Tecnostrutture in India for the First Time

The NPS® System and Italian know-how on Earthquake Engineering in a renowned luxury hotel of New Delhi

Tecnostrutture lands in India, partnering with two local companies, for an important upward extension project at the *Welcome Hotel Dwarka*, a prestigious hotel in the very centre of the Indian capital.

The project

The hotel facility, consisting of a central body of thirteen floors surrounded by a three-floor horseshoe section, has undergone a considerable upward extension by raising the perimeter volumes, from three to thirteen floors in total.

India ITC Hotel. Existing building and graphic projection of the new raised area.

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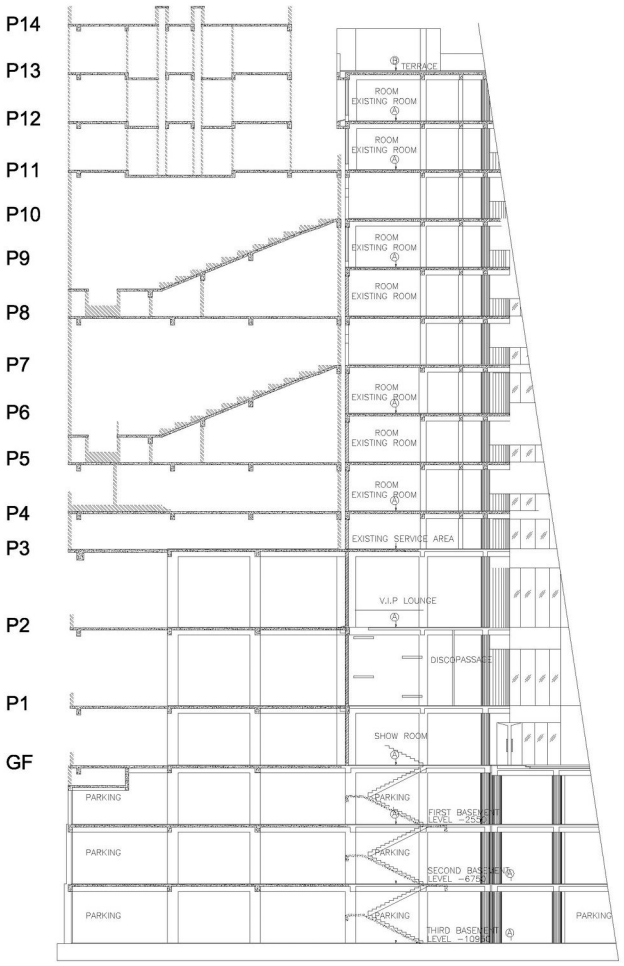
N° Registro Imprese
C.F. e P. IVA 01822060271
R.E.A. N°180664
Cap. Soc. € 200.000,00 i.v.

The significant upward extension operation has addressed four different design issues:

1. Underpinning and reinforcement of the pillars, by designing a method conducive to strengthening the existing structures and foundations. This operation was completed through a micropiling system, while the jacketing technique was used to strengthen the pillars. This technique consists in applying an armoured concrete external jacket on site.

2. Seismic resistance. *Tecnostrutture*'s knowledge on the topic has made it possible to export Italian know-how on seismic applications. The *Welcome Hotel Dwarka* is not only a tall building, but it is in a high seismic risk area, features that made it indispensable for the solution to provide reliable performance. *Tecnostrutture* therefore designed a structural solution that – by means of seismic isolators – would retrofit an existing building to withstand horizontal forces, obviously increased by the enhanced mass, as well as to new vertical forces.

KEY-SECTION



Key View of the additional levels

3. Ten-floor construction in **NPS® L structure** consisting of **PDTI® pillars, NPS® BASIC beams** and fretted metal sheet **slab**. Seismic-resistant system without using bracing walls and fire-resistant up to 120 minutes. At the top of the existing third floor, a transfer beam steel structure was added, resting on seismic isolators, where the ten floors were added, with cinemas, shopping malls and accommodation facilities.

4. Construction of three metal ladder trusses spanning the structural joints.

Tecnostrutture building site in New Delhi

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Design requirements and NPS® structural solution

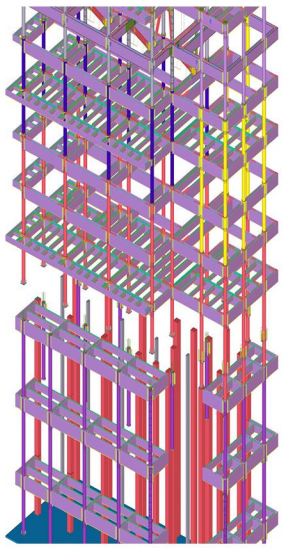
The *Welcome Hotel Dwarka* is an existing accommodation facility, which right from the start showed issues arising from these factors: uncertain geometries and tolerances, sagging already present in the building, occupied and operating retail, as well as functional premises during the work site stages.
Firstly, these issues affected the time frames of *Tecnostrutture*'s supply, not only characterizing the design choices, but also imposing operational work site constraints.
Since parts of the existing structures needed to be demolished, and precise areas of the building had to be occupied, some areas were closed during the works, especially vertical passages such as lifts and main service staircases in specific wings of the building. This made it necessary to correct the production plan during the works. It was required to raise all structures by retrofitting them with the steel work, rather than reinforcing the substructure as initially assumed. The design requirements thus changed during the works, modifying the sequences of activities, and requiring early production of the steel work ladder trusses in the order of priority agreed with the customer.

The advantages arising from using the NPS® L structure

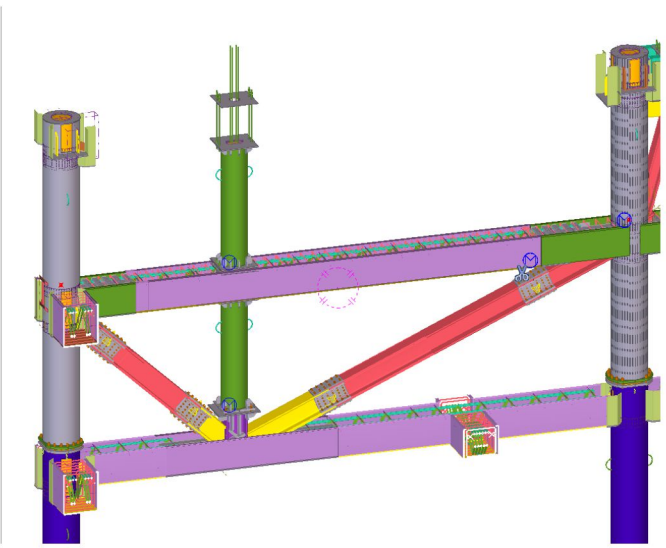
Using the **NPS® system** and the operative abilities of *Tecnostrutture* brought considerable advantages to the *Welcome Hotel Dwarka* project works.

1. Low thickness. As mentioned by **Mr. Stefano China**, Technical Manager of *Tecnostrutture, "The NPS system allows to reduce the overall sections of structures, making the upward extension work considerably easier, especially in a situation as this, in India, where the structures, mainly made in concrete, were often cumbersome".*
2. Self-supporting up to 4 meters. No temporary support of the beams is required in the assembly stage, thus reducing work site time frames and allowing the work stages to overlap.
3. The BIM environment by **Tekla** made it possible to design and produce about 350 tons of complex steel work in 55 business days, with an average of 6.3 tons a day, proving that it is possible to produce the same steel works in about half the time required with more conventional design software. This important advantage is certainly due to the possibility of designing nodes contained in the database, but also to manage rod positions in a more convenient manner, being able to create the workshop technical drawings by exploiting the output template drawings set by the designer.

The use of the **NPS® system** in a well-known luxury hotel in New Delhi emphasizes the key role played by *Tecnostrutture* and its solutions regarding construction on existing buildings, providing a radical change to this community in India, through the implementation of innovative and safe building technologies.



Section showing the vertical development of new floors added to the 3 existing ones



Example of integration between NPS® structures and steel elements

The use of the design software

Although *Tecnostrutture* constantly uses **BIM software** to manufacture its items, this sudden change of plans and the strict deadlines required by the customer posed a challenge to the company's Engineering Department, with regards to the design and development of the three truss ladders, which are defined as Ladder 1 (550 rods for a total of 75000 kg), Ladder 2 (750 rods for a total of 145000 kg) and Ladder 3 (1000 pieces for a total of 135000 kg approximately).

These aspects were the starting point of the *marathon* that led the technical staff of *Tecnostrutture* to supply the drawings to the Indian steel works in May 2018. In order to reduce the timeframes, while one draughtsman tackled the drawing stage of Ladder 1 in Tekla – lasting about 15 days – a second one started working on Ladder 3 using common structural design software, rather than the BIM system by Tekla, which took about one month and a half. On that occasion, the typical interoperability features of BIM software were certainly fully exploited.

Credits

Structural project: *Tecnostrutture*, a company with 35 years of specialized experience in the pre-fabricated composite steel-concrete structure industry.

Acknowledgements

Tecnostrutture would like to thank everyone who contributed to the success of this project.