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MEASUREMENT AND FORCE ADJUSTMENT IN BOILER SUSPENSIONS AND OTHER STATICALLY INDETERMINATE MECHANICAL SYSTEMS

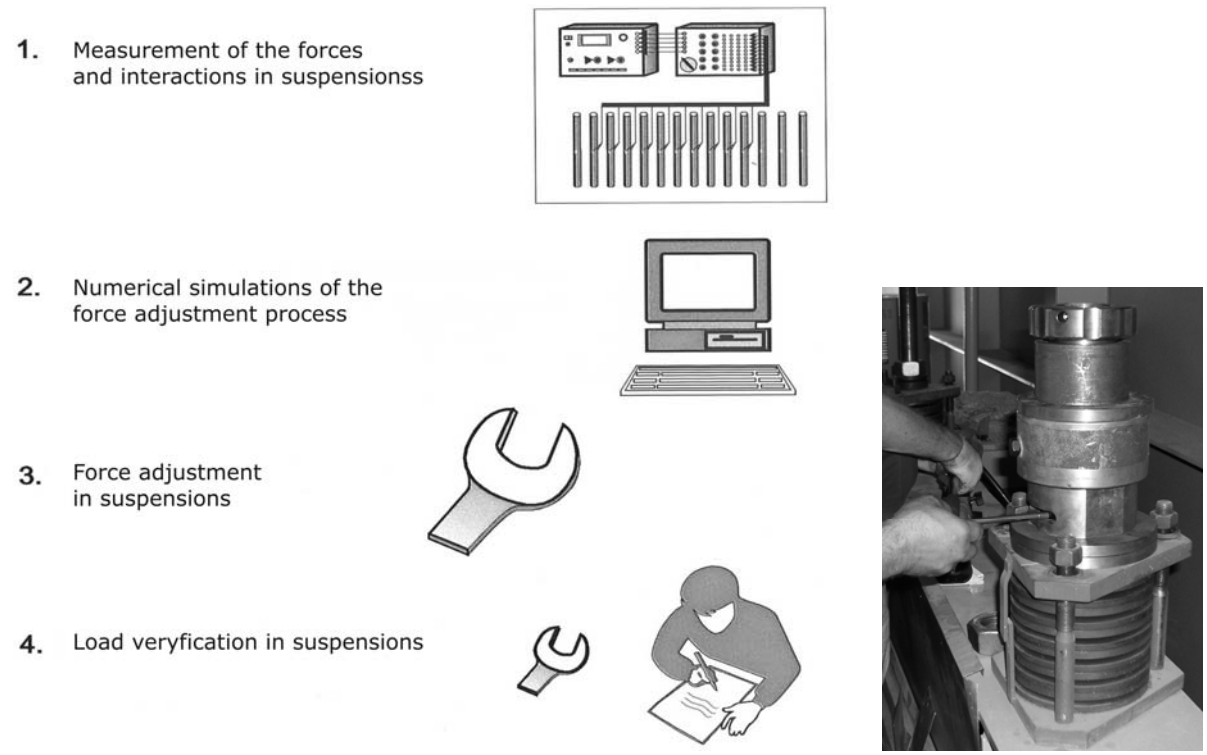
Donat Renowicz, Marek Plaza, Bogusław Plaza, Ewa Renowicz
B.T.H.U. THERMEX s.c.
ul. Konstruktorów 11, 42-219 Częstochowa
POLAND

ABSTRACT

One of the most important factors determining the durability of power boilers is the proper distribution forces in structure and mechanical systems such as suspensions and supports. The reasons of unequal force distribution in these parts could be the following: assembly stresses, stresses occurring during major repairs, improper supporting structure geometry and complete break-down state of the equipment. Big differences between nominal and real loading can lead to a complete damage of suspension elements, springs and thread joints.

Keywords: structure diagnostic, adjustment of boiler suspensions, suspension failure.

1. METHOD OF THE FORCE ADJUSTMENT IN BOILER SUSPENSIONS



Improper load distribution in suspensions (Figure-1) is particularly dangerous in the corners of the boilers causing the increase of stress gradient. Leaks of screen pipes often appear in these places. The excessive bending of steam superheater collectors results from unequal load distribution (Figure-2) in the suspensions casing improper work of waterheater suspensions and noisy functioning of the second pass can be also observed. The reason of the phenomenon is usually vibrations caused by coils hitting against the boiler walls. Improper functioning of the parts working inside the boiler can be caused by displacement of a resultant force of gravity due to modernization. In that case entire object may incline causing its relative displacement with regard to the position of internal parts (e.g. waterheater, etc.) as well as external objects (boiler drum). Such a situation has been noticed when the weight of the front wall of the combustion chamber has been increased and the back wall of the 2nd pass has been unloaded as a result of the modernization. Tilt and torsion of the combustion chamber are further effects of improper functioning of the suspension or lack of their adjustment after modernization or major repairs.

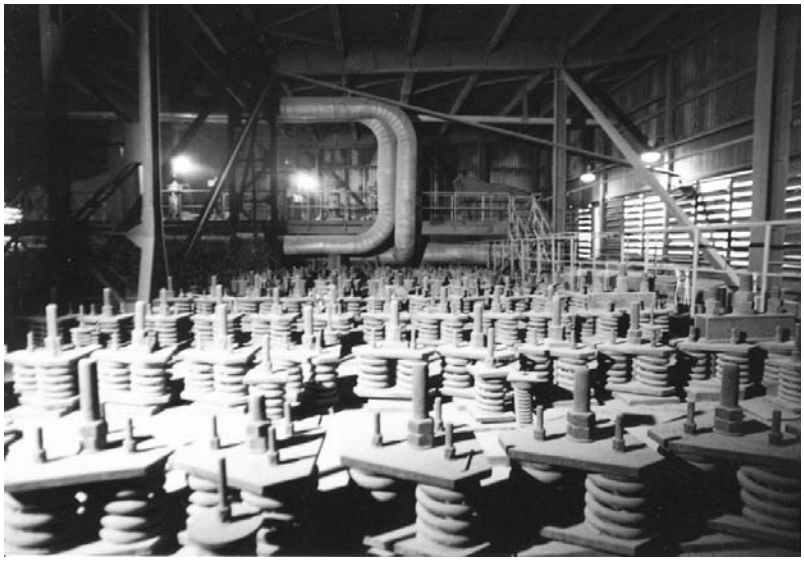


Figure-1. Elastic suspensions of boiler.

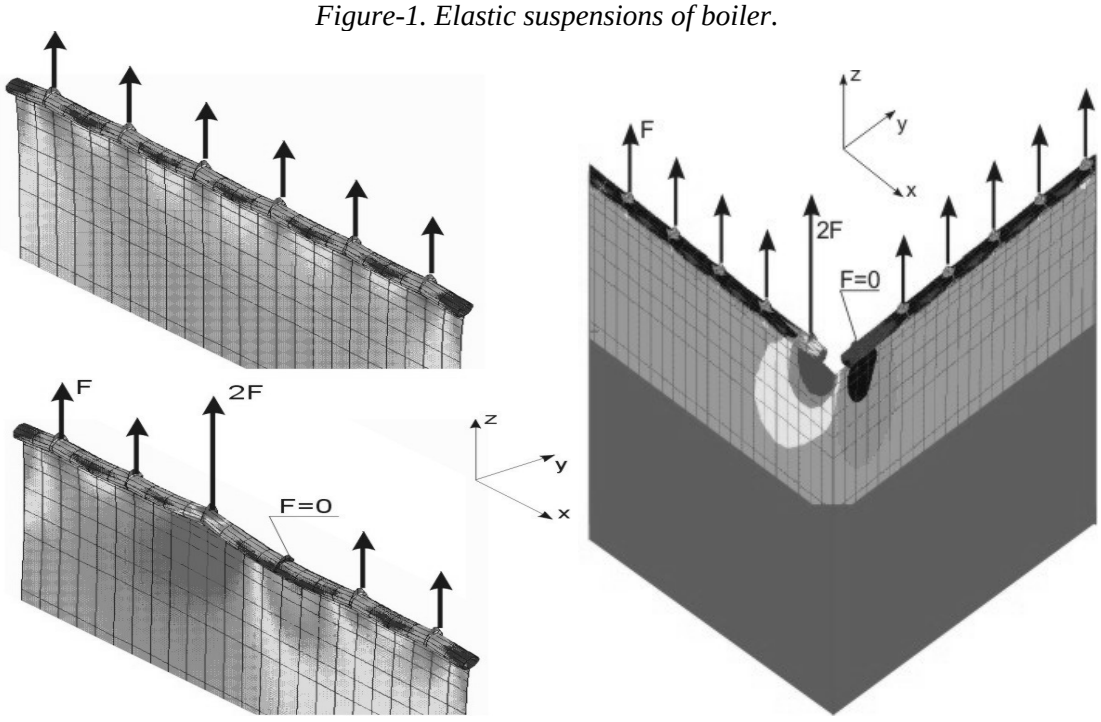


Figure-2. Stress concentration in waterwall caused by suspension overloading and unloading.

The above mentioned effects of inconsequent and incomplete modernization and repairs which neglect the process of load control in the boiler suspension decrease the durability of parts in the mechanical system of the boiler and the so called available residual life in particular. Therefore the mechanical system of boiler suspensions should be maintained and regulated after its assembling and after the period of 3 or 4 years of its failure-free operating as well as after its modernization. Improper functioning of the boiler suspensions can cause some dangerous break-downs, in spite of its seemingly small probability of occurrence (Figure-3,4).

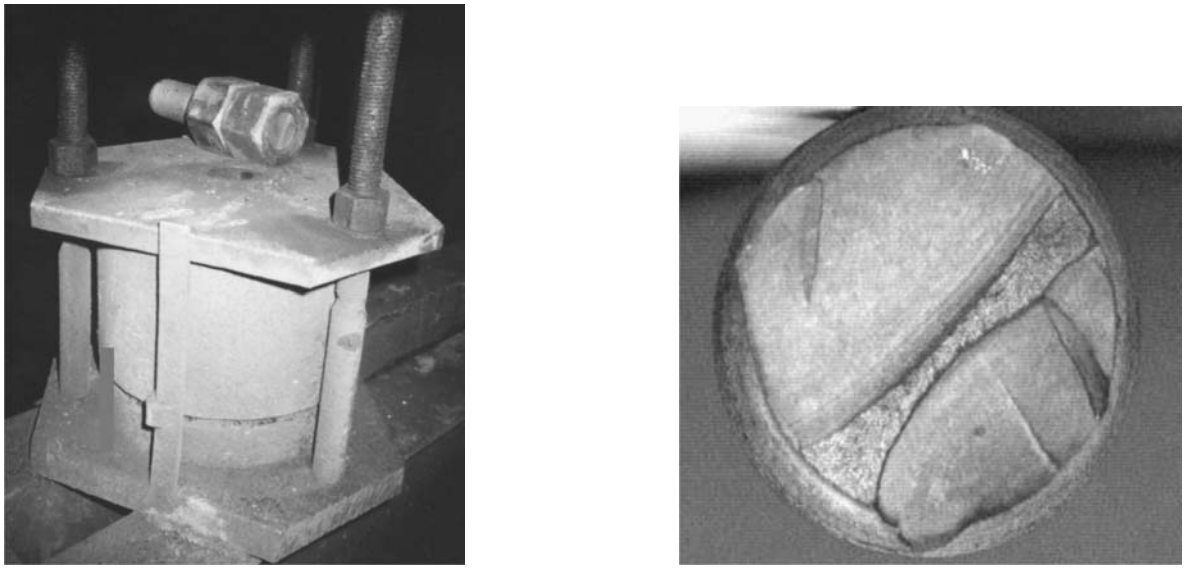


Figure-3. Fatigue failure of the suspension caused by vibrations.

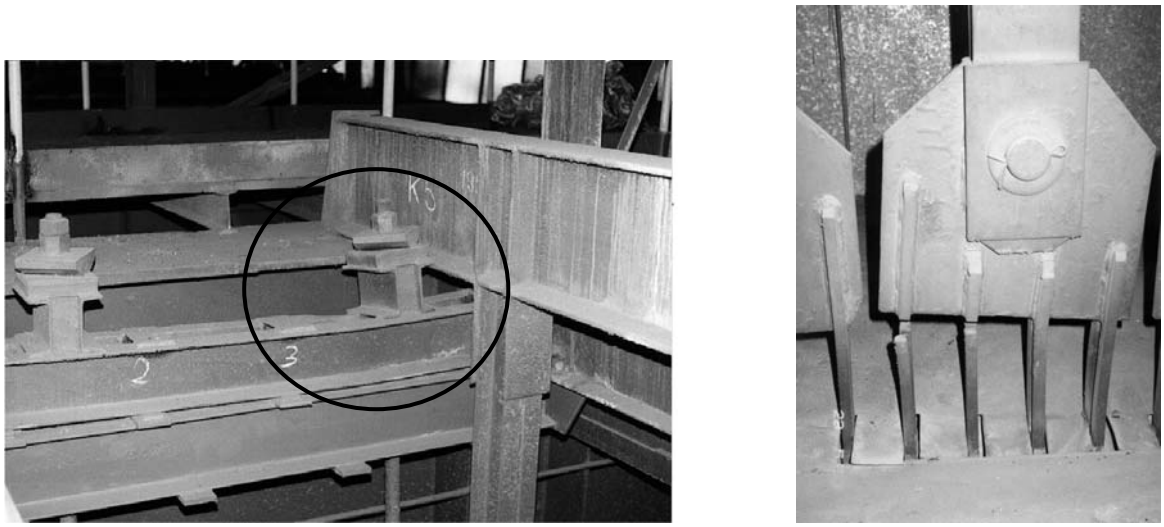


Figure-4. Grate deformation and fracture of suspension pins after overloading.

Bearing in mind the ecology requirements it is necessary to increase the efficiency of modernization of the boiler mechanical systems maintaining at the same time the durability of its parts. It is also necessary to diagnose properly the mechanical systems and thus adapt the best solutions. Periodical examinations of boiler suspensions as well as their elements efforts (especially water-walls) should be performed. The results of these examinations would constitute the basis for determining durability criteria and would be essential for evaluation of its residual life [1,2,3,4,5].

2. CONCLUSIONS

1. B.T.H.U. THERMEX s.c. offers patented DM-3 v.1 method for load adjustment in suspensions used in power plant objects. The proper load adjustment prolong the safety work of boiler. The DM-3 v.1 technology keeps elongation values of mechanical systems proportional to the design assumptions and enables the load distribution in suspensions proportionally to design values. It eliminates excessive stress concentration in waterwalls and structure constraints. Proper load adjustment also permits maintenance correct geometrical position of the object. The load control is very important in case of complex mechanical system composed of few independent systems connected by compensators existing e.g. in fluidized bed boilers, pipelines, etc.

2. RAFAKO S.A. recommends DM-3 v.1 method for suspension control after assembling, major repairs and after failure states of the power boilers.

3. CHARACTERISTIC FEATURES OF DM-3 METHOD:
- high accuracy of the load adjustment,
- low servicing costs,
- possibility of verification of the design assumptions.

4. The DM-3 v.1 method has been verified in a lot of power boilers made in Poland and also made by the other foreign producers and gives well exploitation results.

3. REFERENCES

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