

A “Muskmelon” Concrete Structure Boltun Headquarters Building

「マスクメロン」コンクリート構造
— ボルトン本社屋 —



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Synopsis

Boltun Headquarters is a small office building designed for an architectural hardware supplier. The design concept was a twisted spiral space, inspired by the nuts and bolts from which the company derives its name.

Because the authors did not want columns and beams intruding into the limited storage space, it was decided that the structural scheme would be a regular wall-type frame structure in which the walls, columns, beams, and slabs would be of the same thickness.

However, it soon became apparent that the number of pylons needed in the soft ground to support the weight of this structure would be uneconomical. To tackle this, the excess walls and slabs were reduced to the minimum, leaving behind an irregular and inverted mesh-like configuration of flat columns and diagonal beams. The authors chose to call this a “muskmelon” structure.

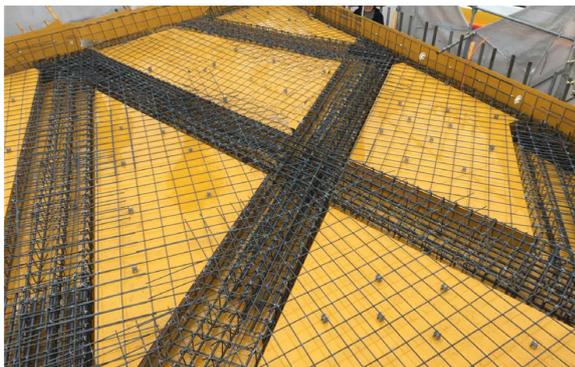


Fig. 1 Beam rebar of the “muskmelon” structure

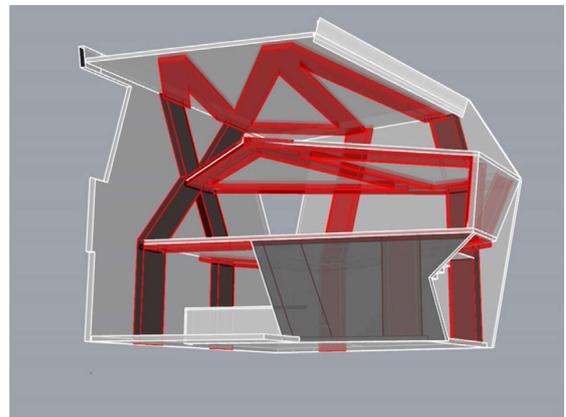


Fig. 2 The “muskmelon” structure looking up

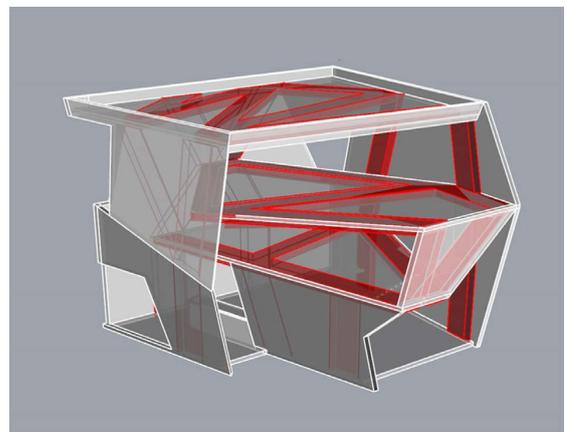


Fig. 3 The “muskmelon” structure looking down

Architectural Data

Structure: Reinforced concrete / modified box frame structure or modified flattened beam-and-column rigid frame structure

Pylons: Steel prefabricated screw-headed pylons

Number of Floors: 3

Owner: Boltun Industries KK

Architectural Design: Yasuhiro Yamashita, Kenji Mizukami, Fumi Otsuka / Atelier Tekuto

Structural Engineering: Jun Sato, Shingi Tarirah / Jun Sato Structural Engineers

Construction Management: Shigeki Matsuoka, Shinichi Uchimura, Koji Izawa / Home Builder

Construction Period: Sep. 2017 – May 2018

Location: Saitama Prefecture, Japan

Building Use: Office

Site Area: 115.81 m² (1246.56 ft²)

Building Area: 78.75 m² (847.65 ft²)

Total Floor Area: 155.79 m² (1676.90 ft²)

Photographs: Toshihiro Sobajima

1. About the Site

The 115.8-m² site sits alongside a busy industrial street, and the project was to rebuild the existing steel-structured warehouse/office building. Being adjacent to a wide street, this site has the advantage of accessibility, with ease of loading and unloading of the quantity and size of merchandise dealt with by the owner. Also, being a corner site, the building would stand out from its surroundings. However, the disadvantages were the continuous noise during the day, the tremors caused by heavy traffic, and the extremely weak ground.



Fig. 4 Site plan

2. About the Client and the Brief

The client is a medium-sized retailer handling a vast range of nuts and bolts together with other architectural materials. They requested that the new headquarters be a warehouse, a showroom, and an office and for it to be an interesting, eye-catching piece of architecture.

However, the budget of 240,000–250,000 yen per square meter was extremely limited, being about 60% of that for an average concrete building. Analyzing the client's requests thoroughly while minimizing the cost and visualizing the final structure, studies were carried out in cooperation with the structural engineer and contractor.

3. Creation through Collaboration

To lower the building cost, wood and/or steel construction was initially considered because of the general understanding that these construction methods are cheaper than concrete and that lighter construction would be better for the weak ground conditions.

However, after some comparative studies between low-cost wood–steel construction and low-cost concrete construction, it was found that there was not much difference in terms of cost. This was due to there being a limit on what could be stripped away from wood–steel construction to lower the cost. With this in mind, the final decision was made to opt for concrete considering its fireproof and soundproof benefits.

The design team was very confident that this project would be feasible in terms of cost despite the limited budget, because of their knowledge and past experience of collaboration. From the very first stages of design, this project saw high levels of collaboration.

Yasuhiro Yamashita had been working with structural engineer Jun Sato for more than 15 years, and the contractor Shigeki Matsuoka, head of Homebuilder Co., Ltd., had been a collaborator for more than 25 years, working on more than 80 projects together. Naturally, most of the members working on-site were long-time partners as well.

As soon as the decision was made to use concrete, collaboration with Mr. Matsuoka enabled a detailed list of more than 20 construction categories to be devised. Each had a budget allocated to it in order to help inform decisions on appropriate materials and architectural details. This was a unique approach that is quite the opposite of normal procedures of cost design and estimation.

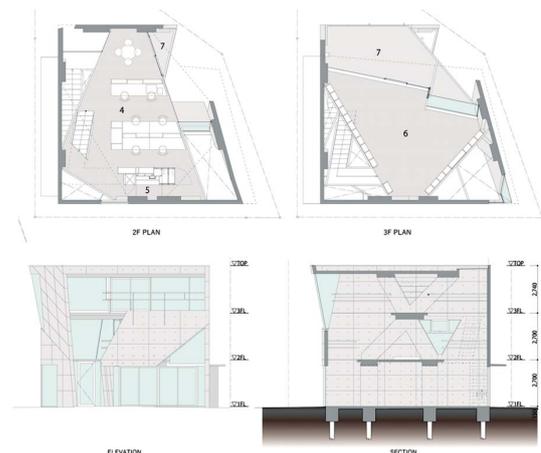


Fig. 5 Drawings

4. In Pursuit of the Inevitable

(1) Unkei and Kaikei

Two famous Japanese sculptors of Buddha statues who were active in the late 12th to early 13th century—are quoted as saying that they did not create the shapes themselves but rather “excavated” the shapes embedded in the pieces of wood. The design process of Boltun Headquarters essentially followed a similar path to that of those two master sculptors.

Aspiring to achieve a powerful, simple yet complex form like nuts and bolts, from which the company name “Boltun” (BOLT + NUT spelled backwards) was derived, numerous study models were made in search of the right form.

(2) The Goal and Obstacle

The goal became to create three-dimensionally connected spaces with “nuke” (noo-kay; a Japanese concept of physical and psychological continuity and the possibility of objects or senses passing through from one space / phase to another) using continuous walls like a one-stroke drawing existing in a piece of architecture. The basic form of the structure was decided upon, but the authors found that because of the weight of the building, 19 pylons were needed, and this was an issue with regards to the budget.



Fig. 6 Study models (30 out of 124 models)

(3) Eliminating the “Excess”

Thus, to reduce the building weight, what could be considered as “excess” concrete was shaved off from the box-frame structure. The process revealed flat columns and flat beams at varying angles within the complex twisting three-story space. The unique structure resembled the mesh-like skin of a cantaloupe or muskmelon: a serene and refined structure purified down to its essential elements, just like a sculpted Buddha carved out of a piece of wood.

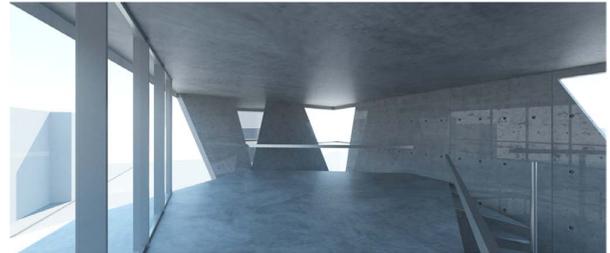


Fig. 7 Original modified structure (3rd floor)
renderings by atelier TEKUTO



Fig. 8 Original modified structure (2nd floor)

5. The Structural Outcome

The process reduced the weight of the structure to 60% of that of a regular structure of this sort, which resulted in reducing the number of steel pylons from 19 to 11.

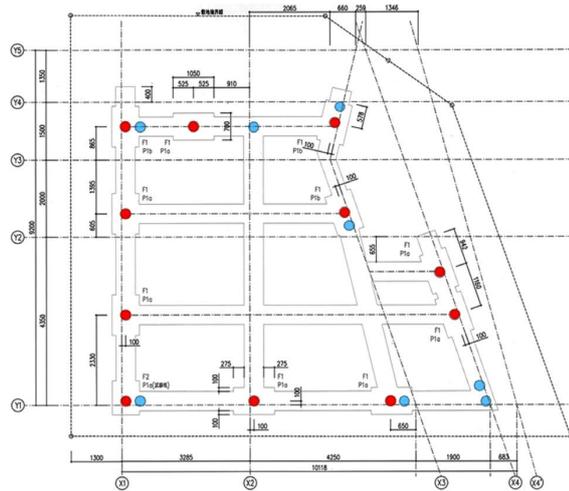


Fig. 9 Original and reduced pylon schemes
red dots show implemented pylons
blue dots show omitted pylons

The openings were glazed, galvanized steel stairs were installed, and minimalistic suspended handrails were designed with the utmost care to not detract from the power and serenity of the structure. For the same reason, some built-in furniture was also installed using only Lauan plywood, a material used mainly for underlayment and backer boards.

The dynamism and freshness this new headquarters building was a true expression of the corporate image of Boltun Co., Ltd.



Fig. 10 Exterior of the completed building

Conclusion

In a densely populated and land-scarce country such as Japan, the BOX frame structure is a well-used solution for relatively small buildings.



Fig. 11 Interior of the completed building

The formwork is simple, with beams and columns flush with the walls and ceilings, enabling a relatively cheap method of construction.

In this project, the authors found a new minimum by stripping away the buildings' "excess". Although the formwork became more expensive in comparison to the regular BOX frame method, this was counteracted by fewer pylons being needed.

It also led to another merit within the design, with interesting patterns being created by the now-exposed flat beams and columns.

In conclusion, the "muskmelon" structure is an effective system that benefits small sites with weak ground the most. It provides an alternative to the common box frame structure while maintaining affordability.

Moreover, it is a new design method for concrete structures that in terms of cost and building weight is compatible with steel or even wood construction. Consequently, the use and practicality of concrete construction are broadened while supplemental design opportunities are facilitated with beams and columns flush with the walls and ceilings, enabling a relatively cheap method of construction.



Fig. 12 Exterior (evening view)

概要

ボルトンは建築金物を取り扱う会社のオフィスビルで、社名の由来であるボルトとナットをイメージした、螺旋状の空間を有する。限られたスペースで柱・梁の突出を避け、音・振動を避けるため、当初、壁と柱、梁とスラブが同じ厚みのRC壁式ラーメン構造が採用され、検討が進められた。しかし、軟弱地盤のため、構造物の重量を支える杭の本数が増え、コスト上、大きな負担となることが判明した。そこで、余分な壁やスラブを極力そぎ落とし、空間い合わせた斜めの扁平柱と扁平梁を残した。結果として現れたのは不規則なメッシュ形態で構成された不思議な空間で、これを「マスクメロン構造」と名付けた。この構造形式はコンクリートの活用がコスト及び軽量化という観点から鉄骨造や木造との比較において、十分に選択肢になりうることを意味する。