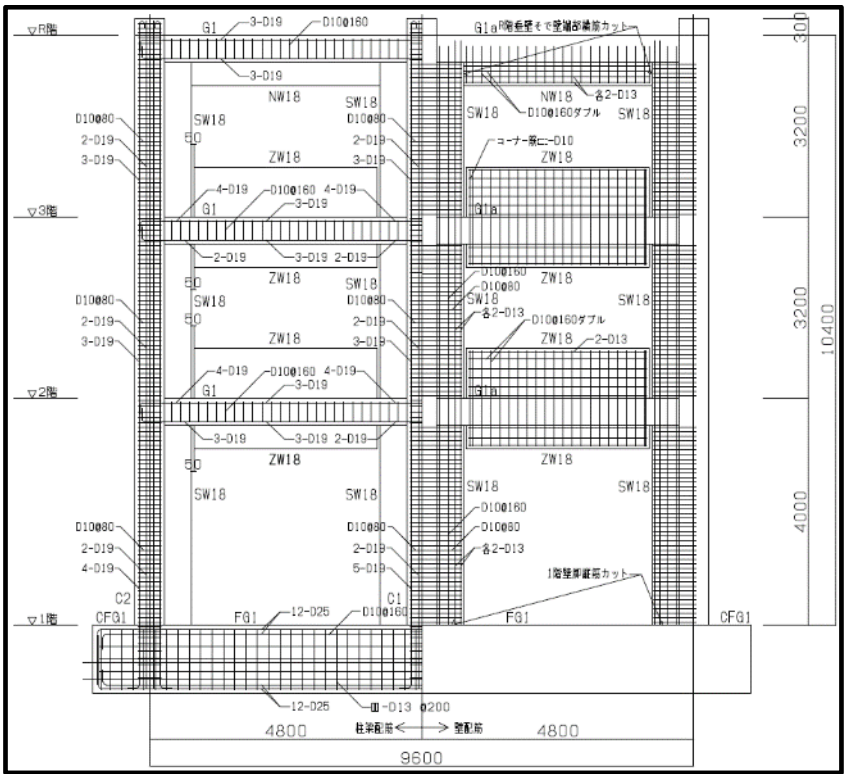
RESILIENCY PROJECT

2019/12 - E-Defense Test Blind Prediction Competition



Supplementary document 2

Building details and drawing translation guide

Tokyo Metropolitan Resilience Project of the National Research Institute for Earth Science and Disaster Resilience (NIED)

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Affiliations

FOREWORD

To interested participants,

On behalf of the Resilience Project team, we would like to again thank you for expressing interest in participating in the 2019 E-defense test blind prediction competition.

In supplementary document 1, we presented an overview of the building's features, the design philosophy and the contest rules.

In this document, a translation of in-depth building details will be provided. This includes the design material properties, a translation guide for drawing sheets, key notes where appropriate, and ground motion information. The Japanese version of the drawing sheets will be uploaded onto the competition website.

It should be noted that material tests will be performed to obtain more representative material properties, and these results will be made available to participants after tests have been completed.

Once again, thank you for showing interest in this competition, and we look forward to your participation.

Sincerely,

Resilience Project Team

Contents

1. DESIGN CONCRETE AND STEEL MATERIAL PROPERTIES

The concrete and steel material properties assumed in the design of the building are listed in Table 1 and Table 2, respectively.

Table 1. Design concrete properties

Property	Symbol	Value	Unit	Equation
Concrete density	γ	23.0	kN/m^3	
Compression strength	F_{cc}	30.0	MPa	
Tension strength	F_{ct}	3.07	MPa	$0.56\sqrt{F_c}$
Shear strength	F_{cv}	2.00	MPa	$F_c/15$
Bond strength	F_{cb}	6.30	MPa	$1.15\sqrt{F_c}$
Young's Modulus	E_c	24.4	GPa	$33500 \times (\gamma/24)^2 \times (F_c/60)^{1/3}$
Poisson's ratio	ν	0.2	-	
Shear Modulus	G_c	10.2	GPa	$E/\{2(1+\nu)\}$

Table 2. Design steel properties

Property	Symbol	Steel ID		Unit
		SD295	SD345	
Diameters		$\leq$16	$\geq$19	mm
Axial strength	F_s	324.5	379.5	MPa
Shear strength	F_{sv}	295.0	345.0	MPa
Young's modulus	E_s	205		GPa

2. DESCRIPTION OF SPECIMEN DRAWINGS

There are two sets of building drawings, the structural set (構) and the conceptual set (意). The structural set provides details on the structural system itself, such as frame dimensions and member details. The conceptual set provides an overview of other aspects of the specimen, such as safety railing locations, ceilings, tiles, and window layouts. The list and description of the drawing sheets provided are shown in **Table 3**.

Table 3. Drawing sheets content

Drawing set	Sheets	Content
Structural (構)	構 1 to 構 3	Frame dimensions and beam/wall locations
	構 4	Frame element details and column locations
	構 5	Hanging/standing/wing wall and slab details
	構 6 to 構 8	Frame reinforcing configuration
	構 9	Foundation beam prestressing details
Conceptual (意)	意 1 to 意 3	Balcony, window and tile locations
	意 4 to 意 5	Ceiling layout and details
	意 6	Safety net placement
	意 7	Tile details
	意 8 to 意 9	Window details
	意 10	Safety railing details

3. STRUCTURAL DRAWING SHEETS TRANSLATION GUIDE

3.1 SHEET 構 1

Sheet 構 1 shows a plan view of the beams (with ID and location) at different levels in the building. The translated sheet layout is shown in Figure 1. The beam IDs can be cross-referenced with **Sheet 構 4** to identify the cross-sectional dimensions and reinforcing layout for the beam elements. Note that all dimensions shown on this sheet and on following sheets are in millimeters.

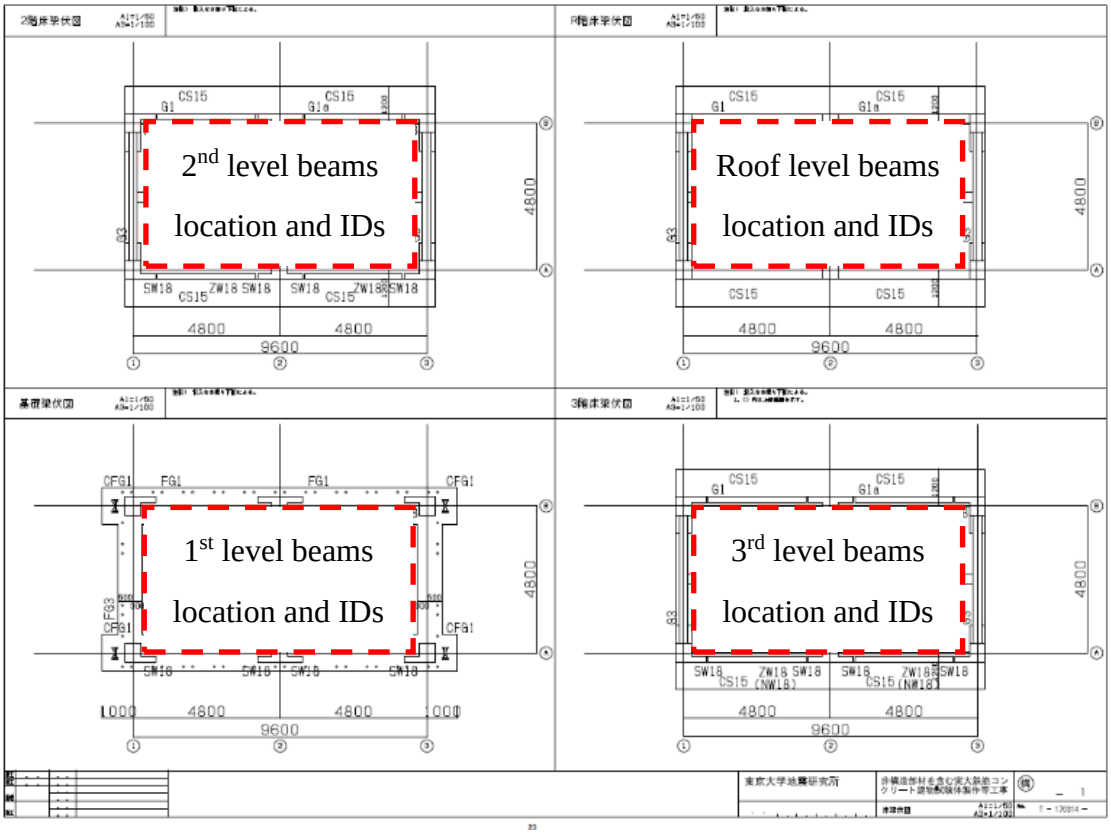


Figure 1. Sheet 構 1 layout translation guide

3.2 SHEET 構 2

Sheet 構 2 shows a side view of the spandrel wall and beams (with ID and location) parallel to the direction of loading (i.e. in-plane elements). The translated sheet layout is shown in Figure 2. The beam IDs can be cross-referenced with **Sheet 構 4**, while the wall IDs can be cross-referenced with **Sheet 構 5**.

There are additional notes and arrows pointing to the ends of the spandrel walls along the roof-level beams and at column bases. The translation are as follows:

- At the roof-level beams (R 階垂壁そで壁端都横筋カット) – the horizontal (flexural) reinforcing bars were terminated at the ends of the roof-level spandrel walls.
- At column base (1 階壁脚縦筋カット) – the vertical (flexural) reinforcing bars were terminated at the base of the column spandrel walls at the 1st level.

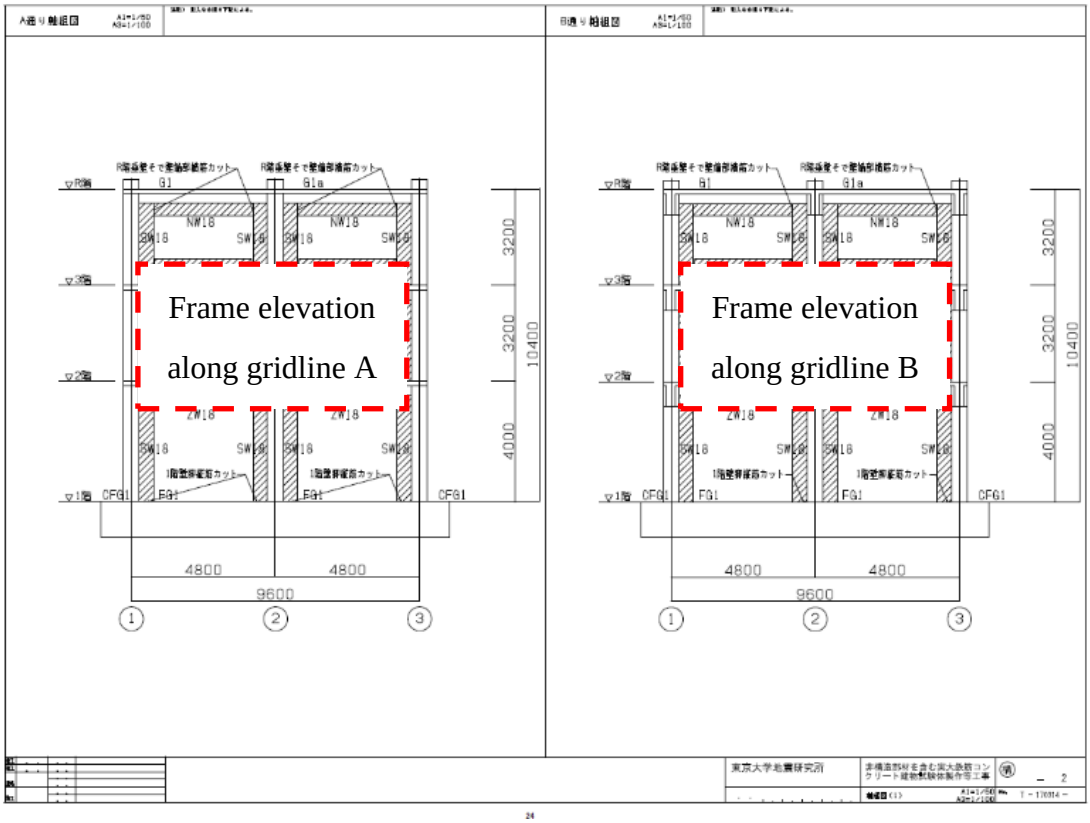


Figure 2. Sheet 構 2 layout translation guide

3.3 SHEET 構 3

Sheet 構 3 shows a side view of the beams (IDs and location) perpendicular to the direction of loading (i.e. out-of-plane elements). The translated sheet layout is shown in Figure 3. The beam IDs can be cross-referenced with **Sheet 構 4**.

Figure 3. Sheet 構 3 layout translation guide

3.4 SHEET 構 4

Sheet 構 4 shows a plan view of the columns (IDs and layout), and the cross-section details for the columns, upper beams, and foundation beams. The translation of the sheet layout is shown in Figure 4.

The translation guide for the columns, beams (upper and central), and foundation beams are shown in Figure 5 to Figure 7, respectively. Of important notes are the remarks given for the foundation beams and the central beam. The translation of these remarks are as follows:

- Foundation beam (PC 鋼材は、PC 鋼材配線図による) – PC strand details are provided in the PC strand layout diagraph (**Sheet 構 9**)
- Central beams (端部下端筋は直交大梁の手前 50 で止め、大梁に定着しない) – the lower bar layer is terminated 50 mm in front of the orthogonal beam.

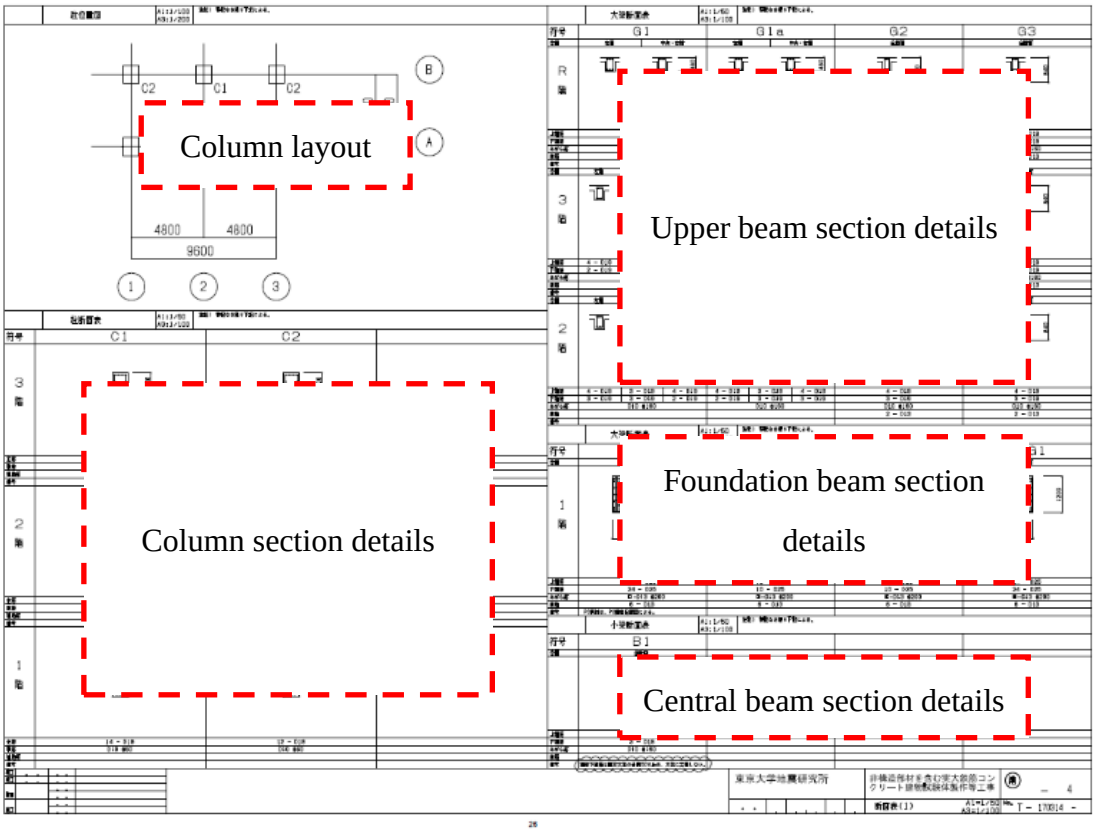


Figure 4. Sheet 構 4 layout translation guide

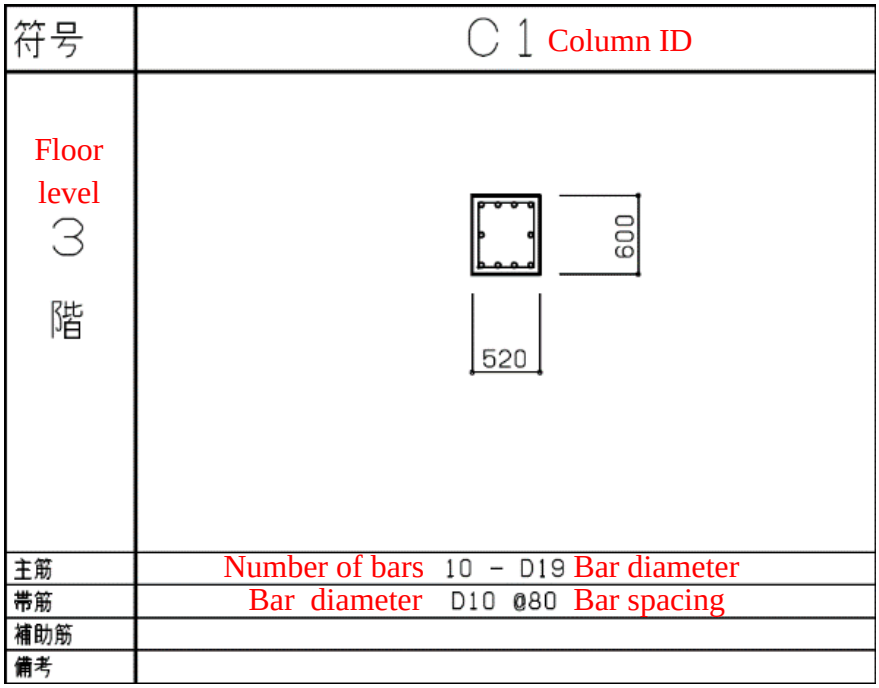


Figure 5. Column section details

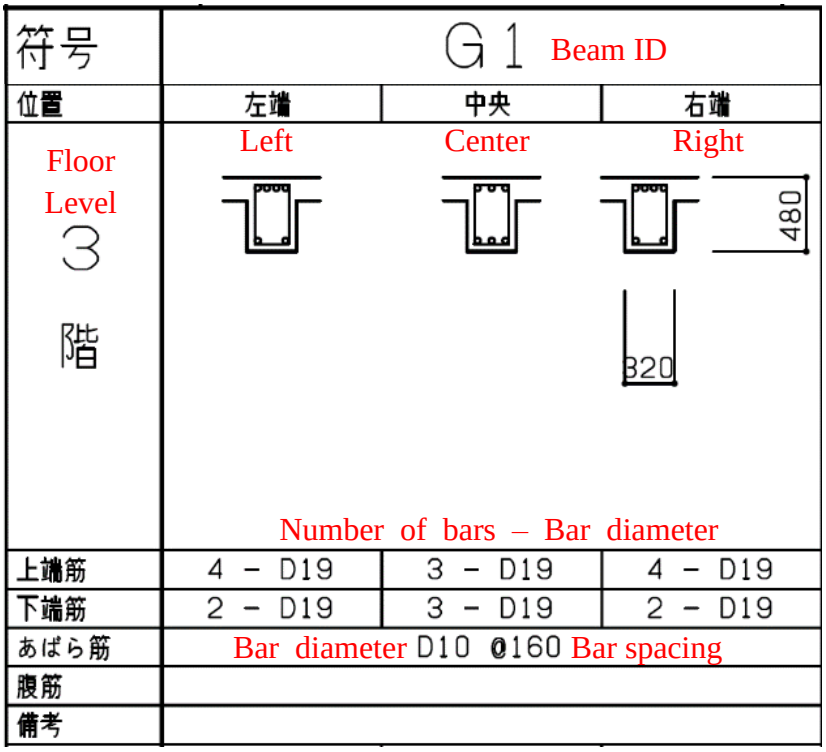


Figure 6. Upper beam and central beam section details

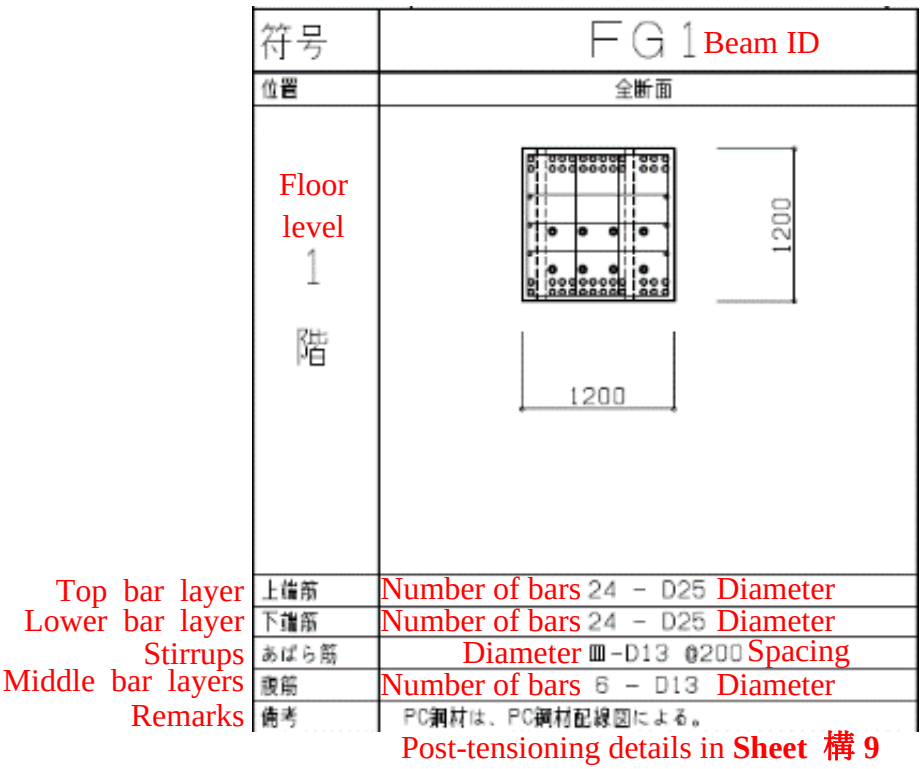


Figure 7. Foundation beam section details

3.5 SHEET 構 5

Sheet 構 5 shows the spandrel wall reinforcement details, illustrations of the frame members with the spandrel walls together, and the floor slab reinforcing details. The translated sheet layout is shown in Figure 8.

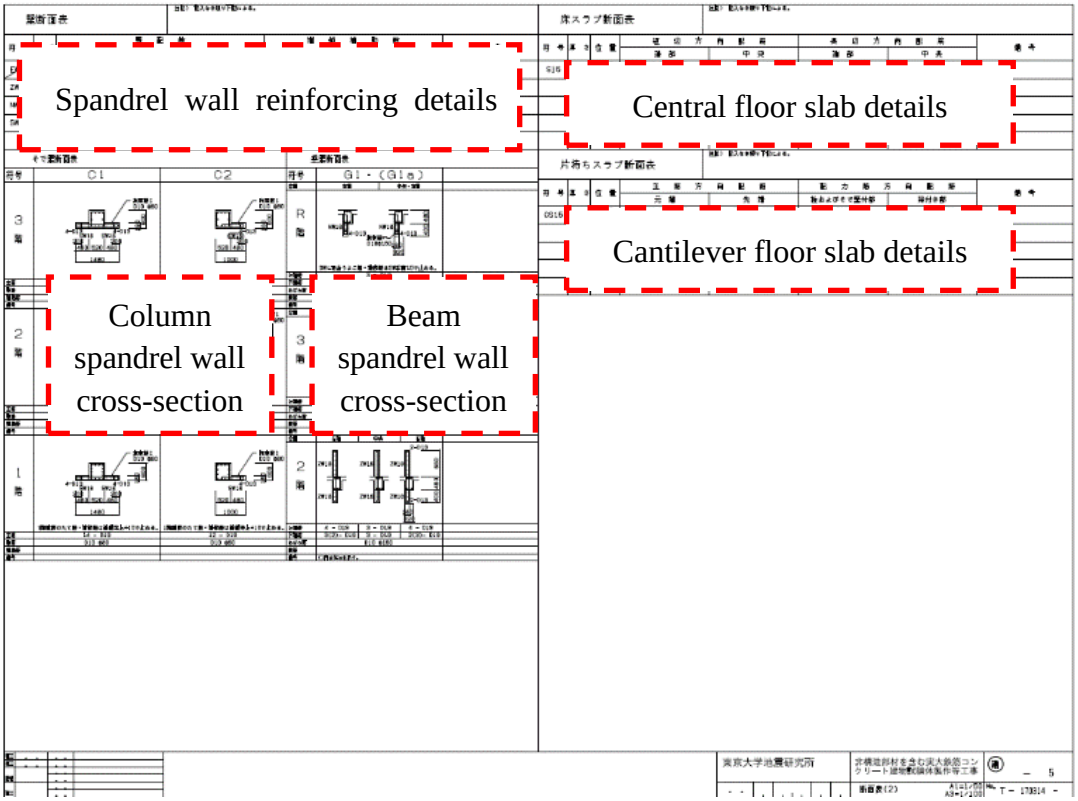


Figure 8. Sheet 構 5 layout translation guide

A translation guide for the spandrel wall reinforcing details and the slab details are shown in Figure 9 and Figure 10, respectively. As the information below the cross-section illustrations are identical to those from **Sheet 構 4**, a guide to translating this portion is not provided. However, there are some important information as follows:

- For all column and roof level beams (拘束筋) – this is indicating the "stirrups" used at the wall boundary zone.
- 1st floor columns (1 階壁脚のたて筋.端部筋は基礎梁上+10 で止める) – vertical reinforcing in spandrel walls are terminated 10 mm from the surface of the foundation slab.
- Roof level beam (SW に取合うよう筋.端部筋は SW 手前１０で止める) – horizontal reinforcing in spandrel walls are terminated 10 mm from the surface of column spandrel walls
- 2nd floor beam (()内は G1a を示す) – the values in the bracket are for beam G1a.

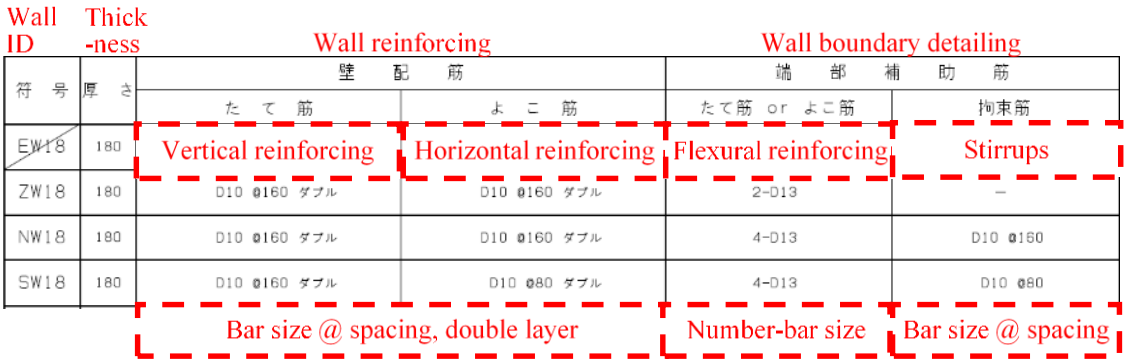


Figure 9. Example of wall reinforcing details

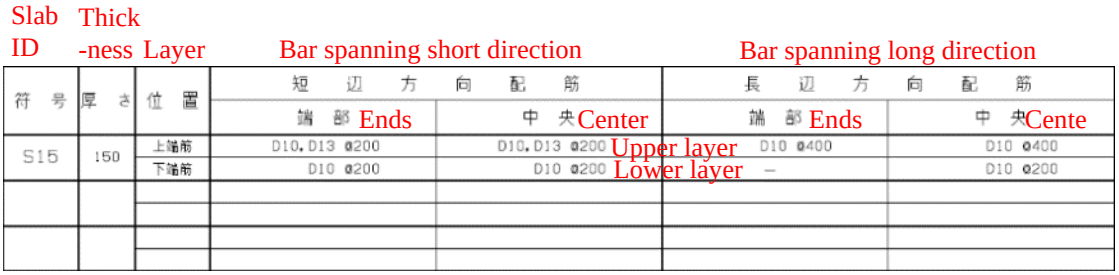


Figure 10. Example of slab reinforcing details

3.6 SHEET 構 6

Sheet 構 6 illustrates the reinforcing arrangement in the frames orientated in the direction parallel to the direction of loading. A translation of the sheet layout is shown in Figure 11.

As with **Sheet 構 2**, there are notes provided at the ends of the beams at the roof level and at column bases. The translation are as follows:

- Roof-level beams (R 階垂壁そで壁端都横筋カット) – the horizontal (flexural) reinforcing bars were cut at the ends of the roof-level spandrel walls.
- Column base (1 階壁脚縦筋カット) – the vertical (flexural) reinforcing bars were cut at the base of the column spandrel walls at the 1st level.

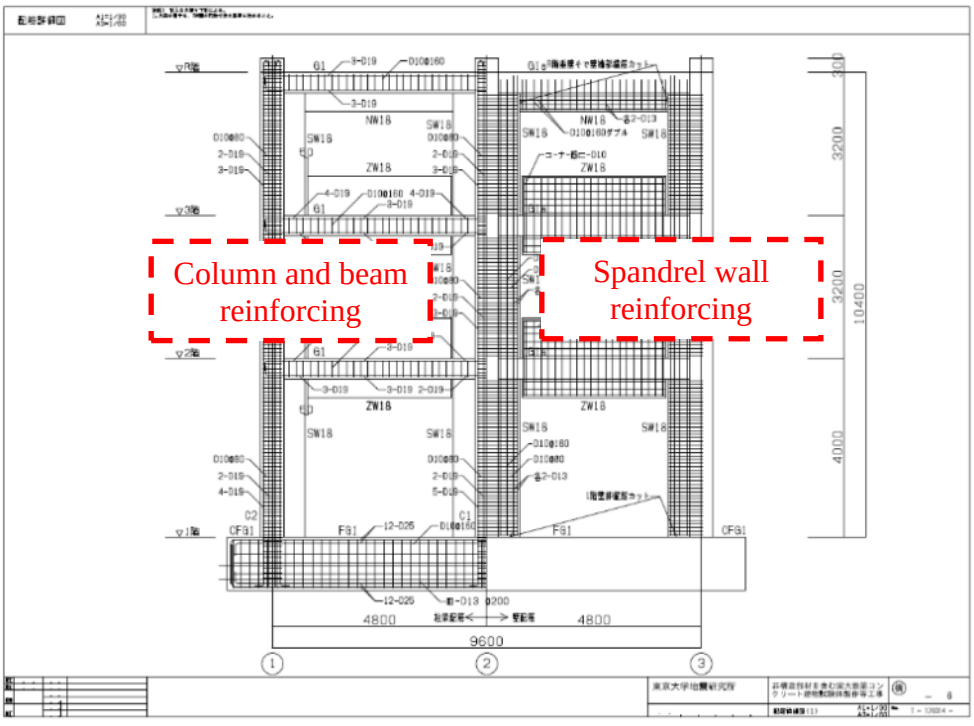


Figure 11. Sheet 構 6 layout translation guide

3.7 SHEET 構 7

Sheet 構 7 shows the reinforcing layout for the frames orientated orthogonal to the loading direction. A translation of the sheet layout is shown in Figure 12.

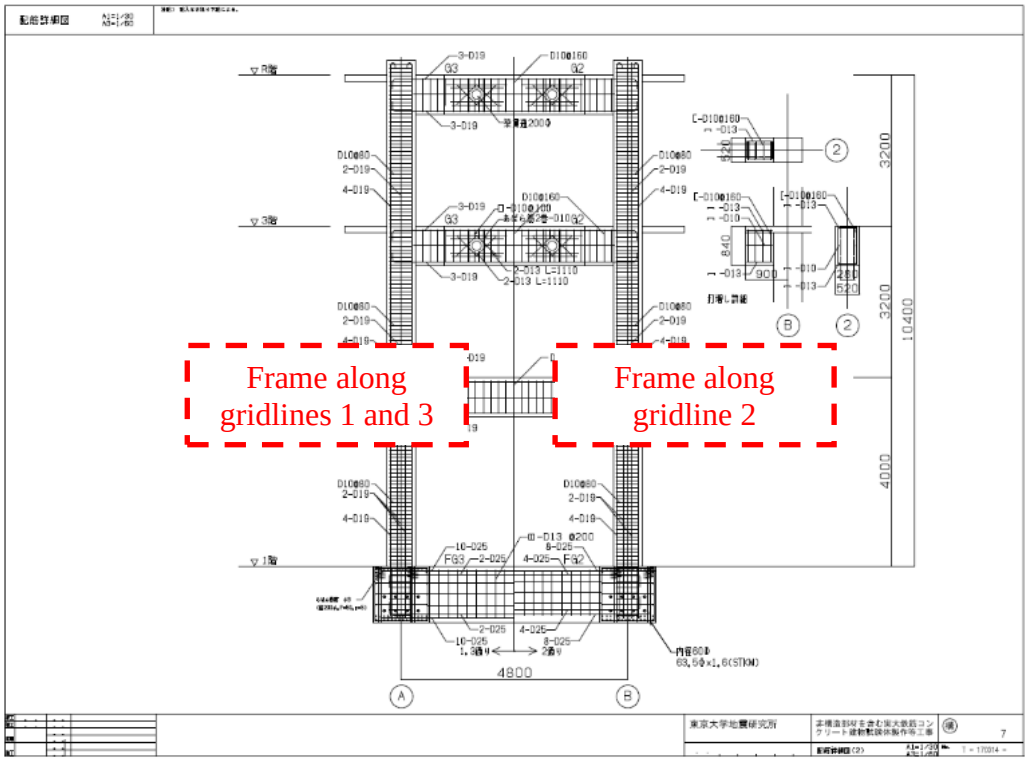


Figure 12. Sheet 構 7 layout translation guide

3.8 SHEET 構 8

Sheet 構 8 shows the slab reinforcing layout. A translation of the sheet layout is shown in Figure 13.

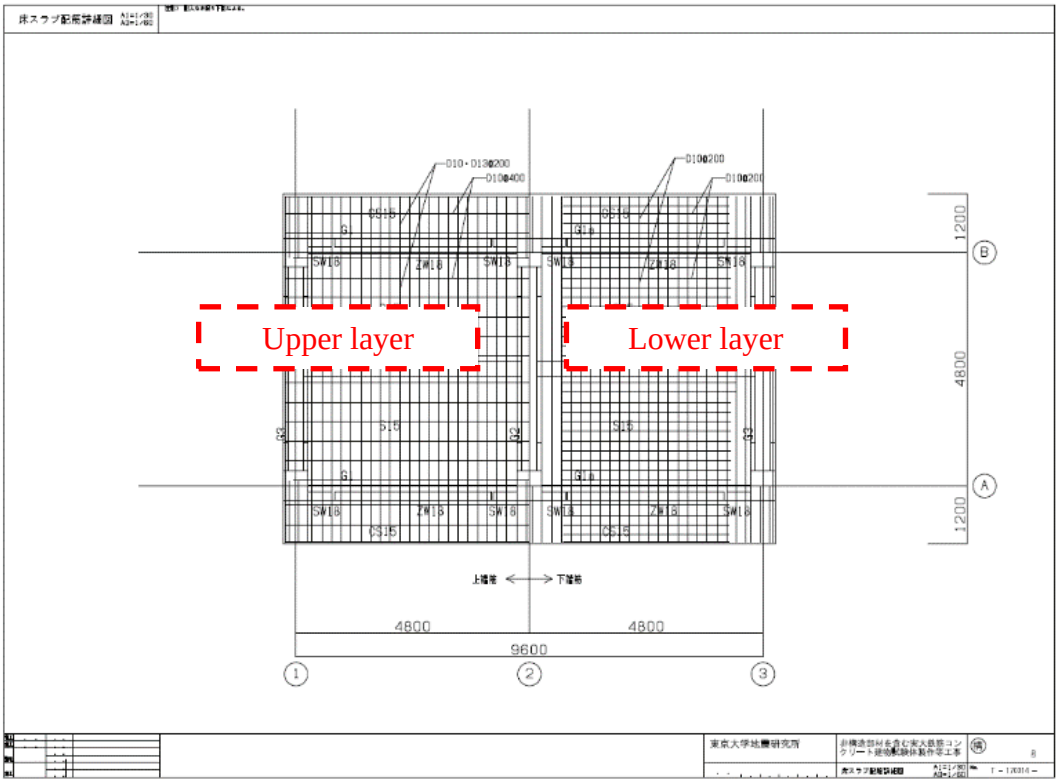


Figure 13. Sheet 構 8 layout translation guide

3.9 SHEET 構 9

Sheet 構 9 shows the layout of the PC strands. A translation of the sheet layout is shown in Figure 13. The reinforcing details provided under each of the three cross sections are identical. The information provided under these cross sections are described in **Table 4**.

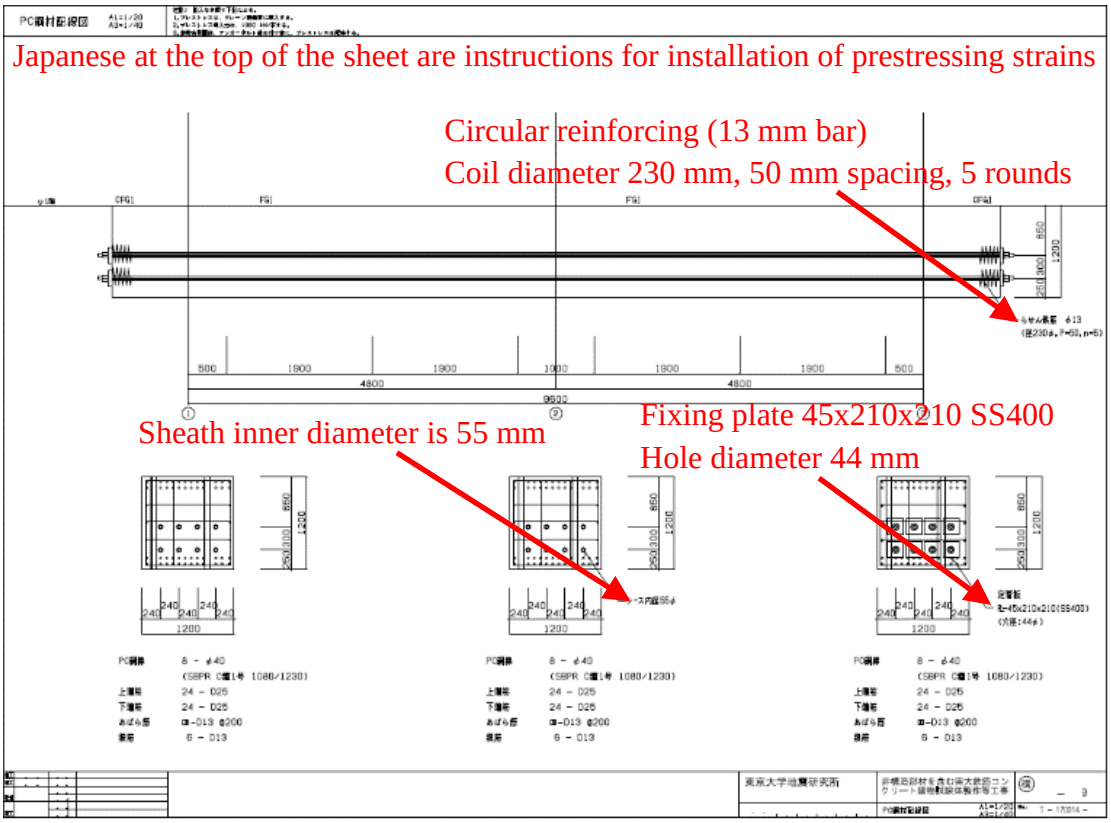


Figure 14. Sheet 構 9 layout translation guide

Table 4. Translation of foundation beam reinforcing details

Variable	Translation	Details
PC 鋼棒	Prestressing strands	8 strands of 40mm diameter *See Table 5 for strand properties
上端筋	Upper flexural reinforcing layer	24 bars of 25 mm diameter
下端筋	Lower flexural reinforcing layer	24 bars of 25 mm diameter
あばら筋	Stirrups	13 mm diameter bars at 200 mm spacing
腹筋	Middle reinforcing	6 bars of 13 mm diameter

The prestressing strand details are shown in Table 5.

Table 5. Prestressing strand details (from Neturen)

Property	**Details**
Size	40 mm
Type	C-1
Classification	SBPR 1080/1230
Nominal cross sectional area	1257 mm^2
Strength at 0.2% permanent elongation	$\geq$ 1360 kN
Maximum tensile load	$\geq$ 1550 kN

4. CONCEPTUAL DRAWING SHEETS TRANSLATION GUIDE

4.1 SHEET 意 1

Sheet 意 1 shows a plan view of the location of the balcony railings, windows, and tiles. A translation of the sheet layout is shown in Figure 15. A translation of the annotations are shown in Figure 16.

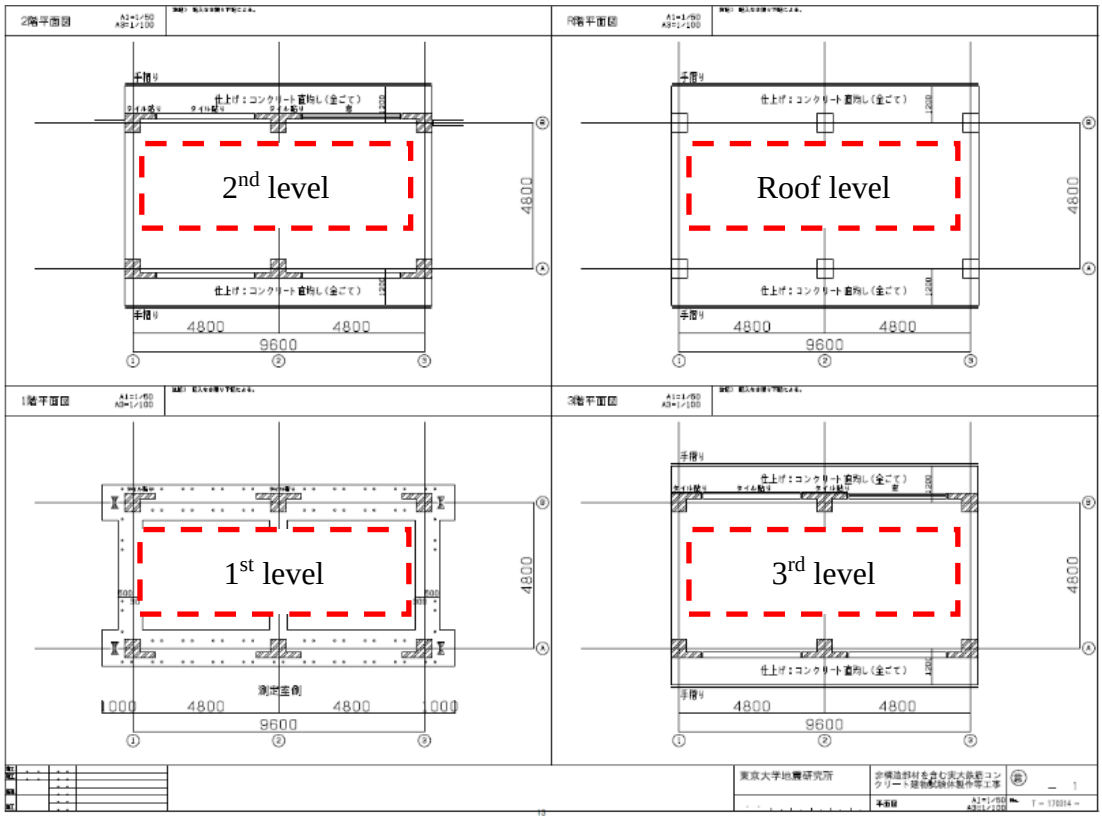


Figure 15. Sheet 意 1 layout translation guide

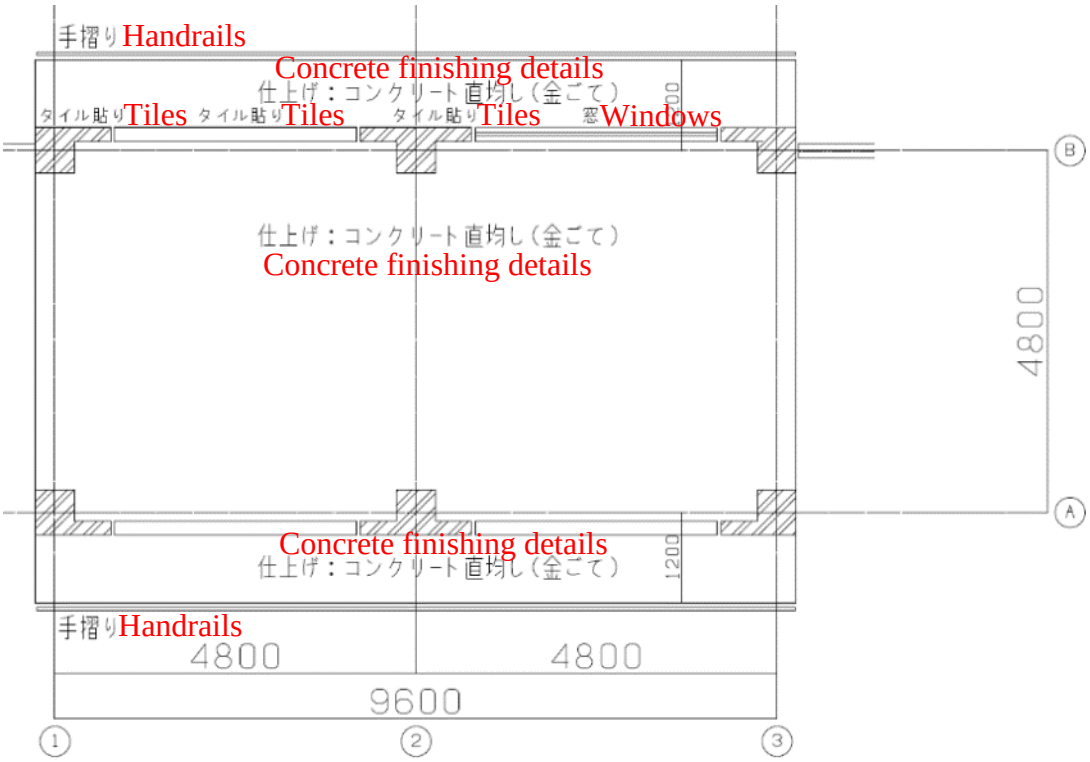


Figure 16. Translation of plan view of vertical non-structural components

4.2 SHEET 意 2

Sheet 意 2 shows a side view of the balcony railings, windows, and tiles on the exterior side of the frames parallel to the direction of loading. A translation of the sheet layout is shown in Figure 17.

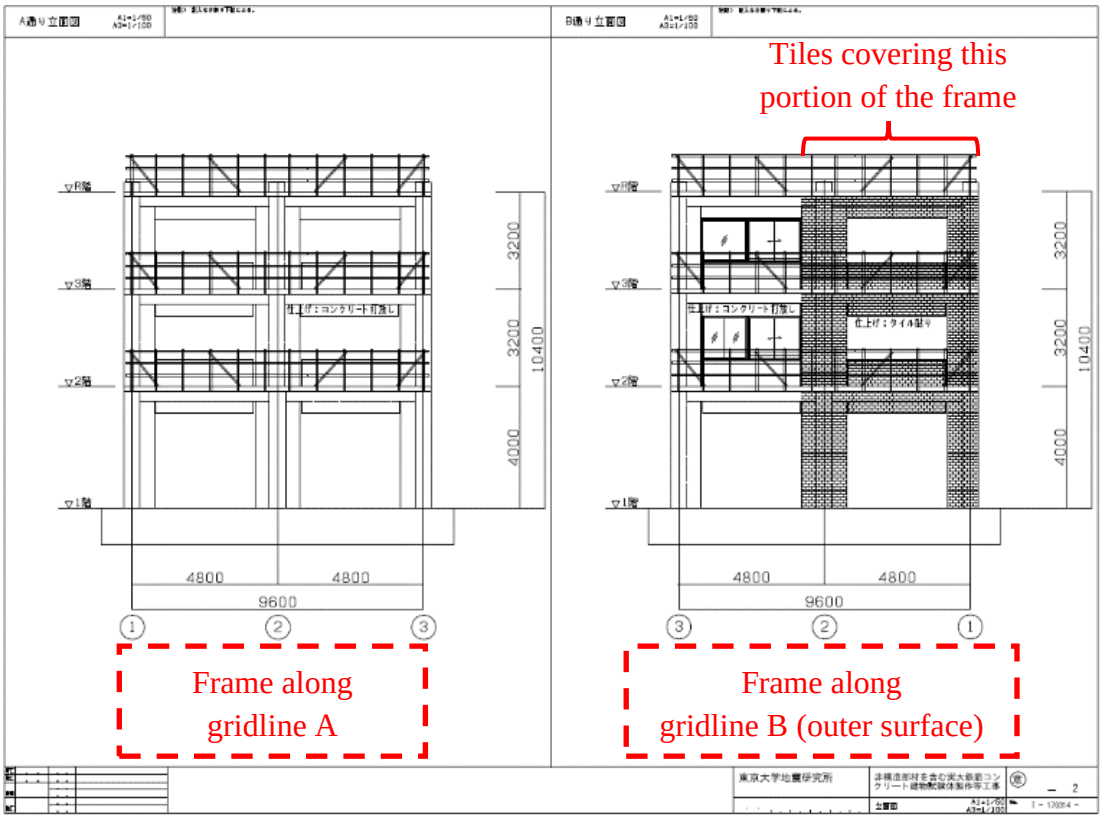


Figure 17. Sheet 意 2 layout translation guide

4.3 SHEET 意 3

The left half of **Sheet 意 3** shows a side view of the window layout on the interior side of the frame along gridline B, while the right half shows a side view of the balcony railing locations in the frame in the direction perpendicular to the direction of loading. A translation of the sheet layout is shown in Figure 18.

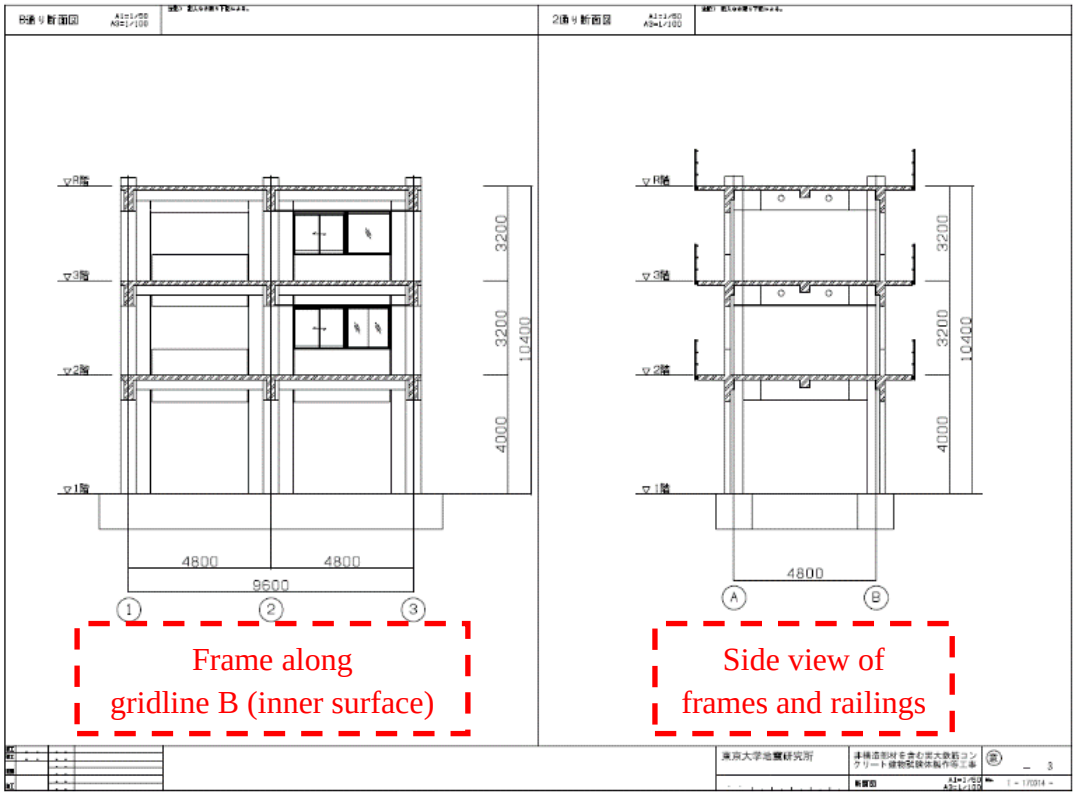


Figure 18. Sheet 意 3 layout translation guide

4.4 SHEET 意 4

Sheet 意 4 shows a plan layout of the ceilings and ceiling inserts on relevant floors in the building. A translation of the sheet layout is shown in Figure 19. A translation of the annotations used in **Sheet 意 4** is shown in Table 6.

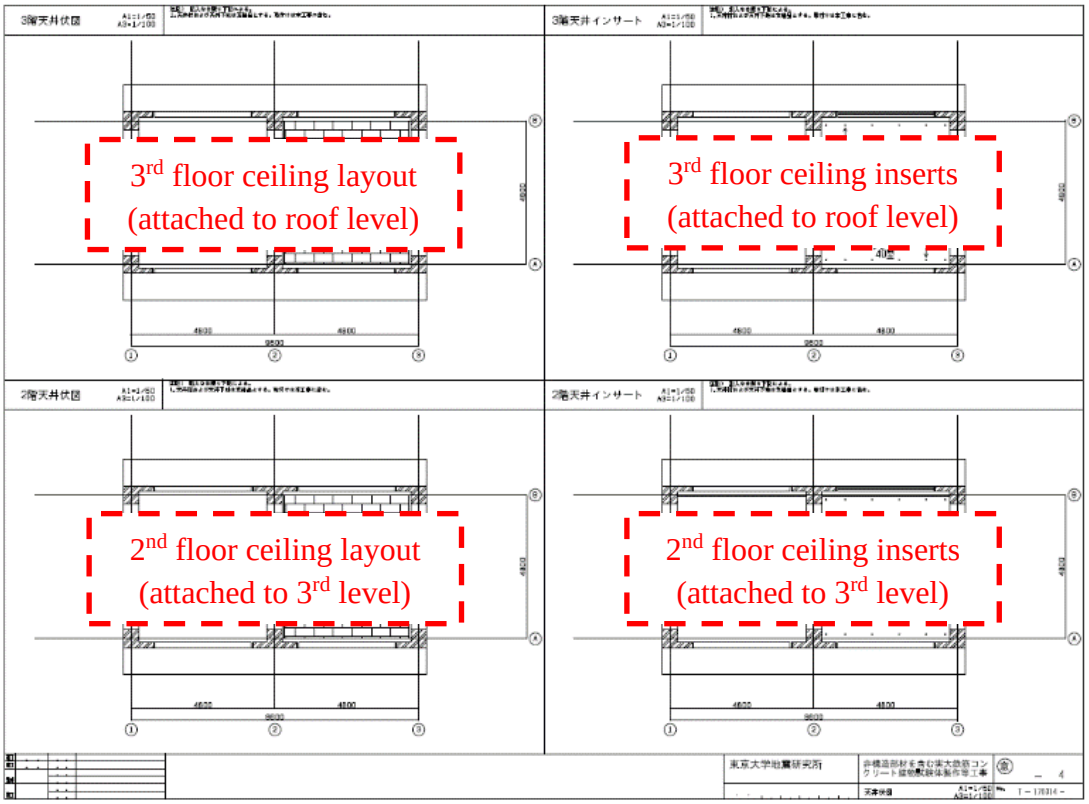


Figure 19. Sheet 意 4 layout translation guide

Table 6. Annotation for ceiling details

Annotations	Translation
3rd floor ceiling layout (attached to roof level)	
LGS 下地せっこうボード t=12.5+	Gypsum board layer thickness = 12.5 mm
ロックウール化粧吸音板 t=12	Plasterboard layer thickness = 12.0 mm
天井高 2360	Ceiling height = 2.36 m
在来 40 型 設計震度 1.83G 短期	Design seismic intensity of 1.83 g
天井点検口 (450 口)	Ceiling inspection point (width = 450 mm)
3rd floor ceiling inserts (attached to roof level)	
天井インサート W3/8”用	3/8” threaded road
野縁受け方向	Direction of main channel
下上ブレース 40 型	Brace type 40
2nd floor ceiling layout (attached to 3rd level)	
LGS 下地せっこうボード t=12.5+	Gypsum board layer thickness = 12.5 mm
ロックウール化粧吸音板 t=12	Plasterboard layer thickness = 12.0 mm
天井高 2360	Ceiling height = 2.36 m
在来 JIS19 型 ブレース無し	Conventional JIS19 type ceiling without braces
天井点検口 (450 口)	Ceiling inspection point (width = 450 mm)
2nd floor ceiling inserts (attached to 3rd level)	
天井インサート W3/8”用	3/8” threaded road

4.5 SHEET 意 5

Sheet 意 5 shows a side view of the ceiling system in the direction perpendicular to the direction of loading. A translation of the sheet layout is shown in Figure 20.

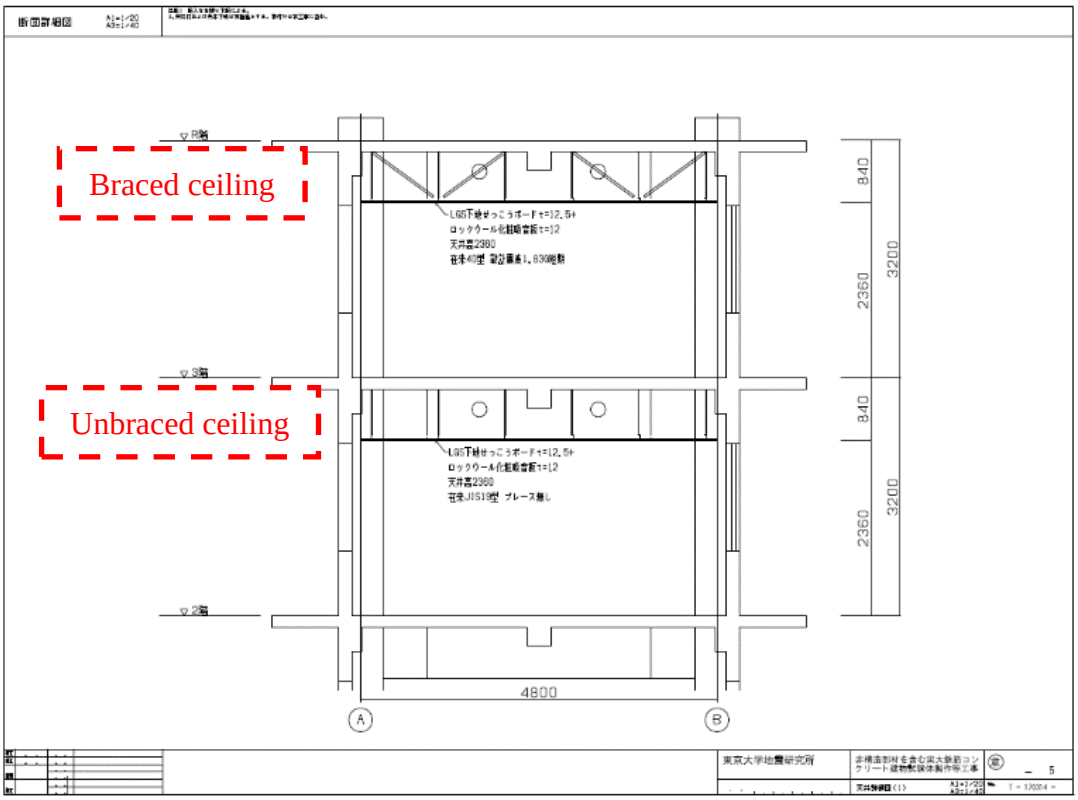


Figure 20. Sheet 意 5 layout translation guide

4.6 SHEET 意 6

Sheet 意 6 shows the layout of safety wires and nets around the building to prevent ceiling tiles from falling out completely and potentially sliding off the specimen. As these details are unlikely to affect the behavior of the building, a translation for this is not provided.

4.7 SHEET 意 7

Sheet 意 7 provides more details on the tiles attached to one of the exterior bays of the frame along gridline B. The left-side of the sheet shows the layout of the tiles on the frame, while the right side shows the cross section of the tiles and adhesive layers. A translation of the sheet layout is shown in Figure 21, and the notation on the right-side of the sheet is shown in Table 7.

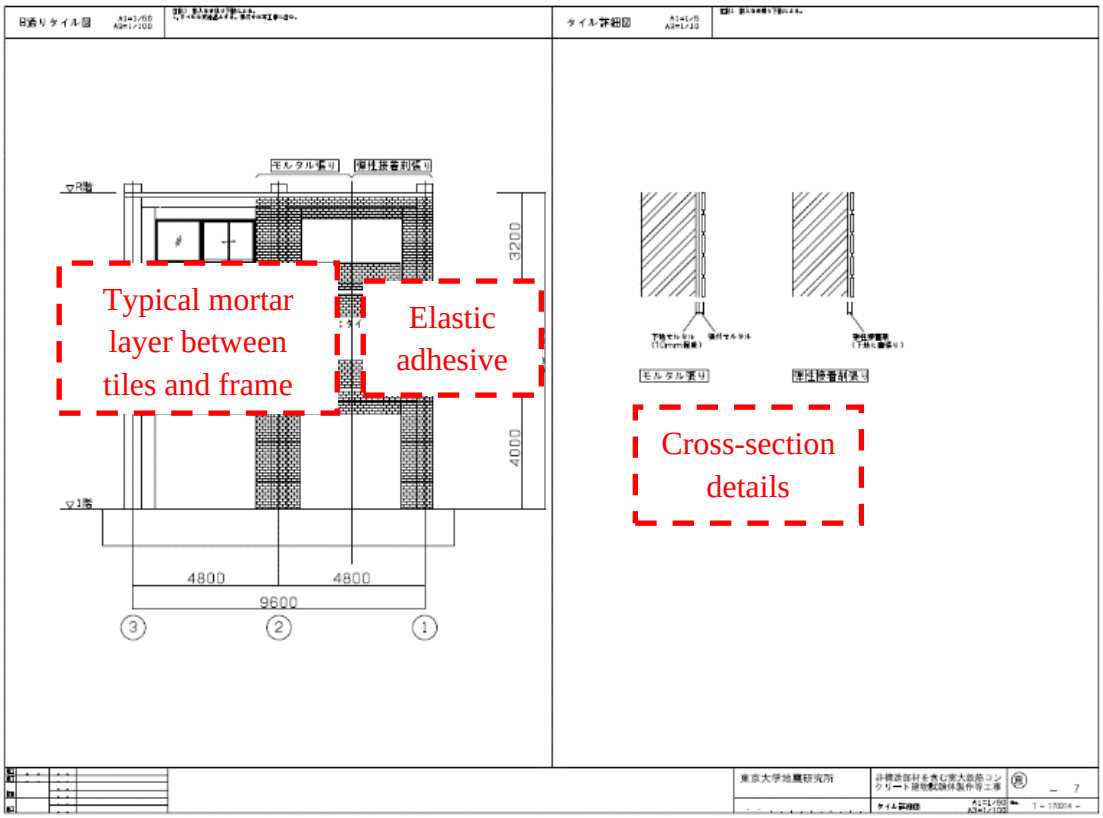


Figure 21. Sheet 意 7 layout translation guide

Table 7. Sheet 意 7 (right-side) notation translation

Notation	Translation
Left cross-section	
モルタル張り	Mortar adhesive
下地モルタル (10 mm 程度)	Ground mortar
張付モルタル	Adhesive mortar
Right cross-section	
弾性接着剤張り	Elastic adhesive
弾性接着剤 (下地に直張り)	Elastic adhesive (directly attached to substrate)

4.8 SHEET 意 8

Sheet 意 8 shows a side view of the windows used in the specimen. A translation of the sheet layout is shown in Figure 22. The notation on the left-side of the sheet is translated as follows:

- Fixed window – 8 mm thickness (4 mm + PVB30mil + 4 mm) + A12mm + 6 mm (shatter-proof film SH2CLAR)
- Sliding window – 4 mm + A16mm + 4 mm (shatter proof film SH2CLAR)

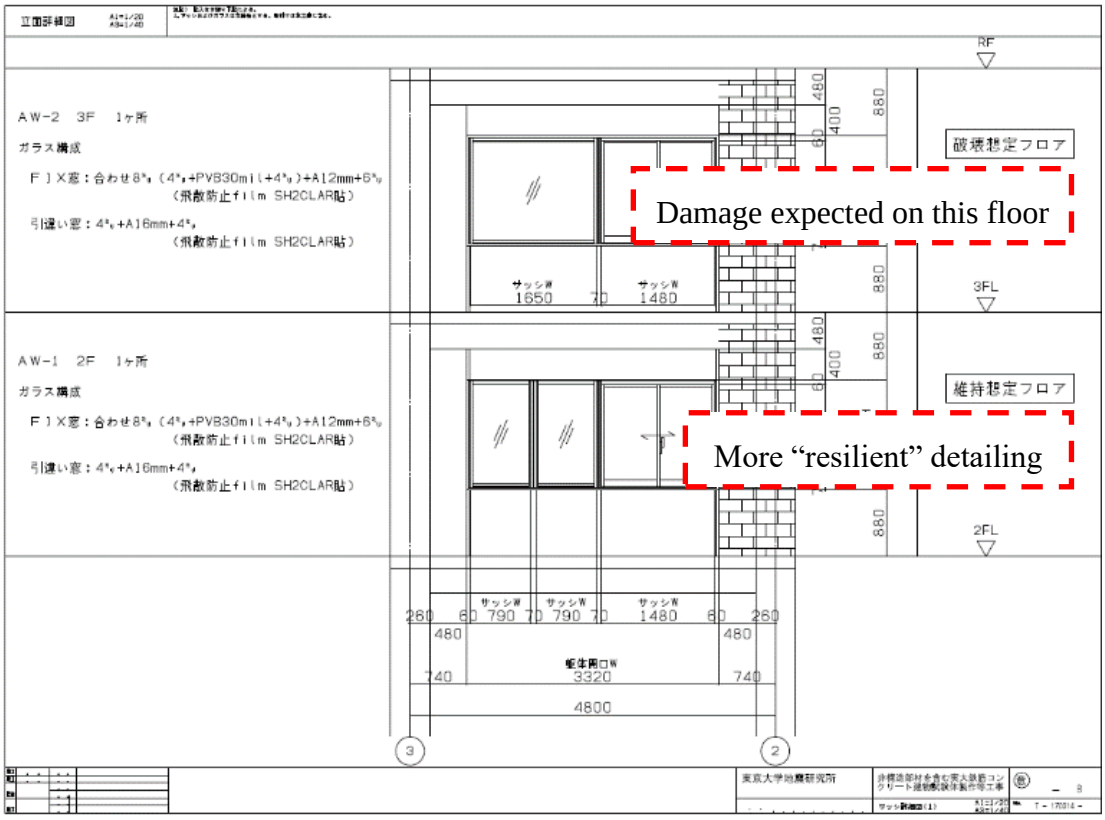


Figure 22. Sheet 意 8 layout translation guide

4.9 SHEET 意 9

Sheet 意 9 shows the window detailing. A translation of the sheet is shown in Figure 23.

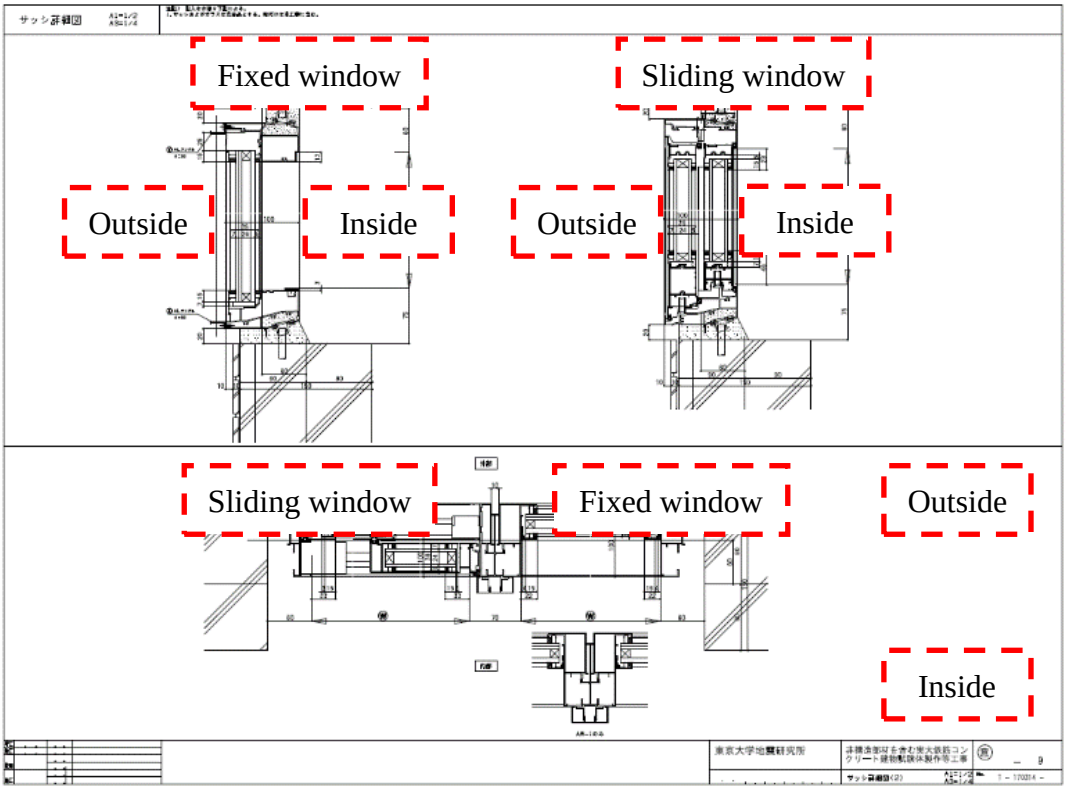


Figure 23. Sheet 意 9 layout translation guide

4.10 SHEET 意 10

Sheet 意 10 provides the information on the railings used on the upper levels along gridlines A and B. A translation of the layout is shown in Figure 24.

Important notes for the railings side view are:

- All pipes have an outer diameter of 48.6 mm and a thickness of 2.4 mm.
- Two pipes are used for each horizontal line, one 6 m long and the other 4 m.
- Diagonal pipes are 1.5 m long.

Important notes for closeup of railing detail

- A plastic cap is attached at the top of the pipe.
- Clamp used to attach pipes together.
- Pipes are welded to steel plate using PL-9x80
- Base plate is PL-12x120x120
- Anchor bolts uses 4-M12 double nut with 240 mm length

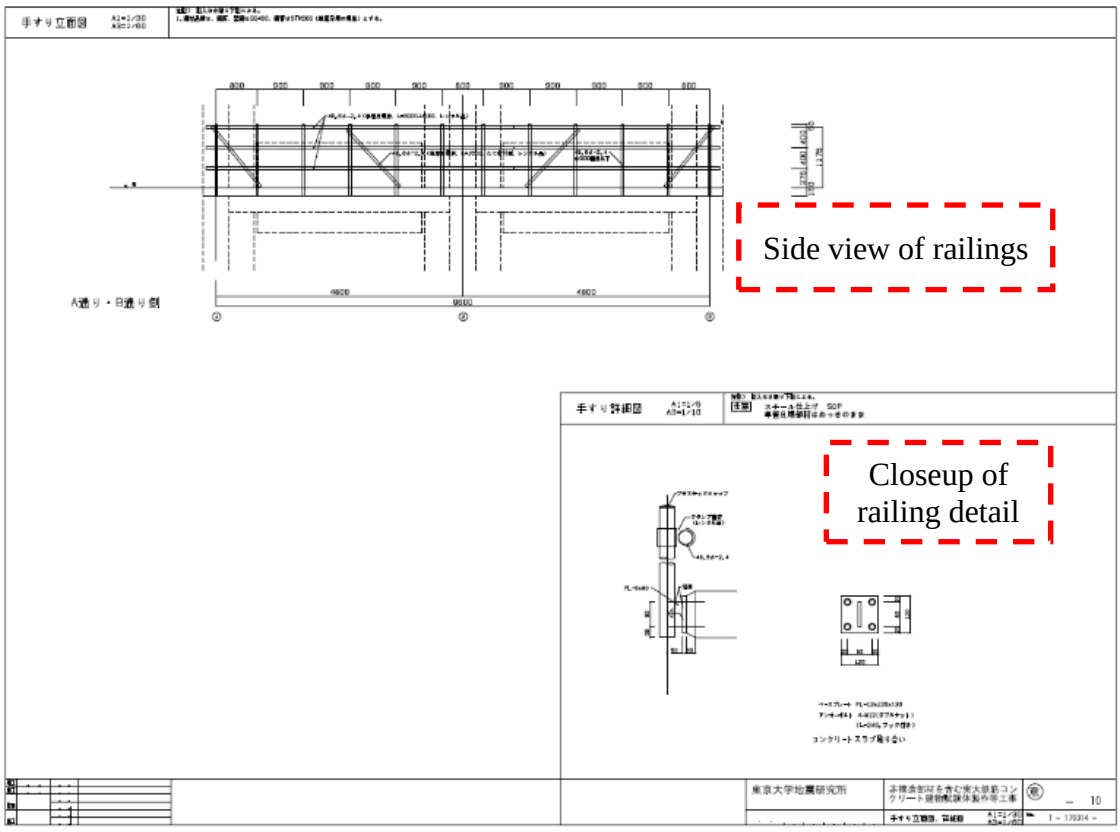


Figure 24. Sheet 意 10 layout translation guide

5. ADDITIONAL CEILING DETAILS

The ceiling board comprises of a 12.5 mm thick Gypsum board layer and a 12 mm thick Rock Wool sound absorption board. The weight density of the Gypsum board layer ranges from 8.1 to 11.7 kg/m^2, while the weight density for the sound absorption board layer is 3.8 kg/m^2. Additional specifications of the ceiling board material can be found at the following links:

- Gypsum board – http://www.gypsumboard-a.or.jp/type/regular.html
- Sound absorption board – http://yoshino-gypsum.com/faq/cate-h.html

An illustration of the ceiling grid and support system is shown in Figure 25. Details of the individual components of the system is shown in Table 8.

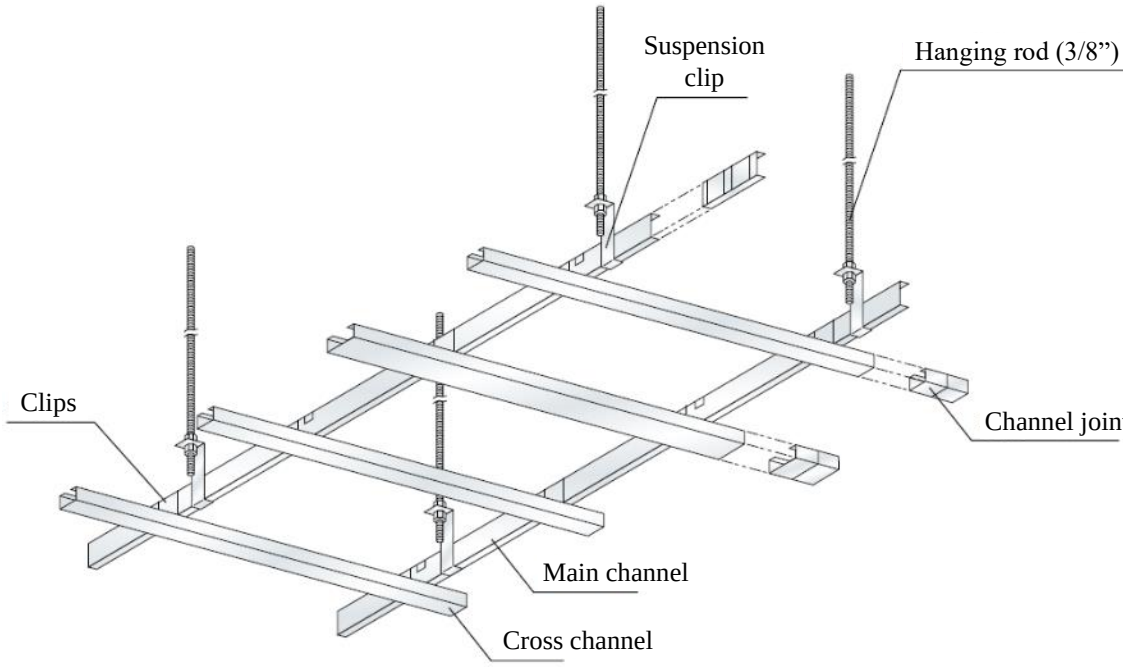


Figure 25. Illustration of ceiling grid and support system

Table 8. Ceiling components

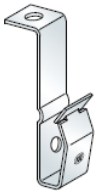
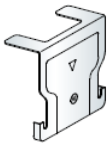
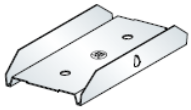
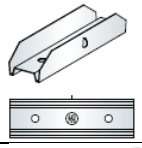
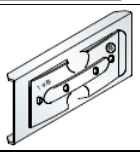
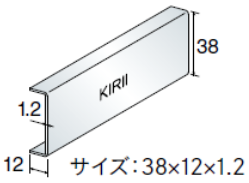
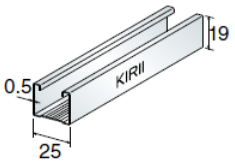
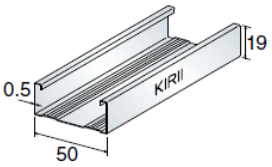
Component	Type	Illustration	Description
Suspension clip	CC-19		2.0 mm thick
Hanging rod	3/8” threaded rod and nuts		3/8” diameter
Clips	CW-19		0.6 mm thickness
	CS-19		0.6 mm thickness
Joints	CW-19		0.5 mm thickness
	CS-19		0.5 mm thickness
	CC-19		1.0 mm thickness

Table 8. Ceiling components (cont…)

Component	Type	Figure	Description
Main channel	CC-19		38×12×1.2
Cross channel	Single CW-19		19×25×0.5
	Double CS-19		19×50×0.5