Around The World

By the very nature of their work, people involved in Irrigation, Drainage and Flood Control tend to end up in some far-flung places. Do you ever wonder what some of the people you once worked with are doing now? We invite our members to tell us what they are up to around the world. In this issue we visit Yemen and Cambodia.

YEMEN

***John Ratsey** has worked for Halcrow for over 25 years and has been involved in a range of projects, usually in the irrigation and drainage field and often in the places that others prefer to avoid. His favourite place for a holiday is home.*

TAIZ: A DIFFERENT DRAINAGE PROBLEM

Some Background

The evening before I left Bangladesh I took the precaution of having dinner with Philip Field in order to get some background on my next project. Phil's advice was very brief and very simple: "forget the text books and work from first principles".

My next project was to review the existing designs and design additional works for Phase II of the Taiz Municipal Development and Flood Protection Project. Phil had worked on the design of Phase I, about 11 years earlier. That project had emerged from the Taiz Upgrading Study which was planned to improve infrastructure generally in the old city part of Taiz. It was quickly realised that it was not worthwhile investing heavily in general infrastructure until the problem of torrents of water cascading down the streets every time it rained had been addressed. Phase I had been successful, although implementation had been prolonged by events such as the civil war, and the World Bank was offering funding for the next phase.

The city of Taiz lies in central southern Yemen at an altitude of about 1250m at the foot of Sabir Mountain, which rises to over 3000m within a few kilometres of the city. Some of the drainage paths within the city serve very local catchments while the two largest wadis are each about 5km long. Progressive urbanisation (the population is estimated to have doubled between 1990 and 2000) has caused people encroachment on the main wadi channels and increased run-off rates while construction has unintentionally modified the catchments.

The Flooding Problem

I was fortunate to see a relatively large flood within two weeks of arriving in Taiz: There is no better way to visualise a problem than to experience it first hand. I quickly discovered that flood-hunting in Taiz had to be a premeditated activity. With the time of concentration in the smaller, urban, catchments being only 5 to 10 minutes, one could miss seeing the peak of a flood by delaying for a few minutes. We also learned from experience that flooded streets would create traffic jams and identified the routes least vulnerable to disruption so that we could cover the maximum ground in the minimum time. Many of the floods were localised and were the product of small, but intense, thunder storms. I recall on one occasion seeing a torrent of water flowing down an otherwise dry street.

The Challenges

The results of the hydrological analysis summarise the problem: The total catchment area for the combined wadi system is about 20km², with a mean slope of 20%, a time of concentration of about 25 minutes and a 1 in 20 year peak discharge of about 300m³/s. Some of the smaller catchments had slopes of over 50%. The steep slopes also result in velocities well above the range encountered in irrigation and drainage project. During the Phase I design the maximum acceptable velocity was progressively increased to 15m/s and this was maintained for the Phase II design work.

Apart from large quantities of water flowing quickly, albeit for relatively short durations, the other problem is sediment, if such a term is appropriate for material which includes large boulders. The steep slopes in the catchment mean this will always be a problem although the situation had been worsened by major improvements to the access road up the mountain behind the city, during which some excavated material appears to have been tipped into gullies.

An initial task was to evaluate the performance of the works constructed under Phase I. The most significant findings were: (a) that masonry armouring over concrete was desirable in the inverts; (b) that the floods would quickly find any weaknesses in material and workmanship; (c) sewer manholes in the base of channels were unwise (the sewers often became surcharged during floods, the manhole covers are blown/sucked off and then sediment enters the sewers, causing blockages); (d) sediment traps designed to intercept the medium to coarse material during larger floods trapped too much fine sediment during smaller floods; and (e) bridge piers caused major flow disturbance and were damaged by coarse sediment.

The drainage system is widely used for refuse disposal, so designs needed to be blockage resistant. Efforts are being made to improve the formal refuse collection system. Skips provided on street corners have been retrofitted with short legs when it was discovered that flat-bottomed skips were capable of floating down the streets!

The final challenge was to fit hydraulically acceptable designs into the constraints such as existing structures and minimise land acquisition. In some locations the culverts run under streets. Phase I include a 3m wide culvert almost 1200m long under streets that were less than 6m wide in places. Some of the drainage channels also serve as open sewers, so sewerage improvements are needed concurrent with the drainage works.

The Engineering Solutions

Yemen has a long tradition in masonry work (it is an abundant resource) and fortunately the skills have not yet been lost. Three basic structure types were adopted: (a) where sufficient space was available, use open channels formed of masonry walls and a masonry-armoured reinforced concrete base slab; (b) where space was limited use a covered channel which comprises the open channel design plus an RC cover slab; (c) where either construction space is very limited or spans exceeded 4m, use RC box culverts with masonry armouring of the invert and lower walls.

Some sections will be culverted in order to create space for new access roads. All culverts are single span to avoid hydraulic problems with the piers. Upstream pier extensions will be fitted to existing piers.

The iSIS modelling software, which includes basic ability to handle supercritical flows, was used for analysis of the change in flow conditions along the channels as water accelerated or decelerated.

Phase II also includes street drainage to address the challenge of getting water off the streets into the main drainage system. Field observations of flood flows are an essential part of the design process in order to see where the water actually flows and then catch it there. Conventional gully and grating designs are unsuitable since they tend to block very quickly. The design objective was therefore to enable trash to pass through the system so all openings are generously sized and some road gratings resemble cattle grids.

CAMBODIA

***Mike Chegwin** has been irrigating various bits of the world for the past 30 years. He is head of Lahmeyer International's Irrigation Department, and now reports back from somewhere deep in the Cambodian jungle.*

THE STUNG CHINIT IRRIGATION AND RURAL INFRASTRUCTURE PROJECT, CAMBODIA

The Stung Chinit Irrigation and Rural Infrastructure Project (SCIRIP) occupies a gross area of approximately 46,000 ha and is located in the districts of Santuk and Baray in the Province of Kampong Thom, Cambodia. Rainfed rice agriculture is practised widely in the Project Area and irrigated agriculture in some small areas having access to stored water.

Main system infrastructure was constructed under the Khmer Rouge regime in the 1970s and 1980s using forced labour, and comprised river diversion works and a main canal some 40 km long. Gated head regulators released water to a system of secondary canals, from which water was sequentially diverted using large labour gangs to construct and remove earth bunds into farm areas in blocks of rice-land split into 200m sided squares by small inter-connected channels without control structures. Gangs were again used to spread water among the blocks by alternate construction and breaching of simple earth dikes.

As with many of the schemes constructed under the regime's supervision, the system was constructed without the capacity to spill significant floods, with the result that the structures were often outflanked by the rivers they were intended to control. Structures were also badly damaged by "grenade fishing" by soldiers of the regime and during the period of civil war marking the demise of the Khmer Rouge. Another characteristic of many schemes is the construction of canals along map grid lines, largely ignoring the topography, with consequent inconsistencies in canal gradients and command areas. Main canal cross-drainage requirements were usually ignored. The quality of construction and construction materials was also variable and often very poor.

The project is designed to increase agricultural productivity and stimulate the rural economy in the Province. To achieve these objectives, at full development stage, the project would provide irrigation supplies to a net area of about 12,000 ha. In the present phase, some 7,000 ha will be rehabilitated and rebuilt, providing wet season supplementary irrigation, and more than 2,000 ha of this area will be provided with dry season irrigation. Drainage infrastructure will be improved, while rural roads and markets will be upgraded to enhance conditions for marketing of the crops harvested. Water user groups will be formed and trained to operate the irrigation

system. Their active participation in design is being encouraged by a donor condition that 2/3 of the farmers on a given secondary must agree to its alignment and design before it may be constructed.
The project comprises the following four components:

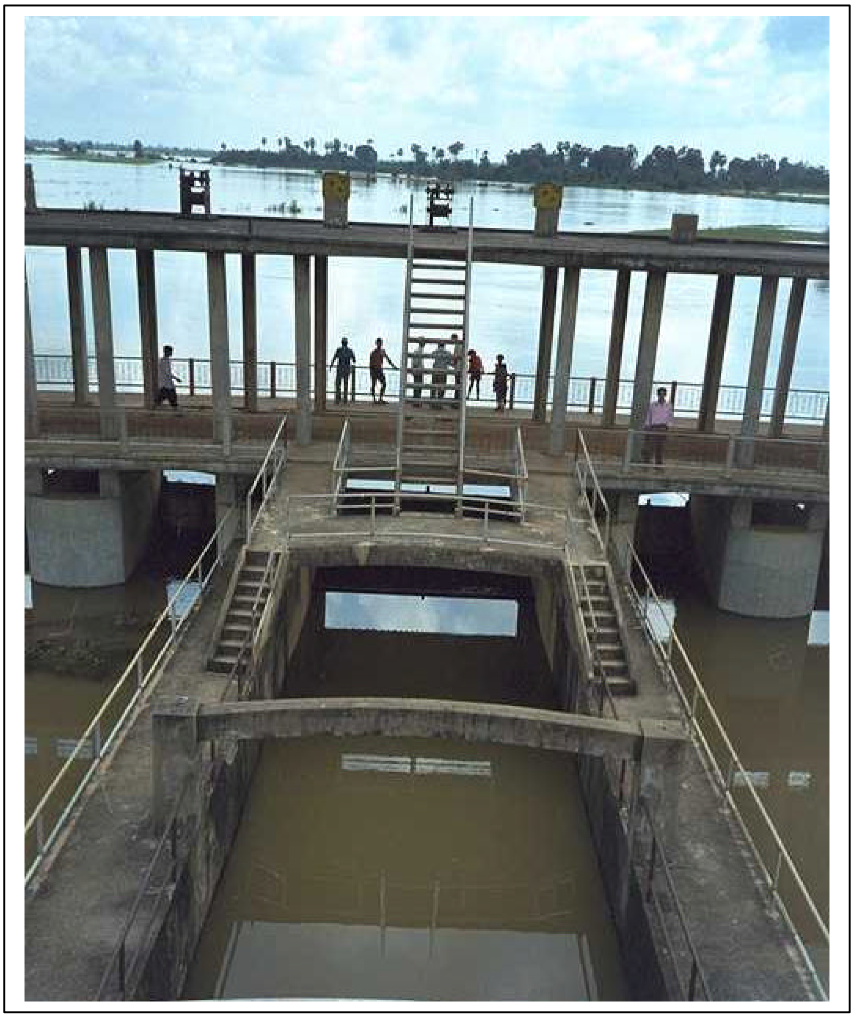
- Farmer community organization and extension services
- Design and construction of irrigation and drainage infrastructure
- System management
- Improvement of rural infrastructure

The Ministry of Water Resources and Meteorology and the Ministry of Rural Development are the main implementing agencies, through their Project Management Offices. At national level coordination is provided through the National Steering Committee, chaired by the Ministry of Economy and Finance, while at the provincial level a Project Coordination Committee will coordinate implementation activities and make adjustments in work programs.

The implementation of the project commenced in September 2001, after the mobilization of the Lahmeyer/SMEC Joint Venture, consultants for the Irrigation Infrastructure and System Management components. The Farmer Community Organization and Extension Services consultants, Groupe de Recherche et de d'Échanges Technologiques, mobilized in November 2001, while a contract for the Rural Infrastructure component was negotiated by the end of February 2002 and it is expected that the contract will be ratified shortly.

The use of digitised orthophotomaps for the detailed design of irrigation and drainage infrastructure and optimisation of storage volume upstream of the diversion weirs is a feature of the design process. Much of the design work is being done on-screen, followed up by intensive consultation with the beneficiaries. Land titling using the same photography is designed to minimise land speculation as the value of land increases with provision of irrigation and drainage infrastructure. Automated software is being used for irrigation canal and drain drawing production. Construction is due to begin during the first half of 2003. The overall project implementation period is six years.

The total cost of the project is estimated at US$ 23.8 million equivalent. The project is financed by the Government of the Kingdom of Cambodia, the Asian Development Bank, Agence Française de Développement and the beneficiaries.



The Stung Chinit Boat Lock and weir.

The river is still an important trade route.