VALVE BODY STRESS CALCULATION INDUCED PIPING FORCE

The purpose of this calculation will be of reference in order to find any possible causes in valve body crack during its installation works after lined piping.
As well, related design condition and thermal stress load was assumed considering working practice condition.

1	Applied piping length,L	100	m
2	Material	A106-B or C.S	
3	Max.Tensile stress	4218.42	kg/cm^2
4	Max. Temperature difference,ΔT	20	oC
5	Thermal expansion coefficient,α	0.012	mm/M.oC
6	Carbon steel elastic coefficient ,E1	2,100,000	kg/cm^2
7			
8	Valve material	Ductile iron(450Mpa)	
9	Max.tensile stress, σ1	4500	kg/cm^2
10	Ductile iron elastic coefficient,E2	2,050,000	kg/cm^2
11			
12	Thermal expansion length,L1=L*α*ΔT	24	mm
13	Clearance between two flange,C	3	mm
14	Max. expansion, λ	27	mm
15	Elongation, ε=λ/L	0.00027	
16			
17			
18	Max. stress(at piping), σ=E*ε	553.5	kg/cm^2
19	Flange section area for bolting area A, M20(6EA)	18.85	cm^2
20	Allowable stress force in Valve,F1=σ1*A	84,823	kg
21	Max. Stress in piping,F2=σ*A	10,433	kg
22	Available sectional one bolt area in body flange	3.1	cm^2
23	Induced stress due to integral force, σ2	3,321.0	kg/cm^2
24	Comparing with stress ratio between σ1, σ2	74%	

As shown on stress calculation comparing between piping and valve material,
Induced thermal stress force is nearly close to assumed maximum
tensile stress for ductile iron valve.
Also, this force may be enough able to cause embrittlement crack considering ductile iron's less tough value in mechanical properties and its characteries.

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