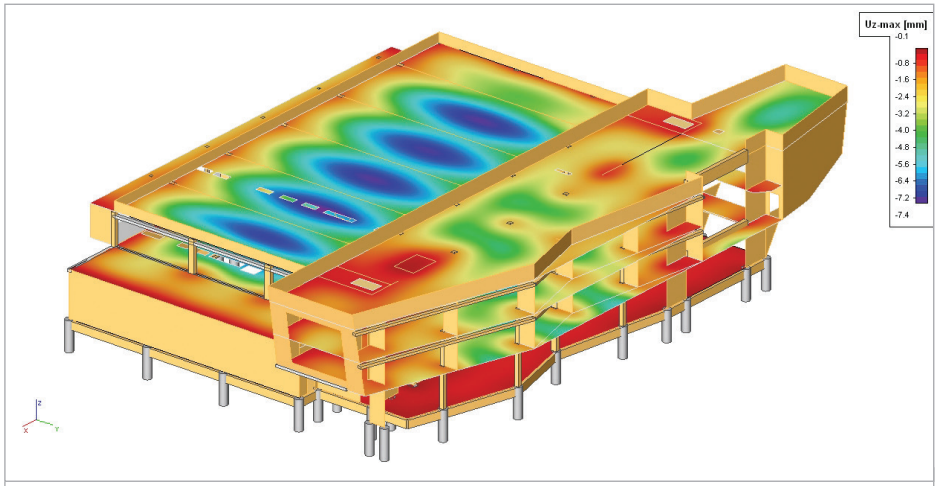
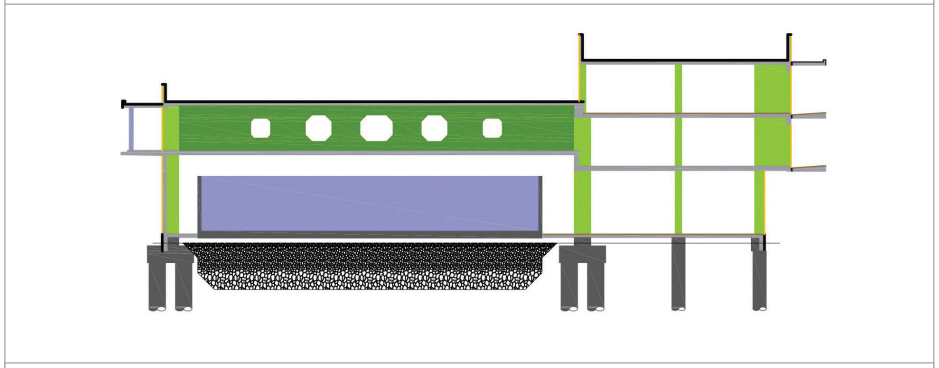
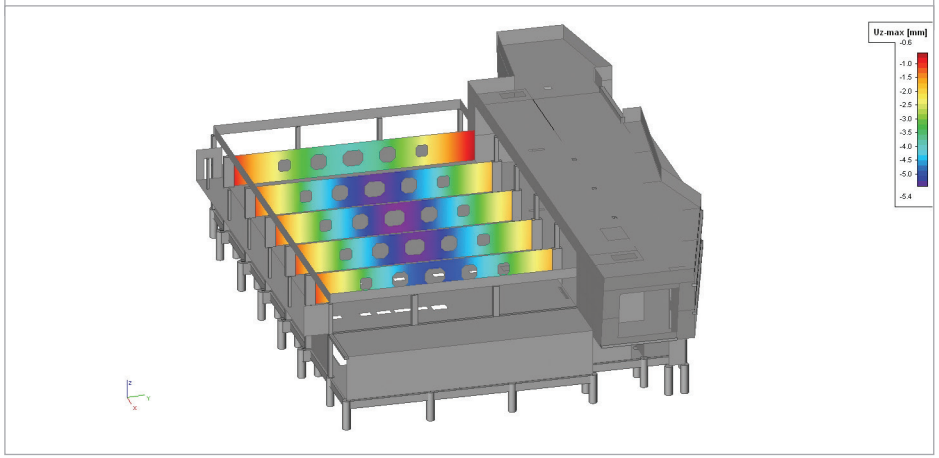
HILASE, New Lasers for Industry and Research - Prague, Czech Republic







Software: Scia Engineer, Allplan Engineering

Description

The main objective of presented project “HILASE” is to develop laser technology with breakthrough technical parameters. In offering these parameters, Laser Centre “HILASE” will be unique, not only in the Czech Republic but also in Europe. The “HILASE” object is divided into two parts; a monolithic two-storey laser hall and a three-storey administrative section. The dimensions of the laser hall are 25.9 m x 49.9 m, with a height of 8.9 m. The ceiling above the 1st floor and the roof above the 2nd floor have a common beam formed in the 2nd floor. The beam is broken by a number of large holes for wiring technology lasers. The beam has a span of 25.9 m and was designed as monolithic-reinforced. The administrative building has the dimensions of 14.7 m x 60.0 m and a height of 11.85 m. The structure is designed as a monolithic skeleton, while the building edge sections are cantilevered on the second and third storeys. The building foundation is designed on piles. The foundation of the laser plate, located on the 1st floor of the hall, is designed with a 420 mm thickness. The dynamic filter is designed under the laser plate in order to reduce the transmission of vibrations from the subsoil into the building.

Conceptual design and structural analysis

The building was designed according to strict technological requirements for the operation of the laser. Especially strict are the limits for the dynamic behaviour of the laser foundation slabs from subsoil vibration. These vibrations are propagated from the subsoil environment to the building structure.
The first natural frequency of the laser slabs must be greater than 25Hz. The limit deflection of any point structure is $<\Delta uz,rqr = 0.2$ micron in 5-50Hz, and the maximum $\Delta uz,rqr = 0.02$ micron in 50-100Hz. These values are very stringent and are difficult to achieve in the design of the foundation slabs. The foundation plate is located in the hall of the building and it is laid in bad geological layers. To reduce vibrations transferred from the subsoil to the foundation structure, the dynamic filter was designed, at the boundary of both systems. The layered structure is composed with a high and very low bulk density and also a high and low speed of vibration through strata. Filter efficiency was determined at a value of 30%. The own response to dynamic exciting (loading) was performed with the use of the spectral analysis computing system with Scia Engineer on the 3D model. Control calculations were carried out in the reference software. The foundation of the laser plate was modelled as a 3D (wall-plate) structure supported by a flexible “Winkler - Pasternak subsoil”. The values of the soil were modelled using envelope subsoil with regard to the fact that the control-verification was made with the system Soilin. The vibration load was considered as 0.00008 m/s^2 and was an expert estimate compiled from experiences of other sites and from vibration measurements in the locality. The ceiling above the 1st floor (the laser hall) and the roof above the 2nd floor have a common beam formed in the 2nd floor. The beam is broken by a number of large holes for wiring technology lasers. The beam has a span of 25.9 m and was designed as monolithic-reinforced. For global analysis several nonlinear 2D and 3D models were created in Scia Engineer. A controlling calculation was performed on the beam element. Crucial to the design of the reinforcement was the “strut and tie” model, which served for the design and control of global reinforcement and reinforcement around the holes. It was confirmed that this method achieved good agreement with the nonlinear calculation made with Scia Engineer.

Conclusion

The design of the laser hall - in particular the foundation of the laser plate - required the linking together of deep expertise in the geotechnical and dynamic sides of structures. Calculations that are made for structures exposed to subsoil environment vibrations are very complicated and require high theoretical and practical experience. In this case, to achieve very strict limits in regard to the dynamic responses of the foundation of the laser plate, the dynamic filter was used at the boundary of both systems to reduce the transmission of vibrations from the ground to the construction. The checking of calculations for the trusses was performed with the “strut and tie” method. It was confirmed that this method achieved good agreement with the nonlinear calculation made with Scia Engineer.

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STATIKA Company Ltd. was founded in 1998. Today the firm is one of the leading engineering companies engaged in the design and assessment of load-bearing construction works, engineering and bridge constructions in all material variants. We use the latest computational method designs. In addition, we provide forensic engineering services for construction with the focus on statics and structure dynamics. This activity provides us with feedback in the design of structures. Some of our professional staff work as lecturers at professional conferences. The company is divided into various departments: concrete structures, steel structures, foundations, bridges and engineering design. This approach allows us to design structures in all material variants. Each section works under the leadership of experienced structural engineers, the creators of many interesting structures. We design a construction from conceptual design to the working design and the delivery of construction documents. Our designs meet the required economic, aesthetic and utility parameters.

Project information

Owner	Academy of sciences of Czech Republic
Architect	Len+k architekti s.r.o., Prague
General Contractor	OHL ŽS, a.s., Prague
Engineering Office	STATIKA s.r.o., Prague
Location	Prague, Czech Republic
Construction Period	09/2012 to 02/2014

Short description | HILASE, New Lasers for Industry and Research

The main objective of presented project “HILASE” is to develop laser technology with breakthrough technical parameters. Generally said, the involved lasers are much stronger, while they are also more efficient, compact and stable. The lasers are also easier to maintain than currently available technology. The project specifically focuses on lasers based on diode pumping and on the development of related technologies. With the given parameters, Laser Centre “HILASE” will be unique not only in the Czech Republic, but also in Europe. The project has great application potential in the commercial sphere. The outputs of this project will be used for technologies in the areas of micro-shaping, testing the resistance of optical materials, cutting, welding, coatings removal and laser hammering.
The building “HILASE” consists of a monolithic two-storey laser hall and a three-storey administrative building.