

Toolkit for designing more sustainable large buildings in peri-urban areas and natural sites

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Abstract. The most sustainable action anybody in the building sector could actually take is decide not to erect any new building, in order to maintain the landscape as untouched as possible and preserved for the sake of our future generations. Unfortunately, this is rather impossible in this day and age, as the building decision usually comes from a necessity and an intention to provide appropriate shelter to a certain activity. This is precisely the reason for which the in-depth study of the impact a building has both on its immediate surroundings and on the urban/ rural environment should be a common practice if we are to design and build in a sustainable manner. The impact a building has on its environment varies according to two main criteria: (1) the type of building we are referring to and (2) the environment in which the supposed building is set out to be inserted in. Thus, it is fair to state that a single-family house with a 150 sq. m gross area build on concrete frame with brick filling built in an urban regulated area is going to have a significantly different impact than a 2000 sq. m construction materials storage warehouse built on a steel frame with term insulated panels in a rather rural and untouched area in the periphery of a village. This latter category makes the scope of the present paper. Concerning the 2nd criteria, the urban environment is highly regulated, and the majority of the space is set out to be built in a manner which mirrors the evolution of the last 130 years of urban studies. Most urban settlements in Europe, be it city, town or village have urban regulatory means of stating the way a certain building occupies a plot of land within the urban frame, its recommended height and suggestion to integrate the areas' specific aesthetics. When referred to the expectancy to have similar regulations for the peri-urban areas, or even the ones outside the built-up area we are often met with a no-man's-land, a rather empty regulatory area which falls in the jurisdiction of local and regional authorities. The present paper aims at offering a toolkit for the local authorities to use as a negotiation frame between the interest of preserving as much as possible the natural qualities of the natural landscape while balancing with the economic reasons and benefits of a new investment in their area. The 'tools' which make up the study concern: volumetric composition of the buildings depending on their function, methods of generating green energy based on the local resources, regulating the percentage of concrete platforms versus greenery in complete harmony with the destination of the investment. Starting from the premise that the building permit conditions for large scale projects due to be erected in natural

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landscape need a thorough regulation and after having an overview of such projects in Romania, this paper provides a practical tool for making sure the current laws are to be applied in a more practical and hands-on manner.

1 Introduction

1.1 International context

The most recent gathering of worldwide preoccupation to limit the greenhouse gases effects on the planets' climate has been under the commonly approved Paris Agreement in 2015. Followed by national plans to reach this goal, and, in Europe's case, under the guidance of the European Directive EU2018/2001, the European states have teamed up in their goal to limit the growth of the global temperature to a maximum 1.5 °C compared to the registered temperatures of the industrial times [1]. Their efforts would be concentrated on various and numerous programs of limiting the processes that generate CO₂ emissions while encouraging the use of renewable energy resources on an extended scale that would reach the desired amount – the 32% of energy produced from renewables [2].

Obviously, the CO₂ emissions topic (out of which the building sector is responsible for 40%) is equally a topic on the economy. Both the European Directive EU2018/2001 and the application specs of the Paris agreement make a difference between the developed countries and the developing ones. Collaboration between states is highly encouraged: trading with renewables and sharing the technologies of managing carbon emissions between member states is allowed and also sharing knowledge for producing green energy is advised.

From the building sector point of view, the directions of action are several and they differ depending on the type of building we are referring to. The sorting criteria for specific actions reveals few typologies on which the directions of action should be diversified: new versus existing buildings, residential versus non-residential buildings, urban insertion versus building in natural habitat.

The current paper aims at zooming in on the non-residential buildings and the ways in which they can be erected in natural habitat, in villages, away from dense, urban areas. The starting point of this reasoning is the well-known principle which states that we are to use the planet's resources responsibly, bearing in mind the fact that the generations to follow will inherit the same earth we'd be using [3]. This stands for saying that we need to protect the existing biodiversity for the sake of our wellbeing and that of the generations to follow. As we all agree that is usually better to prevent than to cure and also considering the historical time we find ourselves into, it might be fair to state that prior to measuring the amount of renewable energy we get to use, prior to measuring the carbon emissions of an average retail store, we could be taking care of the natural capital we still own. The forests, the lakes, the untouched landscape constitute carbon deposits free of charge and the way humans make use of this natural capital is to be studied and managed in a more reasonable way.

1.2 National context

Having mentioned this delay, that I'd call a 'historical' one, between developing countries and the already developed ones the strategies to reach the common climate efficient targets (the temperature limit of 1.5° C and the 32% renewable energy use) involved national strategy making. The differences between these national strategies and the politics put up to sustain them are quite different for the two categories mentioned above.

For example, starting in 2018 France put up a national initiative called '*Zero Artificialisation Nette*' which was publicly implemented starting 2020 and has as a clear

target the reduction of sprawl (as horizontal expansion of urban habitat into nature) by limiting the use of arable and natural land as building sites [4]. Meanwhile, in Romania, the percentage of arable fields destined to host agricultural activities and natural landscape is decreasing as shown in Fig. 2 while the built-up area is increasing (Fig. 1).

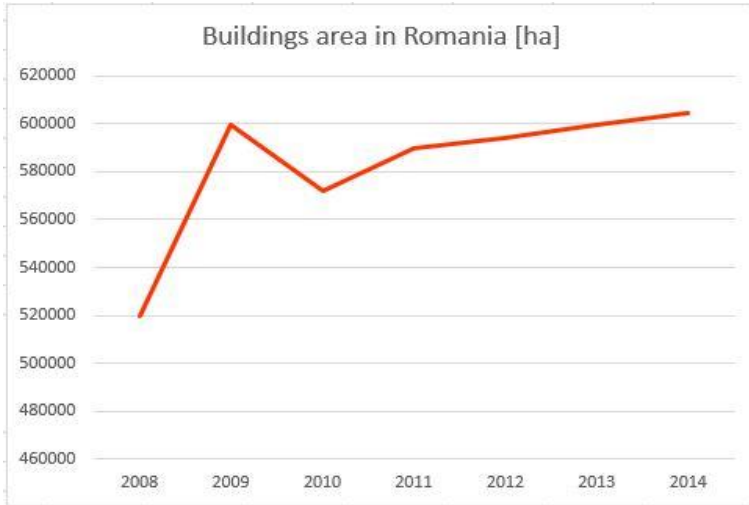


Fig. 1. Buildings area in Romania from 2008 to 2014 based on [5].

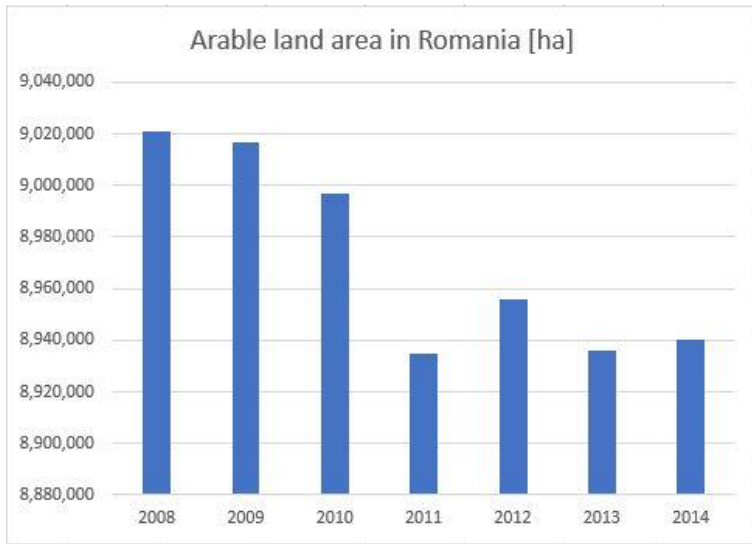


Fig. 2. Arable land area in Romania based on [5].

According to the major 2022 national survey [6], 48.74% of the Romanian population lives in urban areas. The country is organized into forty-two counties and the local administration is one of a centralized typology: decisions are made starting in and by the capital city of the county and they influence the natural unbuilt areas and the surrounding villages under their jurisdiction. The capital city of the county is usually a well-regulated city from an urbanistic point of view, highly regulated with urban laws determining 100% all

building developments within the city and complying to a major General Urban Plan (G.U.P.) which is detailed in both drawings and written pieces which describe the ways in which any new building has to inscribe into the existing urbanistic requirements. The current paper aims at describing a new way in which one could be regulating the ways in which a new investment is to be build up in non-urban centres and in natural and unbuilt habitat which remains unregulated despite it representing the remaining home of the rest of 51.26% of the Romanian population. As more than half of the population resides in non-urban areas and makes a living in the so called 'rural' areas of the country, it is high time we shift the focus from the cities and to the space between urban settlements and focus on strategies of better managing the 'space between'.

In contrast with the urban areas which have been the topic of urban studies for the last two hundred years at least, getting cities more and more regulated according to their progressive development due to their organic growth, the rural environment never made it to the headlines of urban specialists. Even nowadays, the way in which we regulate how to insert a new investment (implying a building) into a natural site remains an equation with several 'correct' solutions, as it all depends on the local authorities which usually operate mostly driven by economic interests. And as the economy evolves, so does the interest of having certain architectural programs which can no longer be hosted inside urban frontiers, into the more welcoming natural land which is still available at affordable prices. Further so, some businesses even require a great position in between large cities as they are supplying merchandise for larger regions, the consequence being that a natural site which has its typical advantages (nature proximity, healthier work environment, great landscapes, high air quality) becomes a targeted spot for certain activities (like a pig farm, for example).

If I were to summarize the procedures for erecting a building in natural habitat, the steps would be the following ones:

1. The Investor looks for a land plot able to provide his business with the most advantageous exposure to target customers. Doubling this feature, the plot has to be easily reachable via traffic conditions on national routs which convey into the same point. Once the economic and marketing factors point out to a natural site which usually has an agricultural function, inquiries are made at the local town hall-the capital county one.
2. Following a general and brief description of the investor's intentions, the town hall issues an Urbanism certificate which states that the land is currently unregulated for buildings and that it has to be regulated by a Zonal Urbanistic Plan – which (once approved by the local authorities) is an urbanistic project with power of law on any land.
3. The first phase is launched – the Zonal Urbanistic Plan (ZUP) as the decisive phase of the project. The focus here is to highlight the economic benefits the new investment might bring to the local area. This ZUP is also doubled by multiple other permits issued by all local authorities amongst which the most specific one - -the one of The National Agency for Environment Protection is usually present and easily obtained. The town hall approves the investor's intention and a "Opportunity permit" is granted for the development of the ZUP.
4. Starting from the design brief of the owner, the integrity of the documentation is produced by architects and urban planners. Based on their work, all other permits are issued.
5. All documents and procedures put in place by specialists are to be successively displayed to public scrutiny through some public consultations which are compulsory, but which usually are never frequented by the locals. Once all phases of public consultation are successfully passed without amendments, the project enters the agenda of the County Council who deliberates upon approval of the

investment. Usually, mainly because of economic reasons, town halls tend to approve a vast majority of ZUPs laid out in rural areas, where neighbours are usual other arable landowners aren't that present in the public life, but who usually thing that a new investment will benefit themselves too as new business opportunities might arise from such proximity.

6. One of the permits being issued is the one of The Agricultural Direction, which is the authority that regulates the land administration of arable land. After paying a certain tax that is being calculated by square meter of plot, the land is taken out the agricultural registry and it becomes available for buildings. After the ZUP is approved by a decision of the County Council, the owner can apply for classic building permitting procedure on a plot that he previously regulated himself through the ZUP in the parameters favourable to his investment.
7. For this second essential phase – the building permit, the National Agency for Environment Protection is being consulted once again, this time with a more detailed project. The Agency checks if the project registers for one that has to make a further study on its future impact on the environment and, unless the function of the new project is something which implies obvious use of chemicals or heavy industry, usually after following a rather bureaucratic procedure, the Agency gives its approval without any mentions, specs or detailed recommendations which would control the quality of future buildings and their impact on the environment.
8. The building permit is obtained from the town hall and the building is being erected in the parameters desired by the investor.

Form an economic point of view, the procedure explained above is a very favourable one which makes Romania a country with return of investment predicament extremely easy to estimate. However, although investments are to be welcomed and the local economy must be stimulated, being given that we actually find ourselves in a historical moment in which we all agreed on limiting our emissions in order to limit the effects of global warming, we believe the procedure described in points 1-.8 above would use some fine-tuning. One of the pieces to improve would be the education of the public on the consequences the natural land management has on our lives on one hand, and the education of all stakeholders which take part in the building decision making: designers, investors and public authorities' representatives.

On closer look, filtering through the lenses of an open source geo-localization tool over a southern county in Romania, the sprawl over a ten years' period is obvious. (Fig. 3).

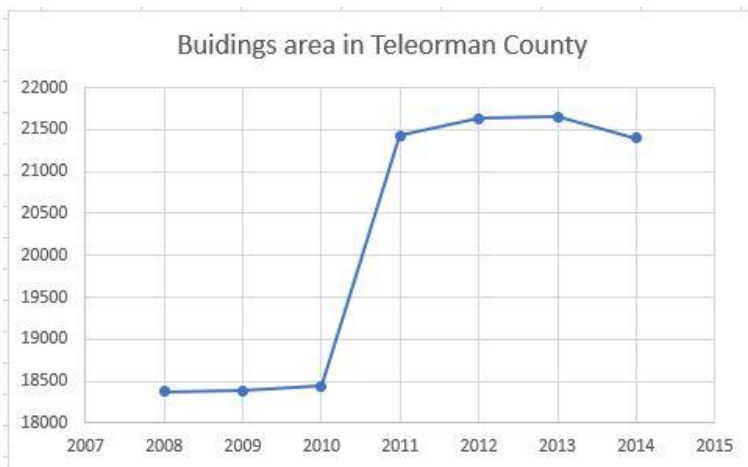


Fig. 3. Buildings area in Teleorman County based on [5].

As displayed in images starting with Fig. 4, we took our geo localization tour to a formerly natural site which is crossed by a European road. On its eastern vicinity, delimited by an old agricultural exploitation road, the site is crossed by Teleorman river, and on its Western side a natural hill of some 15 m height full of local vegetation. The first investment made somewhere between 2012 and 2017 became an anchor for the following ones. The first buildings are visible in Fig. 5, the first red circled area. Today the same area has four of its lots (each measuring on average of 20 000 sq. m) are either build up, in ZUP phase or already during building phase and the area is becoming a new pole of industrial real estate for four different businesses in a ten-year interval. And while this rebirth of investments has revitalized the economic realm of the area by reusing the arable land, what is the outcome of this change from an environmental point of view? Do the current investments have an impact on the local natural environment? Did their design take into account its particular features and geographical particularities? Did they make use of the local resources? Were local spices of plants and animals considered or are we talking about some buildings that might exist anywhere else in the country? How about the landscape priority existing on the site, did the new investments consider the way their buildings are going to impact the existing ecosystems?

As displayed in the slide depicting the 2023 situation, the view of the hill is in for quite a new perspective. What about the water management and all the rainwater that is to be drained on the slope and arrives on the concrete platforms of the new investments? Getting back to where this study started, it is important to say our point of view is not a critique of the way we build in natural landscapes but a raise of awareness. Economy is important and growing it has to be a common drive but is this the only way to do it? Can we do better? Are these questions and observations exclusively the preoccupation of a handful of people? Did the designers take this more considerate approach towards the existing natural habitat of local flora and fauna? Did the investors, as the ones who financed these projects ever consider any of these aspects? But, most importantly, is there any local authority who can answer our questions regarding the way these designs impact their natural proximity? (Fig. 4, Fig. 5).

Form professional experience, we can state that yes, designers usually reflect upon these problems and try to influence the investor into taking a more sustainable approach...which is not always a reality, as for the investor the main drive is the return of his investment in the shortest time frame; sustainability comes second compared to economic motivators. But one would expect a raised impact of these preoccupations in the local community, both public authorities and neighbouring properties. In a schematic approach we could say the stakeholders of a new investment have the following priorities: the investor-his return of the investment and profit, local authorities-economic growth and new employment, designers-best solution accepted by investor, contractor-the greater the profit after the building process, the better.



Fig. 4. Expansion of new built environment over the natural existing one (Google Earth [7])

However, in our study, a common denominator has been identified amongst all stakeholders who has both the quality and the authority to require and recommend a friendlier approach towards the way buildings can be erected into natural landscape: the local authority of The National Agency for Environmental Protection. This institution is the one which condition both the local authorities who issue the building permit and the one who certifies and authorizes the activities of the investor once the building is up and running through the ‘functioning permit’ -compulsory for any commercial activity. Therefore, in our research we have put up a checklist which is to become a toolkit for the evaluators of the Agency and a recommended guide for designers, as it would become a public document. Each National Agency for Environmental Protection is to decide how many of the criteria a new investment is to comply with depending on the natural particularities of their region.



2009



2018



2022



2023

Fig. 5. Evolution of the landscape over a fourteen years' span (Google Maps [8])

Table 1. Toolkit for the Agency for the Protection of the Environment

CRITERIA	sub CRITERIA
1. General	a) Design a building bearing in mind at the same time its 3D model, its Life cycle analysis and Facility maintenance in its operational phase.
	b) Focus mainly on lowering the energy consumption by design.
	c) Take into account the local daylight, sun, wind in order to reduce energy use.
	d) When designing a building take into account that the site it is inserted on is a fraction of atmosphere, hydrosphere, biosphere and geosphere. All of these are interconnected and interdependent.
	e) Design for the climate zone the building is to be inserted in.
	f) Choose to build on sites which offer natural elements to limit energy use (as in the proximity of a lake impacts temperature on a 20km radius)
	g) Design the building envelope as a continuous clothing which limits energy use through good design of openings, shading systems, ventilation, insulation, thermal mass etc.
2. Strategy for Insertion in natural environment	a) Design the building bearing in mind the topography and the natural fabric the building is to be inserted into. May be its geometry can benefit from the
	b) Design a building bearing in mind the fauna and flora already existing in natural site. Nature is the one supposed to cross urban areas not to circle around
	c) As long as the landscape allows for it, consider building high density in order to preserve land and nature and to prevent sprawling
	d) Learn from nature - mimic its language through biophilic design.
	e) Use green, white, blue roofs when/ if possible.
3. Building materials	a) Use durable and sustainable materials and bear in mind the health of the users and the available materials nearby.
	b) Bear in mind to design with building materials which require low
	c) Use materials with reduced embodied energy by its extraction, production, transportation, installation and dismantling.
	d) Use the already available materials: waste/ reclaimed and reused, recycled and avoid the non-renewables.
	e) Use materials with the lowest embodied energy like concrete with 0 cement, organic materials, wood and reused steel etc.
	f) Choose materials which are easily reachable to avoid transportation
	g) Prioritise natural materials which are Carbon depositors (like wood).
	h) Strategy in material choice: reduce, reuse, recover, recycle.
	i) Keep in mind that whatever you design it has to be (low) maintenance. If it isn't maintainable, it is not sustainable.
4. Waste management	a) When choosing materials for a building consider what will happen in the long run with the materials put in place. Design with life cycle analysis of materials in
	b) Have a 0 waste policy on the building site: everything you design has to be dismantlable, with minimal packaging and packaging has to return to supplier.
	c) There is no waste in nature. Design with this principle in mind and provide the new building with materials that can 'feed' other industries once they will not be in use anymore.
5. Water management	a) Reduce water consumption by using smart designed taps, rain water collectors and, when/if possible recover heat from hot water used.
	b) No infiltration of used water into the soil allowed.
	c) Design platforms on courtyards with permeable and rain water drainage friendly surfaces.
6. Natural/ local resources vs. Renewables	a) Focus first on designing buildings that use the local resources available on site and only after, on using renewables.
	b) Use the energy of a nearby river to operate a turbine. As water debits tend to fluctuate with the season, several natural renewables can be mixed (sun+wind).

2 Conclusion

As economic growth is a target developing countries seek to reach within the foreseeable future, we suggest also improve our ways of doing it [9]. We have the advantage to learn from the past [10]. In retrospect, as that portion of history is well documented, we are aware today of the effects the heavy industrial years had in Europe, for example. And, although it is obvious the wealth of the developed countries resides in a certain amount on those years, we believe it is in our responsibility to learn from the past and adapt. As new technologies advance, as the means of producing energy have evolved from fossil fuels to green hydrogen and as they are taking over the energy market, as new ways of harvesting renewable energies from nature are improved, a natural consequence would be to take a better care of (what is left of) the environment in general, and natural sites, in particular. As architects we find ourselves in service of both our clients and also the public space and general public wellbeing and we usually balance these two ones successfully. There are however, situations when the good intentions of a designer might meet some resistance either from an uneducated client, a careless community or blind bureaucracy of local authorities. This is where education and tools to make it accessible might come in handy and this is where we need to help raise awareness that we currently have better ways of designing at our fingertips. And this is the aim of this toolkit placed in the hands of both authorities and designers. As architects and urban planners, we must keep in mind that the end user of our buildings is nature. And, as the wellbeing of humans depends on the wellbeing of nature and its functioning biodiversity, we can make it our mission to take care of it as best possible.

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