HVAC, SANITARY AND ELECTRICAL INSTALLATION SYSTEMS IN COLD FORMED STEEL FRAMING SYSTEM

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ABSTRACT

Decision making process is distinguished by common conventions in open building concept as an industrialised building approach. “Support” includes structural system, “infill” includes non-loadbearing walls, fixed furnitures, finishing materials, HVAC, sanitary and electrical installation systems. In this study; cold formed steel framing system as a new construction technology is distinguished at the level of “support” and “infill” and evaluated in terms of HVAC, sanitary and electrical installation systems. Cold formed steel framing system limited with 3 storey as technologically is prefered in the field of low rise residentials for the reasons of having rapid construction properties, light structural components, potential of %100 recycling of structural components, advantage of energy certification in the context of sustainability and being easy to alterate in use during life-cycle period of the building. Planning of HVAC, sanitary and electrical installation systems at horizontal and vertical plains are being presented for cold formed steel framing system. The effects of above mentioned installation systems to structural system are examined and insulation and vibration solutions in terms of building physics are being shown.

Key Words: cold formed steel frame system, open building concept, infill level, HVAC and sanitary systems.

HAFİF ÇELİK TAŞIYICILI YAPIM SİSTEMİNDE TESİSAT SİSTEMLERİ

ÖZET

Endstrileşmiş bina yaklaşımları içerisinde “open building” konsepti ile karar verme süreçleri ortak kurallar ile birbirinden ayrılmaktadır. “Support” ve “infill” olarak tanımlanan karar –tasarlama düzeylerinde “support” taşıyıcı sistemi, “infill” ise bölücü duvarları, sabit mobilyaları, bitirme malzemelerini ve tesisat ekipmanlarını kapsamaktadır. Bu çalışmada, yeni yapım teknolojilerinden olması bakımından hafif çelik taşıyıcılı yapım sistemi, “support” ve “infill” düzeylerinde ayrıştırılarak, tesisat sistemleri açısından değerlendirilmektedir. Teknolojik limiti 3 kat ile sınırlı hafif çelik taşıyıcılı yapım sistemi, hızlı yapım özelliği, kullanılan malzemenin hafifliği, yapı ömrü içerisinde kullanım aşamasında değişikliğin kolay gerçekleştirilmesi ve yıkım sonrası taşıyıcı sistem bileşenlerinin %100 geri dönüştürülebilmesi nedenleri ile az katlı konut alanında tercih edilmekte, sürdürülebilirlik bağlamında bina enerji kullanımı sertifikalandırmasında avantaj sağlamaktadır. Hafif çelik taşıyıcılı yapıların yatayda ve düşeyde tesisat planlamasında, HVAC, sıhhi tesisat ve elektrik tesisatı çözümlerine yer verilmekte, tesisat sistemlerinin taşıyıcı sisteme etkisi incelenmekte, bina fiziği açısından yalıtım ve vibrasyon çözümlerine değinilmektedir.

Anahtar Kelime: hafif çelik yapı, açık bina konsepti, dolgu düzeyi, HVAC ve sıhhi tesisat sistemleri.

1. INTRODUCTION

Installation principles of cold formed steel framing system is similar to timber frame system (Figure 1). Main difference of these structural systems is; using hollow section conductive constructional steel profile instead of solid section woodwith high insulation value. Wall and floor consist of coming together of many stud and floor joist in an order. Structural steel members have pre-punched holes to allow wiring and pipes to pass through. Moreover, pipes and service ducts are available to pass between cavities of wall studs and floor joists. Installation and alteration of infill systems are easy and rapid due to member properties of cold formed steel frame system. Therefore, maintenance and repair cost occurs less in support system. Decision making process is possible to be distinguished in cold formed steel framing system as support and infill in the context of open building concept.



Figure 1. Cold formed steel framing system
(Photograph by Semih Yıldırım, Houses of Kardelen, Istanbul).

Only diversification of housing can meet diverse needs for space and environment of dwellers who have different economic conditions, life styles and habits [1]. Open building concept enables diversification and adaptation and proposes distinguishing of decision making levels [2].Open building is an organised way of responding to the demands of diversity, adaptability and user involvement in the built environment [3]. In a social perspective it seeks to respond to user's preferences by offering flexibility needed for adaptation of individual units over time. In a technical perspective it seeks ways of building where sub-systems can be installed or changed or removed with a minimum of interface problems [4]. Support comprises structural system, building envelope and staircase of a builing and infill comprises partitioning walls, kitchen and bathroom equipment and all the conduits for electricity, heating, water, and gas, needed to operate the equipment (Figure 2) [5].

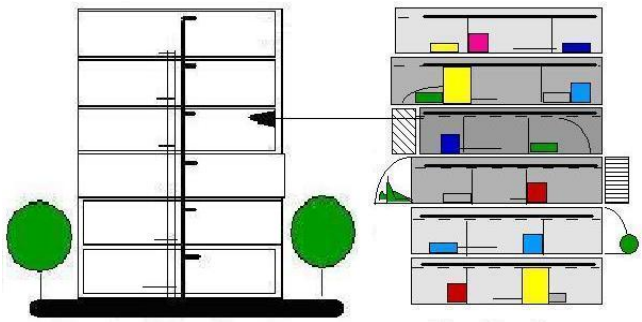


Figure 2. Distinguishing of levels in "open building" concept [6].

2. INSTALLATION SYSTEMS AT INFILL LEVEL

Cold formed steel framing system is examined at fit-out (infill) level in terms of installation systems in this study. The study comprises horizontal and vertical planning of hvac, sanitary and electrical installation systems.

2.1 Horizontal and Vertical Planning

Installation of cold formed steel framing system depends on a defined modular coordination. Pipes and wires run at cavities of wall studs and floor joists, after installation of structural system according to modular coordination rules. Moreover, cutting holes on structural members to accomodate services is possible due to specifications (Figure 3). Sanitary fixtures can be mounted between the studs either at load bearing and shaft wall (Figure 4).

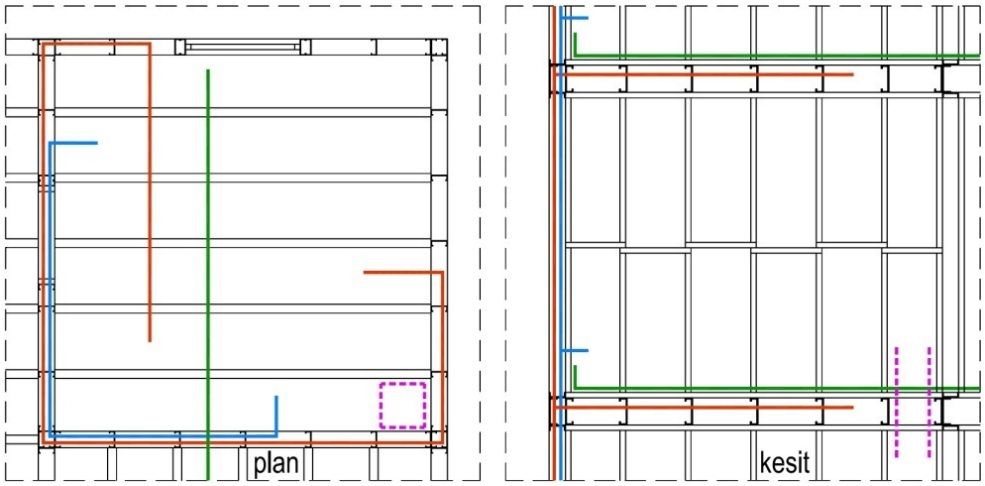


Figure 3. Planning of installation systems at layout and section.

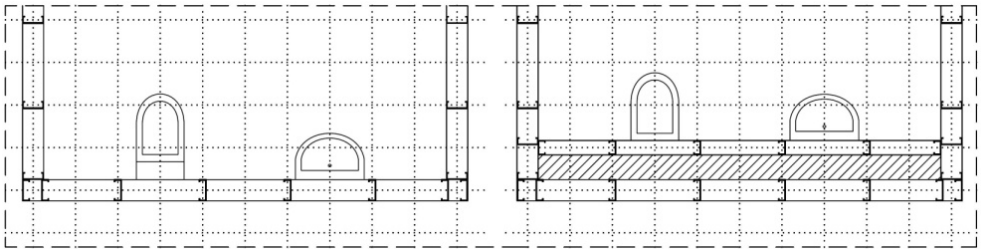


Figure 4. Sanitary fixtures between studs on loadbearing and shaft wall [7].

2.2. HVAC System

HVAC ducts pass through istallation shaft at vertical plain and false ceiling at horizontal plain. Furring out wall is added if the passing between wall studs and floor joist is not available. Heating pipes are laid over floor covering OSB at horizontal plain and so, these pipes are not effected by support system. A vertical shaft is required for grouped pipes coming from heating center to transfer upper storey(Figure5).



Figure 5. HVAC planning and piping on floor for heating
(Photograph by Semih Yıldırım, Houses of Zeytinsuyu Tepesi, Istanbul).

2.3. SanitarySystem

Potable water pipes can be accomodated through pre-punched cut holes in horizontal and vertical structural members without pre-planning, because of having been small diameter of these pipes. Conversely, it is difficult to accommodate waste water pipes through cut-outs, since having bigger diameter of pipe section. Therefore, it is suggested to be planned as 15 cm instead of 10 cm for load bearing or non load bearing wall thickness adjacent to toilets and baths. Sanitary fixtures require strong support such as blocking or sheet metal between supports (Figure 6 ve 7). Connections are fixed to these supports. If requires for fixing of these fixtures, furring out wall is furnished. Water resistant gypsum board or etc. must be used at service shafts.

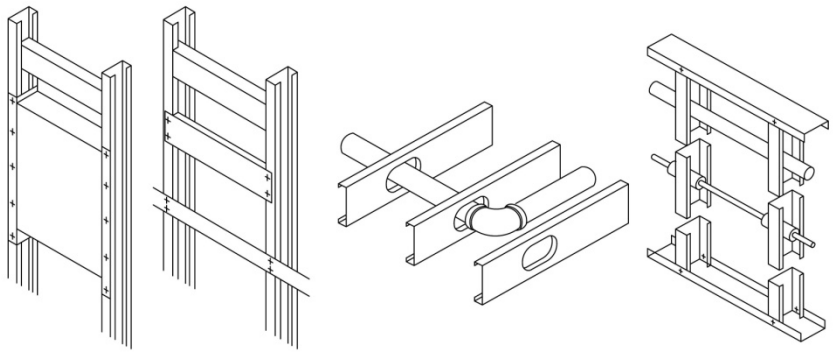


Figure 6. Plumbing on wall and floor [8].



Figure 7. Samples of potable and waste water pipes
(Photograph by Semih Yıldırım, Houses of Zeytinsuyu Tepesi, Istanbul)

2.4. Electrical Wiring

Plastic grommets must be used in all holes through studs and joists to protect plastic pipe and to protect metal pipe from exposure to dissimilar metals which can lead to corrosion. Standoffs prevent contact of the electrical wire with the stud and must be used when the wire runs parallel to studs. Electrical sockets must be fastened to the web of studs at the level needed on the wall. While installation, these sockets must be accommodated adequately as not to be effected by each other at fire circumstances(Figure 8).

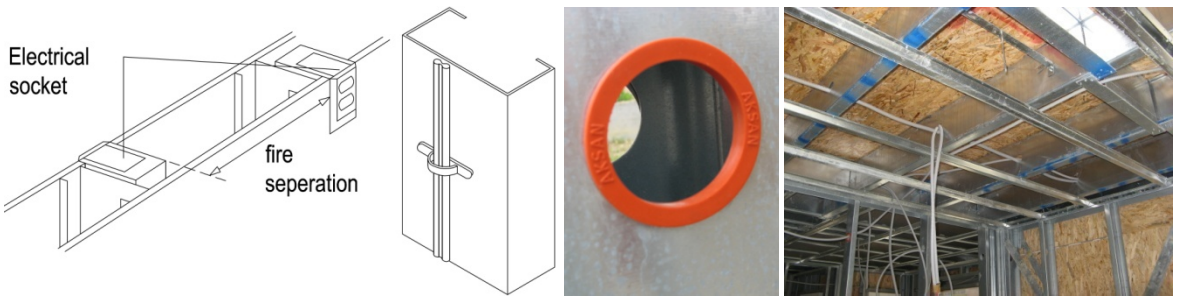


Figure 8. Electrical wiring on wall and floor
(Photograph by Semih Yıldırım, Houses of Kardelen, Istanbul).

3. EFFECTS OF INSTALLATION SYSTEMS TO STRUCTURAL SYSTEM

Horizontal and vertical planning of installation systems as infill system must be considered with support system. Lining up and accomodating at centerline of web of the framing member all the pre-punched holes to facilitate easier installation of services must be done. Flanges and lips of studs, joist or track must not be cut or punched. Holes must not be closer than 60 cm to an adjacent hole in the same member and circular holes must not be wider than 38 mm and longer than 102mm. Galvanized section of profiles must be protected by grommets at cut-out holes. Web holes violating any of the requirements of load bearing must be patched with a solid steel plate (Figure 9). Covering material of smoke pipe must be considered during design phase since having high conducting value of constructional steel members. Cement board is preffered for this kind of usage because of having fire resistant properties.

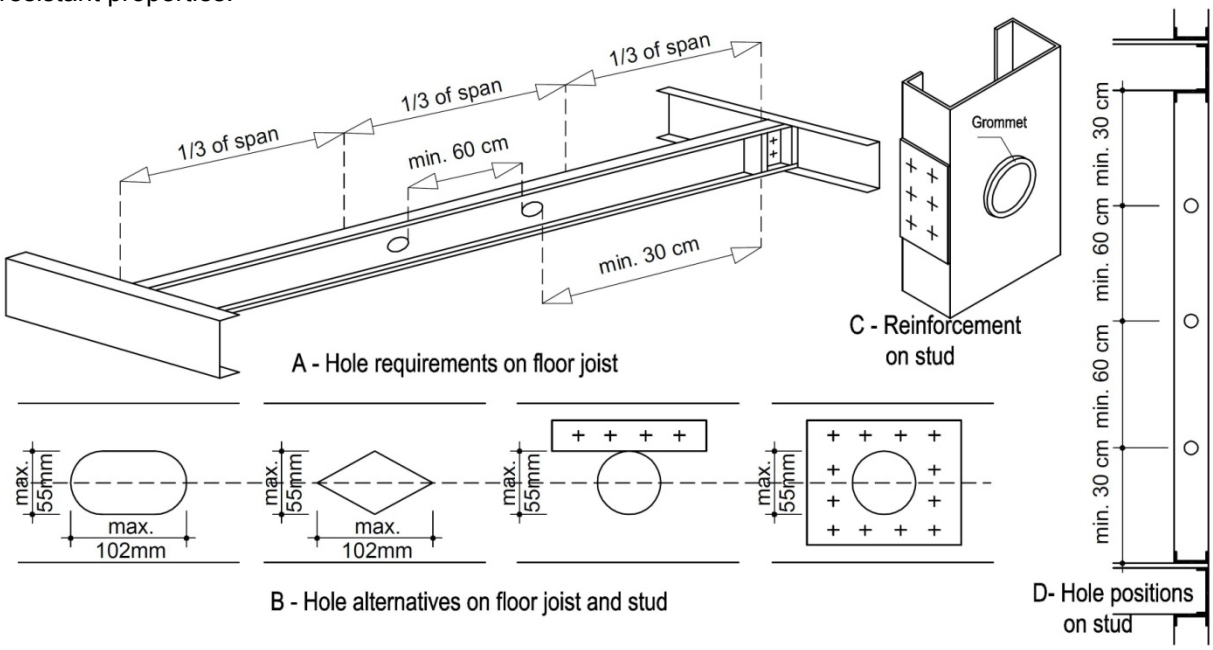


Figure 9. Cutting holes to accomodate services on wall stud and floor joist [8] [9].

4. INSULATION AND VIBRATION SOLUTIONS IN TERMS OF BUILDING PHYSIC

Building envelope must be fully covered by heat insulation in order to avoid cold bridge on constructional steel members, since having been high insulation value of the steel. Vapour barrier must always be installed on the warm side of the insulation. Covering on structural members of ventiduct and connections of these coverings at wet areas must be smoke and air impermeable. Sound insulation must be supplied at service ducts to reduce noise and vibration. The detail as shown in figure 10 is applied against vibration as a typical solution. When required, precautions can be increased by using or adding trapesium sheet, etc. over sub-floor.

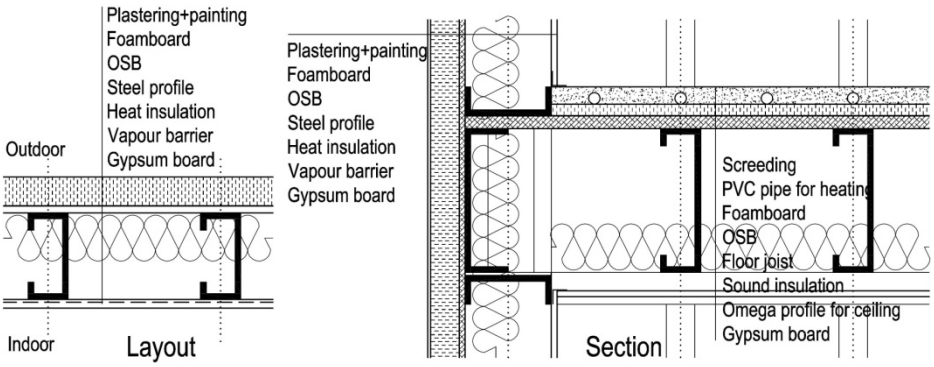


Figure 10. Insulation layers at wall and floor [7].

Glasswool at cavities of wall studs, foamboard over building envelope and subfloor and screeding applications are shown in figure 11.



Figure 11. Insulation applications at wall and floor
(Photograph by Semih Yıldırım, Houses of Kardelen, Istanbul).

CONCLUSION

Service systems in cold formed steel framing system are presented in this study by distinguishing of support and infill levels in the aspect of open building concept. Pipes and wires are able to run inside the wall and floor cavities and run throuh pre-punched or cut-out holes. Specifications are defined for cutting hole. Planning of service systems at infill level have flexibility, since the installation properties of support system. Alteration both support and infill level according to user' s need is easy and rapid. Sound and heat insulation and vibration must be paid attention during pre-planning and installation phase, because of using high conductive structural steel member.

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CIRRICULUM

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