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*(Translation from Russian)*

# DEVELOPMENT OF PERFECT ARCHITECTURAL AND CONSTRUCTION TECHNOLOGIES (BY THE EXAMPLE OF TORUS TECHNOLOGIES) TO ENSURE MANKIND SURVIVAL UNDER CONDITIONS OF CLIMATE COOLING ON THE EARTH

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*Nature is senseless without Man!!!*
*The author*

## Introduction

*"The text was written "at a breath", and as such may contain errors though not fundamental, easily correctible and described with respective comments in further works of the author".*

As a result of stream channel processes (quiet backwaters, streamflow, meandering, etc.) occurring in mega-, macro-, micro- and nanoworlds, the entire Universe consists of nested elastic/soft spherical and/or torus-like single-cavity/single-chamber, multicavity/multichamber shells or their similar-name groups falling within **four** typical information-wise and energy-wise self-supported forms of fluid medium existence [1-3], namely (Fig.1):

1. ***Foam$^4$*** (***four "colors"***) is a structure that consists of a definite number of dodecahedrons or/and their variations contained in a sphere-like shell with a finite and non-finite (the Universe) radius. It should be noted that the four axes positioned at an angle of $109^0 30'$ to one another make natural 4-dimensional tetrahedrical space, with "four colors" being tetrahedron bases.
   It is important that, given a non-finite sphere radius, like the radius of the Universe, the Foam$^4$ is not confined to an enclosing shell; it is rather "free lying foam".

That is, its bubble dodecahedrons (structural spheres) or their variations are not effected by pressure from their own centers, which is characteristic, for instance, of a soap bubble or a football also formed by gas dodecahedrons or their variations but more deformed (squeezed by pressure) in the direction from the center towards the shell.

Therefore, elements of Foam$^4$ constituting the infinite Universe have standard parameters (sizes, distribution of pressure parameters inside dodecahedrons, thickness of face "material", Plato channel sizes, etc.).

Separation of the infinite radius sphere, i.e. the Universe, into four infinite tetrahedrons with virtual bases – "four colors" – is a purely information process (structurization information) infinitely directed away from the center of the infinite Universe.

Therefore, the force with which galaxies are directed towards/pushed/sucked into dodecahedron vertexes (or Plato channels) has the same integral value.

2. ***Bundle$^4$*** consists of a definite number of stretched dodecahedrons or/and their variations rotating in the same direction respective their longitudinal axes and confined to a sphere-like cylinder shell enclosing them.
3. ***VTortex$^{TM}$*** consists of the following components:
   3.1. ***Foam$^7$, seven "colors",*** is a group of $7n_p$ Shikhirin$^7$ cells, where $n_p$ – is a number of the knot line rotations (the meridian) around the longitude of the torus. The base edges of an individual cell rotate unidirectionally respective their longitudinal axes.
   3.2. ***Bundle*** consists of $n_p$ (1, 2, 4, 5, 7 ... non multiples of 3) interlinked threads (external) rolling each other and rotating unidirectionally respective their longitudinal axes located in the cross section on a concentric circumference. The central part of the Bundle$^7$ is a thread (internal) rotating around its longitudinal axis (the torus axis) in the opposite direction respective the external Bundle$^7$ threads.
4. ***Foam$^{VTortex}$ (Benard cells)*** is a layer consisting of a group of VTortex structures concurrently rotating or non-rotating respective their longitudinal axes. The surfaces of the layer "consist" of implosive and explosive ends, respectively, while the VTortex axes are oriented in one direction, for instance, towards the

center of the sphere (a meander with whirlwinds or galaxies) or in parallel with respect to one another (a meander in a water surface layer), and so on.

Edges of dodecahedrons or their variations as well as of Shikhirin[7] cells are Plato-Shikhirin[4,7] channels. The low-pressure dodecahedron vertexes generated by Plato channels (Plato's diaphragm or triangle or Shikhirin's tetrahedron) attract dislocations consisting of fluid medium in one of its typical forms of existence or/and solid inclusions … etc.

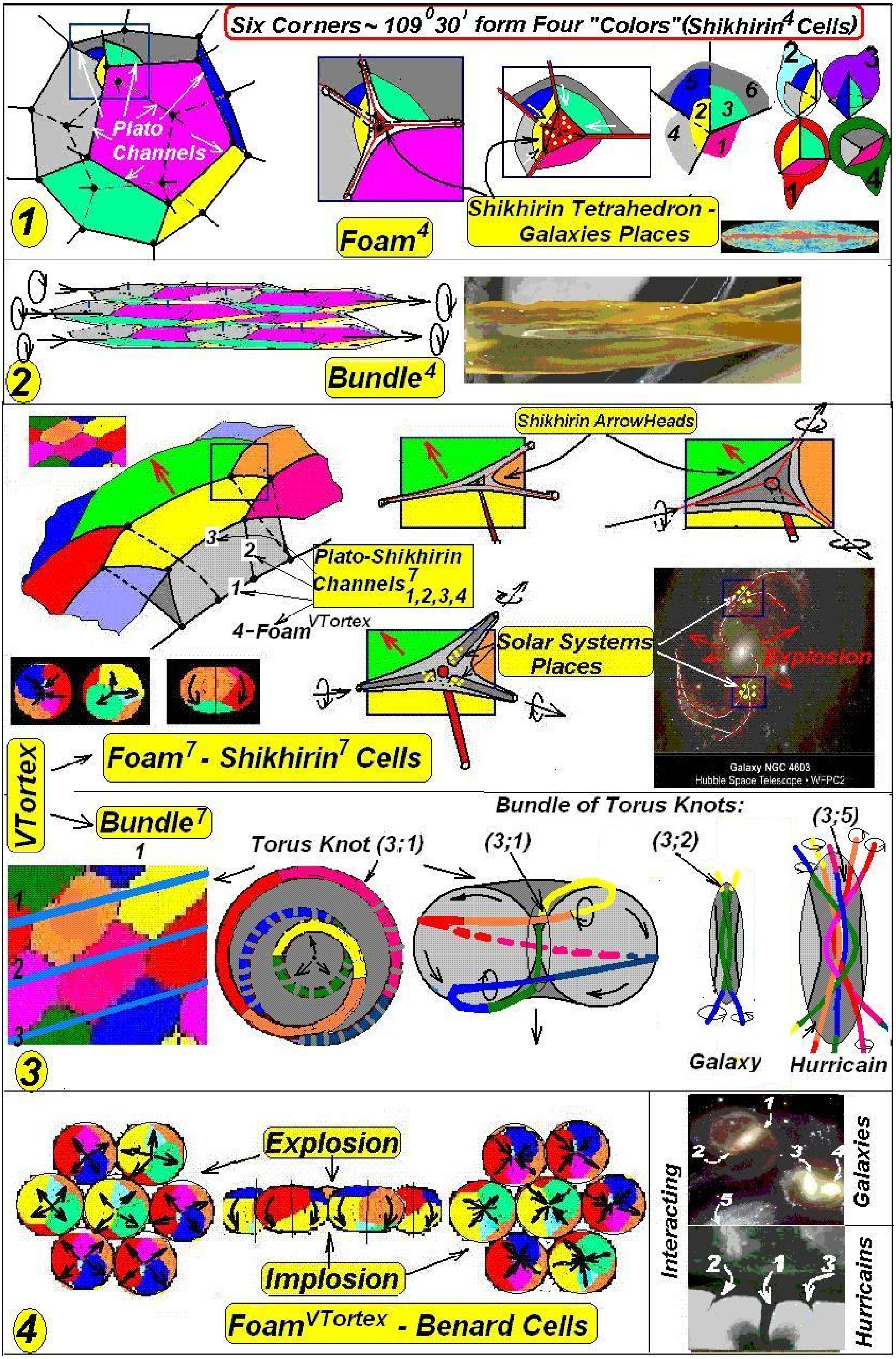
Into Shikhirin[7] cell vertexes, being low-pressure areas, formed by edges, or Plato-Shikhirin[7]$_{2,3}$ channels (Shikhirin Arrowheads), dislocations made by liquid or/and solid inclusions are also drawn into.

For instance, at the megaworld level it means the infinite Universe space filled with gas dodecahedrons or their variations (Foam[4], or quiescent state) changing into a Bundle[4] (and back), i.e. into a stream (flow) with meanders in which individual VTortex galaxies or/and interacting VTortex galaxy groups (Foam$^{VTortex}$ – Benard cells) are formed.

As a result of low pressure created in vertexes of dodecahedrons or/and their variations, vertex areas draw in galaxies consisting of $n_q$ Shikhirin[7] cells, where q = 2, 4, 5, 7, 8, 10, i.e. any number non-multiple of 3.

In vertexes of Shikhirin[7] honeycomb-cell bases (Shikhirin Arrowheads) low-pressure areas are also generated that draw stellar mater (solar systems, etc.) in.

Nature developed and mastered technologies of building optimum information- and energy-wise self-supported shell systems of four types converting to one another in a strict order under certain conditions, namely: Foam[4] $\Rightarrow$ Bundle[4] $\Rightarrow$ VTortex $\Rightarrow$ Foam$^{VTortex}$ and vice versa.



Six Corners ~ 109°30' form Four "Colors"(Shikhirin4 Cells)
Plato Channels
Foam4
Shikhirin Tetrahedron - Galaxies Places
1
Bundle4
2
Shikhirin ArrowHeads
Plato-Shikhirin Channels7 1,2,3,4
4-Foam VTortex
Solar Systems Places
Explosion
Galaxy NGC 4603
Hubble Space Telescope • WFPC2
VTortex
Foam7 - Shikhirin7 Cells
Bundle7
Bundle of Torus Knots:
Torus Knot (3;1)
(3;1)
(3;2)
(3;5)
Galaxy
Hurricain
3
Explosion
Implosion
FoamVTortex - Benard Cells
Interacting
Galaxies
Hurricains
4

Fig. 1. Typical forms of working fluid medium existence in Nature.
Real process of planets and stars manufacturing (3 position) look at http://hubblesite.org/newscenter/archive/releases/1997/18

Moreover, in a process (at a moment) of conversion from one state to another (from one typical form to another) the information constituent is missing (the information chaos), only structurization energy is active; and on the contrary, when a typical form reaches its self-supported state, the structurization energy only maintains this process while the structurization information demonstrates itself "in all its glory" and, as such, forms and supports various function Pi numbers, the golden ratio, prime numbers and radicands as well as information derivatives such as genetic code, molecule structure, etc.

Why should not Man make use of these natural technologies when entering the space cooling phase characterized by cyclic changes of the Earth's axis tilt angles against the ecliptic plane, the Earth and planets precession? After all, in this case Nature itself automatically adjusts to these noticeable changes getting rid of all those incapable of reformation and supporting capable ones!

Man's role is to search, find and implement life-support systems (building structures, clothes, power facilities, transportation means, food, etc.) matched to conditions under which fluid medium exists in Nature in its typical forms, e.g. by using typical bionic and other forms both in changed and quite "new" Earth's conditions taking into account:

- ***Foam***[4] ***or/and its elements*** - attention should be paid to works of V. Shukhov, R. Fuller, F. Otto, H. Hering, N. Foster, I. Hoshegawa and others among which only R. Fuller took into account the principles of 4-dimensional space generation ("four colors").

  Following formation of spherical surfaces, a solidification technology may be used.
- ***The Torus or/and its elements*** - today only man-made element-wise polygonal inflated torus has been suggested made of, e.g. 6, 8, 12 cylindrical shells (parts) connected at respective angles. The design process is based on primitive calculations of cylindrical shells serially connected into an opened

"angular" torus [4]. After the open "angular" torus has been produced it is possible to use a technology of "torus" surface solidification.

- Hard, soft and elastic structures of the ***Bundle[4], VTortex, its basic elements such as Foam[7] and Bundle[7] as well as Foam[VTortex]*** are so far unavailable at all. However, structures built on these principles are the best suited to sharp climatic changes in terms of energy and environment safety (permanent energy and environment maintenance). Moreover, such structures may be subject to smooth and low-cost refurbishment should the living conditions suddenly deteriorate.

In view of the above, the author believes that under the Earth's and non-Earth's conditions it is reasonable to use architectural and construction technologies relating, on the one hand, to more sophisticated spatial forms but, on the other hand, better suited (adapted) to Man's survival in the near future under the extreme Earth's conditions and on other planets not yet prepared for life. Primarily, the matter concerns natural structures implemented as Bundle[4], VTortex and its Foam[7] and Bundle[7] basic elements, Foam[VTortex] as well as energy (free energy) generated automatically during formation of such structures with its subsequent total use [5].

This paper is concerned so far with applications of torus technologies and elastic mechanics in architecture and the construction industry, primarily with multiple-use ***inflated torus formwork (ITF)***.

## Fast Methods of Construction Using Inflated Torus Formwork

*Fast methods are considered to be advanced and good only in case of good engineering preparation of the construction process and properly trained personnel*

*L. Borodina*

The multiuse inflated torus formwork was developed by the author's friend and colleague Larisa Borodina, a scientist and construction expert who since 1992 has designed technologies for fast construction of various purpose building structures based on torus technologies in cooperation with the author [6].

For the first time in the practice of construction of buildings designed for various purposes, particularly, in running model and environment tests and operation of soft shells (inflated forms), L. Borodina used her own designs of rubber-mercury sensors

that after respective thoriating (tuning) were built into the soft formwork material. This fact, perhaps, pioneered introduction of elastic mechanics principles [7] into construction engineering.
In the event of soft formwork deformation under the effect of static loads (different parameters of pressure in the soft shell) or its dynamic deformation caused by concrete mixture while the latter was sprayed onto the form, rubber capillaries were deformed (stretched out) together with the mercury therein that had its electrical parameters changed, particularly, electric resistance [8].
In the author's opinion, by the significance of her intellectual contribution to torus technologies Larisa Borodina ranks the second to "the father" of Torus technologies Ruvim Kozhevnikov (1924-1007).

Design, fabrication and testing of various types of inflated torus framework were performed by the author in 1998-2001.

Along with that, L. Borodina is an expert regularly consulting the author on issues of cavitation process formation, e.g.:

- origination from "nothing" and collapsing to "nothing" of "positive" and "negative" cavitation bubbles, respectively, their functional features and methods of fighting thereof;
- electricity generation in waterfalls, etc.

## Inflated Torus Formwork

Conventional (*not torus-based*) inflated formwork has a serious disadvantage. Made for equivalent size sections, it does not allow construction of vaulted buildings with various dome pendentives and span lengths.
Moreover, due to narrow-mindedness of architects conventional buildings do not possess bionic properties. On the contrary, powerful anti-bionic effects are likely to be present that destroy all living things.
*Smooth* inflated torus formwork and *multiwave* inflated torus formwork (Fig.2) allow floors and ceilings of buildings having various span lengths and pendentives to be concreted using the same formwork [9,10].

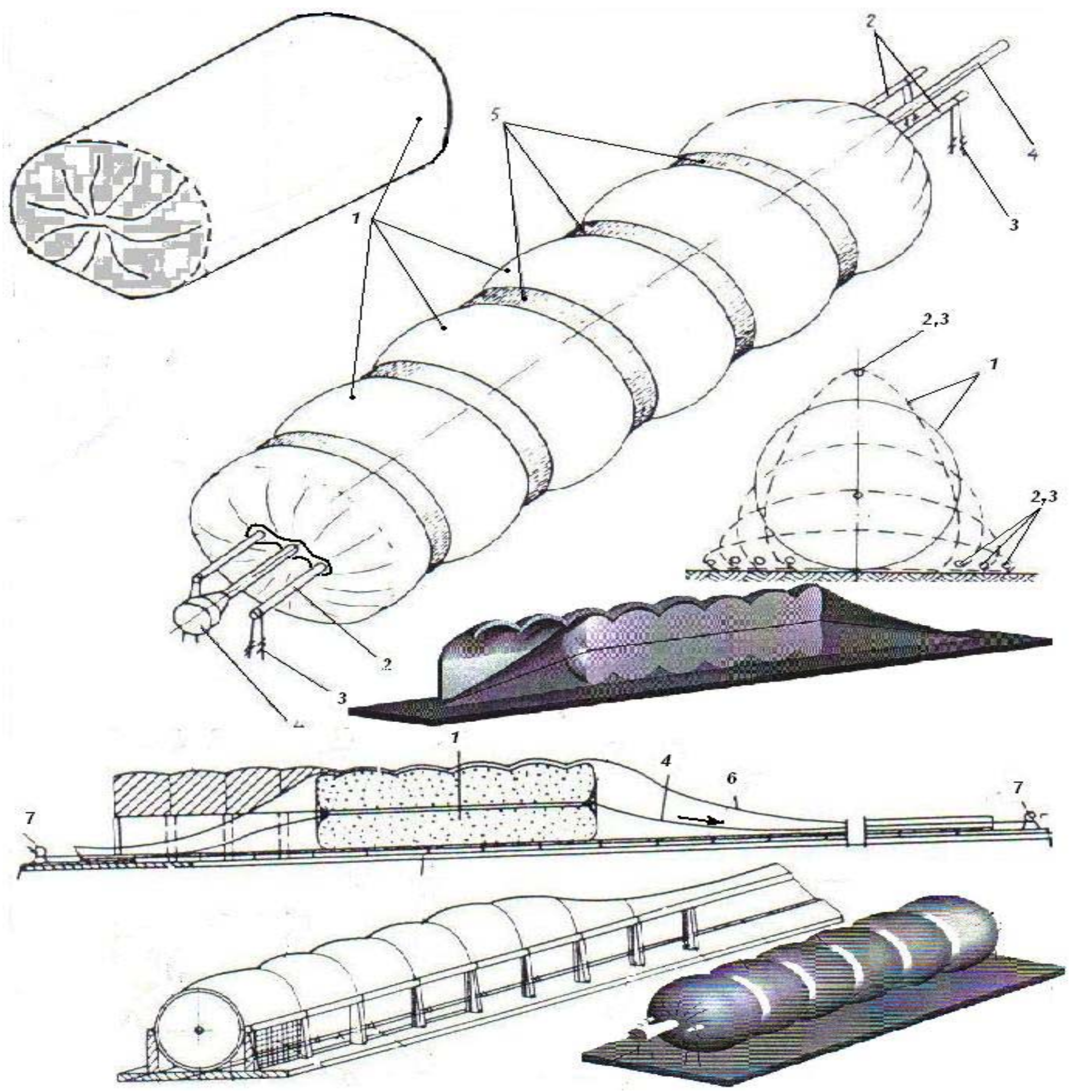



Fig.2  Smooth (top left) and multiwave inflated torus formwork
1 – thin soft torus shell (inflated torus formwork); 2 – tubular supports; 3 – tubular anchors; 4 - thickened cable for eversion and relocation of the torus into a new position; 5 – non-stretchable soft-fabric collars; 6 – soft guiding hose; 7 – winch.
Items 2 – 7 are not indicated on the smooth inflated torus formwork.

Inflated torus formwork (1) for erection of very long buildings by fast methods is moved bay-to-bay in the protective long-length soft hose (6) manually or with a winch (7).
Fig.2 shows options of using inflated torus formwork for concreting of buildings in trenches (cut-and-fill), on the open surface, to ensure required geometries.

Besides, inflated torus formwork (further “ITF”) has a significant advantage of easy form removal without reducing excessive pressure inside the form.

When a force is applied to the end of the ITF, the latter moves to a new bay without any friction against the concrete surface of a vault coming off the vault contour only to make a turn, which requires just a slight effort. ITF is easy to cut out and fabricate using conventional techniques (gluing, welding, etc.).
ITF has a simple design, a light weight and allows to erect the least material-consuming vaulted buildings using a bend method, a spray-on method or a combination thereof.
It is advantageous to use inflated torus formwork for making multilayer (sandwich-type) structures of long objects where it is important not to spend much time on formwork mounting and dismounting.
It should be taken into account that for small structures (with less than 6 m span length) such as residential house utilities, garages, summer kitchens, pump and compressor shelters, etc., it is reasonable to use smooth inflated torus forms, while for 12-36 m long buildings multi-wave ITF are recommended since they are less material-consuming and more robust, compared to smooth vaulted ones, and as such may be used for construction of vegetable stores, equipment houses, workshops, hangars.
For a large span length, the first shell made, for instance, of glass-reinforced cement may be used as retained hard formwork. Then pre-calculated main reinforcement is placed over it, and the second, more robust construction layer, is formed by one of industrial methods, e.g. the spray-on method. After that heat insulation, protective screens, damp-proofing, etc. are established by a similar method, and so on. The list of buildings that may be constructed using ITF can be extended.
To retain inflated torus formwork, we suggested that an inflated torus made of rubber or otherwise be moved in a non-stretchable hose made of soft fabric, film or leather, if smooth cylindrical surface inside the building structure is needed.
Or, vice versa, the protective hose can be made of stretchable fabric while the inflated torus is made of fabric with accurately defined stretchability to obtain shells of a multi-wave shape. The inflated torus may be easily moved within the hose in a needed direction.

Apart from the cylindrical shape, inflated torus formwork can be made as a truncated cone to be used for concreting curved roofing elements of small buildings, cottage attics, shelters and other constructions. Introduction of ITF eliminates the need in precast structures and cranes of large carrying capacity for construction technologies, especially in remote areas.

It should be noted that for buildings with span lengths exceeding 9 m a critical factor is not so much the robustness of the "shell" as ensuring its strength against permanent and temporary loads. To ensure the vault strength either salient or buried stiffening ribs should be set with a pre-determined pitch. For soft inflated formwork there are two ways to make a form for stiffening ribs:

1. The whole inflated torus formwork is made of elastic stretchable airtight fabric with required working pressure. The fabric is strapped across the ITF with non-stretchable fabric straps following a pre-determined stiffening rib pitch (Fig. 2). In some instances the fabric is strapped along the ITF to establish longitudinal stiffening ribs.
2. Twin ITF is made, in which case the working medium (compressed air, foam or water) is contained in the torus made of sheet rubber similar to a football (e.g., 0.5 mm thick) or of elastic airtight fabric. The torus is placed into a long (2.5 – 3 torus lengths) hose where it will move by rolling in the direction or by the slope of the hose orientation. The hose is made of strong non-hermetic fabric with adhesion properties such as nylon impregnated against concrete sticking and performs the ITF force function, namely, prevents the torus inflation to go beyond design sizes.

The ITF operates as follows:

A long hose is put on a prepared support base along the axis of a building structure. Inside the hose there is a soft elastic torus capable of moving (rolling) without friction in a desired direction from one concreting bay to another by means of a cable using a method of concrete spraying onto ITF and a concrete type of needed stripping strength. A continuous concrete placement mode is ensured by proper choice of the torus length such that while a concrete portion is cured in its middle part, concrete spray on the remaining length may be continued after the end part of the torus has rolled over to a newly formed bay. This is done without reducing the speeds of concrete placement and construction.

Fig.2 shows a combined method of construction of long buildings when a wall carcass of reinforced concrete columns is erected on a precast foundation prior to construction of the vaulted part of the building. The supports for the vault between the columns are ensured by vault thickening immediately near the torus floats fixed on the hose.
Concrete is sprayed onto the vault after or before the walls are erected between the columns dependent on a column pitch.
It should be noted that given a large height of columns supporting light-weight floors and ceilings without crane loads, it is possible to use hollow reinforced concrete pipes or fiber-concrete pipes the roots of which are embedded into the base and concreted (like a Cobi pile ) by means of pneumatic concreting. Hollow pipes may be fabricated with a rotor technology directly at the construction site by means of shotcreting, and augmented section-by-section to a required height using inflated toruses [11] with subsequent grouting (if required) directly at the erection place (Fig. 3).

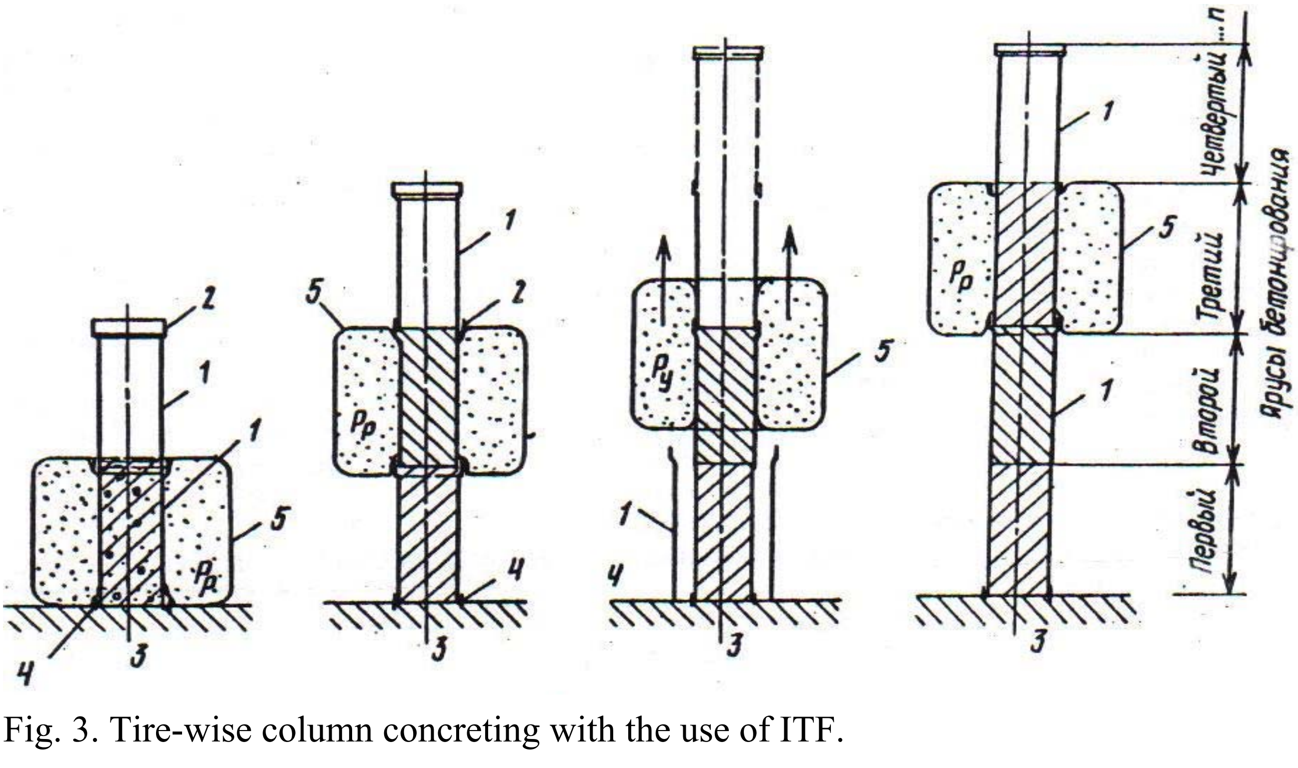



Fig. 3. Tire-wise column concreting with the use of ITF.
*(First, second, third, fourth – concreting tires)*

***Blockouts***

Using the ITF, it is possible to complete pre-construction works in a shorter time including zero cycle facilities laying. The ITF makes it possible to concrete 0.5 – 3 m diameter pipes for gulleys, heating mains, sewerage, irrigation systems and compensate the shortage of metal or reinforced concrete pipes or eliminate them at all.

In this case one can do without pipe joint packing, transportation vehicles and cargo handling facilities. With ITF and fixtures these pipes may acquire any cross-section shape to reduce hydraulic resistance of water and increase their throughput.

ITF makes it possible to implement adapters and bends of concrete pipelines easily and effectively by following the guides (formwork slope or bend supports) running through the formwork.

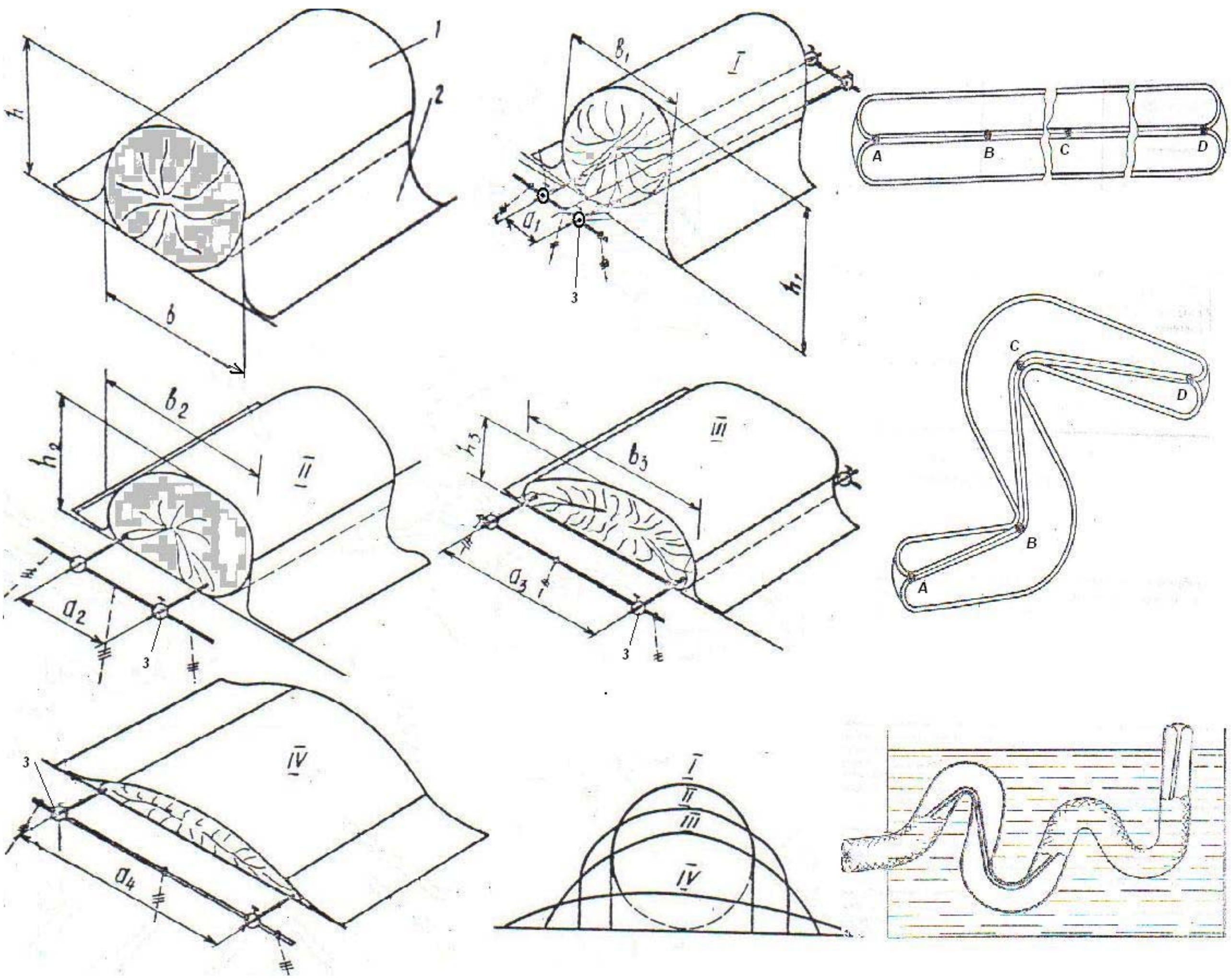



Fig.4 Smooth ITF

1 – toroid; 2 – lean-to elements; tubular supports

Fig. 4 shows a smooth ITF [10] in which tubular supports are entered into its central part (torus) with their subsequent, for instance, parallel separation to obtain required span length and arch rise.
If we move the supports apart from one another and fix the ITF to the base, then on such a framework we can harden the roofing (shell) in the form of a truncated cone of a variable span length and the apex height along the longitudinal axis of the building.
A non-supported inflated torus form has a shape of a long cylinder and possesses exceptional properties distinguishing it from other formwork types. Reduced at the top by the shell, the ITF, when inflated, is easily everted without friction against the shell and thus can be saved for future use, which makes it cost-efficient in use.
To evert the ITF, it is sufficient to apply an external force to the eversible ITF end parallel to the torus axis.
The simplest eversion facility is a rope thickened at one end. Depending on the ITF diameter size, the elastic toroid is everted manually or with a winch.
Secondly, the elastic toroid is easily bent in space in all three directions and retains an obtained configuration without any supports (by means of friction in bend places). By using this feature it is possible to leave channels of various configurations in monolithic concrete for running utilities or leave voids for future anchors [13].
A hollow ITF is prevented from floating up in concrete by internal and external holders. A utilities duct, etc., may be placed inside it.
Given below are some examples of using a single inflated torus for construction purposes:

- erection of buildings with different span lengths and pendentives, see Fig. 5: top left – covering an open subway line; bottom left – a structure erected in a cut-and-fill [10];
- crossing water obstacles during a construction period;
- for bridges over small rivers and creeks by carrying construction materials through a pipe (pipes) laid in the torus cavity.

Fig. 5, the right view, is a cross-section of a gully over which an arch bridge is built by using an inflated torus to let transport vehicles through. Construction of conventional wave protection stone-fill dams is widely used in hydroengineering building practice.

However in this case torus structures can be also used to simplify and, what is more important, speed up dam filling work.

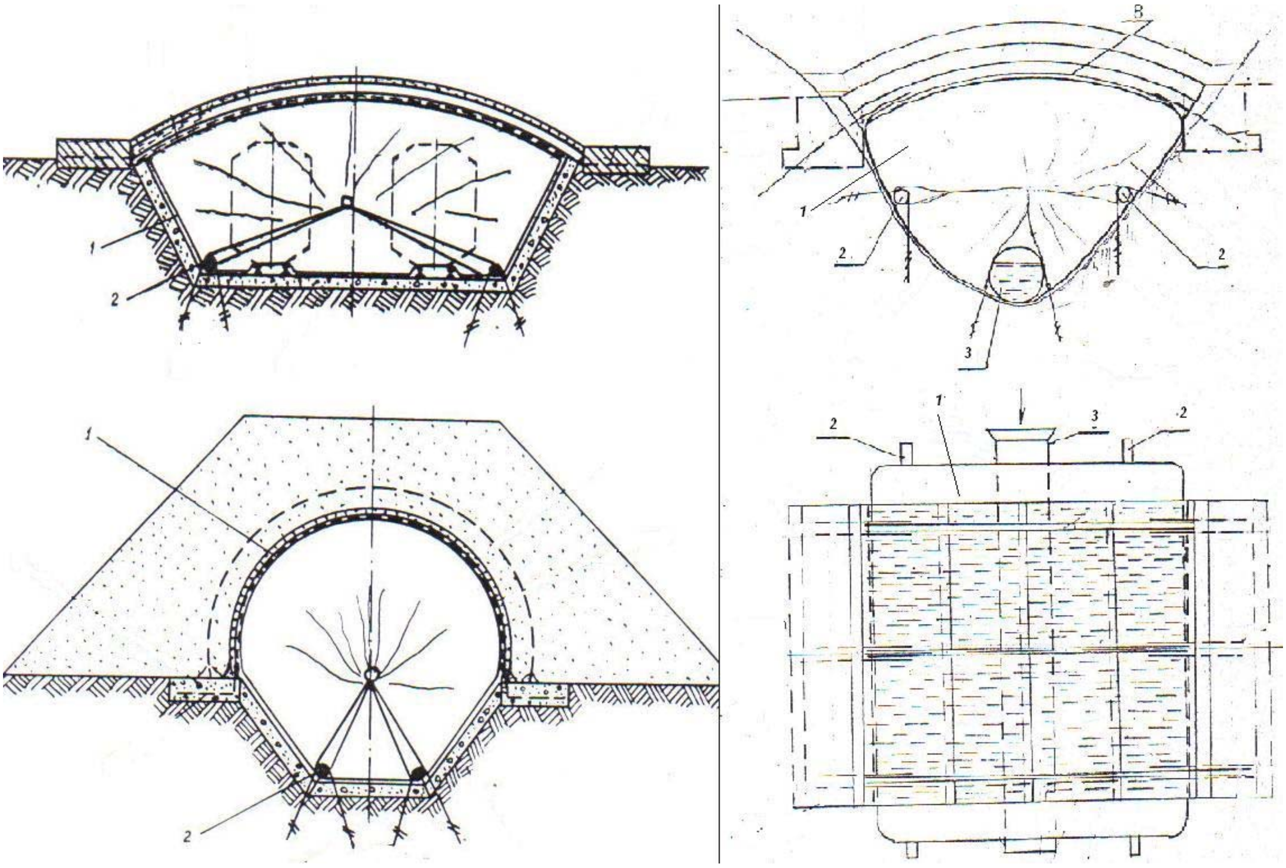


Fig. 5. Examples of using a single inflated torus for construction of building structures with different span lengths and pendentives.

1 – inflated torus, 2 – tubular supports, a pipe for water flowing (a creek).

***Using Torus Technology Methods for Construction of Hydroengineering and Auxiliary Structures***

As was shown above, the use of inflated torus formwork makes it possible to erect various purpose land building structures quickly and with good quality, particularly in areas remote from big construction industry centers. Tools used for spraying a hardening mixture onto ITF are well known to builders. Using ITF, a single spray-on methodology may be used for implementation of not only a load-carrying shell but also to make dampproofing, protective screens, heaters in the form of, e.g. asphalt foam or urethane foam, dyes of any color, etc. Apart from industrial and civil engineering, ITF may be successfully used in military and civil hydraulic engineering (under field, restrictive and extreme conditions).

***Torus Protective Dam***

An inflated torus may be successfully used as a dike to protect the offshore strip from wind onset or heavy sea.

Fig. 6 shows an axonometric view of a soft elastic airtight shell [15]. The shell is made as a cylindrical torus secured to the dam apron with a single pipe tucked into the inflated torus; the pipe uniformly clamps the inflated torus to the apron by clamping elements without affecting its integrity. This supporting pipe is secured only to the abutments and does not move. The other two dam supporting pipes are moveable to provide a required height and shape for the dam.

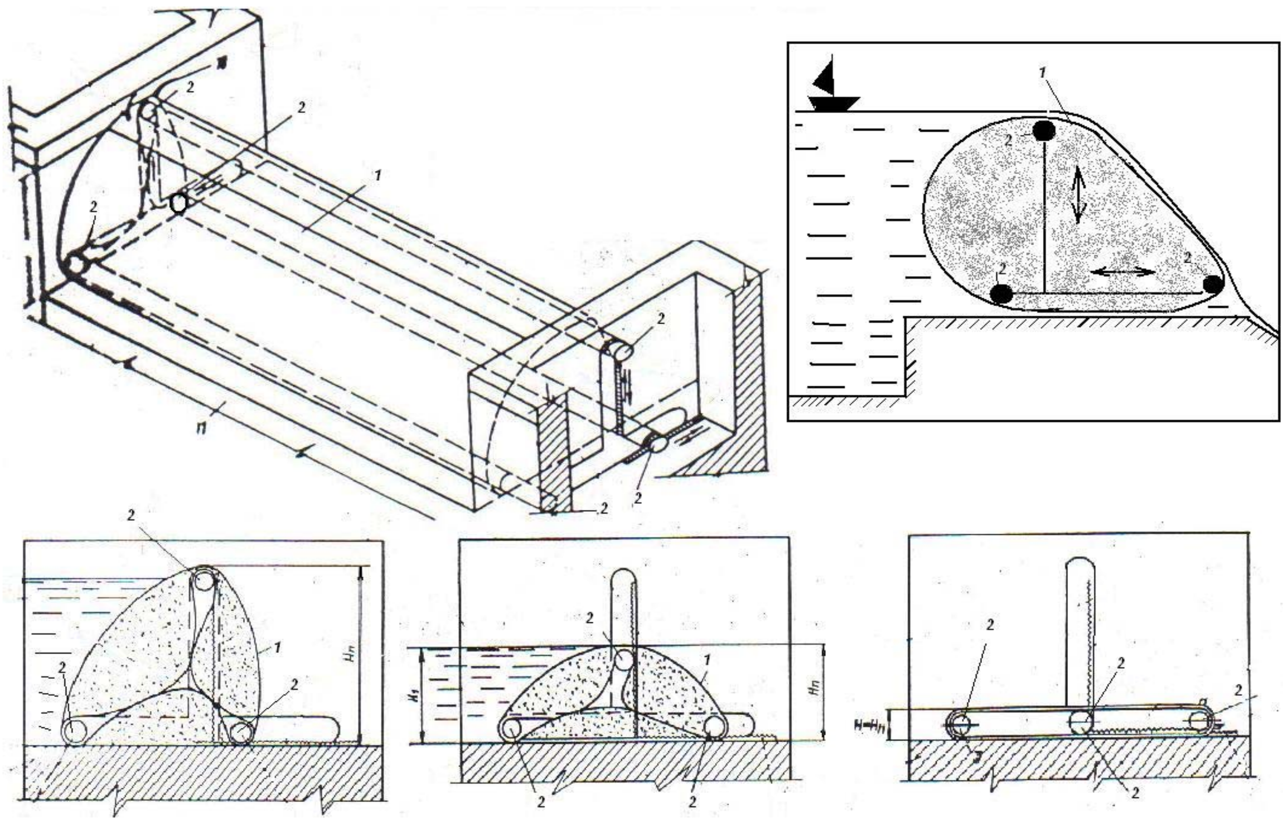



Fig.6 Torus protective dam: 1 – the torus; 2 – supporting pipes.

Fig. 6 is a cross-section of this dam in different application positions.

The dam has an elastic shell 1 shaped as a toroidal cylinder located across the channel between the abutments.

The cylindrical torus is made somewhat longer than the distance between the abutments such that the shell is hermetically sealed at its ends by a tight contact between the shell and the abutments when it is filled with working medium. Through the internal through-hole of the shell, i.e. the central part of the torus, at least three (3) rod drives are passed working primarily in the horizontal and vertical positions.

The drive is selected dependent on particular conditions and may be a rack-and-pinion drive. The shell is connected with a pipeline for feeding working medium, e.g. air, and a heat sink pipeline, both interconnected with the working medium source. The dam body is placed on the foundation, hermetic sealing over which is ensured by fixed securing of the left part of the horizontal drive and by pressing its shell to the foundation.

The dam is operated as follows:

As the dam gets filled with working medium and the drives are moved, the cross section and the height of the dam change.

Such a dam may be used as a flow controller in channels, as a water elevation dam, as a protective breakwater dam, given proper calculation and selection of needed cross-section shape as well as placement of bubble-pipes on the apron.

In the future it might be possible to discuss an issue of including an inflated torus dam into a complex of structures for conversion of wave energy to reciprocal movement with larger area of contact with waves.

An inflated torus dam can protect a water area against waves of pre-calculated height in storm weather and let ships into the water area when there are no waves by driving the dam into a non-operation state

A group of inflated toruses may be used to establish anti-wave protection by securing holders in the form of pipes and cables directly to the water area bottom by means of special anchors. Compressed air (or water under excess pressure) fed into torus shells forces soft protective elements of the torus structure to lift to a needed height at the beginning of a storm thus ensuring protection from the water area waves or making them deviate in a required direction. In such events cylindrical torus shells are second to none among known soft dams and soft fabric obstructions.

Torus dams may be used for water head accumulation in order to create, when needed, a wave that sweeps away everything in its way in the tail bay and floods low areas.

***Torus Elevation and Lockage Facilities***

1. An inflated torus may be used as an elevation device to lift tall open-work constructions such as built-up towers and alike [12] (Fig. 7).

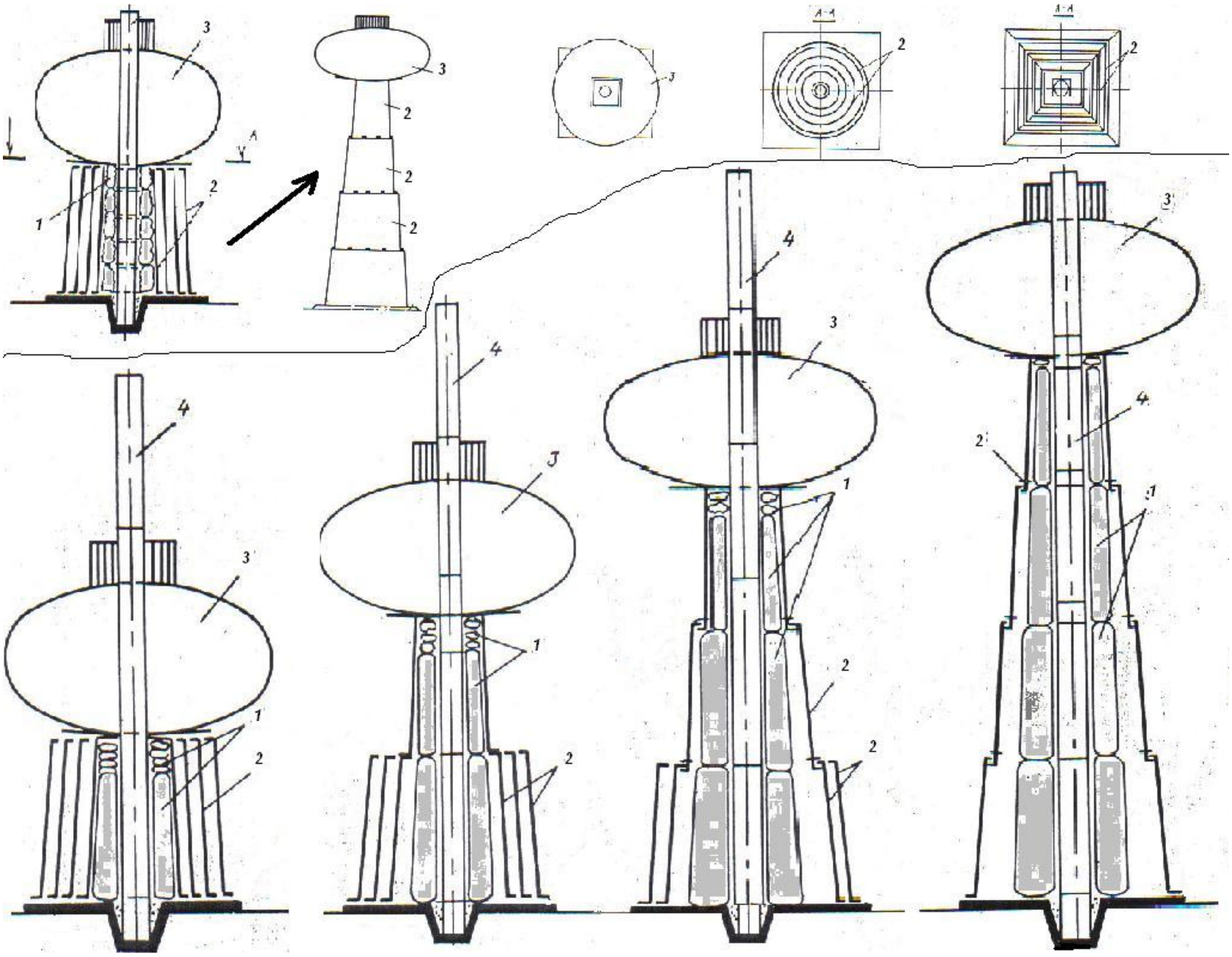


Fig. 7 Torus elevation device

1 – inflated torus; 2 - telescopic sections; 3 – a container elevated by the torus; 4 – a guide post with toruses (1) “beaded” thereon.

2. A cableway crane with “a balloon” made of a pack of inflated toruses filled with light gas allows round-the-clock dam filling making use, if required, of stationary

nets instead of containers that transform small stones into a filtering mass. The latter is dumped onto the dam from the cableway crane by the end-dumping method and withstands being washed away by waves at least throughout the construction period until a protection ordered-mass layer is deposited.

Such a solution makes it possible to eliminate motor transport consuming a lot of fuel and failing because of wheel rubber wear and tear on the dam stone fill.

This solution is suited for construction of trench-type structures when rock matter is used directly to fill a protection dam rather than be disposed of.

In the absence of rock matter for making a dam it is worth while to consider soft guard options for the water area and combined guard options for particular construction conditions.

2. To feed cargo to an air-support structure the following facilities are suggested (Fig. 8). The toroid is hermetically placed at the media boundary. When the toroid is everted, the central body (cargo) movement velocity is twice is fast as that of the toroid, the cargo is “ejected” and the toroid is automatically brought to the original state.

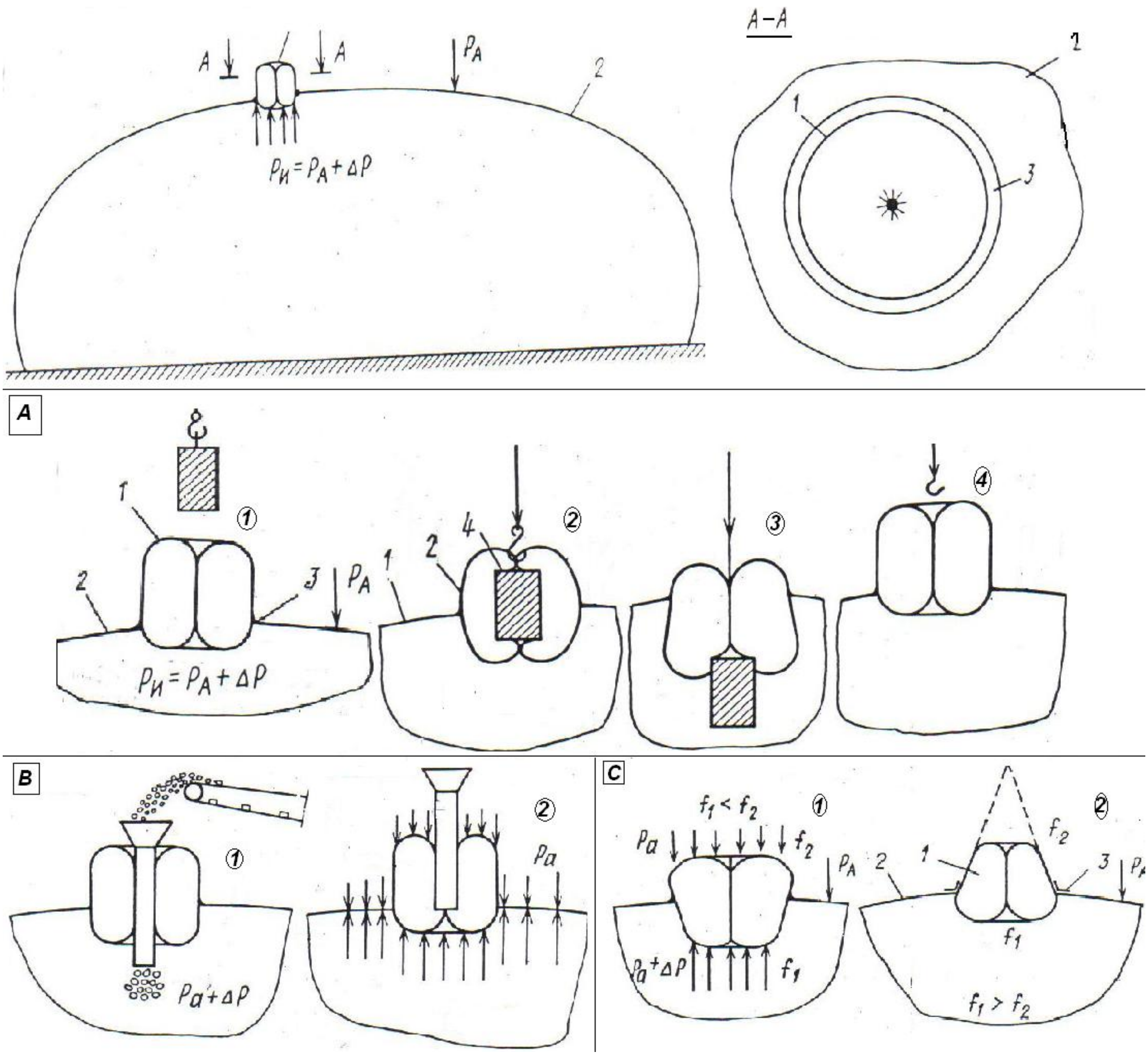



Fig. 8  A facility for cargo delivery to an air-support structure.

A. Loading the facility for feeding separate items;
B. Feeding bulk cargo into an air-support structure through a funnel.
C. Feeding cargo through a cone-shaped toroid automatically going back to the original position for the next cargo feeding operation.

***Important Supplement***

Inflated torus formwork should be used in combination with other torus machines and mechanisms united with ITF by common principles of development, operation and repair.

Such machines and mechanisms include a variety of torus transport vehicles, elevators, air-operated hammers, pile-driving hammers, pipeline transport, containers, furniture and alike [7, 17-19].

For example,

1. A press for making complex-shaped items from billets.
2. A system for heating (cooling) concrete hoses at low (high) temperature. A twin wall of a toroid with fluid medium of a needed temperature provides vacuum-flask conditions for the concrete hose placed in the central part of the toroid.
3. A system of hose-and-torus channels with heating (cooling) to withdraw viscous-liquid drains from an accumulating tank to a sediment collector. Toroids are used as a non-clog control valve while the passing liquid is withdrawn to sediment collectors.
4. Gates, dock building gates. A property of the elastic shell is used that allows the shell to straighten up in the direction away from its anchoring place when excessive pressure is created inside the shell.
5. Subwater pipeline laying facilities.
6. Ventilation ducts
7. Locking devices
8. Water transfer pumps, compressors. A toroid having a cavity filled with gas or liquid under overpressure is not limited by geometries, while replacement of sliding friction by rolling friction in the cylinder-piston pair allows fabrication of high-throughput pumps for water and other liquids transfers.
9. Hose-and-torus filters of various purification grades. When the inner pressure of the toroid rises, the toroid tightly embraces the central body represented by a soft porous filter with a large dirt holding capacity. This feature of the toroid prevents dirty water leakage at the interface between the filter and the torus. To rinse the filter, the toroid makes back-and-forward movements with simultaneous pressure rises and drops in its cavity thereby squeezing dirt out followed by rinsing in clean water.
10. Hose pipelines
11. Technical facilities and systems for protection of capital structures against impact loads. Special torus shock absorbers to protect permanent structures,

various equipment, special-purpose objects (electrical systems, control and communications facilities, heating, illumination, fire-protection, sanitary and life-support systems) and personnel against technogenic (military) or seismic impact loads.

12. Anti-vibration facilities for permanent structures. Toroids as basic vibration-isolation elements used for vibroprotection of equipment from kinematic effects of load-carrying and internal structures the equipment is placed on, as well as for acoustic protection, etc.

It should be noted that promising results of using torus technologies were obtained in the course of the author's cooperation with architect Dmitri Kozlov, an expert in theory and practice, in the architectural bionics field. This work is concerned with using closed long resilient non-stretchable rods originally carrying flexural energy (loaded with flexural energy) [20-23] (Moscow-Zelenograd, Russia) for fabrication of:

- reinforcing layers of toroidal shell material (Fig.9);
- spatial support and/or ancillary structures allowing a toroidal shell that does not contain fluid medium under overpressure to move by eversion. This principle may be used in next generations of toroidal drivers of transport vehicles.
- structures eliminating use of fluid medium at all, etc.

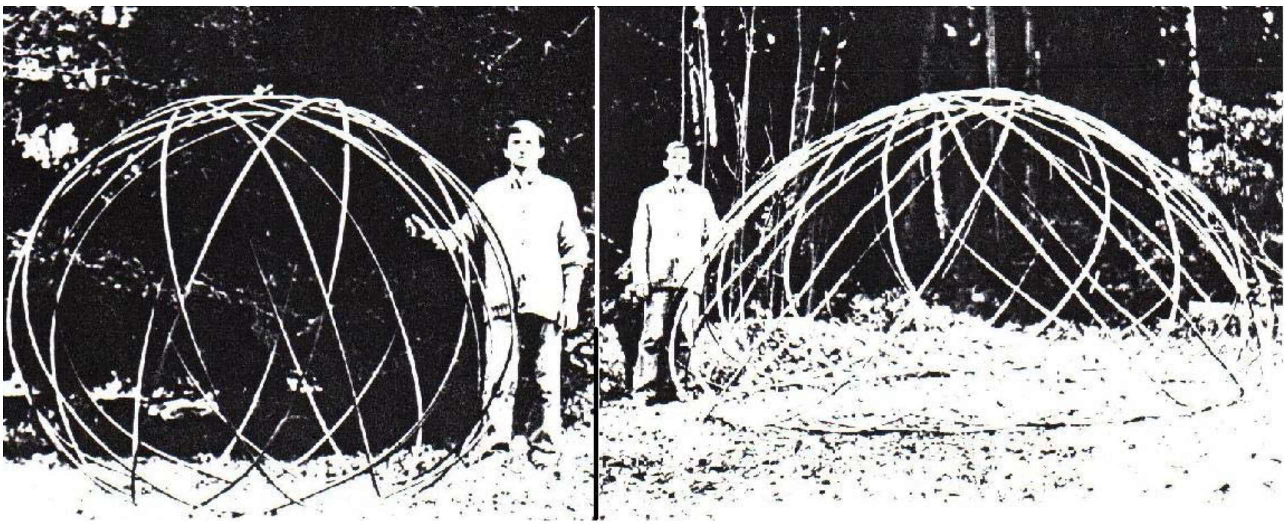


Fig.9 Self-formation of a bulk frame from a flat structure

## Conclusions

Using fast construction methods in combination with torus technologies for construction of land-surface buildings for various purposes makes it possible to reduce construction time from 15-22 years to 4-6 years, i.e. 3.5-4-fold.

The service life of a structure without overhaul for 50-70 years is provided by specially selected curing materials instead of Portland cement-based concretes that are not destroyed at low temperatures (-52$^{o}$C and lower), characterized by high waterproofness (>30) and withstand loads of at least 800 kg/cm$^{2}$. In the Far North areas it is advisable to use slag-alkaline concretes, polymer concretes and other types which improve their original physical and mechanical properties under, for instance, radiation conditions.

Residential and working buildings may have a monolithic construction based on quick-setting robust and waterproof materials such as gypsum-lime-slag cement (GLSC) creating comfortable conditions for living and work as compared to concrete and reinforced concrete buildings.

Gypsum concrete increases formwork turnover 20 times as compared to plain concrete, hardens quickly without energy consumption for steaming, warming up, etc. The waterproofness of the GLSC is ensured by simple methods.

Suggested fast construction methods using ITF allow, in principle, construction of building structures, using the space under the vault of the building and materials of the vault and the foundation; such building structures may include protection screens built by the spray-on method or by setting sheet screens. These methods may be also used for air space protection and diversion of subsoil waters away from the housing and ensure protection against harmful space radiation protection.

Moreover, if needed, during the 50-70-year period additional protection measures can be taken by spraying radiation screen materials onto the building with a special-purpose robot handler (without human participation). The sandwich structure of buildings provides, if needed, higher robustness of the construction by setting additional reinforcement (for instance, in a form of a flat framework) in edges with subsequent shotcreting.

In the preparation period of construction using torus technologies it is important to perform training of construction workers who will deal with ITF, test equipment and spray-on systems.

Special attention should paid to uninterruptible power delivery to the construction site during work with inflated forms. Measures should be taken to provide power to inflated formwork in emergency situations (use of a back-up motor, etc.).

Mastering new fast construction methods using soft ITF can take less time by involving specialists engaged in developments of long-lasting non-destructible fiber glass to be used in different cement matrixes.

It is advisable to fabricate inflated torus formwork at a plant that employs a modern technology of fabric gluing and required equipment for this purpose. This will make the fabrication cheaper and ensure high quality.

Taking into account the fast turnover of the inflated torus formwork, it is sufficient to have two ITF's 20-30 m in diameter.

For laying facility ducts as well as gulleys, drains, sewerage pipes and indents in monolithic concrete, small-diameter and long-length ITF should be used as blockouts in monolithic concrete. Made of special concretes in a jointless monolith, they help to avoid running costs for replacement of pipe sections or elimination of leaks through joints. Torus blockouts are easily fixed, easily laid with a needed slope and bend in both vertical and horizontal planes and save labor costs in construction of the zero cycle of the construction site, being in fact "small-scale mechanization" facilities for formwork jobs at a building under construction.

Huge ITF designed for one-time use may be successfully employed to provide shelter for planes and helicopters as well as for other bulky vehicles against snowdrifts and bad weather.

The ITF cost efficiency means that they are indispensable for construction of the cheapest cold shelters that have a long lifetime and are quick to erect.

The ITF structures have a wide range of applications at the construction site.

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