THE EVALUATION OF THE IMPLEMENTATION OF IN IN-SITU CONCRETE CHANNELS AND PREFABRICATED CHANNELS IN IRRIGATION AND DRAINAGE NETWORKS

Dariyush Yaghoubvand,
Department of mathematic, central Tehran branch, islamic azad university, Tehran, Iran
ceo@shayganmehr.com

Abstract. Generally, in this research, the cost and timing of implementation of on-site and pre-fabricated concrete channels in the irrigation and drainage network of Abbas Dasht plain in Ilam province have been investigated. Data were collected, based on the study documents, contract documents, records of performance and previous studies. T450 channel and trapezoidal channel with a width of 50CM were selected to be 1.1 slope and 60 cm depth. For estimation of costs, a list of irrigation and drainage prices in 2015 was used. MSP software was used to compare runtime. The results of this research indicate that the operation and maintenance of pre-fabricated canals is more complicated than on-site concrete canals.

Keywords: In-situ concrete channels, pre-fabricated channel, irrigation networks, cost, time, Dasht E-abbas.

Introduction. Prefabricated canals in cases where environmental conditions impede the construction of concrete constructions are used in the form of coatings, such as extreme cold and heat, adverse soil conditions, and time constraints on the site of irrigation networks. The technology of making this channel has first arrived in Turkey, but the current construction and exploitation have also benefited from the experiences of other countries.

The use of new materials and methods of construction, including tools for improving the construction and installation of channals. Prefabricated concrete channels are one of the options for building grade 3 irrigation networks, due to industrialization of higher quality construction than concrete conduits. The high speed of construction and installation, longer lifespan and better quality than the on-site canal have had acceptable performance in irrigation networks. Concrete shafts, reinforced concrete, RC concrete saddles, and half concrete pipes are components of the canal and all of them are made in the factory (Ashkelak et al., 2015).

One of the ways to prevent casualties is through the principled and scientific implementation of irrigation networks and increasing the transmission efficiency. For this purpose, it seems necessary to evaluate the work done on the networks and identify the weaknesses and vulnerabilities. The implementation of irrigation network projects in our country has a history of 50 years. Concrete canals since 1961 and prefabricated channels have been used in our country since 1986. In concrete channels, there is the occurrence, collapse and destruction of concrete coating (lining) due to the geotechnical conditions of a single channel bedding bed, which is mainly due to liquefaction, solubility, erosion, and the effect of salts in water such as sulfate, chlorine and carbonate, and also Inappropriate use and maintenance of the irrigation network and the presence of elements such as gypsum, due to the ability of water and sodium to dissolve in order to create divergence in the icing of the canal, in the long run cause the destruction and destruction of the concrete in the canal (Attari et al. , 2013).

However, there are no such problems in the prefabricated concrete channels mounted on the base, because the channel is not directly contacted by the soil. Since the prefabricated parts of the canal are produced in the workshop, it is possible to produce these channels in all seasons. Therefore, the climatic factors and the specific conditions of concrete in the soil will not exist in the canal, and it is easy to control the process of concrete production and to adapt the desired variation depending on the need for the construction of the channel (Islani et al., 2007). Due to the challenges in the country, the evaluation of the performance of in-situ and prefabricated canals in irrigation and drainage networks is the goal of this study.

Materials and Methods. In this study, library and documentary research methods have been used and the main sources used are reference books specialized in the field of study subject and development collections, a set of laws and regulations and scientific articles published in specialized journals about irrigation is drainage. The method of collecting information according to the research methodology by referring to sources and scientific sources including books, magazines and periodicals in libraries, documents and indexes of the price, etc. Also, databases containing valid scientific papers and articles information required for research will be collected. It should be noted that one of the most important limitations in the field of compilation of research is the lack of sufficient resources available to the researcher. For data collection, the Fisher's Tool and the vector-based fingerprinting technique have been used by scientific method and documenting. After collecting information by vector check, the folds are classified according to the title, the subject matter and the chapters of the research, and the information and contents are presented in different sections. Data analysis is done descriptively and analytically.

The studied area (Dasht E-abbas) is located in Ilam, which is one of the important agricultural poles in Khuzestan province. Dasht E-abbas is located in the southwestern part of Iran between the north latitude of 32 ° 15 to 32 ° 30 'and the eastern longitude is 40 ° -47 ° -10 °. This plain is located in the watershed of the Karkheh River in the province of Ilam. The net area is 16,450 hectares.

In this research, according to the type and method of construction of gravel irrigation sub-networks, which are predominantly in the country in two types of concrete channels, to compare these two methods in the design of the Dasht E-abbas, with regard to the strategic location of this area, the evaluatation of speed and cost of running these two methods will be addressed. In the first phase of the research, frequent visits to the Irrigation network of Dasht E-abbas began. At this stage, renal all grade III canals were visited in irrigation network.

Due to the fact that the second phase of the main Irrigation and drainage network of Dasht E-abbas has been around 10 years ago, the contractor's co-contractor is required to provide the design basics. Accordingly, the plan of cultivation in the area of the plan and the proper irrigation method Select and recommend.

Also, the contractor's consultant should review the necessity of constructing groundwater drainage within the scope of the project based on the results of existing layering and drainage studies and present the results to the consultant of the employer in the drainage report.

Reporting the design and drainage reports for the lands of the project area should be provided to the consultant of the employer one and a half months after the start of studies based on the results of the new studies. It is worth mentioning that these studies are considered as engineering services, and the cost of doing it is the responsibility of the contractor and no additional costs will be paid for it.

Results and Discussion. For the construction of the secondary channel network (grade 3), priority is given to three of the prefabricated concrete channels with semi-elliptical section, which should be constructed by the contractor in accordance with the technical specifications and the control of the canals adopted in December 1996 by the Ministry of Agriculture's General Directorate for Agricultural Engineering. The contractor is also required to maintain, load, transport, land and install canals in accordance with the technical specifications above. The channels required for the execution of irrigation grade 3 channels and all its components must be provided from the approved site of the employer's or employer's consultancy and the contractor is responsible for the cost. Prefabricated cannates with a semi-oval section are made in different sizes and sizes and are classified according to the discharge capacity. Prefabricated canals are produced in different types from type 230 to type 600.

• **Channels**

The channels are arranged with semi-elliptical cross-sections starting at 100, and produced in different types. The length of each piece of canal is usually 5 meters and its thickness is about 5 cm.

• **Saddles**

The saddles act as an extension of the canal and involve seams of expansion. These pieces are of a reinforced concrete type and are responsible for providing sealing between the two canals in the two adjacent openings. Condensation can be sealed in different ways, such as the use of rubber strips, scraps, and more. In this project rubber band (1 cm in diameter) is used to seal the canals.

• **Pier**

The base duty is to provide the required height of the canal and also the transfer of forces to the pylon. The height of the bases is from 0.25 meters to 2 meters and is produced in a range of 25 cm. This piece is of reinforced concrete type.

• Beds (footing)

Lounges are used to provide base support and transfer of forces to the bed (in proportion to the load capacity of the soil). This piece of non-reinforced concrete is produced in two types of integrated and separate (end and middle beds).

The height of the bases was obtained based on the height difference between the digits of soil surface after harvesting and the bottom of the soil in the channels. The types of channels introduced in the contract documents for production and installation are preliminary and preliminary aspects and solely for the estimation of costs. During the execution of the operation, it may be necessary, in accordance with the design requirements arising from the principles and rules for designing irrigation grade 3 irrigation channels within the scope of the implementation of the irrigation sub-network and drainage, amount or type of prefabricated canals and related accessories. The subject of the contract is based on the detailed design drawings of the contractor's engineering services office, which requires the provision of appropriate canals and related accessories after the approval of the employer or the consultant of the employer. In this case, the contractor undertakes to carry out the operation of the contract on the basis of a new order according to the declared technical specifications. Obviously, this will be in accordance with the terms of the general terms of the treaty.

The mapping of the route and the channel band and the road of the service should be carefully and after the preparation and notification of the workshop plan, the route of installation of the channels and the execution of all other operations, according to the plans of the workshop, are carefully implemented and the route and the road of the service are captured and detection operations are carried out at a depth of 10-15 cm, as well as bed leveling. Then the excavation of the road before or simultaneously with the drilling operations of the place of the beds, concrete under the beds and the installation of the booths are carefully observed in terms of the distance of 5 meters' channels and the installation digits. The precision at 5 meters' intervals for canals and the number of beds in the beds, as well as the accuracy of the length and location of intakes and other structures is very necessary. Because the inaccuracy of the installation and distances will be less than 5 meters apart, due to the lack of a cantilelet smaller than 5 meters, and changes beyond the normal floor of the canal, there will be problems. Changing the bottom of each canal to the next canal is up to 2 mm. The installation of the base, saddles, and then canals is done using the appropriate machineries.

All parts of the channels and its component parts and other equipment must be well prepared so that they can be easily downloaded, stolen, moved and carried within the workshop. The precautionary measures necessary to prevent damage to them during loading, transportation, discharging and disposing are obligatory and the responsibility for compensating the damages incurred by the contractor.

The contractor is required to use an experienced installer team to install and operate the relevant canals and accessories. This group should be fully integrated in all areas of installation, commissioning, operation and maintenance of canals. Contractor before installing the equipment, all concrete works of the first stage of the installation of the beds and the base and the saddles should be monitored for correct performance. During the loading and installation of the channels in the second stage, the necessary controls are also required. The correctness of the lines, the vertical alignment of the saddles, the parallelism of the lines of the equipment, the horizontal position of the two sides of the saddle, the maintenance of the distance between the shoe and saddle, the co-centrality of the canals and appliances, etc should also be confirmed by the unit of quality control and supervision of the contractor and the consultant of the employer.

In addition to the above mentioned technical issues, the following are required by the contractor to observe the quality items in materials and equipment:

- To investigate the absence of corrosion, seam and cracks on concrete surfaces, including canals, saddles and shafts
- To perform concrete strength tests during concreting, and then include concrete failure, longitudinal and lateral loading
- conduct canal leakage test
- To ensure complete concrete reinforcement of the reinforcement in canals and saddles
- To carry out tests for rubber seals

Important note:

The contractor is required to control the production of canals when they receive it.

- The channels are kept at least 4 days in the water pond.
- The interval from production to loading is at least 8 days.
- The lack of use of concrete components that have been under construction for less than 8 days.

In the area of the implementation of the irrigation and drainage substation network, according to the requirements of the design due to the principles and rules of designing the channels, the implementation of a section or a number of irrigation grade 3 channels by the construction of concrete channels in situ is inevitable, in this case the implementation of this type of channel is as followed.

The construction of grade 3 concrete channels includes cleaning and preparation of channel`s beds and paths, determining the location of excavation and excavation points, selecting a mine, selecting the location of extra soil extraction, transferring soil from excavation to the discharge point, stacking sites, bedding stripping, moving soil from drainage and gravel landing, distributing soil in the channel paths, then mixing soil and water and knocking the soil layer in certain thicknesses and eventually implementing the profile of the transverse and longitudinal channels according to the executive drafts of the contract and the unit orders quality monitoring and control with maximum tolerance, in accordance with the terms of the contract, the concrete is to be put into concrete and the thickness of 8 cm in total channel length. The thickness of landings should not exceed 15 cm after being plowed. The suitability of the soil for the location of the loan must be confirmed by the quality monitoring and control unit prior to transport to the embankment. The length and characteristics of the canals will be specified in the detailed drawings, which will be designed by the contractor engineering services unit.

The preparation of concrete and cement materials used to construct concrete canopies of the channels is included in the terms of the contract and the contractor is obliged to observe them precisely. Any type of concrete should be constructed by mechanical mixing machines or a central machine of concrete and transported by appropriate means to the site of concrete. (All this equipment before the construction of the concrete must be certified by the written supervision unit and quality control). Concreting (concrete) linings can be done by hand, and the use of additional and specific materials in concrete can only be authorized by the approval and approval of the quality control and quality control unit and the consultant of the employer. The concrete mixing plan before the concrete operation is approved by the laboratory approved by the consultant of the employer and the contractor is committed to complying with the aforementioned mixing. Contractor is committed to transfer sufficient samples of concrete materials (sand, sand, water and cement) to the place of borrowing and the place of extraction for 28 days before concrete laying, and to carry out the best concrete mixing test to the laboratory approved by the consultant of the employer, the contractor is committed. Which provided concrete with all the specifications and conditions stipulated in this contract, such as maximum slam, minimum sprays, observance of stone aggregates, quality of stone materials, chemical resistance.

Hydraulically, the shape of the semi-oval channel is the best shape for moving the water flow in the canal. This section is such that changes in flow velocity do not occur due to decreasing flow rate and flow depth, as the flow rate decreases with decreasing flow, but in the inlets with trapezoidal cross section with decreasing flow rate and depth of cross-sectional flow Proportion does not decrease, so the velocity decreases more. Therefore, due to the higher flow rate at least in the prefabricated canal, the possibility of sedimentation in the prefabricated canal is less than the inlet channel. In other words, in the prefabricated canals, a smaller cross-section can cross the same current in the inlet channel.

Table (4-1) Hydraulic Optimal Specifications

عمق هیدرولیکی (D)	عرض سطح آزاد (T)	شعاع هیدرولیکی (R)	محیط ترشده (P)	سطح مقطع جریان (A)	نوع کانال
$3/4\,y$	$4\frac{\sqrt{3}}{3}y$	$y/2$	$2\sqrt{3}$	$\sqrt{3}y^2$	ذوزنقه‌ای
y	$2y$	$y/2$	$4y$	$2y^2$	مستطیلی
$y/2$	$2y$	$\frac{\sqrt{2}}{4}y$	$2\sqrt{2}y$	y^2	مثلثی
$\frac{\pi}{4}y$	$2y$	$y/2$	πy	$\frac{\pi}{2}y^2$	نیم‌دایره‌ای
$2/3\,y$	$2\sqrt{2}y$	$y/2$	$\frac{8}{3}\sqrt{2}y$	$\frac{4}{3}\sqrt{2}y^2$	سهموی

In drainage project of Dasht E-abbas of Ilam province, two sections were used to build channel in the field; one trapezoidal section with a floor width of 30, 0.45 and 0.5 m and an average height of 0.6 m with a body slope of 1.1, and the other half-ellipse, introduced as bridges of 315, 450, and 600. With the above specification for the inlet channel and taking into account the normal depth of water at an average of 0.44, we can calculate the mean contact surface water flow with open air (evaporation) in canals in the trapezoidal section, 1 square meter per unit length.
In the channel discussion, among the three existing brigades, the 450 brigade, which is close to the width of the floor of 0.5 in the trapezoidal channel, is considered as the medium type. By calculating the average water flow depth of 0.42 m, the average contact surface water flow in open air is at 0.58 square meters per unit length. The half-oval canal has a wetted environment less than the canal in the trapezoidal area. As a result, it will be more water efficient and more efficient in terms of water transfer efficiency.

As can be seen, by comparing the water evaporation level in the inlet channel, it can be concluded that this value is greater for a trapezoid section of 45 centimeters, and this higher level causes more water to evaporate from the surface of the canal and, consequently, wasting more water flow is semi-elliptical relative to the canal. Thus, it can be argued, in confirmation of the words of the professors and the hydraulic books, that the semi-ellipsoid section, which is prefabricated, has optimal hydraulic properties than the trapezoidal section. Also, due to the higher flow velocity in the pre-fabricated channel, the possibility of sedimentation in this type of channel is less than that of the channel. In other words, in pre-made channel, a smaller thread can cross the same channel in the channel. In order to prove the best hydraulic cross section, the intersection of the canal with trapezoidal section and pre-made cantilelet with semi-elliptical cross section should compare different hydraulic parameters such as depth and flow velocity in different flow rates. This work has been done by channel design and canal design software in different disks, as outlined in the table below.

Table (2-4) Design of channels with different flow rates

The half-oval channels											
0/04	0/06	0/08	0/10	0/12	0/14	0/16	0/18	0/20	0/22	0/24	Debi m^3/s
0/23	0/29	0/34	0/39	0/42	0/46	0/49	0/53	0/56	0/59	0/62	Depth of flow m
0/35	0/38	0/41	0/44	0/45	0/47	0/49	0/51	0/52	0/53	0/55	Flow rate m/s

Table (4-3) Design of Channel in Place with Different Flow

Trapezoidal channel											
0/04	0/06	0/08	0/10	0/12	0/14	0/16	0/18	0/20	0/22	0/24	Debi m^3/s
0/2	0/24	0/27	0/31	0/34	0/37	0/39	0/41	0/43	0/45	0/47	Depth of flow m
0/31	0/35	0/37	0/4	0/42	0/43	0/45	0/46	0/48	0/49	0/5	Flow rate m/s

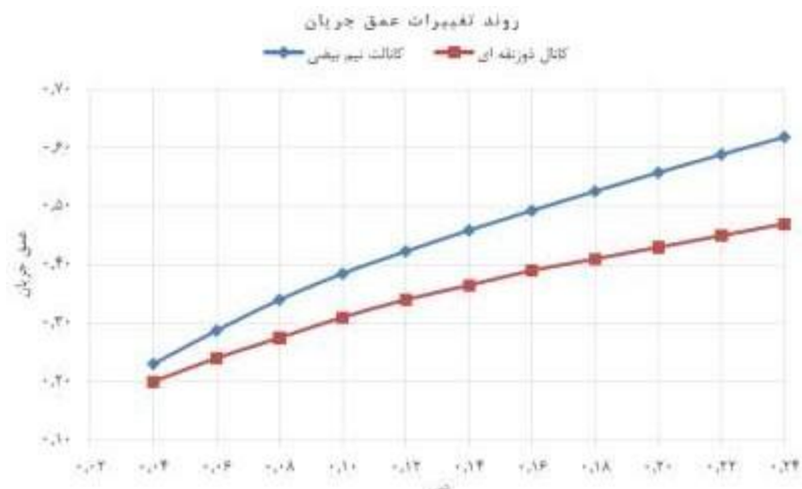

Figure (1-4) Comparison curve of the flow rate changes in different flow rates

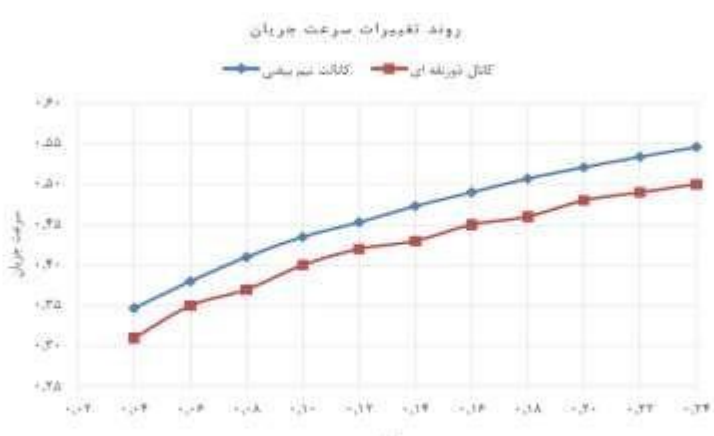

Fig. 2-4. Curve Comparison of Flow Rate Flow Processes in Different Fluxes

Conclusion

- Reducing the time of implementation of the project is noticeable in the semi-pre-fabricated canal channels relative to the channel at the site of 12.9%.
- The speed and quality of construction of semi-prefabricated concrete canal pipes is very high due to the high concentration of construction and the level of error in executive operations is low.
- Implementing a meter-long channel as a prefabricated concrete channel is economically fewer than 8.5% less than the construction of in-situ concrete canals.
- The volume of soil operations in the channel is much higher than the canal, about 42%, which is why its environmental hazards are higher.
- Reducing project execution time and reducing operational costs significantly in pre-fabricated semi-prefabricated canal channels relative to on-site channels.
- In relatively unusual soils of Ilam (Dasht E-abbas), which has divergent property, swelling and the presence of sand layers, the performance of the channel is inferior to the channel, and the reason is the construction of this type of channel deep in the ground and in direct proximity with soil layers. However, the construction of prefabricated channel on the base and the saddle and at a certain distance from the ground surface makes it impossible for the canal body to adhere to these types of soils.
- In the implementation of on-site channels, for each meter, 3,10 cubic meters of soil is needed, meaning that for 90 km of the canal, something about 93 hectares of land should be digested for the construction of a canal, and be converted into a loan. If this number is only about 20 hectares for the prefabricated canal.
- Also, the fact that 70% of the production and operations of the canals are carried out at the factory and in a centralized manner has led to a decrease of 9.9% in the time the project runs in the channel discussion.

References

1. Islami S, Gohari A., Zarean M.J. 1386. "Examination of advantages and disadvantages of using pre-fabricated canals in construction of irrigation networks grade 3 and 4 in Isfahan". Second National Conference on the Construction of Water Installations and Drainage Irrigation Networks, University of Tehran, Faculty of Water and Soil Engineering. November 1-2, 2007.
2. Omidvar Shakilak, Habibi M, Rostami M. 1394. "Investigating Canal Performance in Irrigation Networks and Providing Solutions to Reduce Construction and Operation Problems". 10th International Congress on Civil Engineering, Faculty of Civil Engineering, Tabriz. May 15-17, 1394.
3. Salavat 1373. Methods for Increasing the Efficiency and Productivity of Existing Networks, Proceedings of the Seventh Seminar of the National Irrigation and Drainage Committee, Kerman.
4. Attari M, Smart As, Qamshi M. 1392. "Evaluation of the performance of in situ and prefabricated concrete ducts in irrigation and drainage networks, Shooshtar Daryun 2 & 3 drainage study." Fourth National Conference on Irrigation and Drainage Networks, Shahid Chamran Water Science Engineering Faculty, Ahvaz, March 6-8, 2013.
5. Forozan M, Ma'ranani M. 1998 Comparison of prefabricated and in-situ channels in the irrigation and drainage network of Tajan. Article. National Committee for Irrigation and Drainage, p. 10.
6. Qizilbash M. 1393. "Implementation of the canal (half pipe) at the irrigation and drainage workshop".
7. It's yours. 1387. Problems of irrigation channels of Das network from the point of view of exploitation, maintenance and cultural issues. The 2nd National Conference on Irrigation and Drainage Management. P. 7
8. Mahrani M. 1378. "Advantages of using value engineering technology in the executive plan of irrigation and drainage network of the 4th Tajan", collection of articles of the first national seminar of the value engineer, No. 25. Pages 7-9.