# Organic Workplace Surrounded by Curved Walls — Rever Holdings Ryogoku —

## 曲面壁に囲まれた有機的なオフィス — リバーホールディングス両国 —




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## Synopsis

Rever Holdings Ryogoku was a reconstruction project for the office building of Rever Holdings Corporation—a group company engaged in recycling and waste treatment of metal—to commemorate its 100 year anniversary (**Fig. 1**). Although the word “waste” easily conjures negative images, the owner considers waste to be “resources” and has been working with a strong sense of mission to break down or change the boundaries between waste and resources.

In proceeding with this project, the company aimed to achieve the global objective of circular economy, setting the following themes:

- an advanced workplace involving promotion of communication and a new way of working;
- harmony with the surrounding environment, making use of natural light and airflow;
- harmony with the global environment through positive use of recyclable materials.

To realize these themes, this project used the excellent formability of concrete to make both the inside and outside of the building have organic forms that blend in with the environment, unlike conventional office buildings.

**Fig. 1 Rever Holdings Ryogoku**

## Structural Data

*Main Use*: Offices
*Structure*: Reinforced concrete
*Area*: 2,135 m$^2$
*Building Height*: 19 m

*Owner*: Rever Corporation
*Designer*: TAKENAKA Corporation
*Contractor*: TAKENAKA Corporation
*Construction Period*: Nov. 2018 – Feb. 2020
*Location*: Tokyo, Japan

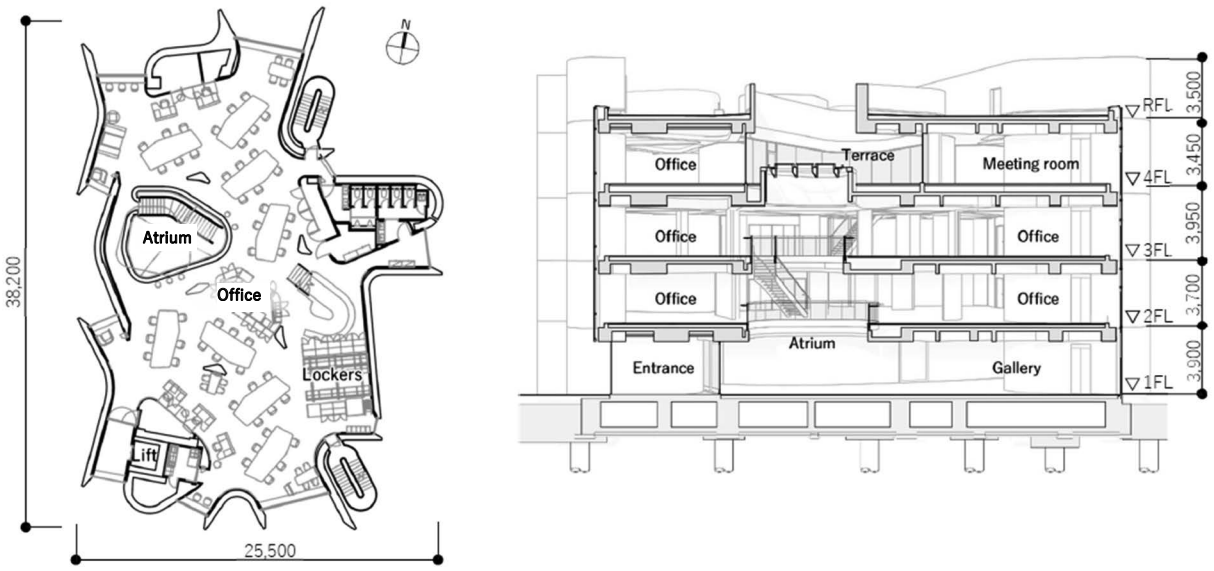


**Fig. 2 Architectural plan and section**

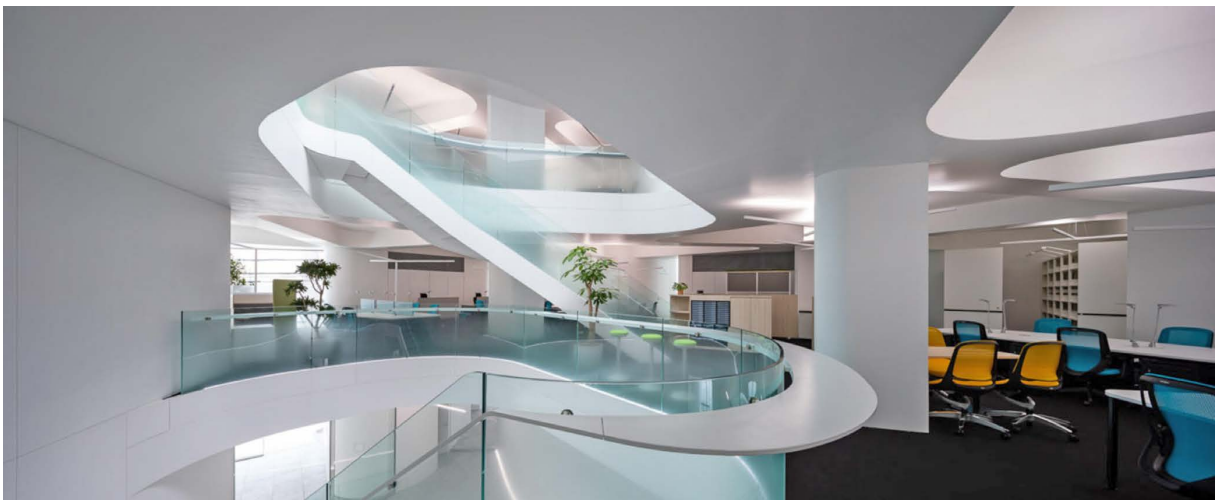

**Fig. 3 Interior of office**

## 1. Design

### (1) Concepts and Aesthetic Design

To achieve an ideal workplace as the new office of an owner who continues growing, taking in a new way of working and accepting changes, the authors created a design with the following concepts.

- Creating a worker-friendly place in which workers can enjoy environmental changes, by providing organic and loosely connected heterogeneous spaces.
- Expanding the workplace throughout the whole of each floor by eliminating the corridors and locating the vertical circulations dispersedly.
- Facilitating grouping regardless of desk arrangements and increasing communication opportunities by developing the furniture layout.

Curved walls were erected on the periphery of the plan, which bring in light softly through the window slits in between (**Figs. 2** and **3**). This provides people with an intermediate area between inside and outside.

### (2) Structural Design

The following two points were important for utilizing the attractions of the curved peripheral walls and organic shaped void, which are the features of this work:

- the structure must make effective use of the peripheral walls;
- the internal structure must be designed to be released from lateral loads.

Therefore, the authors planned for the peripheral walls to resist all lateral loads. Boundary girders were installed in the out-of-plane direction of walls to restrain the deformation.

Because the inner columns support only the vertical loads, the authors developed a structural system inspired by nature that is suitable for the complex plan surrounded by the peripheral walls.

### (3) Capital Design

In the inner column joints, up to seven beams are joined to a single column (**Figs. 4** and **5**); thus, the joints were provided with rectangular capitals and the main bars of the beam ends were anchored in the capitals, not in the columns. The bending moments of the beams connected to the capitals from each direction are transferred through mechanical anchorage, and the capitals are designed to have sufficient sizes and bar arrangements to resist the large bending moments and shear force. Three mechanisms are considered for transferring the stress from beam to the column: the bending resistance of the slabs in the front and rear faces of the column, the shear forces in the front and rear faces, and the torsion in the side face. The accumulation of these forces were used to design the stress transmission around the columns.

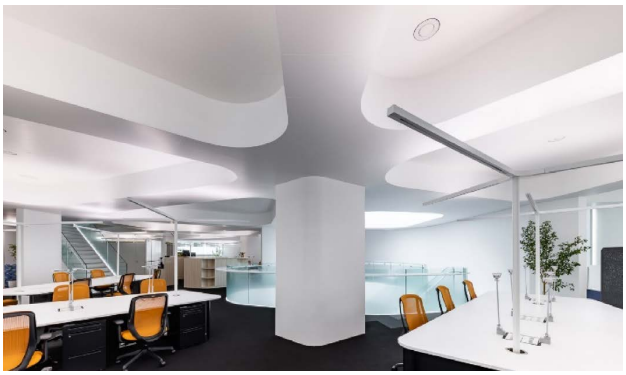

**Fig. 4 Capital**

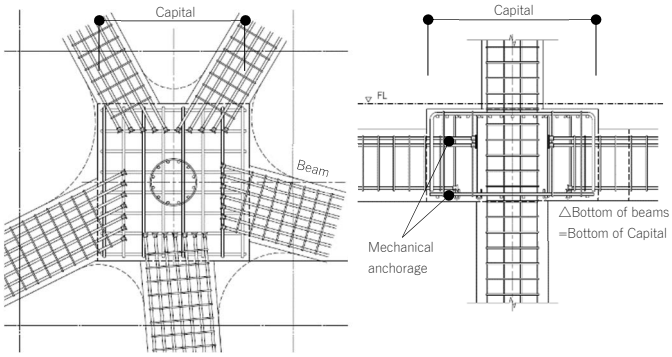


**Fig. 5 Capital plan and section**

### (4) Wall Material

The authors strove to reduce the environmental load by using recyclable materials for interior and exterior finishing and minimizing the amount of building materials to be used. Therefore, paint finish was applied to the exterior walls and only their inside was finished for thermal insulation, and concrete monolithic surface finish was applied under the interior columns, beams, and slabs.

The non-drying shrinkage type concrete (Fine Lead®: Japanese Patent No. 6192208) that was used for this project to prevent cracks in the walls is produced by using air-entraining and high-range water-reducing admixture with shrinkage reducing performance, expansive additive, and crushed limestone. This concrete expands in the early stage of hardening to a degree that does not affect its various performances, and it then makes the total shrinkage strain almost zero because of reduced drying shrinkage [1].

Fine Lead® has often been used in buildings, partly because it is effective for walls with fair-faced exposed concrete that requires excellent design, but this building was the first case of using this material entirely for a curved-wall building with thick exterior walls (**Fig. 6**).

**Fig. 6 Peripheral wall**

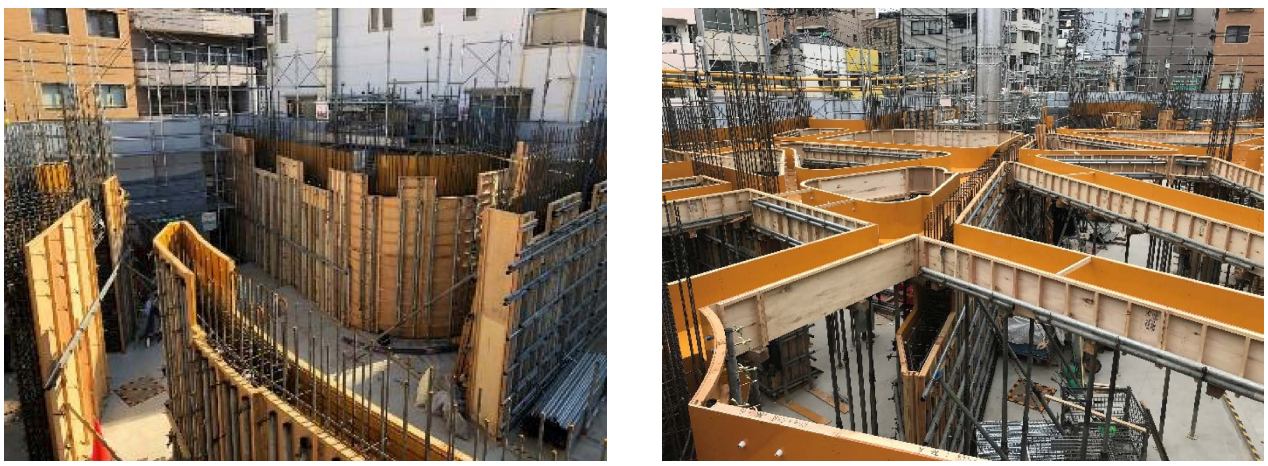

**Fig. 7 Curved formwork and rebar layout**

## 2. Construction

### (1) 3D rebar scheduling

Because the peripheral walls are curved and the inner beams were placed radially (**Figs. 7** and **8**), the authors thought to establish an efficient method for arranging the rebars before construction. For that purpose, structural engineers met with the workers in charge of concrete form and reinforcement works for this building in the design phase. For lively and effective discussions, the authors used the RCS system, which is BIM software for reinforcement work developed by their company. Visualizing the arrangement of the rebars helped the actual work on site.

### (2) Marking method on site

In this project, it was almost impossible to mark the wall positions on each floor level at the distances in the X and Y directions from reference points, which became the biggest barrier in constructing a formwork as indicated on the drawings. That prompted the authors to introduce “next-generation marking” in the construction of this building. This method—which provides accurate marking from the BIM model and the marker’s (prism) position on the tablet screen—has made it possible for one person to perform markings on site, in principle even for an intricately shaped building as in this work, and it became an indispensable technique for realizing this work in terms of both efficiency and accuracy (**Fig. 9**).

## 3. Conclusion

This building took shape by making full use of various concrete technologies to meet the owner’s desire to create a new workplace for employees and represent it in the form of a building. The authors would like to thank everyone involved in this project.

## References

[1] Sato, T., Inoue, K., Honma, D., Ogawa, A., Kawamura, S., Saito, K., Mase, A. et al.: *Application of Non-Drying Shrinkage Type Concrete to Curved Walls*, Summaries of technical papers of annual meeting, Architectural Institute of Japan, pp. 117-118, 2020 (in Japanese).

[Image credits] Figs. 1, 4, 6, 10: Noboru Inoue; Fig. 3: Nacása & Partners

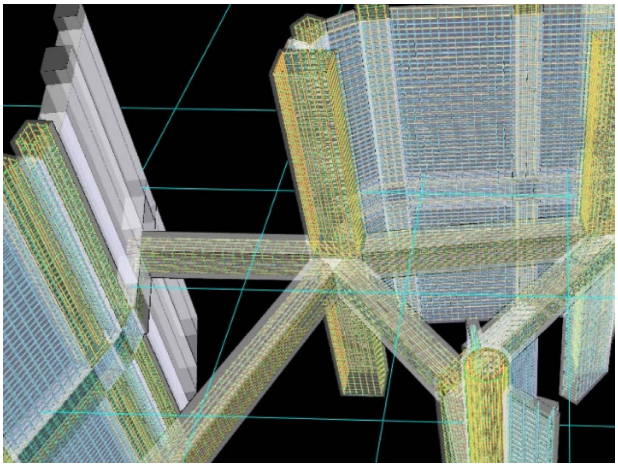

**Fig. 8 3D rebar model**

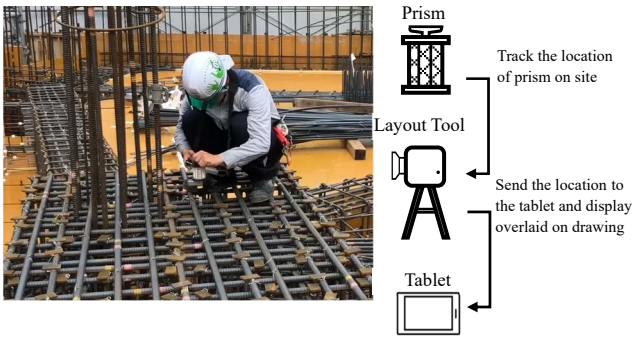


**Fig. 9 Marking work on site**

**Fig. 10 Terrace**

## 概　要

リバーホールディングス両国は 4 層から構成されるオフィスビルの計画であり，平面的・断面的に空間が緩やかに連続した新しいオフィス環境の提案である。このプロジェクトでは，外周部に配置された不連続な11枚の鉄筋コンクリートの曲面壁同士を面外方向の梁で一体化し，互いの動きを拘束することで地震力に抵抗するように計画している。地震力から解放された内部空間は，クモの巣のように張り巡らされた柱と梁により構成した。放射状に拡がる梁の中心に位置する柱は，執務空間のレイアウトや床面の応力と変形などをパラメータとした解析により合理的に決定している。

季節によって温湿環境が大きく変化する日本では，鉄筋コンクリート壁のひび割れを防ぎ，耐久性を高めることが重要であるため，収縮低減型のコンクリート材料を採用した。また柱梁仕口の配筋など設計上の工夫や，BIM モデルを活用した建設上の工夫もこの計画の実現に大きく寄与している。