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Evaluation of the tender results of forest road constructions: A case study in Bolu Regional Directorate

Yılmaz Türk, Selçuk Gümüş

Düzce University, Faculty of Forestry, 81620, Düzce, Turkey

* **Corresponding author e-mail (İletişim yazarı e-posta):** yilmazturk@duzce.edu.tr

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Abstract: The construction of forest roads in Turkey follows a tender process conducted by the General Directorate of Forestry. The amount of work (i.e., excavation volume) is estimated for the approximate cost schedule required for the tender. Unexpected disputes have occurred during the process of finalizing the contracts because measurements are determined by a preliminary survey done prior to preparation of a detailed project proposal. The aim of this study was to compare the road construction data that was calculated during the tender process to the exact values that were obtained as a result of construction. A total of 34 forest roads constructed by Bolu Forest Regional Directorate between 2007 and 2014 were studied. Data were obtained from the tender dossiers to evaluate and compare the cost estimated for the tenders to the actual progress values (excavation quantities, excavation features and costs) of these projects. In addition, these roads have been evaluated according to forest road technical standards. The total length of the assessed roads was 73,879 m, the total costs were USD 977,138, and a total of 726,366 m^3 was excavated during the construction of these roads. Paired sample t-tests demonstrated a statistical difference between the tender cost estimates and the progress payment amounts, and between the estimated amounts of very hard rock excavation and the actual amounts of very hard rock excavation.

Key Words: Forest road construction, tender cost, progress payment, Turkey

Orman yol inşaatı ihale sonuçlarının değerlendirilmesi: Bolu Bölge Müdürlüğü örneği

Özet: Orman yollarının inşası, Orman Genel Müdürlüğü tarafından ihale yoluyla gerçekleştirilmektedir. İhale için gerekli olan yaklaşık maliyet cetvelindeki iş miktarı, yol aplikasyonu sırasında yapılan 1. gözlemsel ölçümlere göre belirlenir. Detaylı proje hazırlanmadan, ön araştırma ölçümleriyle sözleşmelerin tamamlanma sürecinde beklenmeyen anlaşmazlıklar meydana gelmektedir. Bu çalışmanın amacı, ihaleye çıkılırken hesaplanan yol inşa verileri ile inşaat sonucunda çıkan kesin değerlerin karşılaştırılmasıdır. 2007-2014 yılları arasında Bolu Orman Bölge Müdürlüğü (BOBM) tarafından yapılan toplam 34 orman yolu örneklenerek incelenmiştir. Bu projelerin ihale yaklaşık maliyet ve hakediş değerlerini (kazı miktarını, kazı özelliklerini ve maliyetleri) karşılaştırmak için ihale dosyalarından veriler elde edilmiş ve değerlendirilmiştir. Ayrıca, bu yollar orman yolu teknik standartlarına göre değerlendirilmiştir. Araştırma sonuçlarına göre; yolların toplam uzunluğu 73.879 m ve toplam maliyeti 977.138 $ olup bu yolların inşası için toplam 726.366 m^3 kazı yapılmıştır. Yapılan bağımlı iki örnek t-testi sonucunda; ihale toplam tutarı ile hakediş toplam tutarı arasındaki fark ve hakediş çok sert kaya kazı miktarı ile yaklaşık maliyet çok sert kaya kazı miktarı arasındaki fark istatistiksel olarak anlamlı bulunmuştur.

Anahtar Kelimeler: Orman yol inşaatı, ihale bedeli, hakediş, Türkiye

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1. INTRODUCTION

The accessing to forests makes it possible to apply an appropriate rational forestry for intensive and purposeful purposes. Forest roads constitute one of the tools needed for this purpose. Forestry work in our country is carried out in different parts of the country and in the forest area around 22.3 million hectares (OGM, 2015) in a dispersed country. It is possible to work on such a wide and scattered, even mostly mountainous terrain, that these areas have a good road network. The forest roads play an important role in the implementation of other forestry services such as forest protection, cadaster, maintenance, erosion and afforestation activities together with the convenience of transportation of about 15 million m^3 primary forest product every year. It also allows forest villages to meet road needs and people's recreational needs. Forest roads offer economic, social and cultural benefits by this means (Erdas et al., 1995). In order to be able to manage the forests intensively, it is necessary to equip them with a planned road network in appropriate standard and intensity. Such a road network; should be consist of a construction style which, when completed, should lead to equal and complete operation of all parts of the forest instead of roads which are made according to daily necessities and then abandoned and which lead to great economic losses, and that these roads should be maintained for a practically unlimited period of time (Hasdemir, 1995).

The forest road constructions in our country are carried out by the Ministry of Forestry and Water Affairs, General Directorate of Forestry (GDF). Approximately 175 000 km of forest road construction has been carried out daily by GDF. As a result of the assessments made, it was determined that 201810 km forest road is needed for technical and economical multi-functional management and operation of our country forests. GDF has set the goal of building 1 000 km of new forest roads annually. Accordingly, the construction of forest roads is a longer period of time.

Construction of forest roads begins with the writing notification of the request of forest enterprises chefs' for construction of roads that exist in the road network plans to the Forest Regional Directorates according to the current legislation. The application is made by the Directorate of Machinery Supply Branches located in the Forest Regional Directorate offices after having been examined according to the annual work program. The construction of the forest roads is started by a preliminary survey team formed by the technical staff of the machinery supply branch, and enterprise chiefs. The piece of road available in the forest road network plan is firstly applied to the ground by measurements made on zero line. In this stage, taking into consideration the starting point and longitudinal gradient of the road segment, the platform level pile and slope piles are determined and the application is completed. The inclinometer and tape meter are used for this works.

A quantity chart is prepared taking into consideration the road width and site slope, along with the zero line application, in accordance with the "Technical Specifications for Forest Road Construction Works" prepared by the Ministry of Forestry and Water Affairs, General Directorate of Forestry, Construction and Supply Department and Project Etude Branch Directorate. A ground survey based on the experience of the technical team is made beside the quantity chart and is recorded along the way. The ground survey is the process of determining soil, stony and rocky ratios in excavation works to be done along the zero line.

Following the preparation of the quantity chart, an outline table which shows the total amount of excavation and cut volumes distributed to the ground types are prepared. After this stage, the road will be constructed by going out to the tender, according to the construction works tendered with Open Tender Procedure within the Public Procurement Law No. 4734. The forest roads should be constructed with the project, prepared according to the road gradient along the start and end points of the each road segment, instead of quantity chart which prepared according to site slope and road width at each preliminary survey profile point. Because of the determined slope and road standard, road platform elevation and land elevation differences occur. This process cannot be detected until the longitudinal profile of the path has been prepared. This causes the actual excavation volume to vary significantly during the construction of the road.

In the preparation of quantity chart during the preliminary survey, the calculation of the actual transverse section cross sections due to the fact that the difference between the road platform elevation and the land surface elevations is not known is made incorrectly. In the present operations, calculation of these cross-sectional areas is made by taking site slope and cut slope surface gradient into consideration. In this stage, it is assumed that there is no difference between road platform height and terrain height as an assumption. The construction excavation volumes, which are the amount of work in the tender dossier prepared for the road construction by the preliminary survey without the required project preparation, cause the formation of opposition between the contracting firms and the administrations as a result of the tender. Because the estimated amount of work for the project is generally different at the end of the work. This, in turn, results in contractors sometimes making unfair profits and sometimes building roads that do not meet the standards. In both cases, the administration has difficulty in seeking public benefit.

The aim of this study is to compare the technical calculations made when going out tender and the real values realized

as a result of the construction, and to examine the forest roads constructed as a result of the construction process according to the forest road standards. In other words, approximate cost values that are considered for tender calculated by observations only, without project preparation and modern methods, and job completion payment values (progress values) were compared, and finally, it was tried to determine whether there was a difference between the tender and the progress values. It was concluded which items are different and why the difference occurred, in the current construction process.

2. MATERIALS AND METHOD

2.1 Study Area

The progress values and tender approximate cost values were compared and evaluated of the roads constructed in Bolu Forest Regional Directorate (BFRD) from 2007 to 2014. Costs and excavation quantities have been analyzed related to the roads constructed in the framework of the Public Tender Law (PTL) numbered 4734, which was put into effect from January 2003. Bolu Forest Regional Directorate has a total forest area of 1,036,829 ha including 504,468 ha normal forest area, 125,284 ha degraded forest area and 406,466 ha un-forested area. Due to its geographical location, the BFRD is located on the broken and rough terrain in the Western Black Sea Region of Turkey. The BFRD consists of 12 forest enterprise directorates and covers the whole of Bolu and Duzce provinces. In this study, the construction costs and excavation volumes of forest roads in Akcakoca, Aladag, Bolu, Duzce, Golyaka and Yigilca Forest Directorates were examined. Figure / Şekil 1 shows the location and their borders of BFRD in Turkey.

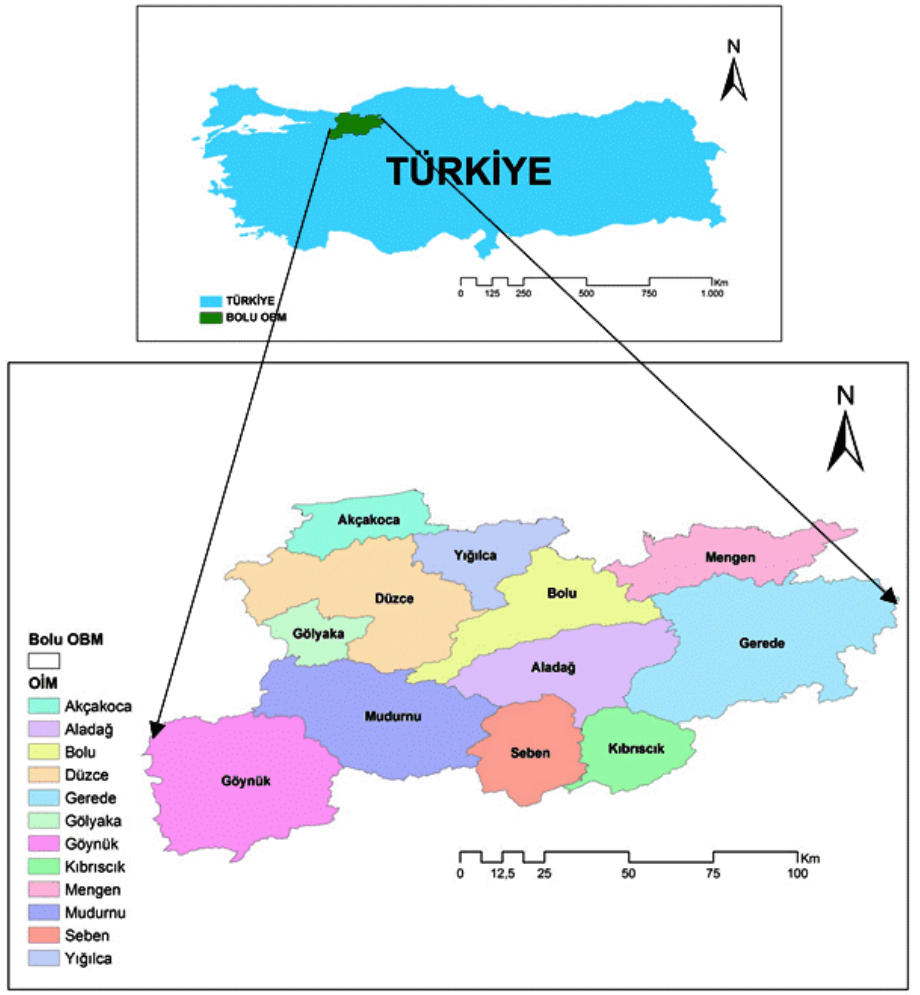

Figure 1. The location of Bolu Forest Regional Directorate's in Turkey, enterprise directorates and borders
Şekil 1. Türkiye'de Bolu Orman Bölge Müdürlüğü'nün konumu, işletme müdürlükleri ve sınırları

2.2 Tender Dossiers and Etude Forms

Tender dossiers constituting the main material of the study were obtained from the forest enterprise directorates. Approximate cost table, tender approval certificate, tender commission decision, approximate cost calculation schedules, approximate cost measure forms, unit price quote table, progress report, bill of quantities report, progress bill of quantities, and the road maps if available, have been obtained from the tender files.

Two etude forms were used in the study. One of these is the cost etude form which contains data about forest enterprise where the road constructed, forest enterprise chefs, road codes, road name, the cost values that the firm or person undertaking the construction of the road has offered according to the values in the approximate cost schedule and the progress cost values prepared at the end of road construction. The other etude form is the excavation form, which contains the following data, the amounts of each work type in the approximate cost schedule and the progress bill prepared at the end of the work, the amounts of each work type in the list of works on which the progress reports are made, together with knowledge of forest enterprise directorate and chief where the road constructed, road codes, road name.

2.3 Field Studies

Forest roads were investigated on study field. The ground classes of the forest roads that were completed were observed and the changes in the vertical and horizontal conditions of the ground were noted on the side of the cut slope. In addition, changes to the bedrock or floor type roadway have been examined.

2.4 Acquiring of Approximate Cost (Tender Bid) and Exact Value (Total Progress) Data

The approximate cost values as 1st survey (field measurement) values, and exact data as 2nd survey values were acquired from the tender dossiers while the data are obtaining. In order to compare the costs, the tender bid (approximate cost job x unit price) and progress payments (amount of work done x unit price), and to compare the amounts of the work also, approximately and exact work amounts were used (Karabacak, 2010, Erbas, 2010).

2.5 Statistical Analysis

It has been determined whether there is any difference between the approximate cost and the progress payment values. The t-test (paired-samples t-test) was used to determine whether the differences between the values were significant. The paired sample t-test, sometimes called the dependent sample t-test, is a statistical procedure used to determine whether the mean difference between two sets of observations is zero. In a paired sample t-test, each subject or entity is measured twice, resulting in pairs of observations. Common applications of the paired sample t-test include case-control studies or repeated-measures designs (Ozdamar, 2002).

3. RESULTS AND DISCUSSION

3. 1 Costs and Excavations Quantities

A total of 34 forest roads constructed by BFRD between 2007 and 2014 were sampled and studied. The total length of the assessed roads was 73,879 m, and the total costs were $ 977,138, and a total of 726,366 m^3 of excavation was carried out for the construction of these roads. Moreover, unit cost was found to be 13.23 $/m and unit excavation amount 9.83 m^3/m. The unit cost are 11.39 $/m, 27.61 $/m and the unit excavation amount were 3.91 m^3/m and 19 m^3/m respectively according to Karabacak (2010) for the Göller Region, and Erbas (2010) for Eastern Black Sea Region.

The total tender bid for the constructed roads is $ 1,090,234 while the total amount of progress payment is $ 977,138 the difference being $ 113,096. Excavation quantities have been specifically examined since 97% of the average cost of constructed roads constitutes excavation costs. The most important component of road construction costs in the construction of forest roads is excavation (FAO, 1992). The amount of excavation found in the cost table is 571,811 m^3, the total amount of exact excavation is 726,366 m^3, and the difference is 154,555 m^3 (Table / Tablo 1).

The cost of the roads has decreased by about 10% (t account value 3,656, difference 99% (P=0.001) significant level) in the exact calculations compared to the tender bid values, at the end of construction phase. On the other hand, it was determined that the amount of excavation increased by about 27% (P=0.098) when compare the exact excavation with the values in the approximate cost. Erbas (2010) found that the cost of roads decreased by 16.28% and the excavation increased by 4.47%, compared the final of the construction and the tender bid. In another study Karabacak (2010) it

has been determined that the cost of roads increased by 4.33% and the excavation by 0.92%. The values obtained in this study are different from the other two studies because of the difference in the region. Figure / Şekil 2 shows the difference between total progress cost and tender bid cost. Figure / Şekil 3 shows the difference between total progress excavation amount and tender bid excavation amount.

Table 1. Differences in total cost and excavation amounts of forest roads made in 2007-2014 at BFRD
Tablo 1. BOBM'de 2007-2014 yıllarında yaptırılan orman yollarının toplam maliyet ve kazı miktarlarındaki farklar

Road Code No	Tender Bid (Approximately) ($)	Total Progress ($)	Difference ($)	Tender Bid (Approximately) (m^3)	Total Progress (m^3)	Difference (m^3)
430	19 691	21 575	1 883	8 148	9 740	1 592
296	47 593	42 421	-5 172	20 667	19 670	-997
33	52 477	52 477	0	22 103	22 044	-58
59	53 706	46 380	-7 326	25 205	23 630	-1 575
314	305 32	27 856	-2 676	16 878	14 898	-1 980
333	24 251	25 071	820	6 544	7 133	589
19	33 015	32 496	-519	10 860	7 979	-2 881
21	32 246	28 432	-3 814	14 496	13 930	-567
30	73 788	67 460	-6 328	112 277	98 490	-13 787
36	22 320	18 668	-3 653	42 346	10 309	-32 038
271	17 009	15 671	-1 338	9 250	10 749	1 499
27-107-224	85 367	60 120	-25 247	22 683	31 916	9 233
081-093	48 142	33 092	-15 050	45 530	104 968	59 438
27	69 421	64 586	-4 835	23 227	59 014	35 786
107-061	68 093	64 293	-3 800	25 353	60 365	35 013
54-56	34 100	33 085	-1 016	19 288	45 585	26 298
93-153	49 161	40 026	-9 135	14 453	32 239	17 787
68	18 136	17 476	-660	9 339	26 714	17 375
365	46 827	48 433	1 606	24 256	24 009	-247
441-442-365	95 846	91 092	-4754	29 190	30 711	1 521
240	63 516	58 666	-4850	28 006	32 470	4 464
201-202-207	75 568	59 976	-15 592	24 522	23 477	-1 045
365	27 532	24 667	-2 865	11 741	10 383	-1 358
352	1 896	3 121	1 225	5 450	5 944	493
Total	**109 0234**	**977 138**	**113 096**	**571 811**	**726 366**	**154 555**

When Table / Tablo 1, Figure / Şekil 2 and 3 are examined, the values for all ground classes determined based on observations only before the road construction have changed in the positive or negative according to the exact amounts. This result shows that the observational methods are not sufficient in determining the amount of excavation and ground classes for tender bid. The differences shown in Table / Tablo 1 cause problems between businesses and contractors as a result of road constructions. According to Acar et al., (2003), geological and geophysical methods and ground classes under the road can be estimated and calculated. In this way, the actual cost of road construction can be predetermined and the fees that the contractors deserve can be paid without any dispute.

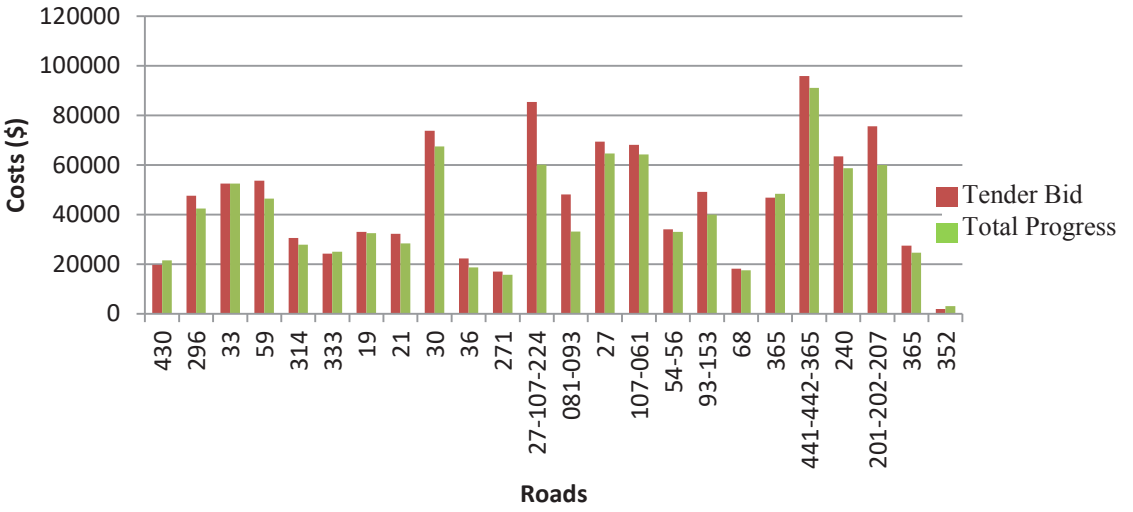

Figure 2. Differences chart between tender bid and total progress costs
Şekil 2. Toplam hakediş ve ihale teklif maliyetleri arasındaki fark grafiği

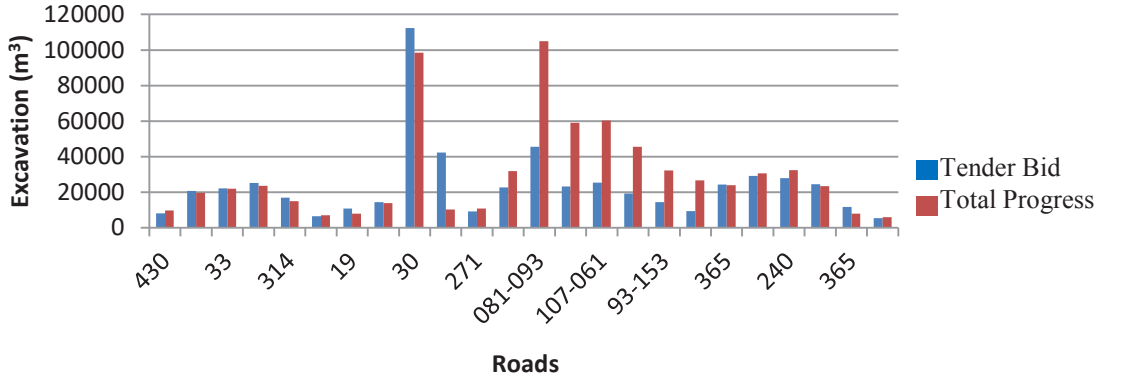

Figure 3. Differences chart between tender bid and total progress excavation among
Şekil 3. Toplam hakediş ve ihale teklif kazı miktarları arasındaki fark grafiği

The length of the roads in tender bid is 75,791 m and the constructed roads length is 73,879 m. The length of the constructed road is approximately 1,912 m (2.52%) less than the tender bids of the road. It has been detected that the value of constructed road length is found to be less in some studies (Karabacak, 2010; Erbas, 2010). In another study, Gumus et al. (2015) have concluded more than for constructed road length. This difference arises from the fact that forest road projects are not prepared.

The total excavation amount has increased by 571,811 m³, although constructed road has been carried out less than the tendered length of the road. This excavation increases is in the rock class. In the ground classes where excavation is expensive, any increase occurrence from the value predicted before the tender increases dramatically the road costs. Figure / Şekil 4 shows a graph of the difference between the total constructed road length and the total tender bid road length.

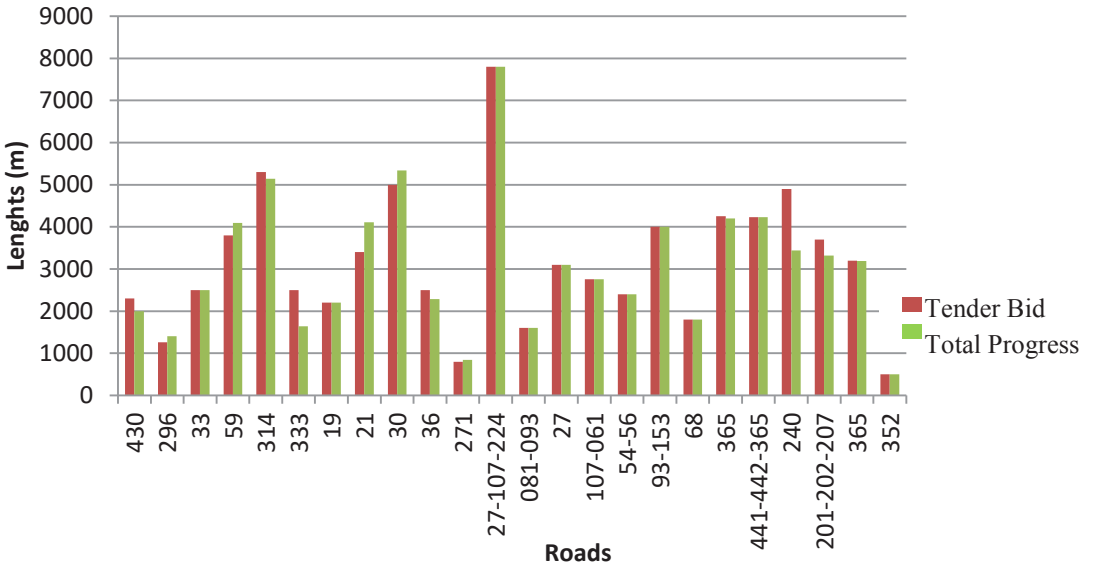

Figure 4. Differences chart between tender bid and total progress road lengths
Şekil 4. Toplam hakediş ve ihale teklif yol uzunluğu arasındaki fark grafiği

It can be seen that the maximum deviation from the tender bid was in the amount of very hard rock excavation by 190,127 m³ [(p=0.015), confidence level 99%] more excavations in examining Figure / Şekil 5 below. The deviations between the tender bid and exact values are determined not only in ground class's distributions, but also road lengths and total excavations amounts. The amount of soil and hard rock has also increased in the exact excavation amounts.

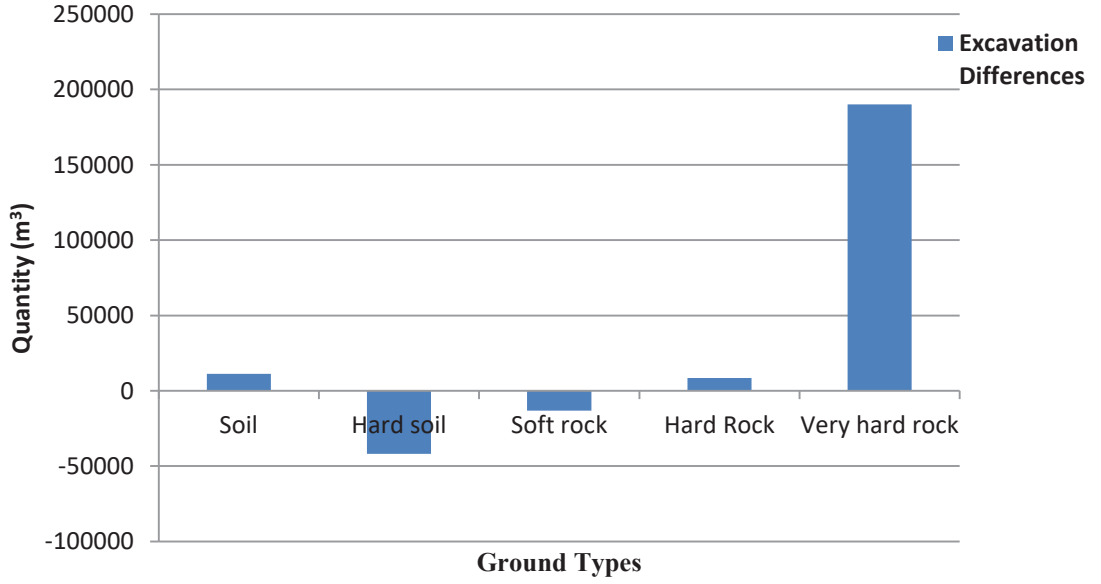

Figure 5. According to excavation classes, differences chart between tender bid and the total progress excavation among
Şekil 5. Kazı klaslarına göre toplam hakediş ve ihale teklif kazı miktarları arasındaki fark grafiği

In similar studies in the Eastern Black Sea Region and the Göller District, the deviation between tender values and exact amounts was not only in the determined on ground classes, but also in the length of the road, and in the total amount of excavation (Karabacak, 2010; Erbas, 2010; Gumus et al., 2015).

3. 2 The Field Examinations of Constructed Roads

The roads that were subject to the study were examined in the field and it was observed that some of the roads were found to have a small amount of soil in the upper part of the excavation slope and the lower parts were rocks or boulders near the whole or the whole.

The roads were traced along the route, and the vertical and horizontal changes in the ground were observed on the side of the excavation slope. It is determined that the grounds, which seem like soil, are rocky or hard soil after the excavation. Beside these, it was observed that the bedrock or floor type road is not regular along the line, shows changes.

4. CONCLUSIONS

A total of 34 forest roads constructed by Bolu Forest Regional Directorate (BFRD) between 2007 and 2014 were sampled and studied. Data were obtained and evaluated from the tender dossiers to compare the approximate cost of the tenders and progress values (excavation quantities, excavation features and costs) of these projects.

The total length of the assessed roads was 73,879 m, and the total costs were $ 977,138 and a total of 726,366 m^3 of excavation was carried out for the construction of these roads. Moreover, unit cost was found to be 13.23 $/m and unit excavation amount 9.83 m^3/m. The total tender bid for the constructed roads is $ 1,090,234 while the total amount of progress payment is $ 977,138 the difference being $ 113096. The amount of excavation found in the cost table is 571,811 m^3, the total amount of exact excavation is 726,366 m^3, and the difference is 154,555 m^3. The cost of the roads has decreased by about 10% in the exact calculations compared to the tender bid values, at the end of construction phase. On the other hand, it was determined that the amount of excavation increased by about 27% when compare the exact excavation with the values in the approximate cost.

The ground class's bids determined based on observations have changed in the positive or negative according to the exact amounts. The observational methods are not sufficient in determining the amount of excavation and ground classes for tender bid. Ground classes can be estimated and calculated by geological and geophysical methods. In this way, the actual cost of road construction can be predetermined and the fees that the contractors deserve can be paid without any dispute.

The length of the roads in tender bid is 75,791 m and the constructed roads length is 73,879 m. The length of the constructed road is approximately 1,912 m (2.52%) less than the tender bids of the road. The total excavation amount has increased by 571,811 m^3, although constructed road has been carried out less than the tendered length of the road. This excavation increases is in the rock class. The maximum deviation from the tender bid was in the amount of very hard rock excavation by 190,127 m^3 with more excavations. The deviations between the tender bid and exact values are determined not only in ground class's distributions, but also road lengths and total excavations amounts. The amount of soil and hard rock has also increased in the exact excavation amounts.

Forest road construction work should be carried out with tenders based on detailed road projects not with preliminary field survey reports. Thus, a more rational use of GDF resources can be achieved, and in the forestry sector, the trust level of the contracting firm can be increased. The design and application of road projects have become an extremely easy process by technological advances reached today. Different software such as Plateia running on the AutoCAD Civil 3D Platform, NetCAD Road Design Module NETPRO and such can be used during the project of forest roads. Road constructions, numerically generated projects with these software should be done by applying to the floor with electronic coordinate measuring instruments.

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