CAE Bolt assessment in car seat structures

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1 Motivation

When dimensioning ~~of~~ seat structures and their adjusting components it is always a challenge to compromise between comfort, lightweight and strength. One of the most commonly found interfaces used in seat structures is the kinematic joint; there can be up to 30 in one seat. The increased demands on lightweight, reduction of development time and cost efficiency require a continuous improvement of simulation models regarding accuracy in predictability.

The objective of this presentation is to illustrate a comprehensive modeling and assessment approach of fastening and kinematic joints in during a simulation of complete seat structures. In order to achieve high quality and efficiency in bolt assessment for all bolt results in various load cases a highly automated concept is required.

2 Testing concept

The basis for the model development are reliable and highly reproducible test results on joint level under several loading directions – from axial load to shear load. For this purpose, we used LWF-KS2 testing concept.

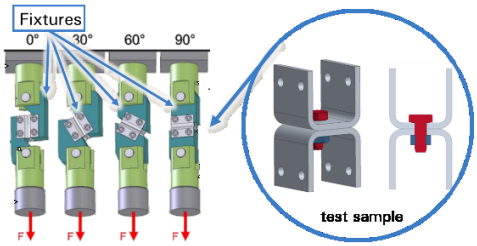

Fig.2 a) LWF-KS2 testing fixtures

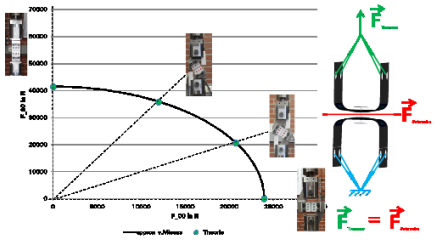

Fig.2 b) LWF-KS2 test results

3 Model development

In “VDI 2230 – part 2 - Systematic calculation of highly stressed bolted joints” several model classes for CAE representations of bolted joints are proposed. Due to a conflict between accuracy and CPU time, none of proposed model classes is applicable for crash analysis of complete seat structures. Due to this challenge, we developed the Brose-Hybrid-Bolt-Model in several steps (see fig. 3).

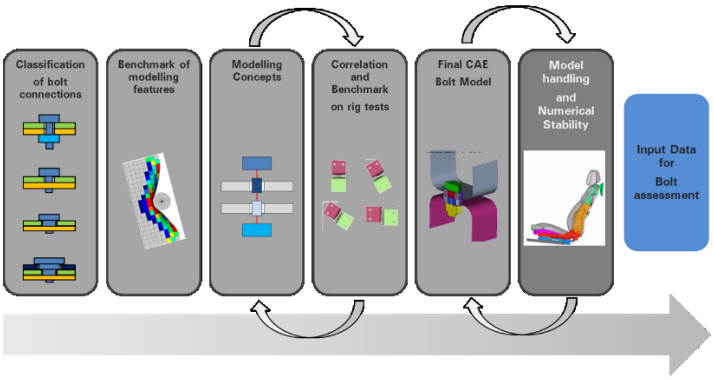

Fig. 3 Steps in development of Brose-Hybrid-Bolt-Model

4 Bolt assessment and verification

The evaluation and assessment effort of many bolted joints is illustrated in Fig.4a. To handle this complexity, an automated assessment tool has been realized. To create an easy to use overview of all bolts in several load cases at the same time a normalized failure criterion was introduced (Fig.4b). The numerical stability and the predictability of the model has been verified in complete seat analyses (Fig. 4c).

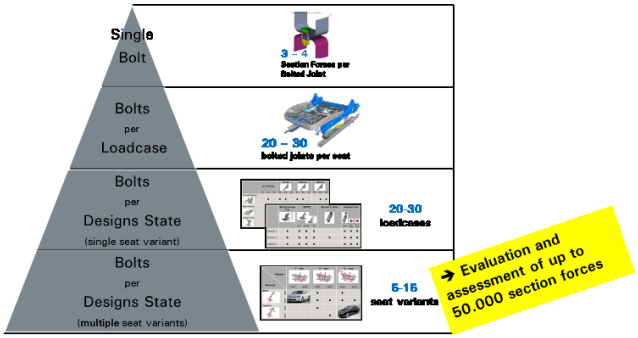

Fig.4 a) Evaluation effort: Bolt assessment

				Seat Variants →		
				Load Cases →		
Bolt	Bolt ROF	Bolt part	Bolt part ROF	ROF	F_axial	F_shear
S110BJ0011	0.4	51	0.4	0.4	24011	1111
		52	0.4	0.4	24010	1103
		53	0.4	0.4	24011	1090
		59	0.4	0.4	24017	1080
S110BJ0013	0.4	51	0.4	0.4	23953	1057
		52	0.4	0.4	23957	1046
		53	0.4	0.4	23962	1042
		59	0.4	0.4	23961	1033
S110BJ0021	0.4	51	0.4	0.4	23929	67
		52	0.4	0.4	23926	62
		53	0.4	0.4	23918	49
		59	0.4	0.4	23923	43
S110BJ0023	0.4	51	0.4	0.4	23858	60
		52	0.4	0.4	23844	56
		53	0.4	0.4	23838	67
		59	0.4	0.4	23820	77

Fig.4 b) Overview: Bolt assessment

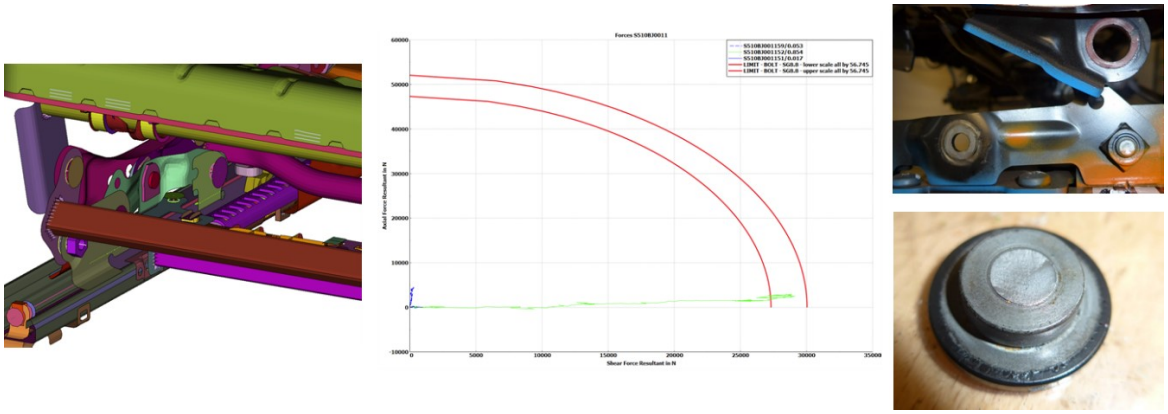

Fig. 4c) Example: Complete Seat

5 Summary and conclusion

The presentation shows a comprehensive modelling and assessment approach allowing a quantitative assessment of bolted joints in full seat system analysis. Correlation on LWF-KS2 level and selected full seat applications predicts even correct failure modes with no negative effect on CPU times. The focus on these investigations allows a high predictability of section forces inside bolts and an efficient assessment concept. The correlation approach is generally transferable to other joining techniques. Brose-Hybrid-Bolt-Model is standard approach for all upcoming development projects.