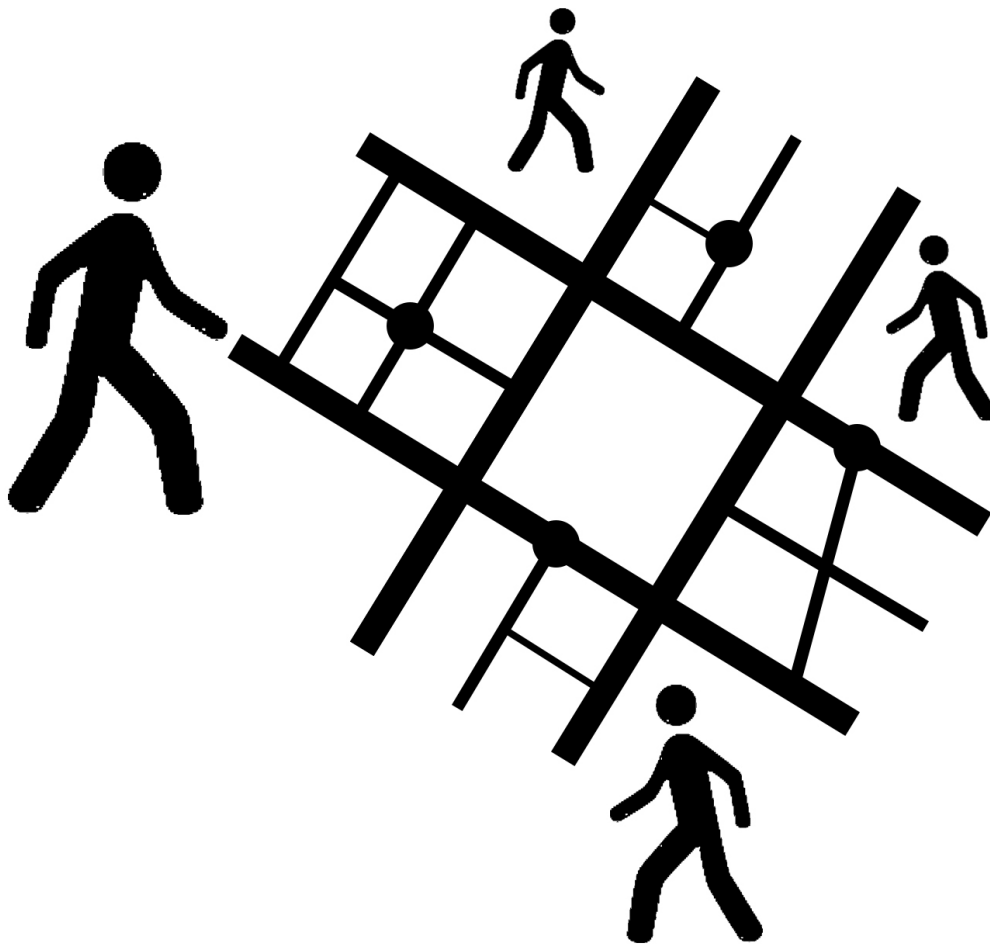


Efficient Circulation Network (CN)



Co-organized by



Schweizerische Eidgenossenschaft
Confédération suisse
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Swiss Agency for Development
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Research conducted by Lesslie Herrera and Yves Pedrazzini (LASUR, EPFL). This document was produced with the contribution of Nadia Carlevaro (GTH Settlement Planning Expert) and Rama Nimri (UNHCR Settlement Planning Officer), as well as the collaboration of Francesca Coloni (Chief of UNHCR Technical Support Section), Ammar Al-Mahdawi (UNHCR Senior Shelter Officer) and other members of UNHCR DRS Technical Support Section.

MAY 2023

CIRCULATION NETWORKS

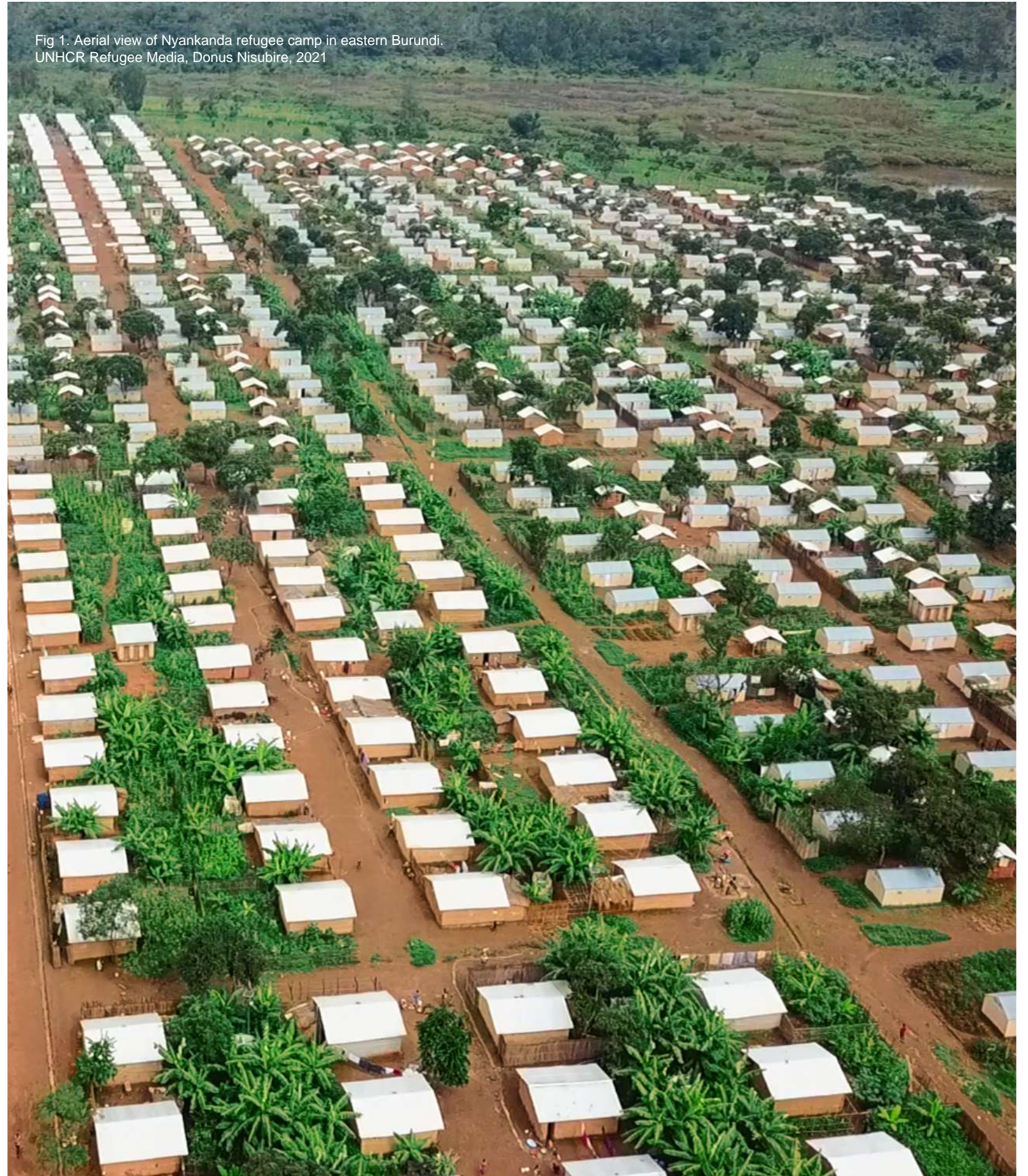
The Planning Principle for Circulation Networks (CN) emphasizes that the size and configuration of the circulation network should follow natural environmental features and be congruent with the socio-cultural context, including the size and types of roads, blocks and network patterns. Similarly, for long-term sustainability, the CN should prioritize pedestrian circulation and walkable distances that facilitate connection and accessibility.

DEFINITION

The circulation network facilitates accessibility, communication and social interactions through its built environment (facilities, utilities, infrastructure, etc.) and natural surroundings (green areas, agricultural areas, firewood collection areas, etc.) in order to ensure the protection of displaced populations and sustainable settlements.

Proper design and planning of the circulation network contributes to vibrant and sustainable communities, meeting the diverse needs of the current displaced population and possible future occupants, minimizing the effect on the natural environment, and contributing to a better quality of life. The circulation network should be safe and inclusive, offering equal opportunity and access to services for all.

Fig 1. Aerial view of Nyankanda refugee camp in eastern Burundi. UNHCR Refugee Media, Donus Nisubire, 2021



Relevant considerations before planning

As well as considering the natural environment, social and cultural aspects, and local regulations, there are four relevant aspects to take into account when planning and designing circulation networks in refugee settlements and IDPs:

1. Proximity to and relationship with the surrounding urban environments:

The physical location of the settlement and the types of social interaction agreed upon between the two populations (displaced population and host community) creates the starting point for planning the circulation network. Access, the layout of facilities, economic relations, and other factors that directly affect circulation through the territory can be defined. According to location, the geographical proximity and relationship can be classified into four types:¹

- a. Satellite: Settlements located at an average distance of 15 km from the host community(ies).² As a result, they may share some public facilities or services and are often connected by national and/or local roads.
- b. Peripheral: Settlements located on the outskirts of cities or communities; may share a variety of public facilities or services due to their proximity. Their connection usually depends on local or inter-city roads.
- c. Integrated: Located practically within the city or community, they are seen as a neighborhood or extension of the city or community. Accessibility to these areas is usually by predefined streets or roads.
- d. Separate: The occupied territory is isolated and has no direct contact with any other community. Frequently these territories have greater needs for infrastructure, facilities and public services. In many cases, they require

¹Typology based on the study conducted by Juan Canet Roselló (January 22, 2019). "Refugee camps: Ephemeral cities. Atlas of Refugee Camps. The Mediterranean Area and Sub-Saharan Africa. Planning Design and Camp assessment Toolkit." p.56. Juana Canet is currently finishing her thesis at the Polytechnic University of Madrid. During a conversation she allowed us to cite her work.

² Idem. The study conducted by Canet considers 15 km average from the distance analysis between the host community of more than 100 refugee camps, whose minimum distance was 0.61 km and a maximum of 177 km.

creation of vehicular access from a national or local road.

Note that in many cases, social interactions between populations may be limited, due to the strengthening of displaced population protections, political negotiations, and historical tensions between populations, among other factors. Despite physical proximity to the host population, some settlements may be understood as spatially and socially separate units.

2. User Priority:

In refugee settlements and IDPs, movement is usually pedestrian, especially in the early stages of development. Therefore, for accessibility, distances between users and facilities/ services should be as close as possible. However, this does not prevent taking other modes of transport into account when planning the circulation network. In most settlements, from the beginning, logistic vehicles (for services, construction and maintenance) operate continuously. The types of users to be considered are:

- a. Pedestrian
- b. Logistic Vehicles (Service, Maintenance and construction)
- c. Personal Vehicles (bicycles, motorcycles and cars)
- d. Public Transportation
- e. Future Circulation (Increase of vehicles)

3. Zoning Categories:

Location plays an important role in planning the circulation network within its territorial context. Zoning categories regularly govern the type of infrastructure and public services to be implemented, often responding to the spatial configuration and to users' social traits and needs. Similarly, a predefined circulation network and type of regulation may be linked to the zoning attributed by local government, influencing dimensions, needs and design. The zoning categories are as follows:

- a. Urban
- b. Semi-Urban
- c. Semi-Rural
- d. Rural

Although this type of circumstance frequently occurs in other types of urbanization, especially in UNHCR settlements, the above categories are very useful for planning the circulation network, and are sometimes mandated by local regulations. However, they may not respond to the size of the settlement and needs of the displaced population. In many cases, due to the number of refugees and/or the size of the settlement, zoning category regulations assigned by the host country are often inadequate. For example, experience in refugee settlements has shown that there are cases where streets mainly governed by local regulations did not work properly, as their dimensioning was insufficient for the population (e.g. causing vehicular and pedestrian congestion, lack of adequate space for vehicle maneuvering, vehicular accidents, pedestrian hazards, unsanitary conditions, blockage or misuse of infrastructure, among other factors). Therefore, proper communication with local governments about needs and constraints will be necessary.

4. Development Stages:

Refugee settlements are usually implemented in the aftermath of humanitarian emergencies. Therefore, the foundations develop quickly, without knowing the settlement's lifespan. The circulation network is usually implemented, consciously or unintentionally, from the very beginning of the settlement. While the circulation network should be planned from the outset, various stages can enhance, modify and/or integrate a new circulation network. These stages are:

- a. Emergency: At this stage, the foundations of the circulation network are generally set, especially the main access, main road or roads, and the morphological pattern of the network. Rather than detailed planning, at this stage the overall concept to be implemented is defined. This stage also influences secondary or tertiary roads. Even in initially unplanned settlements, some physical characteristics will be marked spontaneously, also providing

valuable information on related cultural aspects (e.g. there might be more organic spatial structures, shared areas or private areas).

- b. Protracted Situation: This follows the previous stage, usually featuring a natural increase in population due to the arrival of new individuals. Due to this growth and other needs, populations will often encroach on public space, affecting the area and dimensioning of the circulation network. The settlement usually expands in size and evolves into more transitional types of shelter. Likewise, other common emergency facilities and structures are often replaced by transitional or durable buildings. As a result, the circulation network is modified, enlarged and improved by integrating other elements (e.g., lighting, planters, street furniture, etc.). More secondary and tertiary roads and routes are usually marked. Improvements in the circulation network often change the organization and socio-spatial configuration of the entire settlement, which can cause friction and opposition from the settlers.
- c. Integration: At this stage the circulation network is practically established. However, there are usually improvements and expansion if necessary. It is also necessary to reevaluate the circulation network and its operation.
- d. Urban Growth: At this stage, new settlements may have been established at the boundaries of the settlement, or a natural, not necessarily planned development will have taken place. For a functional network, re-evaluation of the circulation and a probable restructuring of roads is therefore necessary (e.g. to connect with other areas or to improve the dimensioning of roads).

The two most frequent stages in the development of settlements are the state of emergency and prolonged situations, therefore we will focus on these in the following recommendations:

DEVELOPMENT STAGES	RECOMMENDATIONS FOR PLANNING AND DESIGN
Emergency	<ul style="list-style-type: none"> • Recognize the context and local knowledge: Both in terms of mobilization (routes and frequencies), as well as aspects of the construction process (construction systems, rainy seasons, material resources, etc.) this will support their integration. • Have as accurate a topographic plan as possible: This influences the type of network patterns to be implemented, as well as the possible sizing and costs of roads and the drainage system. Avoid complex and costly structures, as well as possible flooding. • Explore local morphological patterns: These can influence the layout of roads and facilitate integration of the displaced population into the host community. • Agree and determine access to the settlement: Accesses will impact the internal configuration of circulation and main roads, as well as foster social interactions between the two populations. • Avoid placing all public services at the entrance: These could block the roadway, hinder logistics and use, or jeopardize the protection of the displaced population. • Define roads clearly and provide adequate sizing: Including space for drainage systems and vending spaces (if applicable). This is especially applicable to main roads or main axes where informal businesses quickly form and large service, logistics and construction vehicles are often mobilized. This will avoid possible tensions and accidents. • Include parking areas: Although most of the displaced population do not have their own vehicles, from the emergency stage there will be mobilization of logistics and essential services vehicles, as well as those of the organizations that will work at the site. • Keep in mind the impact of a conceptual design: This can influence the future of the circulation network. Even when the layout and spatial configuration are seen as provisional (including the location of shelters), this will influence the future development of the circulation network. Populations from unstable environments need to find a minimum of stability for physical and mental health, including spatial permanence and a sense of belonging. Therefore, further spatial redistribution may generate tensions and oppositions. • Satisfy basic needs according to cultural habits: This will help to avoid unnecessary mobilization of shelters or inappropriate constructions manufactured by the displaced population that affect circulation and endanger others.
Protracted Situation	<ul style="list-style-type: none"> • Recognize and balance the circulation needs of the displaced population with those of the host community: Identify and consolidate existing routes, and integrate new routes if necessary to improve them. • Recognize socio-cultural routines and customs: Allow the inclusion of new circulations in secondary and tertiary roads, and define the morphology and geometry of these roads. • Conduct a participatory design process: This will help to recognize social and cultural needs at the circulation level. • Increase, if possible and safe, the number of accesses to the area: It is likely that there will be a larger population and that links have been created between the populations. A greater number of accesses can avoid obstructions, accidents and continue to encourage social interactions. • Integrate other elements for communities' protection and wellbeing: These will support the use of the roads (e.g. lighting, seating areas, shaded areas, etc.). • Provide the circulation network with a nomenclature system: This may facilitate recognition of the area by the displaced population and organizations involved. Evidently, at this stage the groups involved will already use informal "names" for the circulation network. This will help to generate an easily legible spatial system.

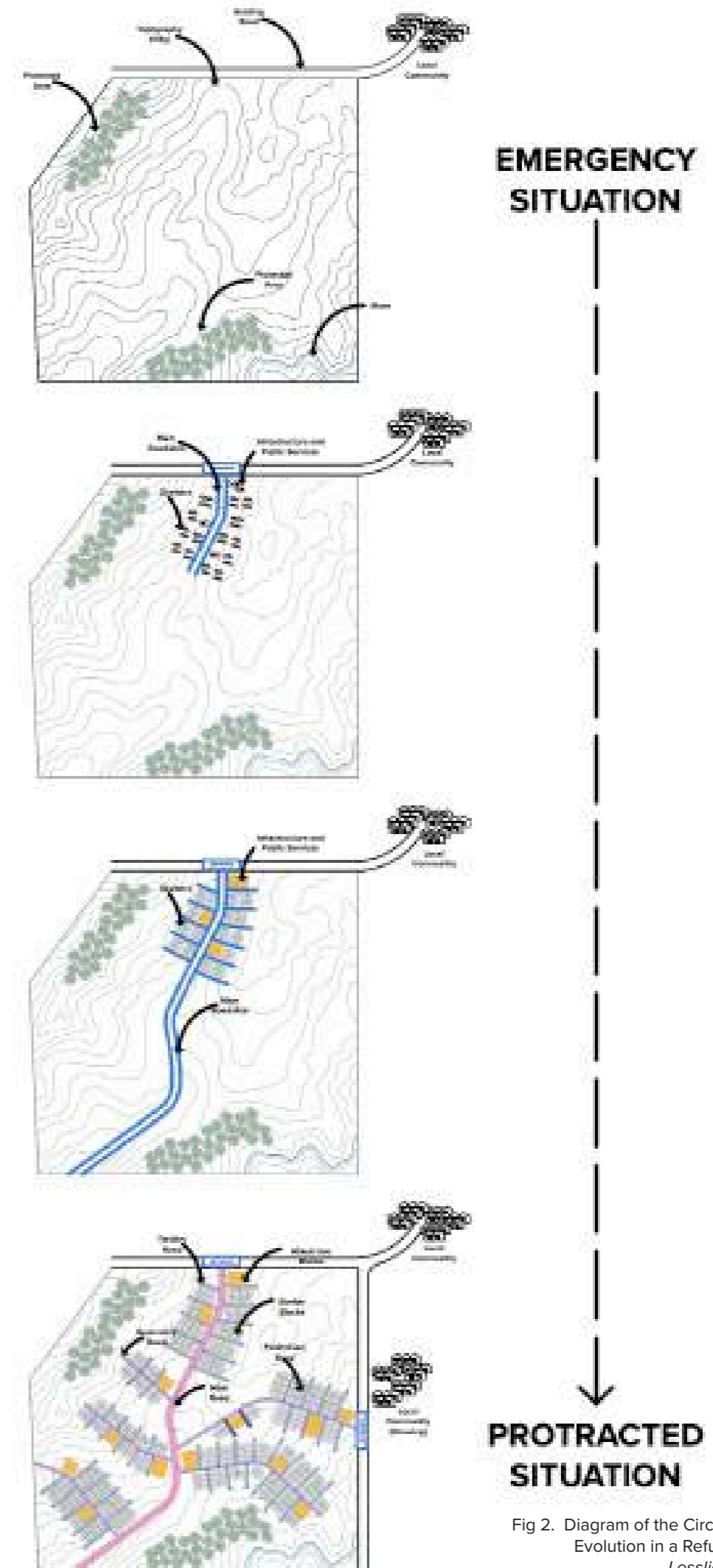


Fig 2. Diagram of the Circulation Network Evolution in a Refugee Settlement
Lesslie Herrera, 2023

ROADS

Roads have a variety of functions to meet the need for housing, work and movement. Careful planning is required to balance potential conflicts between destinations, activities and users. An accessible, legible and well-connected road network encourages people to move and thus influences social interactivity in settlements, which is necessary to maintaining and improving health, strengthening community and building resilience. A good road design supports the safety and security of the displaced populations while minimizing possible disturbance. Usually, roads in UNHCR settlements have six functions:

- 1. Accessibility:** Roads provide access to multiple services and facilities. Also, they provide access to and within the settlement (and its surroundings). Access must be designed for people of all ages and abilities. Safety is a concern in settlements, especially in situations where pedestrians are forced to travel long distances to meet their needs (essential services, natural resources, livelihoods, etc.) and are exposed to potentially unsafe conditions.
- 2. Circulation:** Circulation networks within settlements will mainly be used by pedestrians. Roads should therefore be designed for pedestrians to move freely, without obstructions or limits. The travel and circulation of women, children and people with reduced mobility requires special attention.
- 3. Basic Services and Infrastructure:** Generally, public service networks can impact the requirement for and design of roads. Flood control is one of the biggest challenges for settlements. It is important to incorporate a good drainage system and sizing, supported by sustainable strategies. Similarly, areas with high pedestrian traffic should include lighting, the type and sizing of which will also

* STREET OR ROAD?

In urban theory, streets are usually lined with buildings and public spaces, i.e. they are located in more urban areas, whereas roads do not necessarily have buildings on their margins, and can be found within territories without any settlements. In the history of UNHCR settlements/camps, most streets are known as "roads", although in some contexts "road" is used interchangeably with "street".

affect road design. Roads must also comply with minimum dimensions for circulation and maintenance access, for example, garbage and solid waste management.

- 4. Social Interactivity:** Roads are meeting and interaction points for diverse groups, so the space should be designed to encourage these activities through its elements, dimensions, and materials. It is important to design and plan multifunctional roads that are flexible and adaptable to different situations and activities. In existing settlements without Communal Open Spaces (COS) or with a limited number of them, roads can be used on an ad hoc or itinerant basis for social purposes (events, meetings, etc.) as well as commercial purposes (itinerant markets). Roads not only favor circulation, but also other activities, such as access to basic needs and services, and spaces for businesses such as markets. In states of emergency, as in the COVID 19 pandemic, roads supported livelihoods such as the informal sector as well as the provision of itinerant services (health, education, information centers, etc.).
- 5. Parking:** Although not always a requirement, this may be a key function for some roads, especially where facilities are located that need maintenance or supply. It is also important to designate parking areas for workers and individuals with vehicles. In planning, it is important to consider future development and growth, and the need for private vehicles.

Elements of the Roads

Roads are a public area made up of parts that vary according to activity and function, so some may have a specific purpose for a particular group or an individual privilege, for example, in the case of itinerant vending. In UNHCR settlements, roads are usually composed of two main elements, the roadway and the sidewalk. Their elements and composition will vary according to function, use and hierarchy. For design and planning purposes they are composed as follows:

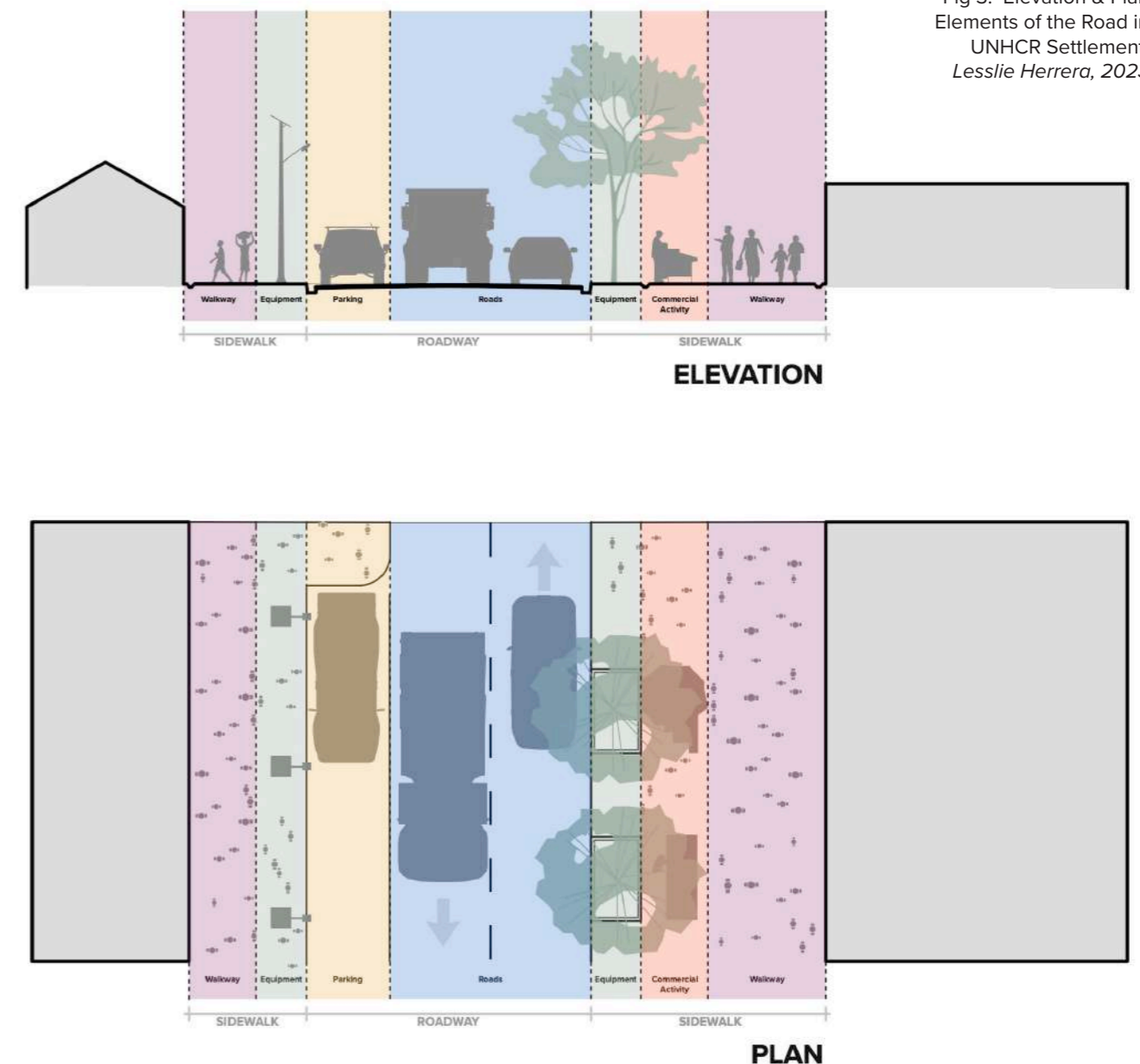


Fig 3. Elevation & Plan Elements of the Road in UNHCR Settlement. Lesslie Herrera, 2023

NOTE:

Please keep in mind that this is a generic drawing and therefore **some elements may not be appropriate or necessary**. The planner's main objective is to contextualize the road elements to the culture or social context and local standards in order to support the protection of displaced populations.

DEFINITION	RECOMMENDATIONS AND COMMENTS	SIZE RANGES ³
<p>Roadway: Its main function is to allow the movement of vehicles. However, in specific cases it may accommodate communal open space or other functions, especially in settlements with limited spatial resources.</p>	<ul style="list-style-type: none"> Geometry varies according to the number of lanes and parking provision. One way roads are usually the most common and easily modulated. Multi-channel roadways create more complex relationships (change of priorities) and structures, and therefore require special attention in terms of safety and security. 	<p><i>One lane:</i> 2.8m – 3m⁴</p> <p><i>One lane (Trucks and service vehicles):</i> 3.3m – 3.5m⁵</p> <p><i>One way/two way 2 lanes:</i> 5.5m – 6.5m⁶</p> <p><i>Bicycles:</i> 1.5m – 2m⁷</p> <p><i>Bicycles 2 lanes:</i> 2.4m – 3.6m⁸</p>
<p>Walkway: Mainly features pedestrian activity. The area most immediate to the built environment is the place of exchange and social opportunities. The central area of the sidewalk allows people to circulate and interactions of short duration.⁹</p>	<ul style="list-style-type: none"> The width should be adapted to the pedestrian capacity. The dimension should avoid crowding or obstructing use, especially for vulnerable groups or those with reduced mobility. Avoid overly wide passages that may give the impression of being abandoned or empty and therefore perceived as unsafe. Consider that a person requires at least 0.80 m wide, in low activity (mostly residential) the minimum is 1.50 m. However, where there is no planting/buffer zone and adjacent to the curb, the minimum sidewalk should be 2.10 m.¹⁰ In the context of UNHCR settlements, this fact depends on the motorized traffic frequency, which usually is very low. However, in protracted situations this factor could change. 	<p><i>Walkway (Low activity):</i> 1.5m – 2m¹¹</p> <p><i>Walkway (High activity):</i> 2 m – 4.2m¹²</p>
<p>Equipment: Often located on the edges of the sidewalk. Can be used for street furniture and landscape elements. Supports the use of the road and its function, providing elements of comfort, enhancement, protection, among others. Equipment can consist of light poles, traffic signs, fire hydrants, signs and other elements, or contain trees, benches and planters.</p>	<ul style="list-style-type: none"> Consider impact and evaluate within the context of the entire road composition. Poor design could cause visual confusion, mobility and safety problems. Trees and plants are often significant elements in the streetscape. Trees have a major impact on sidewalk dimension, as their roots should be considered as much as their canopy. Roots can impact the integrity of surfaces. Lighting can provide a sense of security. Consider lighting designs and their scale, for pedestrians and vehicles if necessary. The location of light poles and luminaires is important; carefully consider their spatial and social effects.¹³ Seating is very important for community vitality and activity. A road with seating is likely to be more heavily used.¹⁴ 	<p><i>Planter:</i> 0.3 m - 1.5 m¹⁵</p> <p><i>Planter with trees:</i> 1.5 m – 3 m¹⁶</p> <p><i>Planter with bench:</i> 1.8 m – 2 m¹⁷</p> <p><i>Seating:</i> 1 m – 1.2 m (Separate 0.3 m- 0.6 m from the walkway + 0.4 m-0.9 m seating area)</p> <p><i>Lighting pole (including installation base):</i> 0.25 m – 0.6 m¹⁸</p> <p><i>Lighting spacing:</i> 2.5 m–3 m¹⁹</p> <p><i>Lighting height:</i> 4.5 m–6m²⁰</p> <p><i>Lighting pole from the curb face:</i> 0.3 m–1 m²¹</p>

3 The following dimension recommendations are based on international recommendations and standards as well as some research related to the different topics.
4 Davis, Duany &Plater-Zyberk, 2018, p. 34; NACTO, 2013, pp. 34-35; NACTO & GDCI, 2016, pp. 126-128; Neufert, 2012, pp. 377-380; UNEP, 2018, p.38.
5 Davis, Duany &Plater-Zyberk, 2018, p. 34; NACTO, 2013, pp.34-35; NACTO & GDCI, 2016, pp. 126-128; Neufert, 2012, pp. 377-380; UNEP, 2018, p. 38.
6 Davis, Duany &Plater-Zyberk, 2018, pp. 34-35; NACTO, 2013, pp. 34-35; NACTO & GDCI, 2016, pp. 126-128; Neufert, 2012, 377-380; UNEP, 2018, p. 38 & 42
7 NACTO, 2013, p. 35; NACTO & GDCI, 2016, pp. 126-128; Neufert, 2012, pp. 382-384; UNEP, 2018, p. 38.
8 NACTO & GDCI, 2016, p. 100; Neufert, 2012, pp. 382 - 384; UNEP, 2018, p. 38.
9 Mantho, 2014, p.57
10 UNEP, 2018, p. 18.
11 Davis, Duany &Plater-Zyberk, 2018, p. 73; NACTO & GDCI, 2016, pp. 80-81; Neufert, 2012, p. 382; UNEP, 2018, pp. 17-18.
12 NACTO & GDCI, 2016, pp. 80-81; Neufert, 2012, p. 382; UNEP, 2018, pp. 17-18;
13 For more information on lighting location, please refer to the UNHCR "Compendium: Protection-Sensitive Access to Lighting", p. 13.
14 Mantho, 2014, p. 81.
15 NACTO & GDCI, 2016, pp. 80-81; Neufert, 2012, p. 384; UNEP, 2018, p. 17
16 Davis, Duany &Plater-Zyberk, 2018, p. 34; NACTO, 2013, pp. 34-35; NACTO & GDCI, 2016, pp. 126-128; Neufert, 2012, pp. 377-380; UNEP, 2018, p. 17.
17 NACTO & GDCI, 2016, p. 81; UNEP, 2018, p. 17.
18 It varies significantly, depending on the material and type of installation
19 NACTO & GDCI, 2016, p. 162;
20 Idem.
21 Keep in mind that this dimension depends of the speed of the roads and type of installation. For example, 50 km/h correspond to 0.8 m (Society of Light and Lighting, 2018, p. 229). Considering that the UNHCR settlements do not have fast vehicular traffic, this dimension could be lower.

ELEMENTS OF THE ROAD

GENERAL NOTE:
Please note that the dimensional ranges of the different sections are based on international recommendations for different element sizes (See text for more information). However, the planner's objective is to adapt them to local standards and environmental needs as well as to the cultural and social context of the displaced populations.

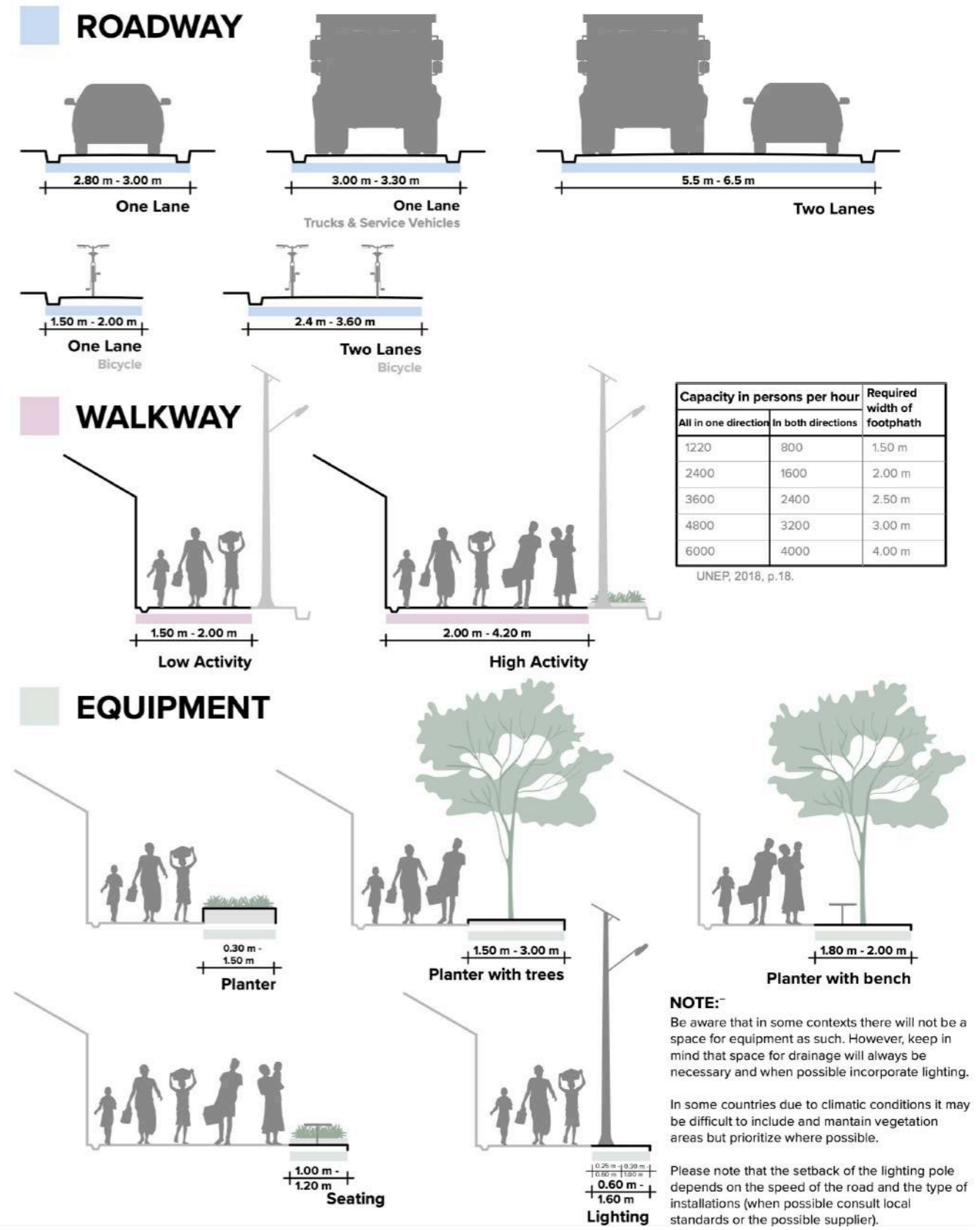


Fig 4. Elements of the Road 1
Lesslie Herrera, 2023

DEFINITION	RECOMMENDATIONS AND COMMENTS	SIZE RANGES
Infrastructure: Mainly located in a depressed surface or on the surface, accommodating the network of public services such as storm water drainage, sewage drainage, electricity, etc. Storm water drains are usually located on the surface, at the curb, and therefore have a greater impact on spatial configuration. Their quality depends on the configuration, material properties and type of drainage used.	<ul style="list-style-type: none"> Planning and design should allow accessible maintenance or repair of the infrastructure. No other elements should impede such tasks. All types of sewers must be kept clear. Adequate maintenance is essential, because drainage systems can become garbage dumps, unhealthy, or may feature inadequate, improvised connections by individuals that put the population at risk. The size of the drainage system is directly related to topography, site-specific calculations and the strategy for water evacuation. Rain gardens and green ducts can be integrated into the planting dimension. Cellular pavements may be integrated into the pedestrian walkway. Streams and channels, depending on the calculation, may have to be added or incorporated into the road. If necessary, create bridges over canals. 	-
Commercial areas: Can be located on the inner side or the exterior side of the sidewalk. Not all IDP or refugee settlements need commercial areas on the road. This element is usually located in roads with high activity, such as main roads. The space occupied depends on its own structure: fixed, semi-fixed or mobile.	<ul style="list-style-type: none"> These areas should be especially planned in settlements where street vending is an integral part of the culture, or where it is anticipated as necessary. Lack of this element will result in encroachment on roads and sidewalks, disturbing the flow of people and traffic. The location and design must not interrupt pedestrian circulation and must avoid causing conflicts or endangering the safety and security of the population. When located adjacent to a wall, the consent of the wall's owners must be obtained. In some cases, the users of a shelter or plot use the road adjacent to their homes as an interconnected commercial space. If possible, in the case of fixed and semi-fixed structures, you may provide infrastructure connections (electricity, lighting, drainage, etc.). This will avoid makeshift connections that may jeopardize the health, welfare and protection of displaced populations, or cause possible tensions between users and even with local government. Street vending should avoid blocking access, other services or signage. For street vending, at least 1 m should be provided for customers without interrupting traffic.²² A minimum clearance of 1.8m should be maintained.²³ Only sidewalks of at least 4 m can accommodate sales.²⁴ Sales stalls should be at least 3m from pedestrian crossings.²⁵ Stalls should be at least 1.5m from trees and planters.²⁶ 	<p><i>Commercial Extension:</i> 1 m–4 m²⁷</p> <p><i>Street vendor (interior):</i> 1.5 m–2 m²⁸</p> <p><i>Street vendors (exterior):</i> 2 m–2.5 m²⁹</p>
Wall or Inner Road Edge: It forms the boundaries of the road space. Although it may be considered a private element, it can be an extension of the public space. This is a transition zone, it can go from a simple wall plane or have a series of steps, porches or change of texture or setbacks.	<ul style="list-style-type: none"> The configuration and use of the area has a major impact on the experience of the road and on safety, so it must be carefully designed to avoid conflicts. Roads with unfinished enclosures often lack spatial definition and can lead to misappropriation and misuse of a private or public area. In other words, the space needs to be legible and coherent. A special consideration is the possible covering of a road wall, as it can have a significant impact as it could block visibility or have stormwater management problems. 	-
Parking: Located on the road next to the sidewalk; usually included in roads with high vehicular frequency or facilities that require the use of vehicles.	<ul style="list-style-type: none"> Often close to infrastructure and services. Spaces generally for service vehicles used for maintenance and construction, and for workers' vehicles from various organizations. Configuration depends on the number of vehicles planned. Always consider a surplus, since certain installations may evolve. In shelter areas it may also be necessary to park vehicles for the population, or for access to maintenance areas (e.g. cleaning of septic tanks or latrines). Parking spaces must be located a minimum of 5m from an intersection.³⁰ 	<p><i>Parking:</i> 1.8m–2.5m³¹</p>

22 NACTO & GDCI, 2016, p. 147;

23 Idem.

24 NACTO & GDCI, 2016, p. 148;

25 Idem.

26 Idem.

27 NACTO & GDCI, 2016, p. 147.

28 CUE & Cardiff University, 2014. P.9NACTO & GDCI, 2016, p. 145; Neufert, 2012, p. 377.

29 CUE & Cardiff University, 2014. pp.12-13; NACTO & GDCI, 2016, p. 147; Neufert, 2012, p. 380.

30 NACTO & GDCI, 2016, p. 207.

31 NACTO & GDCI, 2016, p. 129. Neufert, 2012, p. 382.

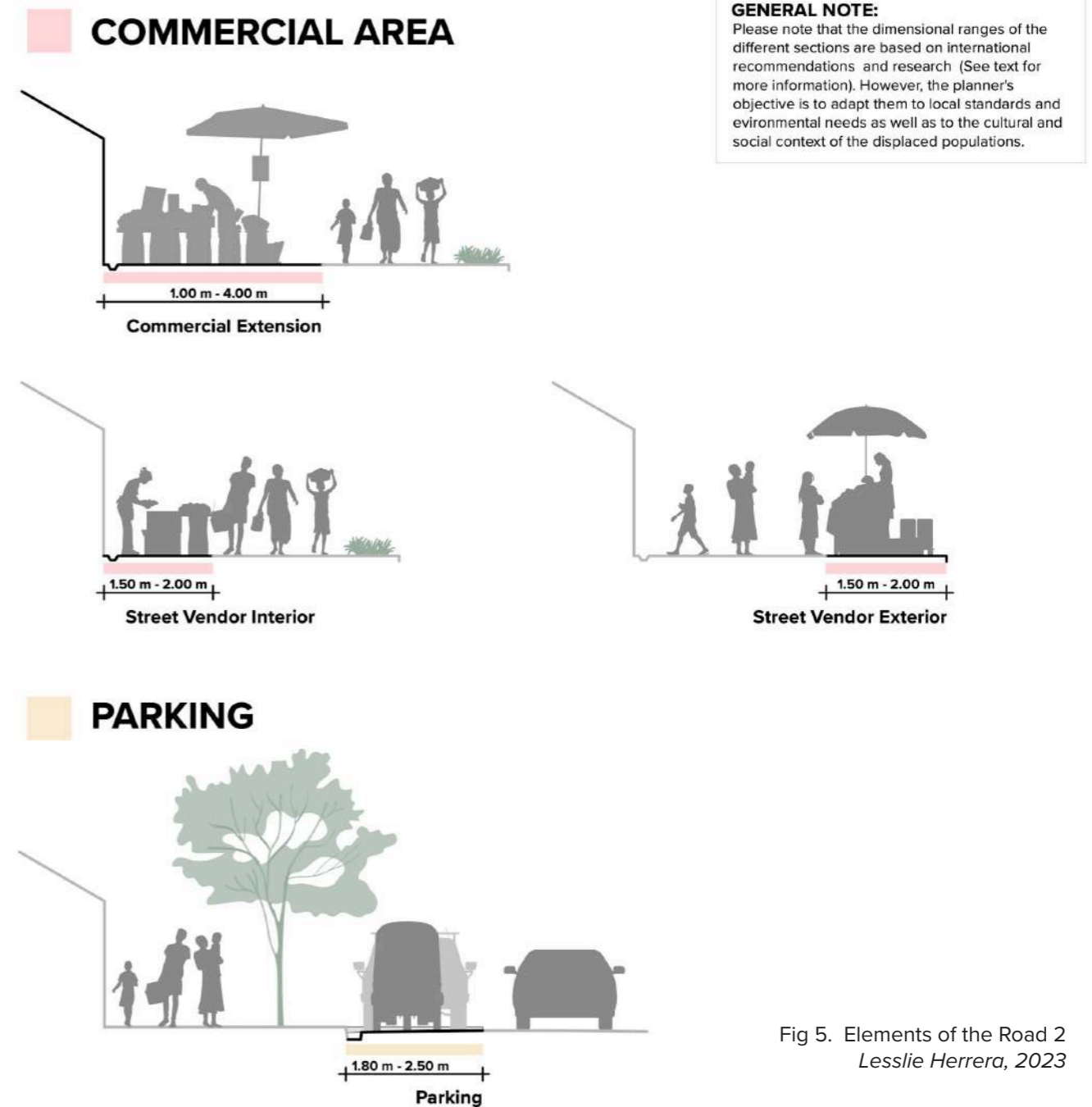


Fig 5. Elements of the Road 2
Lesslie Herrera, 2023

Some elements, such as safe strips, were not considered as design components due to low vehicle frequency, but could be implemented on specific roads if necessary. Note that the setbacks are usually for public space in either entrance to access (facilities) or a small Communal Open Space (e.g. a small square or park), therefore their design and inclusion will be considered in the design of each of these spaces.

Recommendations

- Ensure differentiation between the height of the sidewalk and the roadway, to clearly distinguish between uses; this can influence users' behavior.
- Provide the necessary surface for each of the sidewalk elements. Never underestimate the need for space on sidewalks.
- Provide access for people with reduced mobility through adequate surfacing and ramps if necessary. Ramps should have a maximum slope of 10% and ideally 8%. Similarly, their minimum width is 1.8m and 2.4m is recommended.
- Implement, if necessary, sidewalk extensions to reduce speed or designate parking areas.
- Pay special attention to geometry and its possible impact on pedestrians. Curved roads limit visual depth; straight roads allow continuous views and well-connected spaces but tend to encourage high speeds.
- Adapt materials to design strategies, environmental conditions, construction and maintenance costs.
- Evaluate the social, spatial and functional impacts of all elements, as well as the relationships between them and as a whole.
- Anticipate the need for various elements and specific spacing, including in long-term situations.

HIERARCHY

Hierarchies are usually attributed in order of importance, usually related to the dimension conditioned by vehicular movement and type of liaison. However, in a settlement of this type, the focus should be on the mobility of the pedestrians who will be the main users, while balancing with the needs of other user types. Acknowledge that some roads are more important than others, both in terms of traffic flow and place function, and deserve different treatment.

The roads with the highest use are those where people are likely to gather and interact, such as where school exits, markets and distribution centers or other daily activities are located. To attribute the hierarchy of roads, routes, destinations and functions should be evaluated through the following questions:

- What types of activities will the road host (passage, meeting, economic, housing, etc.)?
- What public services or facilities are located on it or provide access to it (schools, health centers, markets, etc.)?
- What is the predominant frequency or time of use (all the time, during the work week, at night, during the day, etc.)?
- What types of users and traffic flows will it have (vehicular, service vehicles, mixed, pedestrian only, etc.)?
- What groups of people will use the road (all, displaced populations only, mostly women, children, workers, etc.)?
- What geographic scale does it serve (settlement, sector, block, community, mixed)?
- What type of accessibility does it have (public, semi-public, semi-private)?

If applicable, as part of the route assessment, identify the relative importance of existing sites in the host community that are frequented or could be used by displaced populations. The analysis will determine which locations in the surrounding area should be made accessible to the local population, especially by foot and bicycle, as well as the appropriate design and layout of that area.

Recommendations

- Define and plan clear circulation hierarchy.
- Analyze existing locations and access.
- Verify mobility objectives and routes.
- Assign locations according to distances.
- Consult the legal framework and local or national regulations (if applicable).
- Define the road geometry according to the local context (topography, environment and socio-cultural).
- Understand the area in terms of movement and place, identifying proposed connections and links.

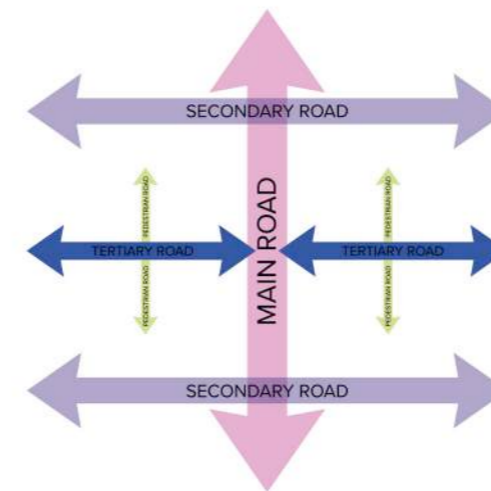
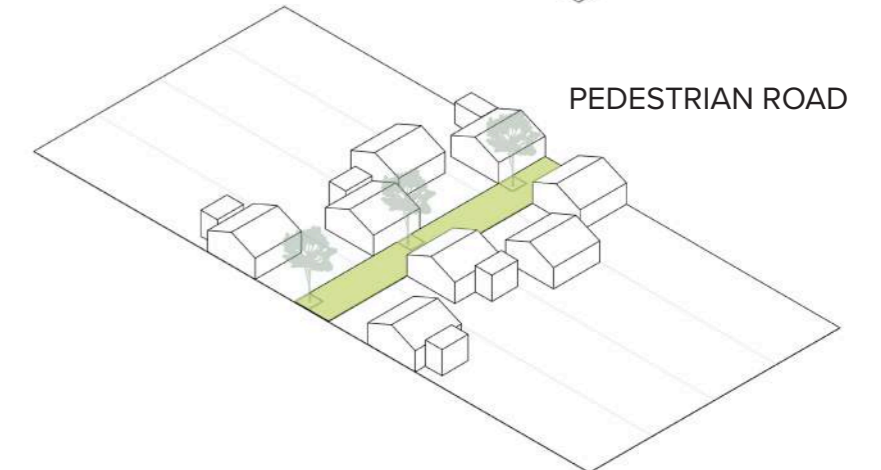
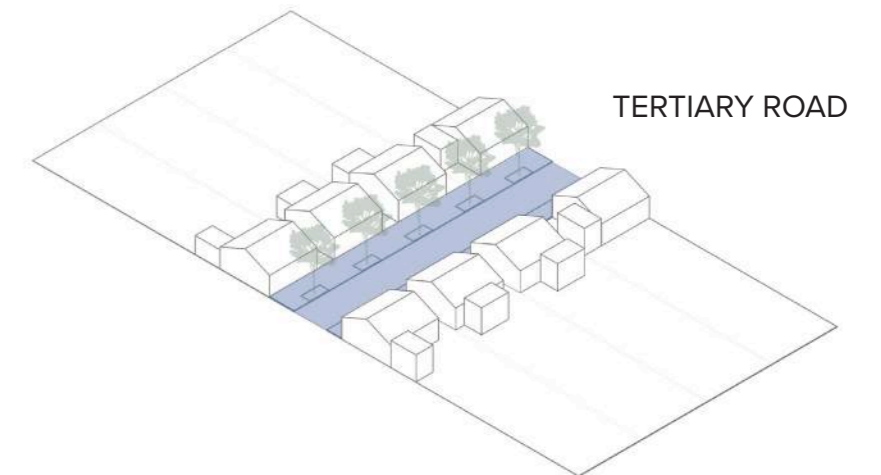
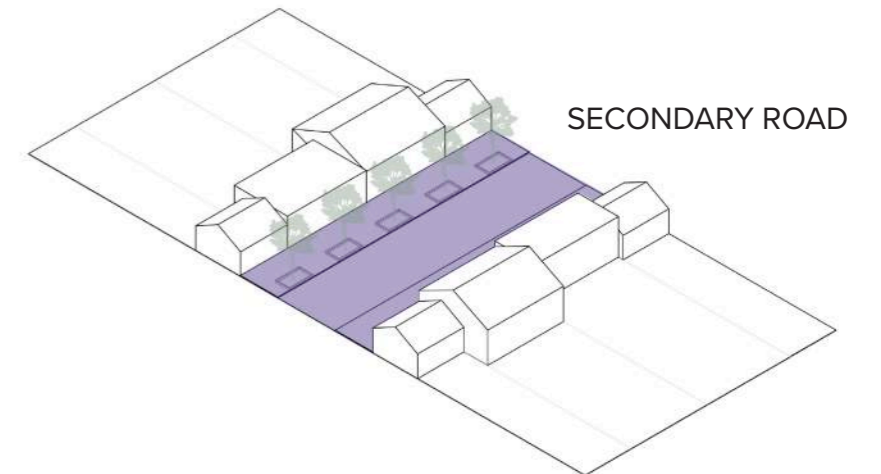
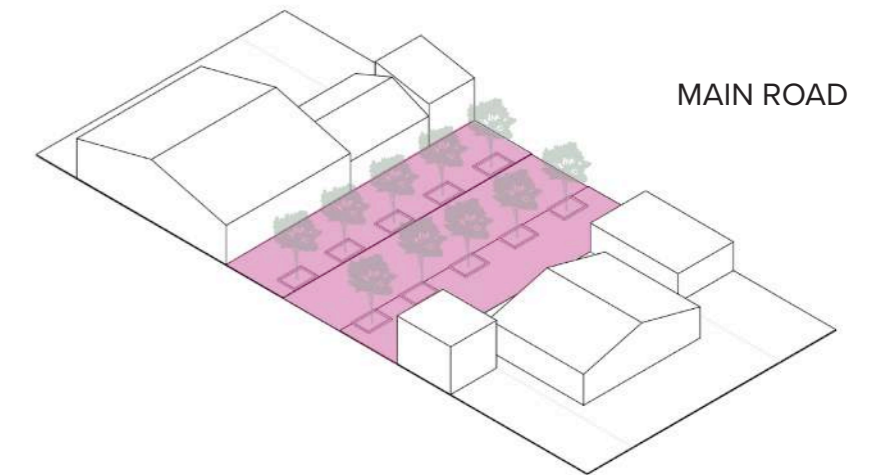


Fig 6. Roads Hierarchy in UNHCR Settlements
Lesslie Herrera, 2023

Note: Drawings Inspired by the Hub Approach. UNHCR, UNCS, UBOS.

Type of Roads:

The types of roads are not only established by basic parameters such as the width of the roadway, sidewalks and elements that compose it, but also the relationship of the road to the built environment and private space, as well as other important details such as the layout within the settlement. As mentioned, the road hierarchy is assigned based on a combination of various factors.¹

It is very likely that circulation in the settlements will be made up of a formal road structure and an informal road structure, due to the difference in development phases and related times. During the emergency phase, the main axes (or part of them) that guide urban development will be established, as well as some secondary roads. However, this being an emergency phase with short implementation times, the roads will not be fully formed. Therefore, some roads (secondary and tertiary) are often formed by the settlers' own movements and their forms of appropriation. Instead of seeing this spatial configuration as an obstacle, this can be used to recognize the destinations and trajectories for design in the protracted situation. Generally, the following types of roads exist in a camp/settlement:

TYOLOGY	FEATURES AND RECOMMENDATIONS
<p>Main roads: These usually serve as the structuring axes of the settlement layout. Main roads connect access and settlement throughout the territory.</p>	<ul style="list-style-type: none"> Connect the settlement at the settlement or sector level. Provide a variety of activities, including economic activities. Provide sidewalks on both sides and at least two vehicular way. Possess, usually, a dimension that allows the entry of vehicles and two directions, both for the construction phase, in case of emergency or with a view to future functionality. Allow the implementation of drainage and infrastructures. Allow safety and security of displaced population (including firebreak protection). Frequently connect infrastructures and facilities that require the entry of large vehicles (e.g. distribution centers). Keep in mind that these roads must be constructed of a material that allows use in rainy seasons.
<p>Secondary roads: Usually connected to the main roads and interconnected with each other.</p>	<ul style="list-style-type: none"> Connect the settlement at sector and block level. Frequently two directions are needed. Provide sidewalks on both sides and at least one vehicular way. Allow the implementation of drainage and infrastructures. Allow safety and security of displaced population (including firebreak protection). Provide space for drainage and other infrastructure.
<p>Tertiary roads: Typically connect to secondary roads. Depending on the size of the settlement, they may be vehicular in nature, or they may be pedestrian roads.</p>	<ul style="list-style-type: none"> Connect the settlement at the block and community level. Generally communicate plots and shelters. Provide sidewalks on both sides and at least one vehicular way. Allow the implementation of drainage and infrastructures. Provide security and protection of the displaced population (including firebreak protection). Depending on the morphological pattern selected, some of these may be cul-de-sacs.
<p>Pedestrian roads: These are for pedestrian use and may be tertiary or in fourth or fifth order in settlements with organic configurations.</p>	<ul style="list-style-type: none"> Connect the settlement, usually at the block and community level. There may be main or secondary pedestrian roads, especially in organic patterns or in difficult topographies. Frequently found in residential areas, but can also be incorporated in other areas, especially areas of high economic activity. Allow access between shelters, open space paths or green areas. Planned or informal, especially in open spaces. Allow the implementation of drainage and infrastructure. Allow safety and security of displaced population (including firebreak protection). Depending on the morphological pattern, some of these may be cul-de-sacs.

Recommendations

- Implement adequate material and maintenance, regardless of type of road, to allow physical mobility and access to basic and necessary needs.³² In times of rain, secondary or tertiary roads built with less resistant materials often make it difficult for people with disabilities to circulate, or force pedestrians from vulnerable groups to enter potentially dangerous narrow corridors.
- Check the size of roads with possible speeds. Some roads may allow vehicles to pass, but high speeds need more space as they can cause lateral friction between vehicles or with other elements on roads that are too narrow (e.g. A local highway that pass through the settlement).
- Consider existing roads that outline or cross settlements. Although road sizing, material and maintenance is determined by the host country, consider crosswalk spaces or spacing if necessary.
- Clearly differentiate circulation routes from service corridors, which can easily be used for general mobility. Therefore, strategies should be in place to limit private access (e.g. visual obstacles or reduced dimensions).

³² For more information, please see the UNHCR "Sustainable Infrastructure Catalogue".

MAIN ROADS (11 m - 22 m)

GENERAL NOTE:
Please note that this is a generic scheme, not all elements represent all contexts, nor their spatial characteristics (shelter types, separations between common and private space, space types, vegetation, etc.). However, the planner's objective is to adapt them to local standards and environmental needs as well as to the cultural and social context of the displaced populations.

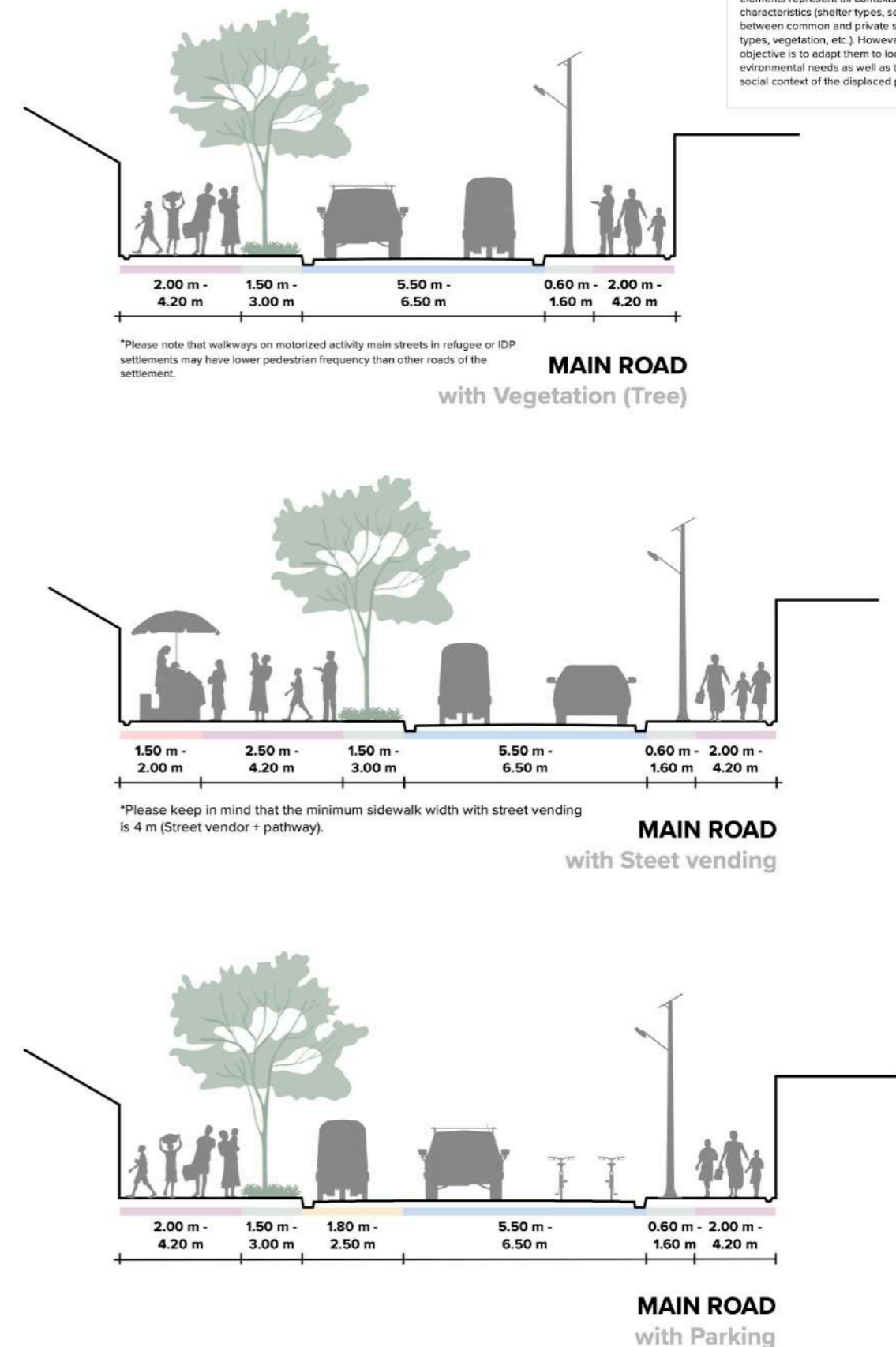
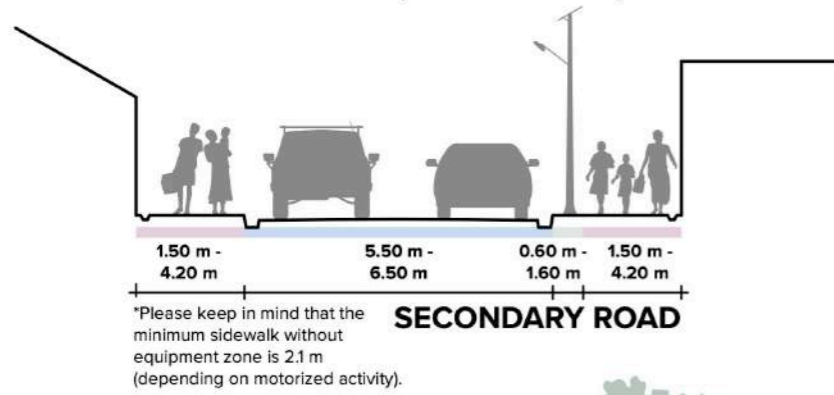


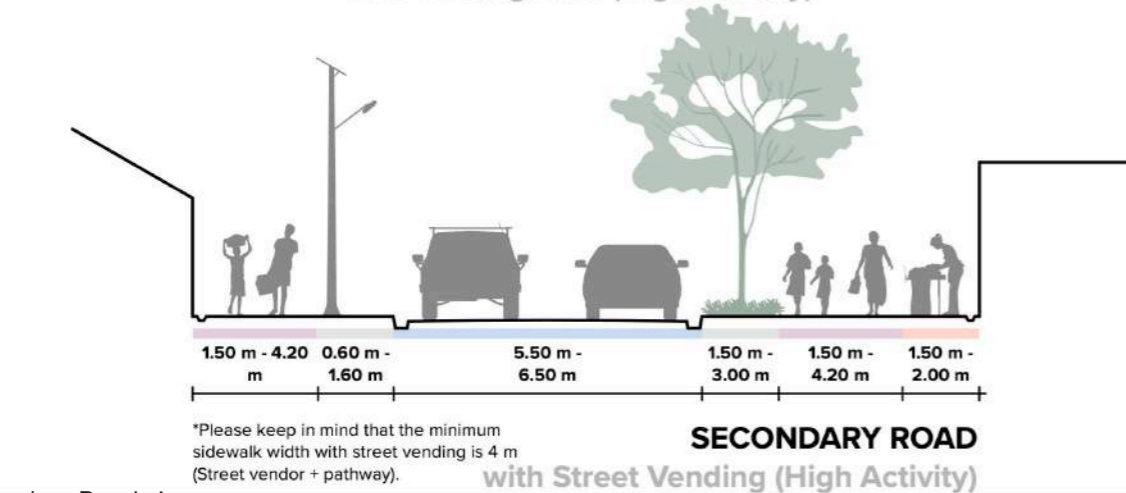
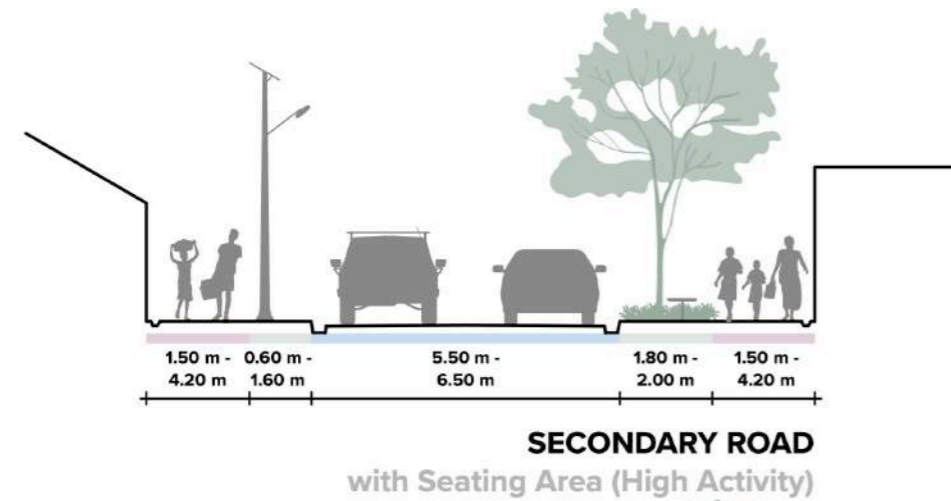
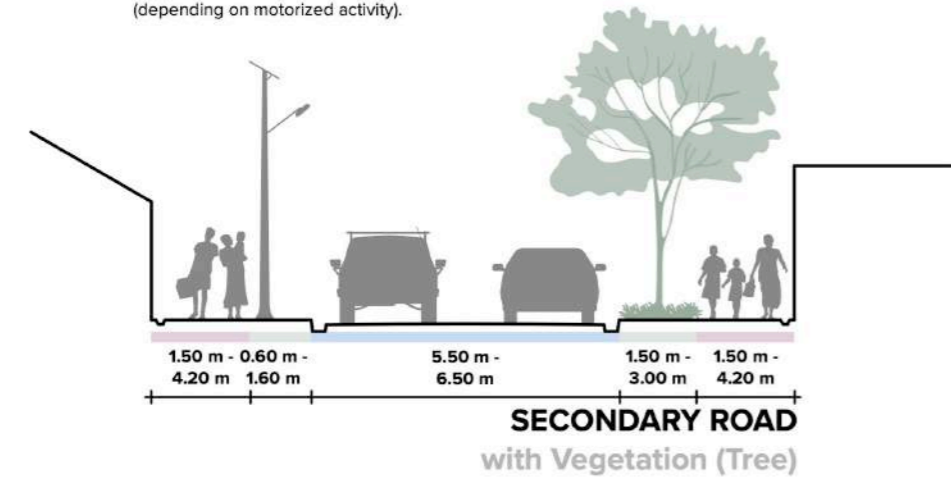
Fig 7. Main Roads in UNHCR Settlements
Lesslie Herrera, 2023

SECONDARY ROADS (9 m - 17 m)

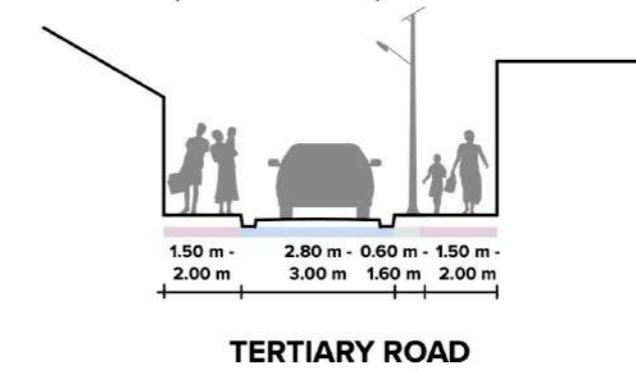


GENERAL NOTE:
Please note that this is a generic scheme, not all elements represent all contexts, nor their spatial characteristics (shelter types, separations between common and private space, space types, vegetation, etc.). However, the planner's objective is to adapt them to local standards and environmental needs as well as to the cultural and social context of the displaced populations.

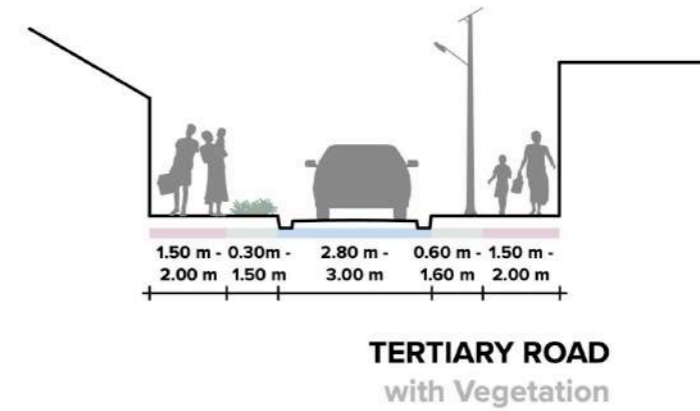
Please keep in mind that some secondary roads may have high or low frequency depending on the activities (e.g. roads with educational facilities are different from those with exclusively residential use).



TERTIARY ROADS (6 m - 9 m)



GENERAL NOTE:
Please note that this is a generic scheme, not all elements represent all contexts, nor their spatial characteristics (shelter types, separations between common and private space, space types, vegetation, etc.). However, the planner's objective is to adapt them to local standards and environmental needs as well as to the cultural and social context of the displaced populations.



PEDESTRIAN ROADS (2 m - 3.50 m)

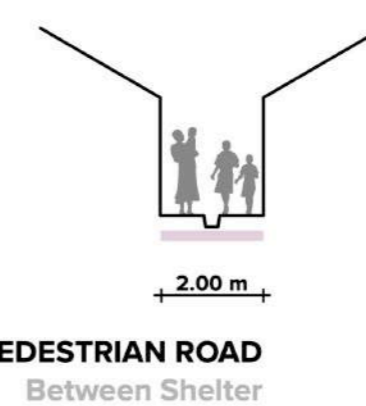


Fig 8. Secondary Roads in UNHCR Settlements
Lesslie Herrera, 2023

Fig 9. Tertiary & Pedestrian Roads in UNHCR Settlements
Lesslie Herrera, 2023

ENVIRONMENTAL CONSIDERATIONS

The structure and morphology of the circulation network should follow the topography as much as possible and consider other environmental aspects (natural resources, protected areas, natural formation of watercourses, etc.) that may modify or limit accessibility and interconnection. Circulation routes must be planned in order to avoid risks for displaced populations, as well as the implementation of costly infrastructure and its maintenance. Therefore, optimize routes and avoid long distances. When planning a new settlement, existing vegetation and other natural factors may occupy a substantial part of the available land, thus influencing the design and use of the land. It is important to attend to protecting the environment (e.g. protected areas, at risk or fragile areas), since poor circulation planning could damage sensitive environmental areas.³³

Vegetation

Vegetation, including tree-lined areas and street planters, is essential to promoting physical and mental health in settlements.³⁴ Beyond its aesthetic value, vegetation provides comfort through shade, reduces or increases air flows, mitigates micro-climatic conditions and reduces radiation transmission.³⁵ Although many studies suggest that street trees are favorable, especially for shielding from pollutants, it is important to consider multiple factors (climate, its use, type and quality of vegetation, etc.) to determine the appropriate vegetation. Not all roads should have trees, but their effect in almost all circumstances is favorable, so it is important to prioritize their inclusion in areas where people gather. However, planting vegetation may be counterproductive in some circumstances, by increasing pollutants (e.g. inappropriate fertilizers), reducing

ventilation³⁶ and tree management and maintenance practices³⁷ (e.g. lack of cleanup of leaves and tree branches can block circulation or drainage systems). Similarly, good integration of trees or shrubs in circulation areas should consider size, species and condition. Avoid causing disturbances or tensions with the settlement or host communities. It is best to prioritize native species (accustomed to the local climate), that are evergreen (active all year round) and easy to maintain.

Wind

Road morphology can increase wind penetration, which is especially important in very hot humid areas. To favor air flow in these areas, road alignments should favor wind penetration,³⁸ with shorter blocks maximizing breezes and minimizing stagnation.³⁹ Similarly, combining the circulation network with Communal Open Spaces can moderate and ventilate the climate. In hilly topographies, where feasible, vegetation on slopes can promote cooler areas and guide circulation. Note, however, that wind penetration can be counterproductive in some contexts, especially in its influence on fire hazards. In hot arid climates, openness to the wind is not a good strategy, as in the mornings it can help to transmit heat and carry sand.⁴⁰

Water

Climate change has generated both more intense and less rainfall in some regions. Settlements are usually located in vulnerable areas that lack local water management systems, or on dry soils where it is difficult for rainwater to infiltrate. Smart design of circulation networks with proper drainage systems can help to manage water and prevent

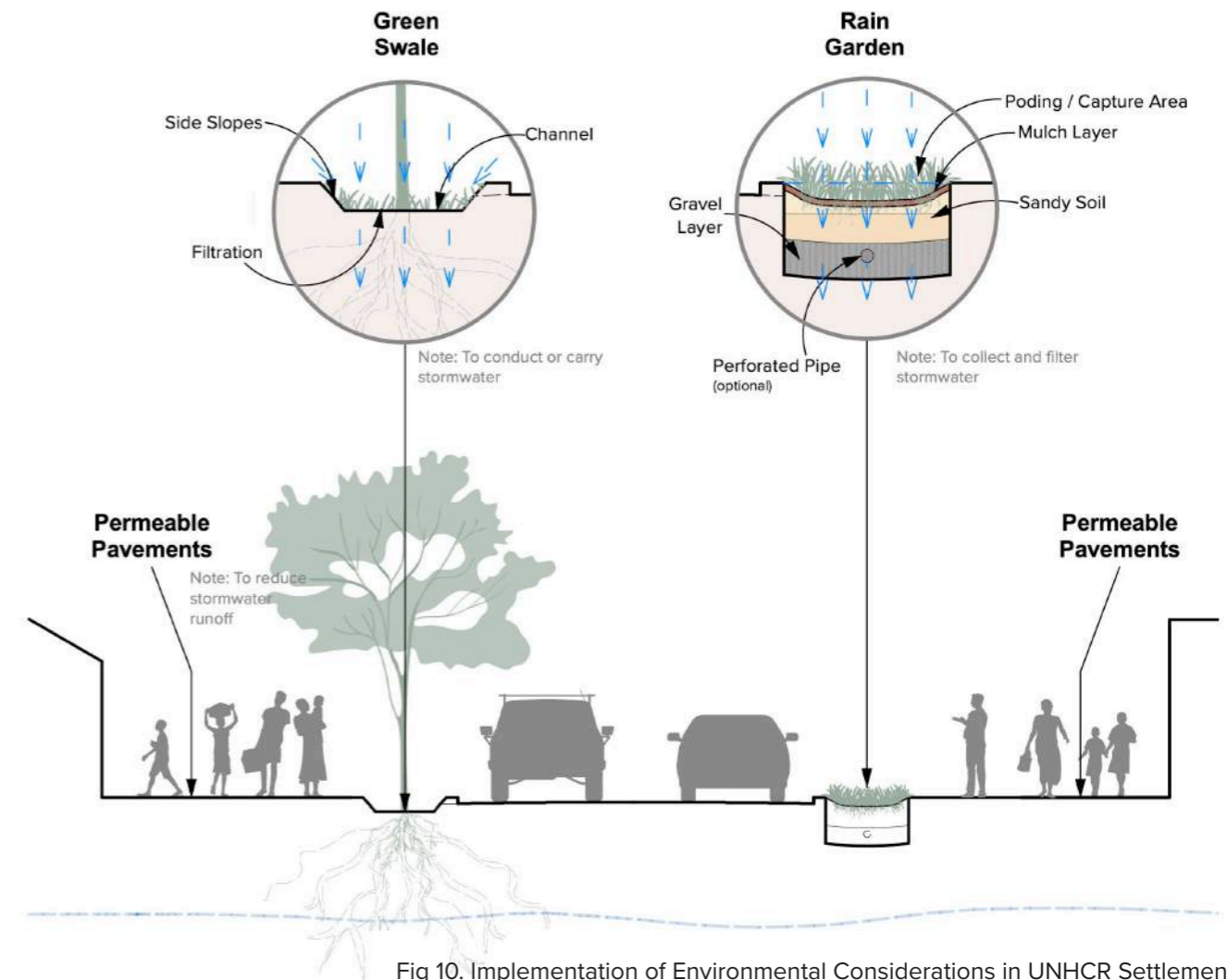


Fig 10. Implementation of Environmental Considerations in UNHCR Settlements
Lesslie Herrera, 2023

flooding. Design should primarily support the conduct of rainwater. Similarly, vegetation planted in roads can intercept rainfall and reduce runoff by increasing soil water infiltration.⁴¹ Plant roots increase capacity and velocity by reducing surface flows and pollution, especially from runoff during the first hours of storms.⁴² Green infrastructure and green streets can help stormwater management beyond the conventional drainage system, incorporating depressed planted areas, typically located between the roadway pavement and the sidewalk.⁴³ This is especially important in areas with poor infiltration. In addition, consider that implementing certain green drainage systems requires low to moderate slopes, and that circulation areas should be of sufficient width to accommodate the planted areas. Elements that can be incorporated from a green perspective are: Green Swales, Rain Gardens, Bioswale, Channels and Streams, Porous Pavements (Filter strips, cellular pavements) and Infiltration Ditches.

Recommendations

- Assess and understand environmental context and related historical development (environmental background and local knowledge, culturally sensitive areas, risk areas, etc.).
- Ensure that the circulation follows the topography and considers environmental factors that favor short and safe pedestrian routes.
- Incorporate vegetation areas that increase thermal comfort and act as windbreaks.
- Consider the climate and prevailing winds in the road design.
- Minimize the impact of the settlement on the environment, especially in rural areas. If required, include a sustainable planting strategy.

⁴¹ Perini & Pérez, 2018, pp. 215 - 216.

⁴² Idem.

⁴³ NRC Solutions, 2022.

³³ For more information on environmental protection while planning, please see UNHCR "The Green Companion Guide" pp. 5-8.

³⁴ Roe & McCay, 2021, p. 124.

³⁵ Scudo & Ochoa de la Torre 2003.

³⁶ Vos et al, 2013; Wania et al, 2012

³⁷ Escobedo, Adams, & Timilsina, 2015; Roy, Byrne, & Pickering, 2012;

³⁸ UN-Habitat, 2018, p. 35.

³⁹ Idem.

⁴⁰ Ibid, p.38.

CONNECTIVITY AND ACCESSIBILITY

The purpose of the various circulation roads is to create a network of connected, safe and accessible spaces that promote walkability - both for the displaced population and, if applicable, the host community. Greater physical connectivity usually means a shorter destination travel time, i.e. short distances and route variety. However, other aspects of the social and psychological experience should be considered, such as how safe, comfortable and pleasant it is to walk, as well as the number of possible destinations. A settlement should encourage travel within its surroundings if necessary. The number of connections it offers with the local context will depend on the nature of the environment, social and political situations, and the moment of development, always prioritizing the protection of the displaced population. To provide good connection and accessibility, roads should allow:

- Easy movement: avoiding obstacles both in the spatial delimitation of activities in each road, and by avoiding roads that are limited by environmental factors (e.g. roads with too steep slopes or roads that are floodable in certain seasons) or social factors (e.g. routes where vulnerable groups may feel threatened).
- Legibility: Easily recognizable through visual language; the type of access is congruent with its function, dimension and physical characteristics (e.g. wide roads for economic activity and semi-private roads with more intimate dimensions).
- Safety: Providing a sense of security through high activity, i.e. through passive observations, avoiding a spatial configuration that may be perceived as threatening (e.g. roads or intersections that are too narrow, dark, or with nooks and crannies).
- Diversity: Including various possibilities and choices during a route (e.g. the same road, route or vicinity includes a school, leisure area and/or an area of economic activity), as well as providing equitable access to basic needs, essential services and livelihoods

Adequate distances between origin and destination

Mixed-use development typically offers greater physical connectivity by providing diverse services and activities in close proximity. However, due to different phases of implementation and growth, mixed-use is difficult to achieve and requires multi-agency collaboration and high investment. Therefore, it is not always possible in contexts where resources, both monetary and material, are often limited. Often the results are not homogeneous across settlement areas. However, it is important to prioritize equitable distribution and relatively short or accessible distances. In urban contexts, areas with accessible facilities are characterized by being able to supply all their needs within 10 minutes and at most 2km from their dwellings.⁴⁴ According to UNHCR's Master Plan Approach⁴⁵ travel time/distance between the shelter and basic services should not exceed 2.5km for children and 5km maximum for adults. However, there are other factors to consider, such as terrain properties and social and cultural factors (age, gender and vulnerable groups). A study conducted by UNICEF in different geographical settings⁴⁶ showed that an acceptable walking distance for women is 30 minutes (approximately 2.5km), but that there were other factors involved, such as the topography. This same study showed that adolescent girls, for their own safety, calculated maximum walking distance according to the number of houses between their home and their destination.⁴⁷ Acceptable distances for some facilities are as follows:

FACILITIES & PUBLIC SERVICES	WALKING DISTANCE	COMMENTS
Education Facilities	0.8km–1.5km	For preschool children, 0.8km maximum ⁴⁸ . For older children, 1km maximum in hilly areas and 1.5km in relatively flat terrain. ⁴⁹
Healthcare Facilities	0.4km ⁵⁰ –5km	Other factors such as the general state of the displaced populations must be taken into account. In some settlements a greater number of such facilities are needed due to generalized chronic diseases or malnutrition. In general, UNHCR recommends at least one health facility within 5km. However, keep in mind the level of service and the target group.
Market Place	0.5km–1km ⁵¹	Varies according to the pedestrian's background; some cultures and contexts are accustomed to walking several kilometers, but journeys to market require individuals to carry extra heavy weights.

44 Azmi, Karim & Amin, 2012, p. 409 ; Great Britain, 2007, p.45: NACTO & GDCI, 2016, p.70.

45 UNHCR, 2019, p. 48.

46 IMC & IRC, 2020, p. 142.

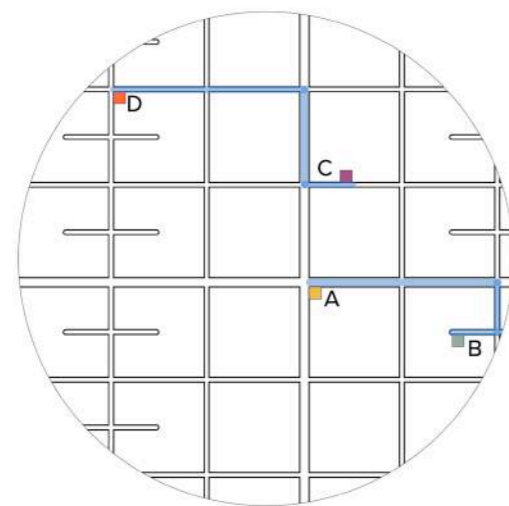
47 Idem.

48 The Safe Routes Partnership, 2018

49 UNICEF, 2009, p. 11.

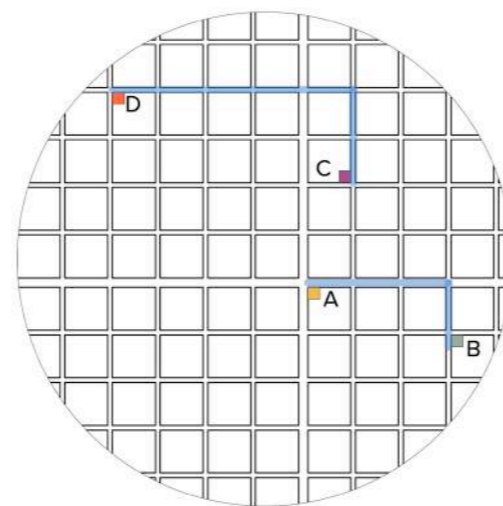
50 Bögel, N. 2020, p. 102.

51 According to the analysis of settlements, the problems and complaints from users arose when the market was located at a distance of more than 1 km.



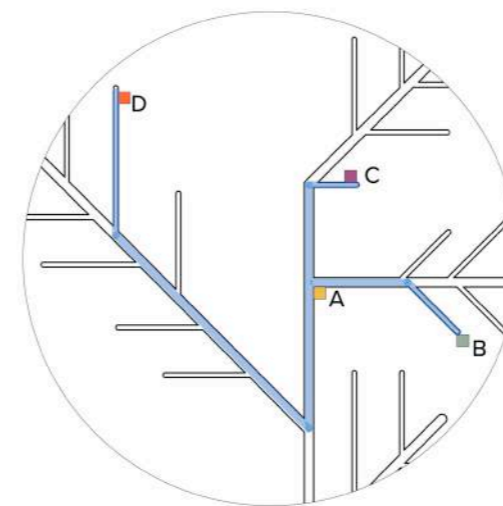
Distance A - B: 600 m (Approx.)
Distance C - D: 700 m (Approx.)

**NETWORK PATTERN
CUL-DE-SAC TYPE**



Distance A - B: 400 m (Approx.)
Distance C - D: 700 m (Approx.)

**NETWORK PATTERN
GRID TYPE**



Distance A - B: 350 m (Approx.)
Distance C - D: 1400 m (Approx.)

**NETWORK PATTERN
TREE TYPE**

**Same geographical location
but different distances
related to the selection of
urban patterns selection**

Fig 11. Distances in different Network Patterns
Lesslie Herrera, 2023

Definition of Intersections

Road intersections play a key role in the population's safety and efficient connectivity. Intersections bring together various users, their activities and choices, which is why conflicts and accidents often occur. Intersections can vary in geometry, type and size and can be complemented by other traffic elements (if necessary). Intersection design should primarily facilitate mobility and visibility by creating safe, easy and intuitive environments. In a pedestrian-first context, intersections should be compact to slow traffic (if necessary) and increase visibility. However, it is not simply a matter of reducing conflict for pedestrians, but allowing all users to see each other properly. Intersection frequency is related to block size; the larger the block size, the fewer intersections. Consequently, a decrease in the number of crossings makes pedestrian activity more difficult and increases intermediate pedestrian crossings, as well as causing more vehicular congestion on main roads or traffic in a future traffic flow. Due to their high accessibility and passive surveillance, intersections are ideal locations for public service facilities (Communal Open Spaces, health centers, markets, distribution centers, etc.). Therefore, a balance must also be found between these site functions and general circulation.

Types of Intersections

- There are several types of intersections depending on the types of roads. In general, there will be:
- Intersection of two main roads (one-way or two-way). The roads generally run through the settlement from one end to the other, therefore acting as the major centers of activity and confluence.
- Intersection of a main and secondary roads. These usually occur at the division of sectors and blocks.
- Intersection of secondary and tertiary roads. These usually occur in more residential areas, i.e. at the block or community level.
- Intersection of tertiary and pedestrian roads. These often arise at the community level and depend on the type of housing (shelter or plot).

Geometry of Intersections

The basic shapes of intersections (or major intersections) should be determined in the emergency or planning phase. In the protracted phase, in which the road is worked out in greater detail, it can be determined how they will work in practice and whether other types of elements (traffic priority, corner radii, signaling, curbs, etc.) need to be incorporated.

TYPES	ADVANTAGES	DISADVANTAGES
Cross Intersection	<ul style="list-style-type: none"> • Comfortable for pedestrians. • Easily legible. 	<ul style="list-style-type: none"> • Has major conflict zones.
"Y" Intersection	<ul style="list-style-type: none"> • Comfortable for pedestrians. • Flexibility in road layout (especially in hilly topographies). • Shorter crossings. 	<ul style="list-style-type: none"> • May hinder visibility. • Limits turns, especially for service vehicles.
"T" Intersection	<ul style="list-style-type: none"> • Reduces conflicts. • Allows orientation to a specific destination (e.g. School). 	<ul style="list-style-type: none"> • May interfere with the interrelationship between two areas.
Roundabout	<ul style="list-style-type: none"> • Reduces speed at intersections. • Facilitates union of several roads or complex junctions. 	<ul style="list-style-type: none"> • Higher cost. • Requires a larger surface area. • Hinders pedestrian and cyclist traffic.
Squared	<ul style="list-style-type: none"> • Easy incorporation of COS or frequent target installations. 	<ul style="list-style-type: none"> • Higher cost. • Requires a larger surface area.

Other more complex or irregular intersections occur where there are staggered junctions, five-way junctions (or more), curved roads, etc. These usually result from the junction of different urban developments (several layouts) or arise informally, and often need to be redesigned as their angles reduce visibility and can endanger the displaced population and the host community.⁵²

Other supporting elements

Other elements, such as crosswalks, turning radii and speed bumps, can support pedestrian intersections, but are uncommon in refugee and IDPs settlements. However, they may be necessary. Road nomenclature can also be implemented from the protracted situation. As vehicular traffic increases, the level of protection should also increase, and other types of signage and elements (pinch points, speed bumps, lane changes, traffic circles, etc.) can be implemented. However, in places of high activity (school exits, plazas, distribution centers, markets, etc.) pedestrian crossings and signage will always be beneficial, regardless of traffic contexts or stage of development.

⁵² For such cases, you may consult the NACTO "Urban Street Design" pp. 100-106.

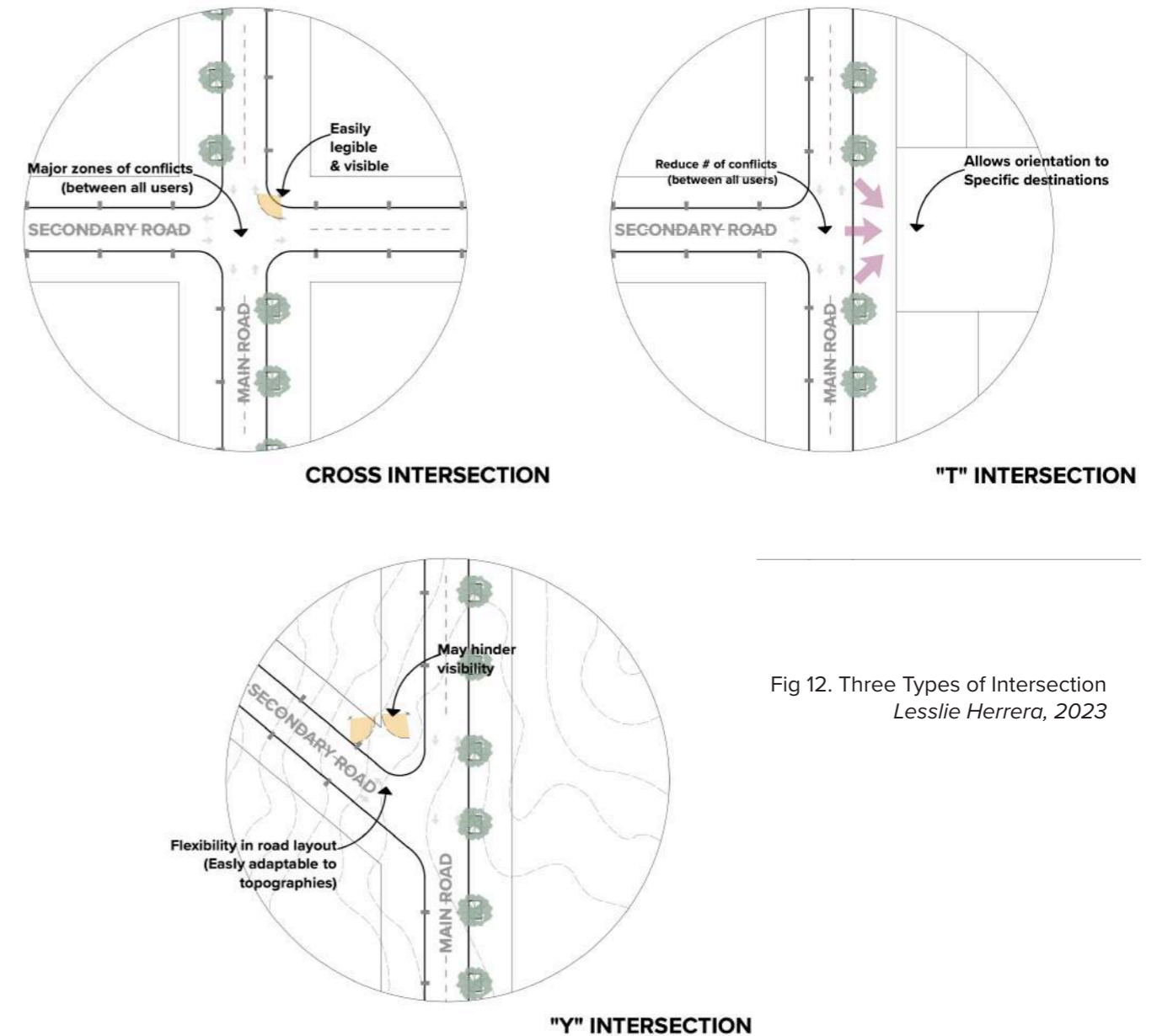


Fig 12. Three Types of Intersection
Lesslie Herrera, 2023

Recommendations

- Design for use across smaller distances with good visibility achieved through increasing the sidewalk or increasing curbs.
- Use simple geometries to increase legibility, visibility and uniformity.
- Create intersections as part of the whole rather than in isolation, taking capacity, traffic and access trade-offs into consideration.
- Understand the context, analyze (possible) routes, landmarks, public transport/taxi connections if any. As well as times/days of peak traffic and activity, consider logistics vehicles and other organizations involved.
- Prioritize pedestrians whenever possible. Increase pedestrian space by providing interaction zones such as communal open spaces, and increase the size of sidewalks and pedestrian-only paths.
- Remember that crosswalks often occur at intersections. If no crossing facilities are present persons are likely to cross in unsafe or unprotected areas. Therefore, provide crossings every 70 m -250 m (depending on the context).⁵³
- Integrate appropriate elements for the most vulnerable populations, such as ramps and refuge areas. and reduce turning radii at corners (if necessary to reduce speed).
- Connectivity should not compromise the privacy of groups or communities.

⁵³ UNEP, 2018, p. 18.

NETWORK PATTERNS

Well-structured, walkable road networks provide easy access to essential services. Increasing dispersed pedestrian movements improves the livability of communities in many ways, as was reflected in the COVID pandemic.⁵⁴ Designing in a manner consistent with the displaced population also implies that the circulation morphology will follow cultural patterns. Designing roads for the Middle East is not the same as designing for East African countries, as the (privacy) needs of the displaced population varies from region to region. The structure or geometric patterns of the network will be determined by the functions the network serves, as well as by physical, topographical and socio-cultural contexts. Geometric patterns have the potential to maximize connectivity or hinder it. Various circulation network patterns exist that allow internal communication in refugee/IDPs settlements; the most commonly used in this context, as a single model or in combination, are:

TYPES	ADVANTAGES	DISADVANTAGES
<p>Grid: Widely used in UNHCR settlements. A rectangular pattern consists of different roads structured perpendicularly to each other, in blocks that form a grid structure.</p>	<ul style="list-style-type: none"> • May favor cultures with semi-urban and urban backgrounds. • Promotes land use efficiency (if topography is suitable). • Maximizes connections between places and can better meet the needs of pedestrians who prefer direct routes. • Facilitates planning and implementation. • Allows for easy land division and implementation of facilities and infrastructure. • Provides easy orientation. • Enables more interconnections, route variety and dispersed circulation. 	<ul style="list-style-type: none"> • Not always suitable for the displaced population's cultures and/or needs. • In windy areas, can channel and accelerate the wind. • The greater the number of intersections, the greater the number of conflict points. • Not responsive to steep terrain (may result in unnecessarily steep roads, difficult to maintain and with greater impact to the natural environment). • Disruptions to the environment are not easily absorbed.
<p>Tree: A system of roads, usually joined by one or more main roads. The branches give access to collector road or other smaller ramifications. The smaller ramifications are usually used as residential roads with cul-de-sacs, scattered housing units, or combined with the grid system.</p>	<ul style="list-style-type: none"> • May favor cultures that need to establish private areas or have large agricultural plots near their shelters. • Favors environmental protection and preserves natural surroundings. • Easy differentiation of hierarchies. • Easy organization of public and private areas. • Easily adaptable to mountainous or steep terrain. 	<ul style="list-style-type: none"> • Requires urban developments to occur in clusters, with single point access to surrounding collector or arterial roads. • Low connectivity. • Increased concentration of traffic on major arterials. • May increase the number of public services and facilities and therefore their cost.
<p>Organic: The pattern is imprecise; their shapes can vary between straight and curved roads or a combination of both. Usually, irregular blocks of various sizes are formed.</p>	<ul style="list-style-type: none"> • May favor cultures that need private areas or have large agricultural plots near their refuges. • Adaptable to landscape contours and complex topographic curves. • Easily absorbs environmental disruptions. • High responsiveness to a variety of terrains. • Dispersion of traffic through the road network. 	<ul style="list-style-type: none"> • May not always be adaptable to the displaced population's cultures and/or needs. • Can be highly disorienting. • Variety of dimensions in blocks and lots. • Difficult land distribution. • No intrinsic hierarchy.
<p>Cul-de-sac: Consists of main/ and or secondary roads that communicate with each other, combined with dead-end roads.</p>	<ul style="list-style-type: none"> • May favor cultures that need to establish private areas. • Easily absorbs environmental disruptions (topography, boundaries or other limitations). • Allows differentiation and assignment of different types of privacy (public, semi-public, private and semi-private). • May favor cultures that need private areas or cultural, social or religious differentiation. • Usually maintains low levels of motorized traffic in necessary areas. 	<ul style="list-style-type: none"> • May lead to land-wasting and cost-intensive turns. • Causes additional travel and emissions from service vehicles. • Weak interior connectivity. • Traffic congestion due to lack of interconnections.
<p>T-Type: Usually rectangular, its main roads communicate with each other, while the secondary or tertiary roads communicate with the main roads of certain sections.</p>	<ul style="list-style-type: none"> • Provides a safer environment. • Can promote differentiation of private and public areas, and enclosures if necessary. • Can improve hierarchical efficiency. • Reduces alternative routes for traffic flow, avoiding potential accidents. 	<ul style="list-style-type: none"> • Not always suitable for the cultures and/or needs of the displaced population. • Low connection. • Can be highly disorienting. • Variety of block dimensions.

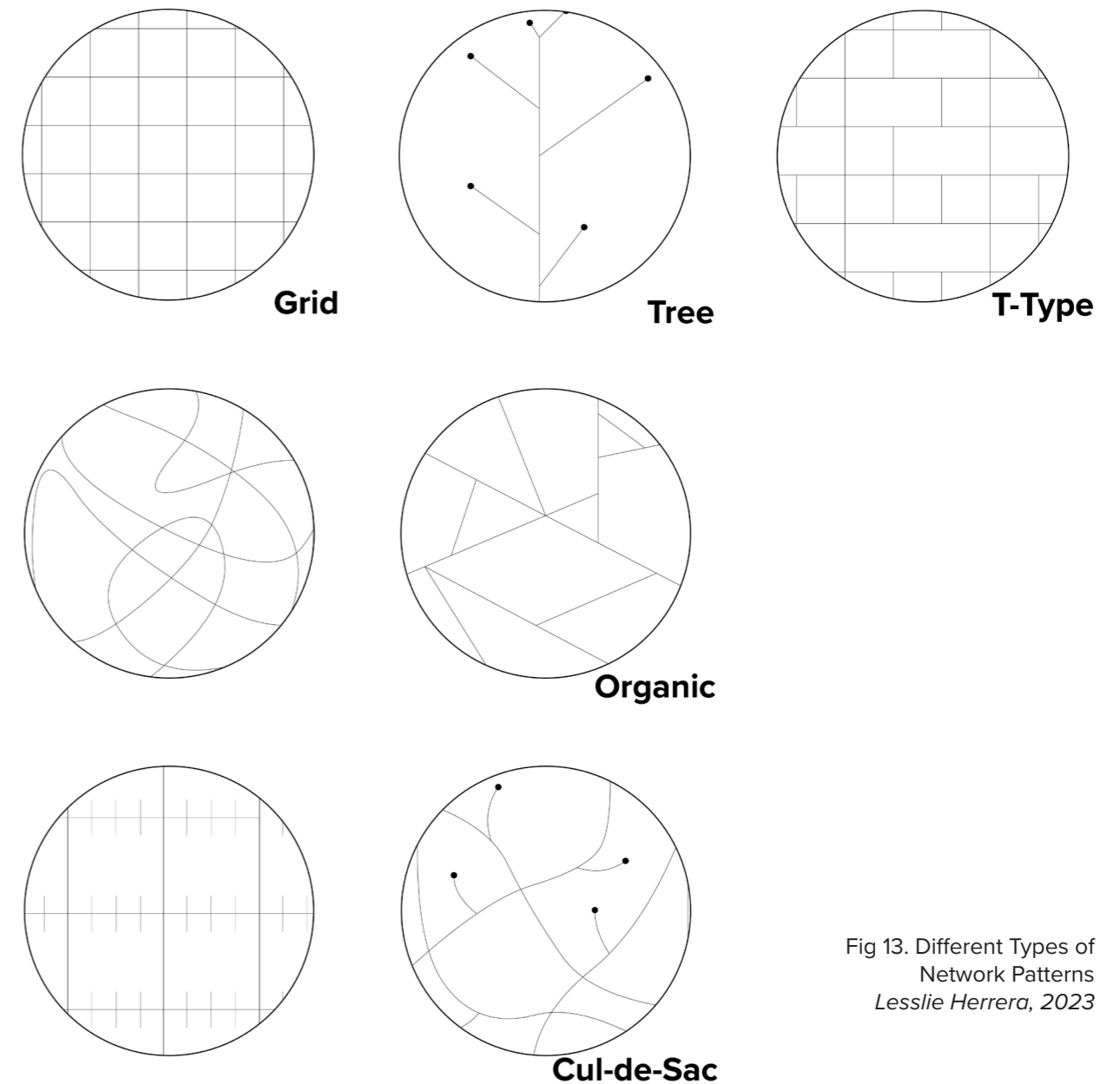


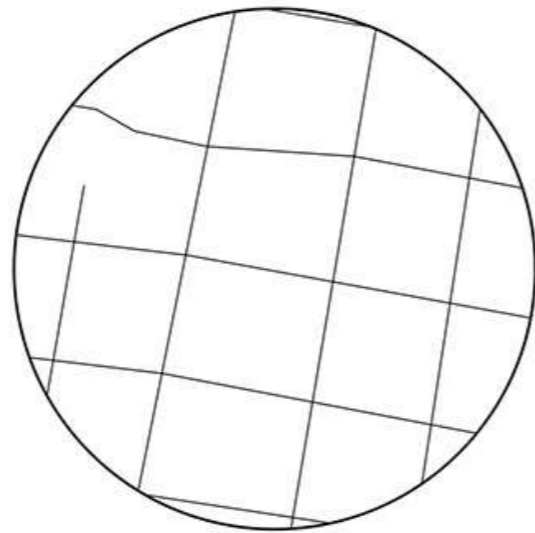
Fig 13. Different Types of Network Patterns
Lesslie Herrera, 2023

Recommendations

- Implement routes that are necessary and have a defined function.
- Have a deep understanding of the topographical context, the host community's and displaced population's social habits, and the local built environment, in order to select appropriate geometric and road layout options.
- Pay attention to connectivity and accessibility to ensure crime prevention (e.g. avoiding poorly traveled routes or back access).
- Avoid layouts whose distribution makes it difficult to protect the displaced population, avoiding narrow spaces or blind spots that put people, especially children, women or people with reduced mobility, at risk.
- Avoid creating excess or poorly defined spaces that are difficult to use or may be uncomfortable for pedestrians.
- Seek the best orientation of roads to ensure adequate ventilation.
- For fire safety, remember to implement 30m firebreaks every 300m. Minimum 2m between structures - use 2 times the height of the structures as adequate distance.
- Topographic slopes should be kept between 1 to 5%, ideally 2% to 4%.



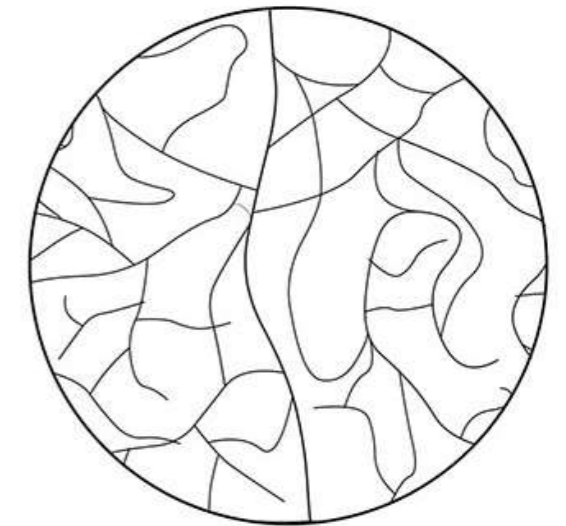
**Ayilo 2 Refugee Settlement
UGANDA**



GRID TYPE



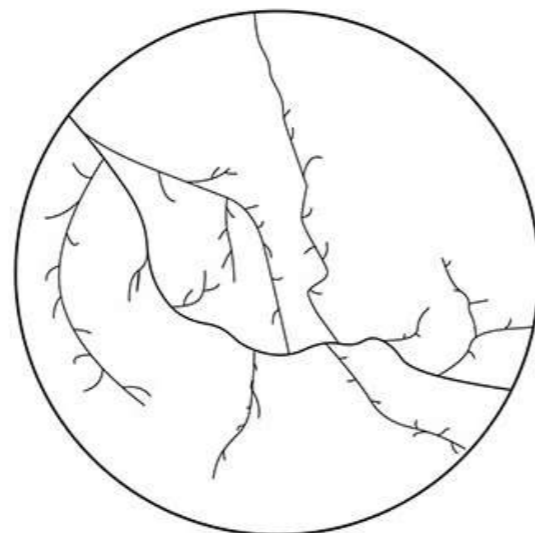
**Kutupalong Refugee Camp
BANGLADESH**



ORGANIC TYPE



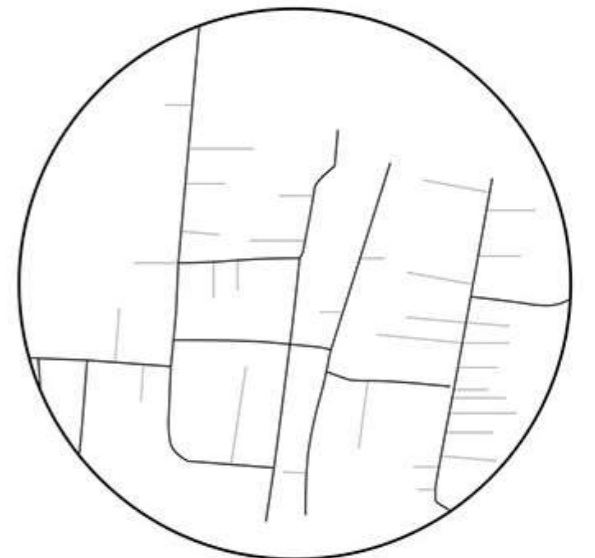
**Jewi Refugee Camp
ETHIOPIA**



TREE TYPE



**Nu Po Refugee Camp
THAILAND**



CUL-DE-SAC TYPE

Fig 14. Different Types of Network Patterns of UNHCR Settlements
Lesslie Herrera, 2023

BLOCKS

The block is the set of structures, plots, shelters, passages, courtyards (semi-private), and/or alleys delimited by public roads. In urban planning, the block is considered the intermediate scale and influences the type of circulation network and the type of buildings to be designed.⁵⁵

There is no ideal block size, but it is generally recommended to promote walkability; therefore, the literature usually recommends blocks between 60m and 180m.⁵⁶ Pedestrians prefer frequent crossings, otherwise they will seek more direct routes that may compromise pedestrian safety. However, smaller blocks are not automatically better, as the increased number of roads and their maintenance requires more investment. As mentioned above, to promote connectivity and accessibility, it is important that the pedestrian path is safe and comfortable, and that destinations are within walking distance. Block size is also determined by function and morphology factors, as well as the type of housing unit (shelter/plot) and related characteristics (family, agricultural, community, etc.). Similarly, there may be different types of blocks, and their morphology (traditional and super blocks), function (family shelters, public services and facilities, mixed), and geometry (square, elongated and irregular) should be considered.

It is worth mentioning that in this context the definition of "block" does not refer to the planning unit of the UNHCR planning module, although, depending on the circumstances, the two terms could coincide.

Morphology

Traditional blocks are usually accessible to both pedestrian and vehicular traffic, as they allow for shorter routes. At the same time, their disadvantage is that they tend to allow traffic access to areas that require

⁵⁵ Davis, Duany & Plater-Zyberk, 2018, p. 27.

⁵⁶ Referring to McNally, 2010, p. 11; and Stangl, 2015.

Please note that these studies have been conducted in urban city contexts, not UNHCR settlements.

Similarly, the greater the number of routes, the greater the amount of square meters of construction and monetary investment. When possible, prioritize pedestrian walkways, as these provide privacy and protection.

Superblocks are large, usually subdivided inside, and have cul-de-sacs or interconnected interior roads to connect shelters/parcels, but these roads do not connect to the outside. Their configuration usually excludes through-traffic, so tends to be shorter in length and construction, therefore monetary investment is lower. However, they tend to overload the arterials that delimit them, as well as their intersections. Similarly, they make pedestrian displacements indirect, and require longer distances. Also, note that they limit the entry of service vehicles (e.g. latrine maintenance).

Function

Housing blocks are usually shelters/parcels, and can be combined with Communal Open Spaces. One of the major difficulties in implementation is their quantity. As they are exclusively for shelter, there is a risk that the distances between shelters/parcels and public services will be greater. Special attention should be paid to the pedestrian roads within the block (if they exist), which may give rise to problems of appropriation and security. In residential areas, dimensions will depend mainly on the selection of the shelter or plot and the dimensions given to them. Remember that UNHCR recommends communities are usually made up of 16 or 20 families. In an emergency phase there are different guidelines⁵⁷ that recommend internal configurations in the blocks for shelters and plots, but when designing, always plan dimension and circulations considering a future protracted situation.

Public service and facility blocks have a **variety of functions**. However, although

⁵⁷ Shelter Cluster, 2018, pp.2-29; Shelter Project, 2005, pp. 386-391.

they are apparently easier to implement, they can hinder the functionality and circulation of the entire settlement by concentrating activities in a single area. In addition, when exclusive areas of this type are foreseen, an oversizing of the areas usually occurs. In blocks of this type, different buildings are usually arranged around squares or squares.

Mixed-use blocks tend to be more efficient, facilitating pedestrian distances and routes. However, the cost is usually higher due to the distribution of facilities and public services. Mixed-use blocks may also cause problems with protection and tensions if users' characteristics and backgrounds are not taken into account.

Geometry

There are a great variety of geometric categories, but the geometry of blocks in a settlement is usually:

Square Block: has the same dimension in width and length. The subdivisions in square models usually create irregularly-sized parcels, unless only its perimeter is parcelled, to create a free shared space in the center that can be useful in some typologies of Communal Open Spaces. A shared central space may be contested or taken over by dominant families, making it difficult to maintain some shared services (e.g. latrines).

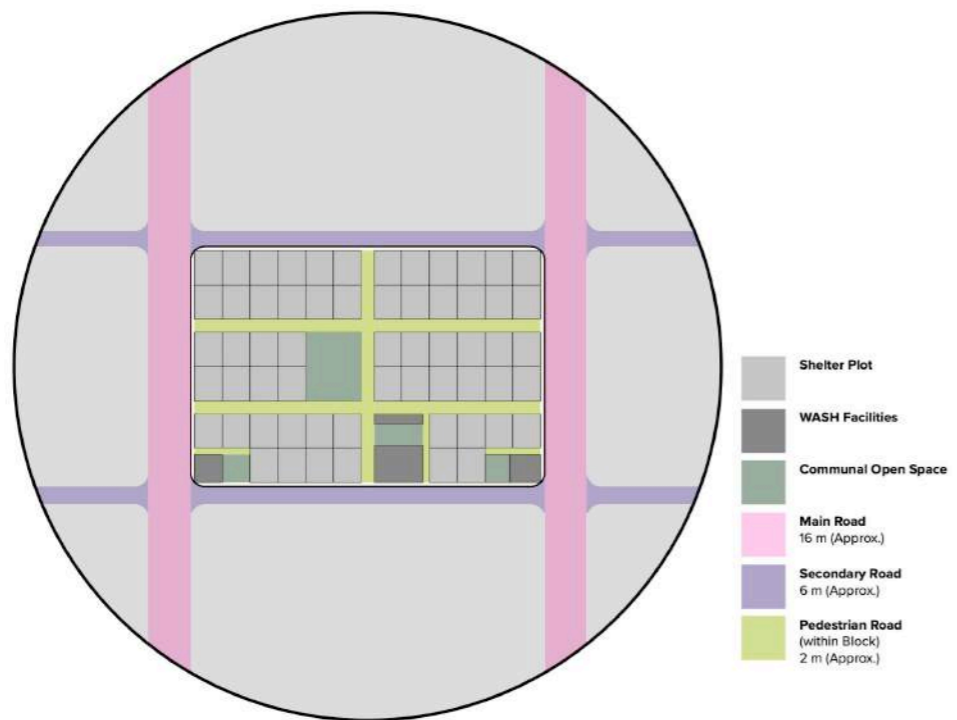
Elongated Block: One end usually longer than the other. The depth of the plots is usually constant. Provides short service alleys if needed. Can be curved along length to suit the terrain (e.g. to bridge slopes). Can promote privacy, as the short side can be exposed to busy roads. In areas designated for facilities or commercial use, can facilitate access from busy roads.

Irregular Block: Characterized by unlimited variations. As these are organic structures, they adapt easily to the shape of the land and slopes. They are not parallel to each other, causing disorientation, and require alleys or common spaces to generate

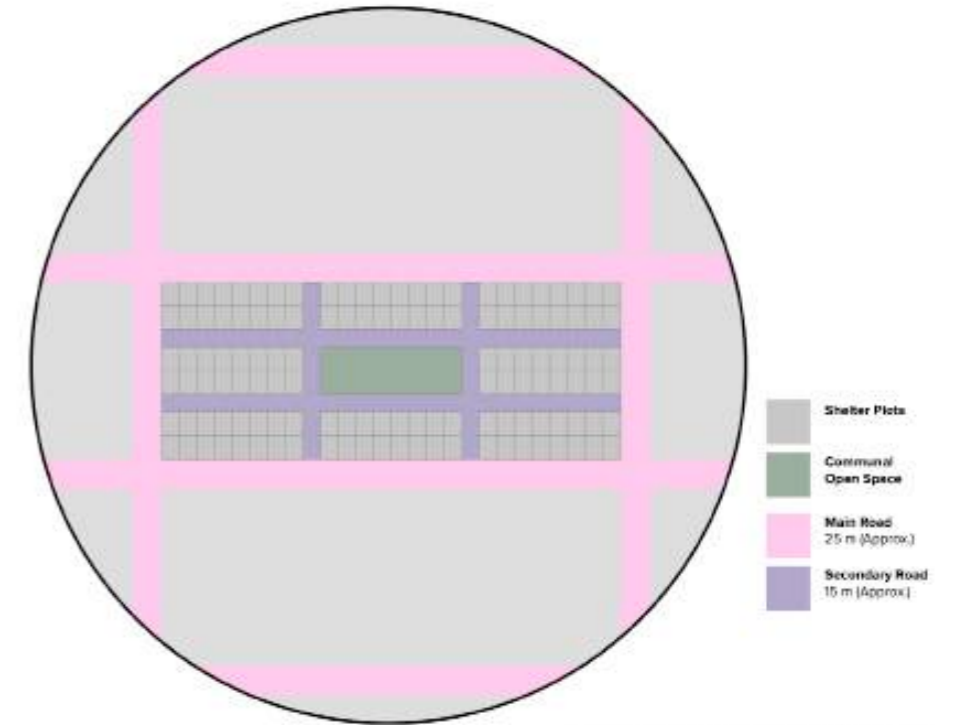
regular, geometrically accessible plots/shelters that are uniformly and equitably distributed.

Recommendations

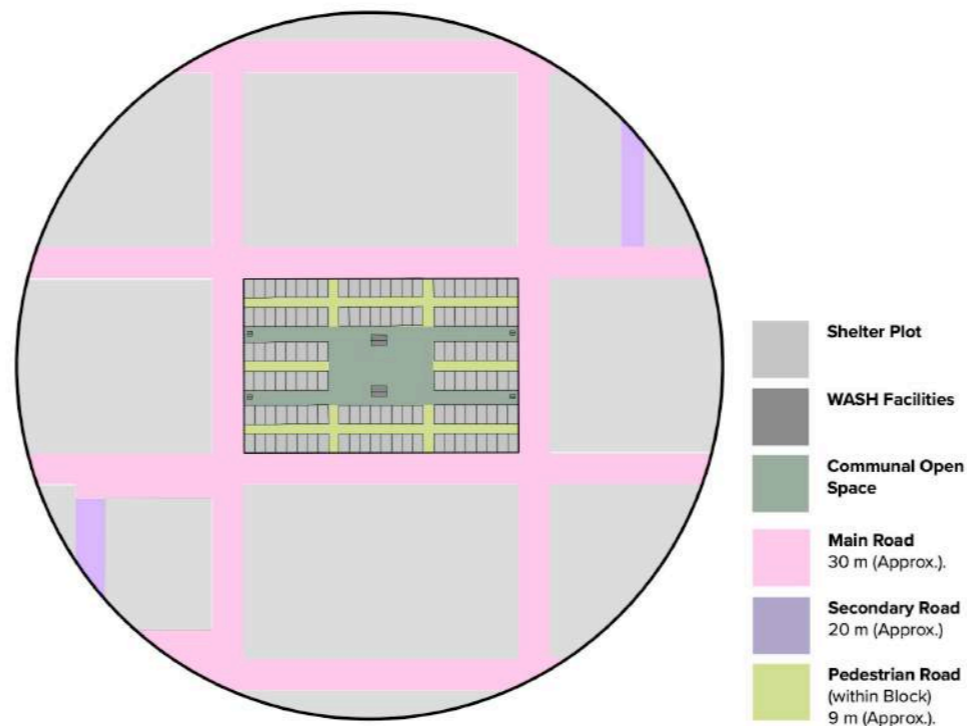
- Consider the morphology of the terrain for the choice of the block and the related circulation. The dimension and geometry may vary throughout the settlement.
- Favor plot size and types according to the social background and culture of the refugees/internally displaced persons, in balance with the context of the host community. Especially highlight local social patterns of urbanization.
- Mix different block types where possible, avoiding high concentrations of activities that prevent roads from meeting demand.
- Ensure equitable distribution of shelter plots among all households and appropriate circulations between them.
- Avoid long lines of "military-style" shelters that increase circulation needs and make circulation difficult.
- Consider Age-Gender-Diversity when designing the blocks, by avoiding block configurations whose circulation jeopardizes the safety of vulnerable groups, or that expose private space to easy attack.
- Design blocks that allow the entry of maintenance, security and emergency vehicles.
- Avoid plots or shelter entrances that meet main roads directly, as this could increase tensions or security problems in the event of significant levels of traffic in future.
- Keep in mind that the more dense a territory is, the greater the need for circulation roads.
- Prioritize, whenever possible, the use of pedestrian walkways on interior roads to provide greater privacy and protection.



*Drawing based on the planning plan of a refugee settlement in Iran.



*Drawing based on the planning plan of a refugee settlement in Rwanda.



*Drawing based on the planning plan of a refugee settlement in Ethiopia.

Fig 15. Different Types of Blocks & their Circulation Network
Lesslie Herrera, 2023

LAND USE PROPORTIONS

Currently, in refugee and IDP's settlements, the Master Plan⁵⁸ recommends reserving 20-25% of the settlement's total surface for roads and walkways. Other international recommendations⁵⁹ for Circulation Networks in urban contexts suggest allocating between 25% and 30% to roads, and a multidimensional study of urban prosperity determines an average of 30% of the land dedicated to streets, footpaths, pavements and sidewalks.⁶⁰ Several factors can affect these proportions, such as the topography, other natural features, urban layout morphology, the housing scheme, number of persons displaced, agricultural land, services found in the host communities, cultural traits, and so on.

As shown in the table below, featuring four refugee settlements, their percentages dedicated to Circulation Networks vary between 10%-41%. These four settlements have an urban layout morphology guided to a greater or lesser degree by the so-called "grid pattern". The size of the territory varies between them, as does the number of refugees. Only one of the four settlements has a hilly topography, which generates a greater amount of Circulation Network (including service corridors). At first glance, it would appear that natural attributes and topography influence the % of Circulation Network land use. Ajoung Thok has a lower percentage than the recommendations propose, which is easily explained by the large size of its blocks (composed of refugee plots). These long walking distances hinder interconnectivity and pedestrian activity. Mahama has the highest percentage of land use, a large part of which is allocated to service corridors. Despite being intended for semi-private use, due to the morphology of the terrain and spatial characteristics, these corridors have become public circulation routes. Similarly, the blocks (composed of shelters), are smaller in size, allowing a greater number of possible pedestrian routes. Zaatari has the lowest percentage of Circulation Network in its formal structure; however, if we consider other forms of circulation inside the block, such as roads and circulation between shelters, which have a more irregular and informal morphology, the percentage would be between 20% and 25%. In Kobe, the roads were planned in greater detail, and feature a defined hierarchy of main roads and interior roads at block level. Despite the integration of challenging natural aspects, there is a high percentage of land use for this purpose, due to the large number of internal roads between rows of plots. Therefore, the camps with a higher percentage of formal or informal land use provide greater connectivity and a greater number of routes that facilitate mobilization on foot. However, this does not mean that they have been better planned, or that their size is adequate. It should also be remembered that the greater the number of roads, the higher the cost of construction and maintenance. These aspects must be weighed and taken into account when planning a settlement.

58 UNHCR, 2019, p.46.

59 UN-Habitat, 2016, p. 32.

60 UN-Habitat, 2020a, p. 77.

COUNTRY	NAME	DATE OF CREATION	MORPHOLOGY AND FEATURES	TOPOGRAPHY	SIZE BASELINE ⁶¹	# OF POCS ⁶²	DENSITY	M ² PER PERSON	% OF CN ⁶³	M ² OF CN PER PERSON
South Sudan	Ajoung Thok Refugee Camp	2013	Grid Layout.	Relatively flat (Slopes between 2% and 5%)	7.17km ² ⁶⁴ (12.2km ²)	46,455	6,479 p/km ²	154.34 m ²	17.20% ⁶⁵	26.56 m ²
Rwanda	Mahama Refugee Camp	2015	Partial grid layout. Hilly morphology. Marked by areas prone to flooding.	Some steep slopes (Between 6% and 18%).	1.75 km ² (1.75 km ²)	55,925	31,957 p/km ²	31.29 m ²	40.79% ⁶⁶	12.77 m ²
Jordan	Zaatari Refugee Camp	2012	Grid layout.	Relatively flat.	5.51 km ² (9.28 km ²)	81,983	14,878 p/km ²	67.29 m ²	9.45 % ⁶⁷	6.36 m ²
Ethiopia	Kobe Refugee Camp	2011	Grid layout. Marked with gullies as buffer zone. ⁶⁸	Relatively flat (Gentle slopes).	4.15km ² ⁶⁹ (4.15 km ²)	37,089	8,937 p/km ²	111.89 m ²	35.10%	39.27 m ²

61 This area does not necessarily correspond to the area of settlements found in official UNHCR documents (added in parenthesis). Due to the diversity of characteristics of each settlement, agricultural lands, areas for future development and buffer zones were excluded to create a baseline for comparison.

62 Last available data of: Ajoung Thok from February 2022, Mahama from March 2022, Zaatari from June 2022 and Kobe from June 2022.

63 To calculate the percentage, first the different CN types were identified and measured through polygons in m². The total sum of all surfaces was then obtained. The total CN was then divided by the baseline dimension of each settlement and multiplied by 100.

64 Excluding unoccupied areas reserved for development and agricultural land.

65 Only considering the area occupied by the settlement.

66 Considering the service corridor and other spaces that are used as circulation.

67 Does not include some paths and other forms of circulation between shelters because no information is available. By estimating such information, it could be closer to 15%.

68 These areas represent less than 5% and are used as open spaces in planning.

69 Information based on the 2012 project and does not include land for agriculture.

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