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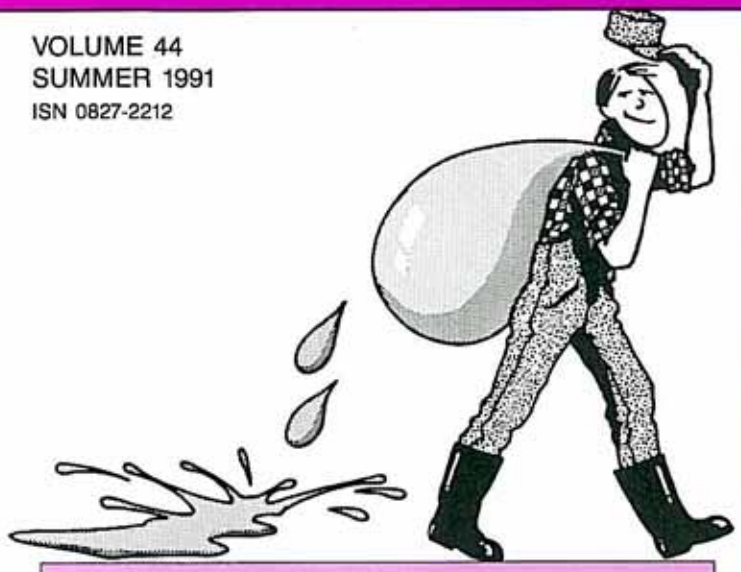

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PRECAST STRUCTURES

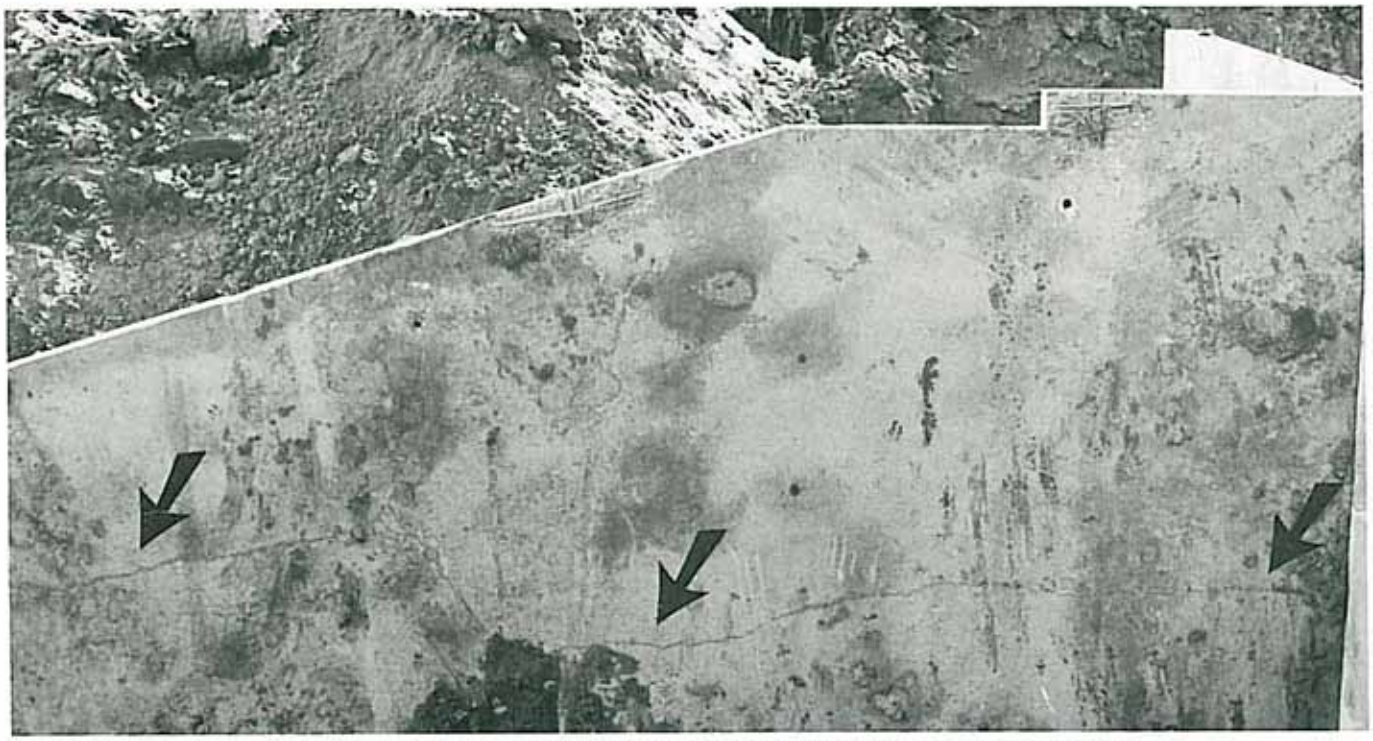
District Engineer Warns of Possible Problems

Precast structures got their start some 35 years ago in answer to the demand for a more cost effective structure that could be manufactured in the winter, says Ron Renwick, district engineer, St. Mary River Irrigation District. This only involved small structures such as turnouts. The structures were comprised of panels that were simple and light enough so they could be assembled using small machinery. Some enterprising engineer devised the waffle panel so that structure size could be increased while keeping weight to a minimum without sacrificing strength. Hence the race to bigger precast structures began.

Entrepreneurs soon realized the market potential and established precast structure manufacturing facilities. Regrettably, concrete specifications were overlooked in the process and controls were much more lax for precast structures than for cast-in-place structures. This was unfortunate because with the substantial cost savings offered by precast structures there was no reason to cut corners on inspections or specifications. These problems have been largely corrected, however irrigation districts are left with some substandard structures, he says.

Next, says Renwick, came the advent of one or two piece structures, a real credit to the precast firms and design engineers as larger more complex structures became practical. Furthermore, installation contractors have acquired large equipment and now even rent cranes to install the larger structures.

Large Precast Check-Drop Structure being assembled in polyethylene lined lateral.



Arrows point to horizontal crack in large 5500 kg panel. Note: Missing lifting hooks that broke away during placement.

As this was happening, two very important components of structure design appear to have been lost: cutoff and filter drainage systems. Again these principles are thoroughly considered with cast-in-place structures but not with precast structures. A means of accommodating the filter system can occur if the base for precast structures is stabilized with granular material. If done properly this can serve as a filter system. This is sensible, because the loss of horizontal cutoff is far outweighed by the addition of a filter system. At any rate, all precast structures should be installed with an adequate cutoff and filter system, says Renwick.

The transport and assembly of large precast structures presents another series of problems. Manufacturers are often facing tight deadlines and attempt to lift "green" panels at the plant with resulting cracking. Transportation can cause further cracking as large panels just can't stand the rigors of transport. Slenderness ratios are sometimes exceeded, further aggravating the problem. Additionally, if a 50 year structure life is required, 150 mm thickness is recommended.

Assembly produces more problems, says Renwick. "Installation contractors often damage components due to rough handling. Also, designers rely on fastening devices to compress sealants to form a water-tight joint and often the fasteners just aren't adequate to achieve this. Further aggravating the situation are bolt holes which don't line up. The solution is to bend bolts so they do fit or drill new holes with resulting damage to both the bolts and concrete. The holes can be filled but it does introduce potential for leakage or seepage. Large precast structures can be vulnerable to frost action which may open joints and develop seepage paths. More robust fasteners are required to counter this. Spreader bars and/or brace cables are required on larger structures. Even the smallest crack or hole can introduce substantial seepage with dire consequences, especially when driven by a head of water," adds Renwick.

Designers routinely use Lane's weighted creep ratio to analyze seepage paths. While it may be proper to apply this method to structures, it was developed many years ago for structures through dams involving materials significantly different than those used for precast structures. Precast structure seepage patterns can become very different than those considered by Lane and careful judgement is required when adapting the Lane method. Furthermore, once seepage paths establish through joints or holes, any upstream cutoff is negated. One method of guarding against seepage involves lining the upstream channel and adequately attaching the lining to the structure. This affords a good factor of safety at minimal cost, contends Renwick.

While precast structure development has progressed to admirable levels and resulted in significant cost savings to irrigation districts, engineers would do well to give the preceding careful consideration. Furthermore, concludes Renwick, anyone considering a precast structure having a capacity nearing 3 m^3/s or larger, or a structure with a 2-3 m drop, should be extremely careful.

For more information please contact Ron Renwick, District Engineer, St. Mary River Irrigation District, P. O. Box 278, Lethbridge, Alberta T1J 3Y7. Telephone (403) 328-4401.■

646 FLEXIBLE CONCRETE

Test Results Inconclusive

Mention the word concrete and not many people think of flexibility. Yet, in the spring of 1990, HFM Systems Ltd. of Vancouver tested their "646 Chemcrete Flexible Concrete" as a repair product for cracks in concrete slip-form lined canals in southern Alberta. Their 646 Chemcrete Flexible Concrete was developed in Austria and is used extensively in the Vancouver area for water-proofing holding tanks and swimming pools. The product's advantages are: its adhesion to existing concrete, flexibility and it can be applied to a surface that is damp. Its one disadvantage is, it should not be applied below 4°C.

Chemcrete 646 is an acrylic that uses cement to start the polymerization process. This gives a very flexible membrane that can be mixed with varying quantities of aggregates to give different wearing surfaces and varying degrees of elasticity from 300% to 40%. The product is shipped in two parts which are mixed on site. For greater tensile strength, a small amount of glass fibre can be added. The Bow River Irrigation District (BRID) and the St. Mary River Irrigation District (SMRID) agreed to let HFM Systems Ltd. test the product in their concrete lined canals.

The BRID selected two sites several miles apart. The cracks ranged in size from hairline to several millimetres wide. All cracks were sandblasted and then repaired. Before the mix was applied, 50 mm wide plastic tape was laid over the cracks to act as a "bond breaker", says Svat Jonas, P. Eng., research engineer, irrigation branch. "Next the primer was applied and as soon as it began to dry, the mix was spread by hand trowel. The thickness of the layer was approximately 2 mm," he adds.

The SMRID selected approximately 15 m of concrete lined lateral, several miles south of the Agriculture Centre in Lethbridge. In this reach the whole cross section of the lateral was covered with the flexible concrete. The same technique of application was used as in the BRID. The cross section was a typical concrete lined ditch, 0.6 m at the bottom, 0.6 m deep with 1:1.5 side slope.
"During the application of the flexible concrete," says Jonas "ten samples were made simultaneously in order to test elongation properties of the material." The tests were performed by the Alberta Farm Machinery Research Centre. Results indicate that elongation varied to a great degree from sample to sample. The uneven thickness of the sample was most likely one of the main reasons,

Svat Jonas demonstrates flexibility of concrete.

says Jonas. The smallest elongation before the first rupture occurred was 5% with a load of 340 kg (750 lb.). The largest elongation was 17% with a load of 295 kg (650 lb.), he adds.

The first hairline cracks began to appear on some patches of flexible concrete in the BRID several days after its installation. Two months later, inspection revealed that some patches of the flexible concrete had partially peeled off, and wider cracks were observed on the other repaired cracks. This damage was observed at both locations, says Jonas. HFM Systems Ltd. felt that the rain and snow showers, together with relatively low air temperatures (3°C) a couple hours after the installation, caused these failures.

The SMRID site was also inspected on a regular basis. No changes were detected until in the spring of 1991 when a hairline crack, several feet long, appeared at the bottom of the ditch.

In conclusion, says Jonas, the material deserves another chance. He recommends using it without the glass fibres to make it more flexible. Before installation, he feels more attention should be given to the condition of the concrete lining itself to ensure it is even repairable. He also feels that the weather conditions should be monitored more closely before the project starts and no attempts should be made to use the product during rainy and cold weather.

For more information please contact Svat Jonas, P. Eng., Research Engineer, Irrigation Branch, Alberta Agriculture, Agriculture Centre, Lethbridge, Alberta T1J 4C7. Telephone (403) 381-5870. ■

ENVIRONMENTAL SUSTAINABILITY INITIATIVE EXAMINES AGRICHEMICALS IN WATER

Public concern and awareness of water quality issues has increased in the past decade and has resulted in a closer scrutiny of agricultural practices and chemical use. Water quality is of particular concern in the irrigated regions of Alberta because of intensive use of water, fertilizers and pesticides. Very little information is available on the effects of agricultural practices, water quality and the environment in Alberta.

To address the above concerns a joint research study between Agriculture Canada and Alberta Agriculture has been initiated to examine the impact of agricultural management practices on water quality. The study includes five integrated projects which are monitoring for herbicides, nutrients (nitrogen and phosphorus) and trace elements in the soil, groundwater and surface water. Funding for the study is provided from special funds allocated to the research branch of Agriculture Canada through the Federal Government's Environmental Sustainability Initiative.

The maximum permissible concentration of herbicides in drinking water is usually 100 micrograms or less per litre. However, the presence of herbicides in surface and groundwater in any amount is largely unacceptable to the public. Herbicides have been detected in groundwater and/or surface waters in Europe, the United States and central and eastern Canada. In a Saskatchewan study herbicides were found in tail water from a flood-irrigated field. In general, herbicide use on irrigated lands in Alberta is relatively low and to date, there is no evidence of herbicide detection in groundwater under irrigated lands in Alberta.

Four of the five studies being carried out by Agriculture Canada and Alberta Agriculture are monitoring for herbicides. One project is looking at herbicide leaching to groundwater, a second is monitoring herbicide losses in tailwater from surface irrigation, a third is monitoring herbicide levels in the soil under conventional and zero tillage management, and the fourth study is evaluating herbicide concentrations in drainage effluent.

The present upper limit for nitrate in drinking water is 10 milligrams per litre. The drinking water limit for phosphorous is 0.2 milligrams per litre, which was set to reduce taste and odour problems with phosphorous

Herbicide being applied to crop.

rather than for health reasons. Nitrogen and phosphorous are the two most common plant nutrients which are linked to agricultural contamination of surface and groundwaters. Both nutrients are applied to the soil through the use of fertilizers, application of manure and decomposition of plant residues. Phosphorous is relatively immobile in the soil and surface water contamination from surface runoff from agricultural fields is the main concern.

Extensive areas of nitrate contaminated groundwater occur in the United States, Europe and central Canada, and are usually associated with high production areas where fertilizer and manure inputs to the land are high. A previous study by Agriculture Canada in Lethbridge has shown that application of manure to land at the recommended maximum rates can result in significant losses of nitrate to groundwater under both irrigated and dryland practices. One of the five studies being undertaken by Agriculture Canada and Alberta Agriculture is examining nitrate leaching under manured fields.

Trace elements such as molybdenum (Mo), cobalt (Co), copper (Cu), zinc (Zn), selenium (Se), and manganese (Mn) are essential to plant and animal nutrition but these elements may accumulate in soil and/or groundwater with resultant toxic effects. Plants can preferentially accumulate Mo, Se and Co and these are potentially toxic to the plant and/or livestock grazing on the plant. Low levels of Zn and Cu are particularly toxic to aquatic species. Drinking water has a distasteful flavour when excess concentrations of Cu, Zn, Mn and Fe (iron) are present.

Trace element contamination of soil and waters is usually associated with industrial processes and by-products (eg. sewage sludge) but many of these elements may be added to the soil through agricultural practices. Sources

include the application of fertilizers (in particular phosphate fertilizers), manure, pesticides and in some regions in irrigation water. One of the five studies is looking at trace element leaching under manured fields.

Results of these integrated studies should indicate whether or not contamination of soil, groundwater or surface water with herbicides, nutrients or trace elements is occurring under irrigation/dryland agricultural management in southern Alberta. Findings will be used to direct further research into sustainable agricultural systems and identify water quality monitoring needs.

For more information contact Dr. Jim Miller of Agriculture Canada at (403) 327-4561 or Gary Buckland of Alberta Agriculture at (403) 381-5882. ■

Manuring field.

IRRIGATION IN ALBERTA

Facts & Impacts

. . .the number of acres under irrigation in Alberta is equal to 95% of the area of Prince Edward Island.

FROM THE FARM PERSPECTIVE

Long-Range Planning Involves District Water Managers, Water Users and the Public

In many respects, irrigation districts are at a crossroads as they look to their future operations. The demands for improved water management combined with limited supplies, the cost of operation combined with a depressed agricultural economy and an increasing emphasis on self-reliance all mean that now, more than ever, long-range planning is critical to the future success of these districts. This is certainly the case for the Western Irrigation District (WID).

Water users and the general public were given the opportunity to gain an appreciation for the issues and concerns facing the WID during a series of information meetings held last fall. The meetings were held in five locations throughout the district. They obtained water users and public opinions with respect to the direction of future developments to be undertaken by the WID. Approximately 350 rate payers and interested members of the public attended.

The information package presented at the meetings included the summary of a report entitled Western Irrigation District: Strategic Plan To The Year 2000 and Beyond, commissioned by the WID. This study was completed in the fall of 1989 by a consortium of consulting companies including: Deloitte Haskins & Sells, UMA Engineering Ltd. and Monenco. The scenarios presented were the basis for much of the discussion.

The study looked at several questions facing the board of directors and staff of the district. Considerations included rehabilitation, expansion, water rates, financial viability and other issues. The options considered included rehabilitation to a level capable of supporting delivery to 95,000 acres and options that would support an increased acreage requiring reservoir development.

Substantial rate increases were identified as being necessary in order to achieve reasonable levels of rehabilitation. Water rates for permanent acres have already increased from $8/acre in 1989 when the study was completed to $13/acre for the 1991 season. The rates are now comparable to those of several other districts in Alberta.

The increases were a concern for most producers, as expressed at the public meetings last fall. Combined with another increase this year, the new rates have focussed the need for rate payers presently on the assessment role to utilize the water rights currently available to them or make the decision to request their rights be cancelled.

As the district is approaching its limits on total water available, it is desirable to identify areas in which development could be intensified. The distribution system consists of over 1100 kilometres of canals.

Participants at the public meetings were asked to express their views on future development. In response, 90 applications were received to add, transfer or remove acres from the assessment role. The district will consider adding up to 9000 acres within a five-year period. There were also requests to remove 2800 acres from the assessment role.

The results of the study, combined with the response from the public at these meetings, will assist the board and district staff in: long-term planning for canal rehabilitation, targeting areas where interest in development is highest and addressing areas of concern.

During these meetings other issues discussed included: wildlife, recreation opportunities and regional water supply. The district is a major water source for the livestock producers. It also supplies water to several communities and is a domestic supply for a large number of farms.

During a period of low commodity prices and rising production costs, the decision by a producer to invest in the future by developing an irrigation project is not an easy one. A long-term plan for the future direction of the district is required through the consultation with the producers affected. The WID has taken a step in establishing that plan by involving the public at the meetings held to date. Craig Gordon, manager for the Western Irrigation District, considered the results "a positive response for the first request for information concerning future development."

For more information please contact Clarence Vos, Irrigation Specialist, Alberta Agriculture, P.O. Box 607, Strathmore, Alberta T0J 3H0. ■

TREE FARMING IN THE EASTERN IRRIGATION DISTRICT

Board Commits To Nurseries

A sure indication that irrigation water is available is the presence of trees and shrubs growing in obvious contrast to a surrounding treeless prairie. Some of these shrubs and trees grew naturally as seeds floated downstream and became established, however most were planted. Much of the recreation within the Eastern Irrigation District (EID) is based on irrigation canals and impoundments and these early tree plantings. Many species of wildlife in the area depend on trees and shrubs for winter habitat. The value and importance of trees in the district to people and wildlife alike cannot be overlooked.

This important fact was recognized in the earliest district records like the Annual Report of Operations and Maintenance 1918 which states:

> "In order to encourage the setting out of farm plantations, the policy of supplying trees free of charge to settlers on irrigable lands, was continued this year. As in 1916 and 1917 a canvass was made of the various settlements and lists prepared of the number and variety of tree desired by each farmer, who had land prepared for tree planting. The varieties from which selections could be made were Willow, Maple, Cotton-wood, Russian Poplar, Ash, Tamarac, Spruce and Caragana, and the points to which shipments were made were Bassano, Brooks, and Duchess."

District foresight years ago to plant trees — makes family camping today a pleasure.

The 1922 Annual Report states that while total figures are not available the following number of trees were supplied by the irrigation investigation branch of the Canadian Pacific Railroad:

Willows	56,800
Poplars	28,000
Maples	1,700

Other sources of supply were the Dominion Government Nurseries at Indian Head, Wolsley and the Brooks Nursery.

The district made a commitment in 1990, says Sandy Rankin, E.I.D. special project coordinator, to return to the policy of rearing trees in nurseries. When large enough, they will be transplanted to district lands adjacent to the banks of selected canals, and the shorelines of reservoirs. The purpose being to increase wildlife habitat and the esthetic appeal of the property. Two very large areas that come to his mind are the shorelines of Lake Newell reservoir and the Crawling Valley reservoir. There are many other smaller reservoirs and wetlands that would be enhanced by the planting of trees and shrubs, he adds.

In June of 1990, a modest start was made by Rankin, on three acres of land at the Rosemary Ditchrider Reservation when some 2,500 seedlings became available to them from the Alberta Agriculture Nursery at Fort Saskatchewan.

A used single-tower pivot with a 20 hp diesel pump was purchased for irrigating the nursery.

The seedlings were planted at one metre intervals in rows spaced three metres apart. This spacing will facilitate cultivation for weed control and leave room to remove them at a later date.

A site has been selected for an even larger project, says Rankin. The site, four miles south of the Town of Brooks, is close to the Aqueduct Ditchrider Reservation, on what is now a grazing lease. The area of planting will be approximately nine acres with 80 rows 152 metres long with 150 trees at one metre spacings for a total of 12,000 trees and shrubs.

A trickle irrigation system will be installed with an electric pump drawing water through a gravel filter bed adjacent to the Scott canal. The trickle emitters will be spaced at 600 mm which will ensure that no plant will be more than 300 mm from an emitter. The area between the rows will be left as unirrigated natural prairie grass to minimize maintenance and weed control, and prevent soil erosion from wind, says Rankin.

Nursery near Rosemary.

The selection of trees will be mainly Poplars, Ash, and Willows with some Spruce. Included are also many high and low bush berries and ornamentals that make excellent cover for upland birds and small animals native to the area.

Some of the plantings will come from nursery stock but many of the Poplar and Willow will be started from cuttings collected locally.

For more information please contact Sandy Rankin, Special Project Coordinator, Eastern Irrigation District, P.O. Box 8, Brooks, Alberta T0J 0J0. Telephone (403) 362-3161.■

CORRECTION

Inadvertently, in our Spring edition of the Water Hauler's Bulletin, the AIPA gave us the wrong date to publish for their Annual Alberta Irrigation Projects Association Conference. It should have read:

November 18-19, 1991
Lethbridge Lodge Hotel

WATER MANAGEMENT POLICY AND LEGISLATION REVIEW

The first step in a comprehensive review of the province's water management policies and legislation was initiated on July 4, 1991 with the release of a discussion paper by Alberta Environment Minister, Ralph Klein.

The discussion paper, "Water Management in Alberta: Challenges for the Future", outlines the five key challenges facing Albertans. It provides a starting point for discussion of water management policy for Alberta.

A series of background papers with more detail on various water management issues are also being prepared by Alberta Environment.

Province-wide workshops will be conducted by the Alberta Water Resources Commission, the Environment Council of Alberta and Alberta Environment later this year. Based on this input, draft legislation will be prepared and made available for public review in 1992.

Interested persons wishing to obtain copies of the discussion paper or the background papers should call Alberta Environment, toll free 1-800-661-5586. For further information contact Kim Lalond at (403) 427-0047. ■

THE WATER HAULER'S BULLETIN

Designed to provide the operation and management personnel of Irrigation Districts with items of interest in their line of work. Comments are welcome. Please contact Duncan Lloyd, editor, at Area Code (403) 381-5539, Lethbridge.

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Alberta AGRICULTURE