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Development of joining technology to improve the crash performance of automotive parts using high-strength steel sheets

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To fully utilize the performance of high-strength steel sheets and realize high-performance automobile bodies, weld fracture prevention is a key technology(Figure 1). To implement appropriate fracture prevention measures, it is essential to analyze the load acting on welds in an actual vehicle and to develop fracture prediction technology based on such analyses.

In this report, fracture risk of spot welds in high-strength steel components was evaluated using Nippon Steel Corporation's proprietary spot weld fracture prediction software, NSafe™-SPOT, and the effectiveness of several fracture prevention measures was experimentally verified. The fracture prediction results showed good agreement with actual component crash tests, accurately identifying fracture initiation sites and dominant load modes(Figure 2,3).

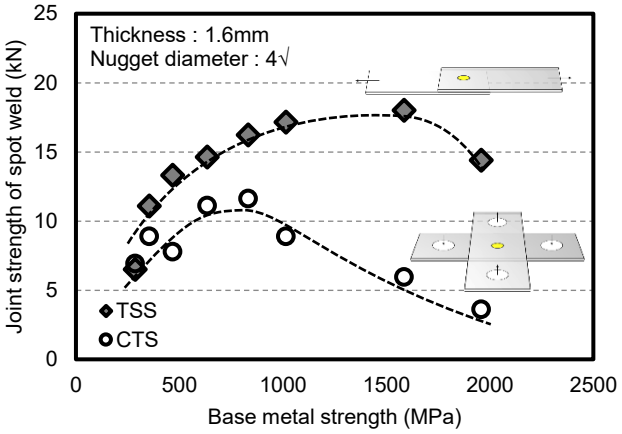

Fig.1 Relationship between spot weld joint strength and base metal strength

Based on the prediction results, fracture countermeasures were selectively applied only to high-risk weld locations, including enlargement of nugget diameter, application of adaptive-controlled temper post-heating, and the combination of spot welding with additional laser welding. Component-level crash tests demonstrated that all countermeasures effectively suppressed premature spot weld fracture and improved maximum load capacity. In particular, the combined spot and laser welding approach further enhanced crash performance by suppressing local buckling between spot welds(Figure 4).

These results indicate that highly accurate fracture prediction enables efficient and targeted application of countermeasures, thereby minimizing increases in process time and cost while achieving excellent crash performance of automotive body structures.

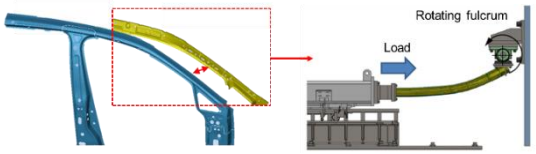

Fig.2 Schematic diagram of crash test of A-pillar

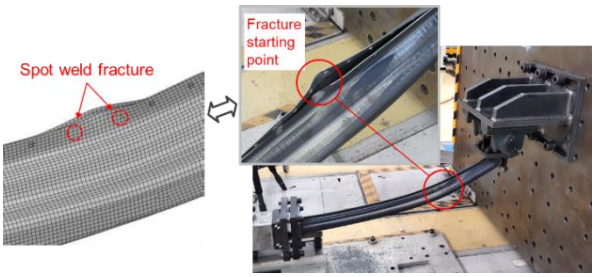

Fig.3 Result of crash test and spot weld fracture prediction in standard assembly condition

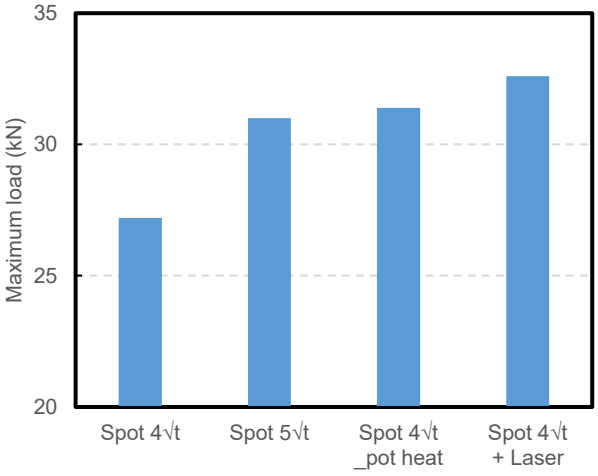

Fig.4 Comparison of maximum loads under various assembly conditions