UDC 666.972

FEATURES OF THE MODIFIED CONCRETE STRENGTH IN CLIMATIC CONDITIONS OF THE MIDDLE EAST COUNTRIES

M. TLAYSS, A. BAKATOVICH
(Polotsk State University)

Discusses the results of the study to determine the effects of climatic factors in the Middle East countries on the strength of concrete. It was found complex positive influences on strength when increased the temperatures and humidity at the stage of curing concrete, which means allowing to increase the strength of concrete. The experiments were carried out on the modified concrete by superplasticizers that based on sulfonated naphthalene formaldehyde compounds, including applied in the Middle East. Production samples of concrete, stored and tested them is in according to operating normative documents in territory of Belarus and the American standards.

Introduction. Modern technologies are based on the use of superplasticizers, as their use provides constructions with high running qualities. To meet the requirements of concrete motility to slow the process of cement hydration in hot climates it is advisable to use superplasticizers as separate supplementsor to get her with ardeningretarders.

Superplasticizers belong to additives regulating the qualities of concrete mixtures according to ASTM C 494, BS 5075 and EN 934-2 classification and to the first group due to extremely high dilution effect of concrete mixtures without strength decrease at all stages of the test.

The most widely used additives based on sulfonated naphthalene formaldehyde compounds, Agiplast and Chriso fluid (France), Cormix (United Kingdom), Lomar D and PSP (USA), Mighty (Japan), Fluimax (Italy), Sikament (Sweden) and complexes there of belong to the first group. Superplasticizers are introduced into concrete mixtures in the form of water solutions of working or high concentration – additive content equals to 0.7…1.5 % of the weight of cement, which makes the motility of concrete mixture by 3…4 times higher than the mobility of the test composition and reduces the water content of concrete 15…25 % along side with the increase of its compressive strength 15…20 % [1].

C-3 additive is the most widely produced in CIS countries. It is a synthetic substance derived from polycondensized products of naphthalene sulfonic acids and formaldehyde. Superplasticizer in a rate from 0.35 to 0.7 % of the weight of cement, makes it possible to produce highly movable, workable concrete mixtures from 2…4 to 20…22 cm without decrease of its strength. It can also be used to reduce the flow of water in concrete to increase its strength [2].

Organic superplasticizers CF110 (according to ASTM C 494 – type F) based on naphthalene polymer and CF92 (according to ASTM C 494 – type G) based on naphthalene sulfonate in combination with retarder at a rate from 0.5 to 0.6 % of dry matter by the weight of cement. These additives are widely used in the Middle East. Typical dosages of superplasticizers, used to increase the workability of a concrete mixture, are 1…3 liters of additive per cubic meter of concrete, if they contain a liquid superplasticizer about 40 % of active substance [3; 4]. Superplasticizers CF110 (type F) and CF92 (type G) are manufactured by «SODAMCO-WEBER COMPANY» Beirut (Lebanon). The company «SODAMCO-WEBER COMPANY» is one of the leaders in the manufacturing of chemical additives for various purposes in the cement and concrete in the Middle East.

Climate, temperature, humidity as well as modifying additives have a significant influence on the qualities of concrete mixture and concrete. The resulted natural factors render significant influence on mobility of concrete mixture at the time of placing in the formwork after transportation and properties of the concrete during its curing after placing [5].

The study of temperature and humidity influence on concrete mixtures and concrete during their production and their treatment is extremely important for the Middle East. A proper way of concrete treatment provides its strength and gives lots of economic benefits, which is the key argument in building.

The procedure of the study. The effect of additives on the properties of concrete mixtures and concrete is studied in accordance with the provisions of the GOST 24211 [6], ASTM C 494 [3; 7]. The mobility of concrete mixture has been determined using a standard cone on STB 1035 [8].

The compressive strength of concrete explored according to the procedure of GOST 10180 [9]. The samples before the strength test were stored in the chambers at temperatures +20 ± 2 °C and +35 ± 2 °C with humidity 60…65 %, and more than 95 %, also in water. Determine the average density of concrete in according to GOST 12730.1 [10].

Experimental part. The first stage of the experiment, investigated the effects of superplasticizers on the basic properties of concrete mixtures and concretes, including manufactured concrete mixtures and molded samples of concrete with reduced water-cement ratio. The study was carried out using Portland cement CEM I 42.5 H of 350 kg per 1 m^3. GOST and ASTM methods were applied to identify the properties of concrete mixtures and concrete under different humidity conditions, storage of samples. The study of the climatic conditions of the Middle East has allowed to establish significant differences in indicators of humidity, even within the same country, for example Lebanon, which depends on season, time of day, relief place, location relative to sea, etc.

The first trial of concrete samples according to the GOST methodis stored in a special chamber with temperature of +20 ± 2 °C and humidity of 95…98 %. The density of concrete ranges between 2444…2449 kg/m^3. The results are summarized in table 1.

Table 1

The physical and mechanical characteristics of the concrete mixture and concrete

Number of sample	Type of admixtures	Consumption admixtures, %, of the weight of cement	W/C	Mobility, cm	Compressive strength, MPa, at the age of	
					7 days	28 days
1	Without admix.	–	0.55	4…5	24.4	30.5
2	Superplasticizer C-3	0.6	0.55	20…21	24.4	30.3
3	Superplasticizer CF110 (type F)	0.5	0.52	21…22	24.3	30.2
4	Superplasticizer CF92 (type G)	0.5	0.52	21…22	26.7	33.4

Superplasticizer C-3 was added in a portion of 0.6 % of the weight of the cement, which increased the mobility of concrete mixture to 20…21 cm. When using superplasticizers CF110 (type F) and CF92 (type G), similar performance was achieved on mobility of concrete by adding additives with the amount of 0.5 % of the weight of the cement. The density of control composition and experimental concrete samples ranges between 2444…2449 kg/m^3. It should be noted that using less additives of CF110 (type F) and CF92 (type G) (compositions 3, 4) slightly reduced water consumption, compared with the composition 2.

Using superplasticizers allows to increase the mobility of the concrete mixture 4…5 times compared to the control composition and at the same time get a full-strength concrete at the age of 7 and 28 days.

According to ASTM method, the samples are stored in water until the strength test is made. To provide such conditions, the formwork is not removed from the structures for two weeks with ensuring permanent spraying structures by water or making a water ponding on the surface of structure. Table 2 shows the results of study on the basic characteristics of concrete mixture and concrete.

Table 2

The physical and mechanical characteristics of the concrete mixture and concrete

Number of sample	Type of admixtures	Consumption admixtures, %, of the weight of cement	W/C	Mobility, cm	Compressive strength, MPa, at the age of	
					7 days	28 days
1	Without admix.	–	0.55	4…5	27.2	37.6
2	Superplasticizer C-3	0.6	0.55	20…21	24.9	33.6
3	Superplasticizer CF110 (type F)	0.5	0.52	20…21	29	35.8
4	Superplasticizer CF92 (type G)	0.5	0.52	19…20	30	37.2

After storage in water, concrete strength indicator with admixture C-3 (composition 2) at the age of 7 days of control composition, values below by 2.3 MPa. For concrete that contains superplasticizer of CF110 (type F) and CF92 (type G) (compositions 3, 4), the strength values are slightly higher than the indicator of control composition ranging from 1.8 to 2.8 MPa, respectively. In this case, the strength of composition 4 exceeds by 20 % the value of composition 2.

At the age of 28 days, strength values of composition 1 and 4 are almost equal, and the strength of composition 3 is 1.8 MPa less. It should be noted that the strength value of concrete with the additives of C-3 is less than 10 % compared to the value of control composition 1.

The comparison of the results of strength tests on samples, according to the methods GOST and ASTM revealed that at the age of 7 days, the control composition 1 and compositions 4, 6 with additives CF110 (type F) and CF92 (type G) (table 2) have a strength of 2.8…4.7 MPa higher than the strength values of similar compositions in Table 1, which are 11…19 %. It should be noted that the strength values of composition 2 in tables 1 and 2 are equal.

At the age of 28 days, the strength value of control composition 1 depending on storage conditions differs by 7.6 MPa, i.e. the strength value increases by 23 % during storage the samples in water. The strength of compositions 2, 4 with increased mobility of concrete mixture during storage in water, slightly increases by 11 % higher than the strength values of samples which stored at the chamber, while for the composition 3, the growth of strength is 19 %.

As a result of comparative tests (tables 1 and 2), the storage of the samples in water is more intensive than when in the chamber, this dependence is particularly evident during the period from 7 to 28 days, regardless the presence of plasticizing additives in the concrete composition.

It should also be noted that in depending on the hardening conditions and the type of superplasticizer, kinetics set of concrete strength is different.

Manufacture and storage of concrete samples at a temperature of +20 ± 2 °C and humidity of 60…65 % refers to the basic temperature and humidity conditions in Lebanon and Qatar, which influences on the strength of concrete. Such temperature and humidity regime correspond to winter climatic conditions in Beirut city (+16 °C of temperature and 55…60 % of humidity), and in Doha city (+22 °C of temperature and 52 % of humidity). The results of study are shown in table 3.

Table 3

The physical and mechanical characteristics of the concrete mixture and concrete

Number of sample	Type of admixtures	Consumption admixtures, %, of the weight of cement	W/C	Mobility, cm	Compressive strength, MPa, at the age of	
					7 days	28 days
1	Without admix.	–	0.55	4…5	23	29.7
2	Superplasticizer C-3	0.6	0.55	20…21	19.3	25.2
3	Superplasticizer CF110 (type F)	0.5	0.52	21…22	23.7	28.1
4	Superplasticizer CF92 (type G)	0.5	0.52	21…22	23.2	26.5

The strength indicators of concrete containing superplasticizers CF 110 (type F) and CF92 (type G) (compositions 3, 4) and control composition 1 at the age of 7 days are almost equal – 23…23.7 MPa, and for concrete with additive C-3 (composition 2) the indicator of strength lower than the indicators of control composition 1 and compositions 3, 4 by 3.7…4.4 MPa, which are 16…19 %.

In a comparison of the results obtained by determine the strength when storing samples as described GOST (storage in chamber) with temperature +20 ± 2 °C and humidity 60…65 %, it is established that at the age of 7 days the indicators of concrete strength of compositions 2 and 4 (see table 3) is less than the indicators of similar compositions in table 1 by 5.1…3.5 MPa, which are lower by 21 and 13 %, respectively. It should be noted that the indicators of concrete strength of compositions 1 and 3 in tables 1 and 3 are almost equal.

Similar tendency for the experimental compositions strength of concrete is observed at the age of 28 days.

As a result of analysis table 1 and 3, it can be concluded that the concrete strength indicator is higher when the samples are stored under humidity of 95…98 % than of 60…65 %. This dependence is noted at 7 and 28 days regardless to the presence of plasticizer additives in the concrete composition. Also, it should be noted that the decrease of humidity from 95…98 % (table 1) to 60…65 % (see table 3) has a negative influence on concrete strength of compositions 2, 3 and 4. Compositions with superplasticizer C-3 and additive CF92 (type G) are the most influenced when decreasing the humidity from 95…98 % to 60…65 %.

Comparing the test results (table 2 and 3), it is found that the humidity conditions of samples storage have a significant impact on the strength of concrete. The decrease of strength is observed in compositions 2, 3 and 4 at the age of 7 days, which is 22, 18 and 23 %, respectively with raised the mobility of concrete mixture. According to test results at the age of 28 days, has been an increase indifference between the values of concrete strength compared with the indicators at the age of 7 days. The decrease in strength of control composition (see table 3) is 21 %. The indicators of compositions 2, 3 and 4 differ by 25, 22 and 29 % respectively.

Analysis of the data of tables 2 and 3 shows that the compositions containing superplasticizers are the strongest influenced by humidity conditions during their storage. For such a decrease in strength of concrete ranges between 22…29 %.

In the second stage of research to study the influence of humidity conditions on hardening concrete was carried out at ambient temperature of +35 ± 2 °C. This temperature is dominant in several regions of the Middle East in the summer times. The individual trial of concrete is stored at a chamber with humidity of 95…98 % at an ambient temperature of +35 ± 2 °C. The results of this study are shown in table 4.

Table 4

The physical and mechanical characteristics of the concrete mixture and concrete

Number of sample	Type of admixtures	Consumption admixtures, %, of the weight of cement	W/C	Mobility, cm	Compressive strength, MPa, at the age of	
					7 days	28 days
1	Without admixtures	–	0.55	4…5	27.8	34.7
2	Superplasticizer C-3	0.6	0.55	20…21	29.1	33.6
3	Superplasticizer CF110 (type F)	0.5	0.52	21…22	31.6	36.2
4	Superplasticizer CF92 (type G)	0.5	0.52	22..23	33.1	38.3

After 7 days storage at a temperature +35 °C, the value of concrete strength with additive C-3 (composition 2) insignificantly more than the value of control composition. At the same time the strength of the compositions 3, 4 are higher by 14 and 19 % respectively.

At the age of 28 days, the growth of strength of control composition equal 25 % with respect to the indicator at the age of 7 days. The strength of composition 4 with superplasticizer CF 92 (type G) is 10 % higher than the indicator of composition 1, and compositions 2, 3 is approached with the value of control composition.

It should be noted that the kinetics strength in compositions with additives is slightly lower than that the control composition. It means that the increase of strength in concrete at the age of 28 days values by 14…18 % with respect to the values at the age of 7 days.

Analysis of the data in tables 1 and 4 allowed to establish a beneficial effect on the kinetics strength when increased the temperature till +35 °C, this indicator corresponds with summer conditions in Beirut and winter in Mecca. At the age of 7 days, the increase of strength in compositions with additives values by 19…30 % higher than those in table 1.

During the tests at the age of 28 days, the greatest effect of increasing the strength concerning 7 days at temperature storage of samples +35 °C is achieved on the concrete with additives CF110 (type F) and CF92 (type G) and values by 20 and 15 % respectively.

Next, we will review the results to determine the strength of the samples stored in water in according to ASTM method. The results of studies on the basic characteristics of concrete mixture and concrete are shown in table 5.

Table 5

The physical and mechanical characteristics of the concrete mixture and concrete

Number of sample	Type of admixtures	Consumption admixtures, %, of the weight of cement	W/C	Mobility, cm	Compressive strength, MPa, at the age of	
					7 days	28 days
1	Without admixtures	–	0.55	4…5	30.5	44.5
2	Superplasticizer C-3	0.6	0.55	19…20	29.8	41
3	Superplasticizer CF110 (type F)	0.5	0.52	19…20	32.8	41.6
4	Superplasticizer CF92 (type G)	0.5	0.52	21…22	36.3	47.9

As a result, storage of samples by the method of ASTM (in water) at a temperature +35 ± 2 °C shows that the strength indicators at the age of 7 days for compositions 1 and 2 virtually identical. At the same time the strength of composition 4 with additives CF92 (type G) exceeds the value of control composition by 19 %.

At the age of 28 days the strength indicators of compositions 2, 3 slightly less by 2.9…3.5 MPa compared with composition 1, and the strength of composition 4 exceeds the control composition by 3.4 MPa. At the same time the strength value of composition with additive CF 92 (type G) is 17 % higher than compositions 2 and 3.

During the study of the kinetics strength of concrete, is noted that the increase of strength in control composition at the age of 28 days is 46 % with respect to the indicator at the age of 7 days. The indicator corresponds to 27…38 % for the compositions that contain additives.

A comparative analysis with the results of table 2 shows that the increase in strength in the compositions in table 5 at the age of 7 days is higher by 12…21 %, and 16…29 % at the age of 28 days.

Thus, storage of samples by ASTM method at a temperature +35 °C can improve the strength characteristics of concrete up to 29 % by depending on the applied additives – superplasticizer.

Considering various humidity conditions of storage (table 4 and 5), it should be noted that at 7 days, the strength of samples which stored in water, is slightly increases by 0.7…3.2 MPa compared with concrete at a relative humidity of 95…98 %.

The essential difference is observed at the age of 28 days. So the strength of control composition 1 is increased by 28 % when stored the sample in water. The strength increases in composition 2 with additive C-3 by 22 %. Strength of compositions 3 and 4 (table 5) exceeds the same compositions in table 4 by 15 and 25 % respectively. Thus, the storage of samples in water influences positively on the kinetics of growth of strength at elevated temperatures.

The next trial of concrete samples stored at a temperature +35 ± 2 °C and humidity 60…65 %, which is similar to the climatic conditions of Beirut in the summer (temperature +32 °C, humidity 55…60 %). Table 6 shows the results of studies on the basic characteristics of concrete mixture and concrete.

Analysis of the strength results at the age of 7 days shows that the control composition and compositions that contain additives insignificantly differ by 0.3…1.6 MPa. The same tendency is observed in 28 days. It is noted a slight increase in strength at the age of 28 days is 8…12 % with respect to the values at the age of 7 days.

Thus, when the humidity is 60…65 %, concrete gains the basic strength during the first 7 days. The inthegrowth of strength significantly slows down.

Table 6

The physical and mechanical characteristics of the concrete mixture and concrete

Number of sample	Type of admixtures	Consumption admixtures, %, of the weight of cement	W/C	Mobility, cm	Compressive strength, MPa, at the age of	
					7 days	28 days
1	Without admixtures	–	0.55	4…5	28.6	31.3
2	Superplasticizer C-3	0.6	0.55	20…21	27.5	30.9
3	Superplasticizer CF110 (type F)	0.5	0.52	21…22	28.9	32.2
4	Superplasticizer CF92 (type G)	0.5	0.52	21…22	30.2	32.7

By comparing the strength values with table 4 is observed insignificant decrease in strength of compositions 2, 4 at the age of 7 days at a humidity of 60…65 %. In the subsequent period of storage before the age of 28 days, increase in strength is more intensive in the compositions 1, 4 (table 4) than in those in table 6. So the increase of strength of control composition 1 in table 4 is 14 %, but in table 6 is 9 %. For composition 3 that contains superplasticizer CF110 (type F) the increase in strength equal 20 % and 11 % respectively, and for the composition 4…16 % and 8 %, i.e. exceeds 2 times.

A comparative data of tables 5 and 6 reveals that at the age of 7 days, the strength of compositions 1 and 2, with a humidity of 60…65 % is respectively lower by 1.9 and 2.3 MPa. However, for compositions 3, 4 these values are more significant and equal 14 and 19 %, respectively.

At the age of 28 days, the strength indicators of compositions in table 5 significantly higher than the values of concrete samples in table 6. For control composition 1, the increase in strength during storage in water is 42 %. The strength of compositions with additives C-3 and CF110 (type F) differs by 33 and 29 %, respectively. The greatest increase in strength of samples which stored in water more than of those that stored under a humidity of 60…65 %, especially in composition 4 which is 46 %. Thus, improper humidity harms the strength of concrete and negatively influences the bearing properties of a construction (the temperature conditions equal to 35 °C and the rate of strength decreases by 40…50 %).

The analysis of tables 3 and 6 revealed that despite the humidity of 60…65 % when stored samples with raising the temperature till +35 °C provides a positive effect on the growth of concrete strength.

So at the age of 7 days, the strength of composition 1 is 24 % higher. The strength for concrete with additives CF110 (type F) and CF92 (type G) increases by 22 and 30 % respectively. The greatest effect in increasing the strength is observed in composition that contains additive C-3 and equal 42 %.

As a result of studies, a considerable influence of humidity on the strength of concrete samples has been observed, it also be noted that the raise of temperature up to 35 °C has a positive effect on the strength indicators.

In some cases, an increase in temperature helps to compensate the negative impact on the strength of concrete during storage samples at low humidity.

Conclusion

According to the results of analysis represented in tables 1–6:

1) when the samples were stored in water in according to ASTM method, the increase in strength is 11…19 % higher than of those that were cured in a special chamber in according to GOST method. Such a tendency is extremely high from 7 to 28 days regardless to the presence of plasticizer additives in concrete;

2) the decrease of humidity from 95…98 % to 60…65 % negatively influences on the modified concrete strength. At the age of 7 days the strength decreases to 13…21 %, and at the age of 28 days – 8…26 %. It is observed that the modified concrete strength at the age of 28 days is 22…29 % lower than that of those were stored in water;

3) raise the temperature to +35 °C positively influences on the samples. So when stored the samples in humid conditions as described GOST the increase of strength at the age of 28 days is 15…20 %, and as described ASTM – 16…29 % compared with the samples stored under a temperature of +20 °C. In spite of low humidity, 60…65 %, the increase of concrete strength is more effective under a temperature +35 °C than under +20 °C, which is 24…42 %;

4) in according to GOST and ASTM, the analysis of climatic characteristics of the Middle East and the storage methods of concrete samples before testing them allowed to determine the range of variation in the parameters of temperature and humidity with maximum approximation to natural of weather in Lebanon, Saudi Arabia and Qatar. It is found that the increase combined of temperature to +35 °C and humidity up to 100 % shows a positive effect on the strength of the modified concrete and concrete without additives. The increase of concrete strength which stored under a temperature of +20 °C and humidity of 60…65 % values from 50 to 80 %;

5) the greatest increase of strength is achieved regardless to the temperature when concrete samples are stored in water, but such conditions of hardening on construction sites in the Middle East countries are possible due to preservation of structural elements in the formwork up to 10…14 days, which entails reduction in the turnover of the formwork and requires the use of larger volumes of formworks for each object under construction, and thus high financial costs for construction;

6) a significant effect of using superplasticizer, allows to increase the motility of modified concrete mixture by 4…5 times, while maintaining the required strength of concrete. Superplasticizers CF110 (type F) and CF92 (type G), according to the results of study of their effect on concrete mixtures and concrete compared to superplasticizer C-3, are more effective and allow to get equally movable mixtures by using fewer additives. Concretes modified by superplasticisers CF110 (type F) and CF92 (type G), shows a less sensitivity with temperature and humidity conditions of hardening and growth of strength compared to concrete that contains additive C-3. At all stages of the study, compositions with additives CF110 (type F) and CF92 (type G) had a higher strength indicators than those without additives and with superplasticizer C-3.

REFERENCES

1. Механизм действия пластификаторов [Электронный ресурс] // Добавки, регулирующие свойства. – Новгород, 2007. – Режим доступа: http:// www.baurum.ru. – Дата доступа: 01.10.2014.
2. Технологический регламент производства разжижителя С-3 / Новомосковский завод органического синтеза. – М., 1981. – 300 с.
3. Technical Data Sheet for Properties of Admixtures / SODAMCO-WEBER COMPANY, P.O. Box. 55–44. – Beirut, 2014. – 2 p.
4. ASTM C 494/C 494M. Standard Specification for Chemical Admixtures for Concrete, ASTM International, West Conshohocken, 1999. – 9 p.
5. Куприянов, Н.Н. Исследование влияние относительной влажности среды при тепловой обработке на формирование структуры и свойства бетона: автореф. дис. ... канд. техн. наук: 05.23.08 / Н.Н. Куприянов. – М., 1974. – 24 с.
6. Добавки для бетонов и строительных растворов. Общие технические условия: ГОСТ 24211-2003. – Взамен ГОСТ 24211-91; Введ. 01.03.2004. – М.: Межгосударств. Стандарт Рос. Федерации, 2004. – 18 с.
7. Whiting, D. Effects of High-Range Water Reducers on Some Properties of Fresh and Hardened concretes, Research and Development Bulletin RD061 / D. Whiting, 1979. – 15 p.
8. Смеси бетонные. Технические условия. Методы определения удобоукладываемости: СТБ 1035-96. – Взамен ГОСТ 10181.1-81; Введ. 01.05.2009. – Минск: Госстандарт Республики Беларусь, 2009. – 17 с.
9. Методы определения прочности на сжатие по контрольным образцам: ГОСТ 10180-90. Бетоны. – Взамен ГОСТ 10180-78; Введ. 01.01.91. – М.: Стройиздат, 1990. – 45 с.
10. Бетоны. Методы определения плотности: ГОСТ 12730.1-78. – Взамен ГОСТ 12730-67; Введ. 01.01.80. – М.: Стройиздат, 1980. – 5 с.

Поступила 05.06.2015

ОСОБЕННОСТИ НАБОРА ПРОЧНОСТИ МОДИФИЦИРОВАННЫМИ БЕТОНАМИ В КЛИМАТИЧЕСКИХ УСЛОВИЯХ СТРАН БЛИЖНЕГО ВОСТОКА

М. ТЛАЙСС; канд. техн. наук, доц. А.А. БАКАТОВИЧ
(Полоцкий государственный университет)

Рассматриваются результаты исследований по установлению влияния климатических факторов стран Ближнего Востока на прочность бетона. Установлено комплексное положительное влияние повышения влажности и температуры на этапе ухода за бетоном на прочность, позволяющее значительно повысить прочность бетона. Эксперименты проводили на бетонах, модифицированных суперпластификаторами на основе сульфированных нафталинформальдегидных соединений, в том числе применяемых и на Ближнем Востоке. Образцы бетона изготавливали, хранили и испытывали согласно действующим нормативным документам на территории Беларуси и по американским стандартам.