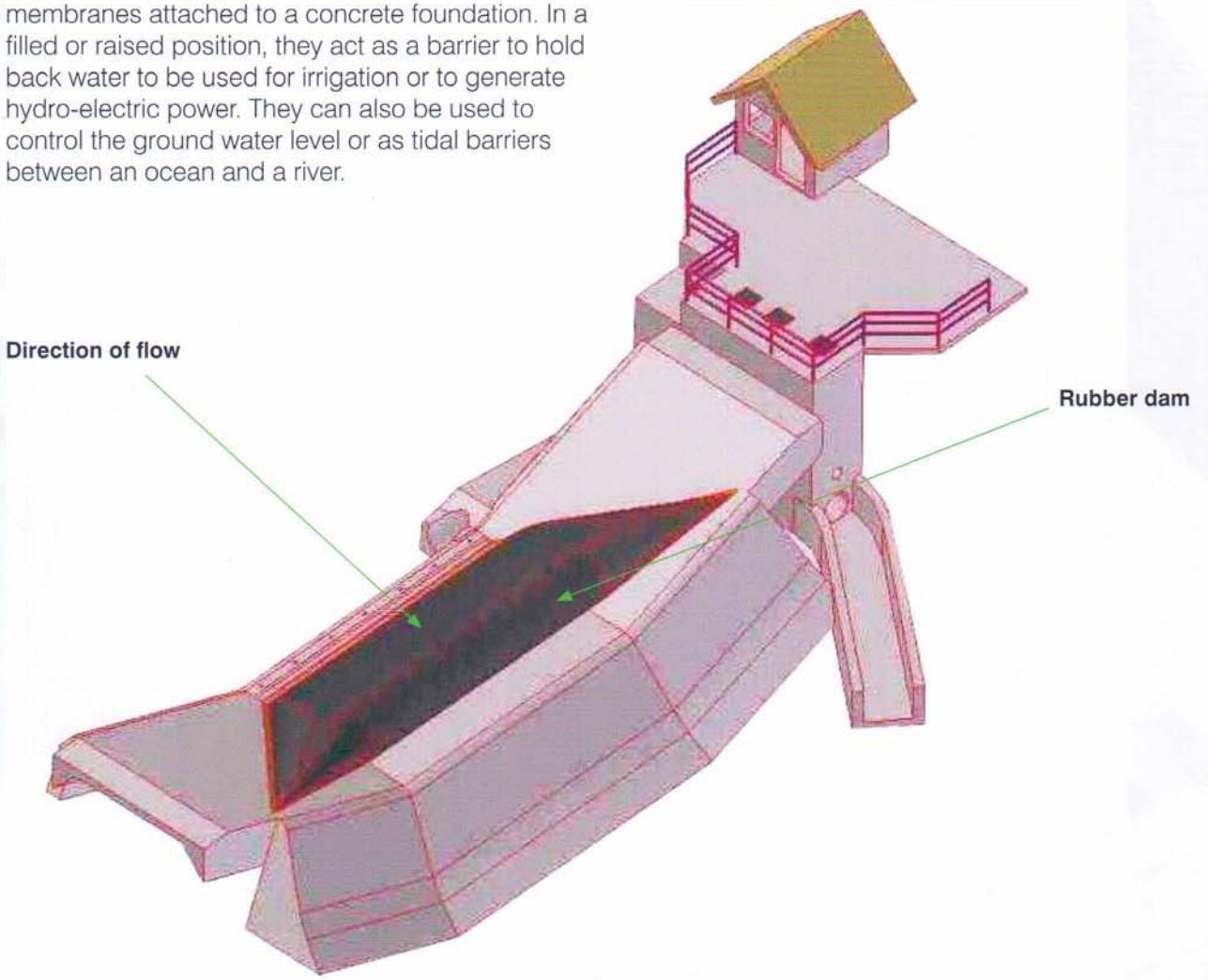
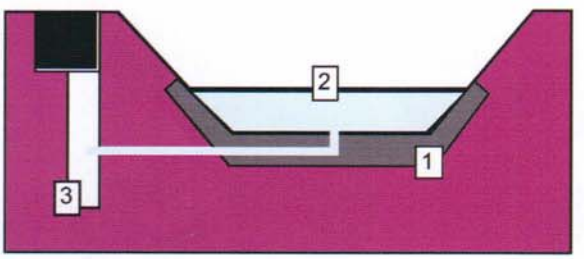
PROFESSIONAL
ENVIRONMENTAL
PROTECTION
PRODUCTS

WATER FLOW MANAGEMENT

1. RUBBER DAM APPLICATIONS

Rubber dams are air filled or water filled rubber membranes attached to a concrete foundation. In a filled or raised position, they act as a barrier to hold back water to be used for irrigation or to generate hydro-electric power. They can also be used to control the ground water level or as tidal barriers between an ocean and a river.





Our rubber membranes are made of high quality hypalon rubber which is highly resistant to influences of water and sun light. The core of the membrane is made of high-strength plyester fabric with thickness of 1.9mm and a tear strength of a minimum of 400 kN/m in longitudinal and a minimum of 300 kN/m in diagonal direction.

Components of rubber dam:

1. Concrete foundation

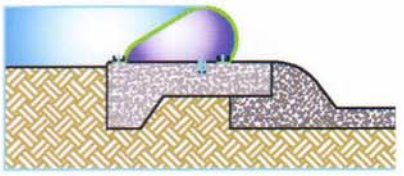
2. Rubber membrane

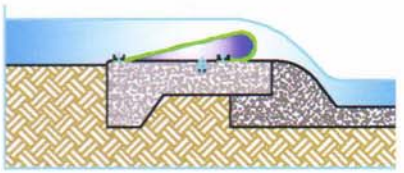
3. Control shaft for filling and monitoring of the dam.

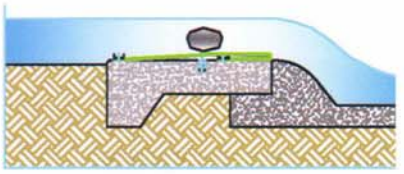
2. ADVANTAGES

Flexibility

Rubber dams flex downwards, which means that flood waters will flow over the rubber dam





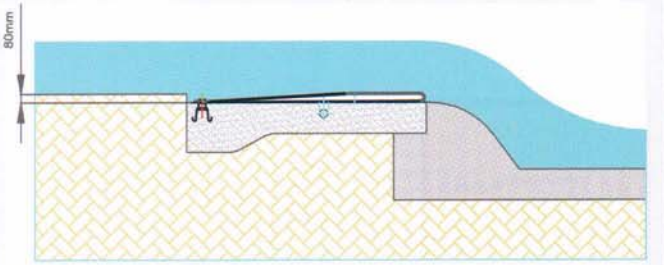


More economical construction compared to steel gates

Rubber dam construction is 30% to 70% cheaper than dams using steel gates. It is also quicker and does not require heavy construction equipment in most cases.

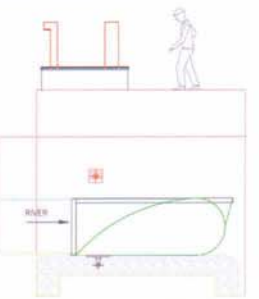
Lower concrete sill height

Rubber dams have a lower spillway profile, i.e. 80 mm (3.15 inch), which means that the overall concrete spillway is lower than steel gates. The overall height for rubber dams is 500 mm while the steel gates are 500mm to 800mm (approx. 20 inch to 32 inch). A lower spillway requirement means lower construction cost.

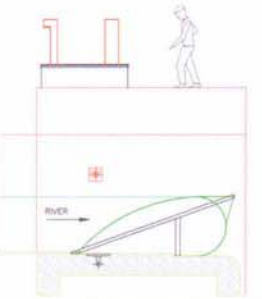


Types of installation

Rubber dams can be installed with a single or dual attachment system.



Single attachment



dual attachment

Rubber dams can be installed at a right angle or on a slope

Bank at right angle.

Sloping bank.

ADVANTAGES

Long life with minimum maintenance

Rubber dams do not rust so they do not need protective coatings or lubrication..

There are no large mechanical moving parts. Rubber dams are noted for a reliable inflation and deflation system. They are extremely reliable and can last up to 30 years which depends an the river flow speed and its carrying power.

UP TO 30 YEARS

DO NOT RUST

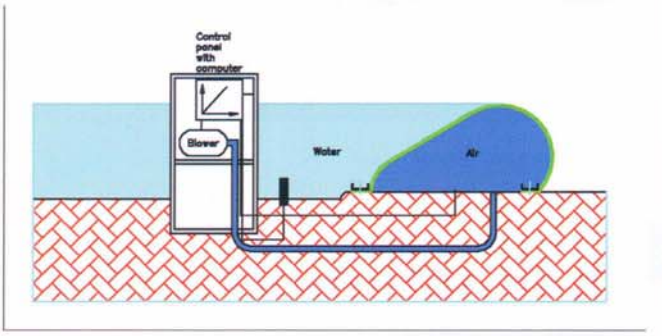
RELIABLE INFLATION AND DEFLATION SYSTEM

Rubber dams are raised or lowered evenly across the entire river span

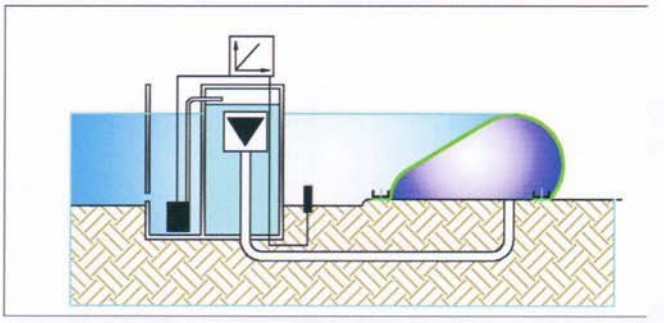
They are very suitable for wide rivers.

Simple and reliable control system

Water level behind the dam is controlled by controlling the membrane height.



Air inflation: water level controlled with air pressure in membrane.



Filling with water: water level controlled with water column in control shaft.

ADVANTAGES

Segmental construction

Using segmental construction (several dams installed in series) spans of several hundred meters can be covered.

Rubber dams in Majdičev Log (5 x 50 m)

Advantage of modular construction

Turnkey installation of the entire dam, including prefabricated control shaft.

Only exception is basic construction works

1. **Project planning**

2. **Supply of the control shaft structure**

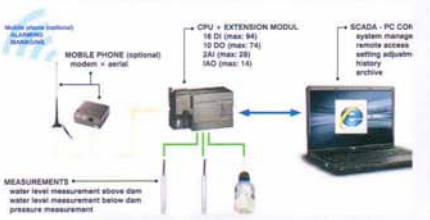
3. **Installation of piping**

4. **Prepare and install the anchoring system**

5. **Delivery and installation of rubber membrane**

6. **Assembly and installation of the filling system**

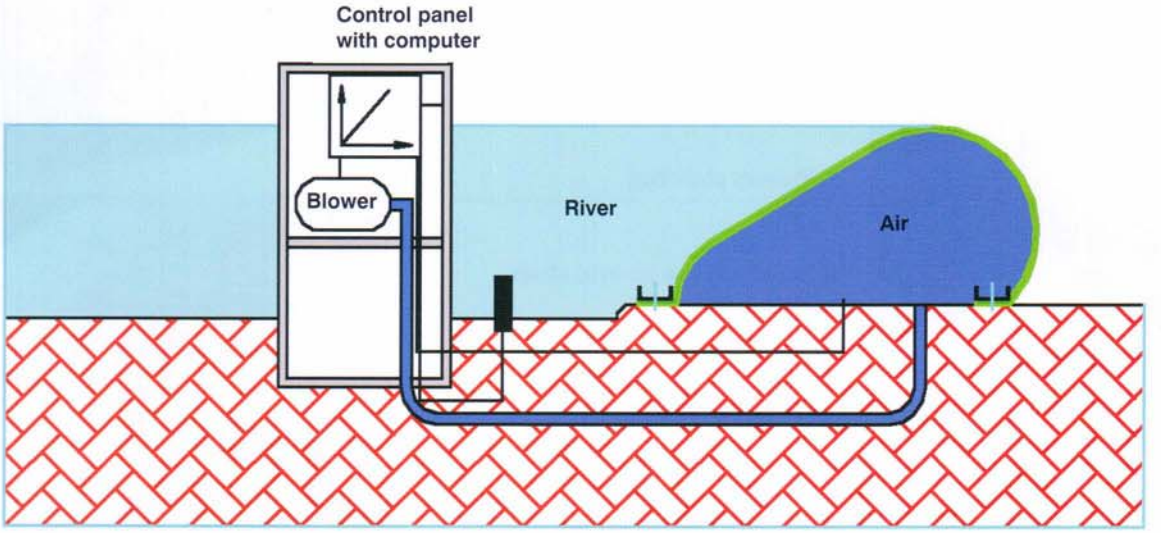
7. **Installation of the electronic control system**



8. **Final test of dam installation**

3. AIR FILLED DAMS

Air filled dam membranes are inflated using air blowers. For safety reasons, each dam is equipped with two blowers to insure that the membrane can be quickly raised. Pressure relief valves are used to prevent over-inflation of the membrane. Deflation and re-inflation are controlled electronically with a Sava 1 or Sava 2 control system. Should all components fail, a safety exhaust valve prevents the water level from rising to dangerous levels.



Advantages of air filled dams:

+ Quicker inflation and deflation.
+ Not affected by cold temperatures (air cannot freeze inside the membrane).
+ Lower construction cost.
+ Low energy consumption.
+ Ability to supply sufficient power by means of solar energy (phV cells).

Disadvantages of air filled dams:

– Vandalism, puncturing or cutting of the membrane (area of the dam installation must be properly secured)
– Uneven deflating of the membrane.
– Sinking of the dam centre
– Vibration caused by overflowing nappe (controlled by installing deflectors).

AIR FILLED DAMS

Time required to inflate with air - in minutes

Height	Length [m]								
[m]	**5,0**	**10,0**	**15,0**	**20,0**	**25,0**	**30,0**	**40,0**	**50,0**	**60,0**
0,40	1,00	1,00	1,53	2,04	2,55	3,06	4,07	5,09	6,11
0,50	0,80	1,59	2,39	3,18	3,98	4,77	6,36	7,96	9,55
0,60	1,15	2,29	3,44	4,58	5,73	6,87	9,17	11,46	13,75
0,70	1,56	3,12	4,68	6,24	7,80	9,36	12,48	15,59	18,71
0,80	2,04	4,07	6,11	8,15	10,18	12,22	16,29	20,37	24,44
0,90	2,58	5,16	7,73	10,31	12,89	15,47	20,62	25,78	16,71
1,00	3,18	6,36	9,55	12,73	15,91	19,09	25,46	17,19	12,90
1,10	3,85	7,70	11,55	15,40	19,25	23,10	16,64	13,01	15,61
1,20	4,58	9,17	13,75	18,33	22,91	14,85	19,80	15,48	18,58
1,30	5,38	10,76	16,13	21,51	14,53	17,43	14,54	18,17	21,81
1,40	6,24	12,48	10,11	13,48	16,85	20,22	16,86	21,08	25,29
1,50	7,16	7,74	11,60	15,47	19,34	14,52	19,36	24,20	29,03
1,60	4,40	8,80	13,20	17,60	13,76	16,52	22,02	27,53	23,80
1,70	4,97	9,94	14,90	12,43	15,54	18,65	24,86	22,39	26,87
1,80	5,57	11,14	16,71	13,94	17,42	20,90	20,08	25,10	30,12
1,90	6,21	12,41	18,62	15,53	19,41	23,29	22,37	27,97	33,56
2,00	6,88	13,75	12,90	17,21	21,51	25,81	24,79	30,99	37,18
2,10	7,58	15,16	14,23	18,97	23,71	20,50	27,33	34,16	41,00
2,20	8,32	16,64	15,61	20,82	26,02	22,50	30,00	37,49	44,99
2,30	9,09	18,19	17,07	22,75	20,49	24,59	32,78	40,98	49,18
2,40	9,90	12,39	18,58	24,78	22,31	26,77	35,70	44,62	53,55
2,50	6,72	13,44	20,16	26,88	24,21	29,05	38,73	48,42	58,10
2,60	7,27	14,54	21,81	20,95	26,18	31,42	41,89	52,37	62,84
2,70	7,84	15,68	23,52	22,59	28,24	33,88	45,18	56,47	67,77
2,80	8,43	16,86	25,29	24,29	30,37	36,44	48,59	60,73	72,88
2,90	9,04	18,09	19,54	26,06	32,57	39,09	52,12	65,15	78,18
3,00	9,68	13,94	20,92	27,89	34,86	41,83	55,78	69,72	83,66

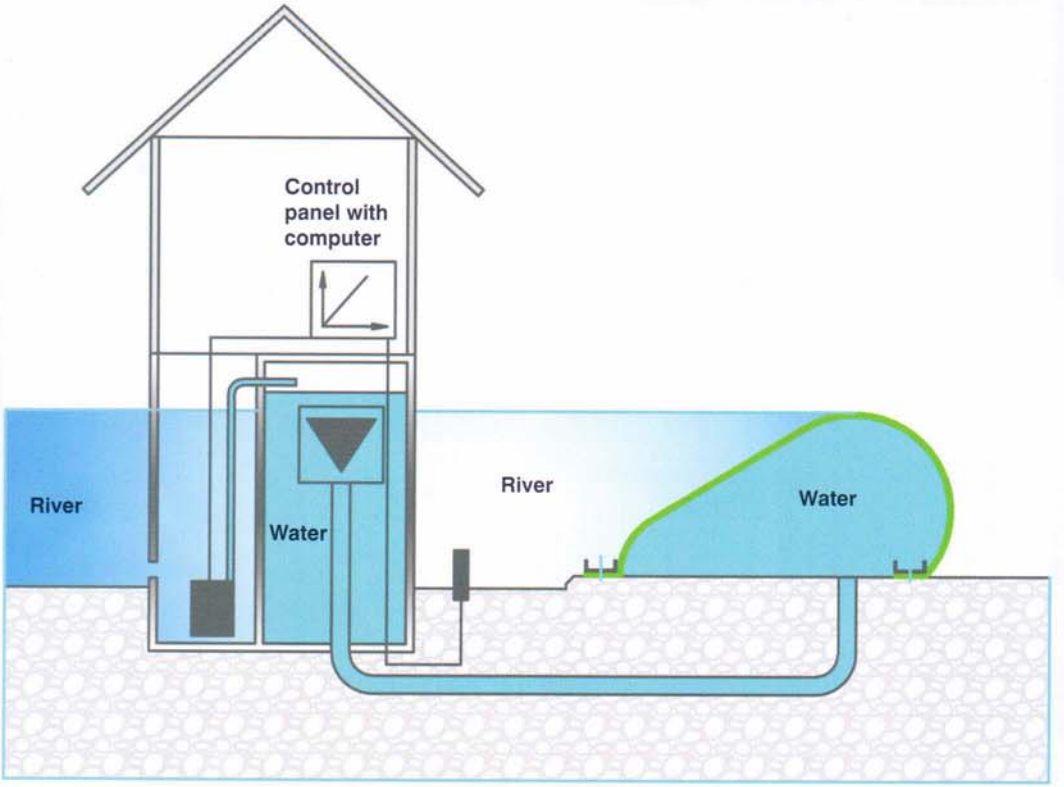
Pipe diameter
For air filled dams

Dam air volume (m^3)	Pipe dia. (mm)
$V \leq 50$	50
$50 < V \leq 100$	80
$100 < V \leq 200$	100
$200 < V \leq 500$	150

Table of inflation times and inflation hoses

4. WATER FILLED DAMS

Compared to air inflated dams, the water filled dams are more stable due to lower vibration/oscillation. On the other hand, they take longer to fill or empty.



Dammed water level is controlled with hydrostatic pressure. Water level in the control shaft is 30cm to 40cm higher than the height of the dam. The difference in height generates the hydrostatic pressure which controls the height of the membrane. Each dam has two pumps for pumping the river water into the control shaft. Water level in the control pit can be raised by releasing water into the pit from the higher level water flow. When using this method. there is no electric power required for filling the control pit. The height of the dam is controlled by the water level in the control pit, controlled electronically with Sava 1 or Sava 2 control system. An overflow pipe, set at maximum dam height plus 40 cm, protects the rubber membrane from over-pressure. Should all elements of the dam fail (electric power outage or similar), a safety release valve will protect the dam in case of excessive water levels.

Advantages of water filled dams:

+ Dam membrane more stable due to weight of water.
+ The membrane height adjustment is even across the entire length.
+ Can be operated without electric power.

Disadvantages of water filled dams:

– Higher construction cost.
– More time consuming during filling or emptying.
– Potential of freezing
– Vandalism through cutting or puncturing

WATER FILLED DAMS

Time required to inflate with water - in minutes

Height [m]	Length [m]								
	5,0	**10,0**	**15,0**	**20,0**	**25,0**	**30,0**	**40,0**	**50,0**	**60,0**
0,40	2,90	5,79	8,69	11,58	14,48	17,37	23,16	28,95	34,74
0,50	4,52	9,05	13,57	18,10	22,62	27,14	36,19	45,24	54,29
0,60	6,51	13,03	19,54	26,06	32,57	39,09	52,12	65,14	31,27
0,70	8,87	17,73	26,60	35,47	44,33	53,20	28,37	35,47	42,56
0,80	11,58	23,16	34,74	46,32	57,91	27,79	37,06	46,32	55,59
0,90	14,66	29,31	43,97	58,63	29,31	35,18	46,90	58,63	39,09
1,00	18,10	36,19	54,29	28,95	36,19	43,43	57,91	40,21	48,25
1,10	20,98	41,97	62,95	33,57	41,97	50,36	67,15	46,63	55,96
1,20	24,97	49,94	29,97	39,96	49,94	59,93	44,39	55,49	66,59
1,30	29,31	58,61	35,17	46,89	58,61	39,08	52,10	65,13	56,27
1,40	33,99	27,19	40,79	54,38	67,98	45,32	60,43	54,38	65,26
1,50	39,02	31,21	46,82	62,43	43,35	52,02	49,94	62,43	74,92
1,60	42,46	33,97	50,96	37,75	47,18	56,62	54,35	67,94	81,53
1,70	47,94	38,35	57,53	42,61	53,26	63,92	61,36	76,70	92,04
1,80	53,74	43,00	64,49	47,77	59,72	51,59	68,79	85,99	103,19
1,90	59,88	47,91	39,92	53,23	66,53	57,49	76,65	95,81	114,97
2,00	26,54	53,08	44,23	58,98	53,08	63,70	84,93	106,16	127,39
2,10	27,93	55,86	46,55	62,07	55,86	67,03	89,38	111,72	134,07
2,20	30,65	61,31	51,09	49,05	61,31	73,57	98,09	122,62	147,14
2,30	33,50	37,23	55,84	53,61	67,01	80,41	107,21	134,02	160,82
2,40	36,48	40,53	60,80	58,37	72,96	87,55	116,74	145,92	175,11
2,50	39,58	43,98	65,97	63,33	79,17	95,00	126,67	158,34	190,00
2,60	42,81	47,57	51,38	68,50	85,63	102,75	137,01	171,26	205,51
2,70	46,17	51,30	55,41	73,87	92,34	110,81	147,75	184,68	221,62
2,80	49,65	55,17	59,59	79,45	99,31	119,17	158,89	198,62	238,34
2,90	53,26	59,18	63,92	85,22	106,53	127,83	170,45	213,06	255,67
3,00	57,00	63,33	68,40	91,20	114,00	136,80	182,40	228,00	273,61

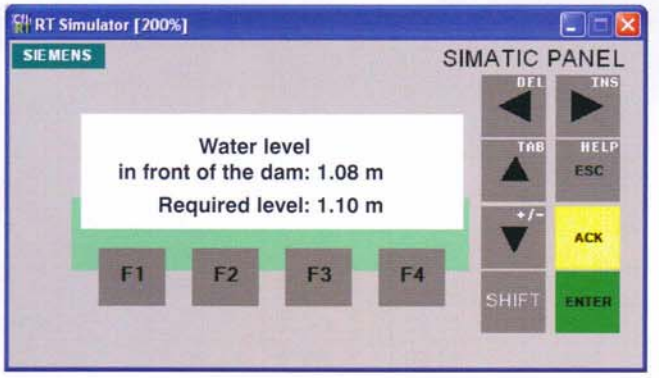
Water filled dams: pipe diameter

Dam volume (m^3)	Pipe diameter (mm)
$V \leq 200$	200
$200 < V \leq 500$	300
$500 < V \leq 700$	400
$700 < V \leq 1200$	500

5. ELECTRONIC CONTROL SYSTEM

Sava 1
- basic electronic control system

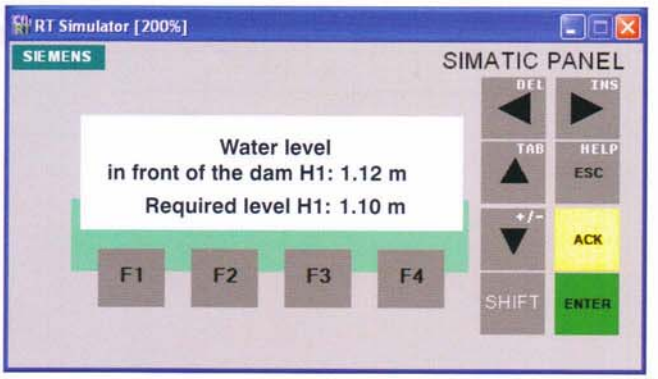
This is a basic controller with a two-line display panel and push button controls for various functions of the dam and for switching to automatic mode.



System Sava 1 capabilities:

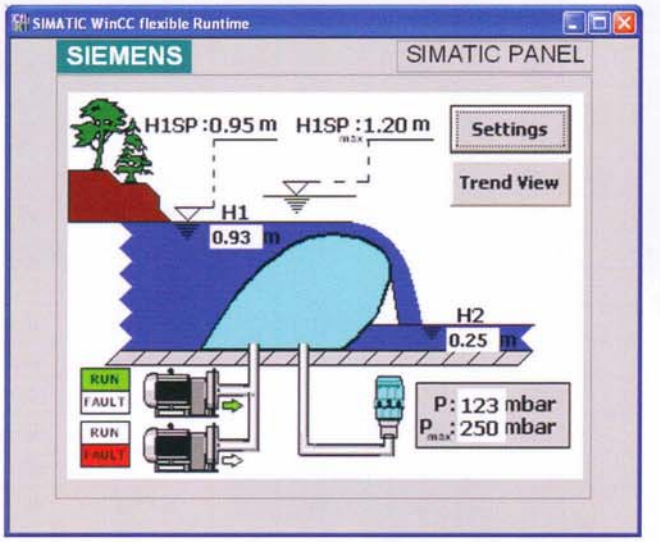
- Set and maintain the desired water level in front of the dam
- Display water level upstream and downstream of the dam.
- Set maximum water pressure in the membrane and display actual pressure.
- Control all functions of the dam.
- Manual control of all functions.
- Expandable.

Controller panel in WinCC flexible for control system SAVA1



Sava 2
- advanced electronic control system

This system can be used with a Siemens controller panel or a PC.



Sistem Sava 2 capabilities:

- Set and maintain desired water level in front of the dam
- Display water level upstream and downstream of the dam.
- Set maximum water pressure in the membrane and display actual pressure.
- Control all functions of the dam.
- Full SCADA monitoring and remote access capability
- Data storage on memory cards, or PC for processing
- GSM alarm in case of control malfuntion or abnormal control values.
- Manual control of all functions

6. MODULAR CONSTRUCTION METHOD

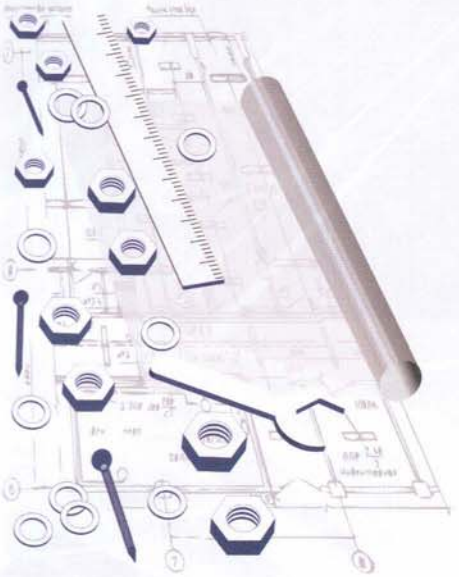
The modular construction method consists of 6 phases.

1. Project planning:

Following site visit and review of construction plans, drawings are prepared for:

- Plumbing installation.
- Rubber dam anchoring elements.
- Rubber membrane design.
- Wiring diagrams.

Plans and drawings are generated using MS Project, AutoCad and Solid Edge programs.



2. Supply of the control shaft structure:

For air filled dams, we can supply pre-fabricated control shaft upon customer's request. Installation is done under our supervision. Air blowers are subsequently installed along with electronic control system. The entire control system can also be installed in a special container, which we can supply upon customer's request

.

3. Installation of piping:

Pipes for filling and emptying the dam are installed prior to pouring the concrete base.

MODULAR CONSTRUCTION METHOD

4. Prepare and install the anchoring system:

Membrane bottom anchoring steel channels are welded to the steel wire mesh prior to pouring of concrete.

5. Delivery and installation of rubber membrane:

Upon completion of the dam anchoring system, the rubber membrane, filling system, and electronic control system are delivered to site. The installation of the rubber membrane takes 3 to 4 days, depending on the size of the dam.

MODULAR CONSTRUCTION METHOD

6. Assembly and installation of the filling system:

The filling system is installed at the same time as the rubber membrane.

7. Installation of the electronic control system:

The electronic control system is installed at the same time as the rubber membrane. Customer is responsible for connection to the power grid.

8. Final test of dam installation:

Prio to handing over the dam, all functions of the dam are tested, including filling and emptying of the rubber membrane, and leak testing. Operation Manual is presented to the customer and dam operators are trained on all functions of the dam.

In addition, Savatech d.o.o. offers service during warranty and post warranty period.