

Impact Assessment of Damage Caused by Accidents (Part 2)

Heavy machinery crashes into snow shelter! ——Efforts for early restoration——



This case study details the impact assessment and emergency restoration response for an incident where a vehicle transporting large heavy machinery lost balance, causing the machinery to collapse from the cargo bed and collide with a snow shelter!! The accident resulted in plastic deformation to numerous support pillars.

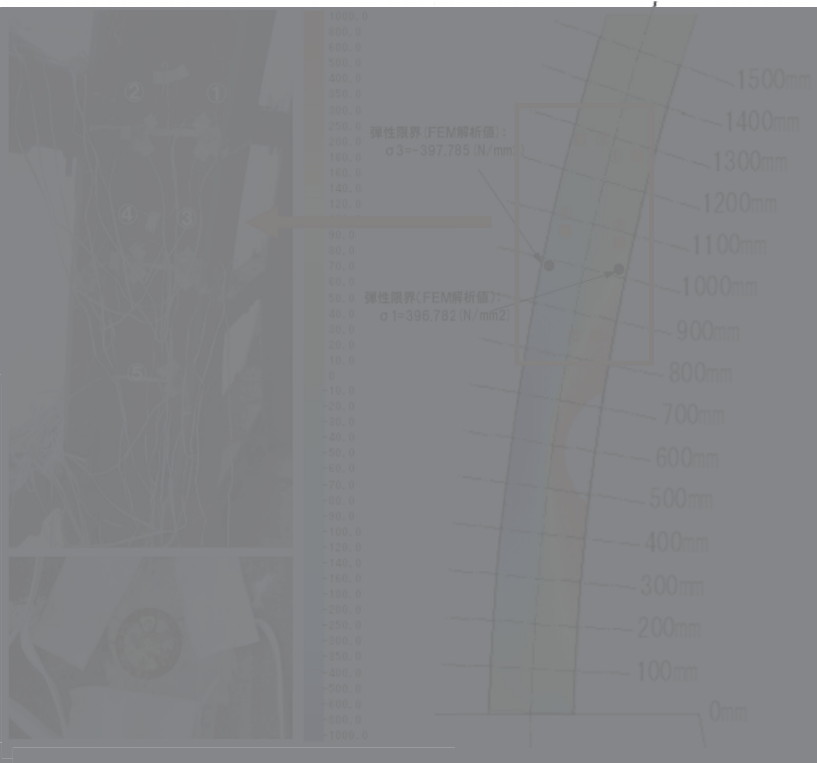
Plastic deformation of support columns due to collision and pull-out of support anchors!!

The impact of the collision has resulted in:
①: Plastic deformation of the support column and
②: Fracture and deformation of the support anchors securing the column. ①: The support column, fabricated from H-shaped steel, exhibits visually detectable cracks at the web-flange boundary. ②: The support anchors show not only fracture at the head section but also significant deformation of the base plate.



Accident Impact Assessment Using FEM Analysis and Validation of Results from Punching Method

These damages were extensive, necessitating urgent measures for the plastically deformed areas. Therefore, we: ① conducted on-site damage shape verification (dimensional survey), ② identified the plastic regions via FEM analysis based on the damage shapes, and finally ③ performed stress relief measurements using the perforation method to validate the FEM analysis. The right figure shows the FEM analysis results, zoomed in on the web surface. It can be determined that plastic deformation has already occurred from the column base up to approximately 1000mm, exceeding the material's yield strength $\sigma_y = 400 \text{ (N/mm}^2\text{)}$ (material SM400). We investigated the actual stress levels using the perforation method for sections ① to ⑤, indicated by the enclosed areas. The table at the bottom right shows the FEM analysis results and the stress measurement results obtained by the perforation method. While section ⑤ was already plastically deformed, making it impossible to achieve consistency between the two methods, for the remaining elastically deformed sections ① to ④, a very high degree of consistency between the analyzed values and the measured values was confirmed.



Emergency Response Using Concrete Barricades

This route serves as a vital access road to tourist destinations and required urgent restoration. As shown in the photo, we have implemented an emergency measure by encasing the support pillars in concrete.



【Arrangement of drilling test results and FEM analysis results Unit: N/mm²】

Verification point	Analysis result: α	Drilling test results: β	Ratio: β / α	Plasticity Judgment
Web	1 59,657	60.0	1.006	Elastic range
	2 53,791	47.7	0.887	Elastic range
	3 333,424	337.8	1.013	Elastic range
	4 -357,490	-368.2	1.030	Elastic range
	5 1008,551	425.1	0.421	Plasticization

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