Urban Transformations and Buildings Typology Changes in Areas of Military Conflict

Svitlana Linda, Oksana Pekarchuk, Serhii Milchevych, Roman Krushelnytskyi, Anton Kolomieitsev
Lviv Polytechnic National University, Institute of Architecture and Design, Bandery str., 12, 79013, Lviv, Ukraine
oksana.p.pekarchuk@lpnu.ua

Abstract. During the period of protracted military conflicts, significant changes are taking place in the social, humanitarian and infrastructural spheres for civilians, who find themselves in the area of military confrontation. The military conflict in eastern Ukraine began in spring 2014. Despite various efforts at the international level, a peaceful settlement of the conflict has not yet taken place. In cases of prolonged conflicts, a buffer zone is formed along the line of contact, the so-called “gray zone”. It is a kind of parallel reality of human existence in very difficult, extreme and dangerous conditions. The purpose of this article is to show how a military conflict determines the direction of urban transformation, and influences the change in the typology of public buildings and structures in the “gray zone”. The article uses a comprehensive approach based on statistical analysis, urban planning and typological analysis of open source materials. In 2014, after the signing of the Minsk Protocol, the term “gray zone” was introduced. This buffer zone corresponds to the length of the collision line and is 457 km, on either side of which there is a 30 km neutral territory. According to the Memorandum, the Cabinet of Ministers approved a list of settlements located in the “gray zone”. Weapons were separated from the demarcation line (from 8 km to 120 km) on both sides. In the “gray zone” in Donetsk and Luhansk regions, 350,000 people are estimated to be living under these difficult conditions, who face a variety of daily problems, because social settlement mechanisms are poorly functioning there. In addition, there is a significant loss of housing and infrastructure (approximately 10,000 infrastructure damage has been sustained). The most devastating settlements are located on the collision line as they are strategic points in the distribution of spheres of influence between the parties of the conflict. Within the “gray zone” are urban transformations, which are associated with the emergence of new functions: military and humanitarian. The military function is reflected in the command and observation point equipment, firing points and boundaries of the defense line, control facilities, fortifications and more. Humanitarian one envisages the emergence of territories where social, medical and humanitarian relief facilities are located. For that purpose, surviving public buildings (schools, hospitals, etc.) often change their function. Thus, it can be argued that in conditions of military confrontation, there is an “adaptation” of the existing urban situation to new needs and “re-profile” the typology of buildings, demonstrating the importance of ensuring their “flexible planning”.

1. Introduction
During the period of protracted military conflicts, significant changes are taking place in the social, humanitarian and infrastructural spheres for civilians, who find themselves in the area of military
confrontation. The military conflict in eastern Ukraine began in the spring of 2014. Despite various efforts at the international level, a peaceful settlement of the conflict has not yet taken place. In cases of prolonged conflict, a buffer zone is formed along the line of contact, the so-called “gray zone”. It is a kind of parallel reality of human existence in extremely difficult, extreme and dangerous conditions.

Scientific writings include definitions that comprise the concept of “gray zone”: Gray Zone Competition, Gray Zone Conflict, Gray Zone Activity [1, 2].

The National Consortium for the Study of Terrorism and Department of Defense used in researchers working definition of Gray Zones as “a conceptual space between peace and war, occurring when actors purposefully use multiple instruments of power to achieve political-security objectives with activities that are ambiguous or cloud attribution and exceed the threshold of ordinary competition, yet fall below the level of large-scale direct military conflict and threaten US and allied interests by challenging, undermining, or violating international customs, norms, or laws” [2,3]. Based on that and other works, we determined Gray Zone as a buffer zone between two or more parties to a conflict, which is countering hybrid threats.

After the conflict has subsided, the “gray zone” can turn into a green border area called the “buffer zone”. This happened with the Great Wall of China, the Hadrian Wall, and the demilitarized zone between South and North Korea. The buffer zone in Cyprus is controlled by UN peacekeepers. The Green Line between two parts of Cyprus has a variable width: in rural areas - 7 km, and in Nicosia, the capital city of northern and southern Cyprus - narrows to 3.3 m [4].

The topic of the “gray zone” has now become relevant for Ukraine. Therefore, the purpose of this article is to demonstrate how military conflict determines the direction of urban transformation, and influences the change in the typology of public buildings and structures in the “gray zone”. The article uses a comprehensive approach based on the analysis of statistics, urban planning and typological analysis of materials that are taken from open sources.

2. Spatial transformations of Donbass environment in the context of military conflict

In April 2014, the armed confrontation began in the Donbas. At the beginning of the hostilities, there was no clear line of confrontation between the armed forces in the territories out of the control of Ukrainian authorities and the armed forces of Ukraine. In 2014, after the signing of the Minsk Protocol, the term “demarcation line” was introduced. On either side of the collision line, the length of which is 457 km, there is a 30 km neutral territory, which the media call the “gray zone”. Weapons were separated from the demarcation line (8 km to 120 km depending on the firing range of the weapon) (Figure 1) [5]. The Decree of the President of Ukraine dated February 7, 2019 #32/2019 fixed the exact geographical coordinates of the “demarcation line” [6].

The collision line or “demarcation line” is a boundary characterized by the appearance of different levels of urban transformation: at the macro level, it is the administrative-territorial transformation of the region, at the micro level, it is the architectural and planning transformation within the settlements that are within the “gray zone” [7].

During the period of armed conflict, the spatial variability of the “demarcation line” could be observed (Figure 2). The instability of the buffer zone is evidenced by the repeated breaches of arms withdrawal on both sides, as recorded by the OSCE mission. The military positions of both sides within the “gray zone” are constantly changing, pushing each other out of control of the settlements. This determined the transformation of the administrative-territorial structure.
During the six years of the conflict, there were changes in the status of settlements, new and changed boundaries of existing administrative-territorial units were created, and re-subordination of settlements controlled by the Ukrainian authorities took place. In accordance with the resolution of the Parliament (Verkhovna Rada) of Ukraine #32-VIII of December 11, 2014, the boundaries of the cities of Mariupol, Volnovaksky, Novoazovsky and Telmanivsky districts were temporarily changed. This resolution will be effective until the transition to the control of state authorities and local self-government bodies of the non-controlled settlements of the Donetsk region [8].

Pursuant to the resolution of the Parliament (Verkhovna Rada) of Ukraine # 177-VIII of February 11, 2015, the boundaries of the Slovyansoserbsk and Popasna districts of Luhansk region were changed. The territory of the Popasnyansky district was enlarged by 51 hectares as a result of the annexation of lands which were under the control of the Frunzensky settlement council of Slavyansoserbsky district and the territory of Zholobok village. It has been claimed that the territory of the Popasnian district is 146 700 hectares and that of the Slavyanoserbsk district is 82 914,72 hectares [9].

According to the decree of the Cabinet of Ministers of Ukraine “On approval of the prospective plan of formation of territories of the communities of Donetsk region” No. 0829-r of September 8, 2015, it is planned to unite 273 councils in 38 united territorial communities [10]. According to the Decree of the Cabinet of Ministers of Ukraine dated 05.08.2015, No. 833-r, as of January 13, 2016, No. 8-p, on the territory of the Luhansk region, which is under the control of the Ukrainian authorities, 24 territorial communities should be created [11].

On September 8, 2016, Parliament approved two resolutions # 4896 of 5 July 2016 and # 4931 of 8 July 2016, which recorded changes in the administrative and territorial structure of Donetsk and Luhansk regions. These resolutions have changed the subordination of settlements from administrative centers located in an uncontrolled territory to a city of regional importance or a district or settlement controlled by Ukraine.

Taking control of settlements within the “gray zone” by Ukrainian troops stimulated the resumption of work of local municipality bodies. In accordance with the Law of Ukraine “On the
special order of local self-government in certain areas of Donetsk and Luhansk regions”, a special order of local self-government was introduced in the settlements of the buffer zone. This demonstrates their administrative and legal subordination to the military leadership.

**Figure 2.** Spatial variability of the “demarcation line” between September 2014 and September 2019

Within the “gray zone” there have been urban transformations, which are associated with the emergence of new functions: military and humanitarian. The military function is displayed in the command and surveillance equipment, firing points and boundaries, defense lines, control facilities, fortifications and more. Humanitarian function foresees the emergence of areas where social, medical and humanitarian relief facilities are located [7]. In addition, other functional locations appear in the gray area: security zones, mine-contaminated areas, accessible and restricted areas, and more. The social function of a place may vary. For example, the ground between two fences can be turned into a concert venue. Cardinal spatial transformations and changes in the environment can lead to negative moods in the settlement community [12].

3. Transport infrastructure and entry-exit checkpoint structure

Due to the confrontation, the transport network was limited and lost its effectiveness. Today, 31% of the Luhansk region and 28% of the Donetsk region are not under the control of the Ukrainian authorities. Due to the loss of control over a part of the territory of the country, the possibilities of transit to the territory of these regions were significantly restricted. Under the control of Ukraine, there is 9,276.6 km of public roads left in Donetsk and Luhansk regions (with a total length of highways of 13,973.7 km): an international value of 209.7 km; national importance 470.3 km; regional importance 222.5 km; territorial significance of 1 376.7 km (from 2 228.8 km); local 6,997.4 km (from 9 697.3 km) [13]. As a result of the loss of road infrastructure, a situation has arisen where residents of settlements need to walk several times longer distances than before, as well as reduced accessibility to service of social infrastructure facilities and enterprises.
According to the State Border Service, there were 9 checkpoints of entry-exit into the uncontrolled territories at different times: Mariupol-1, Stanytsa-Luhanska, Shchastya, Hnutove, Zaitseve, Marinka, Novotroitske, Bugas and Artemivsk-2 [14]. Today, only 5 entry-exit checkpoints operate on the line of contact: Mayorsk, Novotroitske, Hnutove, Mar’inka (in Donetsk region) and Stanytsa-Luhanska (in Luhansk region). Due to intense shelling, other checkpoints were closed. There is high mobility of citizens from controlled to uncontrolled territory in the Donbass. According to official figures in 2019, 6,974 million citizens entered and 6,959 million departed through 5 checkpoints at the demarcation line [15]. In March 2017, the NGO Foundation101 recorded quantitative indicators of equipping the entry-exit checkpoints for urgent human needs. The presence and counting of toilets, drinking water tanks, garbage cans, medical aid and heating facilities were verified at checkpoints in Luhansk and Donetsk regions. The infographic also indicates the location of these sites within or near the entry-exit checkpoints [16].

Along the line of the collision on railway tracks in Donetsk and Luhansk regions at 7 track distances there are entry-exit checkpoints: Gorodniy, Krasny Lyman, Pereizna, Konstantynivka, Volnovakha [17]. On June 25, 2016, as a result of the negotiations of the Trilateral Contact Group on the Peaceful Settlement of the Situation in Eastern Ukraine, the railway connection for freight transport Mykytivka-Mayorsk and Popasna-Stakhanov was restored. For this purpose, the damaged sites at a distance of 10 km were inspected and repaired. As a result, in 2016, the railway transported 11.8 million tonnes of coal and 1.3 thousand tonnes of coke to an uncontrolled territory. This coal was used by thermal power plants throughout Ukraine [18]. Pursuant to the NSDC decisions of March 15, 2017, transportation of goods by rail through the demarcation line was suspended. As a result, Ukraine is experiencing a significant shortage of anthracite, which has been mined in the territories now controlled by illegal armed formations. Ukrainian Railways also included in the development strategy for 2019 the scenario of reintegration of non-controlled territories of Donetsk and Luhansk regions. The document indicates the estimated volume of freight traffic in case of unification of the economy and transport system of Ukraine.

In the Luhansk region, according to statistics provided in July 2016, 32 bridges were destroyed [19]. As of May 2016, 48 road infrastructure objects were destroyed in the Donetsk region, of which 32 were rehabilitated [13]. Due to the fighting in these territories, the construction of capital structures is impractical, so temporary mobile facilities are built to restore transport. The bridges built in the gray area are mostly pontoon. They are held on floating supports and allow the crossing of the river. The construction of temporary bridges in this area is associated with the shelling of areas near the demarcation line, which means that there is a high risk of destruction of capital assets. Bridges are strategic military assets: the dilution of pontoon bridges can complicate the enemy's advance in the event of an attack. An example of the construction of this type of objects is a temporary 70-meter pontoon bridge with an increased capacity near the village of Crymske on the river Siversky Donets [20]. Temporary bridges are also being built to move residents of settlements during the period of reconstruction of capital structures.

4. Destruction and construction of social security facilities and housing stock
Housing development of settlements has suffered the greatest damage. From the start of the fighting to the end of 2017, more than 40,000 residential buildings (throughout the Donetsk and Luhansk regions excluding homes left behind by internally displaced persons and damaged as a result of their military use) have suffered various types of damage. Some 10,000 infrastructure items have been seriously damaged [19]. The most devastating settlements are located on the collision line as they are strategic points in the distribution of spheres of influence between the parties to the conflict. Based on the analysis of information from the “gray area”, it can be argued that repairs to residential and public buildings in some cases are not carried out or are not timely and poorly done, which is due to a lack of
funds and skilled repair and construction crews. Repairs are carried out without resettlement, which complicates the process and increases the time needed for the necessary measures.

One of the biggest problems with rebuilding multi-story homes is the dramatic and frequent changes in prices for building materials. During the development of the project, a sharp change in the price of materials influences the change of the budget, and in the future - to update the documentation. In 2015, 7,186 buildings were repaired on the territory controlled by the Ukrainian authorities, and in 2016 - 10,195. In 2018, 2,958 residential buildings were renovated. In 2019-2020 it is planned to carry out repairs in 3,000 homes. The restoration of housing in the Donetsk region is due to charitable contributions of Ukrainian and international organizations and foundations. In 2019, the Representation of the Norwegian Refugee Council in Ukraine (NRC) began implementing the Housing Program. Under the program, 602 homes located on the collision line and in a 10-kilometer zone in the Bakhmut, Marinka and Yasinovata districts damaged by the fighting are scheduled to be rebuilt [21].

In the area of the collision, new type housing units for the accommodation of servicemen should appear. They must be equipped with engineering and plumbing equipment. Developed modular facilities with bathrooms are designed for the cohabitation of four fighters. The location of the modules is planned to be terrestrial and partially buried in the ground (at places of fire). In high risk areas, containers will be reinforced and equipped with special engineering tools.

Active fighting is constantly being held for the control of industrial zones, which leads to their significant destruction. Often, there are shelling falls on educational institutions. In 2014, 281 establishments were destroyed out of 1,771 (existing in Donetsk and Luhansk oblasts), representing 16% of the total [22]. Health facilities were also severely damaged: in Donetsk region - 48, in Luhansk one - 94. The emergence of a demarcation line made it impossible to access the social infrastructure (schools, kindergartens, hospitals, shops, etc.) located in the uncontrolled territory. In the village of Vodyane, a cemetery is located on the uncontrolled territory. People worry that even when they die, they will not be buried with their relatives.

To address the lack of social infrastructure, one has to look for alternative ways to meet daily needs. Most often, it is the use of similar existing establishments, which are mostly located in neighboring settlements. However, poor road infrastructure or lack of roads and public transport may make it impossible to use these facilities as an alternative. The absence of trade, education, healthcare, and business closures is a significant factor in migrating young people.

In order to improve the health care system, according to the Decree of the Cabinet of Ministers of December 27, 2017, # 995-r, 6 hospital districts were formed (in Slovyansk, Bakhmut, Kramatorsk, Pokrovsk, Volnovakha, Mariupol), and in Luhansk - 3 (Northern, Severodonetsk, Lysychansk). In rural areas, 34 outpatient units are planned to be built in these areas (Figure 3). More than half of these medical facilities have already been put into operation. To facilitate the construction process, experts from the Ministry of Regional Development and the Ministry of Health have developed an information guide that presents reuse facilities for rural health institutions. The following typology of medical institutions is recommended:

- a primary health care center designed to carry out a group practice with 7 doctors providing medical care at the same time for a population of 15,000 people;
- a group practice outpatient clinic designed to conduct a mono-practice with at least 2 physicians providing medical care at the same time for the population of more than 3,000 people;
- mono-practice outpatient clinic designed for conducting a mono-practice with 1 (one) doctor providing medical care at the same time for 1,500 people [23].
The main volume-planning advantages of dispensaries include the following parameters:

- speed of installation (use of a frame and frame-wall design is recommended);
- simplicity of planning structure (dispensaries are usually square or rectangular in the plan);
- one-level planning;
- zoning (among the main areas are the following: diagnostic, resuscitation, hospital, residential for staff, administrative, reception, transportation, technical).

The main outpatient facilities include: doctor's office, vaccination office, treatment room, dressing room, health office / children's corner / lecture room, reception, medical records room, laboratory, medical device storage room, staff room.

Mobile clinics have been set up in small towns and villages 5 to 15 kilometers to the demarcation line to assist the public in the healthcare sector. Their work is organized by the independent medical organization Doctors without Borders (Médecins Sans Frontières, MSF), headquartered in Geneva, Switzerland. The organization provides free humanitarian and medical assistance to victims of conflict (regardless of gender, race, religion or political affiliation) who do not have access to the health care system. In Donbass, mobile clinics provide primary care and psychological support. Each of the mobile teams includes three specialists (doctor, nurse and psychologist). As of September 2018, four mobile clinics were operating, coordinated from Mariupol and Kurakhovo bases (Figure 3). Mobile crews visit 28 locations located in or near the conflict zone: in Mariinsky, Volnovaksky and Yasinovatsky districts, as well as in Mariupol [24, 25]. Clinics are set up in settlements where there is not even an outpatient clinic or even a pharmacy. These mobile establishments operate on the basis of existing medical facilities, abandoned schools or private homes. Mobile clinics of the International Committee of the Red Cross come to the larger settlements of the “gray zone”. In Mayorsk, on September 4, 2019, doctors of the organization hosted a reception at the premises of the military-civilian administration building [26]. According to the principle of the mobile clinic, the First Volunteer Hospital named after M.S. Pirogov, whose teams provide medical assistance in rural areas in government-controlled territories along the demarcation line. In the gray zone, mobile hospitals are organized for the military.

![Figure 3. Hospital districts of Donetsk and Luhansk oblasts with outpatient clinics and locations](image-url)
In 2018, a central city park was reconstructed to humanize the architectural environment of the Toretsk city of Donetsk region, located 7 km from the demarcation line. Local activists, in cooperation with local authorities, have formed an effective public space. The city is also undergoing a major overhaul of the basic educational institution “Toretsk Secondary School I-III degrees № 6”. According to the project, they should overhaul the premises (classrooms, assembly and sports halls, offices, corridors, dining rooms), replace engineering communications, update the material and technical base (furniture, equipment, sports and kitchen equipment) and equip outdoor sports grounds, improve the territory. According to information from the ProZorro system (public procurement system), the buildings of the Krasnogorivka Secondary School of Grades I-III of the Mariinsky District Council of Donetsk region are undergoing major repairs.

If health care facilities and schools are gradually rebuilt, businesses are reconstructed very rarely. In the Donetsk region, heavy industry and mining are a city-forming factor. Their destruction and closure will result in the de-urbanization of the cities located on the collision line. As a result, these cities may lose their urban status. Businesses in the gray zone help to rebuild social infrastructure. Therefore, the issue of maintaining and creating new jobs is very important in this area.

5. Engineering infrastructure

Due to the destruction of the engineering infrastructure, the population often remains without electricity, heat, gas, water supply and sewerage. In 2016, 371 utilities were damaged and destroyed in Donetsk region [13], and 256 in Luhansk region [19]. Due to damage to the gas pipeline Luhansk-Lysychansk-Rubizhne, gas was discontinued in the village of Krymske Novoaydarsky district, Toshkivka and Nizhne villages in Popasnyansky district of Luhansk region. For low-rise buildings, the problem of gas supply is solved by means of conversion of gas boilers to solid fuel. Lack of gas has become a big problem for settlements with multi-story buildings. This branch of the gas pipeline is located between the fortifications of the Ukrainian army and illegal armed groups and is often fired. To do this, a “ceasefire regime” and OSCE-supervised repairs should be negotiated through the Joint Center for the Control and Coordination of Ceasefire and Demarcation Line Stabilization (JCCC).

In 2014, a railway bridge over the Tepla River was blown up. As a result, coal was discontinued at the Luhansk Regional Thermal Power Plant (the town of Shchastya), which supplies 70% of the settlements of the Luhansk region [19]. Due to the destruction of energy objects on the collision line, the security of energy supply has decreased, enterprises whose technological processes require high energy costs were stopped. Starobeshivska and Zuyivska thermal power plants were in uncontrolled territory. Combat operations and landmines in the Gray Area hinder the restoration of power grids. Electricity shortages are compensated for by the operation of the Zaporizhzhya Nuclear Power Plant (Energodar), which results in additional load on the substations. To expand the capabilities of Zaporizhskaya and Dniprovskaya substations, they need to be equipped with additional auto-transformer connections. Reconstruction works are also underway at the two Kharkiv and Zaluzhino substations as they form the configuration of the north-east power transmission network. In order to ensure fuller utilization of the Luhansk Thermal Power Plant facilities, it was planned to connect it to the grid of Ukraine. A new Kremenska substation and several high-voltage transmission lines have been started to increase the capacity of the coal-fired power plant located in Svitlodarsk, Donetsk region [27] Construction is scheduled to be completed in the first half of 2019. However, the deadlines were extended due to a number of problems. The expected start date is May-June 2020.

Drinking water comes to the town of Toretsk from theHorlivka Filtering Station, which is located on an uncontrolled territory, which complicates the repair work. The solution to this problem is to provide an alternative water supply from another water pipeline to Toretsk and settlements that have similar problems. Installation of new water supply networks is not always possible, so an alternative solution to provide running water is to drill wells near important infrastructural objects: schools,
hospitals, etc. They will not fully provide the population with water but will facilitate the life of the local inhabitants in times of crisis.

6. Environmental problems of Donbass

There is often military action on the line of contact. As a result, residents of settlements within the buffer zone were not only in a state of socio-economic crisis, but also on the verge of an ecological disaster. Every year, the problem of flooding of closed coal mines, which resulted from the cessation of pumping water, intensifies. This causes the lands of the mining towns and villages to be flooded, rendering them unsuitable for livelihood and farming. Today the Pervomaisk-Kirov group of mines is separated by a collision line. There are 62 mines in the uncontrolled territory. If water ceases to flow from them, then the territories controlled by the Ukrainian government will be flooded. Geosystem degradation and landscape-geochemical changes occur in combat zones. This is the result of a violation of the soil profile and contamination with chemical elements of industrial and military activities. Prolonged pollution of surface and groundwater by untreated or insufficiently treated water of sewage facilities has led to their poor ecological and sanitary status [28]. For example, in addition to water poisoning, the town of Toretsk is threatened by another man-made disaster - methane explosion under houses. This is due to the flooding of the mines of Pivdenna and the named after Artem, which causes methane to enter the basements of industrial and residential buildings. Forest plantations and nature conservation sites have suffered significant losses as a result of fighting through uncontrolled fires. Large tracts of land became unsuitable for agriculture because of the huge number of residues of explosive objects caused by mining.

7. Conclusions

1. As a result of hostilities that continue in eastern Ukraine since 2014, a buffer territory has emerged, a so-called “gray zone” that separates the territories of Ukraine and territories that are not under the control of the Ukrainian authorities. This buffer zone corresponds to the length of the collision line and is 457 km on either side of which is 30 km neutral territory. According to the Memorandum, the Cabinet of Ministers approved a list of settlements located in the “gray zone”. Weapons were separated from the demarcation line (from 8 km to 120 km) on both sides.

2. The conflict in the Donbas has had a significant impact on the urban structure and architecture of settlements located in the “gray zone” near the collision line. The military action has damaged or destroyed a large number of housing stock, industrial and agricultural sites, social, transport and engineering (water, heat and electricity) infrastructure. Within the “gray zone”, there are urban transformations that are associated with the emergence of new functions: military and humanitarian. The military function is displayed in the command and observation post, firing points and borders, defense lines, control facilities, fortifications and more. Humanitarian one envisages the emergence of territories where social, medical, and humanitarian relief facilities are located.

3. The typology of buildings in the “gray area” is characterized by a change in the functional purpose of buildings, a combination of functions for conducting different spheres of activity, and the use of flexible planning for multiple uses. The main characteristics of the facilities located in the buffer zone are modularity (checkpoint modules, housing units, heating points, health care facilities, hygiene modules, etc.), mobility and transformability. These options simplify the assembly procedure, allow using part of the unit, combine them with each other, as well as easily replace the part when needed.

4. It is established that the revival of “gray zone” settlements in Donetsk and Luhansk regions requires the use of a wide range of elements: a combination of political and socio-economic strategies; formation of ecologically sustainable, economically resource-saving landscapes of settlements. The strategy of creating new types of public spaces with the involvement of the local population in this
process, as well as the renovation of educational institutions will help to solve the problem of segregation, increase the level of community sympathy and reduce the level of violence.

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