TVD PROCESS-a high quality building process

Vladimir Sigmund  
University J. J. Strossmayer, Department of Civil Engineering, Osijek, Croatia

Darko Sigmund  
“Sigmund” d.o.o, Zagreb, Croatia

Stjepan Takač  
University J. J. Strossmayer, Department of Civil Engineering, Osijek, Croatia

Abstract:  
Fast and economical, TVD &Transformable Variable Design”) system is a simple and performing high quality building process, which can suit any architectural shapes and standards of buildings, from social housing to luxurious habitations, with the same high quality work, especially with regards to finishing, thermal and sound insulation. The TVD System has been developed for any types of constructions with all the characteristics of the ones made in the traditional way. It unites planning and building in full compliance with end-user's wishes at minimal cost and in the shortest delays. The concept is simple: the available building materials are so modified that several building phases are integrated, without the use of sophisticated machines nor qualified workers.

Fig. 1 TVD building envelope
The basis of TVD System are „Thermo- Panels”, building elements that enable quick structural erection and satisfy structural, physical and ecological requirements. They consist of a prefabricated electrowelded steel frame and thermal insulation, dry-set and completed „in-situ” with a spray concrete. The panels serve as forms for vertical (flat or bent) bracing walls made out of spray concrete. Industrial production of panels, combined with the use of the typified connections and specially developed tools enable precise and quick building completion according to the project. Buildings constructed in TVD System are low energy houses, nature friendly and ecological. The TVD process as the complete building process been patented.

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TVD PROCESS

TVD process utilizes modern materials and methods, coupled with mechanization and rationalization of building in all its phases, from planning and design to site preparation and structural erection.

Building costs are successively monitored from the beginning to the end, which contributes to a cost reduction and a system optimization. This closed management system with its fully integrated specific software leads to:

* increasing productivity and progressive shortening of erection time;
* lowering non-productive work (form and shuttering works);
* suppressing heavy machines on site;
* diminishing need for qualified workers;
* enhancing high building quality with respect to its structure and finishing works;
* gaining usable area (reducing thickness of walls implies a better coefficient of brut/net area);

Maintenance

* maintenance is limited and easy;
* energy costs for heating and cooling are reduced (TVD=low energy houses);
* together with low pollution (lower CO2 emission-TVD=environment friendly houses).

TVD design

TVD is based on modular co-ordination of measures. The basic module is 30 centimeters, the structural module is 3 or 6 meters. A great structural flexibility is assured by using various structural systems:
- wall-sandwich panels in both directions;
- wall-frame structures with openings;
- skeleton structures;
- infill elements for other structural systems (lattice work, skeleton structures, etc.).

All structural systems have a stiff slab structure for force transfer in horizontal direction.

**Standardized** vertical and horizontal connections of the panels are specifically designed to enable force transfer in both directions and prevent cold bridges (direct contact between outer and inner wall sides).

These combined elements form an efficient soundproof envelope offering an excellent protection against climatic conditions, a good resistance to fire and earthquakes.

![Fig. 4 An outline of the TVD design](image)

By coordinating design, flexibility of the system and freedom in the choice of finishing elements, building is fully optimized.

**TVD building elements**

The basic building elements are „TVD thermo-panels” which consist of prefabricated steel frame (made out of two spaced inter-connected reinforcement meshes) and the insulation in-between (which during the concrete spraying serves as a caisson), dry-set and completed „in-situ” with spraying of concrete; thus forming a purely monolithic structure with uniformed concrete walls and slabs.

Thermo-panels consist of two spaced reinforcement meshes adequately connected and enclosing insulating foam. Their construction is simple and does not require high energy consumption. The components are usually available on the market as building material.

Welded wires (reinforcement mesh) are standardized web-reinforcing wires. Panel-connections and additional reinforcement bars are made of deformed stainless steel reinforcement bars.
Connections (steel and polyethylene tiles) unite steel-mesh and thermal insulation forming a space truss system for one panel. Polyethylene disk and distance holders hold steel link bars in place and guarantee stability and distance between meshes and thermal element. Thermal element, held in place with the space truss, serves as a caisson for spraying of concrete and eliminates the need of formworks. Thermal insulation gives its physical characteristics to the panel and stiffness it in its erection phase. This foam structure (a) stiffens the lattice and (b) serves as a horizontal or vertical support for spraying of concrete.

**Fig. 5 TVD thermo-panels**
Concrete is at the last stage the load bearing part of the “sandwich” panel wall and has minimal cubic strength of 25 MPa. It is sprayed on the panels in two layers.

There are different thickness of panels for the walls, slabs and base plate, each corresponding to a specific use. Panels are 0.60 to 1.20 meter wide and 2.60 to 6 meters high. The biggest building element does not weigh more than 35 kg and can easily be handled by one single person. The panels are very easy to use and any architectural shapes can be designed and further realized. The four types of panel elements serve as follows i.e.:
- bearing panels for facades and load bearing interior walls to guarantee a static, dynamic stable and resistant structure;
- non-bearing panels for partition and decorative walls;
- slab elements for floors and ceilings;
- base plate elements for foundations.

Industrial production of panels, standardized connections, adapted tools, together with a computerized control of the whole building process enable a quick and precise completion of any building, up to 8 stories high, with very little manual work.

**TVD building process**

1. The panels are industrially produced while the excavations are made. Their quantity and size are fixed according to the project. Once on site, the panels are directly assembled with high precision. Through unification, work is simple, repetitive and quick, including spraying of concrete. Final phases, usually done after completion of rough works (plumbing, insulating, electrical installations, plaster, rendering works, doors and windows) are already provided.
Fig. 6 An outline of the TVD construction process

The use of special equipment for erection and classified connections reduces in-situ works are reduced and room for improvisation -and failure- is thereby limited.

2. Openings for windows and doors are precisely cut out before the erection of panels. Around the openings reinforcement is added (when needed). Special forms are placed in the openings and connected to the mesh reinforcement to keep the openings during the spraying of concrete. As an alternative, windows and doors are fixed in advance and directly connected to the meshes.

3. Panels are connected to the foundations with anchor bars and in-between with special links which enable unified work of panels in the wall. Additional wall reinforcement (if required by the structural analysis) and splice bars for slabs/walls connections can easily be added at this phase and connected to the mesh reinforcement. Various panel/panel and panel/slab joints (structural and non-structural) are standardized so that the whole procedure is unified and therefore simplified.

So the floor built with the panels is stable enough to serve as a caisson for the spraying of concrete. Shuttering and strutting are not necessary.

Fig. 7 First phases in TVD building process
4. Plumbing and electrical installations, together with related boxes, are fixed to the meshes. Insulation already exists.

5. First coating with concrete is done with aggregate mixture (0-6mm) with rough finishing for the better adhesion of the next coating.

6. Placement of ceiling slab structure and equipment for slab finishing. Joint starter and splice bars (slab/wall and wall/wall) are added. In these phases slab strutting is needed.

7. Casting of intrados and extrados of floors and upper beams.

8. Second coating is to be carefully carried out in order to have a uniform finished surface and the required wall thickness.

For the next floor phases 2 to 8 are repeated.

Fig. 8 Last phases of the TVD building process for one floor

Inner and outer finishing of the walls as flagging, painting and wallpapering works are the same as for traditional buildings.

References: