Building technology for mass concrete tunnel form method

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ABSTRACT

When there is a need to build a lot of buildings and housing, the bulk of the industrial practices of planning, managing and coordinating the development of related industries is available. One of the systems in large industrial tunnel form system In this paper, the use of concrete in construction of the system is discussed. Characteristics, capabilities and limitations of the architecture of the system and the behavior of the structure against earthquakes, fire and sound insulation scheme has been studied. According to studies of the economic tunnel system running fast and clump that causes small projects can not be justified. System shows, the durability and resistance to seismic well and suitable resistance to moisture. But freedom is less than some of the systems architecture. System also requires special equipment and skilled labor force is not suitable for use in remote areas with no facilities.

Key words: industrial technology building, concrete construction, tunnel format, capabilities and limitations

Introduction

The need of housing industrialization is important in today's society. In communities faced with the problem of housing, industrial building systems in mass buildings is considered. Tunnel system is one of the best industrial scales in many countries including America, Canada, China, Turkey etc. And Its use is very common. Tunnel system for buildings with load bearing concrete wall is used. It will fit within the dimensions used in space are selected. This method, in addition of increasing the speed and quality of performance, improves the structural performance and seismic behavior of structures. In some cases to increase the ease and speed of implementation, non-structural components such as walls dividing, stairs and panels as prefabricated are considered. Then, It is connected to the main structure, which is not recommended about stairs structures. The disadvantages of this method are limitations in the design of interior spaces. It is necessary to do designations in accordance with the limitations of implementation in the category of dimensions and modular tooling and template making. In the tunnel template method, the form of machinery and tools is essential. In the overall tunnel system method, the roof and walls performing is done in one step. And the number of openings is equal to the number of items that will reduce construction time and costs involved. In semi-tunnel method, roof and wall separately are framing and concrete covering. And due to simultaneous use of templates, a lower volume of templates are used which in addition of increasing the construction time, possesses economic benefits. The system of reinforced concrete structures subject to the provisions of 9-topic of national regulations of Building, concrete instruction of Iran (ABA) and the instruction of AC1318 of America. [1, 2, 3].

Figure (1) shows that the Azaran concrete tunnel system project of Tabriz has been implemented by tunnel system[4].

Tunnel system design requirements:

2-1 - Architectural Requirements:

From the striking architectural design standards for concrete structures can include tunnel system.

• The linear block and parallel projection installation up to 1.5 meters of backward in each row due to easier tower moves. If the towers move as rail, maximum ground slope should be 1%.

• In front of the block to be placed on the minimum and maximum distance of 17 meters should be proportional to the path tower.

• If the under-ground is needed, it is better to separate the ceiling and wall of concrete to be used in these classes. Or if you use a template to build a tunnel under the ground, because of the space needed to move the templates, This space can be used to develop the land in the area.
• The size of the tunnel opening is between 3 to 5.5 meters and a maximum depth of 6 m for tunnel in each direction is also recommended.
• In up to 4-storey blocks, plans design should be perpendicular to the sides of the mold from a block away.

In blocks of 4 floors there is a better plan in such a way that the number of shear walls in both directions perpendicular to each other are almost identical.
• The difference in floor level should be avoided [1, 5,6].

Fig. 1: Azaran concrete tunnel system project of Tabriz

2-2 - Structural Requirements:

Some structural requirements for the design of concrete structures with tunnel system is as follow:
• The compressive strength of 25MP for cylindrical structure and minimum stress of 400MPa for steel is required.
• regular plan and elevation of the building is necessary.
• Applying the maximum span of 5.5 meters for ceiling height, net maximum height of 3m (excluding the thickness of the ceiling) and minimum wall thickness of 15 cm for each class is allowed in the tunnel system.
• If the gap is more than 5.5 meters, using of reverse edge pole in front of the entrance tunnel or increasing the slab thickness is necessary.
• All load bearing walls must be of the same thickness.
• To prevent the meeting of asymmetric structure in the perpendicular direction, using the longitudinal axis of the tunnel within a maximum of 25 m is considered.
• Nominal cross sectional area of structural walls on each floor of the building is below the level of at least 3%.

• Nominal cross sectional area of one direction should be at least 80% of the other direction. [7, 5, 1].

3 - Administrative Requirements of tunnel system:

3-1 - Structural Requirements:

Including structural requirements for buildings in the tunnel template during running, we can point out the follow:
• The foundation of the method used for load bearing walls of the tunnel, there is always the foundation tape in freight weak soil foundation can also be used extensively.
• The first floor ceiling height exceeds the height of the type, elevation than the base of the walls to the foundation that runs the width of the wall thickness.
• The tunnel system, connects the concrete foundation wall and the reinforcing bars embedded in the infrastructure are expected.

To ensure adequate connection between the foundation and walls the distribution of expectance bars, cross sections of bars, Fixity throughout the bends and patch details and reinforced concrete
buildings are designed and should be in accordance with the regulations.

- The format of the galley walls of the tunnel system is used as the base template. For the galley format tape is applied to a height of 10 cm. After curing concrete galley and open forms, reinforcement bars along the walls waiting to be done out of the galley.
- To establish a network within the framework of reinforcement and maintaining minimum concrete cover with a layer of plastic transitions between intervals on bars are used.
- To facilitate the transfer of templates, a podium in front of the classes template should be used so the entrance and exit of template to be done from the podium surface.
- Removing mold by crane and be done with manpower and pry tool [1, 5, 7].

3-2 - Requirements for Concrete:

- Concreting must continually be performed before setting the new layer and the previous layer is poured to provide cohesion between layers and the gap to prevent the coldness penetration.
- Concreting should be done in horizontal layers, each layer with a thickness equal to the desired density and then the next layer is poured. Maximum and minimum thickness of concrete should be from 0.15 m to 0.6 m or 3 times the maximum aggregate size should be limited.
- During concreting, to transport surplus concrete on the roof for avoiding the damage to pipes of electricity, shovel should be used instead of excavator.
- If the performance of concrete in the concrete slab and the slab thickness is less than 10 cm of plastic it is better to use traditional method of compression, unless the tables equipped with vibrators to be used.
- When the density of bar is low in the wall, and the cross section of the template creates enough space, hung pipes or chute can be used for concreting.
- To facilitate concreting actions, the lubricants and super lubricants can be used.
- If the concrete is cold or hot, necessary actions to prevent loss of concrete strength should be done. [1, 5, 7].

3-3 - Installation Requirements:

- All electrical installations maps with architectural maps, structural and mechanical facilities should be coordinated and controlled.
- To prevent expection tubes numerousness and electricity pipes integrity, it is better that the sites of switches built entirely on the concrete walls.
- Investment in cans, walls after the installation of reinforcement and level switches can be done.
- In system of tunnel template, piping is carried out in two stages. Vertical pipes in the walls and then running the pipe horizontally in the ceiling.
- All pipes inside the walls of the tubing are runned between the two meshes of reinforcement and piping in concrete cover thickness is not allowed.
- Pendant chain in location of ceiling lights is predictable.
- The place of key tubes to the canister to prevent the entry of concrete juice into cans keys should be sealing carefully with aquarium glue or adhesive PVC.
- Before any construction plans to study mechanical and structural conformity with drawings, architectural and electrical ensurances should be done.
- Preparation of layout plans for kitchen and bathroom equipment is necessary.
- The gates in the ceiling for passages of chimneys and pipes related to expansion source should be mounted on the roof.
- Styles embedded in the concrete walls and ceiling channels for the passage of air in the cooling system are the water cooler project being attempted.
- For pipes passing through concrete walls and roof sheathing should be marked using PVC pipes [1, 5].

4 - Evaluation of tunnel system features:

4-1 - Characteristics of Economic Systems:

Due to the large volume of concrete slabs require more machinery is needed in the tunnel system. The cost for the five-story building is about 12% and about 9% of the skeleton of the building's 10 floors of concrete. Given that many of the walls of the building in terms of runtime Tunnel are provided, the cost of materials, the walls, ceilings and white concrete structure is very low. For example, five-story structure costs about 68% less.

4-2 - in earthquake-resistant systems:

Framing the walls and concrete monolithic slab roof, tunnel systems to improve the seismic performance. And the continuity of the horizontal and vertical components of each structure is this causes the formation of a cohesive system of detailed plastic delayed and shows a good seismic performance. Disadvantage in past earthquakes shows that the structure of the tunnel system, the prefabricated panels and stairs, which this part is not of structural elements can improve the seismic behavior. Also, observations of past earthquakes have shown that the more uncertain the structure and function of load bearing structural members are more independent, The more convenient and more favorable the seismic behavior of the structure will be. The tunnel system is due to the modular
configuration and many parallel lines of wall to wall, has unspecified degree of structures more than the minimum required. If the tunnel system can be run in two directions perpendicular to disrupt the structure, the more desirable mode of behavior of structures against lateral loads will be achieved. The number of load-bearing elements of the building was adequate in both directions and the supply of uncertainty of system is provided in both directions [1].

4-3 - Resistance against Fire Alarm System:

In general, concrete building on fire behaviors of steel and masonry buildings are compared. Concrete Moisture has a great effect on its resistance to fire. An increasing volume percent moisture, about 5% can increase the fire resistance of concrete. However, further increases in humidity can cause explosion of concrete in fire conditions. Escape stairs on the top five floors of the building is required to issue regulations relating to the three national regulations to be considered [19].

4-4 - Thermal insulation of buildings:

The tunnel system is mainly used as thermal insulation in the walls and ceiling of the hot wall system, and the insulation in the outer wall and viewing capabilities over there. The importance of factors such as thermal insulation required, depending on the type of energy used and the type of construction and operation of the provisions of the National Building Regulations shall be the 19-topic. The easiest and cheapest way to be considered for insurance, thermal insulation lining inside the methods used. The internal insulation of thermal bridges is considerable and also because of the reduced temperature difference between the air outside a concrete wall, the wall can increase the risk of frost. In the case of thermal insulation between two layers run, In addition to the thermal bridge at the junction of the floor and the inner blade, a concrete bridge at the junction makes the effect double [1, 10].

5-4 - Sound Insulation System:

If the main part of the concrete wall, sound loss of the wall can be calculated using the mass law. When the layer or layers of concrete walls, including thermal insulation and a variety of internal and external coating, the voice drop to a concrete wall will increase dramatically. The wall thickness of the concrete layer sound scheme further increases. For double-layer walls, sound insulating significantly is greater and that the crossing seam has been performed using double walls, acoustic meets expectations and does not require further action. The ceiling slab thickness reduces airborne sound interestingly and meets the expectations have been set. The sound of percussion, layers of concrete alone is not filled with a resilient foam layer is completed. According to the terms of issue 18 national regulations, building roofs that degree Sound insulating percussion IIC of 60 dB and more 110-IIC of 50 dB lower for ceilings between floors in residential buildings is acceptable [1, 11].

6-4 - Continuation Application:

Possible changes in the plan to keep the internal components of the facility are non-bear loading. While any change in the load-bearing components is not allowed.

There is no structural damage for systems installation. The use of prefabricated wall panels to cover the building is suitable for its repair capabilities [2].

7-4 - Investment required:

Initial funding for the project with a form of tunnel equipment is highly regarded executive. This is due to the increase in the use of machinery, manpower is needed to start providing sufficient funds for tooling and machinery expected. [12].

4-8 - Effects and environmental impacts:

According to studies, this adverse effect on the environment and the positive things they can do to reduce the execution time, reducing the amount of waste thrown building construction, and ultimately, the environment's prevention loss of energy[12].

5 - Results of one of the industrial ways, presently, by a lot of great Mass builders in various countries including Iran are used, is the run of concrete structures using tunnel templates. The tunnel system has good resistance to earthquakes due to rapidly implementation, leads to a cost-saving in total expenditures. It has good resistance to moisture due to the tunnel system and reduction the construction waste and prevent the waste of running time and energy to help the environment. Number of optimized floors is 8 to 10 floors and the system performance of up to 15 floors or 50 meters is permitted. This system allows a high variability in space and form and does not possess openings and architectural gates. The main weaknesses of the system is to meet the performance expectations of the lack of parking space is required for it to be considered separately. Tunnel system to be used for building projects large and small projects in remote areas and lack of it is not used.

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