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Araştırma Makalesi / Research Article

Comparison of Overpass / Underpass in the Light of Various Parameters: Karabuk-Safranbolu Case Study

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Keywords

Overpass;
Underpass;
Culvert;
SPSS;
ANOVA

Abstract

Concrete, stone, steel, and wooden materials are used in the construction of pedestrian over/underpasses. However, there has still been uncertainty when preferring the construction of over or underpass. In this study, an inventory of pedestrian overpasses and underpasses in Karabuk-Safranbolu region was presented in the light of various parameters. Two kinds of overpasses (constructed as steel and reinforced concrete) and an underpass were selected, and cost analyses were carried out comparatively. Additionally, face-to-face surveys were carried out with 300 people in 3 different over/underpass locations, and the results were evaluated by SPSS (statistical package for social sciences) ANOVA (analysis of variance). The advantages and disadvantages of over/underpasses in terms of cost, safety, ease of use/comfort, saving of time, user preference, aesthetic, construction period are revealed by means of the survey studies, data collected by General Directorate of Highways (KGM) and on-site observations, and then presented with tables and graphics. There has not been any standard, regulation, code, or design and safety criteria for the construction of underpasses/overpasses in our country and it is thought that this study will contribute to decision-making process of related authorities such as municipalities, general directorate of highways, etc.

Muhtelif Parametreler Işığında Üstgeçit/Altgeçit Mukayesesi: Karabük-Safranbolu Örneği

Anahtar kelimeler

Üstgeçit;
Altgeçit;
Menfez;
SPSS;
ANOVA

Öz

Yaya geçitlerinin inşasında ahşap, betonarme, çelik veya kompozit malzemeler kullanılmaktadır. Ancak günümüzde, inşa edilecek olan yaya üst/altgeçitlerinden hangisinin tercih edilmesi gerektiği hususunda çeşitli belirsizlikler bulunmaktadır. Bu çalışmada Karabük-Safranbolu bölgesinde yer alan yaya üst ve altgeçitlerinin çeşitli parametreler ışığında bir envanteri oluşturulmuştur. Çelik ve betonarme olarak inşa edilmiş iki farklı üstgeçit ile bir altgeçit seçilerek mukayeseli bir şekilde maliyet analizleri yapılmıştır. Ayrıca 3 farklı lokasyonda her biri 100'er kişi olmak üzere toplamda 300 kişiyle yüz yüze anket çalışmaları gerçekleştirilmiş, elde edilen sonuçlar SPSS (statistical package for social sciences) ANOVA (analysis of variance) ile değerlendirilmiştir. Anket çalışmaları, Karayolları Genel Müdürlüğü'nden (KGM) elde edilen veriler ve yerinde gözlemler ile kullanıcılar tarafından ortaya konulan güvenlik, kullanım kolaylığı/konfor, zaman tasarrufu, altgeçit/üstgeçit tercihi, estetiklik gibi hususlarda avantaj ve dezavantajları tablo ve grafikler eşliğinde ortaya konulmuştur. Ülkemizde altgeçit/üstgeçitlerin imalatında yeterli düzeyde standart, tasarım ve güvenlik kriteri bulunmamakta olup çalışmanın Belediyeler, KGM gibi yetkili mercilerin karar verme süreçlerinde yararlanabileceği bir kaynak olacağı düşünülmektedir.

1 Introduction

Bridges are the structures, constructed to cross over natural obstacles such as stream, river, valley, or artificial obstacles such as highway and railway. According to General Directorate of Highways (KGM) technical guide; A bridge is a highway structure that is constructed to cross obstacles such as bridges, valleys, highways, railroads with a span of 10 m or more (KGM 2013). Structures that

allow only pedestrians to cross the street are called pedestrian bridges or pedestrian crossings. They are also separated as overpass and underpass.

The most important component of traffic is vehicles, but traffic also includes pedestrians. It is known that traffic accidents are among the leading causes of death when the statistics in our country and around the world are examined. When detailed analyses of traffic accidents are made, it is obvious that the injuries and deaths caused by vehicle and pedestrian interaction have a very important role. As can be seen in Table 1, according to the data by TUIK (Turkey National Statistical Institute) approximately 10 % of traffic accidents in our country are caused by pedestrians (Int. res. 1).

Table 1. Faults that cause traffic accidents (Int. res. 1).

Trafik kazalarına neden olan kusurlar
Faults causing road traffic accidents

		Kusurlar - Faults									
		Sürücü kusuru	**Toplam kusura oranı (%)**	**Yolcu kusuru**	**Toplam kusura oranı (%)**	**Yaya kusuru**	**Toplam kusura oranı (%)**	**Yol kusuru**	**Toplam kusura oranı (%)**	**Araç kusuru**	**Toplam kusura oranı (%)**
Yıl	**Toplam**	Driver	Ratio to	Passengers	Ratio to	Pedestrian	Ratio to	Road	Ratio to	Vehicle	Ratio to
Year	Total	faults	total faults	faults	total faults	faults	total faults	defects	total faults	defects	total faults
2002	**538 346**	521 227	96.82	1 254	0.23	12 867	**2.39**	1 332	0.25	1 666	0.31
2003	**568 364**	551 467	97.03	882	0.16	13 208	**2.32**	1 255	0.22	1 552	0.27
2004	**640 906**	623 578	97.30	710	0.11	13 987	**2.18**	1 216	0.19	1 415	0.22
2005	**730 623**	711 572	97.39	769	0.11	14 882	**2.04**	1 603	0.22	1 797	0.25
2006	**851 150**	834 681	98.07	739	0.09	13 789	**1.62**	1 100	0.13	841	0.10
2007	**922 004**	903 860	98.03	795	0.09	15 086	**1.64**	994	0.11	1 269	0.14
2008	**167 231**	151 386	90.53	713	0.43	13 995	**8.37**	698	0.42	439	0.26
2009	**155 982**	139 758	89.60	640	0.41	14 181	**9.09**	958	0.61	445	0.29
2010	**157 970**	141 728	89.72	564	0.39	14 171	**9.86**	992	0.69	515	0.36
2011	**174 605**	157 494	90.20	677	0.39	14 860	**8.51**	1 044	0.60	530	0.30
2012	**181 266**	161 076	88.86	797	0.44	17 672	**9.75**	1 124	0.62	597	0.33
2013	**183 030**	162 327	88.69	774	0.42	16 458	**8.99**	1 913	1.05	1 558	0.85
2014	**193 215**	171 236	88.62	901	0.47	18 115	**9.38**	1 841	0.95	1 122	0.58
2015	**210 498**	187 980	89.30	915	0.43	18 522	**8.80**	1 916	0.91	1 165	0.55
2016	**213 149**	190 954	89.59	869	0.41	18 612	**8.73**	1 717	0.81	997	0.47
2017	**213 325**	191 717	89.87	782	0.37	18 095	**8.48**	1 619	0.70	1 112	0.52
2018	**217 898**	194 928	89.46	1 916	0.88	18 394	**8.44**	1 300	0.60	1 360	0.62

From this point of view, it is obvious that pedestrian-vehicle interaction is an issue that needs to be taken into consideration and solutions should be discussed. Especially in developing countries, this problem is becoming more and more significant due to the high population in urban areas, rapid modernization, and urbanization, violating traffic rules for both vehicle drivers and pedestrians. Overpasses/underpasses are an essential part of urban life to protect pedestrians, who are an important element of sustainable transportation and are always vulnerable and at high risk in traffic.

Mutto *et al*. (2002) compared the situation before and after a pedestrian overpass at a specific location.

Surveys were carried out with 123 pedestrians at peak and off-peak times for pedestrian traffic and they asked pedestrians questions about security, the usability of overpass, etc. Most of the pedestrians expressed their discomforts such as overpasses with too many stairs, insufficient lighting, overpasses used by children as playgrounds, and visual pollution caused by the billboards on overpasses.

Mahdavinejad *et al*. (2012) evaluated pedestrian underpasses in terms of health and psychology in their studies and revealed some results with the survey studies.

Wu *et al*. (2014) studied the factors affecting the pedestrian preference of overpasses. Accordingly, they carried out a survey study with 1131 people and according to the results; eight main factors (gender, age, career, education level, driving license ownership, crossing time, presence and distance of alternative route) play a role in the preference of overpasses.

In their study, Önelçin and Alver (2018) analysed pedestrian behaviours that cross illegally (not using overpass) in various overpasses and the effect of the escalator on the preference of overpasses. They concluded that the number of escalators should be increased in pedestrian overpasses and regular maintenance/repair should be done, barriers should be placed in medians to prevent pedestrians from passing without using overpasses (illegally), and above all, awareness of pedestrians should be raised.

In this study, two kind of overpasses (constructed as steel and reinforced concrete) and an underpass were selected in Karabuk-Safranbolu region and

the advantages and disadvantages of over/underpasses were presented in terms of cost, safety, ease of use/comfort, saving of time, user preference, aesthetic, construction period by means of survey studies, data collected by KGM and on-site observations.

There has not been any standard, regulation, code, or design, and safety criteria for the construction of underpasses/overpasses in our country. Only with the standard of TS 12576 "Structural preventive and sign design criteria on accessibility in sidewalks and pedestrian crossings" are established however, this standard is not sufficient for underpass or overpass preference, but only some suggestions are provided to ensure the accessibility of all potential users effectively.

It is thought that this study will contribute to decision-making process of competent authorities such as municipalities, general directorate of highways, etc. and fill a gap in this regard. On the other hand, a standard, code, regulation, or guide should be established to develop a more effective decision process.

2 Pedestrian Bridges (overpasses) and Underpasses

Pedestrian bridges (overpasses) can be designed with various materials (wood, stone, reinforced concrete, metal, composite), with various construction techniques (beam, arch, cantilever, suspended), for various purposes in terms of their location (highway, railway, river overpasses) and various types of services in terms of access opportunities (stairs, ramps, elevators, escalators). Some examples of pedestrian overpasses are presented in Figure 1.

Figure 1. Some examples of pedestrian overpasses.

An underpass is a structure that allows passing under a highway or a railway (KGM 1997). According to another definition, it is a walking path that ensures pedestrians pass under another road (Washington guidebook 2002). In some cases, the culverts, which are hydrologically designed engineering structures, also serve as underpasses, and in some cases, they are designed specifically for only pedestrians or vehicles. They can be constructed as reinforced concrete prefabricated box or as cast-in-situ reinforced concrete and as masonry. Some examples of pedestrian underpasses are presented in Figure 2.

Figure 2. Some examples of pedestrian underpasses.

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2.1 Karabuk-Safranbolu region pedestrian over/underpasses

Karabuk –Safranbolu road is a 2x3 divided arterial road under the responsibility of KGM 15th Regional Directorate. The population of Karabuk province is 248.014. The population of Safranbolu district is 67.042. The number of registered vehicles in Karabuk province (including districts) is 66.565 (Int. res. 2). The locations of the under/overpasses in Karabuk-Safranbolu Region from Kardemir intersection to Safranbolu bus station are shown on the satellite image in Figure 3 and are listed below.

Figure 3. Karabuk-Safranbolu pedestrian under/overpasses

1- Karabuk Bus Terminal overpass
2- General Directorate of Security overpass (LOCATION 1)
3- School zone overpass
4- Kireç Ocağı zone overpass
5- Safranbolu Bus Terminal overpass

6- Gendarmery zone overpass (LOCATION 2)
7- Ulusoylar market zone underpass (LOCATION 3)
Within the scope of this study, various comparisons are made by selecting 1 steel beam overpass (Location 1), 1 reinforced concrete prefabricated beam overpass (Location 2), and 1 cast in-situ reinforced concrete underpass (Location 3) in 3 different locations in the region.

2.1.1 Location 1

It is a 40 m span steel beam overpass and constructed on 3+750 km of Karabuk-Safranbolu divided road in 2014. There is an elevator shaft but not constructed. Satellite photo and terrestrial photo are given in Figure 4.

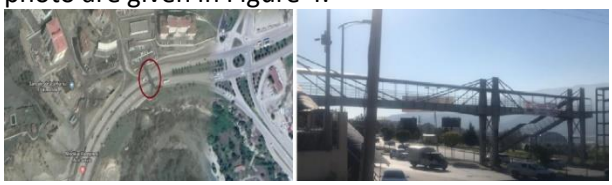

Figure 4. General directorate of security overpass

2.1.2 Location 2

It is a 35.10 m span reinforced concrete prefabricated overpass and constructed on 4+500 km of Karabuk-Safranbolu divided road in 2011. Satellite photo and terrestrial photo are given in Figure 5.

Figure 5. Gendarmery zone overpass satellite photo and terrestrial photograph

2.1.3 Location 3

It is in 4.00x3.00 section cast in-situ reinforced concrete underpass and constructed on 100+765 km of Kastamonu-Karabuk divided road in 2008. In Figure 6, the point and terrestrial photographs of the underpass are seen on the satellite photograph.

Figure 6. Ulusoylar market zone underpass satellite photo and terrestrial photograph

3 Comparison of Over/Underpasses

If a need arises to construct over/underpasses in any region, It has been a controversial issue to decide overpasses or underpasses for decision-makers. Both types have some advantages and disadvantages against each other in terms of certain parameters such as security, capacity, saving of time, cost, aesthetics, construction period, topography, expropriation, local demands, the historic/cultural/touristic characteristics of construction area, and public requirements, etc.). In this chapter, a comprehensive comparison is made, and it is aimed to contribute to the decision-making process of related authorities.
In this context, 3 different types of under/overpasses comparisons have been made in 3 different locations in the region.

3.1 Survey study

Within the scope of this study, face-to-face surveys each of which is 100 people and a totally of 300 people were carried out at peak hours in 3 different over/underpass locations (General Directorate of Security overpass, gendarmerie zone overpass, Ulusoylar market underpass) indicated in Figure 3. It was evaluated through SPSS (statistical package for social sciences) software and the results were presented with tables and graphics.

3.1.1 Location 1

Surveys were carried out by asking various questions to 100 people around General Directorate of Security steel beam overpass. The information obtained as a result of this survey study was evaluated statistically by SPSS-ANOVA analysis. In this location, 44 out of 100 respondents are male and 56 are female.

3.1.1.1 Frequency of overpass use

In observations, 81 people used the overpass. It is determined how often the overpass is used according to gender and age distribution. Accordingly, it is declared that 31 people always, 11 people frequently, 21 people occasionally and 18 rarely use the overpass. The frequency of the overpass use is given in Figure 7 and the distribution of frequency according to education level is given in Table 2.

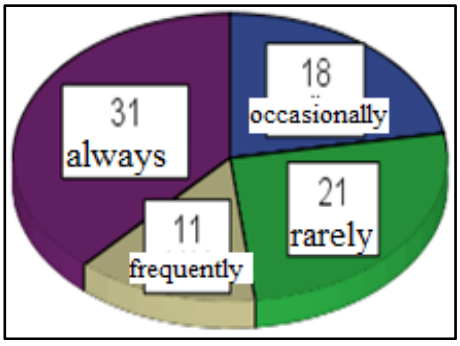

Figure 7. Frequency of overpass use

In conclusion, 31 people always, 11 people frequently, the remaining 58 people either never or occasionally/rarely prefer to use the overpass. This result reveals that the ratio of not using overpass is higher than the ratio of using it.

Table 2. Distribution of overpass use by educational level.

Overpass	Education Level				
	Primary School	Secondary School	University	Post Graduate	Total
Rarely	1	2	15	0	18
Occasionally	5	0	15	1	21
Frequently	2	1	7	1	11
Always	0	2	27	2	31
Total	**8**	**5**	**64**	**4**	**81**

According to Table 2, the educational level is an important parameter in terms of overpass preference. Awareness increases and crossing illegally (not using overpass) decreases in parallel with the increase in the level of education.
In addition, 19 people who crossed illegally were asked how often they cross illegally. It is declared that 8 people always, 4 people frequently, 5 people occasionally and 2 people rarely cross illegally.

3.1.1.2 Overpass safety

Pedestrians using the overpass were asked to evaluate the cross in terms of safety compared to the underpass. 3 people answered it as “very safe”, 52 people answered it as “safe”, 15 answered it as “less safe”, 10 people answered it as “dangerous”, 1 person answered it as “very dangerous” and the results are given as pie chart in Figure 8.

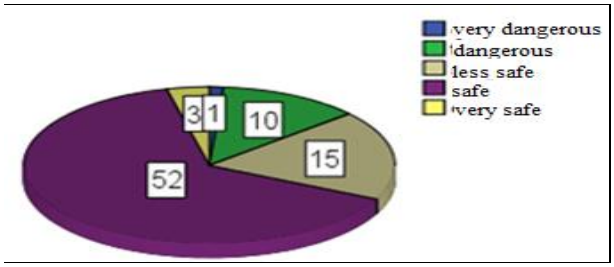

Figure 8. Overpass safety evaluation.

Pedestrians crossing illegally were asked to evaluate the illegal crossings in terms of safety. 2 people answered it as “safe”, 3 people answered it as “less safe”, 11 people answered it as “dangerous” and 3 people answered it as “very dangerous”.
According to general opinion, it is known that passing through overpasses is safe and illegal crossings are dangerous.

3.1.1.3 Ease of use / comfort

Pedestrians using the overpass were asked to evaluate the cross in terms of ease of use/comfort. 2 people answered it as “very hard”, 20 people answered it as “hard”, 22 people answered it as “less easy”, 36 people answered it as “easy” and 1 person answered it as “very easy” and the results are given as pie chart in Figure 9. According to general opinion, the overpass is easy/comfortable to use.

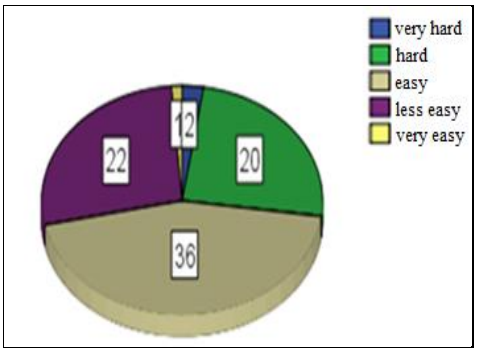

Figure 9. Ease of use/comfort evaluation.

Pedestrians crossing illegally were asked to evaluate the illegal crossings in terms of ease of use/comfort. 4 people answered it as “hard”, 10 people answered it as “easy”, 2 people answered it as “less easy” and 3 people answered it as “very easy”.

3.1.1.4 Preference of over/underpass

Pedestrians using the overpass were asked, "Would you prefer it if there were an underpass instead of an overpass here?" 66 people answered it as “yes”, 25 people answered it as “no”, 9 people said, “I have no idea” and the results are given as a pie chart in Figure 10.

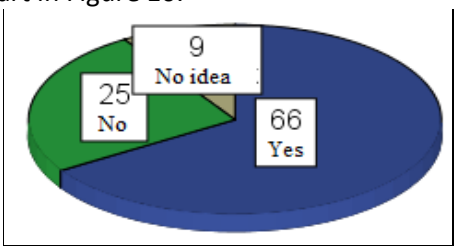

Figure 10. Preference of underpass instead of overpass

The general reasons for the majority of respondents to say “yes” are high number of stairs of the overpass, difficulty to get up and down the stairs, and lack of elevator or escalator. Those who answered as “no”, declared reasons such as being unsafe and inadequate or lack of lighting of underpasses.
From this point of view, it can be said that overpasses are generally not preferred due to

energy loss or getting tired (laziness), while underpasses are not preferred due to safety concerns.

3.1.1.5 Illegal crossing reasons

19 pedestrians crossing illegally were asked why they preferred to cross illegally. 12 people answered, “not to lose time”, 1 person answered, “It is not safe” and 1 person answered, “there is no vehicle while crossing” and 5 people declared various reasons. The results are given as a pie chart in Figure 11.

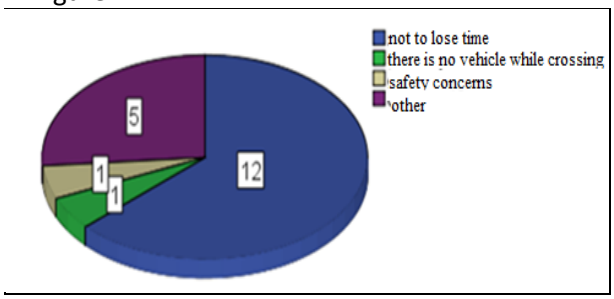

Figure 11. Illegal crossing reasons

The results obtained reveal that, as stated above, overpasses are generally not preferred due to energy loss or getting tired (laziness) but are also considered as a waste of time.

According to ANOVA analysis results;

- Gender and education level did not reveal significant results for the preferences above.
- Legal crossings decreased at the 5% significance level with the increase in the age of pedestrians.
- Even if there is an underpass instead of an overpass, pedestrians crossing illegally are still expected to cross illegally at the 1% significance level.

3.1.2 Location 2

Surveys were carried out by asking various questions to 100 people around the Gendarmery zone prefabricated reinforced concrete beam overpass. The information obtained as a result of this survey study was evaluated statistically using SPSS software. In this location, 58 out of 100 respondents are male and 42 are female.

3.1.2.1 Frequency of overpass use

In observations, 61 people used the overpass. It is determined how often the overpass is used according to gender and age distribution. Accordingly, It is declared that 9 people always, 10 people frequently, 24 people occasionally and 18 rarely use the overpass. The frequency of the overpass use is given in Figure 12 and the distribution of frequency according to education level is given in Table 3.

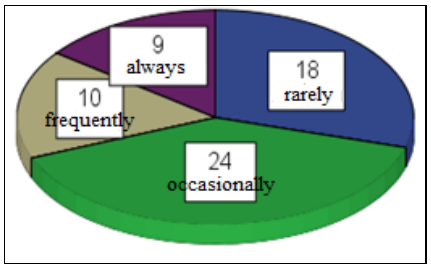

Figure 12. Frequency of overpass use

In conclusion, 9 people always, 10 people frequently, the remaining 81 people either never or occasionally/rarely prefer to use the overpass. This result reveals that it is remarkable that the rate of not using overpass is quite high.

Table 3. Distribution of overpass use by educational level.

Overpass	Education Level			
	Primary School	Secondary School	University	Total
Rarely	0	0	18	18
Occasionally	1	0	23	24
Frequently	0	0	10	10
Always	0	1	8	9
Total	**1**	**1**	**59**	**61**

According to general opinion and expected results, educational level is an important parameter in terms of overpass preference, awareness increases, and crossing illegally (not using overpass) decreases in parallel with the increase in the level of education but almost all respondents at this location have a university degree and to make a comparison or interpret the results in terms of education level will not be suitable, reliable, and reasonable.

In addition, 39 people who crossed illegally were asked how often they cross illegally. It is declared that 20 people always, 8 people frequently, 8 people occasionally and 3 people rarely cross illegally.

3.1.2.2 Overpass safety

Pedestrians using the overpass were asked to evaluate the cross in terms of safety compared to the underpass. 8 people answered it as “very safe”, 43 people answered it as “safe”, 10 people answered it as “less safe”, and the results are given as a pie chart in Figure 13.

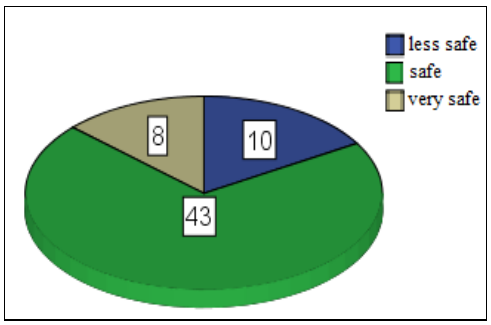

Figure 13. Overpass safety evaluation.

Pedestrians crossing illegally were asked to evaluate the illegal crossings in terms of safety. 4 people answered it as “safe”, 11 people answered it as “less safe”, 20 people answered it as “dangerous” and 4 people answered it as “very dangerous”.
According to general opinion, it is known that passing through overpasses is safe and illegal crossings are dangerous.

3.1.2.3 Ease of use / comfort

Pedestrians using the overpass were asked to evaluate the cross in terms of ease of use/comfort. 1 person answered it as “very hard”, 12 people answered it as “hard”, 16 people answered it as “less easy”, 32 people answered it as “easy” and the results are given as a pie chart in Figure 14.

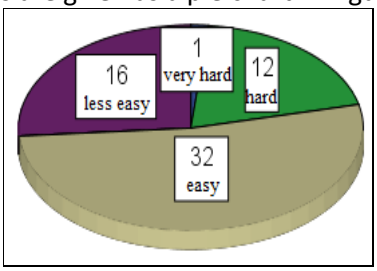

Figure 14. Ease of use/comfort evaluation

Pedestrians crossing illegally were asked to evaluate the illegal crossings in terms of ease of use/comfort. 1 person answered it as “hard”, 17 people answered it as “easy”, 4 people answered it as “less easy” and 17 people answered it as “very easy”.
According to general opinion, the overpass is easy/comfortable to use.

3.1.2.4 Preference of over/underpass

Pedestrians using the overpass were asked, "Would you prefer it if there were an underpass instead of an overpass here?" 46 people answered it as “yes”, 42 people answered it as “no”, 12 people said, “I have no idea” and the results are given as a pie chart in Figure 15.

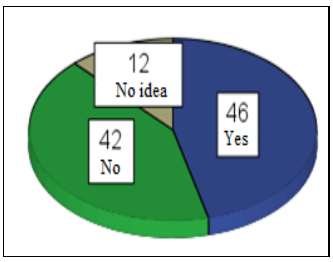

Figure 15. Preference of underpass instead of overpass

The general reasons for the majority of respondents to say “yes” are high number of stairs of the overpass, difficulty to get up and down the stairs, and lack of elevator or escalator. Those who answered as “no”, declared reasons such as being unsafe and inadequate or lack of lighting of underpasses.
From this point of view, it can be said that overpasses are generally not preferred due to energy loss or getting tired (laziness), while underpasses are not preferred due to safety concerns.

3.1.2.5 Illegal crossing reasons

39 pedestrians crossing illegally were asked why they preferred to cross illegally. 28 people answered, “not to lose time”, 2 people answered, “It is not safe” and 5 people answered, “there is no vehicle while crossing” and 4 people declared various reasons. The results are given in Figure 16.

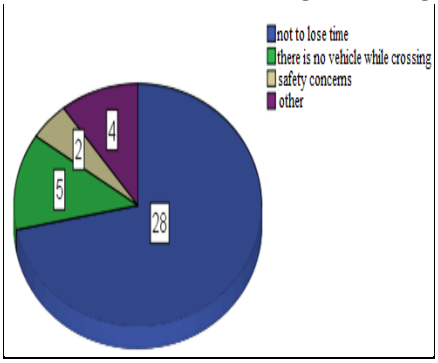

Figure 16. Illegal crossing reasons.

The results obtained reveal that, as stated above, overpasses are generally not preferred due to energy loss or getting tired (laziness) but are also considered as a waste of time.
According to ANOVA analysis results;

- Gender, age, and education level did not reveal significant results for the preferences above.
- Pedestrians who tend to cross illegally find their crossing as dangerous but find the overpass insufficient (very hard) in terms of

ease of use at the 5% significance level, however it is expected that they will prefer illegal crossing even if there is an underpass instead of an overpass.

3.1.3 Location 3

Surveys were carried out by asking various questions to 100 people around the Ulusoylar Market zone cast in-situ reinforced concrete underpass. The information obtained as a result of this survey study was evaluated statistically using SPSS software. In this location, 68 out of 100 respondents are male and 32 are female.

3.1.3.1 Frequency of underpass use

In observations, 63 people used the underpass. It is determined how often the underpass is used according to gender and age distribution. It is declared that 8 people always, 24 people frequently, 15 people occasionally and 16 rarely use the underpass. The frequency of the underpass use is given in Figure 17 and the distribution of frequency according to education level is given in Table 4.

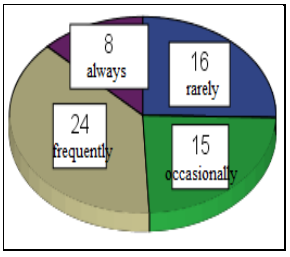

Figure 17. Frequency of underpass use

In conclusion, 8 people always, 24 people frequently, the remaining 68 people either never or occasionally/rarely prefer to use the underpass. This result reveals that it is remarkable that the rate of not using underpass is quite high.

Table 4. Distribution of underpass use by educational level.

Underpass		Education level				
		Primary School	Secondary School	University	Post Graduate	Total
	Rarely	1	2	12	1	16
	Occasionally	2	0	12	1	15
	Frequently	2	6	15	1	24
	Always	0	3	5	0	8
Total		5	11	44	3	**63**

It is known that the education level is an important parameter in terms of underpass preference. The increase in awareness and the decrease in illegal crossing in parallel with the increase in the level of education is expected according to general opinion. But somehow according to Table 4, the result is exactly vice versa of what is expected.

In addition, 37 people who crossed illegally were asked how often they cross illegally. It is declared that 23 people always, 10 frequently, 3 people occasionally and 1 person rarely cross illegally.

3.1.3.2 Underpass safety

Pedestrians using the underpass were asked to evaluate the cross in terms of safety compared to the overpass. 1 person answered it as “very safe”, 13 people answered it as “safe”, 18 answered it as “less safe”, 23 people answered it as “dangerous”, 8 people answered it as “very dangerous” and the results are given as pie chart in Figure 18.

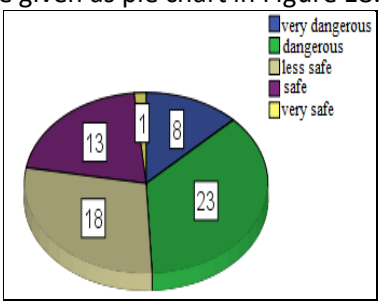

Figure 18. Underpass safety evaluation

Pedestrians crossing illegally were asked to evaluate the illegal crossings in terms of safety. 2 people answered it as “safe”, 3 people answered it as “less safe”, 11 people answered it as “dangerous” and 3 people answered it as “very dangerous”.

According to general opinion, passing through the underpasses is a safety concern and it is known that illegal crossings are dangerous.

3.1.3.3 Ease of use / comfort

Pedestrians using the underpass were asked to evaluate the cross in terms of ease of use/comfort. 2 people answered it as “very hard”, 8 people answered it as “hard”, 47 people answered it as “easy”, 4 people answered it as “less easy”, 2 people answered it as “very easy” and the results are given as pie chart in Figure 19.

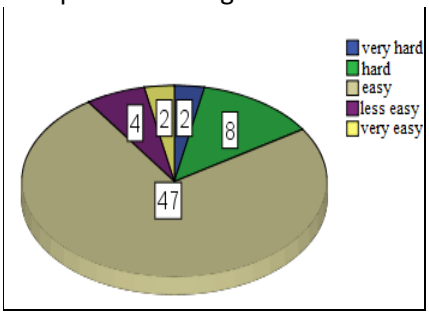

Figure 19. Ease of use/comfort evaluation.

Pedestrians crossing illegally were asked to evaluate the illegal crossings in terms of ease of

use/comfort. 2 people answered it as “very hard”, 2 people answered it as “hard”, 22 people answered it as “easy”, 1 person answered it as “less easy”, 10 people answered it as “very easy. According to general opinion, an underpass is easy/comfortable to use.

3.1.3.4 Preference of over/underpass

Pedestrians using the underpass were asked, "Would you prefer it if there were an overpass instead of an underpass here?" 71 people answered it as “yes”, 28 people answered it as “no”, 1 people said, “I have no idea” and the results are given as a pie chart in Figure 20.

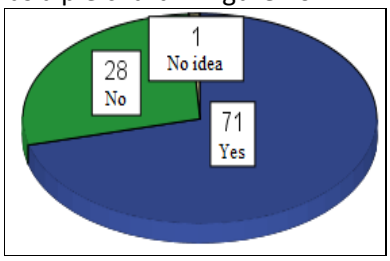

Figure 20. Preference of overpass instead of underpass

The general reasons for the majority of respondents to say “no” are high number of stairs of overpasses, difficulty to get up and down the stairs, and lack of elevator or escalator. Those who answered as “yes”, declared reasons such as being unsafe and inadequate or lack of lighting of underpasses.

From this point of view, it can be said that overpasses are generally not preferred due to energy loss or getting tired (laziness), while underpasses are not preferred due to safety concerns.

3.1.3.5 Illegal crossing reasons

37 pedestrians crossing illegally were asked why they preferred to cross illegally. 12 people answered, “not to lose time”, 5 people answered, “It is not safe” and 14 people answered, “there is no vehicle while crossing” and 6 people declared various reasons. The results are given as a pie chart in Figure 21.

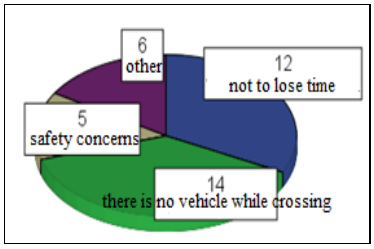

Figure 21. Illegal crossing reasons

The results obtained reveal that, as stated above, underpasses are generally considered as unsafe and waste of time.

According to ANOVA analysis results;

- Gender did not reveal significant results for the preferences above.
- Pedestrians using the underpass tend to find this cross easy/comfortable at the 5% significance level with the increase in the age.
- It was evaluated that with the increase of education level, pedestrians crossing illegally at the level of 1% significance were aware of the danger of this crossing.
- Those using the underpass found it unsafe at the 5% significance level, but they revealed that the underpass is easy / comfortable, however they preferred the overpass instead of the underpass.

3.1.4 All Locations ANOVA Results

- Gender and education level did not reveal significant results for the preferences of over/underpass in all locations.
- In general, it was observed that with the increase of age, legal crossings decreased at the 5% significance level, and pedestrians who cross illegally were aware that illegal crossings were dangerous.
- With the increase of age and education level, it was evaluated that the under/overpasses were comfortable / easy at the 1% significance level.

3.2 Cost analyses

In this part of the study, cost analysis for the over/underpasses in 3 different locations and has 3 different construction techniques/materials (a steel beam overpass, a reinforced concrete prefabricated overpass, and cast-in-situ reinforced concrete underpass) were carried out.

The data used was obtained from the General Directorate of Highways, and the cost information at different dates when the pedestrian crossings were built were updated to 2019 with the help of TUIK (Turkish Statistical Institute) actualization data and the results are presented in tables.

3.2.1 Location 1

It is a 40 m span steel beam overpass and constructed on 3+750 km of Karabuk-Safranbolu divided road in 2014 and cost data is given in Table 5.

Table 5. Location 1 cost data

No	Item No	Analysis Name	Unit of Measure	Quantity	2014 Unit Price (TL)	2014 Amount (TL)	2019 Unit Price (TL)	2019 Amount (TL)
1	23.101 ÖZEL	İnşaat bünyesine giren her türlü profil demiri ve saclarla kiriş, başlık ve bağlantı vb. İmalatların yapılması, galvanizlenmesi ve imalatların yerine konulması (tüm malzeme ve nakliyeler dahildir.)-Beams, posts and connections, etc. with all kinds of profile iron and sheets included in the construction. Manufacturing, galvanizing and placing (all materials and carraige are included.)	TON	56	5.250,46	294.025,76	10.373,27	580.902,87
2	KGM/14.213 ÖZEL	Her derinlikte, her cins ve klastaki zeminde kuruda köprü temelinin kazılması (nakliyeler dahildir.)-Excavation of the foundation of the bridge in dry form on soils of all depths and all types and classes (carriage included)	M3	100	38,00	3.800,00	75,08	7.507,61
3	KGM/16.101/ K-1 ÖZEL	Köprü temellerinde kuruda veya suda her dozda demirsiz beton (C16/20) (tüm malzeme ve nakliyeler dahildir)-Any dose of plain concrete (C16 / 20) on bridge foundations, dry or in water (all material and carriage included)	M3	8	144,15	1.153,20	284,80	2.278,36
4	KGM/16.120/ K-1 ÖZEL	Her türlü inşaatta temel dışında kuruda veya suda her dozda demirsiz beton (c25/30) (tüm malzeme ve nakliyeler dahildir) Plain concrete (c25 / 30) in all kinds of construction except foundation in all doses in dry or water (including all materials and carriage)	M3	10	177,76	1.777,60	351,20	3.511,98
5	KGM/16.133/ K ÖZEL	Köprülerde kuruda veya suda her dozda demirli beton (c30/37) (tüm malzeme ve nakliyeler dahildir)-Any dose of plain concrete (c30 / 37) on bridges, dry or in water (all material and carriage included)	M3	54	417,04	22.520,16	823,94	44.492,79
6	KGM/23.015/ K ÖZEL	Betonarme için ø 14 - ø 32 mm.lik ince nervürlü çelik temini ve işçiliği (tüm malzeme ve nakliyeler dahildir)-Supply and labor of ø 14 - ø 32 mm ribbed bar for reinforced concrete (all materials and carriage included)	TON	3	2.368,19	7.104,57	4.678,80	14.036,41
7	KGM/23.176/ K ÖZEL	İnşaat bünyesine giren profilli demir zati bedeli, profilden üst geçit korkuluk işçiliği, yüklenmesi taşınması, galvanizlenmesi, boşaltılması istifi ve yerine montajı-cost of the profiled iron included in the construction, labour of the rail overpass from the profile, loading, carriage, galvanizing, unloading, storage and placement.	TON	8	3.700,08	29.600,64	7.310,20	58.481,60
8	ÖZEL-1	1.5 metre yüksekliğinde dekoratif panel çit yapılması ve yerine montajı (tüm malzeme ve nakliyeler dahildir.)-1.5 meter in height decorative panel fence and placing (all materials and carriage are included.)	MT	750	30,04	22.530,00	59,35	44.512,23
9	ÖZEL-2	Yaya üst geçit köprülerinde çarpma etkisini azaltan anti-statik zemin kaplaması yapılması (tüm malzeme, montaj ve nakliyeler dahil) (2 cm kalınlıkta)-Anti-static floor covering that reduces the impact of pedestrian overpass bridges (including all material, placement and carriage) (2 cm in thickness)	M2	600	62,78	37.668,00	124,03	74.420,18
			TOTAL AMOUNT (Vat excluded)			**420.179,93**		**830.144,03**

Here, the cost of 830.144,03 TL obtained for 2019 is for the 40.00 m span (length) of the overpass, and to be able to make an accurate comparison, the unit cost (for one meter) must be taken into consideration. Accordingly, 830.144,03 TL is divided by 40 meters and the unit cost of the construction is obtained as 20.753,60 TL/m

3.2.2 Location 2

It is a 35,10 m span reinforced concrete prefabricated beam overpass and constructed on 4+500 km of Karabuk-Safranbolu divided road in 2011 and cost data is given in Table 6.

Here, the cost of 250.587,67 TL obtained for 2019 is for the 35.10 m span (length) of the overpass, and to be able to make an accurate comparison, the unit cost (for one meter) must be taken into consideration. Accordingly, 250.587,67 TL is divided by 35.10 meters and the unit cost of the construction is obtained as 7.139,25 TL/m.

Table 6. Location 2 cost data

No	Item No	Analysis Name	Unit of Measure	Quantity	2011 Unit Price (TL)	2011 Amount (TL)	2019 Unit Price (TL)	2019 Amount (TL)
1	14,113	Kuruda köprü temeli kazısı-Bridge foundation excavation in dry	m3	63,150	33,38	2.107,95	82,67	5.220,90
2	16.023/K-1	her dozda demirli beton-every dose of plain concrete	m3	2,268	56,41	127,94	139,71	316,87
3	16.101/K-1	Köprü temellerinde kuruda veya suda her doz demirsiz beton-Any dose of plain concrete, dry or in water, on bridge foundations	m3	24,608	65,23	1.605,18	161,56	3.975,66
4	16.132/K-2	Öngermeli hariç köprü için kuruda veya suda her dozda demirli beton-" Reinforced concrete, dry or in water, in all doses for bridges, except for pre-stressed	m3	0,938	214,29	201,00	530,75	497,84
5	16.136/K-1	Prefabrik kirişlerin yerine konulması-Replacing prefabricated beams	ton	191,817	56,92	10.918,22	140,98	27.041,95
6	16.137/K-1-A	Köprülerin öngerilmeli boyuna ve enine kirişlerde her dozda demirli beton-Reinforced concrete in longitudinal and transverse beams of prestressed bridges in all doses	m3	79,934	493,43	39.441,83	1.222,11	97.688,43
7	16.138 /ÖZEL	Köprülerde prekast bordür elemanı yapılması- precast border elements in bridges	ad.	43	47,06	2.023,58	116,56	5.011,95
8	16.139 /ÖZEL	Köprülerde prekast bordür elemanın yerine montajı-Installation of precast border element in bridges	ad.	43	22,03	947,29	54,56	2.346,22
9	23.002/K-6	Öngerme çeliğinin yerine konulması-Replacing the prestressing reinforcements	ton	0,389	5 795,90	2.254,61	14.355,12	5.584,14
10	21,053	Köprülerde döşeme, kiriş ve kemer taşıyıcı iskeleleri-Slab, beam and arch supporting scaffoldage in bridges	m3	0,089	17,94	1,60	44,43	3,95
11	23.003/10	Ana kirişlerin enleme kirişlere tespiti-Fastening main beams to cross beams	ad.	6	19,16	114,96	47,45	284,73
12	23.014/K	5 - 12 mm.lik ince nervürlü çelik işçiliği-ribbed bar workmanship of 5 - 12 mm.	ton	5,230	372,64	1.948,91	922,94	4.827,00
13	23.015/K	14 - 28 mm.lik kalın nervürlü çelik işçiliği-ribbed bar workmanship of 14 - 28 mm.	ton	2,914	307,66	896,52	762,00	2.220,48
14	3793	Kılıf borusu temini-Supply of casing pipe	m	39,740	1,43	56,83	3,54	140,75
15	3805	Neopren mesnet tertibatı-Neoprene bearing material	dm3	26,000	26,19	680,94	64,87	1.686,53
16	3000A	Dökme Çimento-bulk cement	ton	12,067	101,78	1.228,18	252,09	3.041,92
17	3000B	P.Ç. 42.5 Çimento-P.Ç. 42.5 Cement	ton	4,751	130,12	618,20	322,28	1.531,14
18	3790C	8 - 12 mm.' lik (Nervürlü) Demir-8 - 12 mm (Ribbed) bar	ton	5,596	687,95	3.849,77	1.703,90	9.535,00
19	3790D	14 - 32 mm.' lik (Nervürlü) Demir-14 - 32 mm.(Ribbed) bar	ton	3,206	674,04	2.160,97	1.669,44	5.352,24
20	3791b	Profil demirleri (I - U - T - W)-Profile bars (I - U - T - W)	ton	2,496	856,72	2.138,37	2.121,90	5.296,26
21	3792/1	Yüksek dayanımlı ön germe çeliği temini-Supply of high strength pre-stress steel	ton	0,433	2 927,82	1.267,75	7.251,54	3.139,92
22	04.613/1-A 1-Ö	Normal akışkanlaştırıcı yüksek mukavemet katkısı-Normal plasticizer high strength additive	kg	5,270	1,40	7,38	3,47	18,27
23	04.613/1-A 3-Ö	Süper akışkanlaştırıcı yüksek mukavemet katkısı-Super plasticizer high strength additive	kg	354,310	3,85	1.364,09	9,54	3.378,55
24	07.006/K	Prefabrik elemanların yerine nakli-Carriage of prefabricated elements	ton	191,816	14,93	2.863,81	36,98	7.093,01
25	07.006/K	Taze beton nakli-carriage of cast in place concrete	m3	27,815	30,63	851,97	75,86	2.110,14
26	08.007/K	Kum - Çakıl yıkanması-Sand - Gravel washing	m3	131,349	4,51	592,38	11,17	1.467,20
27	07.005/K	Kum - Çakılın beton tesisine taşınması-sand-gravel carraige	m3	34,640	8,99	311,41	22,27	771,30
28	07.006/K	Kumun ve çakılın imalat tesisine taşınması (Prekast)-carriage of sand and gravel to the construction site (Precast)	m3	97,851	30,46	2.980,54	75,44	7.382,12
29	07.006/K	Çimentonun imalat tesisine taşınması (Prekast)-Carriage of cement to the construction site (Precast)	ton	32,993	79,98	2.638,78	198,09	6.535,66
30	09.001/K-1	Çimento yüklenmesi, boşaltılması ve istifi (Prekast)-Cement loading, unloading and storage (Precast)	ton	32,993	1,39	45,86	3,44	113,59
31	09.001/K	Çimentonun yüklenmesi, taşınması,boşaltılması ve istifi-cement loading, carriage, unloading and storage	ton	12,067	25,45	307,11	63,03	760,63
32	07.006/K	Nervürlü çeliğin imalat yerine taşınması (Prekast)-Carriage of the ribbed bar to the construction site (Precast)	ton	6,368	236,64	1.506,92	586,10	3.732,31
33	09.012/K-1	İmalat yerine taşınan nervürlü çelik ile öngerme çeliğinin yüklenmesi,boşaltılması ve istifi (Prekast)-Loading, unloading and storage of ribbed bar and prestressing reinforcement carriaged to the construction site (Precast)	ton	9,325	9,68	90,27	23,98	223,57
34	07.006/K	Öngerme çeliğin imalat yerine taşınması (Prekast)-carriage of the prestressed reinforcement to the construction site (Precast)	ton	0,442	298,17	131,79	738,50	326,42
35	09.012/K	Her cins betonarme, profil, lama dem; yükleme, taşıma, boşaltma ve istifi-All kinds of reinforced concrete, profile, lama beam; loading, carriage, unloading and storage	ton	2,496	256,34	639,82	634,90	1.584,70
36	07.006/K	Kum-Çakılın imalat yerine taşınması (Cephe panelleri)-Carriage of sand-gravel to the construction site (facade panels)	m3	2,341	30,46	71,31	75,44	176,61
37	07.006/K	Çimentonun imalat yerine taşınması (Cephe panelleri)-Carriage of cement to the construction site (facade panels)	ton	0,716	79,98	57,27	198,09	141,83
38	07.006/K	Nervürlü çeliğin imalat yerine taşınması (Cephe panelleri)-Carriage of ribbed bars to the construction site (facade panels)	ton	0,625	236,64	147,90	586,10	366,31
39	2640	Drenaj Hendeği ile her türlü büz yanlarına kum-çakıl dolgu yapılması-sand-gravel backfilling on the sides of all kinds of drainage ditches	m3	40,050	7,83	313,59	19,39	776,69
40	23.176/K	Profilli demirden korkuluk işçiliği (Boyama hariç)-Profiled iron railing work (except painting)	ton	2,261	2 359,75	5.335,39	5.844,56	13.214,56
41	25.001/İB-2	Demir yüzeylerin özel (Silis quartzt) kumla, kompresör kullanarak raspa edilmesi ve parlak bir yüzey edilinceye kadar kumlanması-Blasting iron surfaces with special (Silica quartz) sand using a compressor and sandblasting until a bright surface is obtained.	m2	159,730	16,45	2.627,56	40,74	6.507,86
42	25.001/İB-1 ÖZEL	Kum raspa veya zımpara ile temizlenmiş demir imalatın epoxy zinc rich primer astar, epoxy high build arakat ve epoxy son kat boya ile boyanması-Painting of iron manufacturing cleaned with sand blasting or sandpaper with epoxy zinc rich primer primer, epoxy high build undercoat and epoxy top coat paint.	m2	159,730	23,16	3.699,35	57,36	9.162,44
					TOTAL AMOUNT (Vat excluded)	**101.175,11**		**250.587,67**

3.2.3 Location 3

It is a 25 m in length cast in-situ reinforced concrete underpass and constructed on 100+765 km of Kastamonu-Karabuk divided road in 2008 and cost data is given in Table 7.

Here, the cost of 171.747,19 TL obtained for 2019 is for the 25 m length of the overpass, and to be able to

make an accurate comparison, the unit cost (for one meter) must be taken into consideration. Accordingly, 171.747,19 TL is divided by 25 meters and the unit cost of the construction is obtained as 6.869,89 TL/m

Table 7. Location 3 cost data

No	Item No	Analysis Name	Unit of Measure	Quantity	2008 Unit Price (TL)	2008 Amount (TL)	2019 Unit Price (TL)	2019 Amount (TL)
1	14111 Özel	Her derinlikte, her cins ve klastaki zeminde, kuruda tahkimat işleri ve kutu menfez temel kazısı yapılması (kazının depoya nakli dahil)-Dry fortification works and box culvert foundation excavation (including the carriage of the cutting material to warehouse) for all depths, all types and classes soils.	m3	461,580	4,60	2.123	14,479	6.683,27
2	16.100/K-1 Özel	Her türlü inşaat temellerinde (Köprü temelleri hariç) kuruda veya suda her dozda demirsiz beton-Plain concrete in all kinds of construction foundations (except for bridge foundations), dry or in water, in all doses.	m3	12,250	94,05	1.152	296,035	3.626,43
4	16.134/1 Özel	Kutu menfezlerde kuruda veya suda her dozda demirli beton (C25)-Reinforced concrete (C25) in any dose in dry or water in box culverts	m3	183,456	161,14	29.562	507,210	93.050,73
5	21.051	Menfezlerde 6 m ve daha küçük göz açıklıkları için döşeme kiriş ve kemer taşıyıcı iskeleleri-Slab beam and arch supporting scaffolds for the culverts 6 m and smaller in length	m3	300,000	3,85	1.155	12,118	3.635,52
6	3790 Özel	İnşaat Bünyesine Giren Demir Zati Bedeli demir işçiliği (8-50mm) ve nakli-Steel material cost, steel works (8-50mm) and carriage	ton	11,100	1.162,36	12.902	3.658,686	40.611,42
7	2640	Elenmemiş malzeme ile sanat yapıları temel tabanına beton yol ve tretuvar altlarına kum çakıl tabakası serilmesi,drenaj hendekleri ile her türlü büz yanlarına kum çakıl dolgu yapılması (Malzeme nakli dahil) Laying a layer of sand gravel under the concrete road and pavement under the foundation base of the engineering structures with unsieved material, filling the drainage ditches with sand and pebble (including material carriage)	m3	52,235	6,81	355,720	21,435	1.119,68
8	16.100/K-1 Özel	Her türlü inşaat temellerinde (Köprü temelleri hariç) kuruda veya suda her dozda demirsiz beton (C16) Plain concrete in all kinds of construction foundations (except for bridge foundations), dry or in water, in all doses (C16)	m3	0,750	94,05	70,538	296,035	222,03
9	16.131/K-1 Özel	Her türlü inşaatta (Kirişli ve kutu menfezler, köprüler ve betonarme kazık hariç, plak ve kompozit menfezler dahil) kuruda veya suda her dozda demirli beton (Kullanılan her türlü malzeme ve taşımalar dahildir) (C25/30) In all kinds of construction (except for beam and box culverts, bridges and reinforced concrete piles, including slab and composite culverts) all doses of reinforced concrete in dry or water (Including all kinds of materials and carraige) (C25 / 30)	m3	10,620	141,04	1.497,845	443,943	4.714,67
10	3790 Özel	İnşaat Bünyesine Giren Demir Zati Bedeli ,demir işçiliği (8-50mm) ve nakli-Steel material cost, steel works (8-50mm) and carriage	ton	0,454	1.162,36	527,711	3.658,686	1.661,04
11	14.110 Özel	Her derinlikte her cins ve klastaki zeminde kuruda drenaj,kanalizasyon hendeği ve duvar temelinin kazılması (kazının depoya nakli dahil)-Dry drainage, sewer ditch and excavation of the wall foundation (including the carriage of the cutting material to the warehouse) for all depths, all types and classes soils	m3	8,640	3,68	31,795	11,583	100,08
12	16.100/K-1 Özel	Her türlü inşaat temellerinde (Köprü temelleri hariç) kuruda veya suda her dozda demirsiz beton (C16) All kinds of construction foundations (except bridge foundations), dry or water, any dose of plain concrete	m3	1,440	94,05	135,432	296,035	426,29
13	16.131/K-1 Özel	Her türlü inşaatta (Kirişli ve kutu menfezler, köprüler ve betonarme kazık hariç, plak ve kompozit menfezler dahil) kuruda veya suda her dozda demirli beton (Beton santralı ile) (Kullanılan her türlü malzeme ve taşımalar dahildir) (C25/30)-In all kinds of construction (except for beam and box culverts, bridges and reinforced concrete piles, including slab and composite culverts) all doses of reinforced concrete in dry or water (Including all kinds of materials and carraige) (C25 / 30)	m3	22,950	141,04	3.236,868	443,943	10.188,48
14	3790 Özel	İnşaat Bünyesine Giren Demir Zati Bedeli ,demir işçiliği (8-50mm) ve nakli-Steel material cost, steel works (8-50mm) and carriage	ton	1,560	1.162,36	1.813,282	3.658,686	5.707,55
			TOTAL AMOUNT (Vat excluded)			**54.563,87**		**171.747,19**

According to the calculations made for the constructions in selected locations, it is observed that the unit cost of the reinforced concrete prefabricated overpass (7.139,25 TL/m) is approximately 66% less than the unit cost of the steel overpass (20,753.60 TL/m). Besides, it is calculated that the unit cost of the underpass (6.869,89 TL/m) is approximately 4% less than the unit cost of the reinforced concrete prefabricated overpass (7.139,25 TL/m).

Based on this result, the costs of an underpass and a reinforced concrete overpass are almost the same, but the cost of steel overpass is much higher. However, it should not be ignored that there are also various parameters such as (construction techniques,

climatic conditions, expropriation need, aesthetic designs, topography, location of construction, etc.) which can affect construction costs.

3.3 Aesthetic

Pedestrian overpasses and underpasses are structures designed as a solution both to enable pedestrians to cross a road safely and provide continuity of heavy vehicle traffic at the same time, as well as being aesthetic engineering structures.

Pedestrian overpasses can be regarded as one of the visual elements of a city not only for their function but also for their aesthetic contribution to urban design. Although there are a smaller number of overpasses when compared to other urban design structures, their effect on the aesthetic is much more outstanding [11].

For this reason, besides the principles of ensuring pedestrian safety and vehicle traffic flow, presenting engineering solutions that reflect the characteristics of the region in which it is located will aesthetically contribute to the region and will increase the added value in the construction of overpasses. However, especially for historical/touristic and natural sites, preferring an underpass instead of an overpass will prevent deteriorating of present urban texture and urban visuality. In Figure 22, examples of overpasses with an aesthetic value reflecting the urban texture in our country are given.

Figure 22. Aesthetic overpass examples in our country

3.4 Construction duration

Another point to be taken into consideration in the overpass/underpass comparison is the construction duration. This duration can be affected by construction technique, material, climatic conditions in construction period, pedestrian/vehicle traffic in the construction period, public procurement process, etc. In this respect, for the construction period of overpasses traffic flow is not almost interrupted especially in precast applications traffic flow is interrupted hardly ever.

However, in underpass construction, if it is a road/railway that has not been opened to traffic yet, it won't be a problem, but if it is to be built on a road with active vehicle traffic, the vehicle traffic will have to be interrupted at certain times, in some cases, the road will have to be closed completely or the main road route will have to be bypassed by directing the traffic to alternative routes.

Additionally, it should be considered that the traffic interruption due to underpass construction or bypass to alternative routes may be hazardous in terms of causing traffic accidents. Figure 23 shows a traffic accident that occurred recently in our country, during the culvert/underpass construction, where 8 people died, and 4 people were injured.

Figure 23. Fatal accident caused by underpass/culvert construction (Int. res. 3).

When it is evaluated in terms of both construction duration and traffic disruption and/or risk of accident, choosing to construct an overpass especially in main arteries will be a much more reasonable approach.

4 Results and Discussions

Transportation has been a vital factor for economic and socio-cultural development throughout human history. Due to the availability of suitable transportation facilities; nations, regions, cities, industries, institutions, businesses have developed or fall behind. Today, the parallelism between the development of transportation facilities and the development of countries or regions can be observed prominently. Particularly, the phenomenon of globalization makes the importance of transportation more and more evident day by day.

Transportation is the displacement of humans, animals, plants, and goods from one place to another for a specific purpose. Traffic can be defined as the movements of vehicles used in transportation facilities (cars, buses, trucks, etc.) and the movements of mobile objects (pedestrians and animals) on a road or railway. However, the "human" factor both as a driver inside the vehicle and as a pedestrian outside the vehicle is a primary factor affecting traffic.

National or international traffic accident statistics reveal that accidents caused by the interaction of vehicles and pedestrians are in non-negligible amounts and various solutions are tried to be developed to overcome this matter. Especially on urban roads, pedestrian overpasses or underpasses are constructed for reasons such as providing less interaction of pedestrians and vehicles, preventing interruptions in vehicle traffic and time loss, and preventing accidents that may occur due to probable illegal crossings.

There are several parameters for the construction of over/underpasses such as safety, capacity, saving of time, cost, aesthetics, topography, construction period, expropriation, local demands, historical/cultural/touristic characteristics of construction area, and public requirements, etc. However, decision-makers (General Directorate of Highways, Municipalities, Provincial Administrations), need a guide on which of these two types (underpass/overpass) should be preferred.

There is not enough standards/codes or guide for the construction of underpasses/overpasses in our country. Only with the standard of TS 12576

"Structural preventive and sign design criteria on accessibility in sidewalks and pedestrian crossings" are established however, this standard is not sufficient for underpass or overpass preference, but only some suggestions are provided to ensure the accessibility of all potential users effectively.

it is thought that this study will contribute to decision-making process of competent authorities such as municipalities, general directorate of highways, etc. and fill a gap in this regard. On the other hand, a standard, code, regulation, or guide should be established in order to develop a more effective decision mechanism.

Within the scope of the study, an inventory of pedestrian overpasses and underpasses in the Karabuk-Safranbolu region was presented, two different overpasses constructed in steel and prefabricated reinforced concrete and a cast-in-situ reinforced concrete underpass were compared in three different locations, and cost analyses were carried out.

Accordingly, the costs of underpass and reinforced concrete overpass are almost the same, but the cost of steel overpass is much higher. However, it should not be ignored that there are also various parameters such as (construction techniques, climatic conditions, expropriation need, aesthetic designs, topography, location of construction etc.) which can affect construction costs.

Another important point to be considered is that the underpass/overpass preference cannot be solved with a basic engineering approach, but the preferences of the users should be taken into consideration. In this context, face-to-face surveys were carried out with 300 people in 3 different over/underpass locations, and the results were evaluated through SPSS (statistical package for social sciences) software. The advantages and disadvantages of over/underpasses in terms of cost, safety, ease of use/comfort, saving of time, user preference, aesthetic, construction period is revealed by means of the survey studies.

According to survey results;

- The ratio of not using overpass or underpass is quite high. This is an issue that needs to be considered and needs to be created solutions.
- While an increase in the level of education is expected to increase the use of underpass /overpass, but the results do not verify this expectation. From this point of view, this matter is not only related to education and it must be handled in many ways such as sociological, psychological, cultural, etc.
- According to general opinion, it is known that crossing through overpasses is safe, and passing through underpasses is a safety concern and it is known that illegal crossings are dangerous.
- The general tendency is that the use of overpass/underpass is easy/comfortable.
- Overpasses are generally not preferred due to energy loss or getting tired (laziness), while underpasses are not preferred due to safety concerns, and the use of both is seen as a waste of time.

As a result of ANOVA analysis performed for both 100 people in each location and 300 people in all locations;

- Gender and education level did not reveal significant results for the preferences of over/underpass in all locations.
- In general, it was observed that with the increase of age, legal crossings decreased and pedestrians who cross illegally were aware that illegal crossings were dangerous.
- With the increase of age and education level, it was evaluated that the under/overpasses were comfortable / easy.
- It is thought that the lack of significant results especially related to education level is due to the fact that the locations selected for the sampling are located in the University region and the majority of the participants have bachelor or master's degree. It is considered that increasing / changing the sampling area will provide more significant results in terms of education level.
- Even in the case of an underpass instead of an overpass, pedestrians crossing illegally are still expected to cross illegally so it does not matter for the of user preferences in terms of over/underpass.

Over/underpasses are engineering solutions for ensuring pedestrian safety and vehicle traffic flow especially in places which have a traffic congestion, on the other hand, overpasses have an aesthetic aspect. Therefore, besides presenting engineering solutions for ensuring pedestrian safety and vehicle traffic flow, reflecting the characteristics of the region in which they are located will aesthetically contribute to the region and will increase the added value in terms of construction of overpasses.

However, especially for historical/touristic and natural sites, preferring an underpass instead of an overpass will prevent deteriorating of present urban texture and urban visuality.

Another point to be taken into consideration in the overpass/underpass comparison is the construction duration. This duration can be affected by construction technique, material, climatic conditions in the construction period, pedestrian/vehicle traffic in the construction period, public procurement process, etc. In this respect, for the construction period of overpasses traffic flow is not almost interrupted especially in precast applications traffic flow is interrupted hardly ever.

However, in underpass construction, if it is a road/railway that has not been opened to traffic yet, it will not be a problem, but if it is to be built on a road with active vehicle traffic, the vehicle traffic will have to be interrupted at certain times, in some cases, the road will have to be closed completely or the main road route will have to be bypassed by directing the traffic to alternative routes.

Additionally, it should be considered that the traffic interruption due to underpass construction or bypass to alternative routes may be hazardous in terms of causing traffic accidents.

When it is evaluated in terms of both construction duration and traffic disruption and/or risk of accident, choosing to construct an overpass especially in main arteries will be a much more reasonable approach.

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