Creating an INFRA-FREE® Environment with an Integrated Green Network for Istanbul

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Our inchoate cities we inhabit present a multi-layered morphology through underlying armatures of infrastructure, which connect and encompass our daily activities managing the systems, services, and facilities that surround us. Through time and urbanization our cities have optimized themselves through the development of centralized infrastructures. These systems are inevitably entangled throughout every layer of the city, but have been built without a certain connection and resilience to disasters. Everyday and Emergency are usually thought of independently representing two completely separate environments and sets of rules. This paper seeks to find possible answers to create a sustainable future for the urban environment encapsulating everyday/emergency situations. It addresses the larger conceptual scale framework of the city, and does not indulge deeply into the idealistic project scale of the community.

This paper is a polemic response, to derogate from modern assumptions of large-scale "hard" path centralized solutions, the machine city, and to offer a different approach through an infra-free mindset, which is being developed at the University of Tokyo. This mindset looks to coalesce these two environments through diversity, functionality, and locality. This paper sets to introduce an infra-free concept for the urban regeneration of Istanbul. As an introduction, this paper presents a theoretical outline to such a concept.

Key Words: *INFRA-FREE®, infrastructure, environment, recycling, green network, Istanbul*

1. Introduction

We are living in the age of the city, where globalization has created unprecedented relationships and stresses on local and rural economies, and today, as many of us know, we have reached an urban climacteric, in that the urban population will outnumber the rural population. For many, our cities offer the only opportunity for economic production and connectivity by presenting the greatest capacity for connecting resources with populations in need. UN-Habitat, the UN body which studies human settlements, lists three reasons for increased urbanization: natural population growth, reclassification of rural areas to urban areas, and rural to urban migration [1]. Our cities face the pressure of accommodating this growth with increased quantity and quality of services providing basic infrastructures, access to land, education, and health care. It is often perceived that urban areas offer a safer environment to disasters by having the ability to control the physical environment through human ingenuity. On the contrary, our cities tend to be completely removed from their natural environment imposing an artificial landscape making them susceptible to extreme disasters. This condition intensifies in combination with the above mentioned rapid aggregated growth, which can ostensibly explain an increase in urban risk and disasters, as Pelling points out urban vulnerability increases through scale and concentration of energy [2].

Our inchoate cities we inhabit present a multi-layered morphology through underlying armatures of infrastructure, which connect and encompass our daily activities managing the systems, services, and facilities that surround us. Our infrastructures, through time and urbanization, have co-evolved with our cities, becoming inevitably entangled with every layer of the city. In our pursuit of economic growth, cities have optimized themselves through the development of centralized infrastructures providing an exclusive source to supply our essential nutrients. Today, our infrastructures are aged, of high cost, and have repeatedly shown a range of limits to their flexibility and anticipatory capabilities in a variety of "extreme" situations, such as disasters. All culminating in the need to rethink how and at what cost we utilize them.

Everyday and Emergency are usually thought of independently representing two completely separate environments and sets of rules [3]. Emergencies usually symbolize catastrophic hazards, which present more dramatic news stories, but catastrophic and chronic (everyday) hazards often share the same root causes from a decaying urban infrastructure [2]. As Kasperson mentions, 'These everyday hazards path the way for catastrophic disaster by the incremental lowing of people's thresholds of resilience' [4]. This intrinsic connection reinforces the need to connect urban regeneration policies and planning with disaster mitigation, linking and making visible such chronic disasters as unsafe housing, inadequate basic services, and environmental pollution and degradation from the initial outlook.

We will begin with the assertion that the incapacity of existing infrastructures (deterioration/ design) and an increased urbanization (scale/ density) has lead to a more vulnerable urban space. *It is our effort than to show how we can re-conceptualize urban space through the way our infrastructures are integrated into our daily lives.* We hope to make clear how our proposal (IF Constellation) offers a better alternative to the predominantly accepted course of incremental improvement of existing centralized systems, and in the end, offer some thoughts on how we can build a more resilient city, and provide better, more robust, services throughout.

2. What is Infra-free?

'Infra-free' (IF) ultimately represents a change in the way we generate, move, and supply resources. Currently, our cities are built with an industrial mentality metabolizing nutrients in a linear method gathering them from distant locations turning them into products, and finally into waste. Understanding this current paradigm, (IF) looks for tactical junctures to shift the morphology of our infrastructures. These "shifts", hinted towards by the keyword infra-free, move away from large-scale "hard path" infrastructure solutions, and more towards atomizing "soft path" infrastructure [5] solutions. (IF) looks to rethink our buildings, from passive enclosures to active bridges with our environments, and embodiments of the services we depend on, our infrastructures. It looks to the future to develop a way of integrating technology (new and old; universal and local) towards an amalgamated closed-system that augments both human and environmental health eliminating the dependency on centralized “external” infrastructures through the integration of locally generated water, power, construction, waste handling, transportation and communication technologies. With that said, (IF) defines its framework through the synergy of nature and technology in an attempt to harbor these two diverging entities with creative and unique solutions. The next two sections will offer an introductory insight into these two dynamics: nature (biosphere) and technology (technosphere).

2.1. Biomimicry: Looking to nature

Our cities continue to evolve into something more and more disconnected from the genius loci - the distinctive atmosphere of a place. In general, our cities/ buildings do not take advantage of the intrinsic characteristics of their locality (insulation, wind velocity, climate, etc.). The industrial revolution provided humans with unprecedented power over nature, and with this power humans began to remove nature from the equation and have tried to solve the encountered challenges through human creativity alone. (IF) has learned human creativity can only take one so far, and acknowledges the need to discover lessons from nature as well as innovate technologies. Today, our cities have lost their connections to nature, culture, local material and energy flows creating distinct boundaries; while nature's strength is built-in with its blurring of boundaries and coexistence of diverse live forms. (IF) looks to discover from nature keys to a sustainable framework, to take advantage of local conditions, and reclaim natural characteristics. As Benyus points out, 'Nature runs on sunlight, uses only the energy it needs, fits form to function, recycles everything, rewards cooperation, banks on diversity, demands local expertise, curbs excesses from within, and taps the power of limits [6]. For this context, it is important to elaborate and make lucid three of these concepts: multiple functions, diversity, and recycling (zero waste).

Multiple functions: In nature every element plays at least two roles in a successful environment, for example, a plant may provide shading and fertilizing for other components in the system. This is important for several reasons, one is that we must acknowledge that our urban elements can no longer have single purposes - a park can no longer just be a park. *This duality is also important because it allows us to think about our urban elements in multiple states performing multiple functions. Meaning the question no longer becomes about how to add additional systems to an existing city, but clues to how we should (re)design the elements that already exist making them more flexible and in-tuned with other elements and their environment.* In terms of everyday and emergency, (IF) seeks to blend these two worlds and associates everyday objects with possible transformations into essential objects wherein an emergency arises; oppositely, emergency objects tend to have little necessity in everyday life; thus, every object and concept developed by this project can be thought of as being useful and adaptable in either situation [3].

Diversity: The second important mindset to introduce is diversity. While we have optimized our economies for production and economic growth, we have built mono-cultural environments to maximize output. By limiting ourselves to large-scale single sources, we have left ourselves in a vulnerable position creating a strong reliance on its supply, and jeopardizing our livelihood if it is removed by an unforeseen circumstance. Diversity in nature is extremely important, for example, in a poly-cultural environment, if one crop is unable to grow this year, another flourishes and takes its place maintaining the livelihood of the system. Diversity strengthens resilience by not limiting the community to one source for energy, water, or food, and it is these resources that can have the most devastating effect on our recovery. As Pelling points out, limited resources place vulnerable communities at even greater risk [2].

Recycling: The last important aspect of nature is recycling, and thereby, minimizing waste. Here, (IF) looks to create patterns of closed-loops for nutrients recapturing as much as possible. As McDonough and Braungart point out there are two kinds of material flows on the planet: biological and technological nutrients [7]. This brings us to one literal point of convergence between our two dynamics, ideally each feeding back into their cycles without diminishing any quality to them. Ultimately, nature creates no waste serving as the highest standard. Recycling within this framework presents a very important dimension to the way we design, gather, use, and reuse the elements around us. In this case, "wastewater" will be elaborated on later.

2.2. Technology

Through a multi-disciplinary approach and the promise of transferring technologies, (IF) investigates experienced and nascent technologies from pioneering industries offering promising ideas that could be integrated as part of (IF) building technology applications [3]. Technologies are constantly being invented and innovated to add comfort and convenience to our lives, but many times the solutions incorporate a limited view of the holistic picture. It is with this realization that (IF) would like to begin thinking about the 'appropriateness' of technologies. Hazeltine characterizes a technology as 'appropriate' as being small scale, energy efficient, environmentally sound, labor intensive, and controlled by the local community, and is compatible with local, cultural, and economic conditions [8]. In terms of (IF) sustainability, we look to balance a triangle of costs - economic, environmental, and dependency - when deciding what is 'appropriate'.

Every region contains a certain amount of native resources (water, labor, available land, wind velocity, etc.), which embodies their intrinsic carrying capacity. Viable technology options allow us to then enhance that carrying capacity, and provide improved/ new services to support higher populations; however, this can come at an economic, environmental, and dependency cost [9]. In choosing a viable technology we must weigh these three burdens through a set of variables. The flow of this process is displayed in *Figure1*.

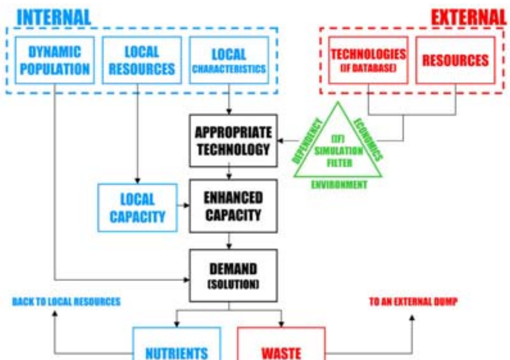

Figure 1. (IF) Lifecycle Metabolization Flow

How often do we think about how resources reach us, or where they go when we are finished with them? How often do we evaluate our services relative to their human or ecological health, instead of only their technological health? These questions begin to embark on the framework in which we intend on evaluating our technologies in order to question the applied definition of what is 'appropriate'. We believe a more intelligent structure should encapsulate all lifecycle processes to respond better to human and ecological needs, while offering a more in-tuned convenience, comfort, and aesthetic. It should optimize its environmental resources, minimize vulnerability and respond to extreme conditions designed for a maximum life span. Key variables that could influence the demand on the system through *lifestyle changes are the amount of consumption and the population density*.

2.3. Application of Methodology

(IF) looks to utilize the three mentioned concepts of nature (multiple functions, diversity, and recycling) as a *framework for reconnecting the urban space to the local context* by understanding the intrinsic characteristics of the area (topography, wind velocity, solar light, etc.) and determining which technologies would best accompany the local site, culture, and people. It is the synergy between using appropriate technologies and the principles and resources of nature that (IF) believes we can strengthen both physical (tangible) and social (intangible) infrastructures of the community. With this assertion, (IF) looks to utilize this framework to creatively provide local and unique solutions within the community that (re)generate an urban environment dissolving the polarity of everyday and emergency times.

At first, (IF) realizes the long-term commitment required to establish sustainable change, and looks to activate the most sustainable element, the community themselves. Through education and participation, we look to provide the proper tools needed to enhance the local environment. (IF) looks to build resilience through the community, utilizing and augmenting the existing social structure, and adding diversity and functionality to the existing physical infrastructure.

To summarize this approach in terms of an urban regeneration process the following critical steps can be realized:

1. Analysis of existing urban conditions of the city (infrastructures, building conditions, topography, etc.)
2. Selecting a community in the city and *evaluating the appropriateness* of (IF) with the community
3. a) Proposal of (IF) strategies for existing urban conditions (secure buildings, existing infra., etc.)
   b) Proposal of (IF) strategies for new urban structures (IF Green zone, etc.)
4. Repeat steps 2 and 3 with other communities (IF Constellation)

3. Urban Development of Istanbul

This section looks to make clear the *first step* in the context by elaborating on the urban conditions of Istanbul. An initial analysis is required in determining which methods are appropriate in creating an (IF) framework for sustainable urban regeneration exploiting the existing morphology of Istanbul’s infrastructures both physical and social. This section provides a general overview of how contemporary Istanbul works as a city, how it supplies services to its 13 million occupants, and includes three grey boxes, which begin to hint towards possible solutions.

3.1. Urban Characteristics of The City

Istanbul covers an area of 480,577 ha. with a sloping topography formed by several hills, valleys and river basins (Figure. 2). The city has been divided into two parts by the Bosphorus strait lying between the Black Sea and the Marmara Sea.

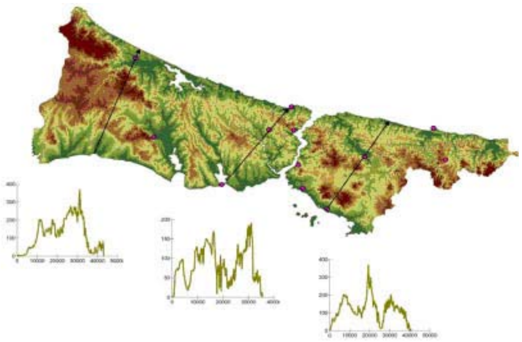

Figure 2. The topographical structure of the city [10]

From a macro-perspective of Istanbul, the north forests of the city cover 2.164 km^2 area representing 40% of the whole city, and built areas have expanded along the south coasts on both sides of the Bosphorus. Because of the influx of migration, built areas have overwhelmed the north forests and the ecological resources of the city (Figure 3).

Figure 3. General land use of the city and the pressure of the built areas on natural resources

The development process of the city started in the Byzantine Period with a small community who settled down on the historical peninsula and the Galata area. But after the Turkish Republic period, as a result of the industrial revolution and migration from rural Anatolia, the city expanded through an uncontrolled process. This rapid urbanization is illustrated in Figure 4.

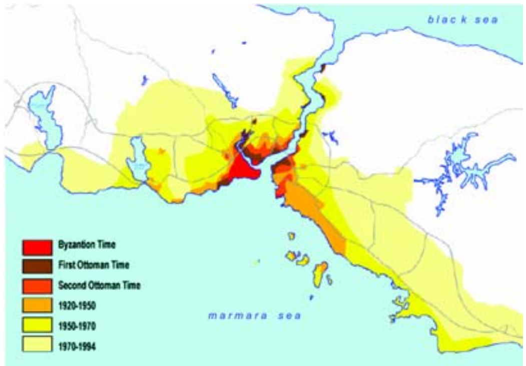

Figure 4. The development process of building areas and settlements [10]

Beyond the great historical and cultural values, which have symbolized the city, Istanbul is the main economic capital of Turkey as the core of industrial and financial development for all of Turkey. Throughout history, the city has always been the capital of every civilization that has settled here, embracing both western and eastern cultures. Furthermore, through its unique location as a passageway between Europe and Asia, today the city symbolizes the front door of Turkey opened to the world.

Today, 15 percent of the Turkey's population lives in Istanbul (13 million), which is equal to the population of 37 cities in the country. As being the socio-economic center of Turkey, Istanbul acts as a black hole in terms of migration from other cities because of the economic and financial problems of the country (Figure 5). Most of the inhabitants prefer to live on the European side representing 69% of the total population. As a result, the population density and business activities have a much higher ratio than the average of the country, *overloading the carrying capacity of the city* on a daily basis; as well as, the unbridled urban expansion creates serious and non-returnable pressures on natural resources even on the city itself.

Figure 5. The blackhole effect of Istanbul [11]

Evaluating the green space of Istanbul, every person has only 1.65 m² green space, where as the optimum green space for a city of this scale is 10 m²/person. Furthermore, the distribution of the green spaces is not balanced amongst the provinces. Through the rapid unstructured growth of buildings, many existing green spaces of the city were destroyed and remain as small islands of green between apartment blocks or road connections. Originally in Istanbul, there was an amazing ecosystem of natural biodiversity; however, the city has lost many of its natural plant species through urbanization. (IF) acknowledges this condition, and looks to reclaim green areas within the communities to serve as catalyst for development and sustainability (See Case Infra I).

CASE INFRA I: IF Green Zone (Diversity + Functionality)

Within an (IF) Community, the (IF) Green Zone is typically an open public space burgeoned from chasms in the urban fabric. Conceptually, the community nucleates around the Green Zone which develops/ grows over time. The space serves as a new methodological morphogenesis for the community as a kind of "self-sustaining" ecosystem. An ecosystem is a system formed by the interaction of a community of organisms with their environment [11]. A. G. Tansley adds an ecosystem can be thought of as a self-organizing system of relationships [12]. Thus, the park is an amalgam of dynamic living elements servicing the community - cleaning wastewater, growing food, producing energy, etc. In ordinary time this space functions as a community park creating green space in the dense urban fabric as a place of leisure and relaxation, of education, of labor, and an informal gathering place for outdoor community activities. In the case of emergency, the space can be used as a place of refuge - a source for water, food, shelter, sanitation, and energy. The chart below illustrates the duality of five key infrastructures. Overall, the Green Zone is developed to improve the standards of environmental health through improved sanitation, adequate water supplies, a decent shelter, and the promotion of improved hygiene practices.

Infrastructures
Ordinary time - Emergency time
Water
- Cleans greywater for irrigation of plants and shrubs
- Provides aesthetic value with fish ponds and water fountains
- Provides leisure activities with small-scale water playgrounds
- A source of drinking water
- A source of bathing water
- A source of cooking water

Food
- A small source of vegetables and fruit (garden)
- Edible plants/ fish
- Vegetables and fruit
- Stored dry food
- Small livestock

Shelter
- Places for leisure and relaxation
- Places for cover against rain and other weather conditions
- Camping areas

Energy
(Microgeneration technologies)
- Provide a local power source
- Supplement and reduce demand on grid
- Provide a continuous source of energy
- Provide energy for heating and cooking
- Recharge batteries

Sanitation
(Dry composting system)
- Public toilets
- Fertilizer for green space
- Public toilets
- A source to maintain hygiene levels (showers, sinks, toilets)

In Istanbul there are 3,391,752 houses on 78,144.56 ha. Area, which would allocate a total of 1,855 m^2 built urban area per a person. According to “The House and Quality of Life Reports of Istanbul”, even if one person was allocated only 50m^2 home area, the population capacity of the city would be 15.6 million people. If the current population increase continues, the number of inhabitants in Istanbul would increase to 19 million in 2020. The result0s of the analysis show that Istanbul’s residential areas have three main problems: first, housing areas are built on geologically risky land; second, there are harmful effects on natural resources and the city because of “bad” planning decisions; and lastly, high density and unhealthy conditions exist within the building blocks. According to the Metropolitan Planning Report, sanitation facilities must be improved first in residential areas which are under greatest risk of disaster, and the development process should start from provinces such us Gaziosmanpasa, Kucukcekmece, Bagcilar, Umraniye, Sultanbeyli, which incorporate a large portion of the lowest-income residents.

However, the risk of an earthquake is the most important issue for Istanbul’s "real" agenda, current precautions are not effective for reducing the dangerous results. In conjunction with this, studies show that a strong earthquake will happen precisely in the Marmara Sea over the next 30 years, and taking in consideration Istanbul’s current condition, 50,000 buildings would be demolished and over 15,000 people would be killed.

3.2. Infrastructural Characteristics of The City

Energy Consumption: In Turkey the total amount of electrical consumption is 118,768 billion kWh which originates mostly from other countries. In Istanbul electrical power is bought from European countries and the amount of consumption is 18,627 billion kWh on the European Side (15.68**%** of Turkey) and 7,821 billion kWh on the Anatolian side (41 % of the European side). General usage types of electrical power are industrial consumption, settlements, offices, municipalities, street lightings, mosques, beneficial offices, drinking water stations, agricultural irrigation, and waste water treatment plants. 1 to 1,500,000 tons of coal and 2,530,347,587m^3 of natural gas (1,974,009,235m^3 residential and 556,338,352m^3 industrial) is spent annually for heating. On average, one household spends 2.5 tons of coal and 20 LPG tube per year, and if they use natural gas they need approximately 1500 m^3 natural gas per year. The natural gas is bought from Russia and is piped through lines constructed under the Black Sea.

As a result, Istanbul is mostly dependent on other countries for supplying highly embodied forms of energy to its inhabitants, even though it has several opportunities to produce energy by itself through the utilization of natural sources such as wind or solar energy. The wind velocity of the city is (>5m/sn) especially in the North and South directions. The amount of solar light is a maximum of 500Cal cm-2 sec-1 in June and July, and a minimum of 100Cal cm-2 sec-1 in December, half of the year is sunny in the city. At first glance, the population density may seem as a disadvantage; however, the density may produce its own energy through the application of appropriate technologies (See Case Infra II).

Water, Sewage and Waste: The main river basins of the city are used for collecting clean water and cover 60% of

CASE INFRA II: Energy

(IF) looks to *activate public spaces and buildings* as a source of energy by supplementing and reducing the demand on the power grid, by utilizing various microgeneration technologies. Microgeneration technologies are technologies that can produce energy on-site rather than large-scale distributed power sources which loose energy during transmission. Such technologies include small scale wind turbines, water turbines, ground source heat pumps, solar thermal collectors, solar electricity and MicroCHP installations which are micro combined heat and power systems utilizing the waste heat which is created from the process of generating electricity for power.

Solar power is a renewable energy with several possible applications in development, which are currently increasing its efficiency, flexibility, and lowering its cost and environmental pollutants during manufacturing. The most conventional application would be to place more traditional solar panels with an array of higher-efficient cells on the roofs of buildings or as applications integrated into the roof surface such as roof tiles or shingles as photovoltaics. Another, more innovative and under development methodology, would be the possibility of enhancing existing and new buildings in the area with photovoltaic coatings [9] which can be applied directly to the steel of buildings to produce energy activating the entire surface of a building, especially the south facing facade.

Focusing on the (IF) Green Zone two more innovative applications to produce energy could be applied. A central structure could be claded with a super-conductive photosynthetic plasma cell skin that is able to generate 200% more electrical voltage per area than contemporary photovoltaics, and would act as a living skin utilizing extracted spinach protein, it would be photosynthetic and phototropic growing to follow the path of the sun [13]. The second situation would actuate smaller installations or urban furniture to produce power by using bendable organic solar cells [14] that can be incorporated into fabrics and more flexible materials.

At first, the system would be used to supplement energy demands during ordinary time, but as local supply grows could be relied on more and more. In a very successful situation the system would supply local needs, and return surplus energy to the grid system as well. The microgeneration technologies would serve an important role in emergency times as well, especially if the community is enable to access energy from the grid. The technologies could recharge batteries on-site and could provide and continue energy and thermal heat demands for the community.

city land. Istanbul is fed with 800,000,000 m^3 of water per year from these natural water resources. The inhabitants of the city consume about 1,900,000 m^3 of water per day and 461,400,000 m^3 per year. One person approximately consumes 170 lt. water per day. Istanbul consists of 1,663 industrial production centers and 7,000 ha. of settlement area have been built surrounding the eight river basins. Moreover, on the Anatolian side of the city, the settlements located around the river basins accommodate 610,000 people who *do not have any central sewage system* as of yet, because of the rapid urban expansion and incapacity of the city they are jeopardizing Istanbul's natural water sources.

As a result of this process, the water is piped utilizing underground lines from the closest river basins located in adjacent cities (Figure 7). In Istanbul 11.497 km pipelines serve for the carriage of domestic water to the city. The drinking water purification plants produce 710,299,233 m^3 of water per year utilizing 201,415,514 KwH energy for the purification process. Although annually the rainfall amount of the city is 850 mm which is higher than the average for Turkey (646 mm), all the rainwater is lost by discharging it through drainage lines to the rivers or sea. The underground structure of water, sewage, and natural gas pipelines are not efficient in the sub-urban and outer-suburb areas located far from the city center.

Figure 6. The sewage and water infrastructures of Istanbul

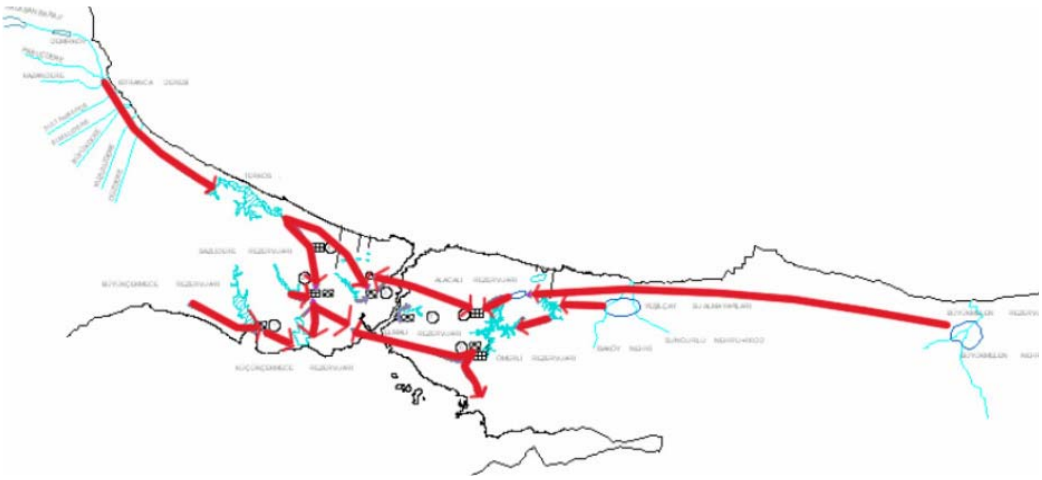

Figure 7. Existing and proposed water resources and main water carriage lines of Istanbul [10]

Domestic and industrial wastewater is carried to the wastewater treatment plants, after the primary physical treatment process, the water is then discharged through the sea using 12,388 meters of underground pipes and 7,889 meters of undersea pipes. The total amount of treated wastewater is 3,428,870 m^3/day. Although Istanbul has 11 wastewater treatment plants, the performance of the system is very weak as compared with the daily water consumption of the city. As well as, the amount of sludge which remains after the treatment process, which will cause some problems in the future, according to the "Istanbul Water and Sewage Master Plan Report". The amount of sludge accumulated by 2030 will be 70,000 tons, and currently there is no structural solution yet. An alternative solution would be to process wastewater on site (See Case Infra III).

In Istanbul approximately 12,000 tons of garbage is produced per a day and half of the rubbish is of organic generation. All the solid waste is carried by the trucks to the storage areas, the storage centers and their service areas has been shown in Figure 8. The recycling systems of solid waste in

CASE INFRA III: Water + Wastewater

(IF) looks to utilize the natural hills of Istanbul for their potential gravitational energy, and several simple harvesting techniques to collect water. Another, positive characteristic, and a rather unique aspect to Istanbul, is the elaborate and ancient water system that still exists throughout the city. Historic aqueducts, cisterns, old water pipelines connected to traditional fountains, and Turkish Baths of the city are neglected and most of them are not working today, but these inherent infrastructures can be play an emphatic role on not only supplying water but also for recalling the ancestral usage of resources.

In realistic terms, (IF) does not look to isolate itself from current infrastructures, but to supplement them with community-based alternatives, which enhance the everyday, and safeguard against emergency situations. (IF) looks to create a more diverse and robust system in supplying water. The (IF) Green Zones, would be designed to maximize the area able to capture local rain water, maximize potential use of existing cistern infrastructure, and create natural wetlands that can act as wastewater cleaning parks. For example, the use of wetland plants, such as green plants and non-pathogenic microbes, could be used throughout the higher portion of the park to clean greywater, and cycle it down to the lower portion for irrigation of plants, flowers and shrubs. Mark Nelson describes his Wastewater Gardens™ technology:

Primary treatment, to separate solids, occurs in a conventional, watertight septic tank or settling lagoon. But then instead of passing directly into a leachfield, with its attendant problems of little further treatment, smell, clogging, and large-size the nutrient-rich wastewater effluent is fed into a lined, two-cell, subsurface flow wetland. In this type of wetland the sewage water is kept 5-10cm. below the surface of a bed (.5-1m deep) of gravel. wastewater is generally held in the wetland system for 5-7 days [15].

This allows for safe removal of the hazardous chemicals, and creates a garden while supplying water for various other green components.

Istanbul are not enough, and most of the garbage is dealt with by burying or storage techniques, but with respect to the solid waste storage areas there is great risk and problems with leakage of garbage-water. Even though there are some precautions in order to prevent the danger, the current systems are not efficient.

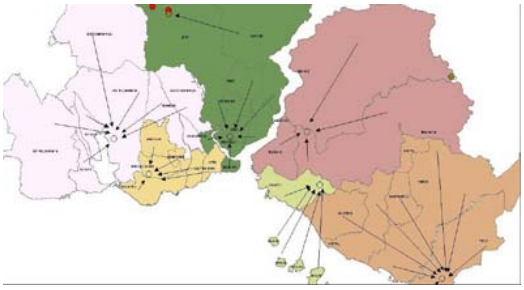

Figure 8. Waste Water Storage centers and their service areas in Istanbul [10]

3.3. General Evaluation of the City: Appropriateness for (IF)

Although the city has many advantages with its unique geographical location, global importance and historical, cultural, natural potentials, the results show that Istanbul is faced with many problems that need to be solved. The rapid urbanization process has forced the built area to expand through the forests and water basins, and has over-populated the city. This process has created hidden layers of costs at the expense of the daily needs of its inhabitants. With respect to providing a sustainable future for the city, the spatial structure should be re-planned according to natural, social and economic values. The advantages and weaknesses of the city for a sustainable future plan strategy have been summarized in Figure 9.

Because Istanbul is at the beginning of a renewed urban regeneration process it needs to challenge the wrong political decisions. The installation of an Infra-Free environment within the complicated urban structure of Istanbul is acceptable, even though the process may seem difficult at first look.

3.4. Application Of The IF Green Network To Istanbul

Although it is underdeveloped in terms of urban regeneration our recent experiences show that the creation of

Advantages of the City	Weaknesses of the City
- Unique geographical location and global importance - Historical, cultural, tourist potentials - Natural potentials: north forests, water basins, biodiversity, special climate	- Economic accumulation - Migration from Anatolian cities - Uncontrolled urban expansion - Lack of institutional activities
Opportunities	**Threats**
- Beneficial effects of global potentials for effective solutions - Center of information and technology - A central region which is able to develop alternative researches about technology and energy	- The existence of vulnerable building stocks and land types - The destruction on the natural resources and historical heritages - The center of military issues because of the geo-political importance

Figure 9. The general opportunities and weaknesses of the city for future strategies (produced from Istanbul Metropolitan Planning Report, 2005)

compact and polycentric cities with dense mixed uses seems to be the most sustainable urban form. Also, it should be noted, that today's city is becoming a more and more fragmented agglomeration of disconnected urbanscapes. As Graham and Marvin point out, 'Today's infrastructure straddles and interconnects urban, interurban, and international scales, aligning with dominant vectors of global-local flow rather than the modern ideal of intra-urban connectivity' (The city is no longer a container, it has lost its territorial coherence) [16]. This leads us to the implication that infrastructure networks are simultaneously being 'unbundled' locally, while on the other hand, being integrated internationally. Through what we define as a freely connected (IF) Green Constellation for the city environment we present a new approach for an environmentally pleasant, educative and safe network of pedestrian movement creating a web of organic communities providing a series of choices and experiences about ordinary urban life and emergency conditions for people as they move through the urban mosaic. In terms of thinking about the overall city organization, the concept is similar to Kevin Lynch's city as a galaxy model (Figure 10).

(IF) looks to build resilience in our cities by adding functionality to existing urban elements and supplemental self-generating micro-infra to diversify supply. This resilience begins with the (IF) communities, allowing urbanization and city design to occur at the community scale. (IF) communities can be thought of as living microorganisms, not in terms of defined isolated units, but as integrated perceptual wholes, which exhibit qualities that are absent in their parts. At the city scale, these microorganisms can be multiplied throughout the city by identifying communities and potential nodes within the city (Figure 11).

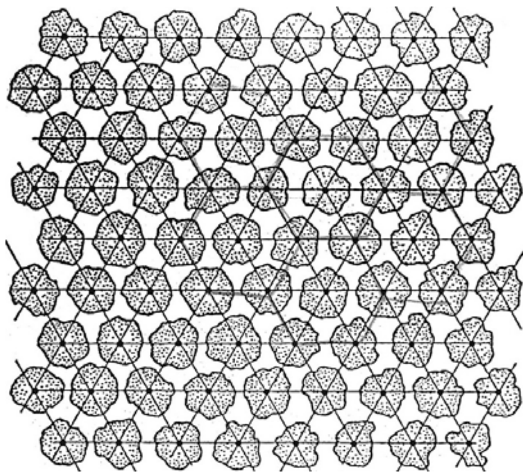

Figure 10. Kevin Lynch's Galaxy Model [17]

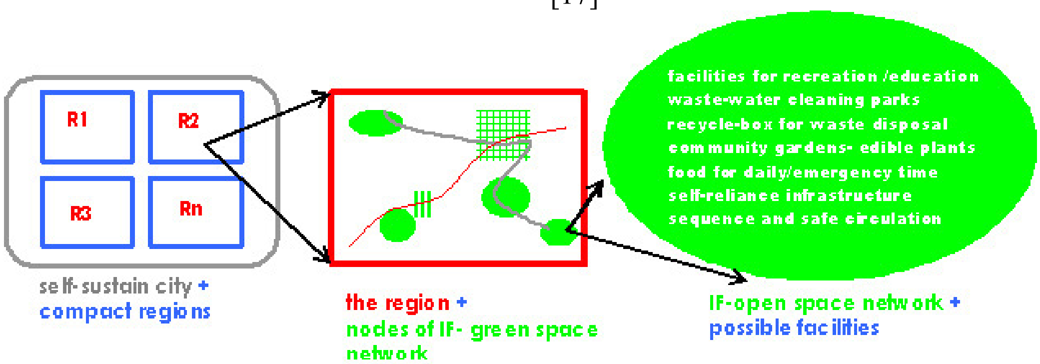

Figure 11. The conceptual organization of IF -GREEN NETWORK in urban scale

(IF) solutions can vary from community to community based on intrinsic local conditions supporting the integration of 'appropriate' technologies. Overall, these communities form a network of spaces that strengthens the overall city resilience. These microorganisms are linked through communication technologies, and circulation paths that serve as safe routes for the population.

(IF) city model shares characteristics with several previous theoretical city models expanding on the idea of an ecological city.

For Frank Lloyd Wright his Broadacre City model looked to create an even dispersal utilizing the landscape and larger ecological systems as an important role in merging the city into the countryside revealing the openness of the country landscape with the sophistications of city life [18].

For Lynch, with his model City as an Organism, which he ultimately discarded as an analogy, he found it useful as a conceptual shift from the city as a centrally controlled, centrally organized, standardized system of industrially produced elements to a self-organizing, differentiated, multi-centered, ecological constellation [19].

As we stated above, Istanbul faces many problems that need to be addressed. If we consider the population density, and the embodied process involved in generating water and energy for the consumption in Istanbul, the city is not only a threat to itself, but also to the country as a whole. With its collage of layers and complicated infrastructures Istanbul grows and survives today, as an uncontrolled organism, which could we hope to (re)define as a constellation of self–organizing and self-controlling microorganisms.

The IF green zone system, which we stated above, can be multiplied throughout the city from region to region as a closed-looped and self-regulated network of green spaces integrated within the city. In Figure 12 each green square symbolizes one (IF) community. Each unit has its own green space network, which is integrated to the city as a part of the (IF) system for urban sprawl.

The (IF) open space network represents a new layer of connectivity in a multi-layered fragmented city reducing the disadvantages of centralized infrastructure such as energy consumption, water and waste treatment.

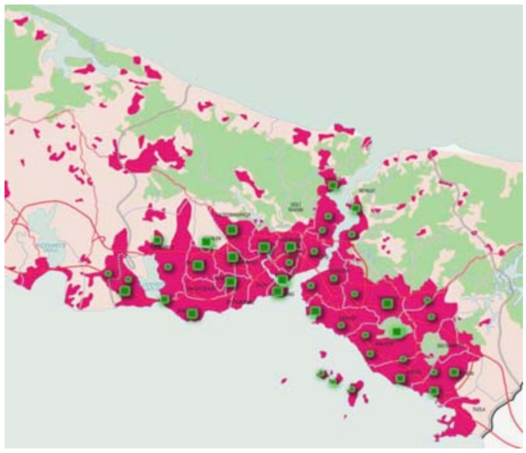

Figure 12. Proposed (IF) Green Network System in Istanbul

The system is a generator for a sustainable and ecological Istanbul. This inter-connected open space network represents green areas for the city and contiguous 'urban' escapes from the stresses of chaotic urban life. Furthermore, they are built with social and physical resilience for emergency situations in the case of sudden disasters such as earthquakes, floods or fires (Figure 13).

IF-Open Space Network for EVERYDAY	IF-Open Space Network for EMERGENCY
Large-scale green areas "IF Green Zone" (parks, waterfronts): - Community, science & culture center - Urban-agriculture with community gardens - Learning nature/ disaster issues with urban activities - Waste water cleaning parks - Rain water harvesting/ energy generation	**Large-scale green areas "IF Green Zone" (parks, waterfronts):** - Logistic and disaster mitigation centers - Temporary hospitals/ food service - Energy supply - Temporary shelters, - Hygiene promotion: toilets, showers, sanitation
Squares (nodes, ports): - Transition and meeting area - New work/ education opportunities - Energy generation	**Squares (nodes, ports):** - Emergency transportation - Evacuation centers for debris and people
Empty/ green lots: - Social area for leisure and communication - Waste water cleaning and rain water harvesting	**Empty/ green lots** - Storage for food & equipments - First gathering spaces for neighborhood survivors
Empty/ green lots: - Social area for leisure and communication - Waste water cleaning and rain water harvesting	**Pocket parks/ corners** - Mobile units for disaster equipment - Storage for water & dry food in 1st stage

Figure 13. Functional Potentials of IF-Open Space Network's Components in everyday urban life and emergency

4. Conclusion

We hope that through a brief explanation of existing conditions, and through the proposal of theoretical applications of infra-free ideology we have presented some interesting possibilities for the urban regeneration of Istanbul. The (IF) Green Constellation offers possible solutions to merge two different stages together through anticipation, and understanding of nature intrinsically linking urban design and disaster management. It is our belief that in order to generate a sustainable urban environment a shift in the way we conceptualize the services that supply our daily lives needs to occur.

In realistic terms, (IF) does not look to isolate itself from current infrastructures, but to supplement them with community-based alternatives, which *enhance the everyday, and safeguard against emergency* situations. All the solutions should be integrated into a larger system, which augments the intrinsic value of the locality, and provides a self-sustaining alternative in case of an emergency. In conclusion, (IF) suggests a flexible resilience through the addition of green spaces, the education of communities, diversity, multi-functional design, and recycling. This system is not necessarily novel in all of its principles, but holistically tries to utilize technology synthesized with nature through creativity, innovation, and vision to create a better and self-sustaining urban space for all.

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