ANNEX 5-B

Case study

RESIDENTIAL BUILDING
“LA FENETRE”
IN DEN HAAG

A novel construction system was used to create a 16 storey apartment building in the city centre of Den Haag, Netherlands. The steel super-structure is supported on inclined tubular legs and the building is designed to be 'transparent'.

RESIDENTIAL BUILDING *LA FENETRE* IN DEN HAAG, NL

An exciting steel structure, called *La Fenetre* forms a landmark at a busy road inter-section in The Hague (Den Haag) close to Rotterdam. Its 16 storeys of apartments are supported on a myriad of inclined tubular legs. It uses a novel structural system called *INFRA+*, which is based on a series of I beams at 0.6 to 0.9 m spacing, in which a concrete slab is pre-cast around the bottom flange of the beam. The coverage of the inverted pre-cast slab is 2.4 m, which is suitable for transportation and installation.

The inverted slab is typically 70 mm thick and is exposed on its underside. Services are located on the slab and also provide for under-floor heating and cooling. The flooring attached to the top flange spans between the beams, and may use a gypsum screed placed on floor boarding or shallow decking.

The construction system may also be used for offices and hospitals where there is a need for under-floor distribution of services. In this building, water pipes were also embedded in the slab to provide heating, and the inverted slab is able to radiate heat or "coolth" to the space.

The façade is fully glazed and with its 20 m long tubular legs, the building appears to be transparent. The structure is braced internally and also consists of strategically located tubular members.

Fire tests have been carried out at TNO in Delft to justify 120 minutes fire resistance of the otherwise unprotected steel beams due to the thermal insulation provided by the inverted slab. Excellent acoustic insulation was also achieved. Constructed started in early 2004 and was completed in late 2005.

Application Benefits:

- Stability provided by inclined tubular columns
- Transparent façade with minimal floor zone
- Exposed concrete slab with embedded water pipes
- Fire resistance of 120 minutes
- Under-floor services distribution
- Excellent acoustic insulation

Project Team:

Client:	Latei projectontwikkeling
Architect:	Architectenbureau Uytenhaak
Superstructure	Oostingh Staalbouw
Project Engineers	Adams
Flooring Contractor:	PreFab Limburg BV
Sevices contractor	Heijmans

Under-floor servicing in INFRA+

Building during construction

Construction Details

In the *INFRA+* system, a variety of steel beams may be used depending on their span and loading. Although the top flange of the beam is not laterally restrained, torsional restraint is provided by the slab cast around the bottom flange. A typical beam span : depth ratio is 20, and so a 450 mm deep I beam can span up to 9 m.

The form of construction is illustrated for the *La Fenetre* project in the above figure. Services can be passed through elongated openings formed in the web of the beams, and a floor of minimum depth of 600 mm is created.

The inverted concrete slab is designed to support its own weight and loads from services, and is typically 70 mm thick. The floor comprises a gypsum screed poured on floor boarding or shallow (20 mm) decking and is 60-80 mm thick. The structure is designed to support the imposed floor loading of up to 3 kN/m^2.

The *INFRA+* precast floor panels may be supported by perimeter steel beams placed below the floor panels. The slab is cast 100 mm short of the edge of the beams. The supporting beams align with internal separating walls. Heating/cooling pipes may also be cast into the slab, depending on the application, and radiate into the space below.

In *La Fenetre*, the inclined tubular legs are located below column positions on a 6 m × 9 m grid and are brought down to 8 discrete positions at ground level to optimise on the foundation requirements. Fire protection costs are minimised by the thermal insulation provided by the inverted slab, and the use of tubular members with high massivity. The tubular columns provide for stability of the building together with internal tubular bracing.