

The Evolution of Urban Zoning from Conventional to Form Based Codes; Introducing Non-Euclidean Zoning Techniques

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Abstract

Zoning has always been one of the basic tools of land use control available. Zoning is the regulation and restriction of land uses according to a predetermined plan. This paper will present a look at conventional zoning, its origins, the evolution of the zoning, and the scope of zoning types. Regardless of the varieties, most zoning codes can be classified into at least one of the following broad categories: Euclidean zoning, Performance/Impact zoning, Incentive zoning, Form-based zoning and Hybrid Zoning. In this article, a descriptive-analytical method is used to review the existing documents and extract the materials in order to introduce the approach of FBC, its advantages and disadvantages. So, after defining each concept, the Critiques of Euclidean Zoning will be explained and then a new approach of zoning named Form-based Codes will be introduced to develop a better way of zoning in order to select homogenous areas of urban and rural terrain to adopt determined and certain rules of planning.

Keywords: Euclidean and non- euclidean zoning, Performance/Impact zoning, Incentive zoning, Form-based zoning, Hybrid zoning.

1. INTRODUCTION

1.1. Historical Roots of Zoning

Laws for regulating urban area are common for a long period [2]. By manipulating the pattern, form, and use, they have a robust impact on life quality influencing everything within daily life to the demographic structure of schools for people living in the vicinity [3].

In Roman times for example, regulations affecting urban form dealt with street size and building height to minimize wind impact on dusty streets and avoid street shading by tall buildings [2]. In the City of Rome, Julius Cesar restricted the height of buildings to minimize obstruction of sunlight. Regulations identifying type, embellishment, height, setback, and window size of the building were already present in medieval era [3]. The Laws of the Indies enacted by King Phillip the II of Spain in the 16th century, guided urban development in the Spanish colonies of the Americas, and addressed in detail the form of the urban environment. Codes have also

regulated uses if perceived incompatible with urban spaces or other uses. Keeping industrial buildings and functions separate is an example of zoning practiced since ancient times. Talen [3] mentions restrictive laws in both ancient Rome and 17th century London that kept industry out of central areas or other city parts [2]. In the late 19th century [In America], land use regulation and nuisance laws were used as a way to discriminate against minority groups. This land use control was a way to discriminate against Chinese workers and keep them from living or operating a business near the general population, forcing them to live in "Chinatown" enclaves where they were allowed to live and operate their businesses [4]. By the late 1800's there was already a significant history of building ordinances and regulations in Europe and European cities more frequently embraced regulations. US efforts at the time were scattered and isolated such as New York's Tenement House Act of 1867 applied to one only type of city building [3]. However, it was becoming more apparent that a more coordinated approach was necessary to address challenges of the 1800's rapid city expansions such as sanitation, infrastructure, housing and open space [2].

According to Talen [5] zoning was invented by the German engineer, Reinhard Baumeister in the 1870's

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which separated the entire city into zones of land value and intensity. According to this way of making cities so clearly differentiated into zones, zoning, is described as “planning in recognition of the differences in different parts of the city” [ibid].

1.2. Zoning Scope and Content

Zoning has always been one of the basic tools of land use control available. “Zoning is the regulation and restriction of land uses according to a predetermined plan” [6]. The public regulating for the land use is zoning. Zoning is adapted by local governments including counties, cities, towns, and villages for controlling the kinds of uses and the density, bulk, as well as dimensions of the uses [7]. Zoning supporters believed that it improves the urban residents health. However, unlike housing reformers, they consider zoning as the way for protecting the well-being and health of the middle and upper class by creating a decentralized, suburban and healthy environment by zoning. Today, in the USA, safety, health, and welfare are continually the legal foundation for zoning as the primary factor for land use patterns [8].

It was introduced as a novel system of order.

“By zoning, the idea of orderliness in development of a city was claimed, rooted and demonstrated to encourage the erection of right building, in the right place, in the right form” [9]. There are mainly four ways by which zoning ordinances control future development [6]:

1. Incorporating future land use into a comprehensive plan
2. Protecting existing land uses from incompatible uses
3. Adequately serving future development with streets, schools, parks, and utility systems
4. Directing development away from environmentally sensitive areas

“Hypothetically, zoning is principally aims at segregating the uses that are regarded as incompatible. Though, zoning is practically utilized as an authorizing system for prevention of the novel development from damaging present businesses or residents” [10].

Despite the different zoning code of every city, the scope of conventional zoning integrates regulation for:

Regulation of Use: Provisions to regulate use are generally organized in three or four categories [11]:

- Residential
- Commercial or business
- Industrial or manufacturing
- Agricultural

Acceptable uses by district can be expressed in three forms:

- Permitted uses including open space, agricultural, residential, industrial, or commercial;
- Prohibited uses, that can be extremely specific and are significantly site-oriented;
- Conditional uses, which require special permits.

Regulation of Intensity: Intensity can be defined in planning terms as the measure of the quantity of a specific use permitted at a specific location. Often the major distinction between certain zoning districts is the intensity

of the use. Residential zones, for example, may be identical except for the minimum lot size required. A measure of density used in the comprehensive plan. A measure of intensity for commercial and industrial zones is often calculated in floor-area ratio (FAR). Intensity is also regulated through maximum height restrictions, for structures built on an individual parcel [ibid].

Regulation of Dimensions: The regulation of dimensions is closely related to intensity regulations and also derives from concerns about public health, safety, and welfare. Ordinances regulate lot and building dimensions through:

- Lot width and depth-are controlled to avoid odd shaped lots
- Building heights-Building heights often are used to control the intensity and overall visual appeal and consistency of a zone [11].
- Quantity of probably occupying space structures (lot coverage) is often stated in floor area ratio (FAR) [10].
- Location of a building or buildings on the lot (setbacks) - Bulk standards are more often than not controlled by yard and setback requirements. These prohibit building within certain distances of the front, rear or side lot lines [11].
- Proportions of the space kinds on the lot (indeed landscaped and paved spaces) including impervious cover, are regulated as the environmental protection as a result of the established straight relationship between runoff, water quality, and impervious cover. Minimum parking standards are coordinated with use, the impression that various demand levels for transportation and parking are generated by various uses [10].
- Minimum parking that must be provided- In zones that do not allow parking in front yards, setbacks may still be required to provide open space and visual clearance for pedestrians and automobiles [11].

2. STRUCTURE OF ZONING; THE NUTS AND BOLTS OF EUCLIDEAN ZONING

Zoning can control a variety of elements namely *Use, Intensity, and Bulk* [6]:

- **Use:** The height restriction, placement of building, and parking requirements become very critical in controlling intensity of use.
- **Intensity:** Refers to the amount of use of land in terms of building area (like Floor Area Ratio), minimum lot size and number of buildings on the lot.
- **Bulk:** Denotes for the actual volume and size of building. The relationship between buildings and their location is regulated by setback requirements based on the height and size of the building, exterior walls location at all levels related to lot lines, streets as well as other buildings. Providing sufficient air and light, landscaping, and signage are also important factors in regulation of the whole quality of the constructed environment.

The ordinance includes two main components of the zoning text and the zoning map [11]. The map is used to illustrate where each use zone is located. The zones are readable down to the parcel level of the community, so

each property owner can see where and how his or her property is designated. The second part of the ordinance is the text, which specifies what the portion of each parcel upon which structures can be placed, the maximum size of the structures, and what the structures can be used for. At the beginning of each of the zoning district texts, the municipality lists building uses that are allowed by right, uses that require a special permit, and uses that are strictly prohibited. The text and map combine to prescribe for a property owner what is an allowed use of his or her parcel of land [ibid]. The basic components of zoning ordinances are as follows [6]:

3. TYPES OF ZONING

Irrespective of the varieties, many zoning codes might be categorized into at least one of the following extensive classes: Euclidean zoning, Performance/Impact zoning, Incentive zoning, Form-based zoning and Hybrid zoning. Form-based zoning and the evolution from Euclidean zoning to Non-Euclidean will be introduced at specified in-brief sections.

3.1. Euclidean zoning: Use-based (functional) zoning

The idea of land use zoning was legitimized by the US Supreme Court in 1926, regarding Village of Euclid, Ohio vs. Ambler Realty Co [12]. Use and height restrictions on various zones were put by this most extensively documented kind of land-use regulation in the US termed Euclidean zoning. As a main phase of confining ‘incompatible uses’, conceivable land uses are sorted by Euclidean codes into more wide classifications such as

agricultural, commercial, residential, institutional, industrial, or open space.

[Infact] Land use regulations are not new. They did not begin with zoning and they will not end with the types of codes promoted by New Urbanism, Smart Growth, or whatever movement supersedes them. The need to regulate the built environment, either through form or function has been cornerstone of civilization [13]. At the turn of the twentieth century, cities viewed land use regulation as a powerful force that could help shape the pattern of urban land use [14].

Until the 20th century, modern zoning would not be arisen. It would not be an ideal of the designer, however, it would be a protection versus negative perceived and actual uses [10]. Modern zoning initiated in Germany as a method for controlling development and public health issues, however, zoning was not separated by the German system into uses completely. Adapting the system by American designers, they found that housing should be isolated from nonresidential development, in addition, the residential districts should be isolated by housing type as well including multi-family and single-family units [8].

According to (Parolek, et al. 2008), zoning slowly evolved to outline exclusive use-based zones out of the need to minimize fire spread by separating buildings and uses, and provide for more sunlight. Smoke producing industries were slowly separated from residential development to minimize fire threats. This slowly resulted into the exclusive separation of uses within a city as single-family, commercial, and industrial uses were segregated and deemed incompatible. Separating uses resolved many problems and contributed to the health and welfare of urban dwellers [2]. These practices are normally denoted as traditional zoning, conventional zoning, or Euclidean zoning [15].

Table 1. Components of zoning ordinances; Adopted from [6]

Section	Description	Examples
Zoning map	Show zoning district boundaries on the map	Separate map book or pocket map
Definitions	Describe terms used in the zoning ordinance	“Dwelling unit”, “structure”, “lot”, “yard”
General provisions	Describe operational rules and provisions applicable to the zoning ordinance	Title; purpose; authority; applicability of zoning ordinance; establishment of zoning districts; rules of interpretation
Zoning district regulations	All zoning district and overlay district regulations. It also includes development standards.	Permitted and conditionally permitted uses in agricultural, residential, commercial, industrial, and floodplain overlay districts; parking
Special development standards	Specific development standards applicable to all uses and districts	Signs, nonconforming uses and structures, home occupations, cycling facilities, bed and breakfast inns
Administration and enforcement	Procedural requirements for all administrative and legislative reviews, appeals, enforcement, and penalties.	Site plan review, architectural review, zoning ordinance amendments and rezoning, filings of appeals, enforcement and revocation of permits and penalties

Typically, land use is divided in two ways, by its function and by its physical characteristics. So, there are specified ordinances following this fact. Three kinds of controls are normally utilized by these early zoning ordinances through establishing 3 various zoning plans for the whole municipality. The whole area was zoned by a plan into use districts. The municipality was zoned by another plan into height districts, putting height restrictions over structures established within each district. The city was zoned by third plan into area districts founding minimum lot sizes with the distant residential lots with greater minimums compared to the older residential area near the city center [16].

As a result, these early regulations tried to reduce the unrestrained development and prevent land uses as a 'nuisance' to other nearby uses [6]. Hence, a steady practice of separating 'incompatible' uses turned into as the norm [17]. Euclidean zoning includes the advantages and disadvantages, briefly as [18]:

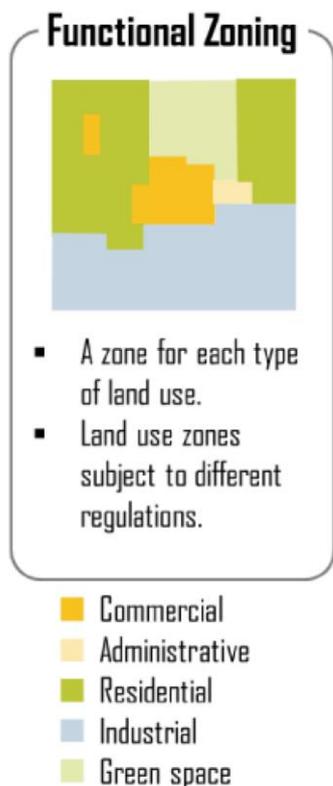


Fig 1. Use-based (functional) zoning; Adapted from [21]

Advantages

- It knows zoning applicants and administrators.
- It is able to protect property values.
- It is able to inhibit mixing of incompatible land uses.

Disadvantages

- No flexibility referred as too restrictive by property owners.
- Not comprehensively regulating the design.
- Encouraging dispersed sprawling developing patterns.
- Not encouraging a combined use.
- Promoting automobile-dependent development patterns.
- Working against historic mixed-use vicinities.

- Limiting the developing potential of features that are “foregrounded in” but not permitted by later zoning amendments.

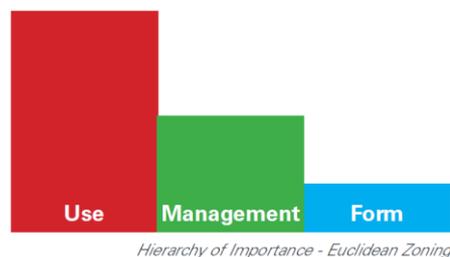


Fig 2. Hierarchy of Importance- Euclidean zoning; Adapted from [17]

3.2. Performance/Impact zoning

Land use planners were progressively baffled with the limitations of conventional Euclidian zoning with its strict division of land uses and minimum requirements. Performance zoning encounters the problem of isolating possibly incompatible land uses from a diverse angle. As the term states, within the performance standards, the planner considers the effect instead of use. The zones might be retained by a performance-based by law, however, they would be on the basis of the performance levels stated by neighborhood features or environmental abilities instead of use categories. Preparing the performance standards necessitates a community to consider particular factors of the economic, social, and physical environment for determining the required levels of performance [19].

Parolek, et al. state that performance zoning was established to “providing incremented flexibility in the types and number of land uses permitted in different zones” [20].

Regularly, utilizing Euclidean zones as a foundation, the Impact and Performance zoning methods make more uncommon land uses possible to move toward the present zones in case conforming to the fixed standards developed for that district. Different land uses create different external effects from noise and traffic to glare and waste generation. Under effect zoning, performance standards are developed for managing the effects and promoting the compatible development well. Another method is performance zoning that uses various dimensional ratios for regulating land-use intensity [21].

Within intensity zoning, land use zones are defined by the permitted intensity level. Hence, a flexibility level is enabled in urban developing because it allows the developers to choose the types of development occurring as long as these development abide to density limitations [22]. Floor area ratio or ‘FAR’ (the ratio of building floor area to lot area), livability space ratio (the ratio of non-vehicular space like landscaping or lawns to the overall site area) and open space ratio (the ratio of open space to total site area), are the examples in this regard. These are often utilized to state particular site effects, from open space quality and shading to the placement and size of parking lots [21].

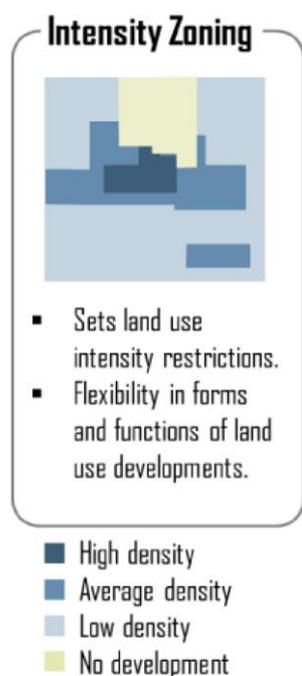


Fig 3. Performance/Impact zoning; Adapted from [21]

One of the performance zoning advantages is that a specific character of the community can be reflected well by the intensities and types of effect regulated by the performance standards rather use categorizations [19].

3.3. Incentive zoning

Similar to the previous methods, in incentive zoning, Euclidean zoning is used as a baseline. Yet, to allow higher flexibility and diversity within the Euclidean zones, by incentive zoning, the projects can exceed standard requirements in case providing some benefits to the local community [21].

Incentive-based zoning was established to encourage developers to progress in particular locations, hence, the city would permit incremented density, lot coverage, building height, or floor-area ratio. Other “fixes” also involved specific permitting processes such as conditional use variances and permitting [20]. For instance, in exchange for offering amenities (transit access, parks, plazas, affordable housing, or public art), projects are normally permitted to construct at greater densities or to higher building heights rather than normally permitted [21].

3.4. Hybrid zoning

Elements of the different above mentioned methods are included in most modern zoning codes [ibid]. Hybrid zoning is the combination of form-based elements or performance standards into a common zoning code [particularly in single-family residential areas] [10] In addition, it includes performance zoning elements to state more strongly developed areas, and incentive zoning to state decreased parking needs as well as creating further affordable housing. By combining form-based elements [in

thicker downtown areas] into a conventional zoning code, particular design elements can be targeted by a community preferred for the novel development and it becomes possible to refine and concentrate standard bulk needs while still regulating permissible uses. By this method, the best elements of each practice are identified and integrated into an overall new code (11). This new practice of integrating philosophies is normally denoted as Hybrid zoning, a method identifying the best factors of each practice and integrating them into a novel whole [21].

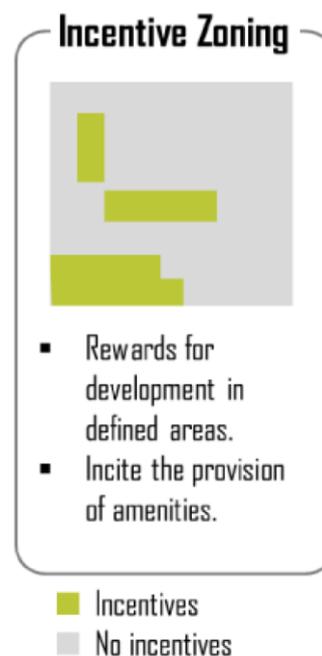


Fig 4. Incentive Zoning; Adapted from [21]

It is aimed at achieving the best of both worlds, by regulation of the form and the environmental effect and the use. This method attracted a huge deal of attention in the 1990s-2000s when more jurisdictions learned regarding form-based zoning, however, they still tend to recall the basic structure of their ordinance [10].

Composite or Modular zoning is a particular type of hybrid zoning taking 3 fundamental components of development including use, building design or form, and site design or orientation. It combines and matches them to construct various flexible zoning districts. The component of ‘use’ makes the kinds of land uses (commercial, residential, and industrial) allowed within a zoning district, however, the element of ‘form’ defines the height limits, façade design standards, and entryway typologies. Ultimately, the component of ‘orientation’ determines the arrangement of the site, with standards for location of the buildings related to the sidewalks, the location of landscaping and open space, and the location of pedestrians access the site. A zoning district is created by any integration of these factors. It means that zones may be much more extremely customized to each community’s unique requirements. Here are the brief Pros and Cons of Performance zoning [18]:

Advantages

- Integrates into the existing zoning code.
- Maintains basic standards that code users know.
- Permits sustained control over land uses.
- Offers greater potential to integrate land uses by mixing compatible land uses into development patterns.
- Puts higher significance on building and site standards.
- Creates zoning districts with multiple components making it simple to zone property for compatibility with nearby features.

Disadvantage

- Contains the impact of some overlays adding complexity.
- Multiple regulations on use and form may be too multifaceted or dampen the development.

4. EUCLIDEAN ZONING: SUCCESS, FAILURES, CONSEQUENCES, AND CRITICISM

4.1. Critiques of Euclidean zoning

Criticisms of Euclidean zoning are resultant from the overall spectrum, from planning luminaries like Jane Jacobs; property rights protestors; and from numerous ordinary individuals finding flaws in using the conventional zoning. Form-based codes were established to state 3 remarkable barriers made by Euclidean zoning including difficulty in integrating uses, redevelopment, and enhancements in the public realm [10]. The biggest criticism of Euclidean zoning is the major part it played in creating sprawl [4]. Mainly, Euclidean zoning results in the promotion of inefficient and unsustainable cities:

Other administrative issues with Euclidean zoning are being outdated and complex in nature cause Euclidean zoning is static in nature. Many cities' zoning ordinances are, at best, decades old. A typical city zoning ordinance is strictly text-based, as each zone's regulations are described [11]. Also Euclidean Zoning has Slow Administrative Process.

Euclidean zoning is proscriptive by nature, showing what not to do at a particular area, but rather gives no indication what the city and its citizens really need for that area [23]. Any change in the area plan or bringing a new proposal by a developer, needs a review process that requires public announcement, planning commissions and city council approvals that are time consuming and costly.

4.2. Successes of Euclidean zoning

Euclidean zoning has been successful in achieving its original goal of separating incompatible uses from each other. Through zoning ordinances and zoning maps, it is almost possible to predict future use and development. Zoning also protects the single-family use the most by

giving highest priority in the pyramid, which guarantees property rights to homeowners [6]. Zoning also functions as a place holder for future growth areas in a community, and an appropriate change of zone can open up parcels to development when infrastructure has reached the area [11].

4.3. Failures of Euclidean zoning

Compared to these few successes of Euclidean zoning, Euclidean zoning is considered to be a failure as it is the root cause of many socio-economic and environmental problems of American cities today. As Andres Duany states that “whoever controls the codes controls the city and ultimately the society” [6].

The separation of uses that was so desired by cities in the early 20th century occurred in a pedestrian-dominated transportation system. The intent of separating the daily activities of living, working and shopping was well intended to improve the quality of life for residents concerned with the overcrowded conditions of cities at the time. The proliferation of the automobile and the extent of its use for the majority of daily transportation needs have mutated the separation of these uses into a much larger scale. This large, automobile-orientated environment leads to excessive infrastructure requirements, loss of open space, increased air pollution, limited provisions for pedestrians and a much lower quality public realm [11].

5. FROM EUCLIDEAN ZONING TO NON-EUCLIDEAN

To overcome the rigidity and limitations of Euclidean zoning, more flexible zoning techniques have been evolved by planners known as Non-Euclidean zoning. This later model tried improving incrementally from the previous one. The need for creating good design development prompted innovations through various zoning techniques, which can be applied in various combinations with the Euclidean zoning. Several known Non-Euclidean zoning methods are: Planned Unit Development (PUDs), bonus/incentive zoning, inclusionary zoning, overlay zones, cluster zoning, Transfer of Development Rights (TDR), performance zoning, and special districts with design standards [6]. These Innovations in zoning were devised to remedy the already apparent negative effects of zoning [13]. Here is the Comparison between Euclidean and Non-Euclidean Zoning:

5.1. Alternatives to Euclidean Zoning

Zoning known as an effective method for development regulation, has encountered innovative alternatives to conventional zoning in recent years in order to improve planning outcomes. Table 3 shows a variety of zoning types.

Table 2. Matrix of comparison - Euclidean zoning vs. non-Euclidean zoning; Adopted from [6]

Zoning type	Euclidean zoning/ traditional zoning	Non-Euclidean zoning
Definition and purpose	“A municipality is divided into districts, categorized by use limitations, height limitations, and other regulations regarding the density, bulk, and minimum acreage of a parcel.” It is mainly aimed at separating incompatible uses and promoting safety, health, and general welfare.	“Those regulatory patterns varying the traditional pattern of parcel-by-parcel, district-by-district zoning.” It includes everything else other than Euclidean zoning. The various types of Non-Euclidean zoning are pre-set in the applicable zoning ordinance. Its primary purpose is to overcome the rigidity of Euclidean zoning and to provide flexibility.
Types	<ul style="list-style-type: none"> – Agriculture – Residential (single family, multifamily, mobile home, etc.) – Commercial 	<ul style="list-style-type: none"> – Bonus/Incentive Zoning – Overlay Zones – Cluster Zoning – Planned Unit Development (PUD) – Transfer of Development Rights (TDR) – Performance Zoning – Form Based Codes
Review process and getting approval	If the proposal meets all the zoning standards, it is not time consuming	Could be time consuming depending on getting approval for variance and special exception.
Features of zoning	Focuses mainly on land use, setbacks, density (FSI), and building height	Different for different zoning types – includes land use, standards for streetscape, parking, actual building footprint with setback, building height, densit
Built environment	Limited in regulating physical design based on the socioeconomic requirements	Depending on the detailing of the zoning codes, predictable built environment can be achieved.

Table 3. Zoning types and Descriptions

Zoning type	Description
PUD	<ul style="list-style-type: none"> • Gives flexibility to communities looking to integrate different uses together- even enable the mixing of uses within the same building. • Enable municipalities to create custom zoning standards • As opposed to conventional zoning that regulated use on lot-by-lot basis, PUDs are developed on a group of contiguous parcels or tracts that meet certain minimum area requirements to create a unified master plan [6]. • The concept of the PUD is an extension of cluster zoning, which can be used to maintain the overall density of a development while preserving open space and environmentally sensitive areas as an amenity for the residents (Arendt 1996, 7) [11]. • The placement of individual buildings are clustered increasing the density in certain areas, creating more open spaces, [6]. • Permitted uses are much greater in number allowing mixing of uses, [6]. • A major criticism of PUDs is that even though internal connectivity is often achieved Between different uses, the PUD often fails to effectively connect to the local street system (Barnett 2003, 256). This lack of connectivity can lead to an additional burden on arterial roadways [11].
Bonus or incentive zoning	<ul style="list-style-type: none"> • An attempt to control the spread of low density developments, while maintaining their current zoning ordinances, creating more livable communities. • Bonus or incentive zoning may allow a developer to build at a higher density than a certain zone • Bonus and incentive approaches have been criticized because of the time consuming nature of negotiations that are often required, as well as its ability to undermine the certainty of the underlying zoning ordinance [ibid].
Inclusionary Zoning	<ul style="list-style-type: none"> • Denotes for a program imposing price controls over a percentage of the novel development [24].

Zoning type	Description
	<ul style="list-style-type: none"> • Normally, by inclusionary zoning ordinances, some affordable units are mandated, an income level is designed defined by median income, and provided for an reasonable period. However, incentives are provided by inclusionary ordinances for the developers, where a density bonus is the most usual [25].
Overlay Zoning	<ul style="list-style-type: none"> • Defends natural resource areas. • Overlay zones are precisely tailored to defend the environmental areas including a forest, aquifer, reservoir, or beach area. • Overlay zones are more effective compared to other land use controls in environmental protection as a result of their flexibility, their concentration on particular environmental areas, and using performance standards be them [26].
Cluster zoning (Conservation-oriented development)	<ul style="list-style-type: none"> • Cluster zoning is a zoning technique where development density is defined for a total specified area, instead of on a lot-by-lot basis. By the specified cluster zone, a developer is able to exercise larger flexibility in planning and assigning structures, providing the overall density requirement is satisfied. Cluster zoning known as conservation-oriented development, makes is possible to cluster and construct the total number of homes in a specified land more compactly onto one or more portions of the land; normally, double the density is focused on half the land. By such a strategy, it is possible to develop the smaller homes (less expensive) on smaller lots (less expensive), hence, alternative housing options are provided for multiple community population groups and the opportunity is offered to maintain remaining land for neighborhood and public use [27].
Transfer of development rights (TDR)	Another zoning related device is the transfer of development rights (TDR). The method is intended to focus the development in areas in which it is required and to limit it in areas in which it is not required. Property owners in areas that are being preserved can sell their development rights to property owners in areas where greater density is desired. This can be an effective tool to encourage farmers to retain their land for agriculture [11].
Performance zoning	Performance-based regulation is created assuming that the effects of land use as a function of intensity, or the physical functions and characteristics, instead of particular land uses themselves (residential or commercial). The main goal of performance-based land use regulation is to adapt land uses to site features. This regulation offers for higher discretion based on the allowed land uses while trying to restrict the effects of the land uses via the performance criteria. Although traditional zoning separates land uses, in performance-based methods, better land use integration is allowed providing that meeting performance criteria [28].

Nowadays, zoning is become complex including many philosophies and variations for constructing and running the ideal code for any given context. The use-based codes, transect method, intelligent urbanism and SMART codes are some popular movements associated with zoning all focusing on arrangement of our cities well eventually achieving the objectives of the general plan [29].

5.2. Form-Based zoning as a suggested solutions for Euclidean zoning: The transect alternative

Form-based code (FBC) is the latest response to the failure of Euclidean zoning to create livable communities. FBC differs from other alternatives to current zoning ordinances in that it can actually replace the ordinance as a land use regulation tool instead of just modifying or adjusting the existing ordinance. FBC controls the use of the land at a lower priority in the hierarchy of form, density, and use [11]. Form-based codes include numerous benefits over conventional zoning ordinances. Transect Planning and the Smart Code is in many ways a sound alternative to conventional zoning, responding well to the increased desire for a sense of place. Its environmental sensitivity is clear, as its tight connection with ecological terminology suggests. It places an emphasis on regional

rather than parochial concerns, and claims to be more developer-friendly than conventional zoning without allowing incompatible uses to neighbor each other [30].

5.2.1. FBC elements

- Three regulatory types of FBCs exist including [10]:
- *Mandatory codes* should be followed by developers in a considered area.
 - *Optional or parallel codes* are provided as an option, sometimes with given incentives to the developers choosing them.
 - *Floating zone codes* include all the other codes' regulations, however, they are not tied to particular land areas via a regulating plan.

In any case, form-based codes include 3 or 4 distinct components, in general: *1.the regulating plan, 2. the building form standards, 3. a set of terms, and 4. optional architectural standards* [11]:

- **A Regulating Plan** is a map or plan allocating various standards of the code to physical location. This is the same as a zoning map, where the boundaries denote for coding document to define more exact rules for design. Normally, in the regulating plan, the zones are applied within a framework of blocks and streets to contribute to

make a transition between zones and to guarantee the specific character of the "public realm" [31].

• **Building Form Standards** are “Regulations that control the features, configuration, and functions of buildings defining and shaping the public realm”. The building form standards are probably what most people think of when they think of form-based Codes, because these standards define the physical creation of the built environment in each section. This section of the Code would include standards such as setback, minimum and maximum lot width, minimum and maximum building height, parking and allowed land uses [4].

• **The glossary** consists of definitions of all technical terms contained in the code [10].

• **Architectural standards (optional element):** The code may also include sections on standards for blocks, architecture, green building, and landscape [31].

5.2.2. FBC process

There are three phases and one pre-phase identified when creating Form-Based Codes for a community [4]:

Pre-Phase 1: Scoping- choices are made at the beginning that will affect the process and content on the

code. The degree of change a community wants can be determined in this phase.

Phase 1: Documenting- survey and documentation of a community’s unique characteristics and patterns are carried out. Basic elements considered, are neighborhoods, districts and corridors at the macro scale, and thoroughfares, buildings, parks, plazas, architectural styles, and landscaping, as minimum requirements at the micro scale. Designing a code around the community is what makes a “place-specific” code stand out from traditional zoning.

Phase 2: Visioning- is where the desired outcome of the code is created. The key to creating a good vision for the community is to have the community involved in the visioning process from the beginning.

Phase 3: Assembling- the actual code document is organized and formatted, and the Code is implemented.

5.2.3. FBC evaluating

The best practices of form-based coding are reflected by the following questions. Positive answers to these questions are received by the effective form-based codes typically [32]:

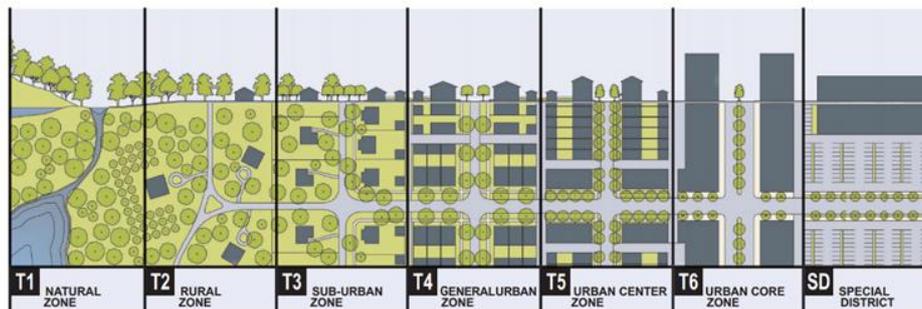


Fig 4. A typical rural-urban transect, with transect zones, Adapted from [1]

Table 4. Questions for evaluating FBC

Is the code enforceable?	<ul style="list-style-type: none"> • Is a plan implemented by the code to reflect particular community intentions? • Are the code administration procedures obviously defined? • Is the form-based code efficiently matched with other applicable guidelines and regulations controlling development on the same property? • Is the designed, intended, and programmed code regularly updated?
Is the code easy to use?	<ul style="list-style-type: none"> • Are the overall format and structure of the code readily apparent to find by the users easily based on their interest? • Can users readily comprehend and implement the physical form planned by the code? • Are the objectives of each regulation obviously defined and apparent even to planning staff and citizens not participating in its preparation? • Are technical terms utilized in the code explained in a vibrant and understandable mode? • Does the code format lend itself to suitable public use and distribution?
Will the code produce functional and vital urbanism?	<ul style="list-style-type: none"> • Will the public realm be shaped by the code to invite social interaction and pedestrian use? • Will the code produce identifiable and walkable neighborhoods providing for daily requirements? • Is the code on the basis of a sufficiently detailed physical plan and/or other clear community vision directing development and aiding implementation? • Are parking needs compatible with pedestrian-scaled urbanism?

6. CONCLUSION

Euclidean zoning ordinances are text-based documents that can become tangled, lengthy and cause confusion among developers and planners. The relatively simple organization and graphic nature of form-based codes makes them easier to comprehend and more accessible to all involved parties [11]. The following table explains the advantages and drawbacks of other Non- Euclidean zoning techniques [6].

Governments are involved in the organization of settlements via the development of urban planning regulations. Providing public services as part of government duties to citizens in any geographical area is subject to the rules governing that area. Therefore, the organization of cities and the regulations required to do so play an essential role in the regulation of cities, the ease of assigning roles to subordinate bodies, as well as responsiveness to the needs of citizens and their legal rights. Urban planning regulations are often manifested in the form of appropriate land use patterns, such as land use forms, construction codes and methods, development trends, and other legal constraints on urban planning that require the approval of city authorities for any activity across the city. In our country, regulations on zoning, building density and land use have been set in urban development plans. There are three general zoning categories, i.e. density, height and functional zoning, in Iran's urban planning system. Although such a zoning code is clear, due to overemphasis by municipal officials on quantities such as population numbers and their quantitative derivatives such as growth rates, per capita values, etc., the number of applications for change of land use is still on the rise. Apart from the enforceability of existing regulations, the lack of a systematic approach to formulating urban zoning codes on the one hand, and the low operational

awareness of executives in updating their knowledge of modern zoning practices, on the other, have led to harmful effects of the hidden aspects of current zonings and their improper implementation on cities. Adaptation of the three zoning types, i.e. density, height and functional zoning, to the physical zoning boundary determined by the boundaries of urban blocks - without due attention to the socio-economic characteristics of the area - will have no effect other than sprawling and unstable urban growth. Moreover, incentive zoning, which seeks to increase land use efficiency and flexibility as executive tools for structural planning aimed at developing a fluid urban plan, has had little ability to address zoning problems.

The inefficiency of these practices underscore the need for new approaches. Recently, a set of methods and tools have been used at the global level with a view to the nature of the area with the aim of providing form-based bylaws that are referred to as form-based codes. These codes are a mix of design rules and regulations that give rise to some form of land development based on the intrinsic characteristics and identity of the context. The main emphasis of these codes is on the form and physical aspects alongside the context. The missing link in current planning, which is one of the reasons for its failure, is its lack of emphasis on form as well as its one-dimensional look at function. Thus, given their context-orientedness, form-based codes can close the gap between different types of zoning.

Form-based codes are a tool that when properly used can create neighborhoods and town centers with great form, can create street networks and engaging public places, and can hold new development to a higher standard but they must be applied properly. The public charrette is the greatest findings tool for code calibration available to a community looking to engage in any type of coding or visioning [13].

Table 5. Non-Euclidean zoning techniques; Adopted from [6] and [11]

Type of zoning	Advantages	Disadvantages
Inclusionary zoning	It provides certain percentage of affordable housing for low and moderate income groups	Sometimes the housing cost is shifted from developer to buyers
TDR	Helps in preserving open space, historical areas, wetlands, and other environmental sensitive areas; while creating higher density development in urban areas	<ul style="list-style-type: none"> • Finding the areas with permitted higher density might be difficult • TDR might not be enabled in all cities or states
Cluster zoning	<ul style="list-style-type: none"> • Preserves open space by concentrating development with high density in certain part of the site • Reduces cost of development and infrastructure 	Might create leapfrog development
Performance zoning	<ul style="list-style-type: none"> • Monitors the impact of development on environment and sets performance standards to avoid the negative impacts • More flexible than Euclidean zoning in following development standards 	The calculations of performance estimates could be confusing and difficult to comprehend
PUD	<ul style="list-style-type: none"> • 1. It is planned up front in its entirety, up front, with careful attention to a site plan [6]. 	A major criticism of PUDs is that even though internal connectivity is often achieved between different uses, the

Type of zoning	Advantages	Disadvantages
	<ul style="list-style-type: none"> • 2. PUDs can also allow for more innovative development design [6]. • 3. In some cases, PUDs allow flexibility that a normal subdivision and/or zoning regulations cannot [6]. • 4. They can allow for an increase in density or reduction in street width as well as a mix of land uses on one site [6]. • 5. In return for this flexibility in site design, the developer often offers increased community amenities and open space. Examples of community amenities include bike trails, recreation centers, landscaped medians and natural open space [6]. 	<p>PUD often fails to effectively connect to the local street system (Barnett 2003, 256). This lack of connectivity can lead to an additional burden on arterial roadways [11].</p>

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