STATE OF THE ART AND FUTURE TRENDS IN TIMBER-HOUSE TECHNOLOGIES IN SLOVENIA AND SWEDEN

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The main building techniques in Sweden and Slovenia are on-site building, off-site prefabrication and modular systems. Single-family wooden housing has a long tradition in both countries, but it is less dominant in Slovenia than in Sweden, where approximately 90% of the single-family houses are built with timber frames. Sweden’s long tradition of industrial manufacture of single-family timber houses has during the last 15-20 years been developed for the manufacture of multi-storey timber buildings. Today, one in every seven new residential multi-storey buildings in Sweden has a timber frame, but this is almost non-existent in Slovenia. It seems that the wood construction system in Sweden is passing from a formative to a growth phase, but that in Slovenia it is still in the formative phase. In Slovenia there are very few wooden multi-storey buildings; mostly two-storey buildings such as tourist facilities, schools and some residential buildings.

Construction on-site

Construction on-site means that the building materials are transported to the building site where the various elements are assembled and erected. The method requires a great deal of organization and planning. Risks associated with damage to materials and prefabricated components, and moisture damage must be considered (Fig. 1). Of necessity, on-site construction tends to take a long time. With the on-site building technique, wall components are assembled resting on joists or on the ground and then erected. In Slovenia, a non-negligible amount of wooden houses have appeared recently, constructed on-site through smaller carpentry workshops. On-site construction of single-family houses is very rare in Sweden.

Figure 1: Examples of on-site building. | 1.1 House N, Linnaeus University, Växjö, Sweden. 2011. | 1.2 Waldorf school, Ljubljana, Slovenia, 2013. | 1.3 House S, Velike Lašče, Slovenia, 2014.
Off-site prefabrication

In both Slovenia and Sweden, the trend is towards a higher degree of prefabrication, i.e. a greater part of the building work takes place at an industrial plant in a well-controlled environment with approved quality assurance. The actual on-site assembly of the building until the roof is laid takes only one or two days. The prefabrication can include various components such as wall and floor elements, roofs, trusses etc., and also volume modules. Both components and modules are prefabricated with insulation, installations, windows and doors (Fig. 2).

With prefabricated wood modules, the total cost is often 20-25% lower than building on-site, partly due to a time saving of up to 80%. In Slovenia, most of the large house manufacturers offer off-site prefabrication. In Sweden, off-site manufacture is totally dominating for single-family houses and this method of manufacture is also becoming more and more common for multi-storey housing.

Figure 2: Examples of off-site prefabrication. | 2.1 Manufacture of wall elements. | 2.2 Window sections ready for transportation to the building site. | 2.3 Manufacture of modules for a modular system.

Modular System

Working with modular systems is a great help, since it is difficult to design traditionally and then translate the design to an industrial context. It is easier to adapt the construction and organisation of the building to the limits of the system from the beginning. For example, the modules have to be of a size that can be transported by lorry and that will fit on roads and under bridges. The modules also have thicker structural beams than normal, which can be a challenge if the building height is restricted. In addition, the system requires an early commitment in the project, with very little scope for making changes later (Fig. 3).

Figure 3: Examples of modular-system housing. 3.1 Residential apartments Skagersvägen, Stockholm, 2013. | 3.2 Multi-residence buildings, Ekorren, Skellefteå, 2009. | 4.3 Student housing, Kungshamra, Stockholm, 2002.

Future trends

Timber multi-storey building has gathered momentum in recent years in European countries. Construction of the first experimental buildings was completed and trust in new timber building is now growing. The number of projects, as well as the rising interest from different groups and customers, show this trend. We see opportunities for further development and future trends in high prefabrication, partnership and increased responsibilities for planning and construction, improved and systematic feedback of experiences, and team cooperation. There are numerous challenges associated with the construction of wooden buildings, and these challenges are best met through further research and more pilot projects to increase the knowledge of life cycle costs, construction costs, maintenance costs, sound and vibrations, through the general increase in the number of wooden buildings that are being erected.