STATIC AND CONSTRUCTION OF INTERCONTINENTAL HOTELS WARSAW - ICW

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THE STATICS AND DESIGN OF THE WARSAW INTERCONTINENTAL HOTEL - ICW

The Warsaw InterContinental Hotel (ICW) is at present one of the PORR Group's most spectacular projects under construction.

In the heart of Warsaw, not far from the Financial Center and Directly next to the Warsaw Tower, a hotel is being built on a base area of 53m by 44m. The unusual structuring of the building - Dictated by architectural requirements - Involved a highly complex staticsystem to withstand Both vertical dead and use loads and horizontal wind loads. Having five basement levels, the project needed adequate building pit sheeting and its stabilization by supporting three levels. A ground slab as much as 2 to 3 m thick with diaphragm walls Arranged as deep-foun-dation units under highly loaded columns and wall piers which provided to safely transfer the high vertical forces and Minimize settlement. For the transmission of the loads from the cantilevering element on the 21st floor of the building, it what Necessary to Provide a statically complex and structurally demanding holding system. The great height of the building (70m above ground level) and the limits of available crane capacity called for the development of a special scaffolding and formwork system for providing the beam system combined with partly precast members and precast floor units. In the end, the design of the suspension building with a large load-bearing system at its head portion and with suspended ceilings allowed the provision of a support-free hotel reception hall on the ground floor.

INTRODUCTION

InterContinental Hotel Warsaw (ICW) is currently one of the most spectacular in execution conceived projects PORR.

In the center of Warsaw, not far from the Financial Center and next to the Warsaw-Tower, a hotel complex is on one Floor area of 53 x 44 m built.

As can be seen from the pictures, the object has a unique building structure with a solid base portion, a highly constricted building shaft and whose projecting part is supported by a slender corner post of the building head. The reason for the cross-sectional constriction in the Shaft region ensuring a minimum tanning of the immediately underlying residential building was.

With progressive development project initially mandatory frame condition for architectural accent was House. She was also an eminent challenge for the planning involved in the development of static and structural support structure and in their implementation during construction on the other. The polishing planning took place was carried out from January 2001 on location in Warsaw. The structural design was entirely of Vienna by the pro-

1 Warsaw Tower, 2 Warsaw [illegible], 3 InterContinental Hotel Warsaw

visualization PE

jektierungsbüro for industrial, structural and civil engineering GmbH. & Co. Nfg. KG, field statics and construction accomplished. Construction began in April 2001, with completion scheduled since November of 2003.

KEY DATA

Total gross .... 57 400 m 2
Total net .... 40 400 m 2

175 pitches in five underground levels, net (6,300 m 2 net, 9.330 m 2 gross) service and building services (kitchen, restaurant, etc.)
,,, Ground to 7th floor

78 apartments in the floors 8-20328 room suites in the floors 22-41

A total of 406 keys to 490 building axes gym - health club on floors 43 and 44, 44 floors above 0.00, eaves height of 152.29 m above 0.00

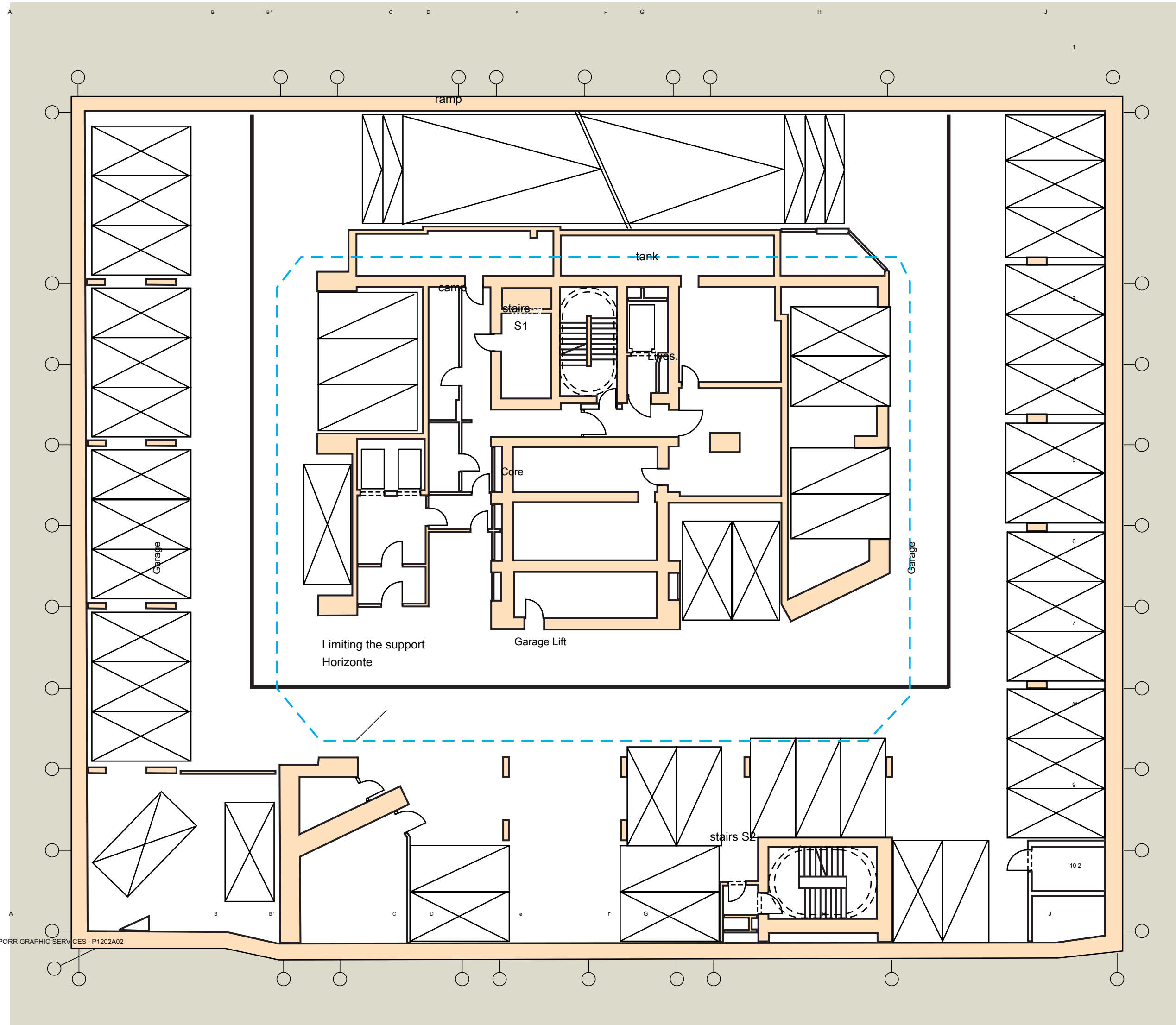
Detail of the corner pillar reinforcement B 9

Photo: Breakfast

TECHNICAL DESCRIPTION

As already mentioned, the building is divided into a civil part with five basement levels, the base area from the ground floor to the fourth top

GARAGE (2nd - 5th UG) 4. UG



storey buildings, as well as shank with constricted floor plan cross-section and corner post from the fifth to the 20th floor. The building head with the control room floors extends from 21 to 41. Upstairs on the full floor plan dimensions of 34x310 m. In the center of the building is a continuous core which is formed of two elevator groups, the main staircase and freight elevators including ventilation and service shafts.

The foot part of the triangular corner post forms an additional escape staircase which ranges and from the fifth lower floor to the fourth floor receiving the powerful corner post on a solid end cover, which extends up to the 20th floor and deriving the share borne by the head part (about

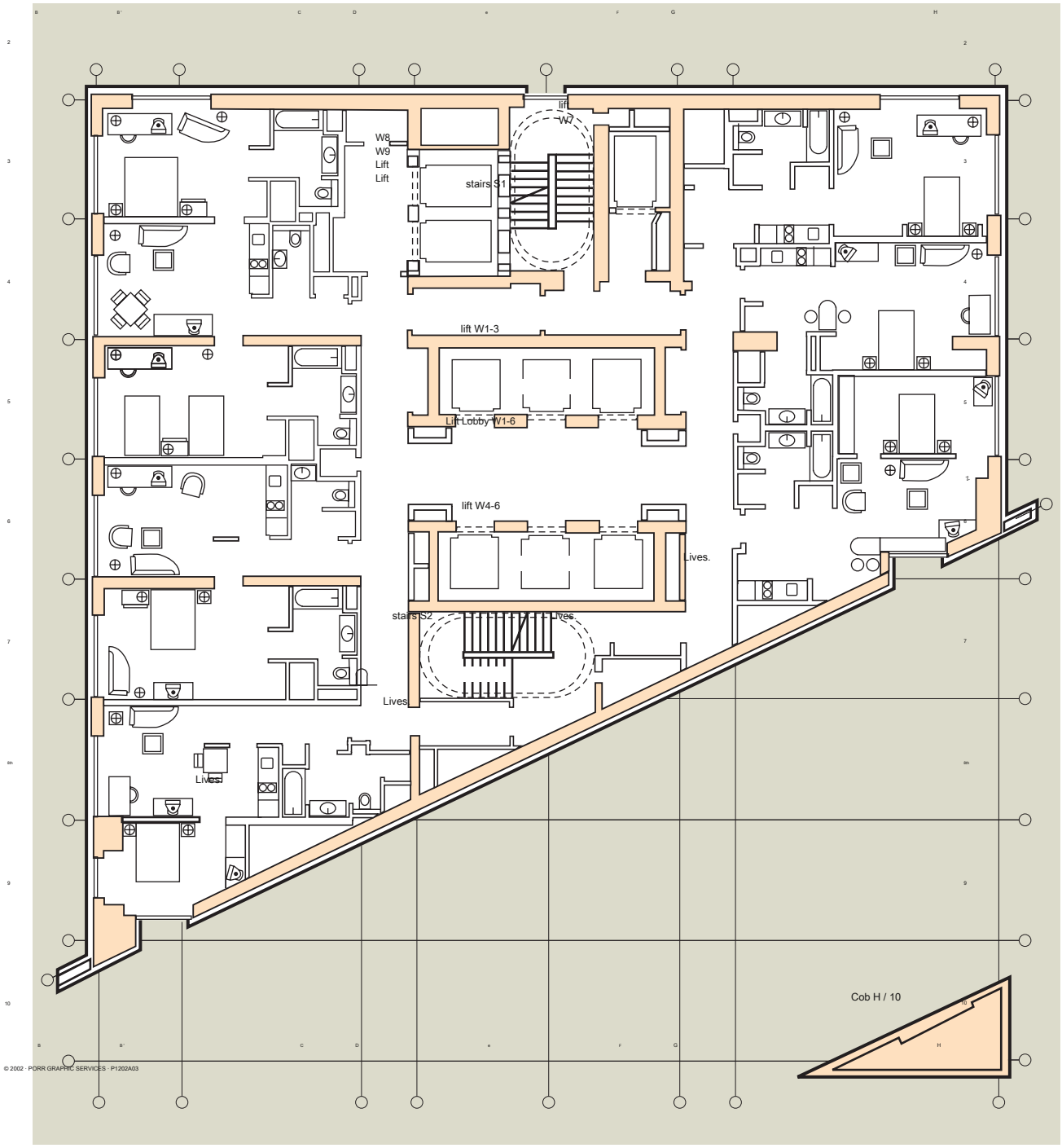
90,000 kN).

THE SUPPORT STRUCTURE

The building is designed as a reinforced concrete frame structure. In all floors flat slabs form with 23 cm thickness and wall panels as partition walls in room-situ concrete with spans of 8.10 m, the supporting structure. The expense of building overhanging head through the facade wall panels, 40 cm thick, of 22 to 31 upstairs in the axes 10 / BH, H / 5-10 and by the inner wall sections D / 8-10, F / 7- 10, 8 / DC, 8 / FH and 6 / FH and added through a solid Abfangungsrost (wall thickness 90 cm) in the 21st floor in the main support elements

- are the corner column H / 10, and the diagonally extending wall disc axis Z in the shank region - initiated. In the rest, running through part of the building

APARTMENTS 8th - 20th floor.

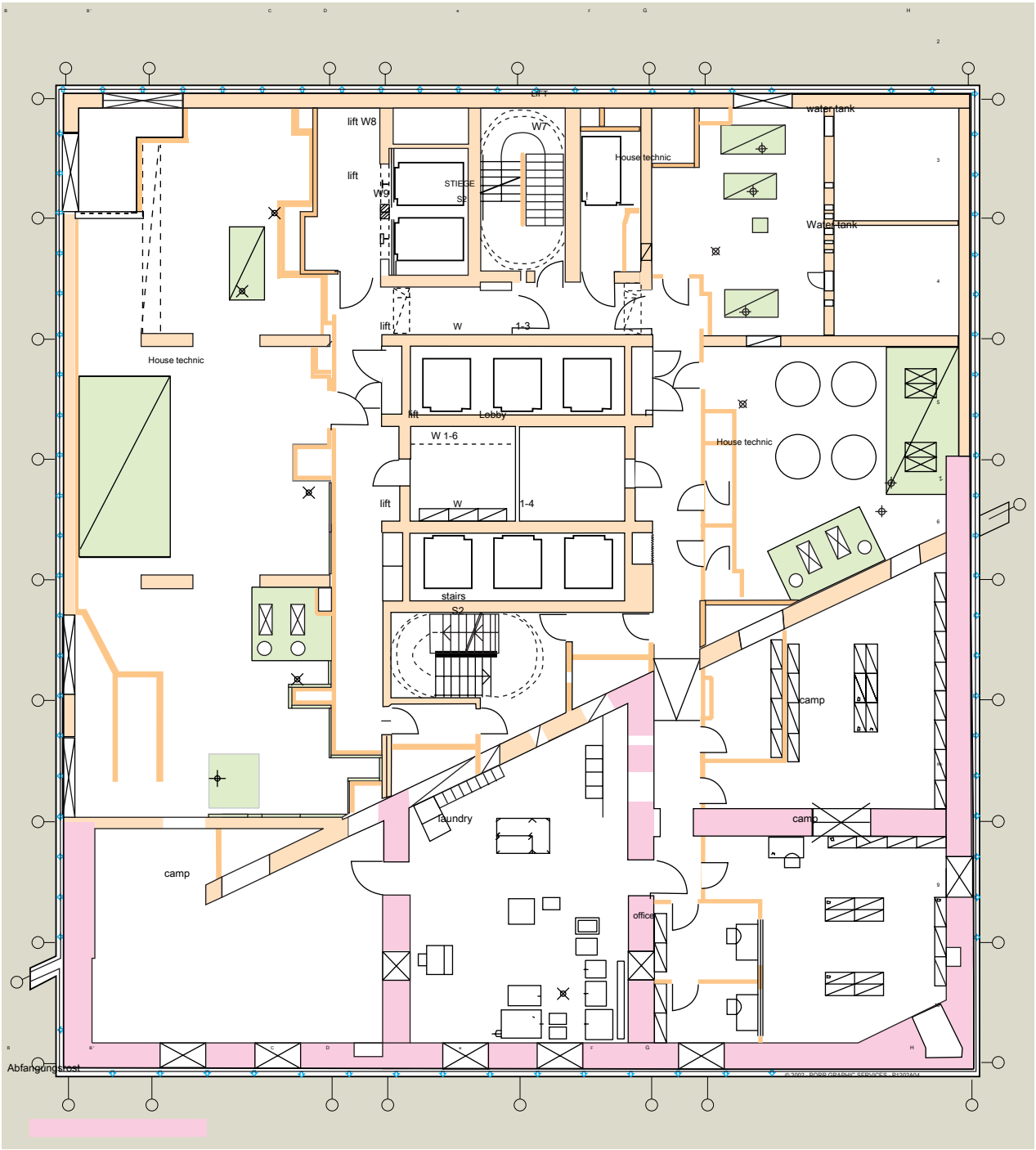


west of the diagonal shear wall he follows the Load transfer through the columns and the wall panels of the building core and the facade walls. The loads of the wall panels of the axis 4 and 6 between axis B and the central core is made from the third floor to the foundation bed by massive reinforced concrete columns (210 x 90 cm). This also applies to the axis 4 / GH where the load bearing is effected by a pair of supports.

View of the support Horizonte - Looking to ramp

Photo: Breuhöfer

ABFANGUNGSGESCHOSS 21 OG.



The loads of the inclined wall disc are introduced from the third floor by powerful wall stub length / width = 400/70 and 100 cm in the lower floors in the foundation plate, each 80,000 kN. The removal of the horizontal loads from wind occurs primarily by the two coupled by means of solid joists and nuclei by the façade wall in axis 2 / BH. The largest calculated deflection of the building construction under extreme wind load is 15.30 cm and is therefore short of required value of one thousandth of Gebäiudehöhe.

After this introductory building description is made in detail to the static and structural cardinal points:

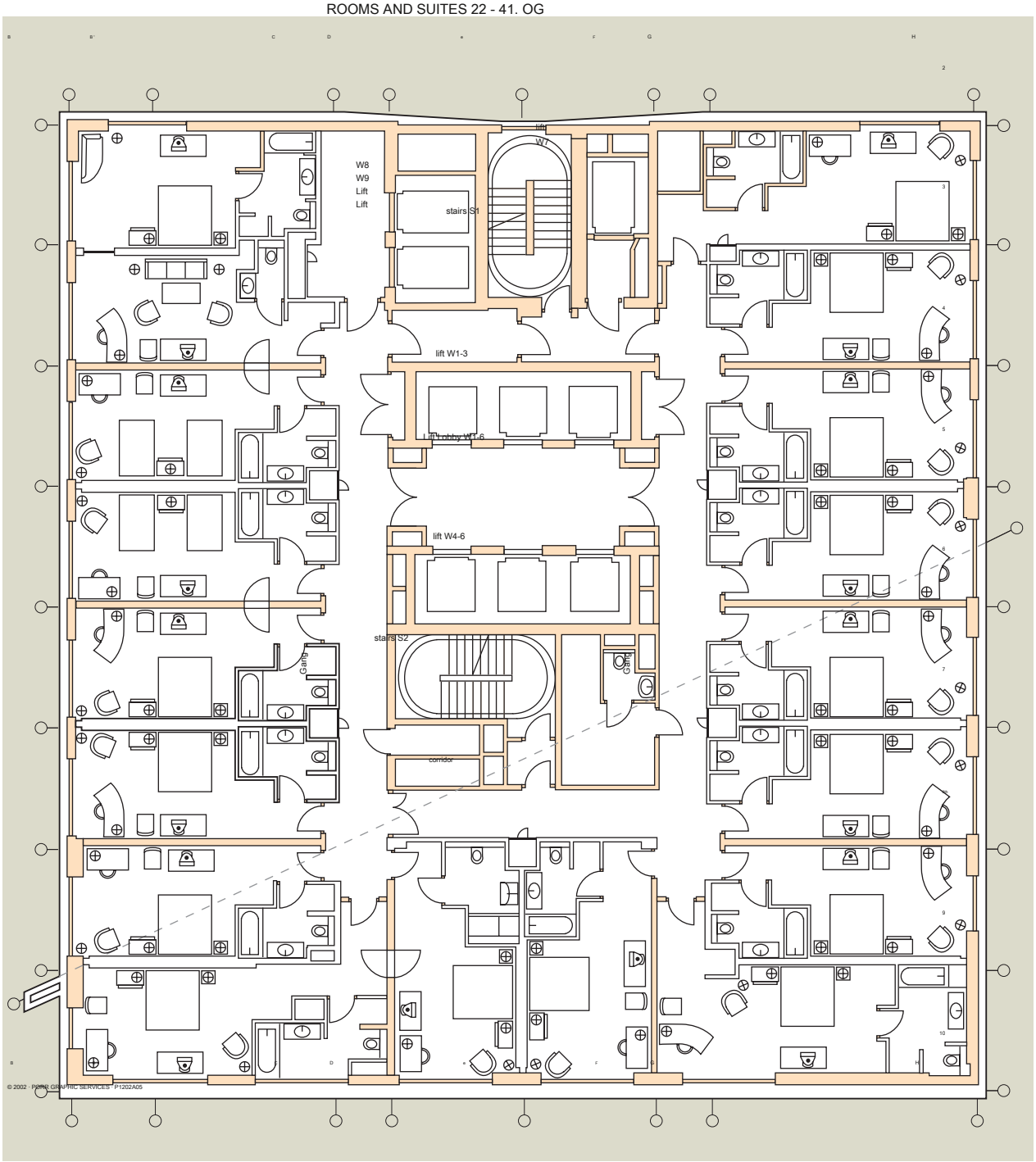
- retaining wall
- founding
- Abfangungskonstruktion the 21st floor

• Hanging House

THE PITS-enclosure

If the fuse of the pit by a diaphragm wall with a wall thickness of 80 cm. This is being drilled to 29 m below ground. The excavation bottom is on
20.80 m. Due to the great depth and the foundation soil situation a backup by three support Horizonte (lid) to 5.37 m, 11.54 m and 14.6 m under Baunull is required. The cover thickness is 30 cm, the width at the middle bolt 9 m. An anchoring the wall was the one hand, by the decreasing with increasing depth shear parameters of the pending

ROOMS AND SUITES 22 - 41. OG



1st section ... Überbrückungskonstruktion the 21st floor

Photo: Breakfast

cohesive soil layers and the resulting high anchoring forces impossible. On the other hand, the tightness of the wall at the prevailing groundwater situation would have been problematic.

The top support horizon is designed as a closed plane frame. The sides engaging supporting forces are on average 580.0 kN / m. The two lower-lying support horizons are correspondingly higher load. Here the central support force is 680 kN / m. These two lower layers are connected by the support extending along axis 1 garage ramps with each other. There is thus a helical supporting structure in the form of an open ring. In contrast to the closed flat annular outer bearing forces to the end sections occur in the first time here employed space frame system whose components are ablate over the trench wall in the pending building.

Resulting from the normal force N bolt forces are distributed over the overlap distance Lu on the trench wall directly by the activated Bettungskräfte of soil removed (see System Sketch "load transfer of the free lid edge").

The locking transverse force Q e from the existing supporting force n the slot wall results is derived tangentially steel dowels and friction forces in the diaphragm wall and the existing soil.

The vertical Bearing the lid takes place on the one hand by the integration in the cover and selectively by steel outriggers from profiles HEB 400 with brackets along the free inner edge.

In contrast to the conventional arrangement of two separate planar support horizons the subsequent concrete demolition in the ramp area, which means a considerable saving of time and machine due to the omission of the demolition work is omitted in coiled lid.

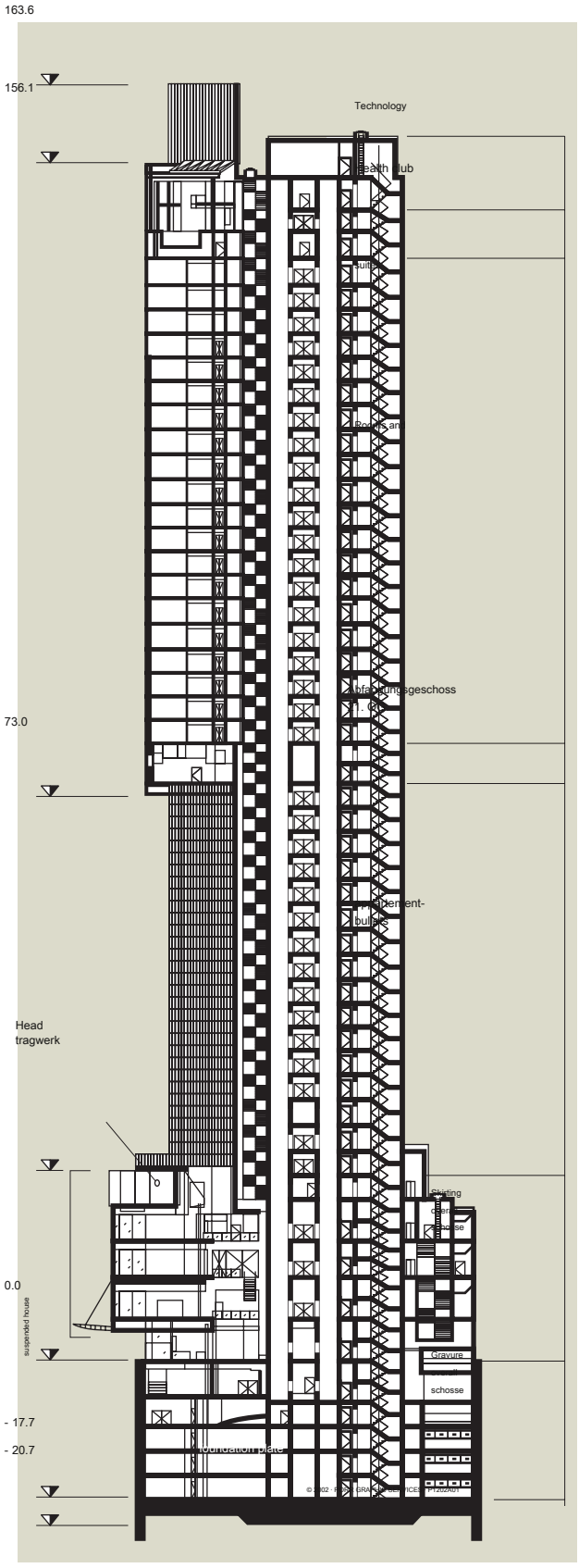
FOUNDING

The structure is formed flat, and rests on a continuous foundation plinth. The thickness is in the field of highly loaded support elements, such as lift and staircase cores, as well as the powerful individual supports

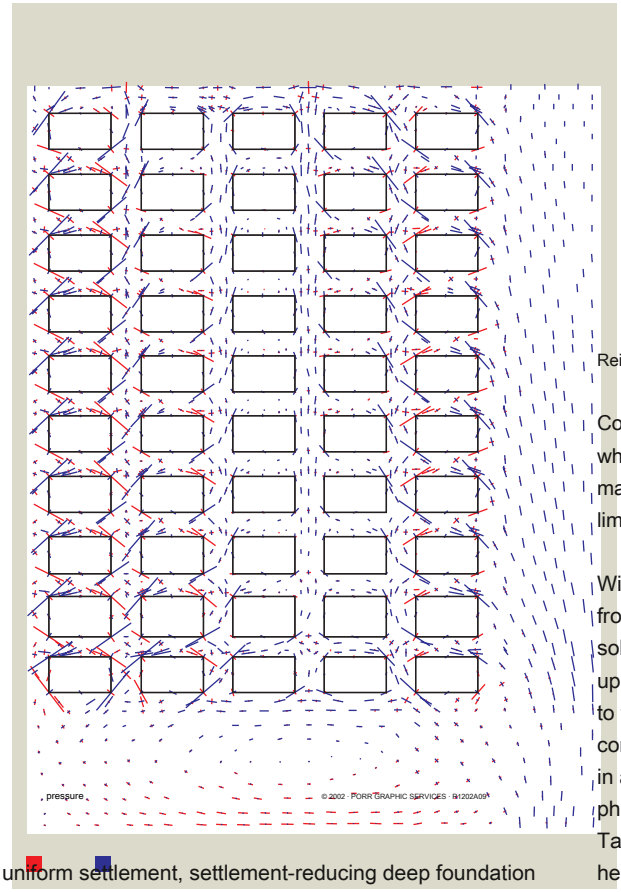
3 m, and is reduced to 2 m in the edge region. The connection of the bottom plate to the diaphragm wall is carried out articulately. As a sealing action in the connection joints with the upcoming groundwater around two source joint tapes and an additional injection tube were provided.

Since the locally very high loads despite the high rigidity of the bottom plate higher and especially un-

RULE SECTION OF THE BUILDING NUCLEAR



ABFANGUNGSSCHEIBE AXIS 10:
HAUPTSPANNUNGSTRAJEKTORIEN



Reinforcement of the rails of the main beam in the 21st floor

Photo: Breakfast

cause uniform settlement, settlement-reducing deep foundation elements were placed in these highly stressed areas. These consist of single slot wall elements among the columns in B '/ 2,

4, 6 and diaphragm wall boxes in the range GH / 9-10; BC / 8-10 and GH / 5-6. The load transfer of the deep foundation elements **via skin friction with 60 kN / m$_2$ and peak pressure of 2.000 kN / m** Second At a load bearing of 60% through the bottom plate and 40% by the deep foundation elements, a bond length of the trench wall from 17.0 to 21.3 m resulted from the lower edge of the base plate.

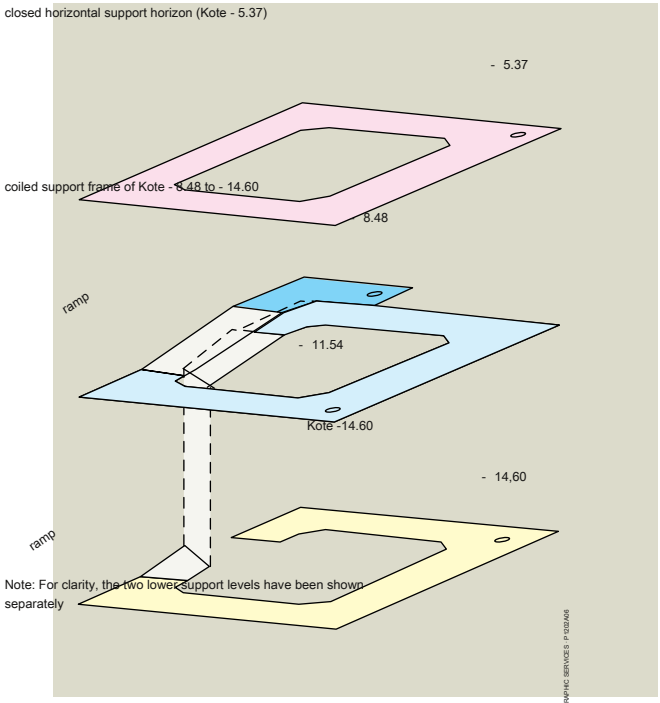
ABFANGUNGSKONSTRUKTION IN THE 21ST FLOOR

The architectural structure of the building with reduced floor plan from the fifth to the 20th floor and control plan from 21 floor here requires a powerful Abfangungskonstruktion with a height of 5.90 m. This consists of a massive carrier ring in the facade plane of the axes 10, H and B, as well as cross members in the axes D, F, 8. The wall thickness is a uniform 90 cm. The supports of this grate form the corner column H / 10, the cantilevered wall bracket B / 9-10 and the facade support H /. 5 The cross beams in the axes D, F are superposed in axis 10 and the inclined wall disc axis Z and take the loads of the regulating wall overlying discs on. At a height of 70 m above ground level, a suitable structure had to be found to the first with the

Construction phase to produce a self-supporting aluminum grid which could absorb the expense of subsequent strokes. To make matters worse, the carrying capacity of existing tower cranes was limited to a maximum of 100 kN.

With regard to the height situation, a conventional scaffolding from ground level and a retired situ concrete in one pour. A solution of semi-finished part supports that self-supporting pick up the remaining construction weight, was also not possible due to the limited crane capacity. To run came ultimately following construction: The main structure - the carrier ring - is produced in an armor consisting of steel trusses, cast in place in two phases. the carrier ring in the axes of the first phase was H Taking full advantage of Rüstträgerkapazität and concrete to a height of 2.30 m 10th For the preparation of L-shaped cross-slices prefabricated elements the self-supporting and as permanent shuttering the building loads (crash scaffolds were first assembled into trough carriers,

DIAGRAM OF COVER DESIGN



So that the trough carrier were static as far upgraded that they could derive the Betonierlast the following section.

After hardening of this primary rust the armor of the support ring has only been lowered to mobilize its own bearing capacity fully and to relieve the armor itself, but while maintaining the contact between two supporting elements. Thus, it was possible to distribute the loads of the second Betoniertaktes to bottom edge of ceiling above the 21 floor in proportion to their stiffness to both support systems. The Endverformungen of the structure could be reduced to a minimum.

After the completion of the peripheral support ring it was now possible to provide the transverse walls finished, which were also made for reasons of weight in two sections. The grate form prestressed hollow core slabs with 12 cm layer of concrete that are stored on specially provided consoles in the grate beams. These are designed so that all the loads of the building and the final state can be absorbed.

The production of the Abfangungstragwerkes thus took place in the following operating cycles:

- Preparation of Bearing for the compression beam of Ortbetonkranzes in axis B / 9-10, columns H / 10 and B / 5,
- Installation of the compression beam
- Preparation of the scarf together with shuttering floor and fall protection for the first concrete section of the support ring
- Reinforcement and concreting of the first section
- Attaching the prefabricated elements for the transverse girders
- Reinforcement for the beams
- Filling the channel support (first concrete section) of the transverse slices
- Lowering the armor
- Reinforcement of the second portion of the ring carrier
- Concreting at full storey height
- Reduction of armaments
- Installation of the prestressed hollow boards (grate)
- Supplementing the transverse walls to full storey height
- Preparation of the Aufbetonplatte on the hollow floorboards

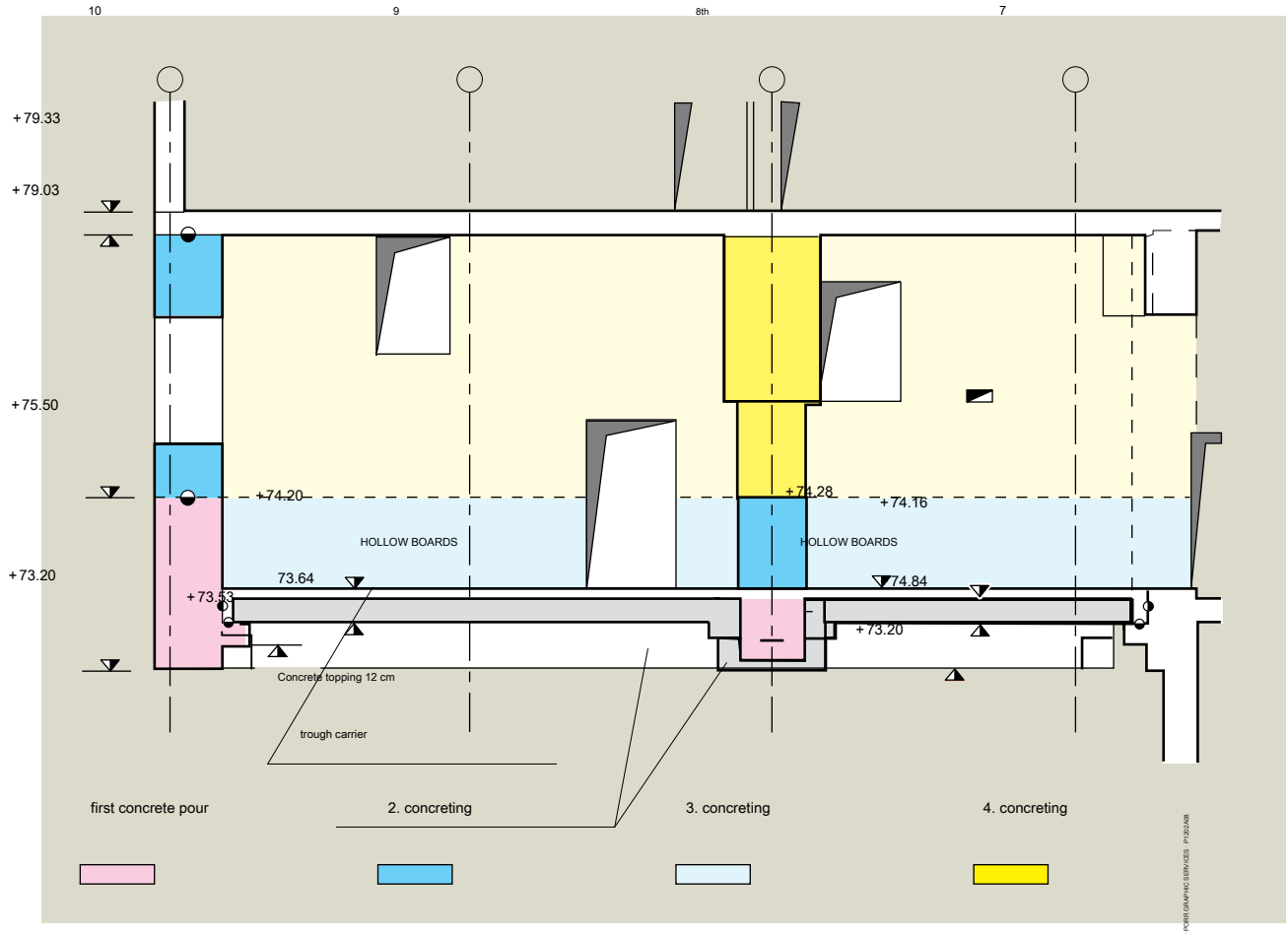
This complex sequence of operations took including the BetonAushärtungzeiten six weeks to complete.

THE HANGING HOUSE

A building in the building is the so-called hanging house. This extends from the first to the third floor and spanning the area between the axes B to G and 11 to 8. The choice of the suspended construction, the specification of the architects after a column-free input and lobby on the ground floor could be fulfilled.

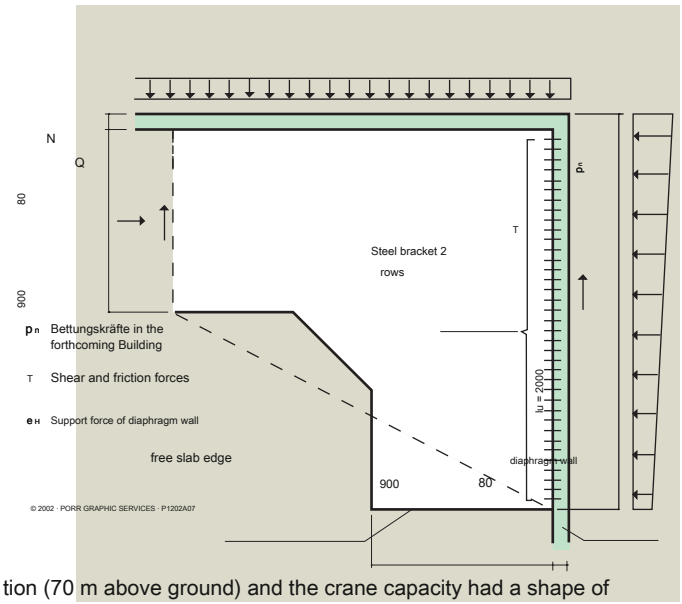
The support system forms a reinforced concrete box girder on the fourth floor with six projecting to both sides transverse slices at intervals of 5 m. The span of the main carrier is 25 m.

SECTION achieved by affixing IN 21 OG



Suspension columns are made of steel mounted with a mutual distance of 11.60 m in the Kragarmenden the transverse slices. In these columns are each bound to ceiling level cross beams derived prorated floor loads in the "hanger". After the manufacture of the head support structure on the fourth floor and the mounting of the suspension pillars the suspended ceilings were prepared starting with the lowest. To avoid forced stresses in each subsequent ceiling areas as a result of longitudinal deformation of the suspension pillars reduction streets were left open. With completion of the top-suspended ceiling, after the decay of the deformations under its own weight, they have been closed subsequently.

Load transfer IN THE FIELD OF FREE COVER EDGE



SUMMARY

The unusual structure of the house - due to architectural requirements - also had a demanding static support structure to accommodate the vertical dead and live loads and the horizontal loads from wind result. In five underground floors a corresponding retaining wall and the horizontal support by the three support Horizonte was required. For the safe discharge of the high vertical forces and minimize the subsidence a powerful bottom plate from 2 to 3 m deep foundation elements came together under high load supports and pilasters for execution. To accommodate the loads of the projecting part of the building in the 21st floor a statically and structurally complex Abfangungskonstruktion was eventually required. With regard to the Höhensitua-

tion (70 m above ground) and the crane capacity had a shape of the scaffolding and formwork design for producing the support ring, combined with semi-finished products and prefabricated floor elements are developed. Finally, the construction of the hanging house enabled with a powerful header structure and suspended ceilings, a column-free design of the hotel lobby on the ground floor.

Literature:

Randl, N., vetch, M .: shear transfer between old and new concrete. Concrete and reinforced concrete, Vol. 95, 2000,
H. 8, pp 461 - 473. Polish standard PN-B-3264 (January 1999): Concrete, reinforced and prestressed concrete structures (point 7.5.).

Triangula

Photo: Breakfast

InterContinental Hotel Warsaw

Visualization: PB