0.51% for imported and local bars respectively. At the end of the 6-week immersion of steel bars in Na_2SO_4 solution, local bars had over 30% mass loss higher than the imported bars. With the exception exposure of rebars specimens to Na_2SO_4 solution, the aqueous solutions were averagely about 87% more severe on imported bars than the local. Further study reveals that in Lagos metropolis, the mean bar sizes for the different diameter of rebars considered for the imported are higher in diameter than the corresponding local type, with a very small margin. Also, there is a smaller degree of uncertainty in the imported reinforcing bars size having COV in the range of 0.06 to 0.20 and the local reinforcing bars in the range of 0.25 to 0.75 for the same diameter size range. The degree of uncertainty or dispersion in the size geometry of local and imported bars is very fundamental to the development of reliable standard of practice for building civil engineering industry. Though quality Testing Boards also agreed to compare with climate condition and local standard imported steel bars (Ukraine) are below. The research can extend to chemical analysis of other foreign bars with high hardness such as Brazil reinforcement.

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Tracing Path: From Conserved/ Museum towards Vivid City– Role of Urban Design

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Abstract The relation to the "historical city" can have two contradictory goals, ie. the tendency to form two opposing contradictory models: on the one hand, the preservation of all levels of values shows and proves its priori historicity, which in the final form manifests itself in obtaining the character of a museum model, where the historical city turns into an exhibit of the time in which it was created and which reflects the civilization in which it originated; on the other hand, the need for their socio-economic development, especially in relation to gentrification, tourism development introduces new activities. Both models should not be seen as separate or opposing, but the way to preserve the "historic" of the city as a base value should be discovered, and enable it to attract and live its "history", evolving and changing on the principles of the time in which it was created, accepted and adapted to the cultural needs of the time it should take. The aim of the paper is to make relations between relevant theories resulting in principles of tracing relation between two models taking into account Landry's concept of *Creative city,* and Castells's theory of *Project identity*, Healey's *Collaborative theory,* Mrdjenovic's *Integrative game of urban design* using method of comparative analyses between theories and case study analysis. The hypothesis of the research is that urban design can be an integrative discipline that evokes historical cities to become vivid and livable. The research will result in principles for urban design that can trace a path form museum to vivid city.

Keywords Historical City, Creative City, Project Identity Vivid City, Participation, Game Theory

1. Introduction

What is meant by the definition and meaning of historical cities? Are not all the cities that are "lasting" in fact, "historical cities" that were simultaneously adapting to "novelties" (technological, social changes ...) fighting for the preservation of their identity? The cities' struggle for preservation of the identity was facilitated by their physical creation, in which each original materialization, carried the impossibility of changing its physical structure, providing resistance to any conquerors.

Therefore, the aim of the research is describing the extended role of urban design in sustainable urban regeneration of protected urban ambient historical cities. Contemporary urban regeneration implies the creation of sustainable places by affirmation and promotion of local characteristics. The assumption is that integral urban design can generate sustainable spatial-program solutions and create integral space as a subject of sustainable urban regeneration. The thesis of the work is that urban design is considered as a process which assumes a leading role in urban regeneration. Such a process plays the role of forming integral space, respecting and advocating local identity and cultural values, in accordance with the environmental principles of space organization and construction, while providing social cohesion, the development of cultural tourism and commercial sector through institutional sustainability. The aim of this work is the description of the participative process in generating integral spatial-program solutions for urban design of the public space of the Bač Fortress Suburbium. The expected result of this research is the definition of the principles urban design for regeneration of historical cities.

Sustainable development of protected urban ambient historical cities defines the framework for their regeneration, while including them responsibly into the contemporary socio-economic trends. Integral development as an equivalent of sustainability implies simultaneously the preservation of non-renewable resources, such as the urban cultural heritage, as well as enabling its development with positive externalities on

other development sectors. "Integrative urban planning wants to cease with the fragmentation of our landscapes and our lives by using activist design solutions. Strongly refusing to idealize the past or to cowardly avoid the present, integral urban plan attempts to resist the divisions in urban and social structures, pointing to contemporary challenges and formulating inspirational alternatives for a wealthier tomorrow." [1]. This research will discuss and test on a practical example the extended role of urban design, to be an integrating instrument in the urban regeneration processes and provide a holistic development of these ambient. Understood as a process of space creation, urban design with its different process dimensions, from subjective-expressive, multi-disciplinary to socio-collaborative, can offer creative solutions in the regeneration process and globalization challenges.

The complexity of the globalization process introduces the story of identity as the pillar of socio-economic development, therefore changing the focus on the urban planning and design relation in the context of urban regeneration. In a global society, the power of local identity is becoming very strong in the global market race. Castells defines several areas of urban objectives that encourage the preservation and development of local identity: "... urban demands on living conditions and collective consumption; the affirmation of local cultural identity; and the conquest of local political autonomy and citizen participation." [2]. Urban design as the advocate of multi-dimensional factors in the quality of place [3] represents a framework in the regeneration and creation of integral space. Its artistic dimension qualifies it for the re-examination of its role as the dominant discipline in the urban regeneration process. Understood as a decision-making process, it can create a framework for the regeneration and integration of the sustainability dimension, through the creation of a global identity and space. This also justifies one of the research opinions, which will be discussed in this paper.

Sustainable approach to urban regeneration creates a balance between the protection and development of local identities, including them responsibly into the global trends as the pillars of socio-economic development. The simultaneous need for the protection of inherited values, and the development of new ones, stresses the importance of an integral approach. At the same time, it implies the preservation of non-renewable resources, such as urban cultural heritage, as well as facilitation in the development of new ambient values. Such an approach combines the concepts of space with different development paradigms (economic, social, physical, divided space) and promotes a multi-dimensional global site[1]. In that way, a global site (space) becomes a subject of regeneration, and focuses on the problem of global and local identities. The significance of research lies in the analysis of the role of urban design in securing integrative methods for holistic development of ambient values in the processes of harmonizing horizontal and vertical relations, according to the dynamic of globalization and relatively static relations of local tradition.

On a broader philosophical level, the problem lies in the process of achieving rationality and creating an issue of its universal existence. In that sense, relativization of values raises questions regarding the subject of the regeneration as an affirmation of the existing and creation of new ambient values. On the theoretical level, this paper will discuss the advantages and disadvantages of the two most present paradigms in urban decision-making: rational-comprehensive and collaborative, as well as the role of urban design in integrative processes. The problem of the first paradigm is limited rationality of stakeholders and experts in perceiving the totality of reality, therefore a lesser possibility of generating integral solutions in the urban regeneration process. The problem of the second paradigm can be the absence of strategic approach in generating solutions – responding to temporary problems; as well as the ethical behaviour in the communicative procedure, which is carried out in the process. In relation with different traditions, there is a dilemma regarding the role of urban design, on the relation process-product.

The determinant factor in this dilemma is the rationality procedure carried out in the social context, thereby, the favoured urban paradigm as well. Viewed as a product, urban design treats space as a realization of rationality defined on higher structural levels, through the so-called top-down approach; while in process orientation, urban design is often linked to the collaborative paradigm, the bottom-up approach.

2. Urban Design as a Path towards Vivid Cities with Historical Values

It can be said that the historic cities, by their character and essential role, generate durability with the aspiration to eternal existence. But most importantly, the cities contained and conveyed the "motive" of their duration that is to enable the living inside the city, which it represented at every moment of its existence, a prerequisite for rest and duration. If "life in cities" ceased to exist, cities would die by the nature of the law of life, slowly extinguishing, and simply disappearing. In fact, cities would "die".

The main question of this research is what approach, architectural and urban profession should have in relation to historic cities (both in whole and parts) in order to ensure its livability and durability? Furthermore, how to do to make their durability, both physical and material, even more vital, be able to successfully realize its basic function towards eternity. The basic paradigm of the historical cities is defined by following postulates:

1 *Glocal*identity and space imply the ethical integration of local and global identities. In the process of "glocalization", the risks of homogenization ofcultural expressionsand the exclusion of local cultures from the "global network" are reduced.

1 City as a physical creation is not holistic city;
2 City without livability loses its reason of existence and duration;
3 City is holistic only if its physical creation develops and continues following the life of its people.
4 The city is holistic only if its physical form develops according to the needs and interests of its citizens;
5 Only integrative approach between physical city form and its living patterns can enable its durability and eternity. (Figure 1)

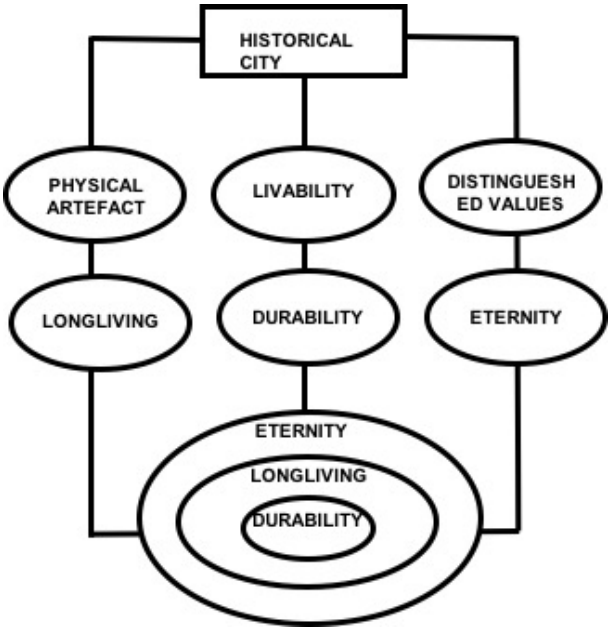


Figure 1. Lifecycle of cities

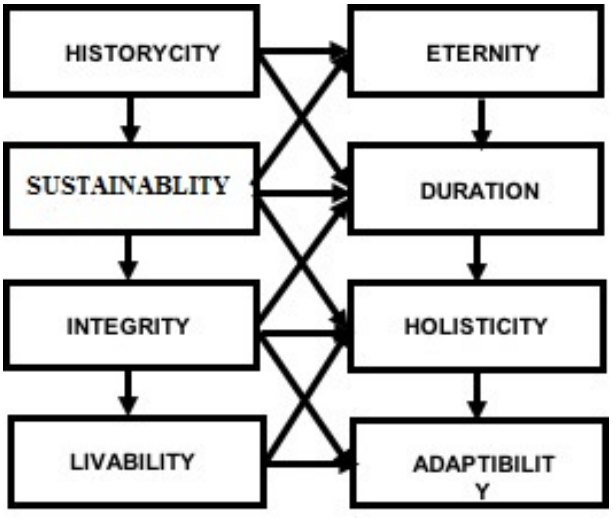


Figure 2. Premises of historical cities

Another question arises: What are the "essential qualities" that we as experts should incorporate in the development of "historical cities" and, besides their "preservation", to start "improving" their existence and duration. This is explained by the following premises:

I HISTORY CITY is a characteristic that speaks on the time when cities were created;
II SUSTAINABILITY is the premise of its emergence and development over time;
III INTEGRITY, ie, more precisely, holistic characteristic of its contents / activities; of the structure (functions, material ...) and forms;
IV LIVABILITY of historic cities over time, which means the constant presence of people in it.
V ADAPTABILITY of historic cities over time, adapting them to "life" that has taken place in it earlier.

Therefore, this research will focus on the comprehension of urban design as a creative, participative and collaborative process, in which it is possible to create solutions in a holistic relation of multi-dimensional qualities of city place in the regeneration procedure. In perceiving urban design as a creative, socio-spatial process, we would like to point out several interdependent dimensions in which it is created. Firstly, it can be observed as a space of imagination and creation of urban designers, architects, and then it is termed as a subjective-expressive process. In the context of the collaborative paradigm, it represents a socially communicative process, where new relations are established and spatial values are defined in dialogue relations. Understood as a technical process, it is linked with expertise of urban designers and relies more on the rational approach to solution formation. Its third dimension takes place in an interdisciplinary communicative process as a field for analysis and communication of different professional views [3].The above-mentioned process dimensions are intertwined and form a network, making urban design an important factor in integration and communication of different presentations, interests and needs in the regeneration process. "Seen as a process of place creation, urban design integrates different dimensions of space production". [4].

Understood as a multi-dimensional process in which the qualities of place are generated by the participants in the process, uniting the different "images of the world" into a communicative and creative consensus. This raises the question of the ethics of integrity in creating multi-dimensional identity, i.e., a type of communicative process that is practiced in participation. The problem of integrating interests and value choices occurs in risky and uncertain situations that practically always appear in complex urban problems like urban regeneration. This question determines the aim of the process as coherent management of different types of rationality of the participants in the process. This problem, i.e., goal is achieved in theory and, in my opinion, through Habermas' communicative action [5]. The theory has its limitations in the barriers for open communication in the structure of the communicative process. The barriers refer to physical context – mechanical (for example, noise), semantic (like

incorrect use of words), psychological barriers referring to beliefs, experience and assumptions. The communicative process can be easily manipulated by different instruments of persuasion. [6].

In that sense, we would say that the integration problem amounts to the elimination of barriers in communication. Guided by this assumption, we have come to the conclusion that removing the barriers in the domain of physical context and semantics is ethically justified. However, this poses a question of ethical justification for removing the psychological barriers in the process of communication. Dare we influence the beliefs; analyze differently the experiences, cultural differences, and question the assumptions, prejudices of the interlocutor? In fact, we speak of the process of self-actualization and we support Maslov's opinion that there is a kind of "self" that should be actualized[2]. A human being is not a *tabula rasa*; it is not a ball of clay or play dough. It is already present, at least as some kind of "gristly" structure [6].Where is the boundary between the ethical and manipulative communication in the process of participation? What are the principles of a sustainable process of participation in the urban regeneration of identity? The problem in integration is actually 'manipulative integration'. The process of integral urban design should transfer the phenomenon of "consensual chaos" into the phenomenon of "consensual identity" (term, T. Mrđenović).

In this process of balancing between subjective realities, rationalization and identity objectification, I single out the barriers of open communication as the key limiting factor, i.e., the positions which are favoured by the instrumental or strategic communicative action, the rational and collaborative paradigm. It is my opinion that both paradigms are on the line of sustainable urban regeneration. The rational secures vertical integration, ethical communication and unification of different global images into a coherent whole, while the collaboration creates a horizontal network through mediation of different perceptions of reality. [4]

Questions are raised regarding the hidden interests, and herein, we shall introduce the game theory by which the communication barriers can be analyzed. According to the classic definition, the game theory represents a "rational mathematical theory that deals with rational decision-making in conflicting and partly conflicting situations" [7]. The games are divided according to the number of participants and outcomes of situations. Regarding number, they can involve two or more participants; and regarding outcomes of situations games with a zero sum or non-zero sum [7] in fact, games that lead to a compromise or a consensus. The rationale of this theory is based on the assumption that the participants in the game wish to maximize their interest, to make their moves and accordingly choose individual strategies. The game theory, considering that it includes different protagonists and is based on conflicting situations can also be applied to the process of urban decision-making. As the process of urban design includes many participants in the decision-making, it can be said that it represents a kind of game.

On the other hand, if the game is defined as an artistic game of finding a solution for common problems, urban design obtains a new role in the process of sustainable urban regeneration. Then the players, i.e. protagonists, become the participants in the drawing of the common image, representing the factors of creativity. As such, they become sincere in their artistic game, because art represents truth and sincerity. In this game, the image of the future is articulated; giving a common framework of values that are larger than the sum of individual values, the best outcome of the classic game theory. In order for the common image to be drawn, coloured and coherent, the players should play openly, that is, they should be included as active factors in the process of urban design. As the advocates of creativity in the artistic dimension of the urban design process stand out urban designers and architects, who by relying on the intuition, power of visualization and creation of coherent composition, direct and facilitate the communicative process using the collaborative and rational approach. Rationalization, in fact, is necessary so that the elements of the image are brought in harmony with the dimensions, proportions, colours, tonality, light and shadowing. The image created as such presents a consensual solution, carrying with itself a new value.

In the development of the win-win solutions, urban design has an integrating role because through a consensus it joins the scientific, artistic and collaborative approach. The first implies research of facts and past states in order to determine and foresee the future ones, as well as a rationalization of the effects of possible alternatives in the future; rationalization of real problems and valorisation of alternatives. On the other hand, the artistic approach deals with seeking the truth about the real values, which implies an openness and sincerity in approach, while using imagination and the existing state of things in order to make a new value [8]. In the basic definition of the game theory lies the strategic planning of the moves by individual players, while I would say that on the basis of the integral game of urban design is also strategic planning; in which players make their moves to draw a common image of the future. The basis of the game in both cases, in fact, is the strategic planning of moves; while the ways, methods and techniques of their planning differ.

2"…actualization of self implies that one's experience is total, alive, without selfcensureship (selflessly), with total dedication and fixation. This means experiencing without adolescent self-consciousness. In such a moment of experiencing, a person adopts entire and full humanity." [6]. In a global and network society, Castells speaks of personal and collective identity crisis, where actualization of self is necessary so that individuals could become subjects, groups organizations, and a civil society can be developed [2].

3. Case Study: Integrative Game of Urban Design in the Regeneration of Public Space in the Bač Fortress Suburbium

In the creative process of urban design, we prefer to speak of the factors and advocates of the process. The advocates of the process are certainly individuals that possess a certain degree of creativity, potentials of imagination, visualization, argumentation and objectification; while the factors of the process are protagonists who are interested in participating and contributing to the search for sustainable solutions in an integral way. Additionally, the advocates of urban design are urban designers, who with their creativity can perceive and unite spaces with different traditions, by using adequate methods and procedure techniques. In this chapter, we shall introduce the integral game of urban design as an innovative method for the integration of different rationality types in the process of urban design and urban regeneration.

Methods, techniques and tools of the integral decision-making process in urban design vary in relation to the rationality type, i.e., the degree and type of participation and collaboration in generating the results in a specific decision-making phase. In the context of sustainable and integral urban design, both types of rationality play a significant role in the formation of an integral image of fragmented realities. In different phases through the iterative procedure, they contribute to the integration of different perceptions of complex reality or future. Generally, they differ in relation to the degree of expertise and level of collaborativeness they support. They can be categorized according to the phase of integral urban design they support: (P) Preparation A) analysis of the present, V) Vision, S) Strategy, I) Implementation [9];as well as according to the level collaborativeness: (a) Disciplinary, b) Interdisciplinary, c) Collaborativeness); and according to the type of rationality they support, whether: (a) it improves argumentation, b) improves collaboration and trust-building, c) improves the flow of ideas and information, d) develops creativity, e) raises the awareness level, e) develops identity and space character).

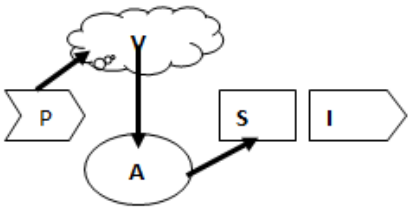
Integral game of urban design is an innovative method and integrates different processes of urban design, such as the subjective-expressive, social-creative, social-communicative, technical-rational, and interdisciplinary. The aim of this method is to develop different types of rationality in a community by an adequate regeneration process and achieving the quality of place through a creative game in the visualization of space. The method is rationalized in the key segments of the process, using argumentative and expert methods. In this way, it creates the future of the place through its spatial visualization, using three-dimensional and two-dimensional presentations, drafts, drawings and text, different expert methods of polling, interviewing, context analyses, morphological analyses, as well as collaborative methods that support argumentation by use of different diagrams such as problem tree and tree of aims and measures. The essence of the urban design integral game is to establish a relation between different types of rationality, as well as between the phases of the planning process. As a method, it implies a continual procedure in the development of social creativity, as well as its rationalization.

In the light of creating the conditions for communicative action in the regeneration processes and integration of reality fragments, the method integrates the advantages and disadvantages of the two most present paradigms in urban decision-making, the rational-comprehensive and collaborative; changing the role of urban design in the integrative processes. The problem of the first paradigm is the rationality limitation of stakeholders and experts in perceiving the totality of reality; therefore there is a lesser probability for the generation of winning solutions and decisions for different dimensions of regenerative processes. The problem of the second one can be the absence of a strategic approach in the generation of solutions, i.e., responding to current problems, without insight into the possible development program-spatial solutions in the regeneration processes. [4]

The method facilitates the practical command of integrating rational-comprehensive and collaborative paradigms in urban decision-making and process oriented urban design, for establishing a relation with sustainable principles of regeneration. The purpose of the method is in establishing the relations between two paradigms. "Position that I stand for is optimistic one, based on the assumption that communicative action can integrate positive and overcome negative aspects of each the paradigm, using creativity as a mean for open communication, flow of ideas and thoughts. Therefore argumentative approach uses creativity to make linkages in strategy making crosscutting both paradigms providing particular identities, interests and needs to be recognized as well as having an ideal picture of development as a coherent whole." [4]

Integral game of urban design has been applied as a method in the Summer School of Architecture in Bač in 2010, in the workshop with the topic Participative Approach in the Shaping of Public Space - the Bač Fortress and its Suburbium. [10] part in the workshop, together with the students of the Summer school and stakeholders from the local community: representatives of the Directorate for Urban Construction, Tourist Organization of Bač municipality, "Centuries of Bač" Fund, Radio Bačka, and the local population. The process of integral urban design was created in such a way that the process proceeded through the following phases:(1) Preparation of the participative procedure, (2) Defining the desired future – visioning, (3) Analysis of problems and potentials, (4) Defining strategic objectives and measures for improving

public space, (5) Spatial solution testing. The method, in a holistic way, has supported different phases of the process, which were built incrementally an integrated into the ambient presented in Figure 12. In that sense, the method has combined different fragmentary methods by passing through the decision-making phases depicted in Figure 3. P – Preparation of participative process is the first phase of strategic collaborative urban design where social profile of all stakeholders should be done as well as choose the right participative methods like mapping stakeholders, nominal group technique, brainstorming, artistic workshops (which was crucial for this case), trainings, etc. V- Visioning can be second or third phase of the process (or not needed at all in urgent situations like flooding, etc.) where chosen relevant stakeholders should create common ie. consensual image of desirable future, defining values they want to promote as well as principles of achieving it. Vision is represented by image, logo and textual description. A – Analysis of present is second or third phase of the process, depending on specific situation in the community where problems and opportunities are recognised and clarified by all relevant stakeholders from public, private and civil sector. S – Defining aims and strategies is third of fourth phase in the process where relevant stakeholders define (integrated) aims and strategies for achieving vision or solving main problems. I – Implementation is the last phase in the process where relevant stakeholders define action plan with roles and responsibilities among stakeholders from public, private and civil sector making strong partnerships for realizing their strategies, aims and vision. The following case study will give further explanation on their substance.



P-preparation,
V-Visioning,
A-Analysis of present,
S – Aims and strategies,
I - Implementation

Figure 3. The path of the urban design integral process applied in the case of the regeneration of public space Bač Fortress and its Suburbium

3.1. PHASE 1: Preparation of participative Process

The first phase the participative process was carried out by the mentors and students of the Faculty of Architecture in Belgrade who had recorded the existing state on the terrain through the identification of the needs and wishes of the local population (using polls and interviews), as well as through the identification of spatial potentials and development limitations of public spaces (by visiting the terrain and taking photographs, notes and sketching).

Figure 4. Students of the Faculty of Architecture in Belgrade while doing interviews with inhabitants of the suburbium

Figure 5. Making mock models of street fronts as the base for creating solutions throughout the entire process, [10]

Figure 6. Participants of the Summer school in Bač, during training about participation in the regeneration of protected urban ambients. [10]

The remaining phases of the participative procedure were realized through trainings lasting a day and a half as part of the Summer school of Architecture in Bač [10]. The training was conceived according to the principles of adult education; the methodology and realization were adapted to the needs of the Summer school. The training consisted of seven modules: MODUL 1 – Concept of sustainable

development and urban ambient of cultural-historical importance , MODUL 2 – Participative planning and forming of urban ambient of cultural-historical importance: integral approach, MODUL 3 – Realization of the integral approach – Defining the desired future – Visioning, MODUL 4 – Realization of the integral approach – Analysis of problems and potentials, MODUL 5 – Realization of integral approach – Defining integral objectives and spatial-physical dimensions, MODUL 6 – Realization of integral approach – Solution creation, MODUL 7 – Realization of integral approach: Spatial solution testing. Within the first two modules students gained knowledge and skills regarding the sustainable approach to regeneration and identification of qualitative characteristics, which are in accordance with the principles of sustainability. The remaining phases of the qualitative characteristics of places were realized together with the above-mentioned stakeholders.

3.2. PHASE 2: Visioning –Creating Desirable Future

In the visioning process, among the participants besides the students, were also relevant stakeholders from the local community: inhabitants of the Bač Fortress Street, the representatives of the Tourist organization of Bač municipality, "Centuries of Bač" Fund, Radio Bačka. The process was supported by brainstorming and nominal group techniques, as well as by creative techniques of visualization and text. The vision was formulated on several levels: through key words, the slogan, drawing-image and a sentence that describes the vision more elaborately.

Integral vision of the suburbium's inhabitants:

THE STREET OF SMILING FACES - We want our settlement to develop in a way of active promotion of its cultural values with improvements of quality of our life. We want to be active participants in the development cultural manifestations and promotion of its past life and values.

Figure 7. Integral vision of the inhabitants of Bač Fortress Street [10]

Tourist organization of Municipality of Bac

VISION- THROUGH BAC TOWARDS MIDIVAL TIMES

Midival Bac Fortress with its suburbia should present authentically way of living with various activities:

- Traditional dish,
- Traditional crafts,
- Accommodation in authentic ambient,
- Activities on and around water

Figure 8. Integral vision of the Tourist organization of Bač municipality: THROUGH BAC TO MIDIVAL TIMES

RADIO BAC

VISION – TOWER WATCH

- Reconstruction of the midival way of living,
- Traditional dish,
- Alternative medicine,
- Tourist participation in traditional crafts,
- Gate as border of presence,
- Story of founded knight

Figure 9. Integral vision of Radio Bačka: TOWER BRIDGE FROM PAST TO PRESENT

Fond Centuries of Bac

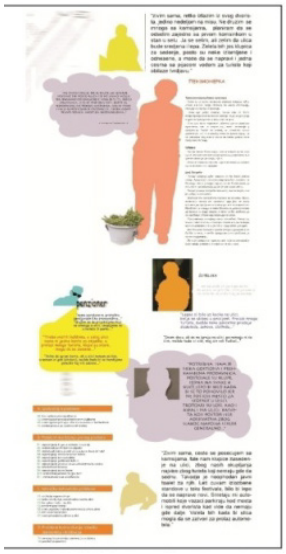
VISION – BACHOOK

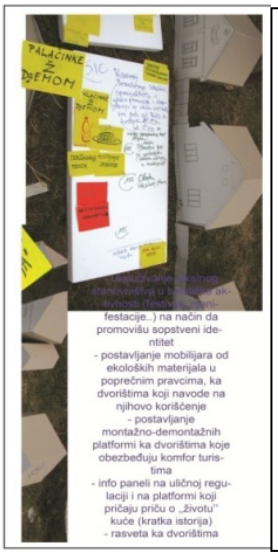
- Multiculturality,
- Livable suburbium,
- Traditional crafts,
- Artaction of star architects,
- Richnes of flora and fauna /egology

Figure 10. Integral vision of "Centuries of Bač" Fund: MULTICULTURAL LIVING BAC

3.3. PHASE 3: Problems and Potentials

The following phase of the process was the identification of problems and potentials that hinder or facilitate the realization of the vision, by using brainstorming techniques. The recognized problems and potentials have been grouped and classified by hierarchy using the problem tree technique, which has facilitated their rationalization and the realization of cause-and-effect relationships.





Identification of problems and potentialities was done using different methods: interview with inhabitants, brainstorming and nominal group technique with stakeholders. They recognized main problems as lack of knowledge on how to reconstruct their houses in line with protection, lack of activities in suburbia, lack of promotion of values, etc. The figure is an illustration from the workshop

Figure 11. Identification of problems and potentials

3.4. PHASE 4: Integral Objectives and Measures

The problem tree served to formulate the strategic integral objectives and spatial-program measures that contribute to the realization of the objectives. In this iterative procedure, individual visions have been redefined so they could be adapted to real development needs and potentials.

3.5. PHASE 5: Spatial Presentation through the Integration of the Previous Phases, Different Global Images, Values and Interests

Figure 12. Integral presentation of urban design strategy for the regeneration of Bac Fortress Street / Mimicry model of the street [12]

As the end result, with the creative and rational development of the mock model of the existing street fronts, different phases of integral urban design, types of rationality and different global images were combined into a coherent future. That way, an integral place with a specific identity was designed, while respecting and affirming the inherited values, including the local population and other relevant stakeholders in the development of cultural tourism and commercial sector.

4. Conclusions: The Role of Urban Design in Ensuring Principles of Vivid Historical City

The research implies that the preservation of historical cities cannot be based solely on the protection and preservation of their physical creation, that the "monumental feature" of the time in which they were created to remain. Also, the "transformation" of historical cities into certain exponats, creates an illusion that the city as it is seen at the time has always been like it. The documents depicted that the epochs through which the city was passing were constantly changing and adapting city over time.

The preserved physical facilities of cities turned into museum exhibits have always demanded great investments in order to maintain their historicity or have ceased to be of interest in people (except for scientific researchers) that made them never - reasonable in time. All of these reasons reflected in time on their abandonment, neglect, the gradual extinguishment of the museum function, and led to the gradual phase-out of cities gradually, while continuously providing (in ideal conditions) the preservation and regeneration of their "exponential splendor".

In this line, the research showed that process oriented urban design is significant in the process of urban regeneration for two reasons. Firstly, it can affirm the existing or create a new identity, by using its artistic, subjective-expressive and interdisciplinary dimension. Secondly, in cases where there are no inherited ambient values, there is a greater possibility of a consensus being achieved in its socio-communicative process through a creative environment for "hard and soft infrastructure" [11]. We can conclude that, from a theoretical standpoint, process oriented design has a greater possibility for creating an integral place, i.e., integral ambient values in the regeneration process. Therefore, this kind of process integrated above mentioned model of preserving non-renewable values and bringing back into life the values that are lost or forbidden as well as introducing new values that are upgrading preserved ones enabling contemporary life to create integrated place; making these areas integrated on physical, socio/economic and cultural level horizontally and vertically.

As it was shown in the case study, the result of this research refers to the description of the specific method of integral game/play of urban design, which has combined the different types of rationalities in the participation process, while realizing particular interests into a coherent ambient of a higher value. Thereby, the framework for the urban regeneration of the Suburbium is defined by creation and integration of different development visions and their transfer into strategic alternatives and measures through evaluation in relation to problems and potentials. The advantage of this method, compared to the one-dimensional one, is that it combines different types of rationalities and facilitates horizontal and vertical integration, i.e., the creation of multi-dimensional places as the subject of sustainable urban regeneration. "Urban design, considered as decision making and communicative process, as well as creative imaginative and rational can provide framework for sustainable regeneration." [4] This means new rationality that is in line with modernism and cosmopolitan culture.

Therefore, we can derive several principles that integrative urban design game should follow in order to trace path from museum to vivid city:

1 PRINCIPLE - Continuously, ensuring the preservation, maintenance and restoration of physical creation, functions. It is also important to preserve and maintain the museum functions of the display and description of the old vectors on which the city rests;

2 PRINCIPLE – Provide: new opportunities, new (occasional) content and activities to increase the level of attractiveness such as: 1. Organizing occasional events that resemble earlier times: - for example, the time of knightly martial arts 2. Organizing modern activities such as: e.g. artists' colonies, music manifestations, meetings of "devotees". 3. Organization of mass "fair" manifestations: e.g. fairs, fairs, religious gatherings;

3 PRINCIPLE - Introduction of possibilities of accommodation capacities for different tourist needs, such as: residential towers, exclusive nights, apartments for renting, hotel capacities within the existing physical structures;

4 PRINCIPLE - To re-populate settlements of cities: Residents (owners) "old people", employed "residents" who work on the maintenance of cities, planning, providing apartments;

5 PRINCIPLE - Enabling "minor" interventions to the existing physical creation: 1. Filling existing housing structures with communal systems: construction of sewage and water supply systems, introduction of energy - power networks, maintenance systems. 2. Renovation of interior spaces, primarily residential 3. Edition(greening) of open spaces, on the principles of the time in which they were created;

6 PRINCIPLE - The minimal "over-construction" of the existing physical creations on the postulates of the time in which they were created: the revival of the parts of the city that were collapsed, and which existed earlier, and the effective "extension" of certain circuits on the principles of clarinet time these circuits were created.

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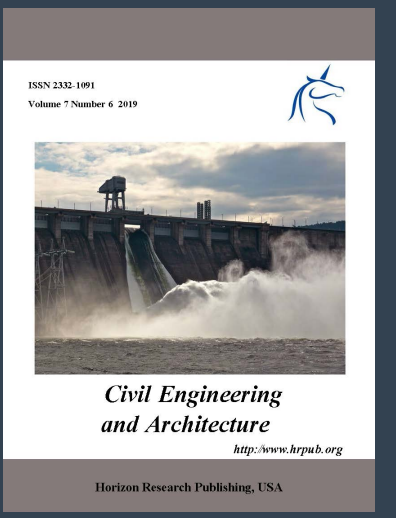

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