Art Museum & Library, Ota

図書館と美術館を一体化した 5 つの箱からなる複合文化施設
― 太田市美術館・図書館 ―


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Fig. 1 Bird's eye view of the Art Museum & Library, Ota

Fig. 2 Night view

Synopsis

The Art Museum & Library in Ota City is a complex with a floor area of 3,153 m^2. Because the library and museum are interconnected, the building was designed such that users experience the atmosphere of a town while in the building. The building was conceived as a catalyst for bringing the flow of people back to the front of the station and developing the streetscape in front of the station into an attractive and enjoyable place to walk.

Structural Data

Floor Plan: 3 floors above ground, 1 basement level
Site Area: 4,641 m^2
Building Area: 1,496 m^2
Gross Floor Area: 3,153 m^2
Owner: Ota City
Architect: Akihisa Hirata Architecture Office
Arup Provided Services: Electrical engineering, Mechanical engineering, Structural engineering
Contractor: Ishikawa Construction Co., Ltd., Douo Kensetsu Co., Ltd.
Construction Period: Jul. 2015 – Dec. 2016
Location: Ota, Gunma, Japan

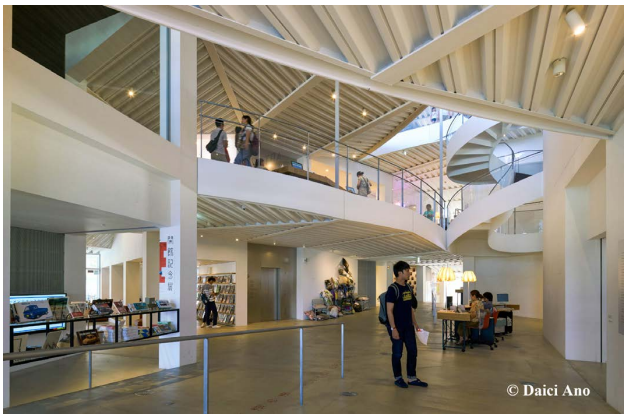

Fig. 3 Internal view

1. Introduction

This building consists of two elements: earthquake-resistant BOX elements and LIMB elements. The BOX elements are made of reinforced concrete (RC) to achieve good soundproofing and to bear heavy objects and seismic forces. Meanwhile, the LIMB elements have a light and clear façade and are made of steel beams and columns in order for the building blends into the town.

2. Structural Plan

(1) Consists of Five Square Boxes

The main feature of the building is that it consists of five cubes (BOXs) for the main use of museums and libraries and a peripheral passage (LIMB) connecting the BOXs (**Fig. 4**).

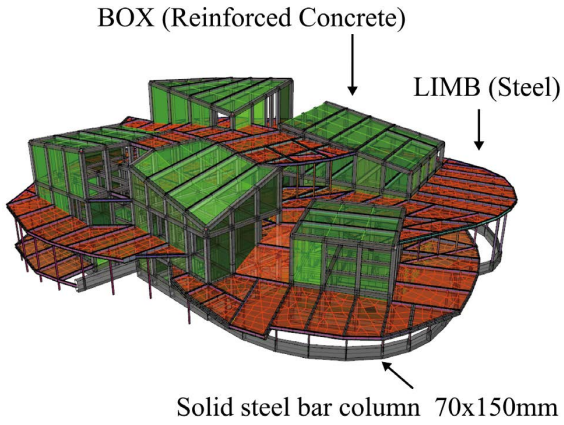

Fig. 4 Structural analysis model

As a structural feature, the limb of the slope shape at the outer periphery is continuously connected from the ground level to the roof, and the limb consist of five RC BOXs. The limb works as one of the brace elements against seismic forces. As for the construction, the limb is composed of a glass façade and a floor, and because it required the thinnest possible floor composition, the construction of the BOXs was designed to have a rigid structure with high-rigidity RC shear walls. The limb was decided to be a lightweight floor construction by making it from steel beams and a composite deck.

Fig. 5 Front façade

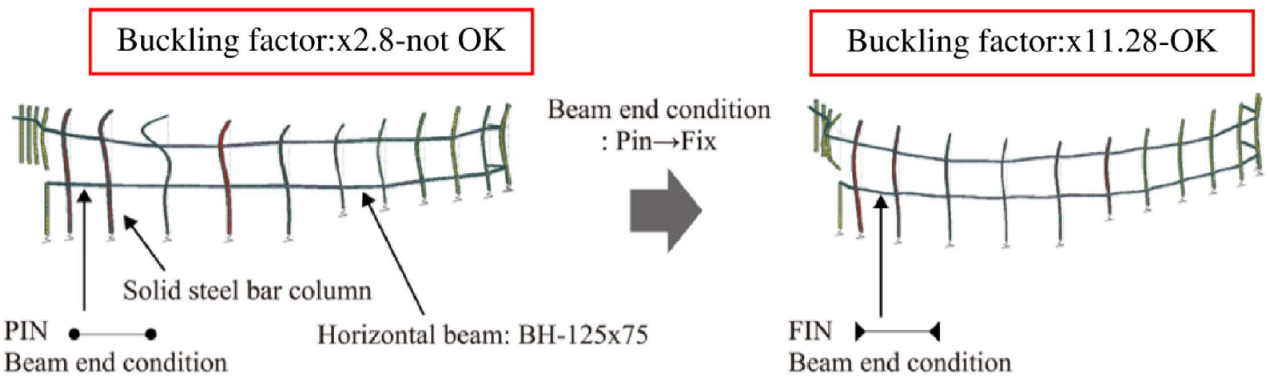

Fig. 6 Results of buckling analysis

(2) Design for Liveliness of the City

All passengers who are walking around the station can see inside the building because the architect realized a very clear façade system. Originally, Arup proposed perimeter columns with a standard circular hollow section (ca. 150 mm in diameter), but then instead of the original scheme, Arup proposed the cleverer façade column system. It comprises solid steel columns and fixed-end horizontal beams. According to the Japanese design code, the slenderness ratio of a column must not exceed 200.

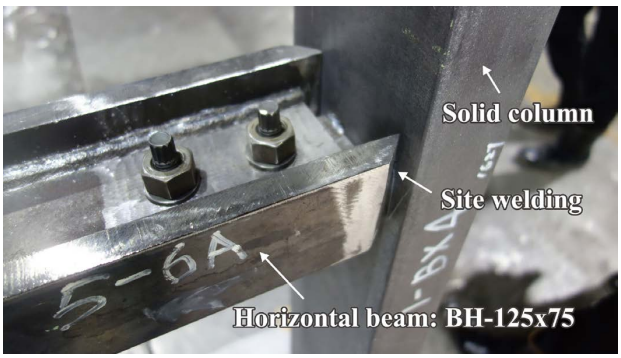

Fig. 7 Horizontal beam joint

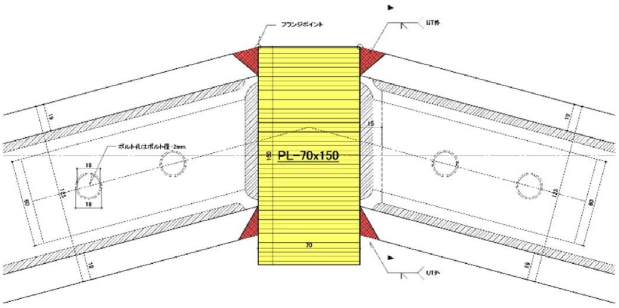

Fig. 8 Joint detail

(3) Ensuring Buckling Capacity

This column slenderness ratio of 200 was set considering the effects of the horizontal beams. If the ends of the horizontal beams were pinned, then these columns could not maintain adequate buckling capacity. Thus, to increase the buckling capacity of the slender columns, the authors decided to weld all the beam ends on site. The other issue was how to accept the tolerance of construction. These columns support the 8-m-span beams. Rotational rigidity of the beam ends might weaken the buckling capacity of the columns.

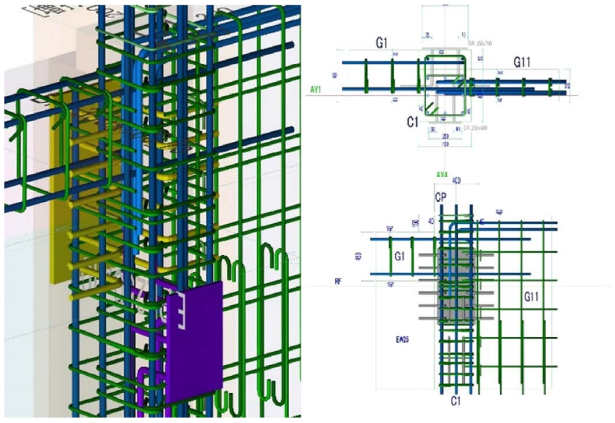

Fig. 9 Step 1: 3D model for rebar

Fig. 10 Step 2: Base plate embedded in RC column

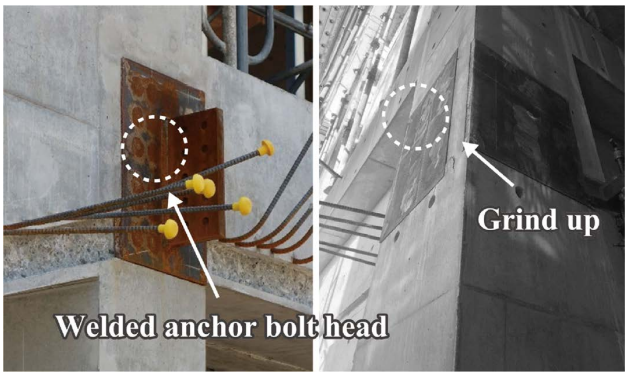

Fig. 11 Step 3: Base plate after welding is ground up

Fig. 12 Step 4: Gusset plate attached to base plate

Fig. 13 Step-5: Installation of the steel beam and deck plate

3. Construction Steps

Because the columns are small (400 mm × 400 mm), the study began with the creation of detailed three-dimensional (3D) reinforcement drawings. After the 3D study of the rebar was completed, the details of the steel frame attached to the RC construction were studied, and finally, after the base plate was cast into the frame, the steel beams were welded.

4. Conclusion

This project shows that by using intelligent and thoughtful detail design, traditional materials and structural systems can become a next-generation structural system. In this project, new RC and steel joints, framing, deck joints, and joints between RC and steel were developed and installed thanks to the many efforts of the contractor. To realize a new design, an understanding owner and architect are absolutely essential. Fortunately, the present owner, architect, and contractor are passionate about achieving new designs and spaces with new styles.

概　要

太田市美術館・図書館は2017年に完成した複合施設である。建設地は群馬県太田市で，太田駅前のまちづくりの拠点となることを目指した。太田市美術館・図書館は人びとの感性を刺激する多彩な美術作品や創造的発想の源泉となる知識を提供する図書資料を同時に提供できる空間である。

開かれた建築空間を実現するため，ファサードには繊細な構造要素が望ましいと考え，耐風材と床を支持する柱を一体化させた無垢柱を採用している。地震力に対しては BOX と名付けられた耐震壁付きラーメン構造が全て負担する計画とした。内部空間の床は階段を用いることなく移動することが出来るようにスロープ形状となり，床が建物全体の空調ダクトとなるような計画となっている。床をダクトとして利用するため，構造スラブとなる合成デッキは鉄骨下端に合わさるように配置した。5 つの耐震要素は合成デッキ床にて一体化されているため，時刻歴応答解析を行うなどして床スラブの健全性を検証した。