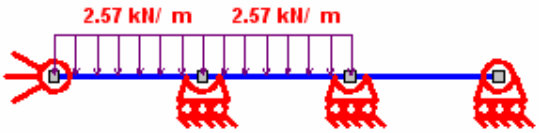
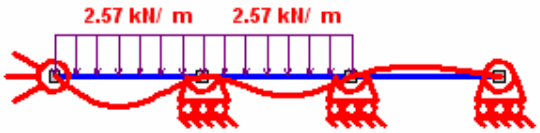
MAIN BEAMS
CLEVER SOLVER
TEST SCHEDULES





Castalia s.r.l.
tel. +39-02-26681083
fax +39-02-26681876
E-mail staff@castaliaweb.com
Via Pinturicchio, 24
20133 Milano (Italy)

Rev. 1.0 del 21-5-2007

These test are mainly intented to prove Sargon static solver reliability, and are a first set of tests regarding "main beams", that is simple beam models easy to check by hand or using published data. Since in statically indeterminate structure results depend on shear areas, and since usually published results do not take into account the effect of shear deformation energy, shear areas have in these cases been set to 0, thus neglecting shear energy contributions. These tests do use notional section data values, such as 1 for second moment of area and so on.

The results obtained are always quite satisfactory, that is error are always almost un-existent. Sometimes the need of defining numbers having periodic set of digits (e.g. 1/3) can lead to error different from 0.

Setting up benchmarks like these is not a trivial matter. Extensive work has been done to assure the highest reliability of all data. Errors have been computed automatically by program "checksolvers", a software testing tool developed by Castalia srl.

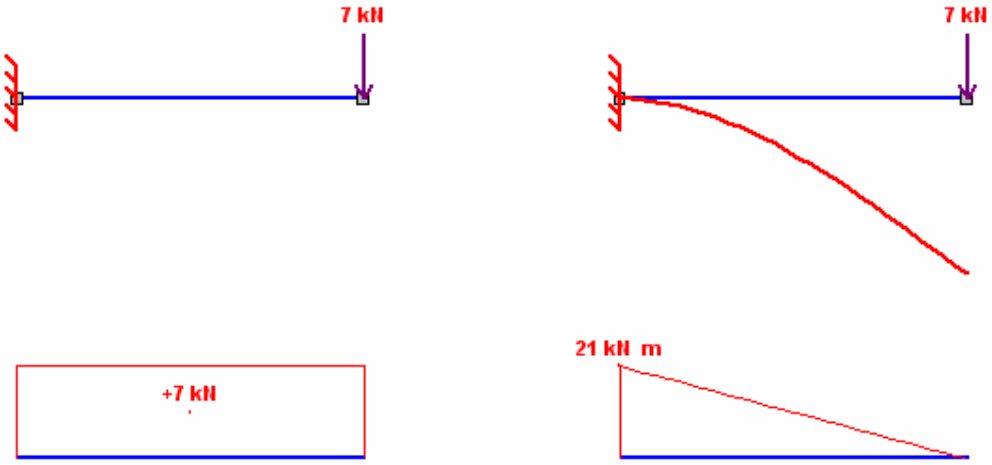
This work is open and can be used elsewhere. We ask, nonetheless, to be informed of any use of these data and we ask that these data are used but citing the source, that is the following:

"Data have been computed by Castalia srl for its fem static solver "CLEVER" validation.
Castalia srl: http://www.castaliaweb.com "

"Questi dati sono stati calcolati da Castalia srl per la validazione del proprio solutore statico fem CLEVER.
Castalia srl: http://www.castaliaweb.com "

Milan, May 2007

TEST SCHEDULE CASTALIA_STAT001		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT001**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Cantilever with end shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT001		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT001**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Free tip
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	7.0000e+003	Th	7.0000e+003	**0.0000e+000**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	-7.0000e+003	Th	-7.0000e+003	**0.0000e+000**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-2.1000e+007	Th	-2.1000e+007	**0.0000e+000**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**

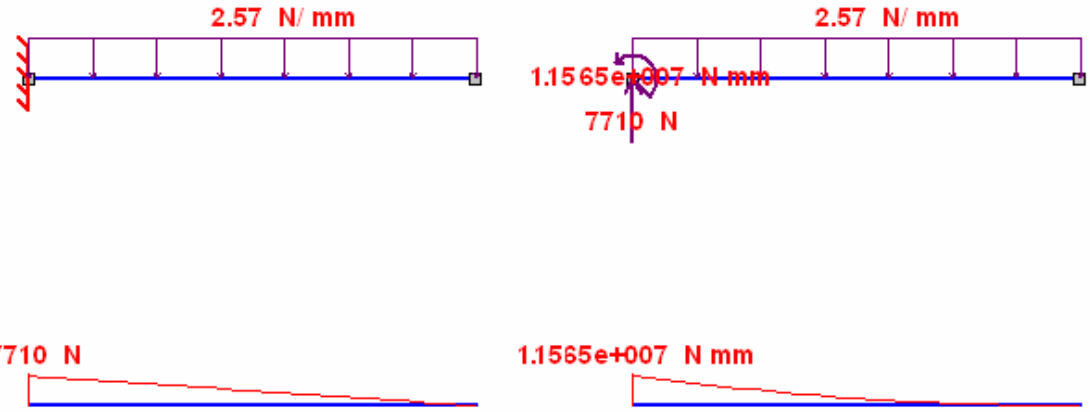
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Cv – Tv) / Tv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT002		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT002**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Cantilever with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT002		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT002**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	7.7100e+003	Th	7.7100e+003	**-1.8190e-012**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	1.3642e-012	**1.3642e-012**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.1565e+007	Th	-1.1565e+007	**3.7253e-009**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	3.2596e-009	**3.2596e-009**	**0.0000**

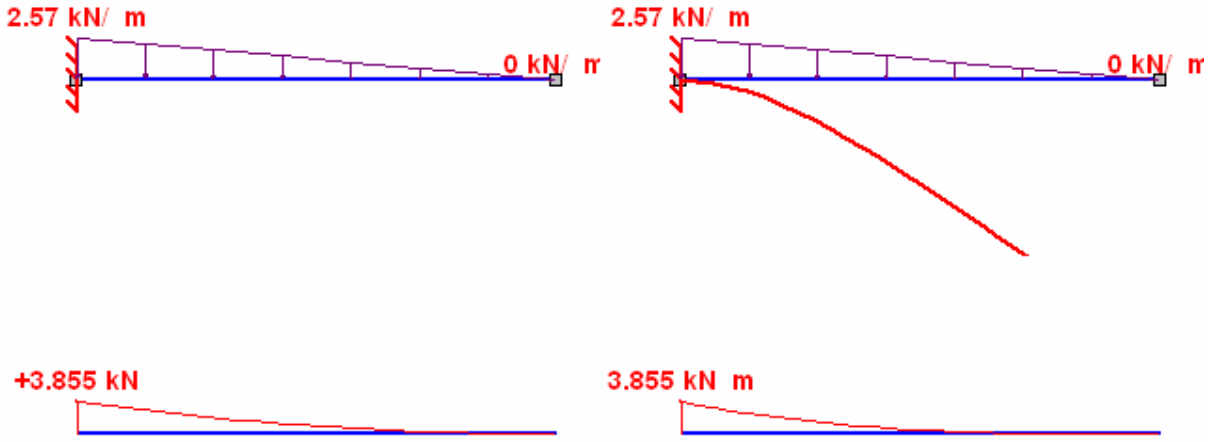
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Cv – Tv) / Tv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT003		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT003**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Cantilever with distributed linear load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT003		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT003**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000			-	As shown

LOAD

Type	Value	Points of application
force linearly distributed	2.570e+000- 0.000e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.8550e+003	Th	3.8550e+003	**9.0949e-013**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.5475e-013	**-4.5475e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-3.8550e+006	Th	-3.8550e+006	**-5.5879e-009**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-6.9849e-010	**-6.9849e-010**	**-0.0000**

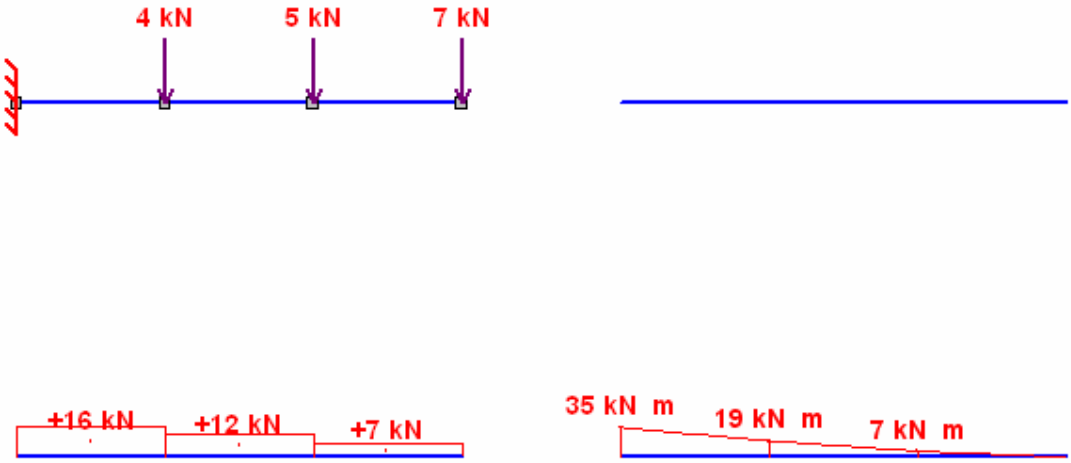
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Cv – Tv) / Tv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT004		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT004**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Cantilever with end and internal shear forces

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT004		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT004**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Free tip
NODAL FORCE	5.000e+003	Dx2
NODAL FORCE	4.000e+003	Dx1
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.6000e+004	Th	1.6000e+004	**1.7462e-010**	**0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	1.2000e+004	Th	1.2000e+004	**8.7311e-011**	**0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	-1.9000e+007	Th	-1.9000e+007	**-1.6391e-007**	**0.0000**
Bending M2, I extreme. Beam # 3. Load case # 1	-7.0000e+006	Th	-7.0000e+006	**-1.0431e-007**	**0.0000**

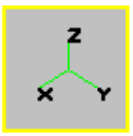
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

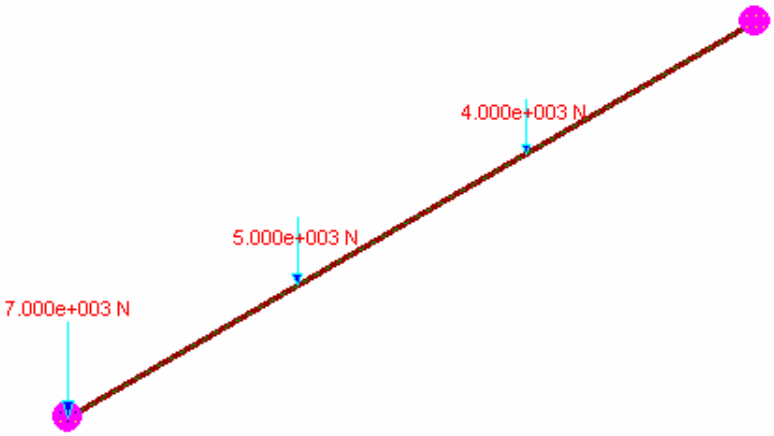
100(Cv – Tv) / Tv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT004BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT004BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Cantilever with end and internal shear forces

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT004BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT004BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD		
Type	Value	Point of application
NODAL FORCE	7.000e+003	Free tip
force concentrated	4.000e+003	Dx1
force concentrated	5.000e+003	Dx2
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA					

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.6000e+004	Th	1.6000e+004	**-5.4570e-012**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	-7.0000e+003	Th	-7.0000e+003	**5.4570e-012**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-3.5000e+007	Th	-3.5000e+007	**-1.0000e-001**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	3.7253e-009	**3.7253e-009**	**0.0000**

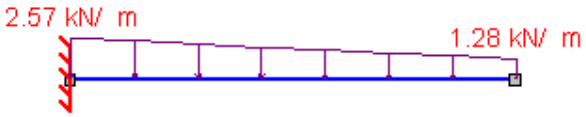
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

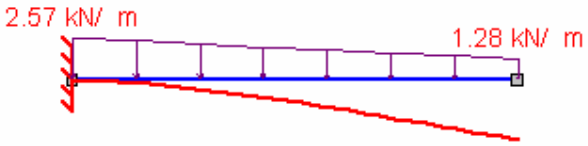
100(Cv – Tv) / Tv relative error percentage

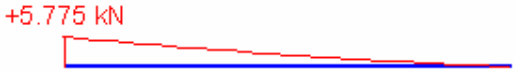
Computational notes:

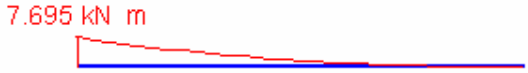
Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT005		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT005**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**









Problem description:

Cantilever with linear load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT005		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT005**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	2.570e+000- 1.280e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	5.7750e+003	Th	5.7750e+003	**1.8190e-012**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-9.0949e-013	**-9.0949e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-7.6950e+006	Th	-7.6950e+006	**-4.6566e-009**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-2.3283e-010	**-2.3283e-010**	**-0.0000**

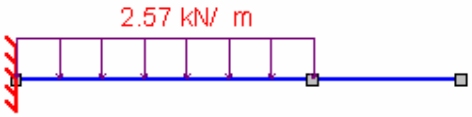
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

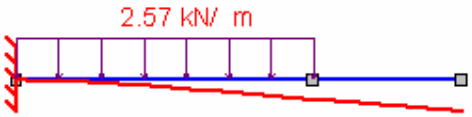
100(Cv – Tv) / Tv relative error percentage

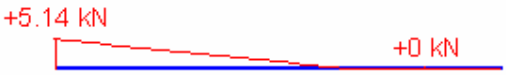
Computational notes:

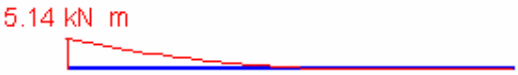
Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT006		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT006**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**









Problem description:

Cantilever with distributed internal constant load (clamped side)

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT006		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT006**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	2000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Clamped tip-Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	5.1400e+003	Th	5.1400e+003	**9.0949e-012**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-9.0949e-012	**-9.0949e-012**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-5.1400e+006	Th	-5.1400e+006	**-2.8871e-008**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	1.0710e-008	**1.0710e-008**	**0.0000**

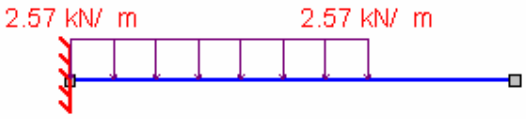
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

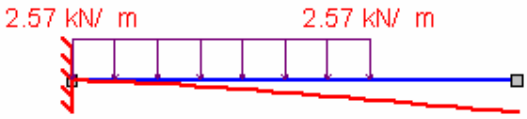
100(Cv – Tv) / Tv relative error percentage

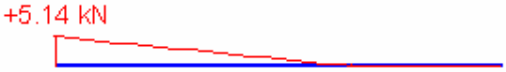
Computational notes:

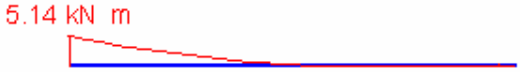
Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT006BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT006BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**









Problem description:

Cantilever with distributed internal constant load (clamped side)

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT006BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT006BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	2000	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	2.570e+000- 2.570e+000	Clamped tip-Dx1
		-
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	5.1400e+003	Th	5.1400e+003	**2.5700e-004**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-5.1400e+006	Th	-5.1400e+006	**-5.1400e-001**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-6.9849e-010	**-6.9849e-010**	**-0.0000**

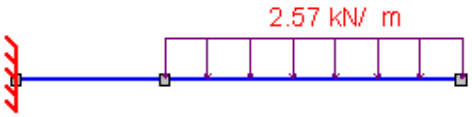
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

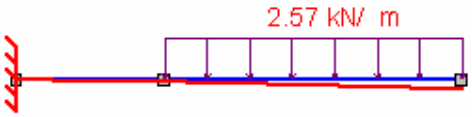
100(Cv – Tv) / Tv relative error percentage

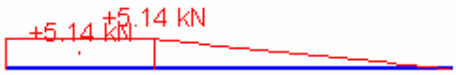
Computational notes:

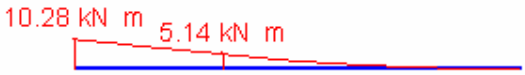
Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT007		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT007**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**









Problem description:

Cantilever with distributed internal constant load (free tip side)

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT007		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT007**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Dx1-Free tip
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	5.1400e+003	Th	5.1400e+003	**1.4552e-011**	**0.0000**
Shear T3, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-3.6380e-012	**-3.6380e-012**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.0280e+007	Th	-1.0280e+007	**-1.4901e-008**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	5.1400e+006	Th	5.1400e+006	**7.4506e-009**	**0.0000**

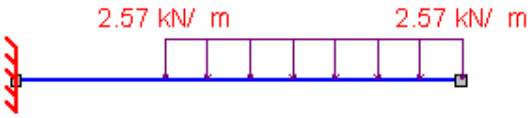
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

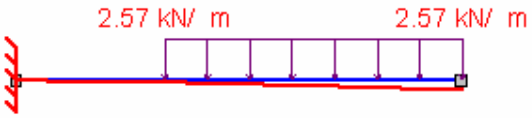
100(Tv – Cv) / Cv relative error percentage

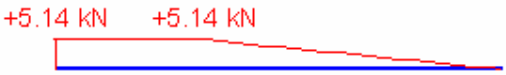
Computational notes:

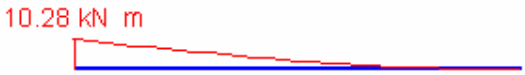
Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT007BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT007BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**









Problem description:

Cantilever with distributed internal constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT007BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT007BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1000	-	-	As shown

LOAD		
Type	Value	Point of application
force linearly distributed	2.570e+000- 2.570e+000	Dx1-Free tip
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA					

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	5.1400e+003	Th	5.1400e+003	**2.5700e-004**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.5475e-013	**-4.5475e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.0280e+007	Th	-1.0280e+007	**-2.5700e-001**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-6.9849e-010	**-6.9849e-010**	**-0.0000**

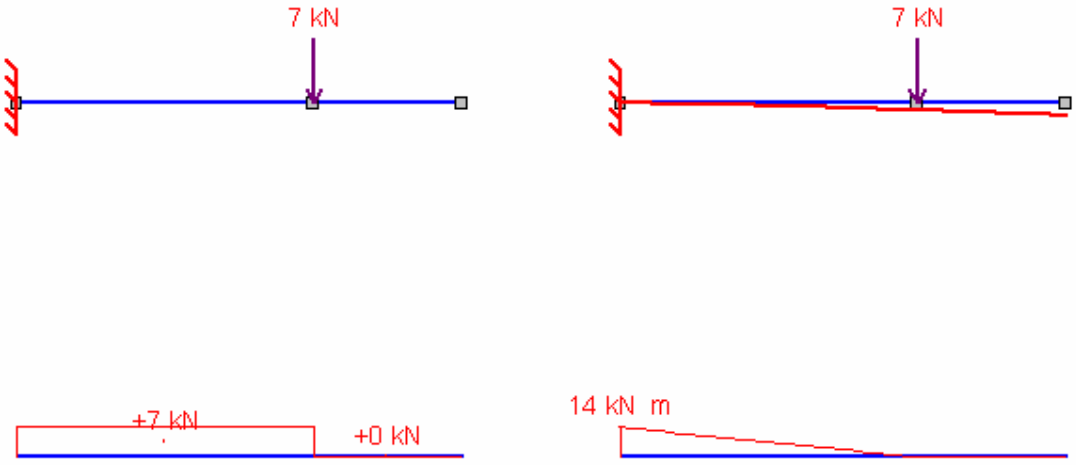
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT008		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT008**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Cantilever with internal shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT008		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT008**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	2000	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	7.0000e+003	Th	7.0000e+003	**3.6380e-011**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	-7.0000e+003	Th	-7.0000e+003	**-3.6380e-011**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.4000e+007	Th	-1.4000e+007	**-1.0803e-007**	**0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-1.8626e-008	**-1.8626e-008**	**-0.0000**

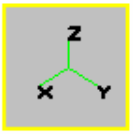
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

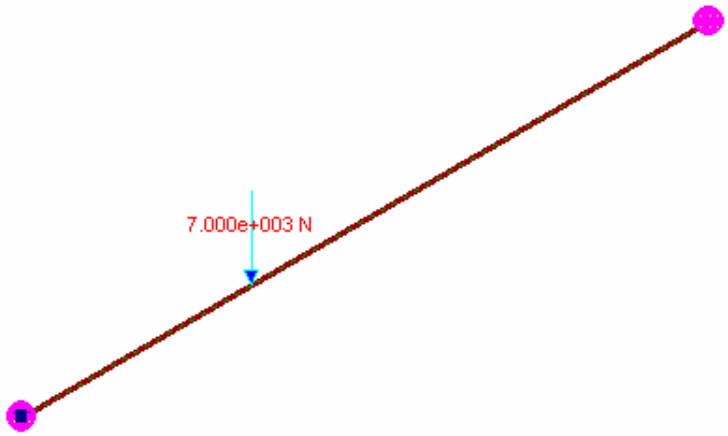
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT008BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT008BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Cantilever with internal shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT008BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT008BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	2000	-	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	7.0000e+003	Th	7.0000e+003	**-1.8190e-012**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	1.8190e-012	**1.8190e-012**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.4000e+007	Th	-1.4000e+007	**-7.0000e-001**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	1.8626e-009	**1.8626e-009**	**0.0000**

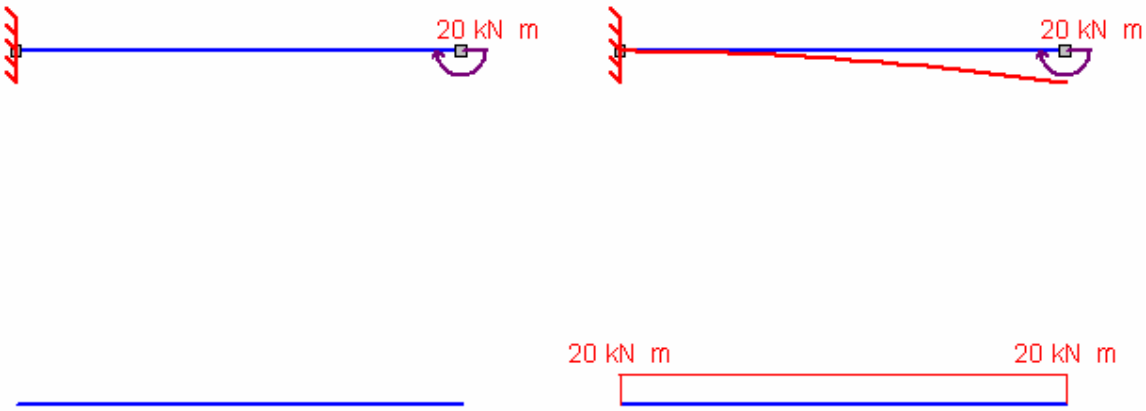
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT009		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT009**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Cantilever with end bending moment

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT009		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT009**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
NODAL MOMENT	2.000e+007	Free tip
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-2.0000e+007	Th	-2.0000e+007	**-7.4506e-009**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	2.0000e+007	Th	2.0000e+007	**0.0000e+000**	**0.0000**

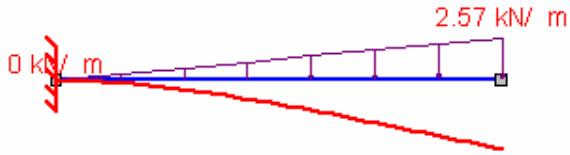
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

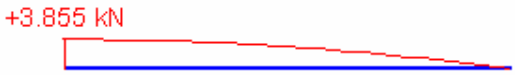
100(Tv – Cv) / Cv relative error percentage

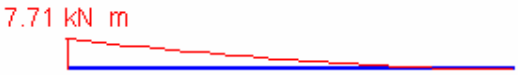
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT010		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT010**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Cantilever with distributed linear load (most loaded tip)

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT010		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT010**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	0.000e+000- 2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.8550e+003	Th	3.8550e+003	**-1.8190e-012**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	9.0949e-013	**9.0949e-013**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-7.7100e+006	Th	-7.7100e+006	**3.7253e-009**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	1.6298e-009	**1.6298e-009**	**0.0000**

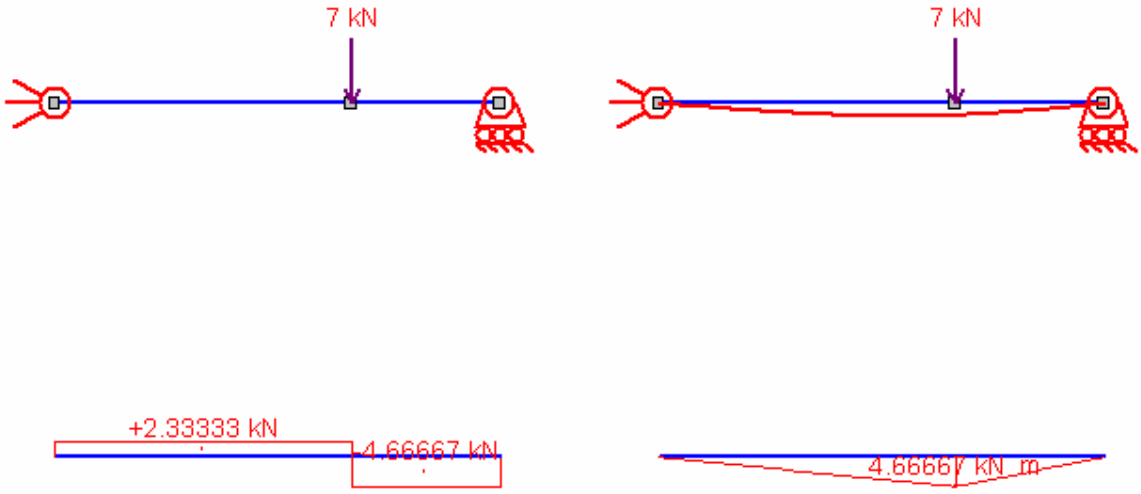
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT011		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT011**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with internal shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT011		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT011**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1			Constraints
3000	2000	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.3333e+003	Th	2.3333e+003	**3.3333e-007**	**0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	-4.6667e+003	Th	-4.6667e+003	**3.3334e-007**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-1.8626e-009	**-1.8626e-009**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-4.6667e+006	Th	-4.6667e+006	**3.3334e-004**	**-0.0000**

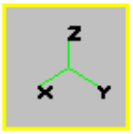
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

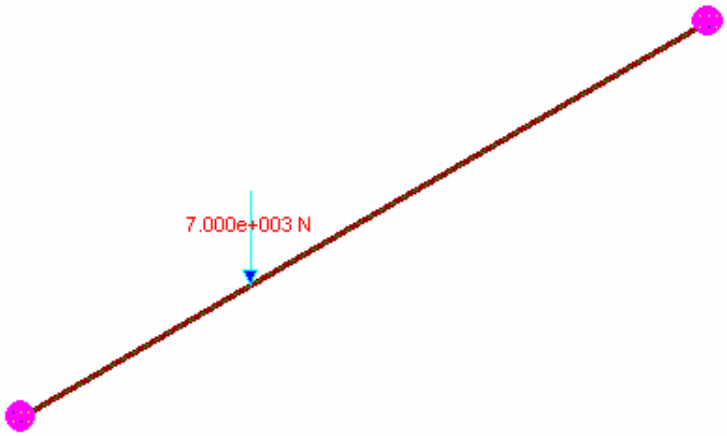
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT011BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT011BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Simply supported beam with internal shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT011BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT011BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	2000	-	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.3333e+003	Th	2.3333e+003	**-2.3300e-004**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	4.6667e+003	Th	4.6667e+003	**2.3300e-004**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	6.9849e-010	**6.9849e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-9.3132e-010	**-9.3132e-010**	**-0.0000**

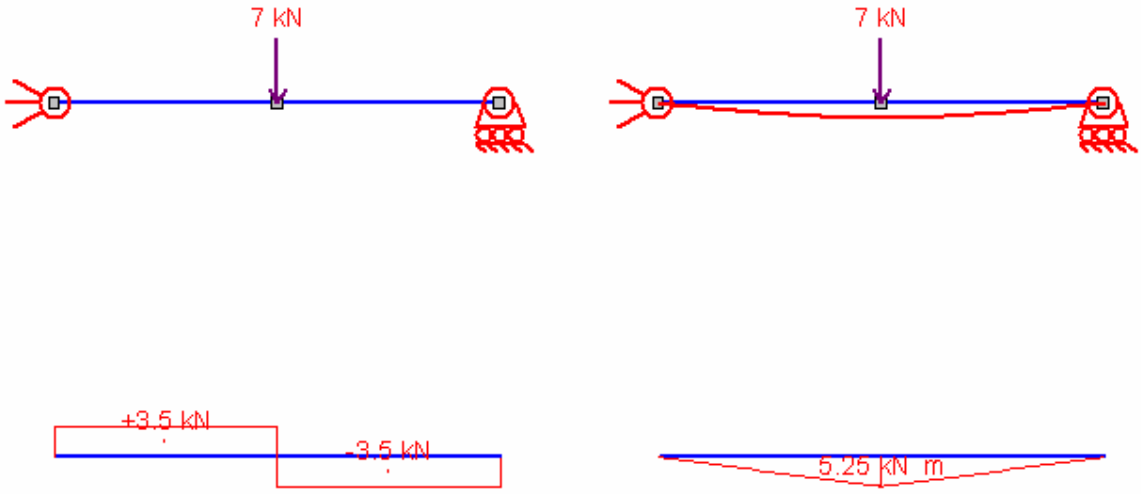
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT012		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT012**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with internal shear force (midpoint)

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT012		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT012**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1500	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.5000e+003	Th	3.5000e+003	**-1.8190e-012**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	-3.5000e+003	Th	-3.5000e+003	**1.8190e-012**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-5.2500e+006	Th	-5.2500e+006	**-1.8626e-009**	**0.0000**

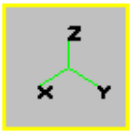
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

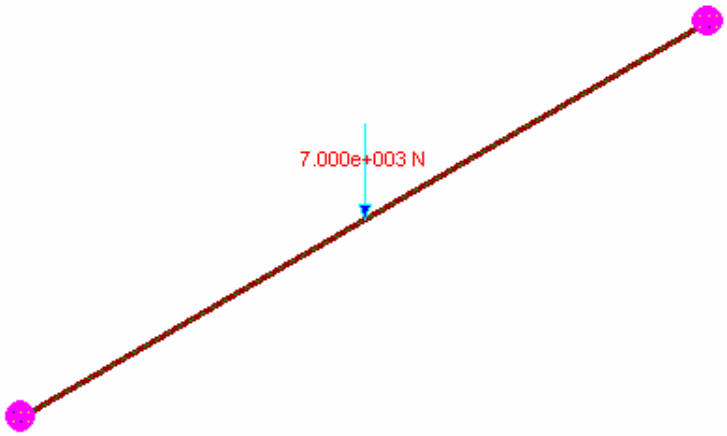
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT012BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT012BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Simply supported beam with internal shear force (midpoint)

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT012BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT012BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1500	-	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.5000e+003	Th	3.5000e+003	**0.0000e+000**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	3.5000e+003	Th	3.5000e+003	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-9.3132e-010	**-9.3132e-010**	**-0.0000**

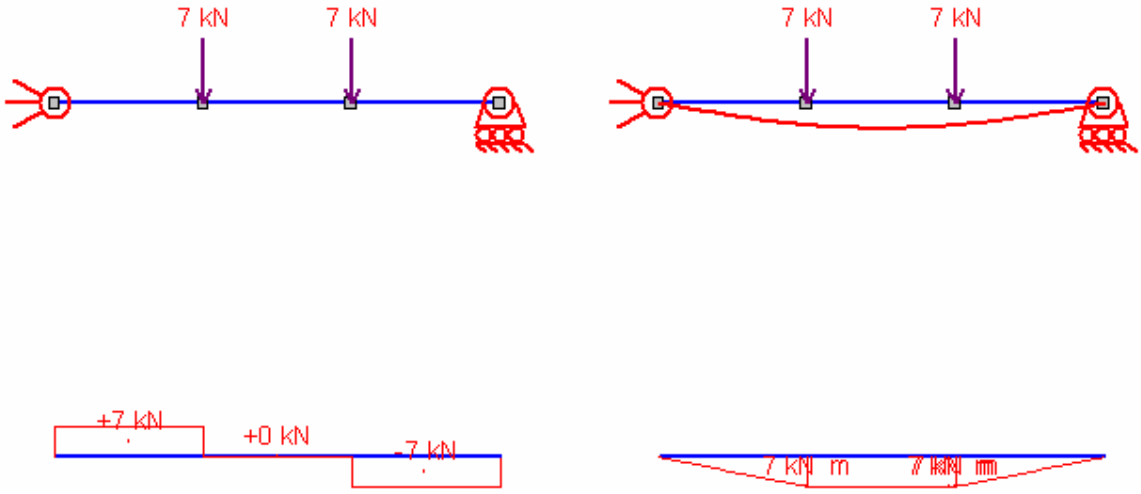
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT013		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT013**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with two equal internal shear forces

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT013		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT013**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
NODAL FORCE	7.000e+003	Dx2
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	7.0000e+003	Th	7.0000e+003	**0.0000e+000**	**0.0000**
Shear T3, J extreme. Beam # 3. Load case # 1	7.0000e+003	Th	7.0000e+003	**1.4552e-011**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-6.5193e-009	**-6.5193e-009**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	-7.0000e+006	Th	-7.0000e+006	**-9.3132e-009**	**0.0000**

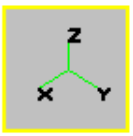
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

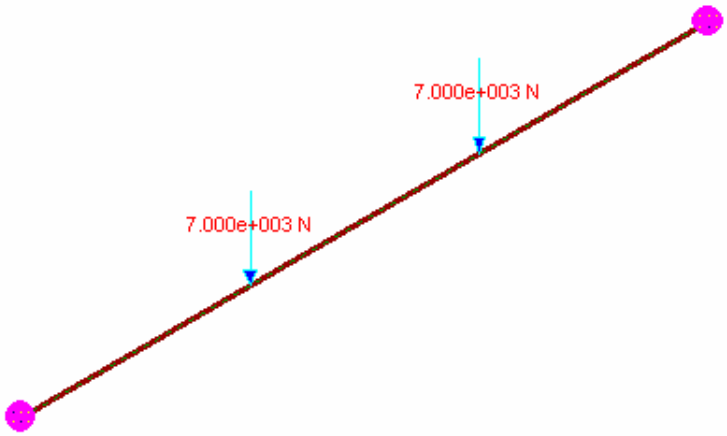
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT013BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT013BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Simply supported beam with two equal internal shear forces

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT013BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT013BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
force concentrated	7.000e+003	Dx2
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	7.0000e+003	Th	7.0000e+003	**-9.0949e-013**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	7.0000e+003	Th	7.0000e+003	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	1.8626e-009	**1.8626e-009**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-9.3132e-010	**-9.3132e-010**	**-0.0000**

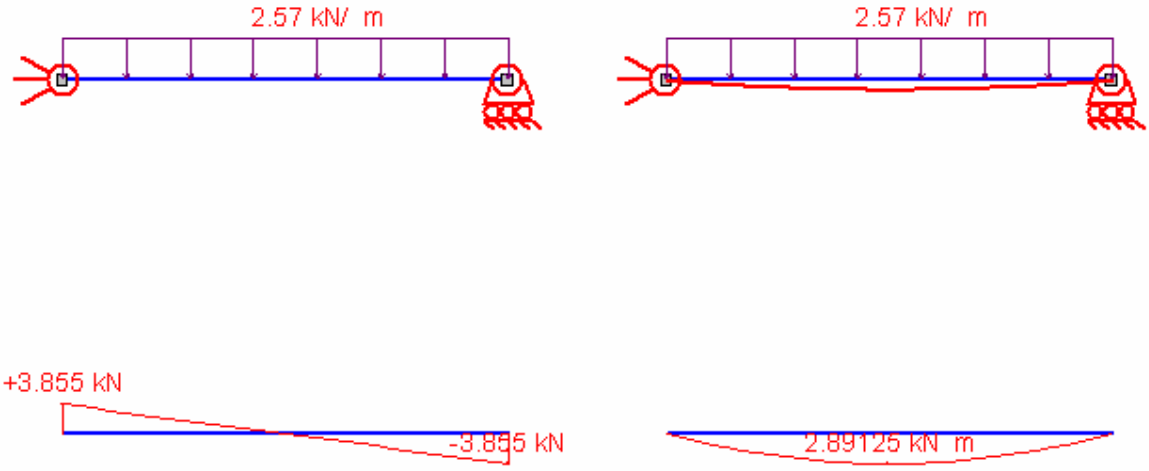
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT014		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT014**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT014		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT014**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.8550e+003	Th	3.8550e+003	**-9.0949e-013**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	3.8550e+003	Th	3.8550e+003	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**

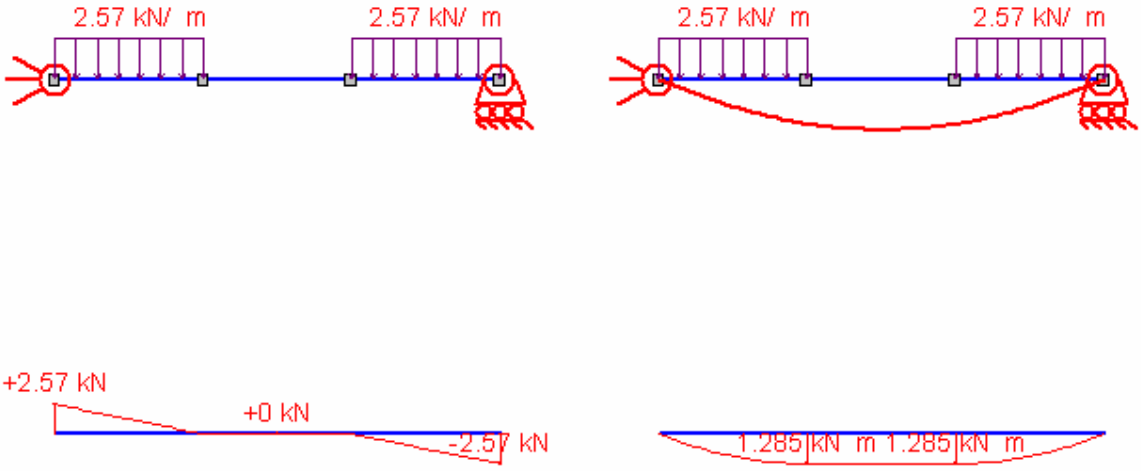
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT015		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT015**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with two internal distributed constant loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT015		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT015**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Left end-Dx1
force distributed	2.570e+000	Dx2-Right end
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.5700e+003	Th	2.5700e+003	**1.3642e-012**	**0.0000**
Shear T3, J extreme. Beam # 3. Load case # 1	2.5700e+003	Th	2.5700e+003	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-1.2850e+006	Th	-1.2850e+006	**4.6566e-010**	**-0.0000**

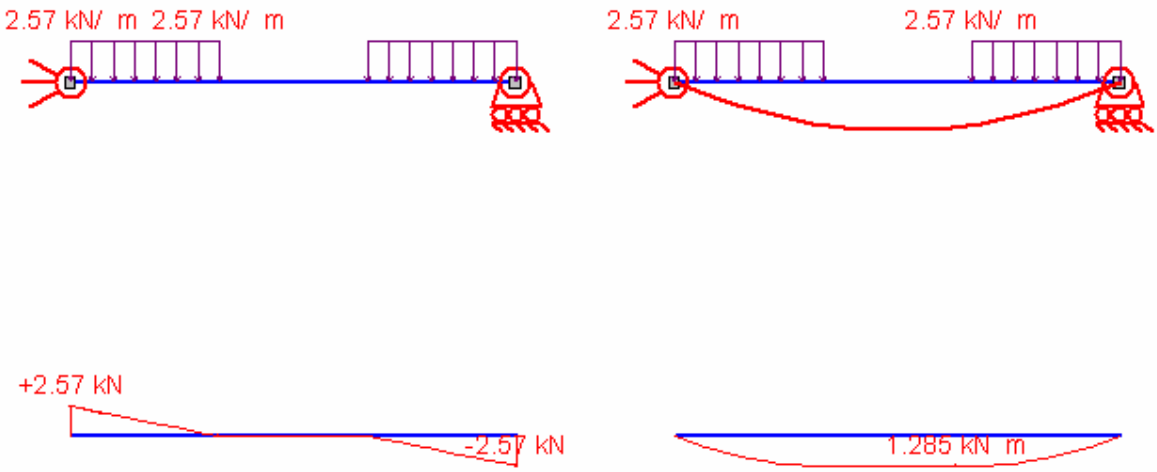
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT015BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT015BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with two internal distributed constant loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT015BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT015BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	2.570e+000- 2.570e+000	Left end-Dx1
force linearly distributed	2.570e+000- 2.570e+000	Dx2-Right end
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.5700e+003	Th	2.5700e+003	**-2.5700e-004**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	2.5700e+003	Th	2.5700e+003	**-2.5700e-004**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-1.1642e-010	**-1.1642e-010**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-2.3283e-010	**-2.3283e-010**	**-0.0000**

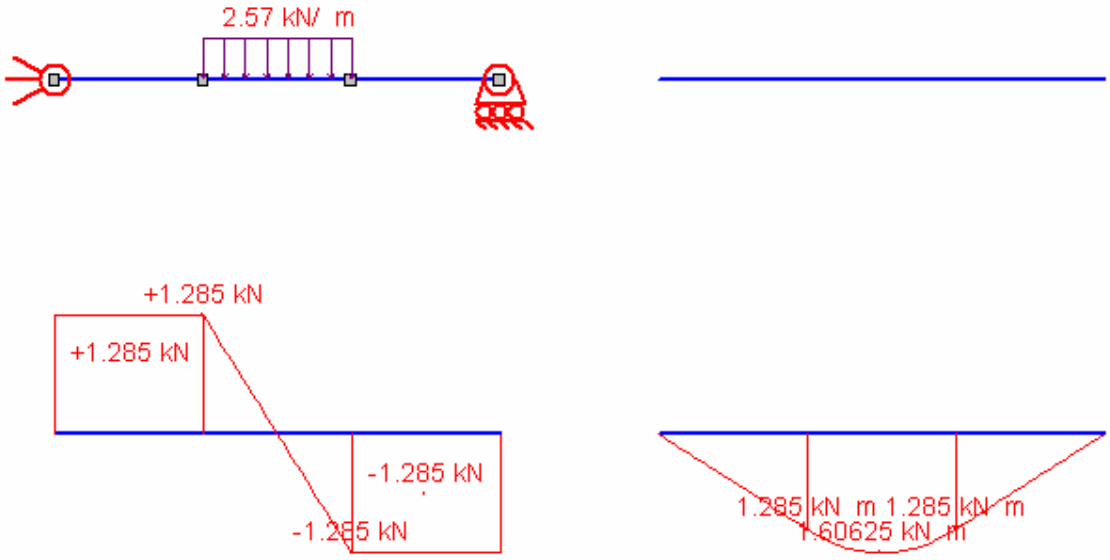
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT016		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT016**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with internal distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT016		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT016**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Dx1-Dx2
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.2850e+003	Th	1.2850e+003	**0.0000e+000**	**0.0000**
Shear T3, J extreme. Beam # 2. Load case # 1	1.2850e+003	Th	1.2850e+003	**-9.0949e-013**	**-0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	1.2850e+006	Th	1.2850e+006	**-2.0955e-009**	**-0.0000**
Bending M2, J extreme. Beam # 3. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**

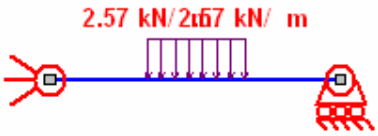
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

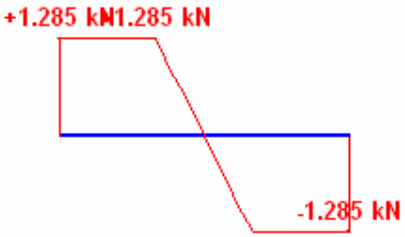
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT016BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT016BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Simply supported beam with internal distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT016BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT016BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	2.570e+000- 2.570e+000	Dx1-Dx2
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.2850e+003	Th	1.2850e+003	**2.5700e-004**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	1.2850e+003	Th	1.2850e+003	**2.5700e-004**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	1.1642e-010	**1.1642e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-3.4925e-010	**-3.4925e-010**	**-0.0000**

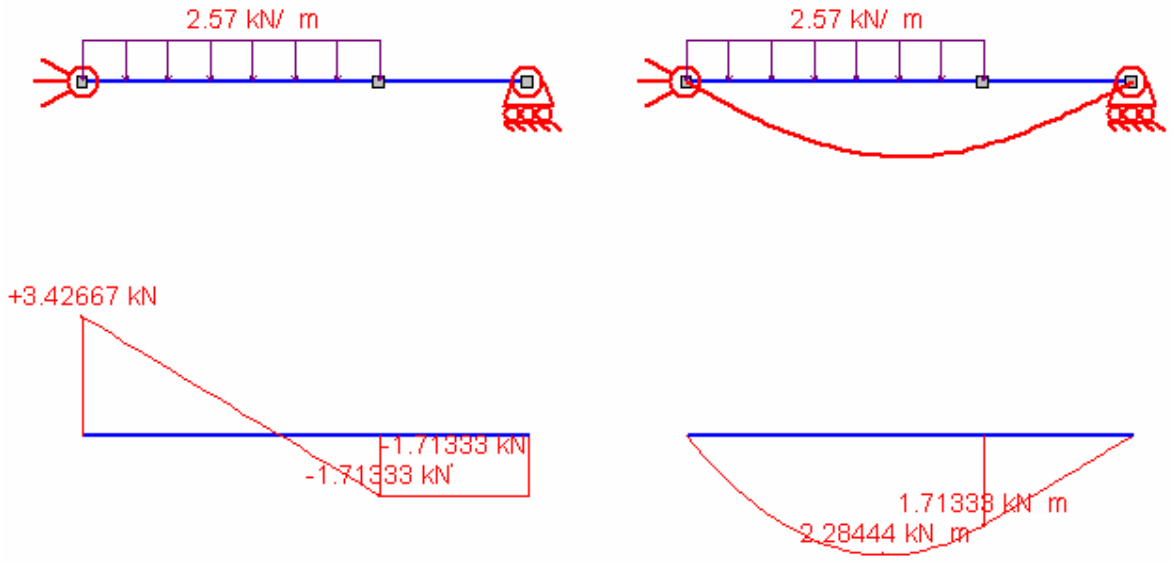
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT017		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT017**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with internal distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT017		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT017**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	2000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Left end-Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.4267e+003	Th	3.4267e+003	**-3.3333e-007**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	-1.7133e+003	Th	-1.7133e+003	**-3.3334e-007**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-2.3283e-010	**-2.3283e-010**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-1.7133e+006	Th	-1.7133e+006	**-3.3333e-004**	**0.0000**

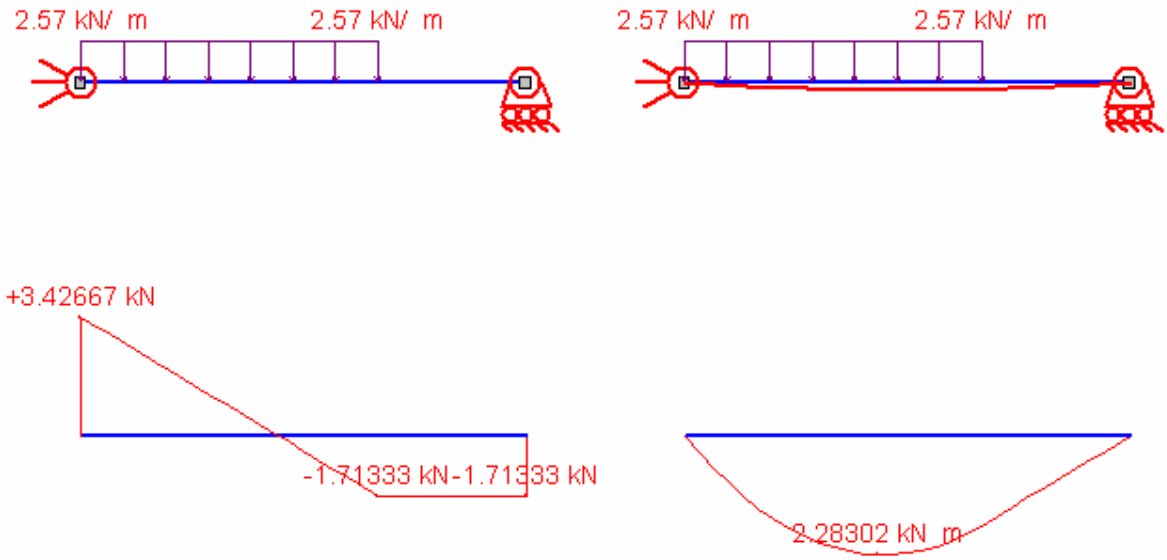
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT017BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT017BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with internal distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

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TEST SCHEDULE CASTALIA_STAT017BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT017BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	2000	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	2.570e+000- 2.570e+000	Left end-Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.4267e+003	Th	3.4267e+003	**8.5333e-005**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	1.7133e+003	Th	1.7133e+003	**1.7167e-004**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**

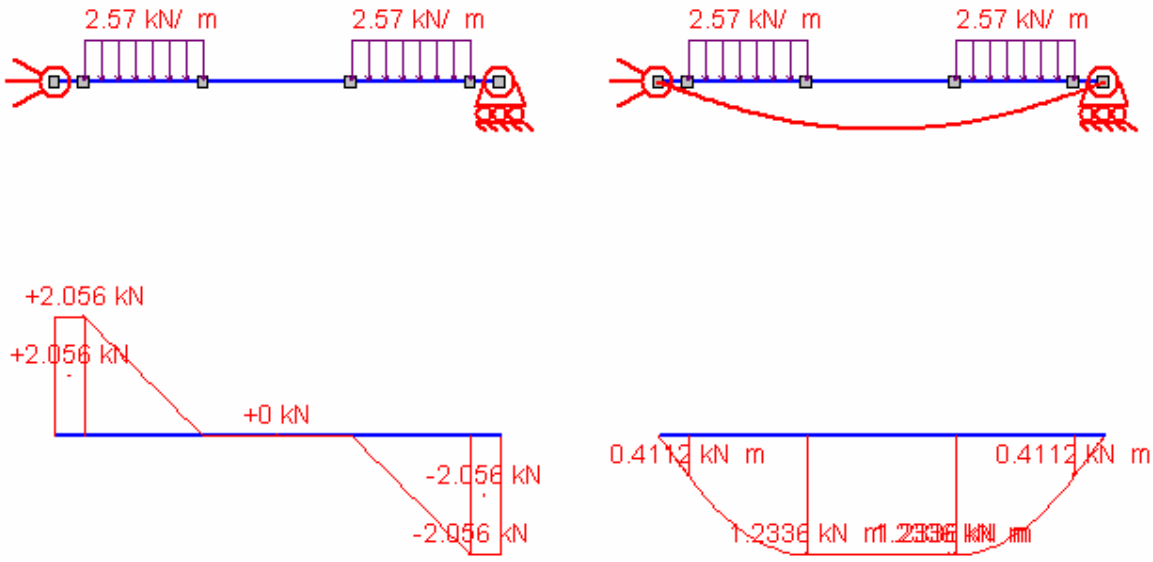
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT018		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT018**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with two internal distributed constant loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT018		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT018**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Left end-Dx1
force distributed	2.570e+000	Dx2-Right end
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 3. Load case # 1	0.0000e+000	Th	1.8190e-012	**1.8190e-012**	**0.0000**
Shear T3, J extreme. Beam # 5. Load case # 1	2.0560e+003	Th	2.0560e+003	**-5.8208e-011**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-4.1120e+005	Th	-4.1120e+005	**1.1176e-008**	**-0.0000**
Bending M2, I extreme. Beam # 3. Load case # 1	1.2336e+006	Th	1.2336e+006	**-1.6997e-008**	**-0.0000**

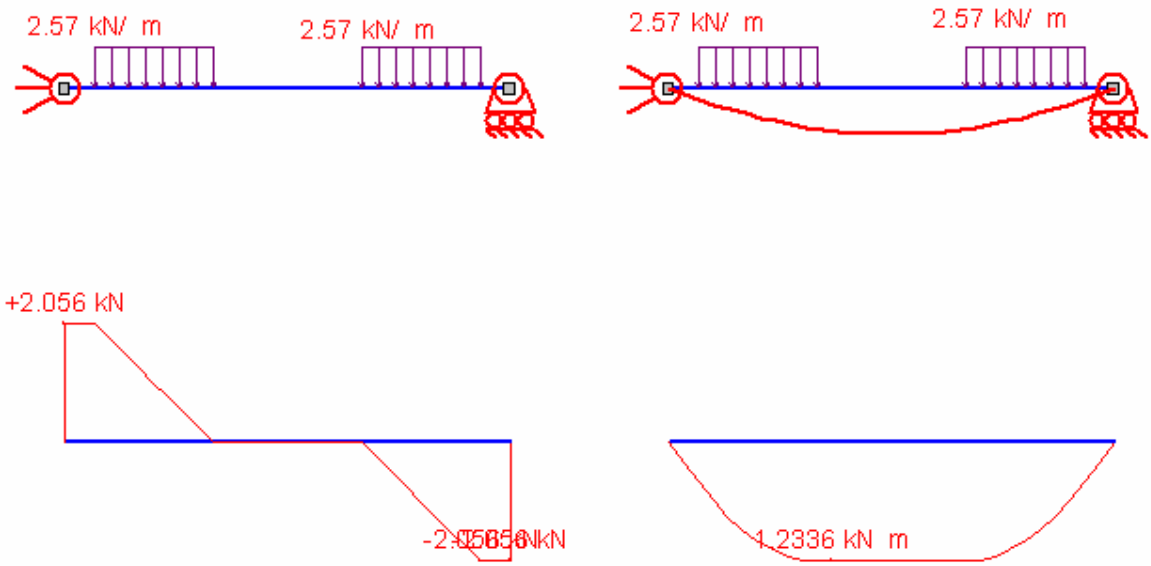
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT018BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT018BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with two internal distributed constant loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT018BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT018BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	2.570e+000- 2.570e+000	Left end-Dx1
force linearly distributed	2.570e+000- 2.570e+000	Dx2-Right end
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.0560e+003	Th	2.0560e+003	**-2.9812e-004**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	2.0560e+003	Th	2.0560e+003	**-4.9858e-004**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	1.1642e-010	**1.1642e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-3.4925e-010	**-3.4925e-010**	**-0.0000**

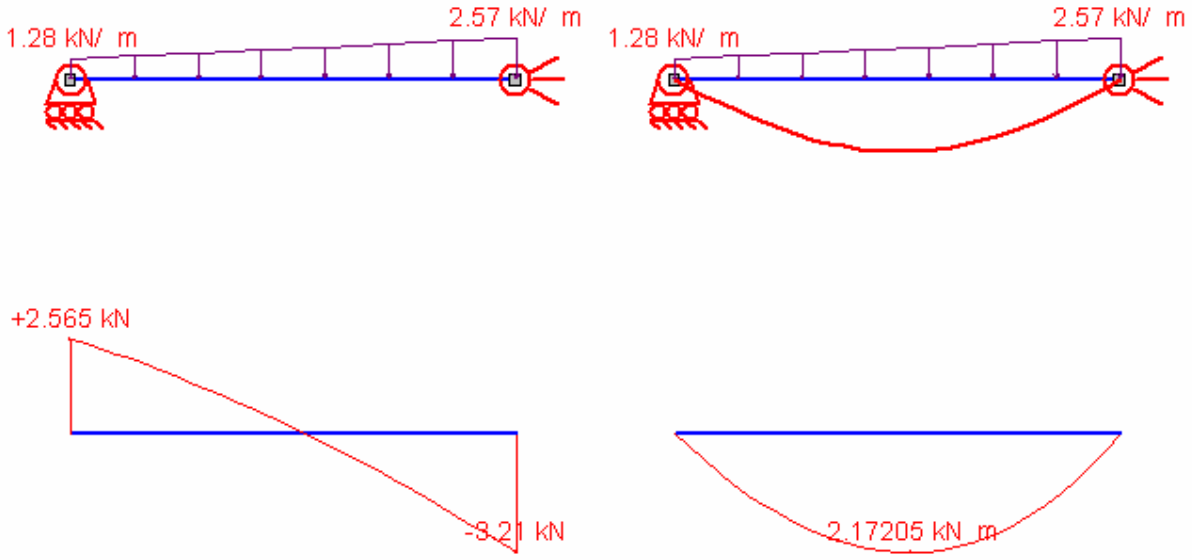
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT019		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT019**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with distributed linear load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT019		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT019**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	1.280e+000- 2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.5650e+003	Th	2.5650e+003	**0.0000e+000**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	3.2100e+003	Th	3.2100e+003	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	4.6566e-010	**4.6566e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**

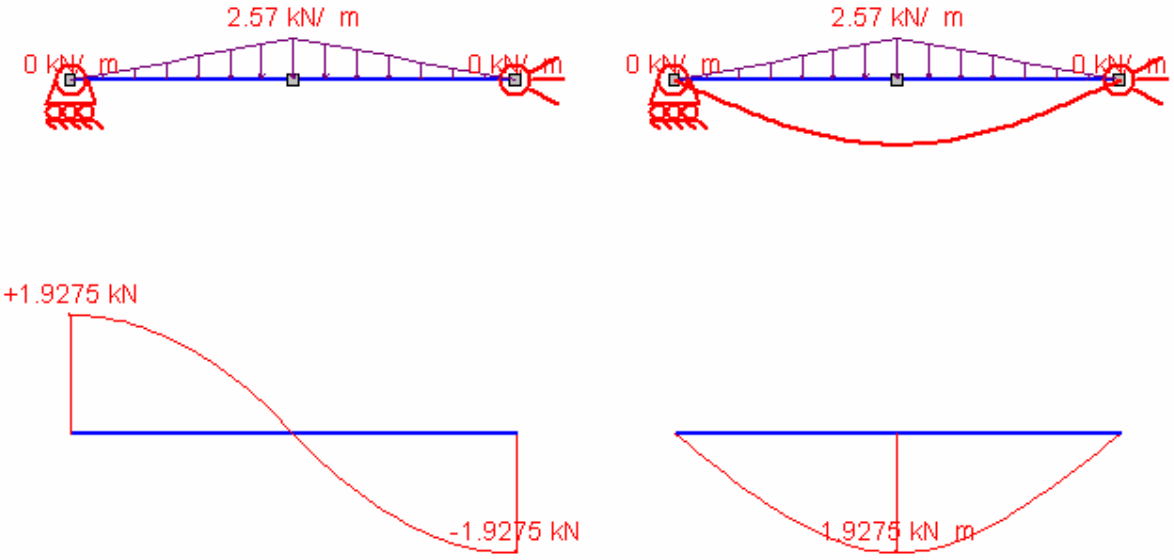
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT020		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT020**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with two distributed linear loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT020		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT020**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1500	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	0.000e+000- 2.570e+000	Left end-Dx1
force linearly distributed	2.570e+000- 0.000e+000	Dx1-Right end
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.9275e+003	Th	1.9275e+003	**-1.1369e-012**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	6.8212e-013	**6.8212e-013**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-1.9275e+006	Th	-1.9275e+006	**9.3132e-010**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-9.8953e-010	**-9.8953e-010**	**-0.0000**

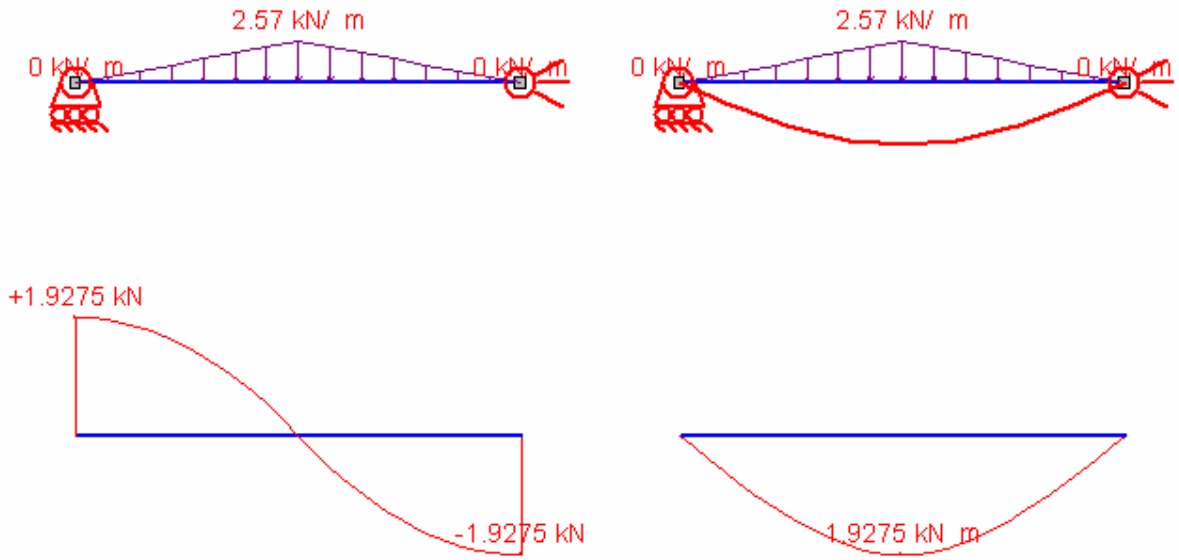
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT020BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT020BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with two distributed linear loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT020BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT020BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1500	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	0.000e+000- 2.570e+000	Left end-Dx1
force linearly distributed	2.570e+000- 0.000e+000	Dx1-Right end
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.9275e+003	Th	1.9275e+003	**-1.3642e-012**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	1.9275e+003	Th	1.9275e+003	**4.0927e-012**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	2.3283e-010	**2.3283e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**

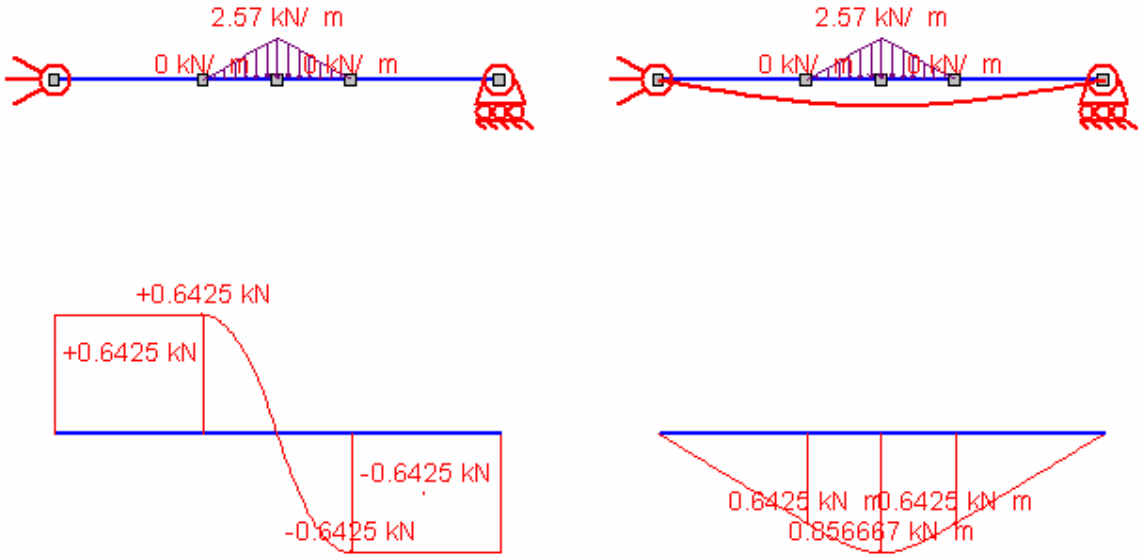
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT021		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT021**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with two internal distributed linear loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT021		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT021**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]	Dx3 [mm]	Constraints
3000	1000	1500	2000	As shown

LOAD

Type	Value	Point of application
force linearly distributed	0.000e+000- 2.570e+000	Dx1-Dx2
force linearly distributed	2.570e+000- 0.000e+000	Dx2-Dx3
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 2. Load case # 1	6.4250e+002	Th	6.4250e+002	**-5.5707e-012**	**-0.0000**
Shear T3, I extreme. Beam # 4. Load case # 1	0.0000e+000	Th	-1.8190e-012	**-1.8190e-012**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-6.4250e+005	Th	-6.4250e+005	**4.1910e-009**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	-8.5667e+005	Th	-8.5667e+005	**3.3342e-005**	**-0.0000**

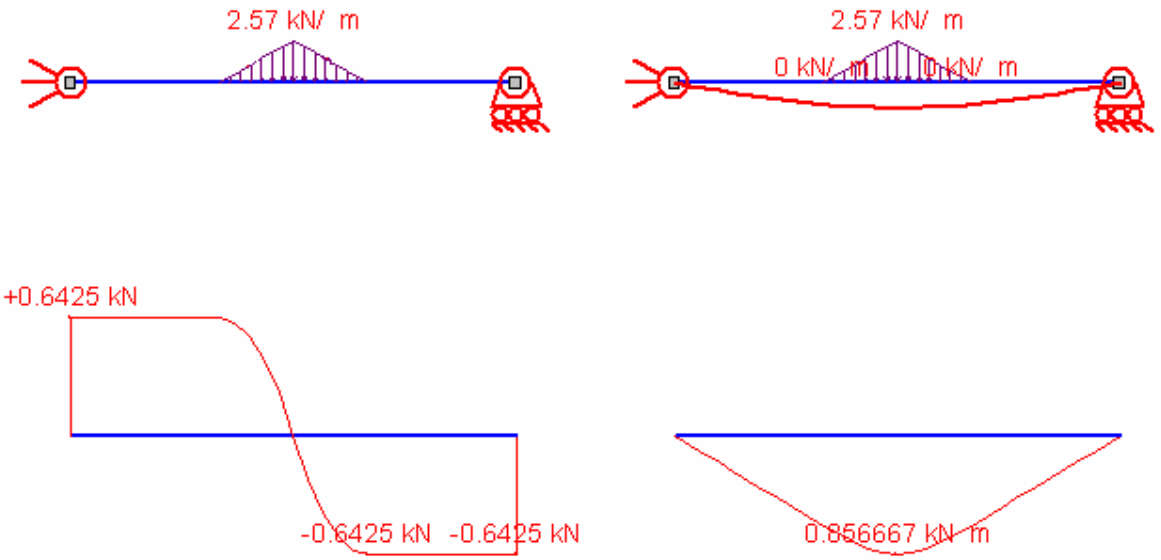
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT021BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT021BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with two internal distributed linear loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT021BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT021BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]	Dx3 [mm]	Constraints
3000	1000	1500	2000	As shown

LOAD

Type	Value	Point of application
force linearly distributed	0.000e+000- 2.570e+000	Dx1-Dx2
force linearly distributed	2.570e+000- 0.000e+000	Dx2-Dx3
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	6.4250e+002	Th	6.4250e+002	**1.2850e-004**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	6.4250e+002	Th	6.4250e+002	**1.2850e-004**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	1.7462e-010	**1.7462e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-1.1642e-010	**-1.1642e-010**	**-0.0000**

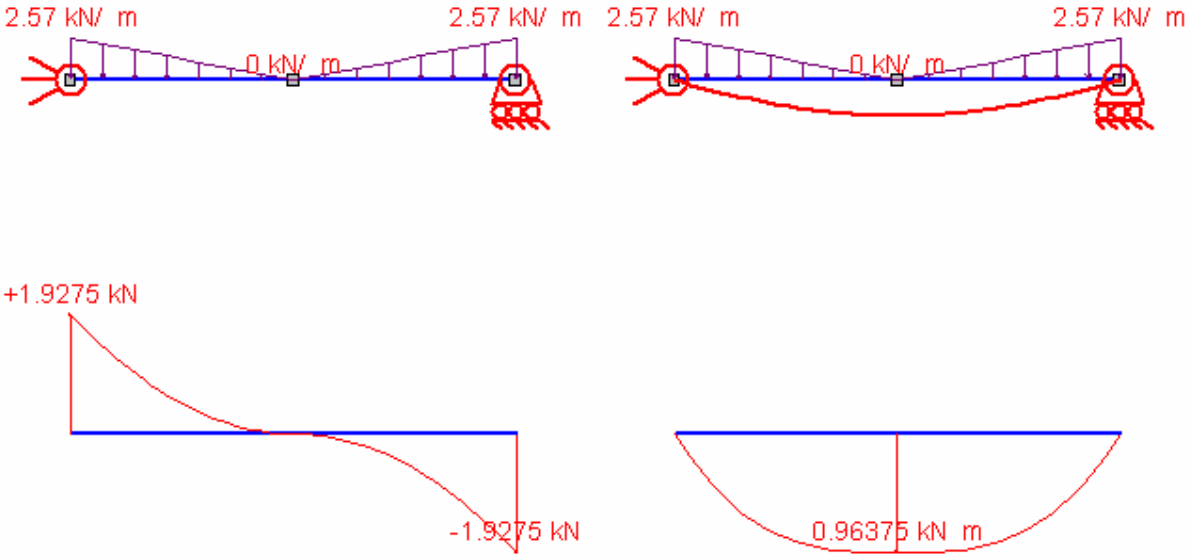
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT022		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT022**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with two distributed linear loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT022		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT022**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1500	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	2.570e+000- 0.000e+000	Left end-Dx1
force linearly distributed	0.000e+000- 2.570e+000	Dx1-Right end
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.9275e+003	Th	1.9275e+003	**-4.5475e-013**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-9.0949e-013	**-9.0949e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	6.4028e-010	**6.4028e-010**	**0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	9.6375e+005	Th	9.6375e+005	**1.1642e-009**	**0.0000**

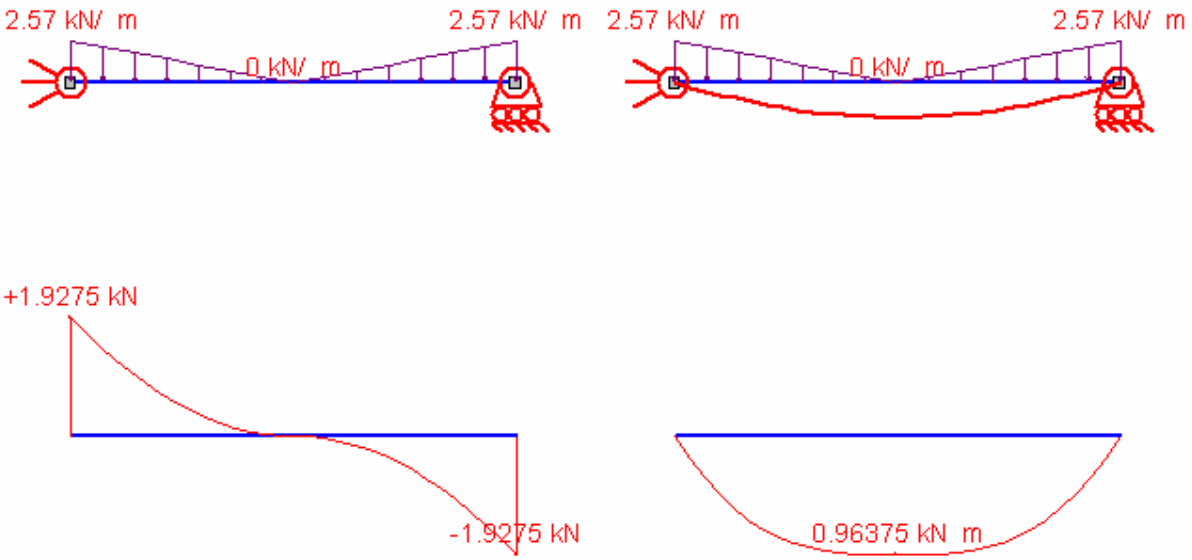
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT022BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT022BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with two distributed linear loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT022BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT022BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1500	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	2.570e+000- 0.000e+000	Left end-Dx1
force linearly distributed	0.000e+000- 2.570e+000	Dx2-Right end
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.9275e+003	Th	1.9275e+003	**0.0000e+000**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	1.9275e+003	Th	1.9275e+003	**-9.0949e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	5.8208e-010	**5.8208e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**

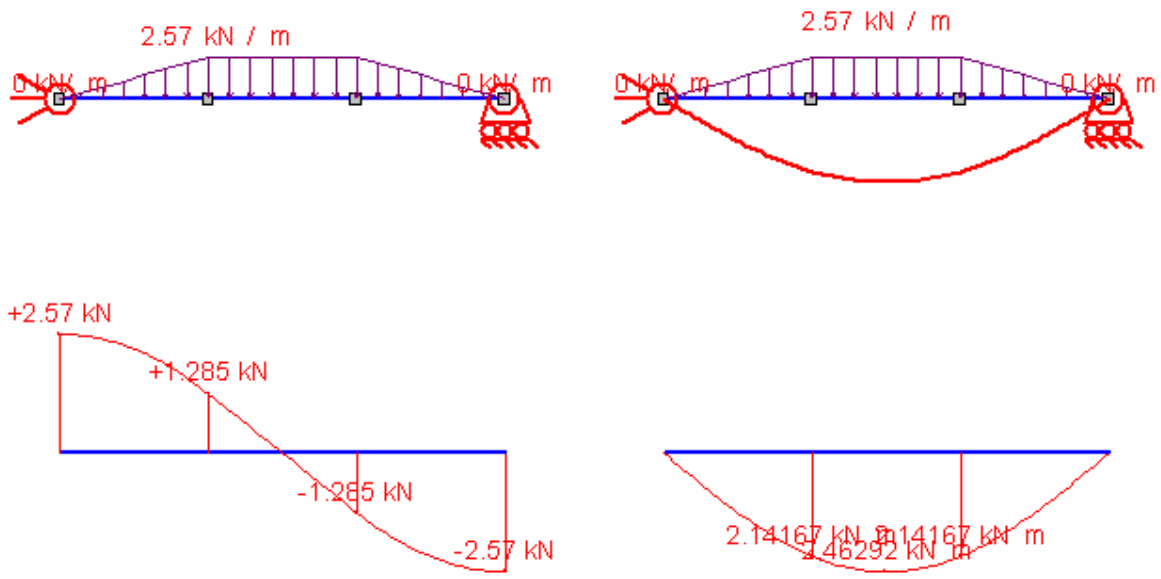
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT023		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT023**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with distributed variable load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT023		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT023**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	0.000e+000- 2.570e+000	Left end-Dx1
force linearly distributed	2.570e+000- 2.570e+000	Dx1-Dx2
force linearly distributed	2.570e+000- 0.000e+000	Dx2-Right end
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 2. Load case # 1	1.2850e+003	Th	1.2850e+003	**6.3665e-012**	**0.0000**
Shear T3, J extreme. Beam # 3. Load case # 1	2.5700e+003	Th	2.5700e+003	**4.0927e-012**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	3.3469e-010	**3.3469e-010**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	-2.1417e+006	Th	-2.1417e+006	**3.3333e-004**	**-0.0000**

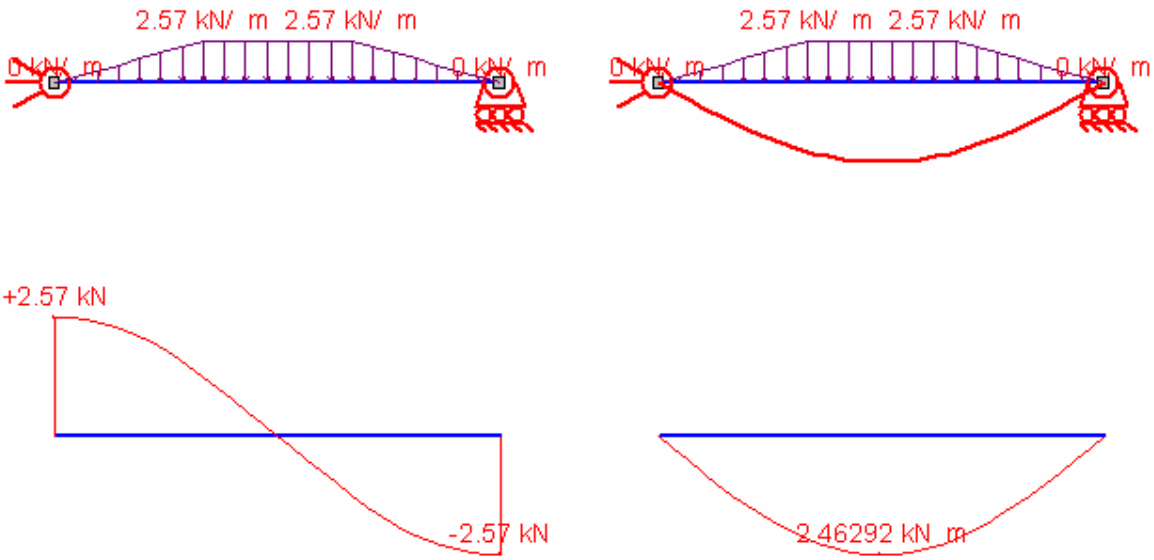
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT023BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT023BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with distributed variable load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT023BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT023BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	0.000e+000- 2.570e+000	Left end-Dx1
force linearly distributed	2.570e+000- 2.570e+000	Dx1-Dx2
force linearly distributed	2.570e+000- 0.000e+000	Dx2-Right end
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.5700e+003	Th	2.5700e+003	**1.2850e-004**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	2.5700e+003	Th	2.5700e+003	**1.2850e-004**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-2.3283e-010	**-2.3283e-010**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-9.3132e-010	**-9.3132e-010**	**-0.0000**

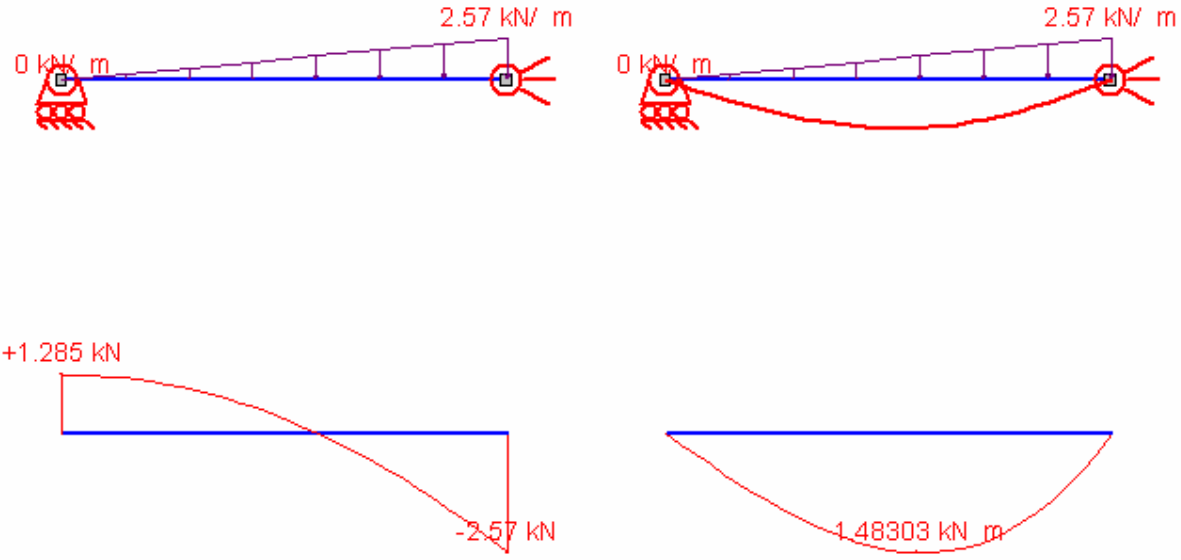
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT024		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT024**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with distributed linear load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT024		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT024**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	0.000e+000- 2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.2850e+003	Th	1.2850e+003	**0.0000e+000**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	2.5700e+003	Th	2.5700e+003	**-9.0949e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	2.3283e-010	**2.3283e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-2.3283e-010	**-2.3283e-010**	**-0.0000**

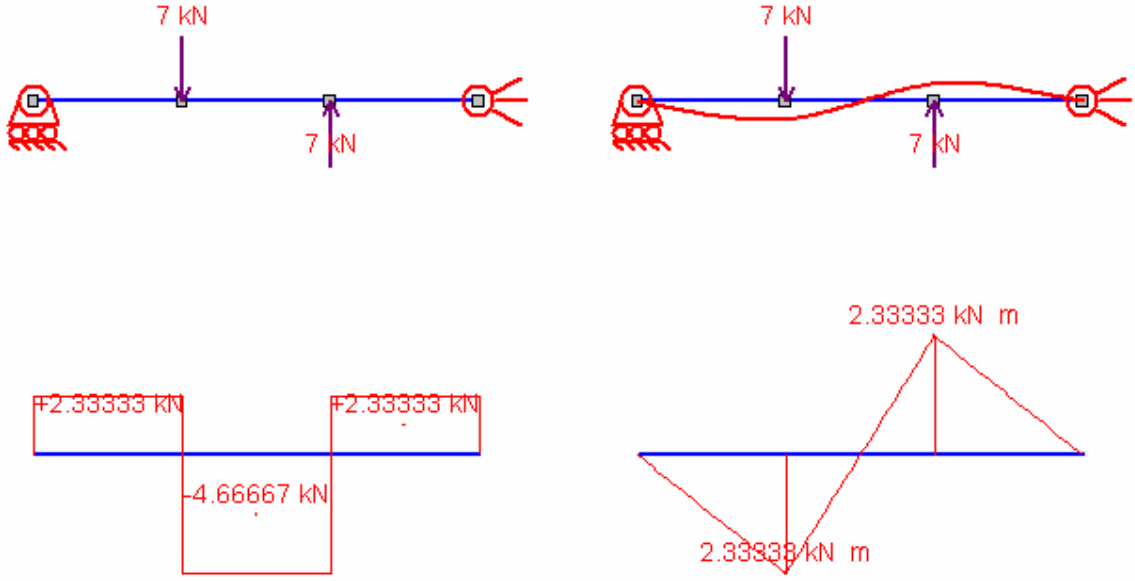
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT025		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT025**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with two shear forces

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT025		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT025**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
NODAL FORCE	7.000e+003	Dx2
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.3333e+003	Th	2.3333e+003	**3.3333e-007**	**0.0000**
Shear T3, J extreme. Beam # 2. Load case # 1	4.6667e+003	Th	4.6667e+003	**-3.3333e-007**	**-0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	2.3333e+006	Th	2.3333e+006	**3.3333e-004**	**0.0000**
Bending M2, J extreme. Beam # 3. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**

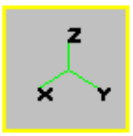
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

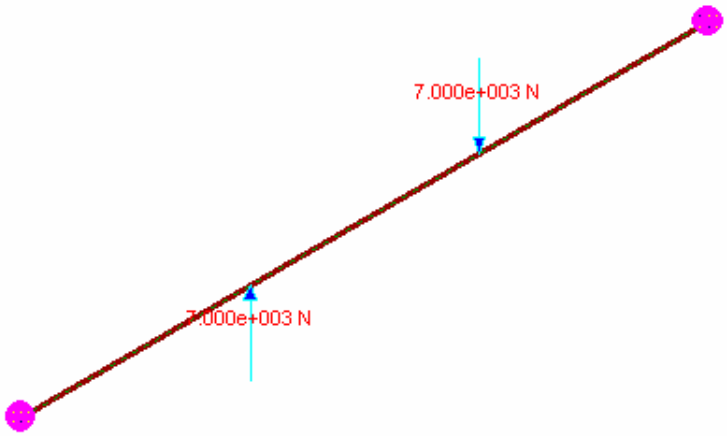
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT025BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT025BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Simply supported beam with two shear forces

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT025BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT025BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
force concentrated	7.000e+003	Dx2
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.3333e+003	Th	2.3333e+003	**4.6700e-004**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	-2.3333e+003	Th	-2.3333e+003	**-4.6700e-004**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	2.3283e-010	**2.3283e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**

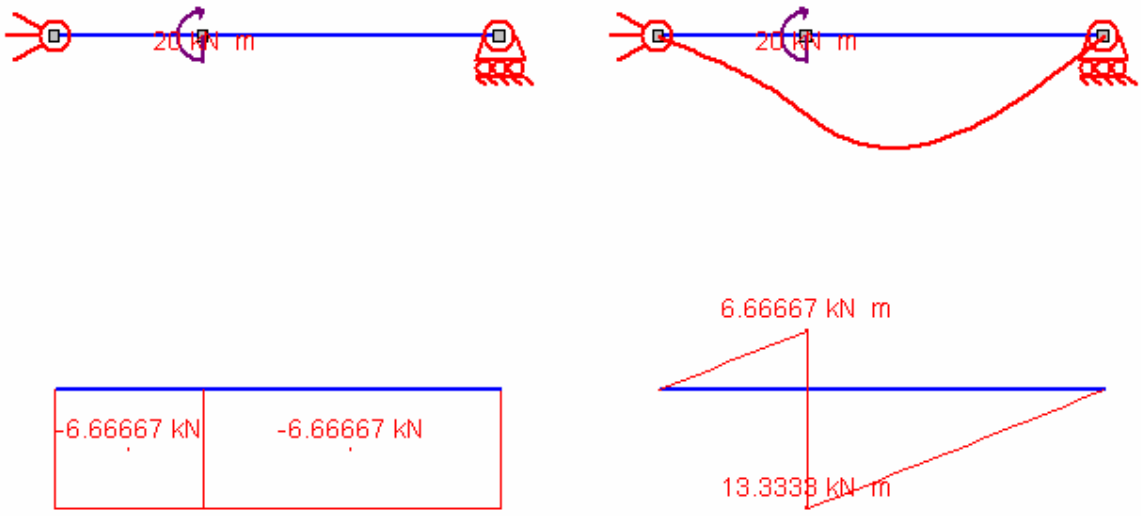
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT026		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT026**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with internal bending moment

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT026		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT026**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1000	-	-	As shown

LOAD

Type	Value	Point of application
NODAL MOMENT	2.000e+007	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, J extreme. Beam # 1. Load case # 1	6.6667e+003	Th	6.6667e+003	**-3.3332e-007**	**-0.0000**
Shear T3, J extreme. Beam # 2. Load case # 1	6.6667e+003	Th	6.6667e+003	**-3.3334e-007**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	6.6667e+006	Th	6.6667e+006	**-3.3332e-004**	**-0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	1.3333e+007	Th	1.3333e+007	**3.3333e-003**	**0.0000**

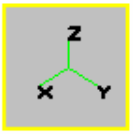
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT026BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT026BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with internal bending moment

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT026BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT026BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1000	-	-	As shown

LOAD

Type	Value	Point of application
moment concentrated	2.000e+007	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-6.6667e+003	Th	-6.6667e+003	**3.3333e-007**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	6.6667e+003	Th	6.6667e+003	**-3.3333e-007**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	1.5930e-010	**1.5930e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-1.8626e-009	**-1.8626e-009**	**-0.0000**

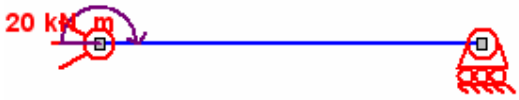
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

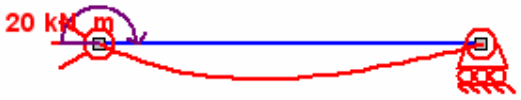
100(Tv – Cv) / Cv relative error percentage

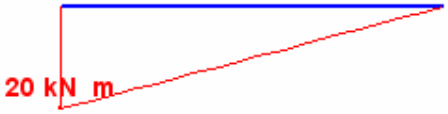
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT027		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT027**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Simply supported beam with end bending moment

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT027		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT027**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
NODAL MOMENT	2.000e+007	Left end
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-6.6667e+003	Th	-6.6667e+003	**3.3333e-007**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	6.6667e+003	Th	6.6667e+003	**-3.3333e-007**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	2.0000e+007	Th	2.0000e+007	**3.7253e-009**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-1.8626e-009	**-1.8626e-009**	**-0.0000**

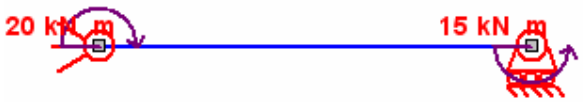
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

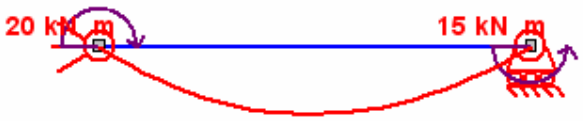
100(Tv – Cv) / Cv relative error percentage

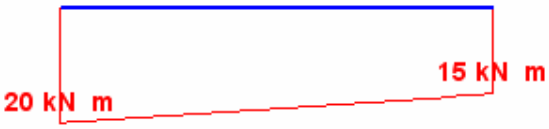
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT028		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT028**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Simply supported beam with bending moments at both ends

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that’s why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT028		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT028**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
NODAL MOMENT	2.000e+007	Left end
NODAL MOMENT	1.500e+007	Right end
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-1.6667e+003	Th	-1.6667e+003	**3.3333e-007**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	1.6667e+003	Th	1.6667e+003	**-3.3333e-007**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	2.0000e+007	Th	2.0000e+007	**7.4506e-009**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-1.5000e+007	Th	-1.5000e+007	**0.0000e+000**	**-0.0000**

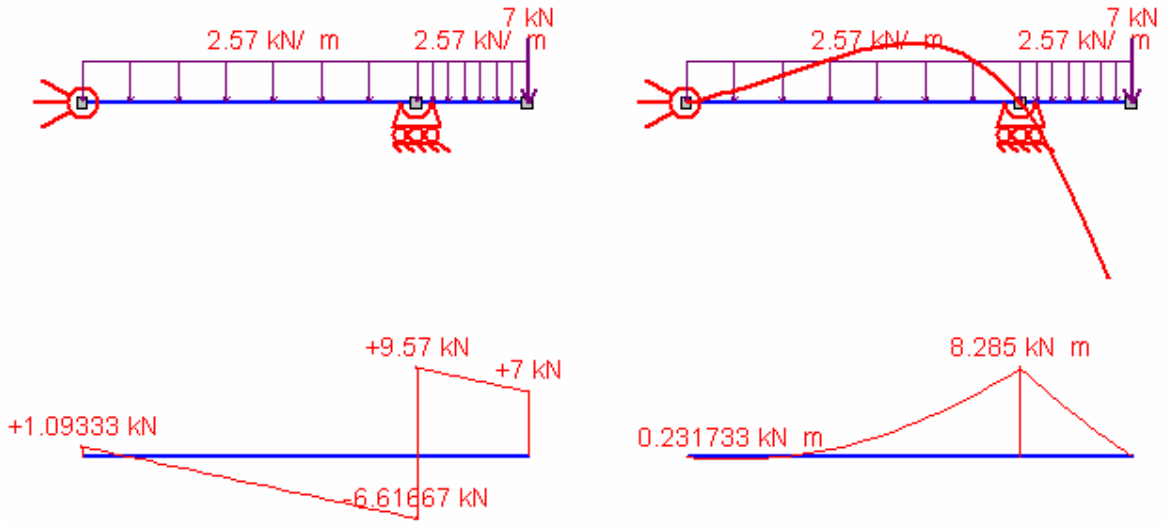
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT029		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT029**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Intermediate support beam with distributed constant load and end shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT029		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT029**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
4000=3000+1000	-	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Free tip
force distributed	2.570e+000	-
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.0933e+003	Th	1.0933e+003	**3.3333e-007**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	6.6167e+003	Th	6.6167e+003	**-3.3333e-007**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	8.2850e+006	Th	8.2850e+006	**1.8626e-009**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	2.4447e-009	**2.4447e-009**	**0.0000**

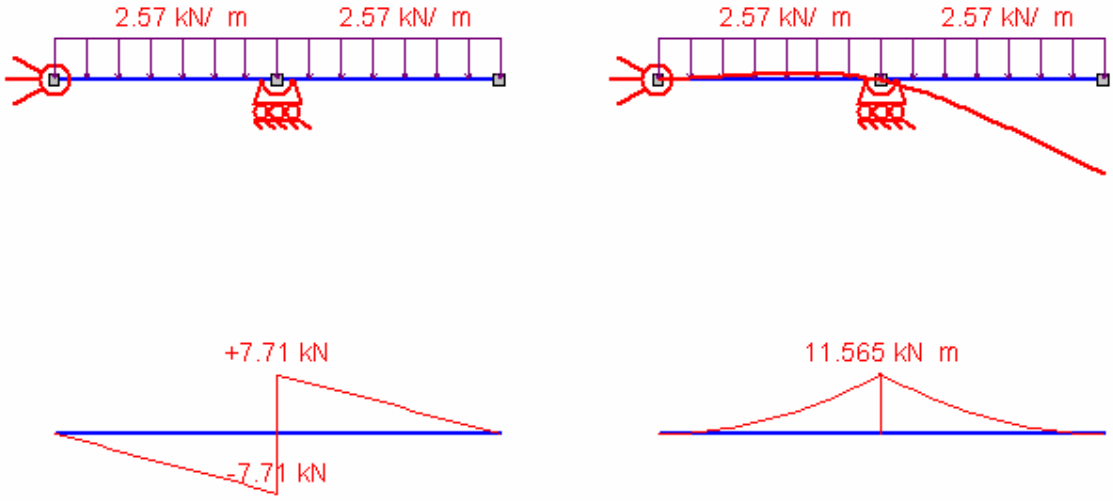
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT030		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT030**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Intermediate support beam with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT030		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT030**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
6000=3000+3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-1.3642e-012	**-1.3642e-012**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	7.7100e+003	Th	7.7100e+003	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	1.1565e+007	Th	1.1565e+007	**3.7253e-009**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**

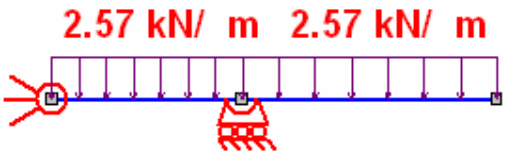
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

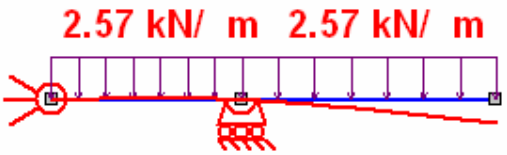
100(Tv – Cv) / Cv relative error percentage

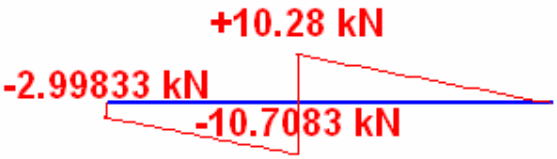
Computational notes:

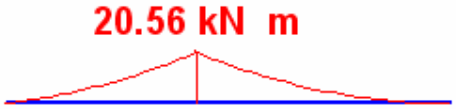
Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT031		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT031**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**









Problem description:

Intermediate support beam with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT031		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT031**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
7000=3000+4000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-2.9983e+003	Th	-2.9983e+003	**-3.3334e-007**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	1.0708e+004	Th	1.0708e+004	**3.3333e-006**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	2.0560e+007	Th	2.0560e+007	**7.4506e-009**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	9.3132e-009	**9.3132e-009**	**0.0000**

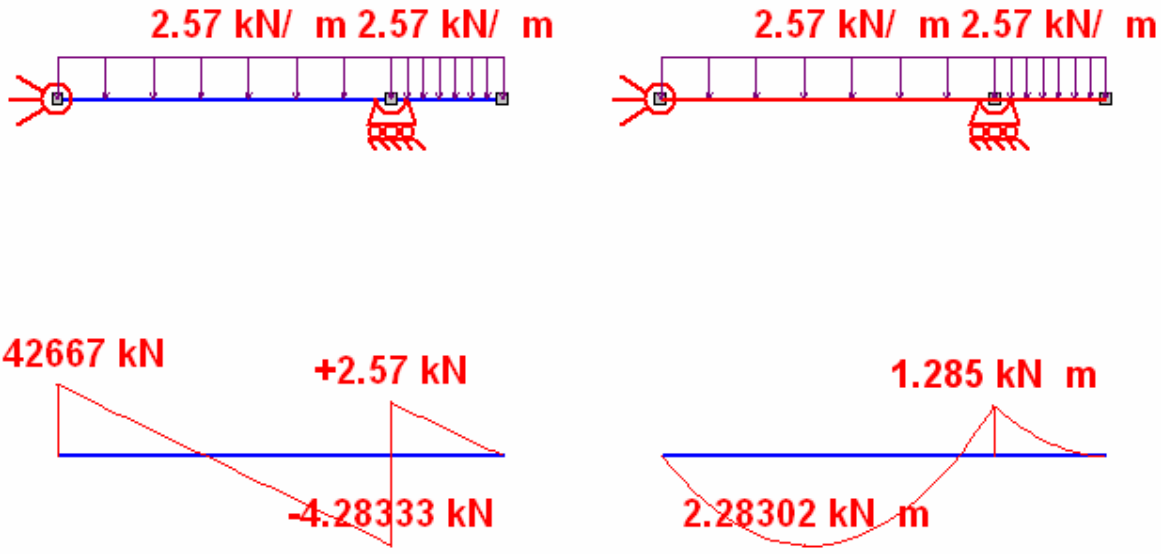
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT032		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT032**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Intermediate support beam with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT032		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT032**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
4000=3000+1000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
force distributed	2.570e+000	-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.4267e+003	Th	3.4267e+003	**-3.3333e-007**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	4.2833e+003	Th	4.2833e+003	**3.3333e-007**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	1.2850e+006	Th	1.2850e+006	**-2.3283e-010**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-3.4925e-010	**-3.4925e-010**	**-0.0000**

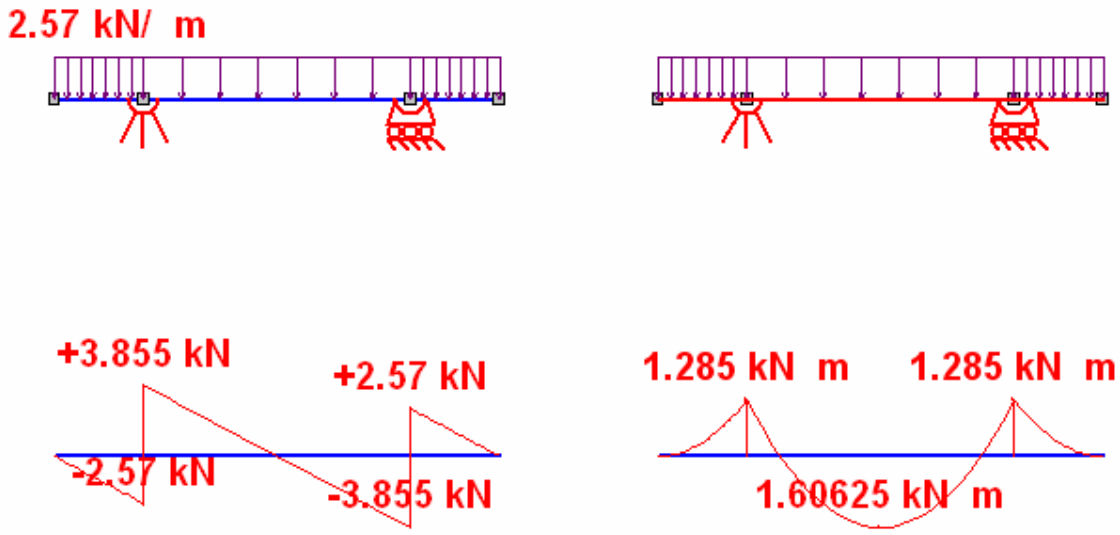
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT033		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT033**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Intermediate support beam with two distributed constant loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT033		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT033**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
5000=1000+3000+1000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, J extreme. Beam # 1. Load case # 1	2.5700e+003	Th	2.5700e+003	**-9.0949e-013**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	3.8550e+003	Th	3.8550e+003	**-4.5475e-013**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	1.2850e+006	Th	1.2850e+006	**2.3283e-010**	**0.0000**
Bending M2, J extreme. Beam # 3. Load case # 1	0.0000e+000	Th	-1.2806e-009	**-1.2806e-009**	**-0.0000**

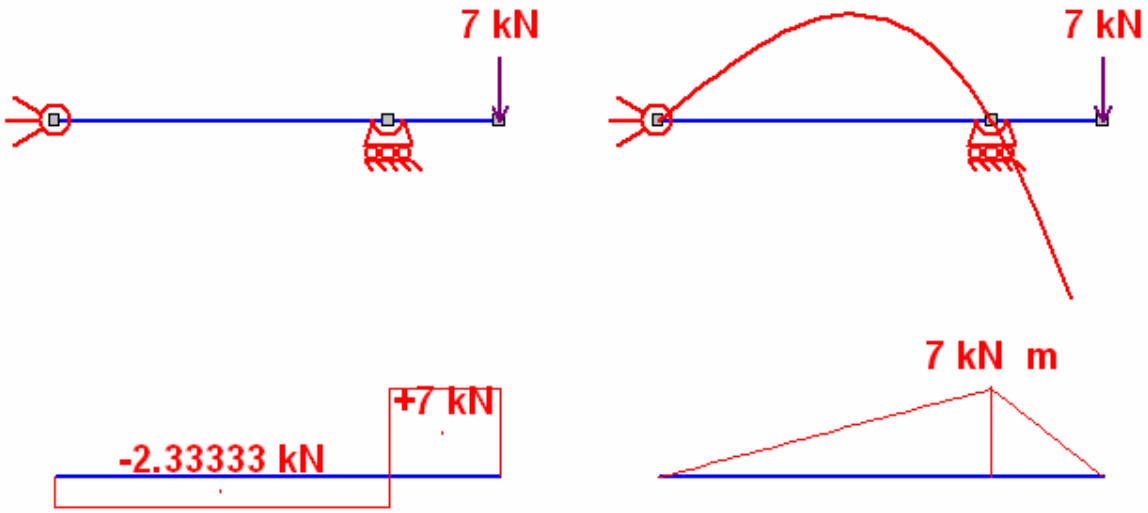
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT034		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT034**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Intermediate support beam with end shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT034		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT034**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
4000=3000+1000	-	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Free tip
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, J extreme. Beam # 1. Load case # 1	2.3333e+003	Th	2.3333e+003	**3.3333e-007**	**0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	7.0000e+003	Th	7.0000e+003	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	7.0000e+006	Th	7.0000e+006	**2.7940e-009**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**

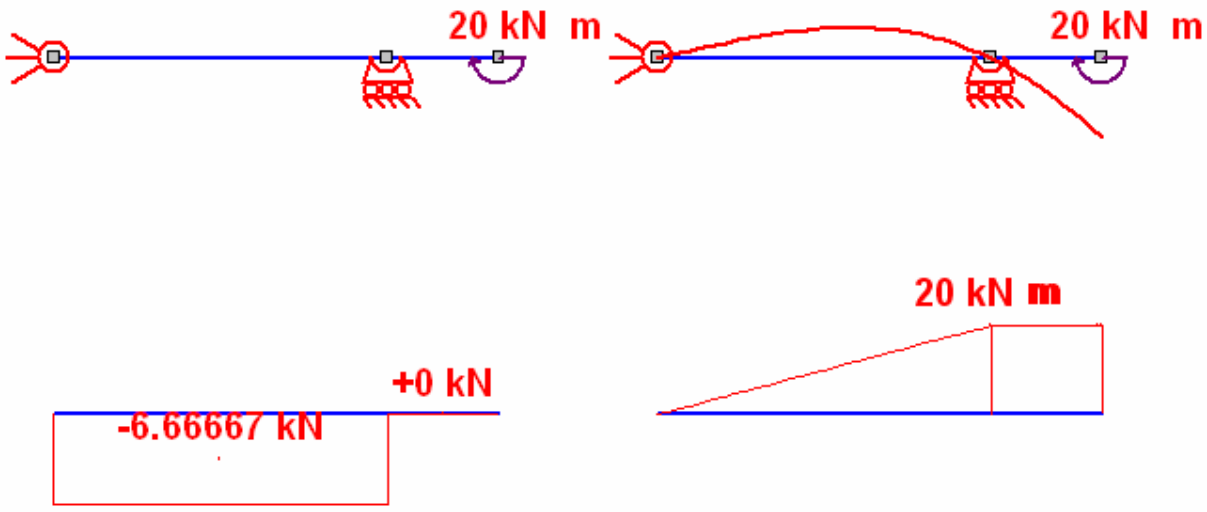
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT035		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT035**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Intermediate support beam with end bending moment

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT035		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT035**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
4000=3000+1000	-	-	-	As shown

LOAD

Type	Value	Point of application
NODAL MOMENT	2.000e+007	Free tip
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, J extreme. Beam # 1. Load case # 1	6.6667e+003	Th	6.6667e+003	**-3.3333e-007**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	0.0000e+000	Th	2.9104e-011	**2.9104e-011**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-1.8626e-009	**-1.8626e-009**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	2.0000e+007	Th	2.0000e+007	**2.9802e-008**	**0.0000**

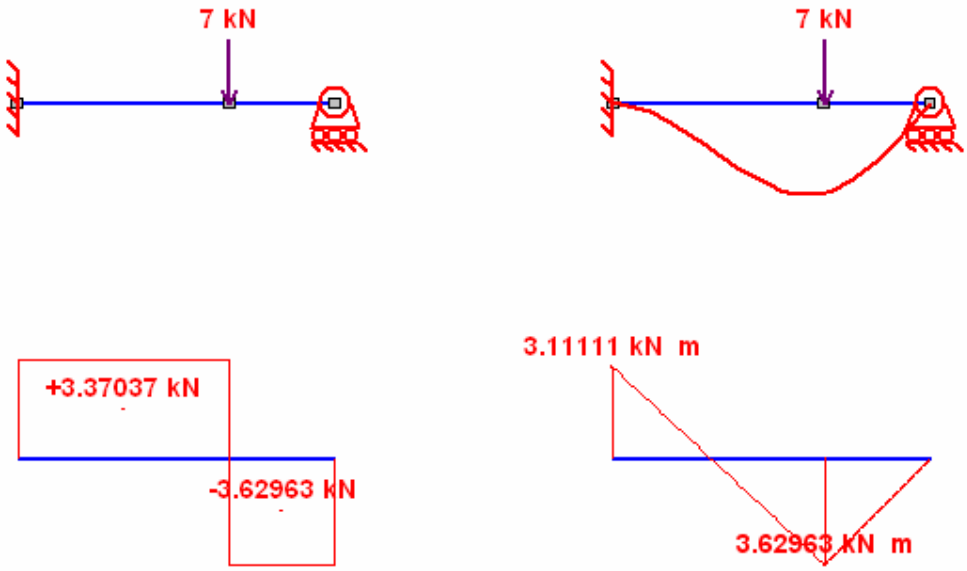
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT036		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT036**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (end 1 fixed - end 2 simply supported) with internal shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT036		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT036**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	2000	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.3704e+003	Th	3.3704e+003	**3.7037e-007**	**0.0000**
Shear T3, J extreme. Beam # 2. Load case # 1	3.6296e+003	Th	3.6296e+003	**-3.7037e-007**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-3.6296e+006	Th	-3.6296e+006	**3.7037e-004**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-1.8626e-009	**-1.8626e-009**	**-0.0000**

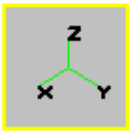
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

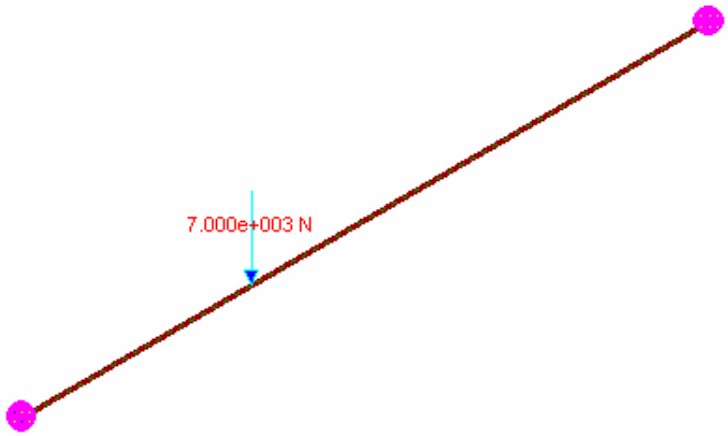
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT036BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT036BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Beam (end 1 fixed - end 2 simply supported) with internal shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT036BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT036BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	2000	-	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.3704e+003	Th	3.3704e+003	**-3.1074e-004**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	3.6296e+003	Th	3.6296e+003	**3.1074e-004**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-3.1111e+006	Th	-3.1111e+006	**2.3322e-001**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**

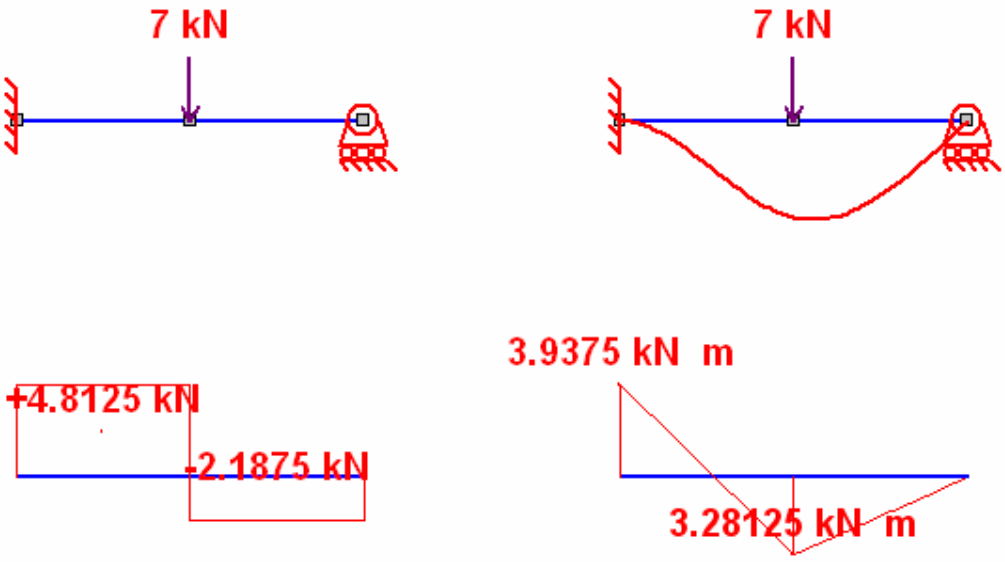
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT037		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT037**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (end 1 fixed - end 2 simply supported) with internal shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT037		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT037**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1500	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	4.8125e+003	Th	4.8125e+003	**9.0949e-013**	**0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	-2.1875e+003	Th	-2.1875e+003	**0.0000e+000**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-3.9375e+006	Th	-3.9375e+006	**-9.3132e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-3.2813e+006	Th	-3.2813e+006	**-9.3132e-010**	**0.0000**

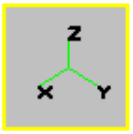
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

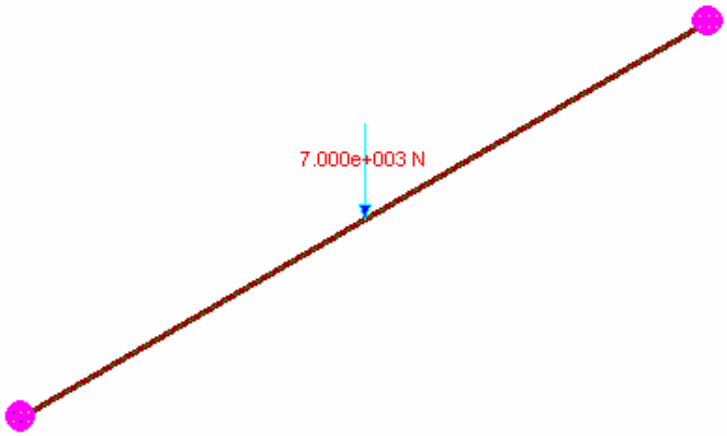
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT037BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT037BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Beam (end 1 fixed - end 2 simply supported) with internal shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT037BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT037BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1500	-	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
		-
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**Sezione1**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	4.8125e+003	Th	4.8125e+003	**0.0000e+000**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	2.1875e+003	Th	2.1875e+003	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-3.9375e+006	Th	-3.9375e+006	**0.0000e+000**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**

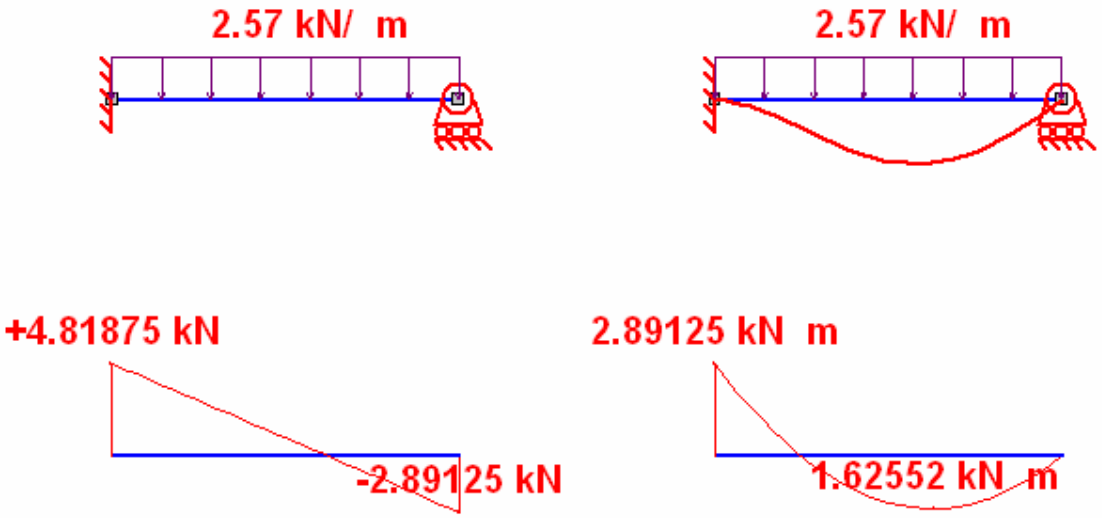
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT038		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT038**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (end 1 fixed - end 2 simply supported) with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT038		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT038**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	4.8188e+003	Th	4.8187e+003	**-9.0949e-013**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	2.8913e+003	Th	2.8912e+003	**-4.5475e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-2.8913e+006	Th	-2.8913e+006	**-9.3132e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**

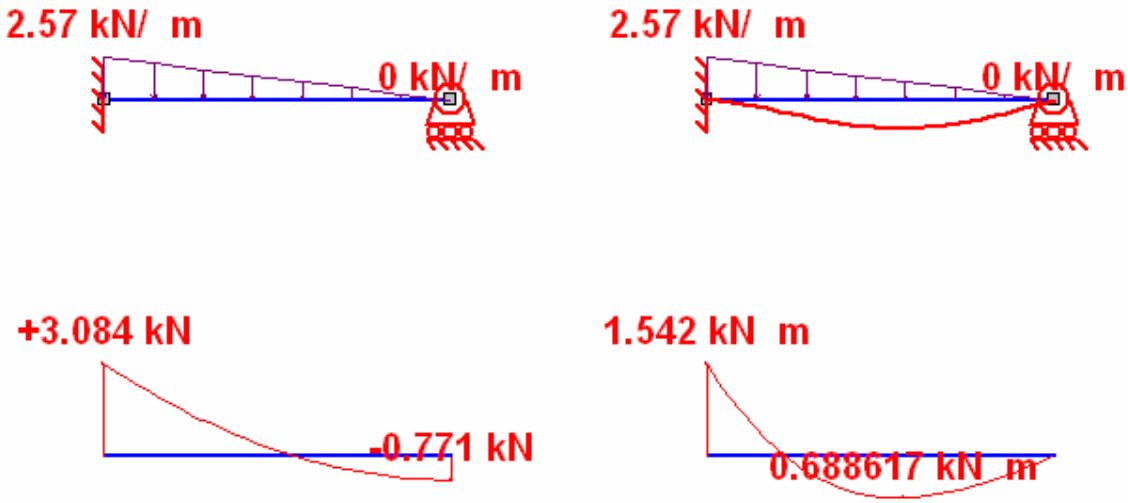
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT039		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT039**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (end 1 fixed - end 2 simply supported) with distributed linear load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT039		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT039**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	2.570e+000- 0.000e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.0840e+003	Th	3.0840e+003	**-4.5475e-013**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	7.7100e+002	Th	7.7100e+002	**1.2506e-012**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.5420e+006	Th	-1.5420e+006	**-9.3132e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-1.1642e-010	**-1.1642e-010**	**-0.0000**

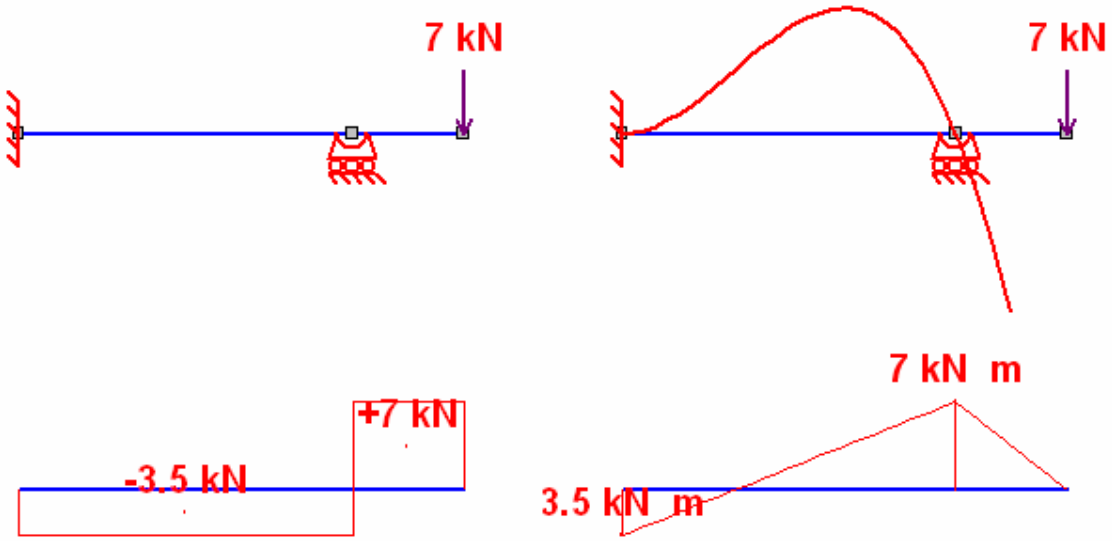
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT040		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT040**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Cantilever, intermediate support, with end shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT040		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT040**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
4000=3000+1000	-	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Free tip
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-3.5000e+003	Th	-3.5000e+003	**-7.2760e-012**	**0.0000**
Shear T3, J extreme. Beam # 2. Load case # 1	-7.0000e+003	Th	-7.0000e+003	**-1.4552e-011**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	3.5000e+006	Th	3.5000e+006	**7.4506e-009**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	7.0000e+006	Th	7.0000e+006	**1.4901e-008**	**0.0000**

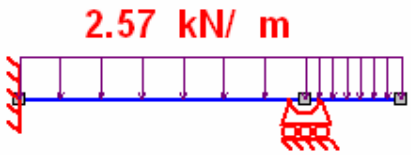
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

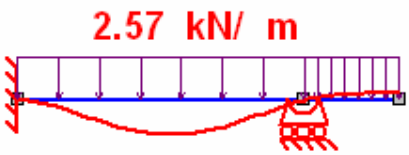
100(Tv – Cv) / Cv relative error percentage

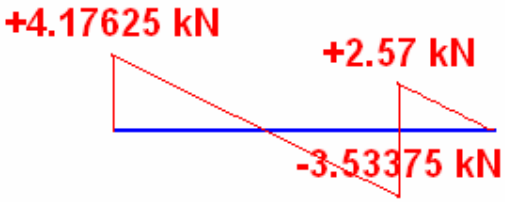
Computational notes:

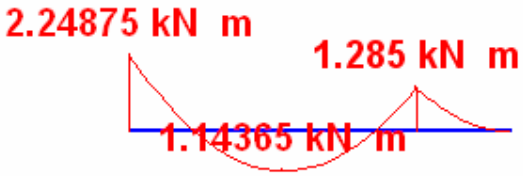
Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT041		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT041**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**









Problem description:

Cantilever, intermediate support, with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT041		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT041**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
4000=3000+1000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	4.1763e+003	Th	4.1762e+003	**-9.0949e-013**	**-0.0000**
Shear T3, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	4.5475e-013	**4.5475e-013**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	1.2850e+006	Th	1.2850e+006	**-2.3283e-010**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	5.8208e-011	**5.8208e-011**	**0.0000**

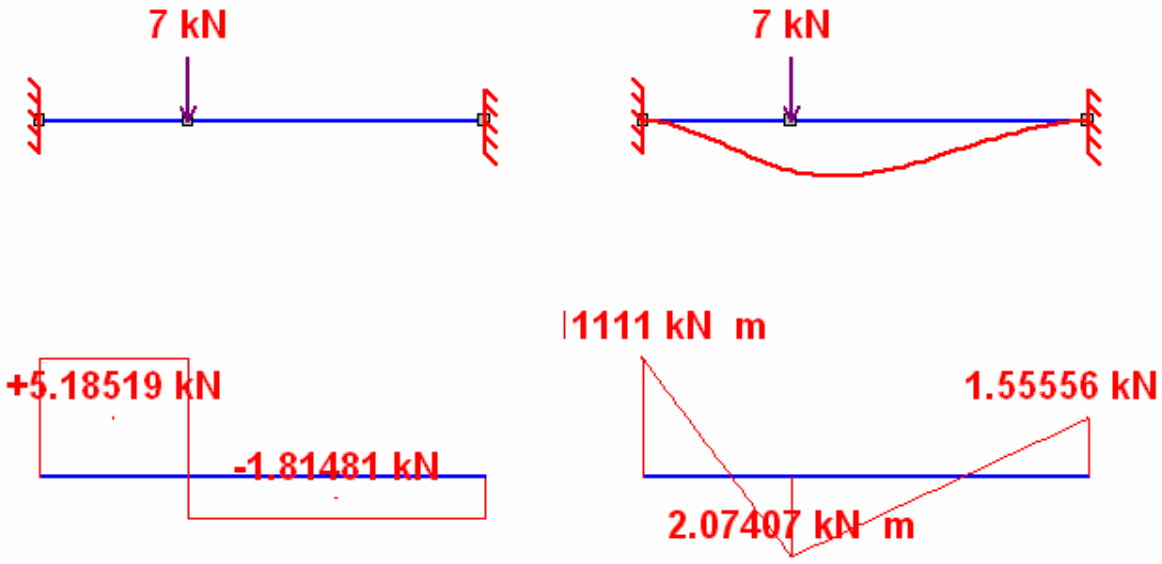
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT042		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT042**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (both ends fixed) with internal shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT042		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT042**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1000	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	5.1852e+003	Th	5.1852e+003	**1.8518e-007**	**0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	-1.8148e+003	Th	-1.8148e+003	**1.8519e-007**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-3.1111e+006	Th	-3.1111e+006	**-1.1111e-004**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-2.0741e+006	Th	-2.0741e+006	**-7.4074e-005**	**0.0000**

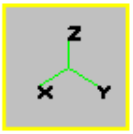
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

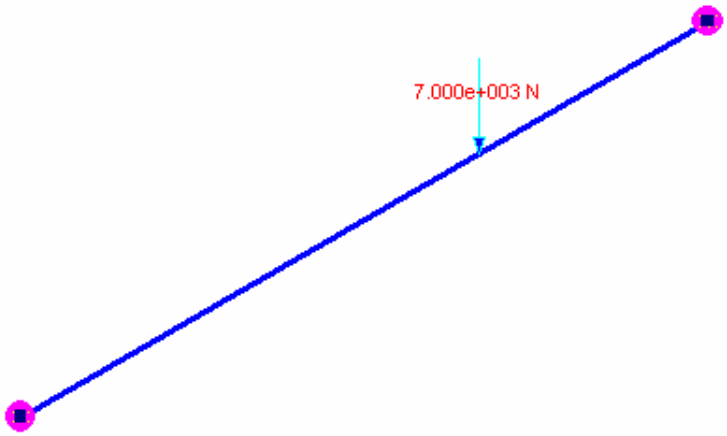
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT042BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT042BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Beam (both ends fixed) with internal shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT042BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT042BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1000	-	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	5.1852e+003	Th	5.1852e+003	**3.1130e-004**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	1.8148e+003	Th	1.8148e+003	**-3.1130e-004**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-3.1111e+006	Th	-3.1111e+006	**-1.1109e-004**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	1.5556e+006	Th	1.5556e+006	**-2.3378e-001**	**-0.0000**

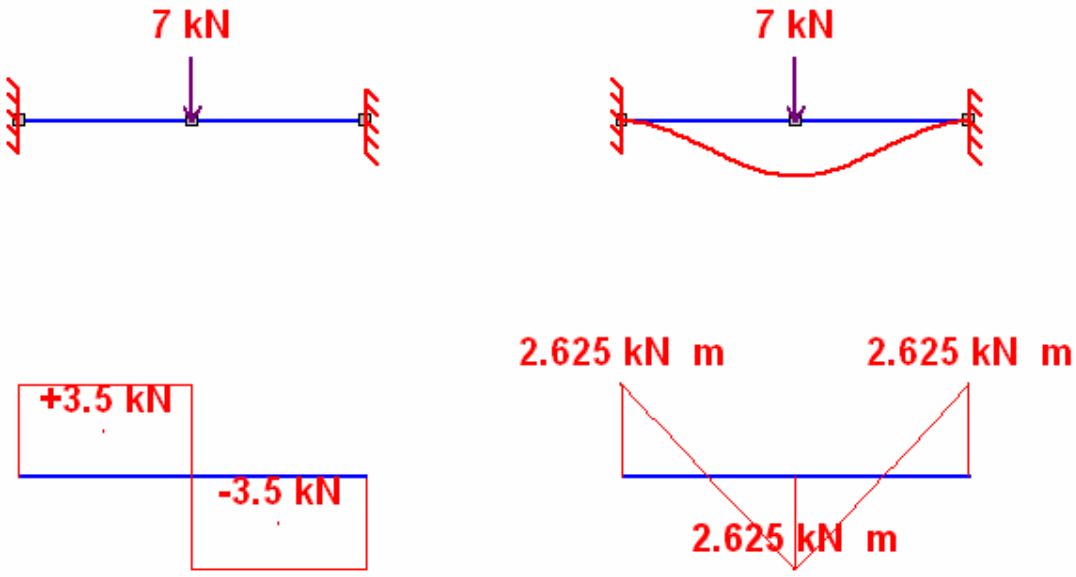
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT043		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT043**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (both ends fixed) with internal shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT043		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT043**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1500	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.5000e+003	Th	3.5000e+003	**-9.0949e-013**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	-3.5000e+003	Th	-3.5000e+003	**9.0949e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-2.6250e+006	Th	-2.6250e+006	**4.6566e-010**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-2.6250e+006	Th	-2.6250e+006	**4.6566e-010**	**-0.0000**

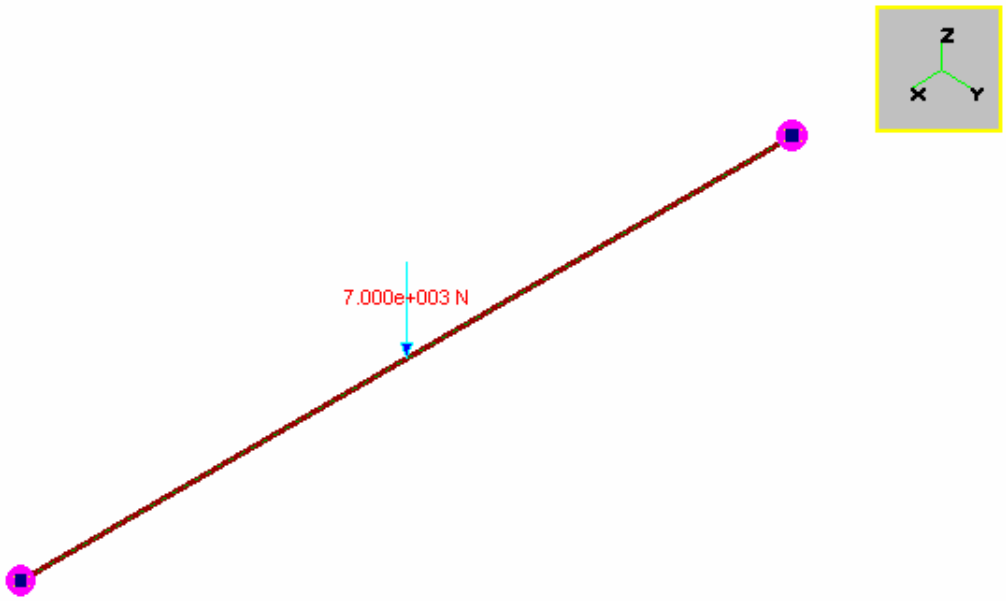
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT043BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT043BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (both ends fixed) with internal shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT043BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT043BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1500	-	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.5000e+003	Th	3.5000e+003	**0.0000e+000**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	3.5000e+003	Th	3.5000e+003	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-2.6250e+006	Th	-2.6250e+006	**0.0000e+000**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	2.6250e+006	Th	2.6250e+006	**0.0000e+000**	**0.0000**

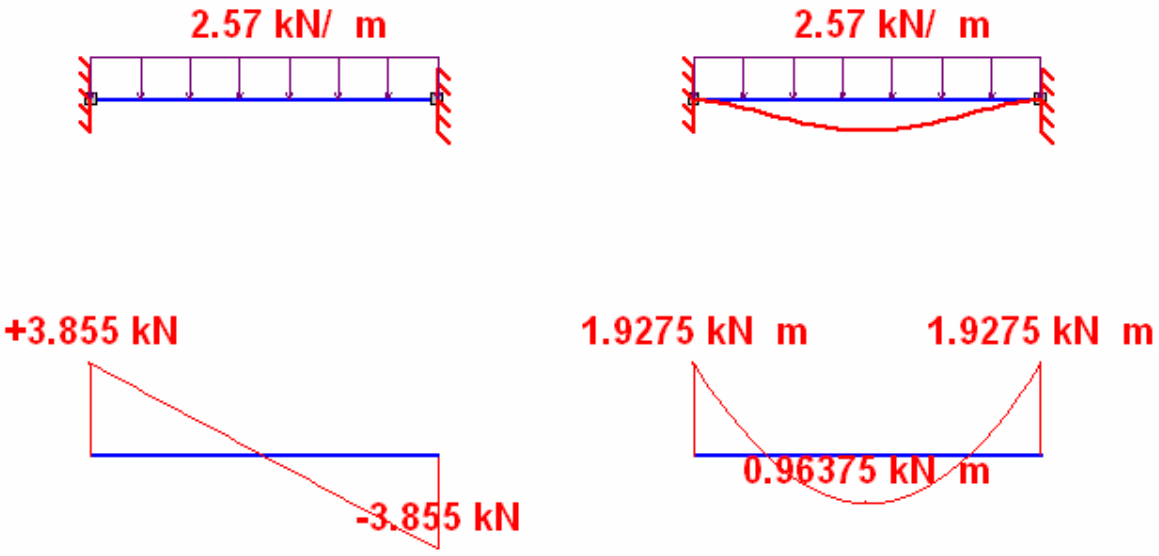
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT044		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT044**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (both ends fixed) with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that’s why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT044		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT044**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.8550e+003	Th	3.8550e+003	**-4.5475e-013**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	3.8550e+003	Th	3.8550e+003	**-4.5475e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.9275e+006	Th	-1.9275e+006	**-6.9849e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	1.9275e+006	Th	1.9275e+006	**-4.6566e-010**	**-0.0000**

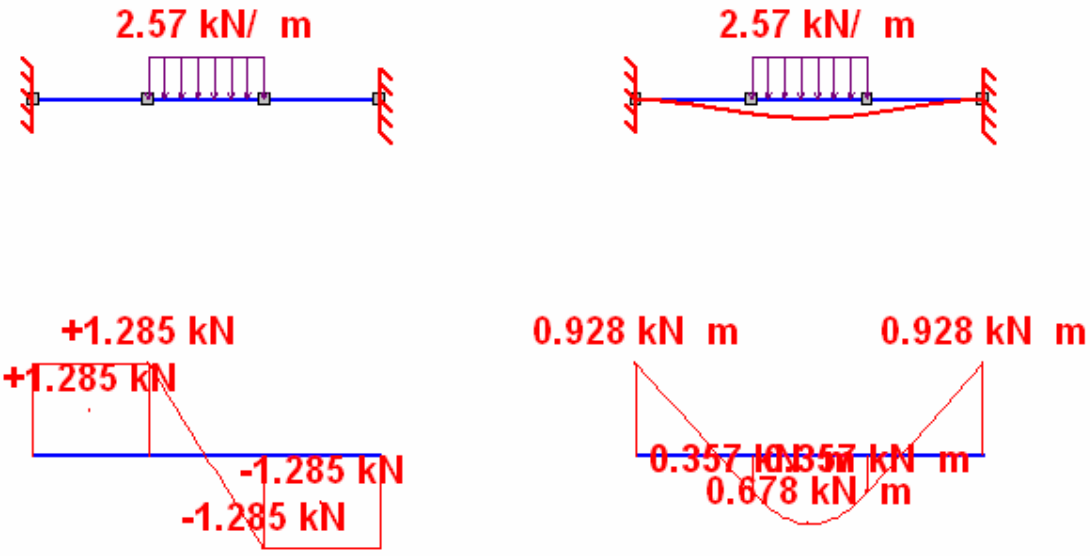
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT045		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT045**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (both ends fixed) with internal distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT045		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT045**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Dx1-Dx2
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.2850e+003	Th	1.2850e+003	**-2.2737e-013**	**-0.0000**
Shear T3, J extreme. Beam # 2. Load case # 1	1.2850e+003	Th	1.2850e+003	**-2.2737e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-9.2806e+005	Th	-9.2806e+005	**4.4445e-005**	**-0.0000**
Bending M2, J extreme. Beam # 3. Load case # 1	9.2806e+005	Th	9.2806e+005	**-4.4445e-005**	**-0.0000**

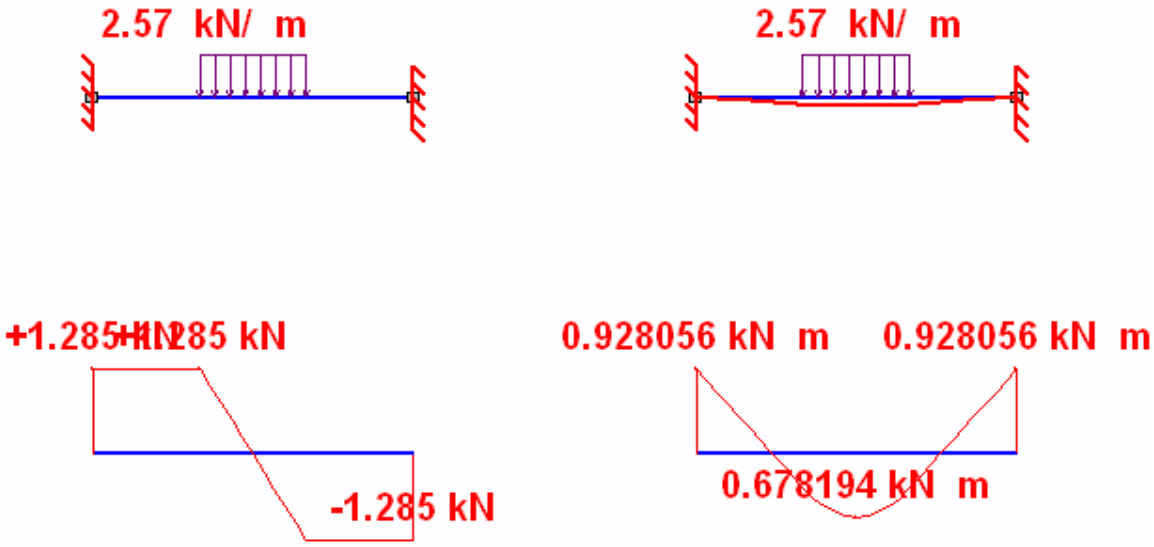
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT045BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT045BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (both ends fixed) with internal distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT045BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT045BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
3000	1000	2000	-	As shown

LOAD		
Type	Value	Point of application
force linearly distributed	2.570e+000- 2.570e+000	Dx1-Dx2
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA					

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.2850e+003	Th	1.2850e+003	**2.5700e-004**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	1.2850e+003	Th	1.2850e+003	**2.5700e-004**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-9.2806e+005	Th	-9.2806e+005	**-1.7129e-001**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	9.2806e+005	Th	9.2806e+005	**1.7129e-001**	**0.0000**

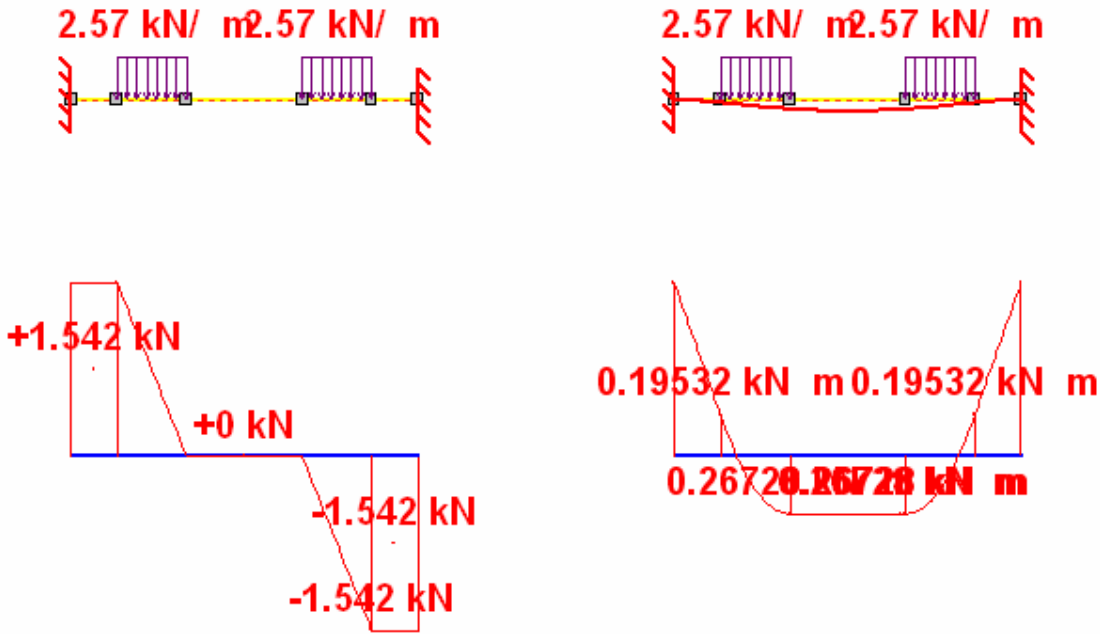
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT046		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT046**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (both ends fixed) with internal distributed constant loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT046		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT046**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]	Dx3 [mm]	Dx4 [mm]
3000	400	1000	2000	2600
Constraints				
As shown				

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Dx1-Dx2
force distributed	2.570e+000	Dx3-Dx4
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**Sezione1**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 4. Load case # 1	1.5420e+003	Th	1.5420e+003	**-4.5475e-013**	**-0.0000**
Shear T3, I extreme. Beam # 3. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-8.1212e+005	Th	-8.1212e+005	**-9.3132e-010**	**0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	2.6728e+005	Th	2.6728e+005	**6.4028e-010**	**0.0000**

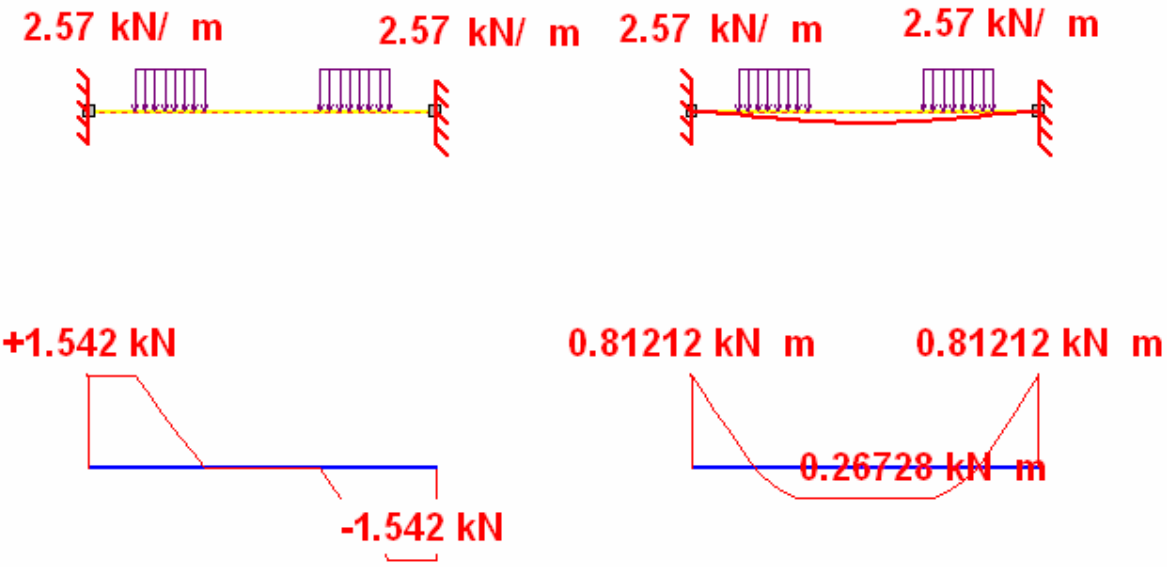
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT046BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT046BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (both ends fixed) with two internal distributed constant loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT046BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT046BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]	Dx3 [mm]	Dx4 [mm]
3000	400	1000	2000	2600
Constraints				
As shown				

LOAD

Type	Value	Point of application
force linearly distributed	2.570e+000- 2.570e+000	Dx1-Dx2
force linearly distributed	2.570e+000- 2.570e+000	Dx3-Dx4
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.5420e+003	Th	1.5420e+003	**-2.2737e-013**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	1.5420e+003	Th	1.5420e+003	**6.8212e-013**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-8.1212e+005	Th	-8.1212e+005	**8.2240e-002**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	8.1212e+005	Th	8.1212e+005	**-8.2240e-002**	**-0.0000**

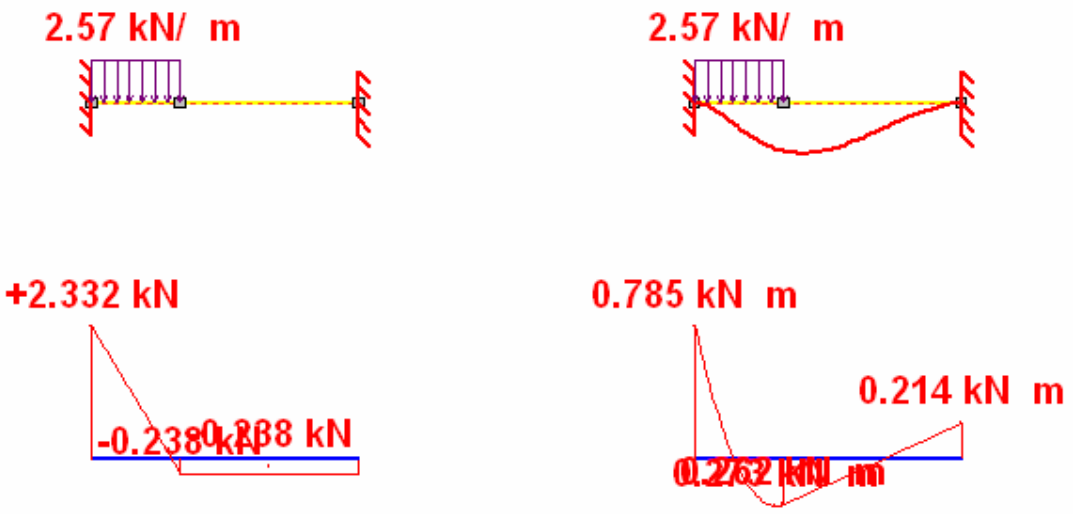
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT047		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT047**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (both ends fixed) with internal distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT047		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT047**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Left end-Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.3320e+003	Th	2.3320e+003	**3.7037e-008**	**0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	-2.3796e+002	Th	-2.3796e+002	**3.7037e-008**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-7.8528e+005	Th	-7.8528e+005	**2.2222e-005**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	2.1417e+005	Th	2.1417e+005	**-3.3333e-005**	**-0.0000**

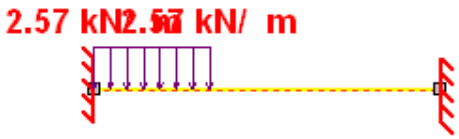
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

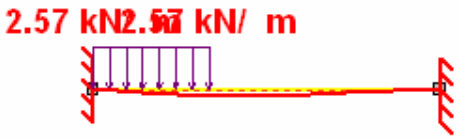
100(Tv – Cv) / Cv relative error percentage

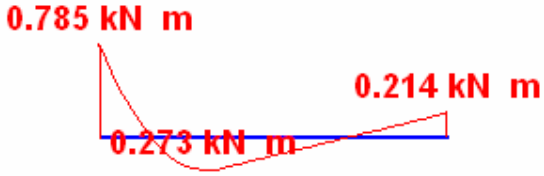
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT047BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT047BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Beam (both ends fixed) with internal distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT047BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT047BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1000	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	2.570e+000- 2.570e+000	Left end-Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.3320e+003	Th	2.3320e+003	**-1.9033e-004**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	2.3796e+002	Th	2.3796e+002	**-6.6667e-005**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-7.8528e+005	Th	-7.8528e+005	**1.1424e-001**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	2.1417e+005	Th	2.1417e+005	**-5.7144e-002**	**-0.0000**

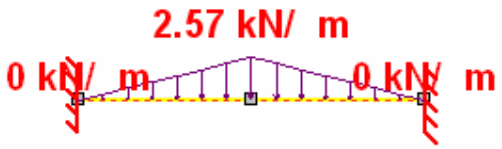
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

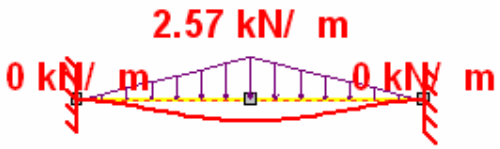
100(Tv – Cv) / Cv relative error percentage

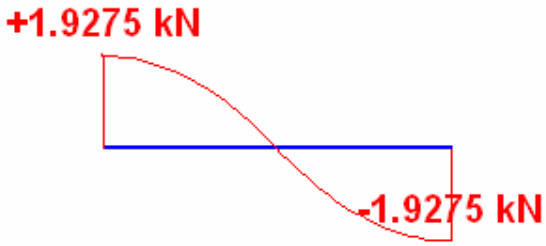
Computational notes:

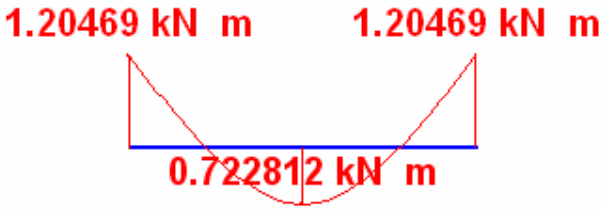
Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT048		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT048**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**









Problem description:

Beam (both ends fixed) with two distributed linear loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT048		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT048**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1500	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	0.000e+000- 2.570e+000	Left end-Dx1
force linearly distributed	2.570e+000- 0.000e+000	Dx1-Right end
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.9275e+003	Th	1.9275e+003	**-9.0949e-013**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	0.0000e+000	Th	2.2737e-013	**2.2737e-013**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.2047e+006	Th	-1.2047e+006	**6.9849e-010**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-7.2281e+005	Th	-7.2281e+005	**4.6566e-010**	**-0.0000**

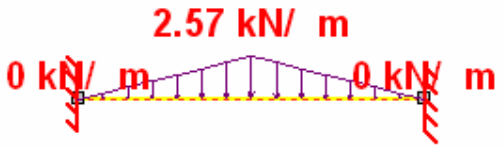
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

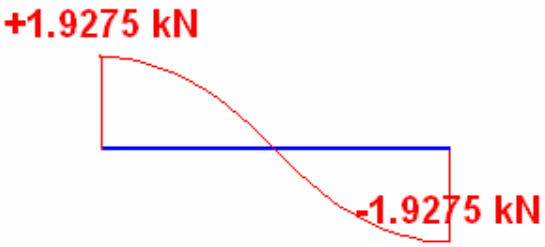
100(Tv – Cv) / Cv relative error percentage

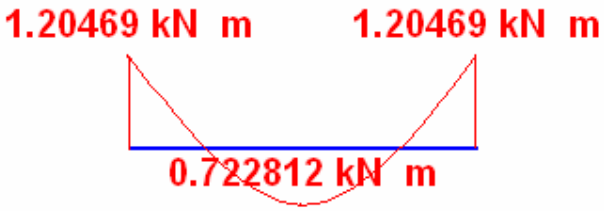
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT048BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT048BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Beam (both ends fixed) with two distributed linear loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT048BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT048BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	1500	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	0.000e+000- 2.570e+000	Left end-Dx1
force linearly distributed	2.570e+000- 0.000e+000	Dx1-Right end
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.9275e+003	Th	1.9275e+003	**-4.5475e-013**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	1.9275e+003	Th	1.9275e+003	**3.1832e-012**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.2047e+006	Th	-1.2047e+006	**-3.4925e-009**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	1.2047e+006	Th	1.2047e+006	**1.1642e-009**	**0.0000**

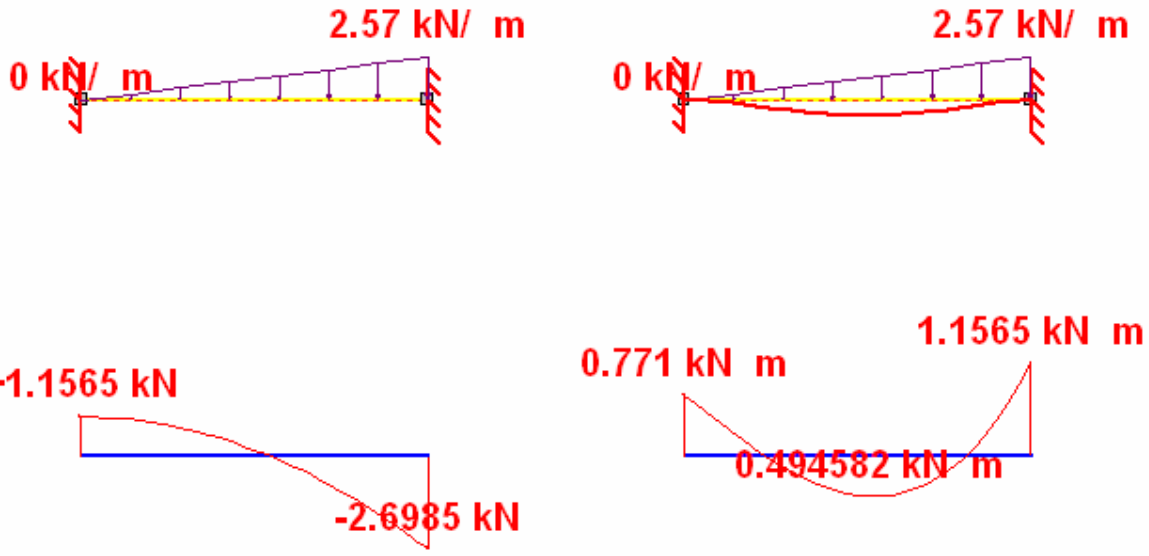
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT049		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT049**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (both ends fixed) with distributed linear load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT049		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT049**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	0.000e+000- 2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.1565e+003	Th	1.1565e+003	**0.0000e+000**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	2.6985e+003	Th	2.6985e+003	**-9.0949e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-7.7100e+005	Th	-7.7100e+005	**2.3283e-010**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	1.1565e+006	Th	1.1565e+006	**-2.3283e-010**	**-0.0000**

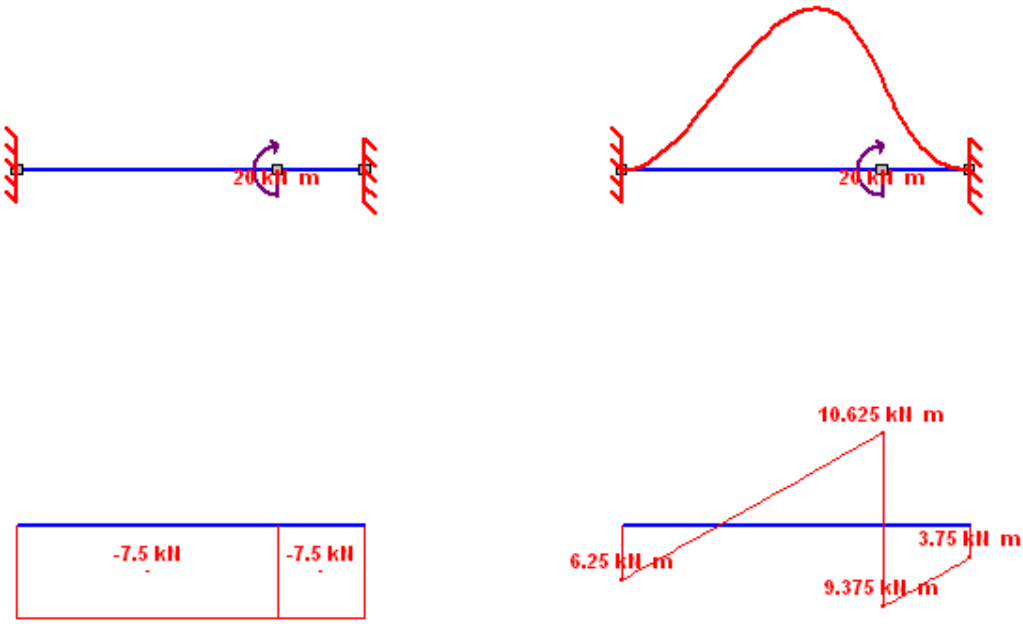
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT050		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT050**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (both ends fixed) with internal bending moment

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT050		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT050**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	2250	-	-	As shown

LOAD

Type	Value	Point of application
NODAL MOMENT	2.000e+007	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-7.5000e+003	Th	-7.5000e+003	**1.8190e-012**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	6.2500e+006	Th	6.2500e+006	**-1.8626e-009**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	1.0625e+007	Th	1.0625e+007	**-1.8626e-009**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	-3.7500e+006	Th	-3.7500e+006	**0.0000e+000**	**-0.0000**

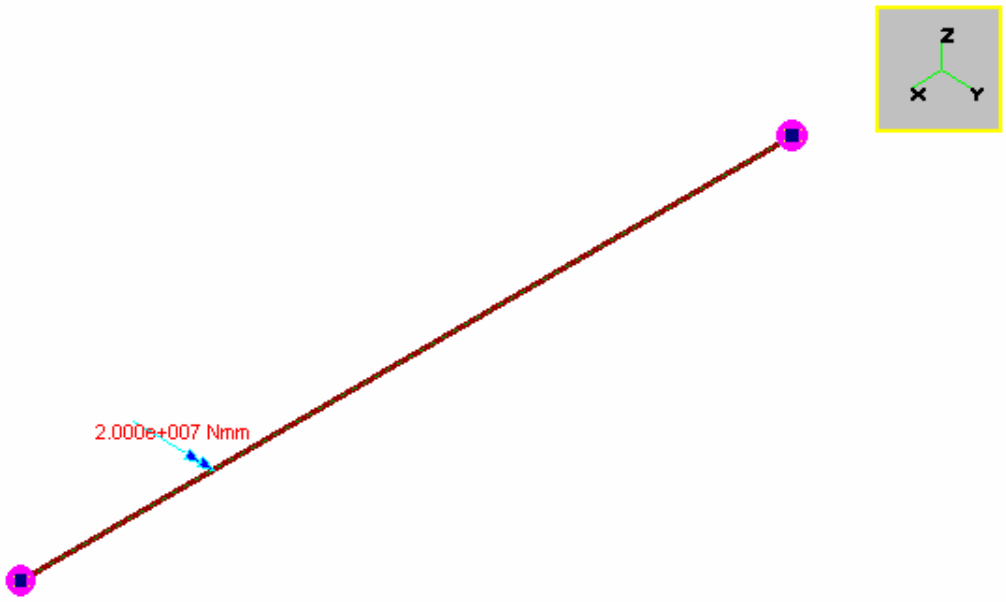
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT050BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT050BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Beam (both ends fixed) with internal bending moment

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT050BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT050BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
3000	2250	-	-	As shown

LOAD

Type	Value	Point of application
moment concentrated	2.000e+007	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-7.5000e+003	Th	-7.5000e+003	**0.0000e+000**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	7.5000e+003	Th	7.5000e+003	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	6.2500e+006	Th	6.2500e+006	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-3.7500e+006	Th	-3.7500e+006	**0.0000e+000**	**-0.0000**

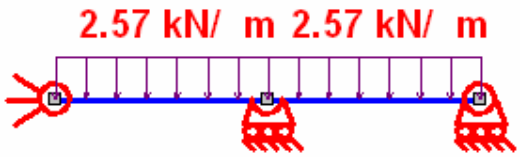
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

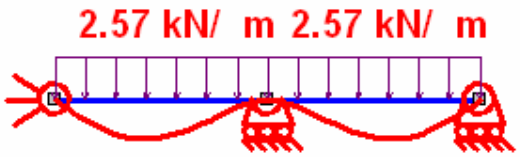
100(Tv – Cv) / Cv relative error percentage

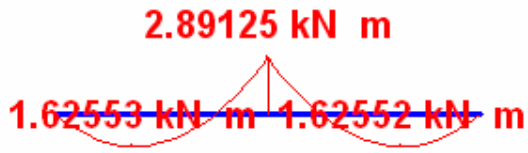
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT051		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT051**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Continuous beam (2 spans) with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT051		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT051**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
6000=3000+3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione 1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.8913e+003	Th	2.8912e+003	**-9.0949e-013**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	4.8188e+003	Th	4.8187e+003	**-9.0949e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	-2.8913e+006	Th	-2.8913e+006	**0.0000e+000**	**-0.0000**

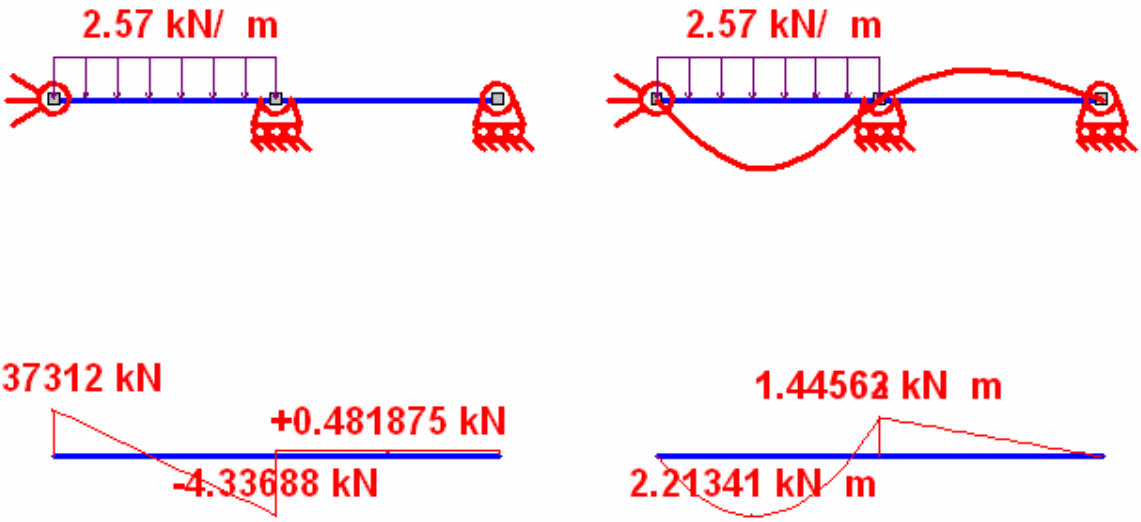
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT052		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT052**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Continuous beam (2 spans) with internal distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT052		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT052**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
6000=3000+3000	3000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Left end-Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione 1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.3731e+003	Th	3.3731e+003	**-9.0949e-013**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	4.8188e+002	Th	4.8187e+002	**-1.7053e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-2.3283e-010	**-2.3283e-010**	**-0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	-1.4456e+006	Th	-1.4456e+006	**2.3283e-010**	**-0.0000**

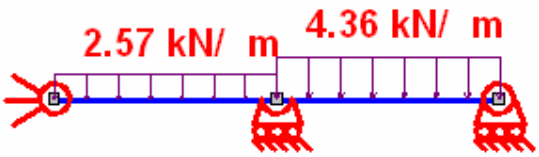
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

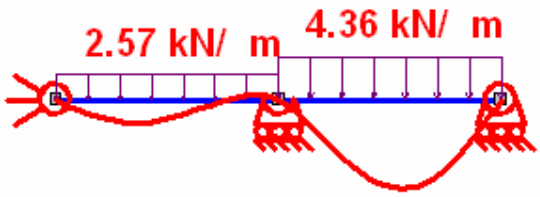
100(Tv – Cv) / Cv relative error percentage

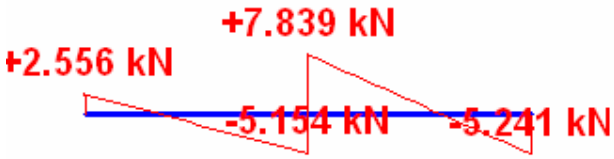
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT053		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT053**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Continuous beam (2 spans) with distributed variable load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that’s why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT053		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT053**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
6000=3000+3000	3000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Left end-Dx1
force distributed	4.360e+000	Dx1-Right end
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**Sezione 1**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.5556e+003	Th	2.5556e+003	**-9.0949e-013**	**-0.0000**
Shear T3, J extreme. Beam # 2. Load case # 1	5.2406e+003	Th	5.2406e+003	**1.8190e-012**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	2.3283e-010	**2.3283e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	3.8981e+006	Th	3.8981e+006	**9.3132e-010**	**0.0000**

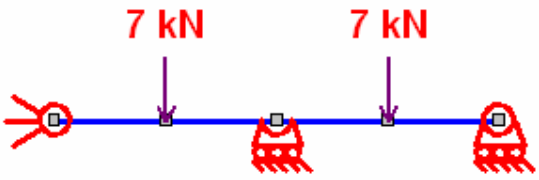
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

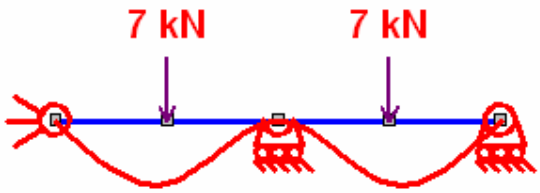
100(Tv – Cv) / Cv relative error percentage

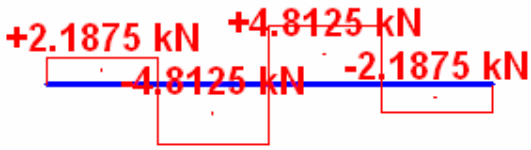
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT054		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT054**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Continuous beam (2 spans) with two shear forces

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT054		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT054**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
6000=3000+3000	1500	4500	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
NODAL FORCE	7.000e+003	Dx2
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**Sezione 1**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 3. Load case # 1	-4.8125e+003	Th	-4.8125e+003	**-9.0949e-013**	**0.0000**
Shear T3, I extreme. Beam # 4. Load case # 1	-2.1875e+003	Th	-2.1875e+003	**0.0000e+000**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-1.7462e-009	**-1.7462e-009**	**-0.0000**
Bending M2, J extreme. Beam # 3. Load case # 1	3.9375e+006	Th	3.9375e+006	**9.3132e-010**	**0.0000**

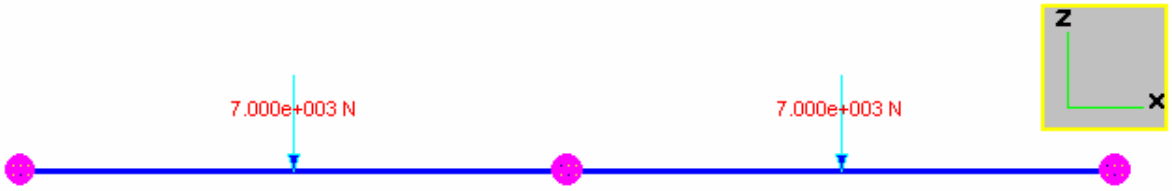
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT054BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT054BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Continuous beam (2 spans) with two shear forces

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT054BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT054BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]	Dx2 [mm]		Constraints
6000=3000+3000	1500	4500	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
force concentrated	7.000e+003	Dx2
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**Sezione 1**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, J extreme. Beam # 2. Load case # 1	2.1875e+003	Th	2.1875e+003	**0.0000e+000**	**0.0000**
Shear T3, I extreme. Beam # 1. Load case # 1	2.1875e+003	Th	2.1875e+003	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	3.9375e+006	Th	3.9375e+006	**0.0000e+000**	**0.0000**

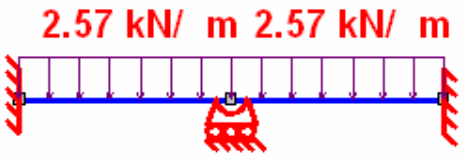
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

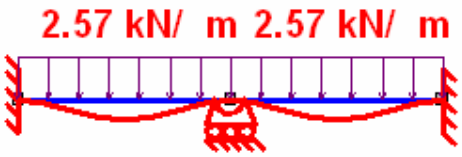
100(Tv – Cv) / Cv relative error percentage

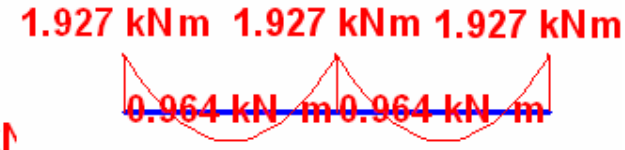
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT055		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT055**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Continuous beam (2 spans, ends fixed) with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that’s why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT055		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT055**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
6000=3000+3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione 1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.8550e+003	Th	3.8550e+003	**-9.0949e-013**	**-0.0000**
Shear T3, J extreme. Beam # 2. Load case # 1	3.8550e+003	Th	3.8550e+003	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.9275e+006	Th	-1.9275e+006	**-4.6566e-010**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	1.9275e+006	Th	1.9275e+006	**-2.3283e-010**	**-0.0000**

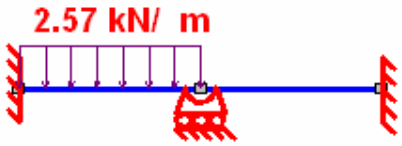
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

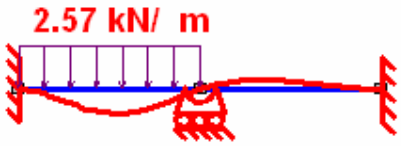
100(Tv – Cv) / Cv relative error percentage

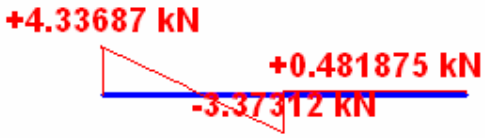
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT056		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT056**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Continuous beam (2 spans, ends fixed) with one internal distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT056		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT056**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Dx1 [mm]			Constraints
6000=3000+3000	3000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Left end-Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione 1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	4.3369e+003	Th	4.3369e+003	**-9.0949e-013**	**-0.0000**
Shear T3, J extreme. Beam # 2. Load case # 1	-4.8188e+002	Th	-4.8187e+002	**1.1369e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-2.4094e+006	Th	-2.4094e+006	**-4.6566e-010**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	-4.8188e+005	Th	-4.8187e+005	**5.8208e-011**	**-0.0000**

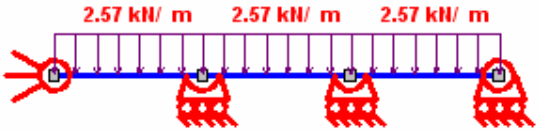
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

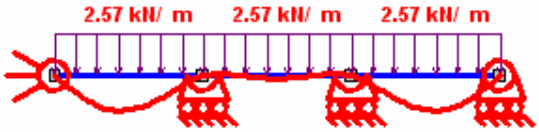
100(Tv – Cv) / Cv relative error percentage

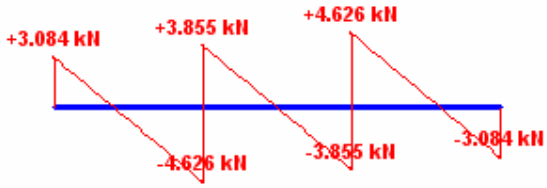
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT057		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT057**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Continuous beam (3 spans) with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT057		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT057**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
9000=3x3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione 1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.0840e+003	Th	3.0840e+003	**-9.0949e-013**	**-0.0000**
Shear T3, I extreme. Beam # 3. Load case # 1	4.6260e+003	Th	4.6260e+003	**-9.0949e-013**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	2.3130e+006	Th	2.3130e+006	**4.6566e-010**	**0.0000**
Bending M2, J extreme. Beam # 3. Load case # 1	0.0000e+000	Th	-2.3283e-010	**-2.3283e-010**	**-0.0000**

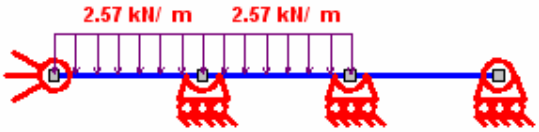
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

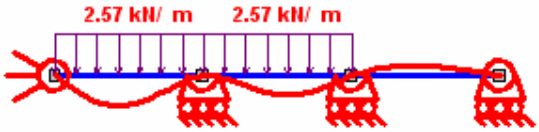
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT058		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT058**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Continuous beam (3 spans) with 2 internal distributed constant loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT058		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT058**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
9000=3x3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	First and second spans
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione 1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.9555e+003	Th	2.9555e+003	**-9.0949e-013**	**-0.0000**
Shear T3, I extreme. Beam # 3. Load case # 1	2.5700e+002	Th	2.5700e+002	**-1.1369e-013**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	7.7100e+005	Th	7.7100e+005	**-2.3283e-010**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	2.6985e+006	Th	2.6985e+006	**0.0000e+000**	**0.0000**

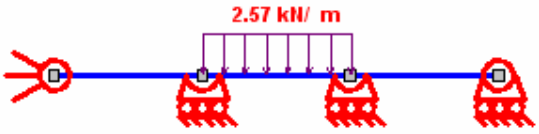
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

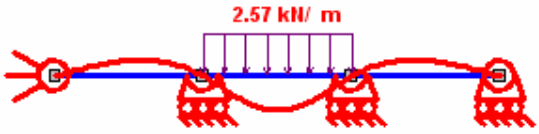
100(Tv – Cv) / Cv relative error percentage

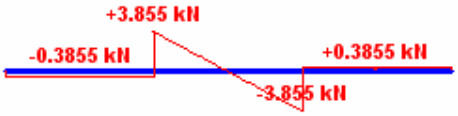
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT059		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT059**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Continuous beam (3 spans) with one internal distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT059		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT059**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
9000=3x3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Central span
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione 1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-3.8550e+002	Th	-3.8550e+002	**0.0000e+000**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	3.8550e+003	Th	3.8550e+003	**-4.5475e-013**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	1.1565e+006	Th	1.1565e+006	**-4.6566e-010**	**-0.0000**
Bending M2, J extreme. Beam # 3. Load case # 1	0.0000e+000	Th	1.1642e-010	**1.1642e-010**	**0.0000**

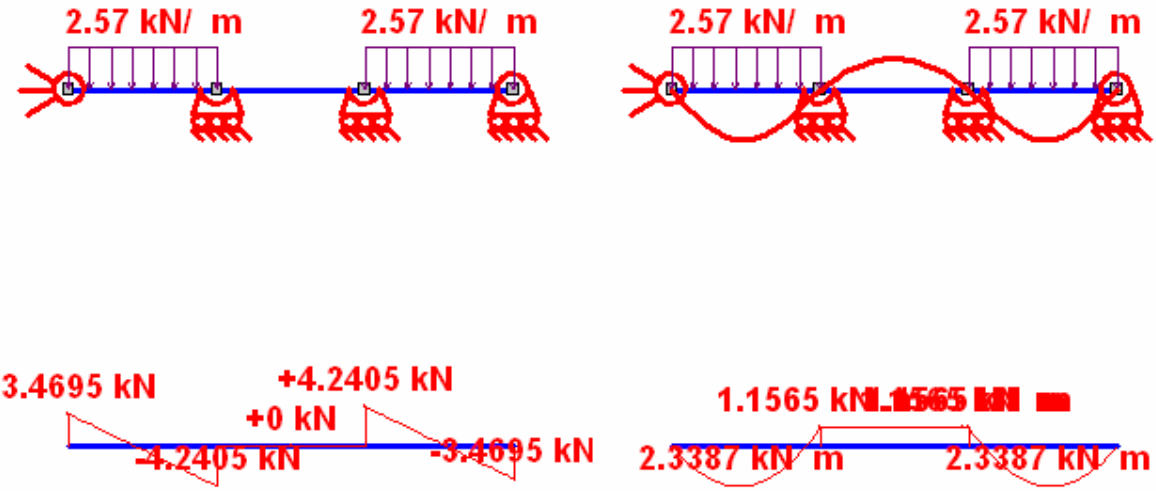
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT060		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT060**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Continuous beam (3 spans) with two internal distributed constant loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT060		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT060**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
9000=3x3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	First span
force distributed	2.570e+000	Third span
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione 1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.4695e+003	Th	3.4695e+003	**-9.0949e-013**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-4.5475e-013	**-4.5475e-013**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	1.1565e+006	Th	1.1565e+006	**2.3283e-010**	**0.0000**
Bending M2, J extreme. Beam # 3. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**

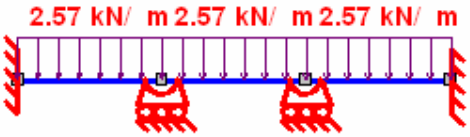
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

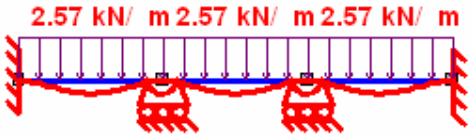
100(Tv – Cv) / Cv relative error percentage

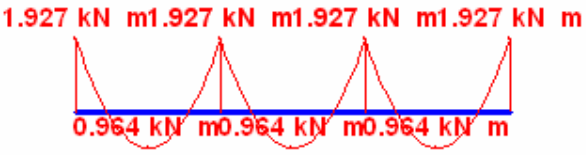
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT061		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT061**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Continuous beam (3 spans, ends fixed) with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT061		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT061**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
9000=3x3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione 1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.8550e+003	Th	3.8550e+003	**-9.0949e-013**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	3.8550e+003	Th	3.8550e+003	**-9.0949e-013**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	1.9275e+006	Th	1.9275e+006	**2.3283e-010**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.9275e+006	Th	-1.9275e+006	**-4.6566e-010**	**0.0000**

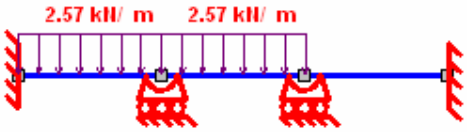
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

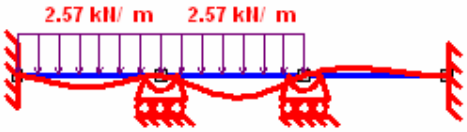
100(Tv – Cv) / Cv relative error percentage

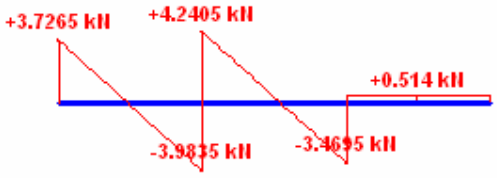
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT062		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT062**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Continuous beam (3 spans, ends fixed) with two internal distributed constant loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results, they have absolutely not been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that’s why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT062		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT062**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
9000=3x3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	First and second spans
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione 1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.7265e+003	Th	3.7265e+003	**-9.0949e-013**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	4.2405e+003	Th	4.2405e+003	**-9.0949e-013**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	1.0280e+006	Th	1.0280e+006	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.7990e+006	Th	-1.7990e+006	**-4.6566e-010**	**0.0000**

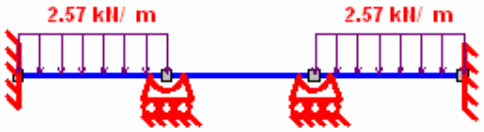
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

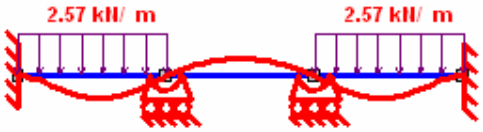
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT063		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT063**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Continuous beam (3 spans, ends fixed) with two internal distributed constant loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results, they have absolutely not been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that’s why CESCOPLUS pictures have been used to describe the problem**.**

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT063		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT063**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
9000=3x3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	First span
force distributed	2.570e+000	Third span
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione 1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	4.4975e+003	Th	4.4975e+003	**0.0000e+000**	**0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-1.1369e-013	**-1.1369e-013**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	6.4250e+005	Th	6.4250e+005	**3.4925e-010**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-2.5700e+006	Th	-2.5700e+006	**-9.3132e-010**	**0.0000**

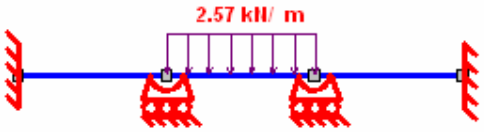
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

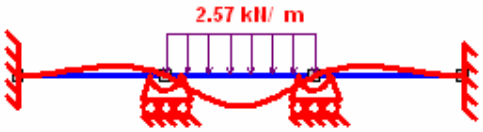
100(Tv – Cv) / Cv relative error percentage

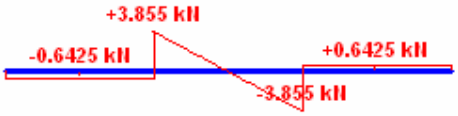
Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT064		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT064**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**







Problem description:

Continuous beam (3 spans, ends fixed) with one internal distributed constant loads

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT064		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT064**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
9000=3x3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Central span
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione 1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-6.4250e+002	Th	-6.4250e+002	**-2.2737e-013**	**0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	3.8550e+003	Th	3.8550e+003	**-9.0949e-013**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	1.2850e+006	Th	1.2850e+006	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	6.4250e+005	Th	6.4250e+005	**3.4925e-010**	**0.0000**

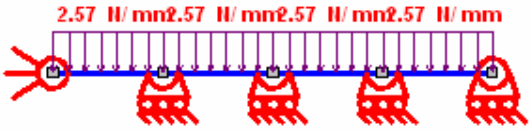
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

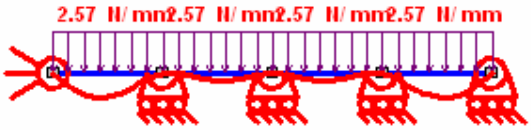
100(Tv – Cv) / Cv relative error percentage

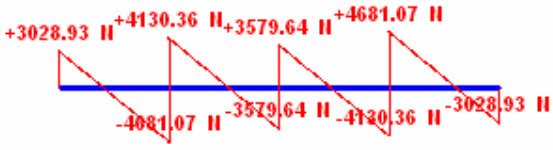
Computational notes:

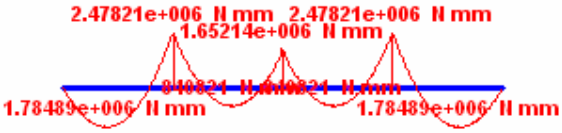
Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT065		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT065**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**









Problem description:

Continuous beam (4 spans) with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT065		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT065**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
12000=4x3000	-	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione 1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	0.000e+000	0.000e+000	1.000e+000	0.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	0.000e+000	1.000e+000	0.000e+000	0.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.0289e+003	Th	3.0289e+003	**-4.2857e-004**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	4.1304e+003	Th	4.1304e+003	**1.4286e-004**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	1.6521e+006	Th	1.6521e+006	**-1.4286e-001**	**-0.0000**
Bending M2, I extreme. Beam # 4. Load case # 1	-2.4782e+006	Th	-2.4782e+006	**-2.8571e-001**	**0.0000**

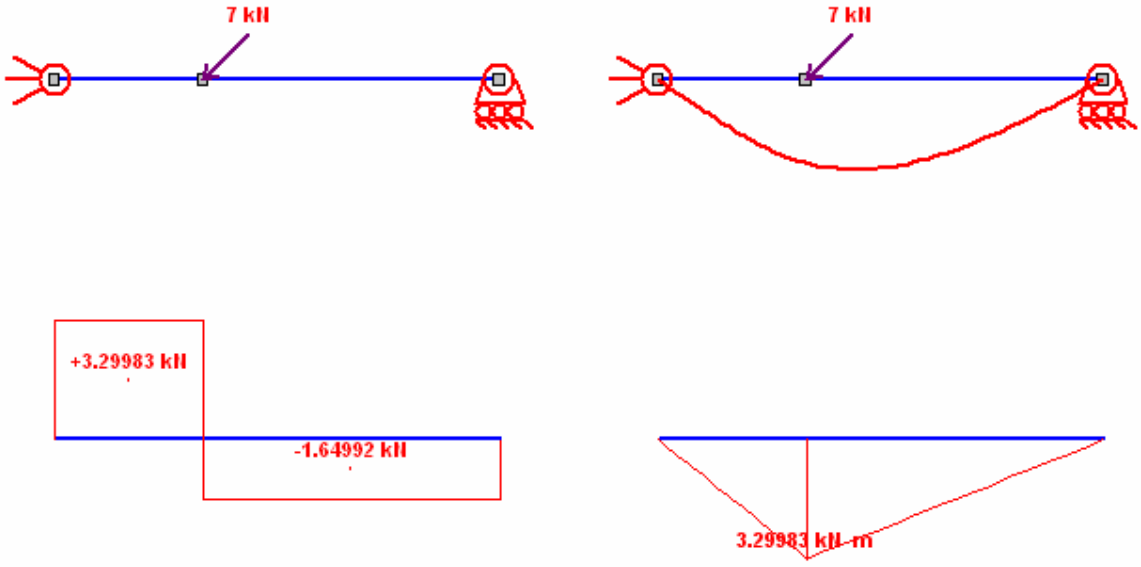
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT066		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT066**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with internal inclined force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT066		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT066**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	alpha [deg]	Dx1 [mm]		Constraints
3000	45°	1000	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.2998e+003	Th	3.2998e+003	**3.5400e-004**	**0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	-1.6499e+003	Th	-1.6499e+003	**-1.7700e-004**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-1.3970e-009	**-1.3970e-009**	**-0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	3.2998e+006	Th	3.2998e+006	**3.5400e-001**	**0.0000**

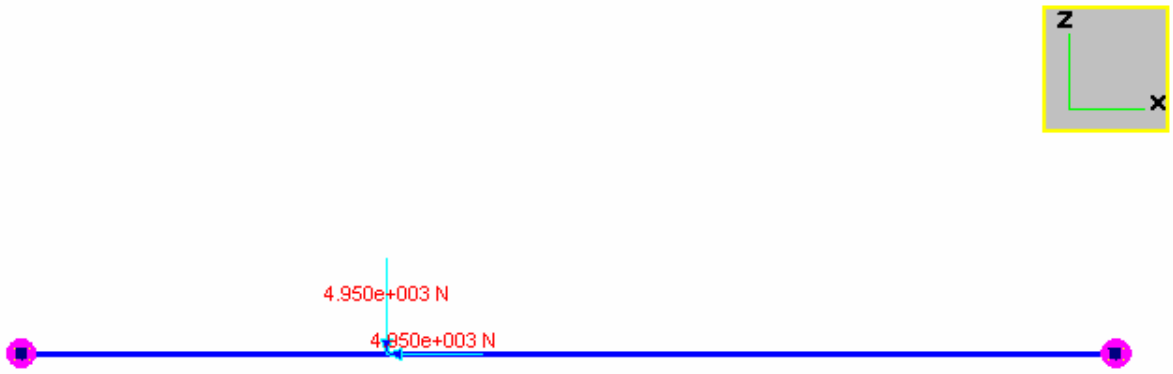
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT066BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT066BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with internal inclined force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:
Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT066BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT066BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	alpha [deg]	Dx1 [mm]		Constraints
3000	45°	1000	-	As shown

LOAD

Type	Value	Point of application
force concentrated	4.950e+003	Dx1
force concentrated	4.950e+003	Dx1
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**IPE200**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.2998e+003	Th	3.2998e+003	**5.1899e-004**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	1.6499e+003	Th	1.6499e+003	**1.2008e-005**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-6.9849e-010	**-6.9849e-010**	**-0.0000**

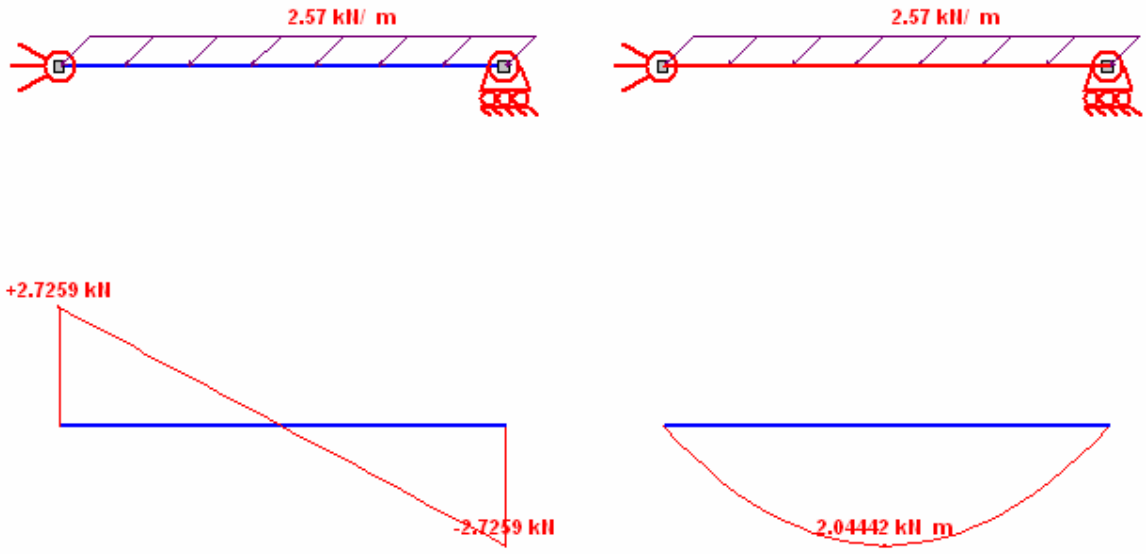
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT067		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT067**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Simply supported beam with inclined distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT067		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT067**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	alpha [deg]			Constraints
3000	45°		-	As shown

LOAD

Type	Value	Point of application
force linearly distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					IPE200
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
2.981e+003	2.051e+007	1.540e+006	6.254e+004	2.051e+005	3.081e+004
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
2.597e+005	4.776e+004	8.296e+001	2.273e+001	2.887e+001	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.7259e+003	Th	2.7259e+003	**-6.4100e-004**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	2.7259e+003	Th	2.7259e+003	**-6.4100e-004**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	4.6566e-010	**4.6566e-010**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**

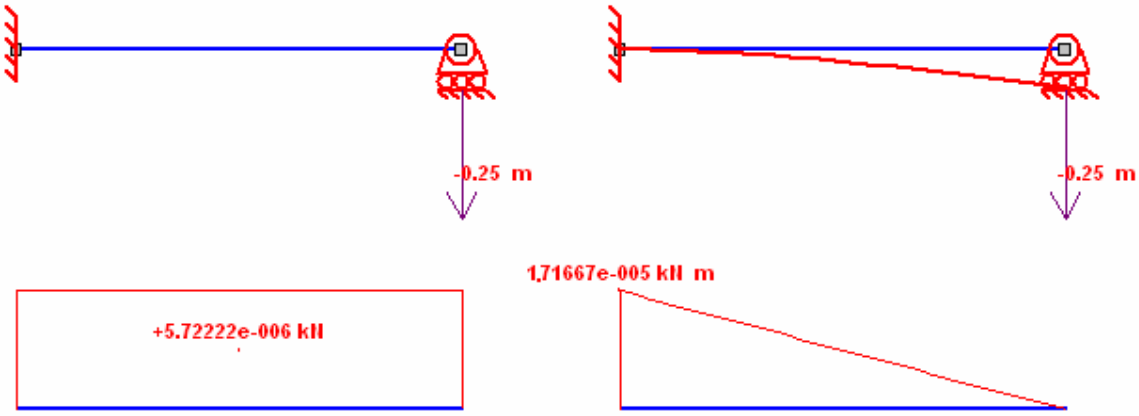
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT068		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT068**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Supported cantilever, right bearing translational settle

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT068		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT068**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
Settle	250mm	Right end
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	5.7222e-003	Th	5.7222e-003	**2.9666e-010**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	-5.7222e-003	Th	-5.7222e-003	**-2.9666e-010**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.7167e+001	Th	-1.7167e+001	**-2.1999e-007**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	7.1054e-015	**7.1054e-015**	**0.0000**

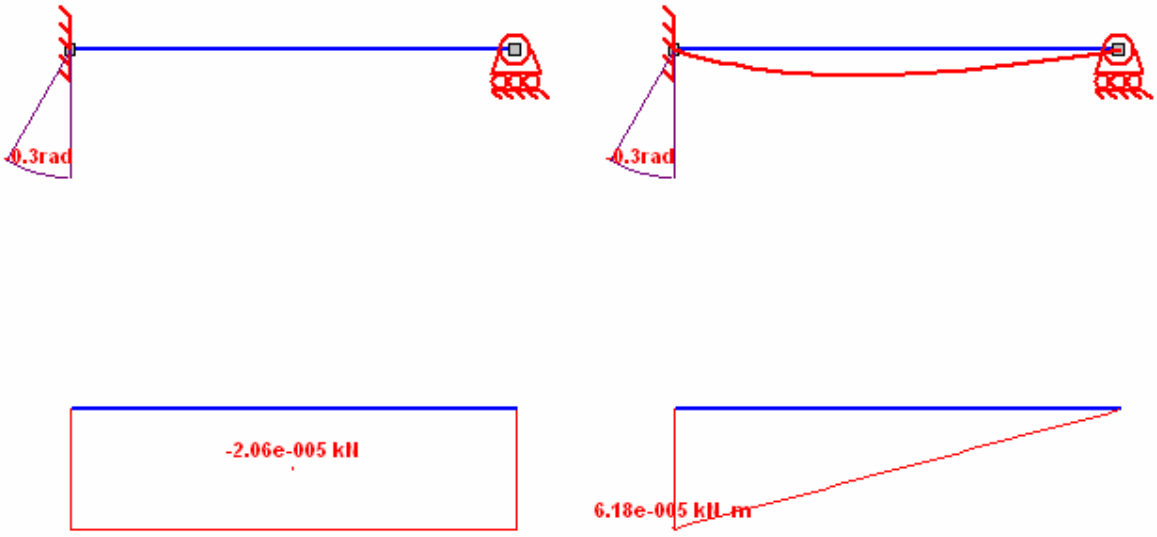
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT069		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT069**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Supported cantilever, clamping rotational settle

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT069		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT069**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
Settle	0,3rad	Left end
		-
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**Sezione1**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-2.0600e-002	Th	-2.0600e-002	**-2.6798e-010**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	2.0600e-002	Th	2.0600e-002	**2.6798e-010**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	6.1800e+001	Th	6.1800e+001	**8.0394e-007**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**

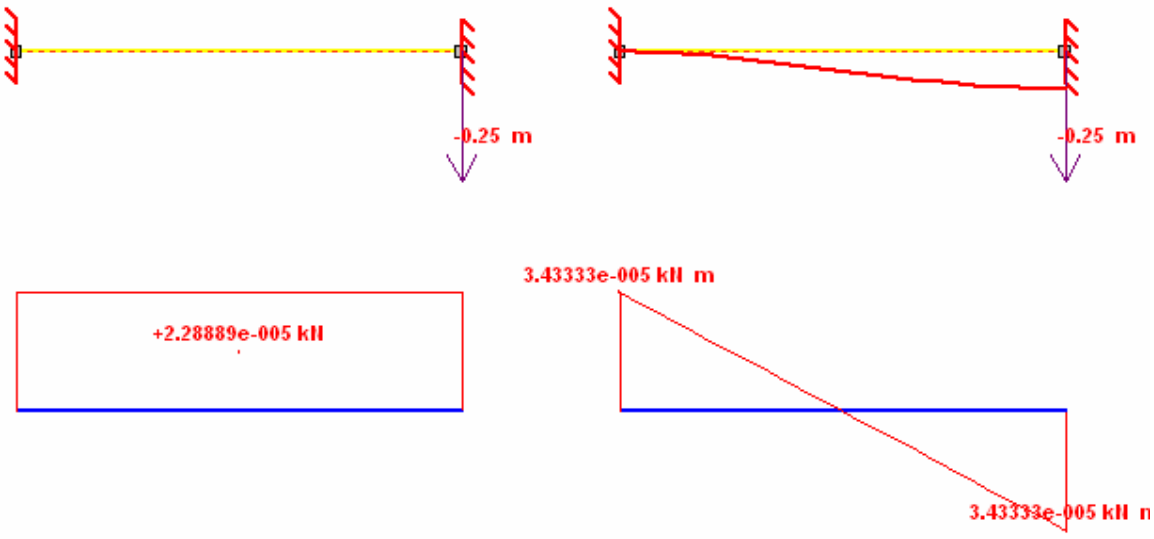
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT070		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT070**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Fully restrained beam. Left clamping translational settle.

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT070		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT070**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
Settle	250mm	Right end
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	(C_v – T_v)	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	2.2889e-002	Th	2.2889e-002	**-1.1132e-010**	**-0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	-2.2889e-002	Th	-2.2889e-002	**1.1132e-010**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-3.4333e+001	Th	-3.4333e+001	**-3.0190e-009**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	-3.4333e+001	Th	-3.4333e+001	**-3.0190e-009**	**0.0000**

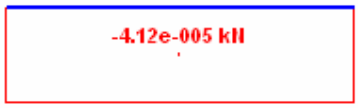
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

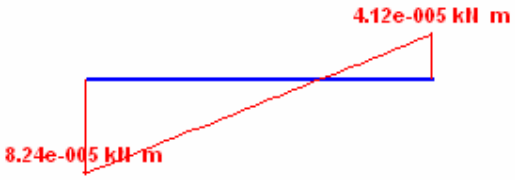
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT071		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT071**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Fully restrained beam. Right clamping rotational settle.

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT071		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT071**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]				Constraints
3000	-	-	-	As shown

LOAD

Type	Value	Point of application
Settle	0,3rad	Left end
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-4.1200e-002	Th	-4.1200e-002	**-5.3596e-010**	**0.0000**
Shear T3, J extreme. Beam # 1. Load case # 1	4.1200e-002	Th	4.1200e-002	**5.3596e-010**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	8.2400e+001	Th	8.2400e+001	**1.0719e-006**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	4.1200e+001	Th	4.1200e+001	**5.3596e-007**	**0.0000**

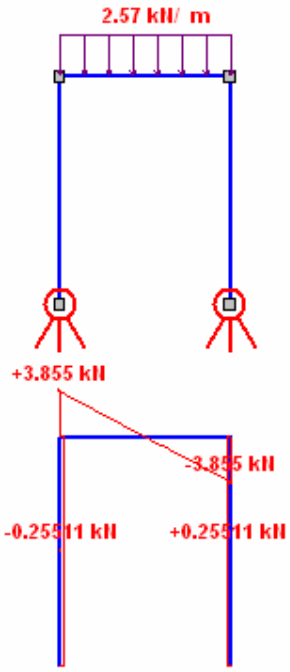
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

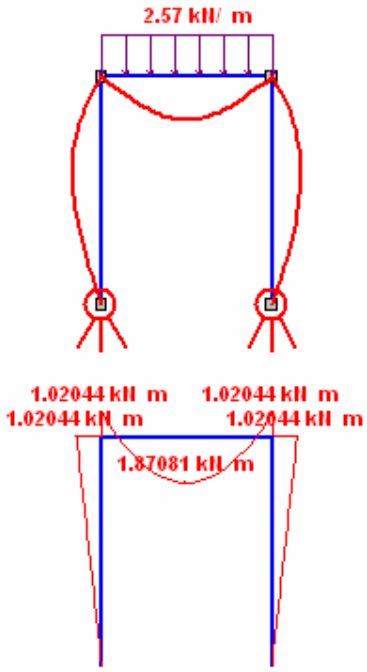
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT072		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT072**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Hinged frame with constant distributed load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that’s why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT072		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT072**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-2.5511e+002	Th	-2.5511e+002	**8.4235e-006**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, I extreme. Beam # 3. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	1.0204e+006	Th	1.0204e+006	**-3.3294e-002**	**-0.0000**

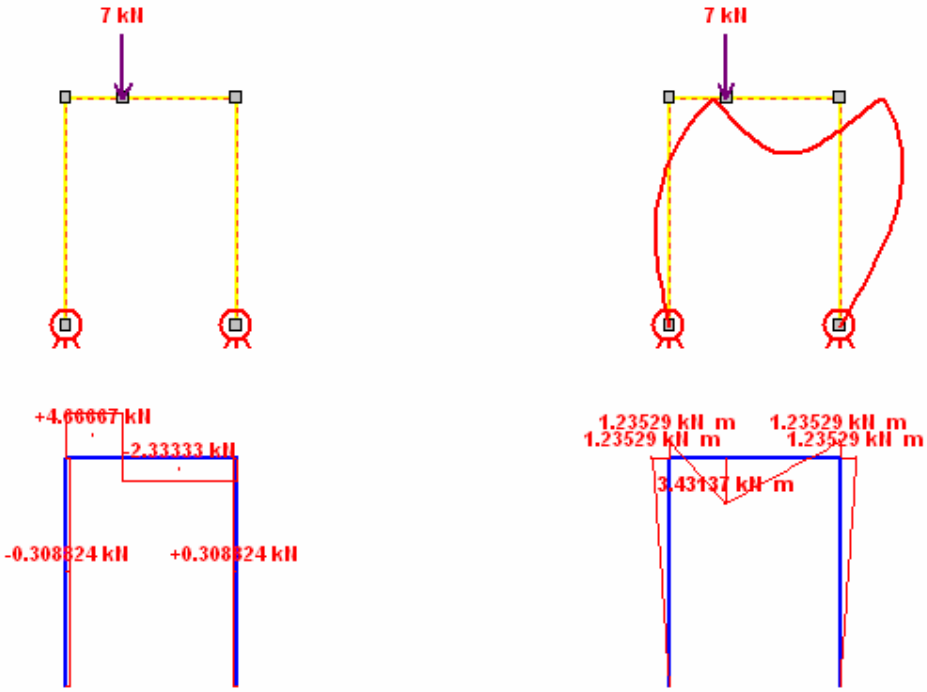
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT073		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT073**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Hinged frame with shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that’s why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT073		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT073**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]	Dx1 [mm]		Constraints
3000	4000	1000	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
		-
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**Sezione1**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-3.0882e+002	Th	-3.0882e+002	**1.0260e-005**	**-0.0000**
Shear T3, I extreme. Beam # 4. Load case # 1	3.0882e+002	Th	3.0882e+002	**-1.0153e-005**	**-0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	-1.2353e+006	Th	-1.2353e+006	**4.1441e-002**	**-0.0000**
Bending M2, I extreme. Beam # 3. Load case # 1	3.4314e+006	Th	3.4314e+006	**4.0965e-002**	**0.0000**

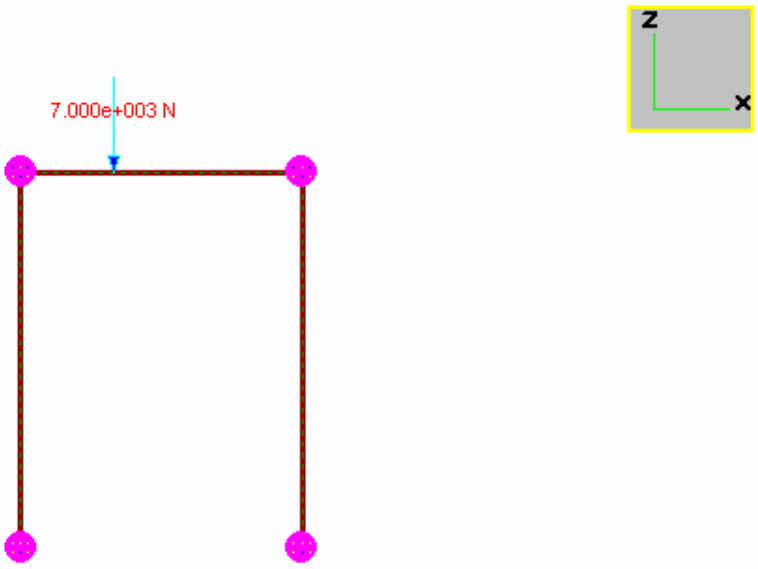
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT073BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT073BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Hinged frame with shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT073BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT073BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]	Dx1 [mm]		Constraints
3000	4000	1000	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-3.0882e+002	Th	-3.0882e+002	**2.5701e-005**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	3.0882e+002	Th	3.0882e+002	**-2.5594e-005**	**-0.0000**
Bending M2, I extreme. Beam # 3. Load case # 1	-1.2353e+006	Th	-1.2353e+006	**1.0321e-001**	**-0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**

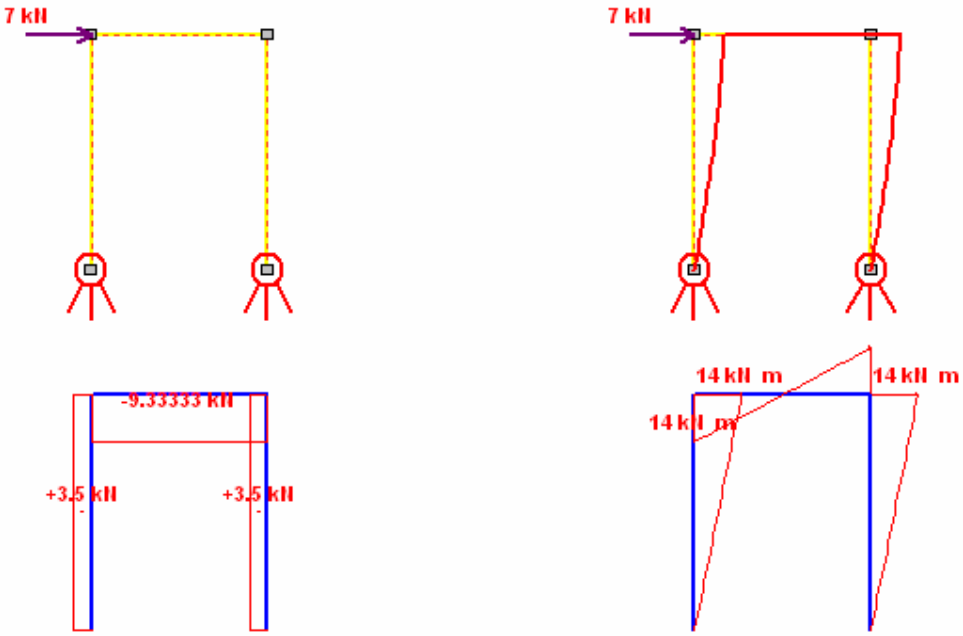
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT074		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT074**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Hinged frame with horizontal force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT074		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT074**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000		-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 3. Load case # 1	3.5000e+003	Th	3.5000e+003	**-1.1227e-004**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-1.4000e+007	Th	-1.4000e+007	**-4.7739e-001**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	1.4000e+007	Th	1.4000e+007	**-4.4908e-001**	**-0.0000**

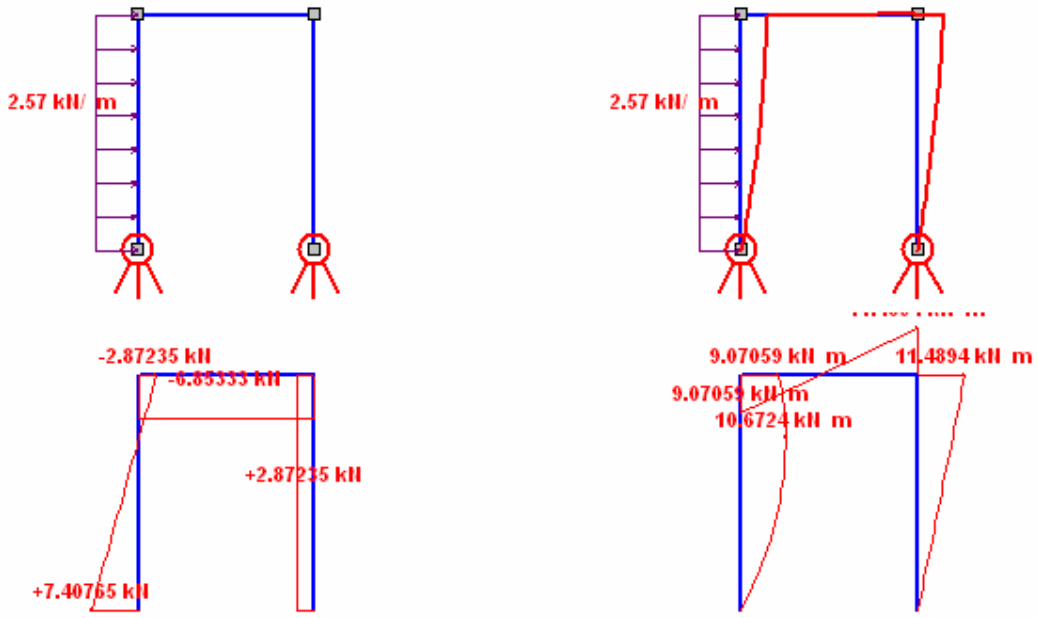
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT075		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT075**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Hinged frame with constant distributed load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT075		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT075**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	7.4076e+003	Th	7.4076e+003	**9.7936e-005**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	3.2596e-009	**3.2596e-009**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-9.0706e+006	Th	-9.0706e+006	**-3.9274e-001**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	1.1489e+007	Th	1.1489e+007	**-3.6317e-001**	**-0.0000**

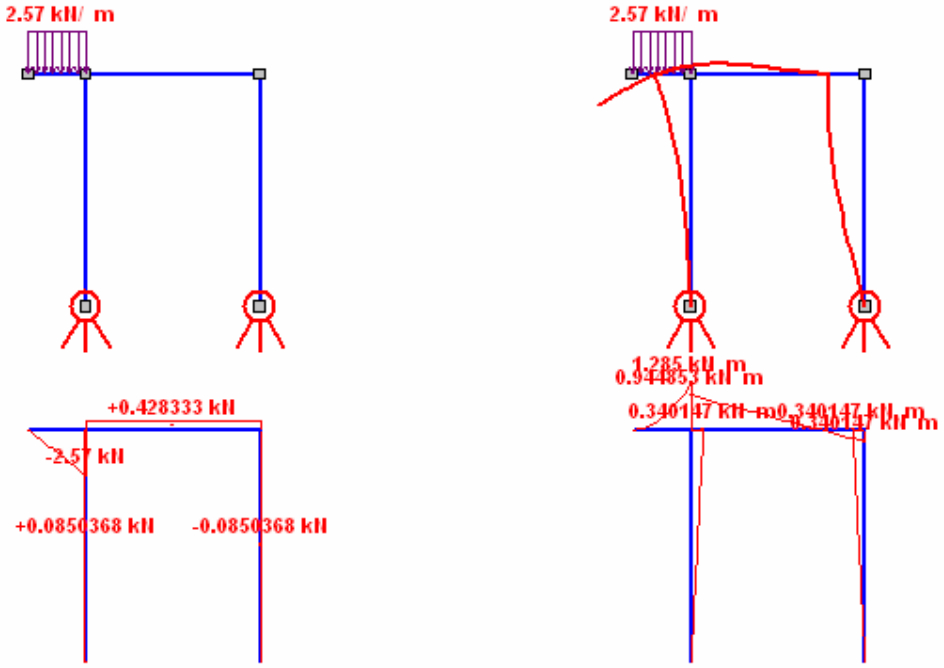
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT076		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT076**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Hinged portal frame, projecting beam. Constant distributed load.

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT076		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT076**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]	Projecting beam [mm]		Constraints
3000	4000	1000	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Projecting beam
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	8.5037e+001	Th	8.5037e+001	**-2.7735e-006**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-3.4015e+005	Th	-3.4015e+005	**1.1054e-002**	**-0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	-9.4485e+005	Th	-9.4485e+005	**-1.1054e-002**	**0.0000**

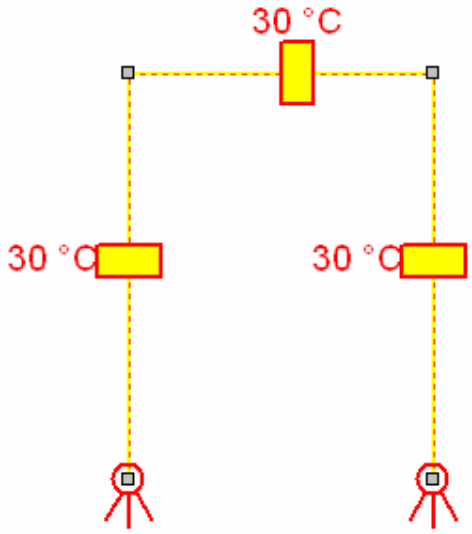
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT077		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT077**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Hinged frame with temperature increase

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT077		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT077**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
temperature	3.000e+001	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-2.4538e-006	Th	-2.4538e-006	**4.6237e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	9.5410e-018	**9.5410e-018**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	9.8153e-003	Th	9.8153e-003	**1.5050e-010**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	9.8153e-003	Th	9.8153e-003	**1.2960e-010**	**0.0000**

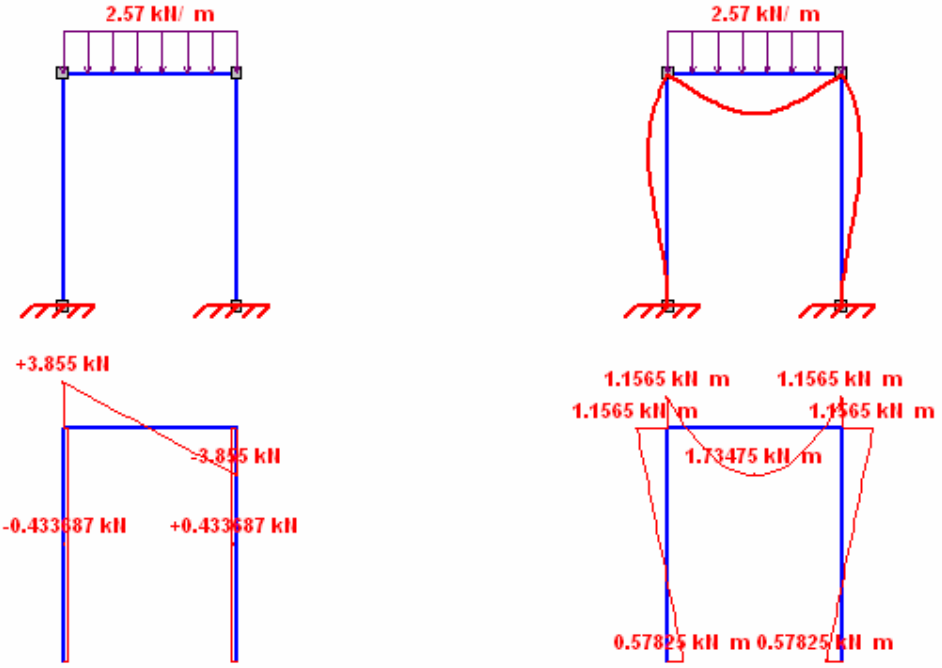
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT078		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT078**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Fixed frame with constant distributed load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT078		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT078**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-4.3369e+002	Th	-4.3369e+002	**6.7086e-005**	**-0.0000**
Shear T3, I extreme. Beam # 3. Load case # 1	4.3369e+002	Th	4.3369e+002	**-6.7086e-005**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	5.7825e+005	Th	5.7825e+005	**-1.7076e-001**	**-0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	1.1565e+006	Th	1.1565e+006	**-9.7580e-002**	**-0.0000**

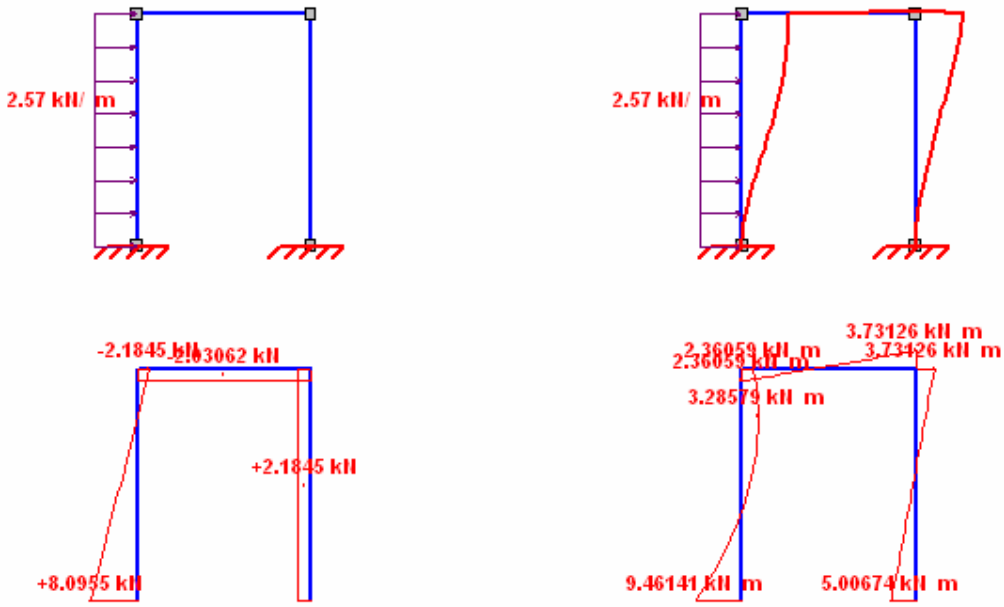
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT079		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT079**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Fixed frame with constant distributed load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT079		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT079**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 2. Load case # 1	2.1845e+003	Th	2.1845e+003	**-3.3716e-004**	**-0.0000**
Shear T3, I extreme. Beam # 1. Load case # 1	8.0955e+003	Th	8.0955e+003	**3.3867e-004**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-9.4614e+006	Th	-9.4614e+006	**-2.0656e+000**	**0.0000**
Bending M2, I extreme. Beam # 3. Load case # 1	2.3606e+006	Th	2.3606e+006	**-7.1089e-001**	**-0.0000**

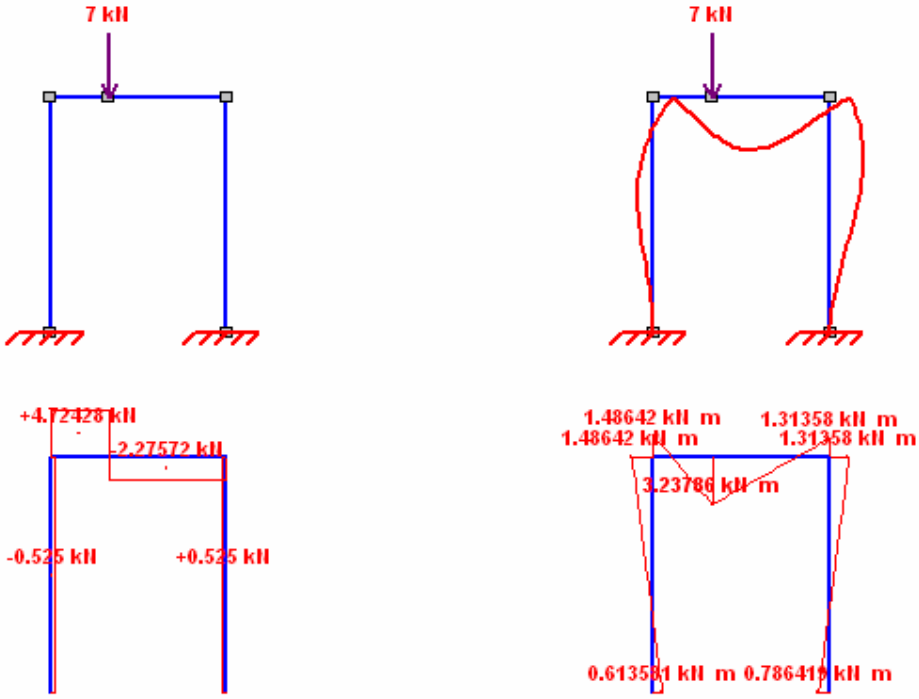
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT080		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT080**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Fixed frame with shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT080		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT080**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]	Dx1 [mm]		Constraints
3000	4000	1000	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-5.2500e+002	Th	-5.2500e+002	**8.1147e-005**	**-0.0000**
Shear T3, I extreme. Beam # 3. Load case # 1	5.2500e+002	Th	5.2500e+002	**-8.1275e-005**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	6.1358e+005	Th	6.1358e+005	**5.1894e-001**	**0.0001**
Bending M2, I extreme. Beam # 2. Load case # 1	-1.4864e+006	Th	-1.4864e+006	**8.4342e-001**	**-0.0001**

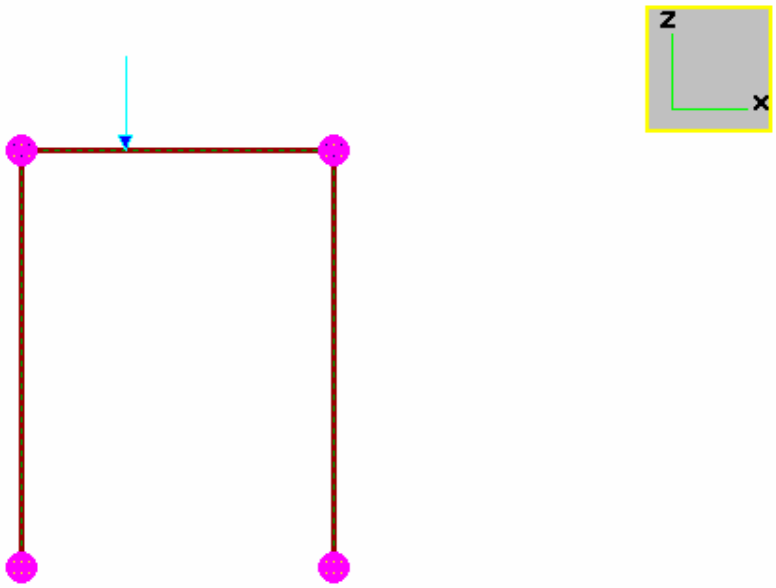
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT080BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT080BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Fixed frame with shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT080BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT080BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]	Dx1 [mm]		Constraints
3000	4000	1000	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-5.2500e+002	Th	-5.2500e+002	**1.0749e-004**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	5.2500e+002	Th	5.2500e+002	**-1.0743e-004**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	6.1358e+005	Th	6.1358e+005	**4.7076e-001**	**0.0001**
Bending M2, I extreme. Beam # 3. Load case # 1	-1.4864e+006	Th	-1.4864e+006	**9.0063e-001**	**-0.0001**

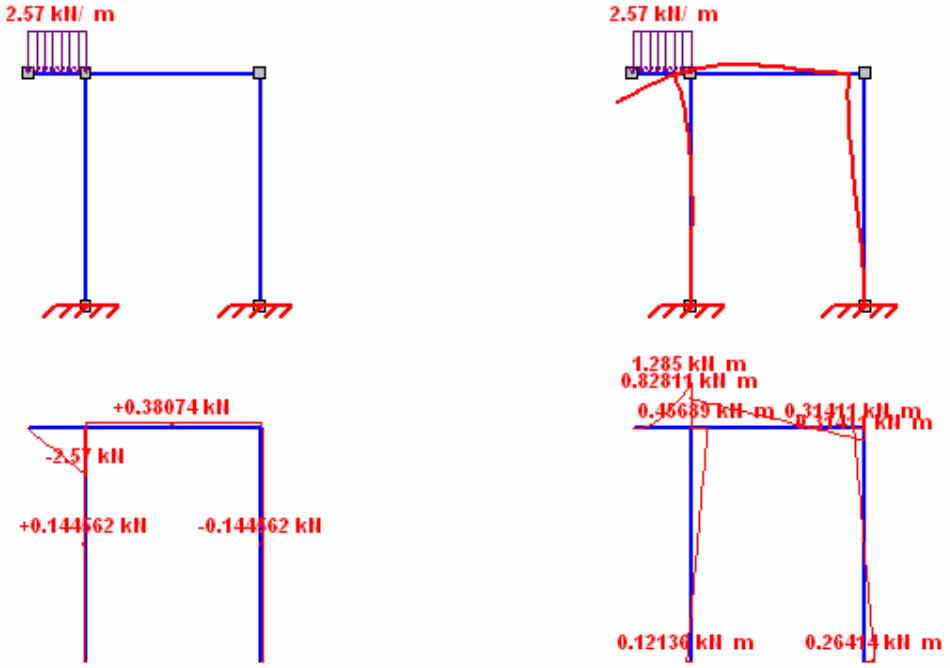
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT081		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT081**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Fixed portal frame, projecting beam. Constant distributed load.

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT081		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT081**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]	Projecting beam [mm]		Constraints
3000	4000	1000	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	Projecting beam
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.4456e+002	Th	1.4456e+002	**-2.2388e-005**	**-0.0000**
Shear T3, I extreme. Beam # 3. Load case # 1	-1.4456e+002	Th	-1.4456e+002	**2.2336e-005**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.2136e+005	Th	-1.2136e+005	**1.0441e+000**	**-0.0009**
Bending M2, I extreme. Beam # 3. Load case # 1	2.6414e+005	Th	2.6414e+005	**9.3023e-001**	**0.0004**

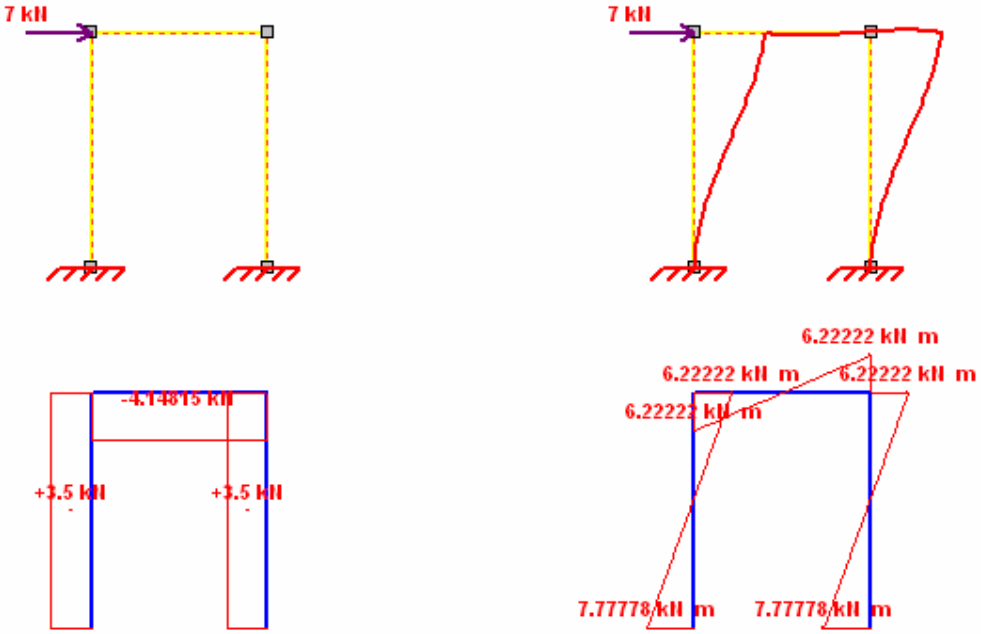
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT082		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT082**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Fixed frame with horizontal force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that’s why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT082		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT082**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.5000e+003	Th	3.5000e+003	**5.4252e-004**	**0.0000**
Shear T3, I extreme. Beam # 3. Load case # 1	3.5000e+003	Th	3.5000e+003	**-5.4029e-004**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-7.7778e+006	Th	-7.7778e+006	**-3.8385e+000**	**0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	6.2222e+006	Th	6.2222e+006	**-1.6685e+000**	**-0.0000**

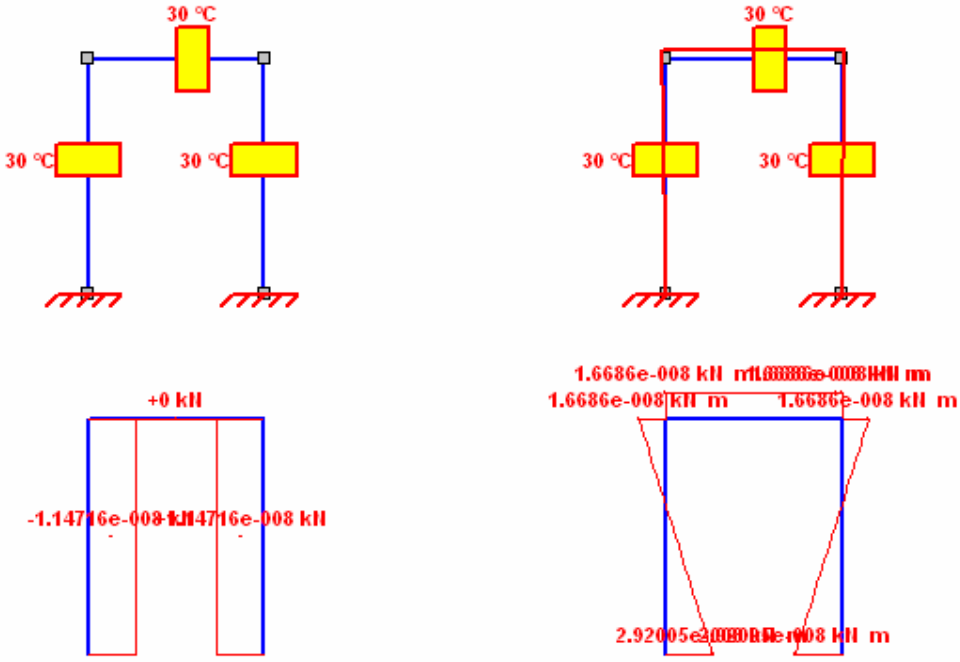
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT083		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT083**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Fixed frame with temperature increase

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that’s why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT083		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT083**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
temperature	3.000e+001	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-1.1472e-005	Th	-1.1472e-005	**6.3623e-012**	**-0.0001**
Shear T3, I extreme. Beam # 3. Load case # 1	1.1472e-005	Th	1.1472e-005	**-6.3752e-012**	**-0.0001**
Bending M2, I extreme. Beam # 2. Load case # 1	-1.6686e-002	Th	-1.6686e-002	**1.9794e-009**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	2.9201e-002	Th	2.9200e-002	**-3.4697e-009**	**-0.0000**

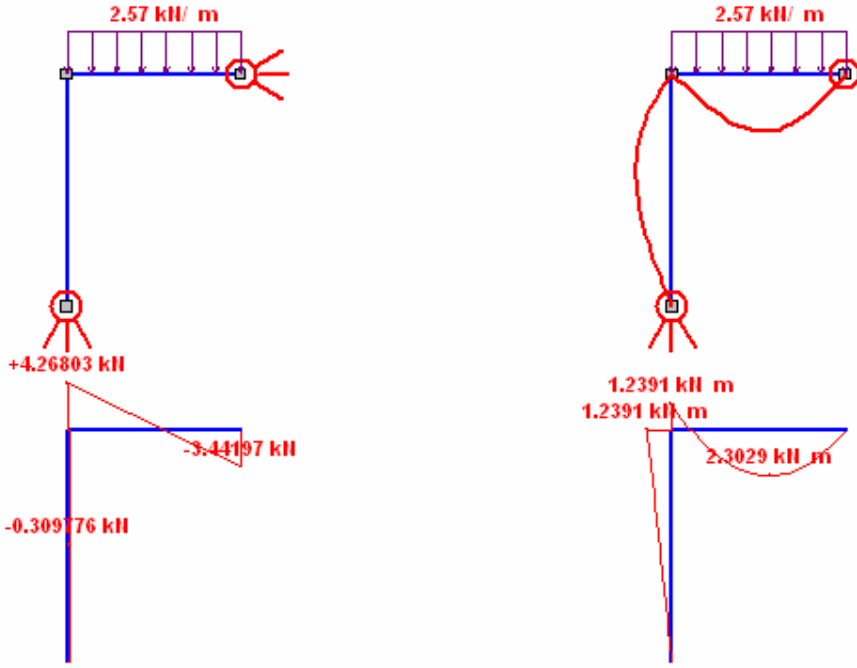
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT084		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT084**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Half portal frame (hinged) with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT084		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT084**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-3.0978e+002	Th	-3.0978e+002	**6.3460e-004**	**-0.0002**
Shear T3, J extreme. Beam # 2. Load case # 1	3.4420e+003	Th	3.4420e+003	**8.4586e-004**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	1.2391e+006	Th	1.2391e+006	**-2.5386e+000**	**-0.0002**

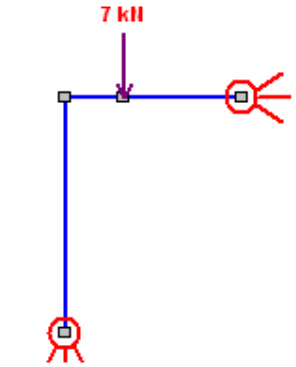
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

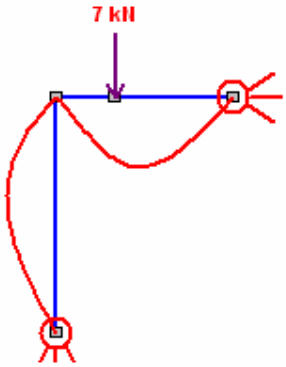
100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT085		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT085**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**





Problem description:

Half portal frame (hinged) with shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT085		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT085**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]	Dx1 [mm]		Constraints
3000	4000	1000	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-4.1667e+002	Th	-4.1667e+002	**7.7955e-004**	**-0.0002**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	1.6667e+006	Th	1.6667e+006	**-3.1184e+000**	**-0.0002**
Bending M2, J extreme. Beam # 2. Load case # 1	-3.5556e+006	Th	-3.5556e+006	**-2.0783e+000**	**0.0001**

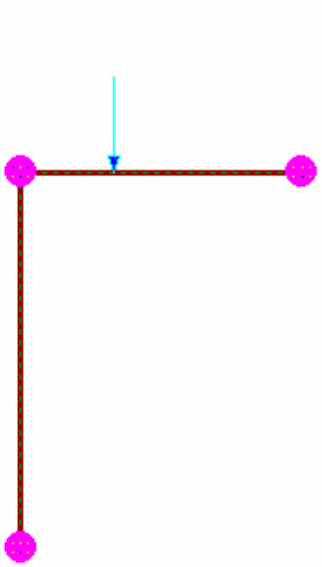
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT085BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT085BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Half portal frame (hinged) with shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT085BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT085BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]	Dx1 [mm]		Constraints
3000	4000	1000	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-4.1667e+002	Th	-4.1667e+002	**7.9205e-004**	**-0.0002**
Shear T3, J extreme. Beam # 2. Load case # 1	1.7778e+003	Th	1.7778e+003	**8.2246e-004**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	1.6667e+006	Th	1.6667e+006	**-3.1684e+000**	**-0.0002**

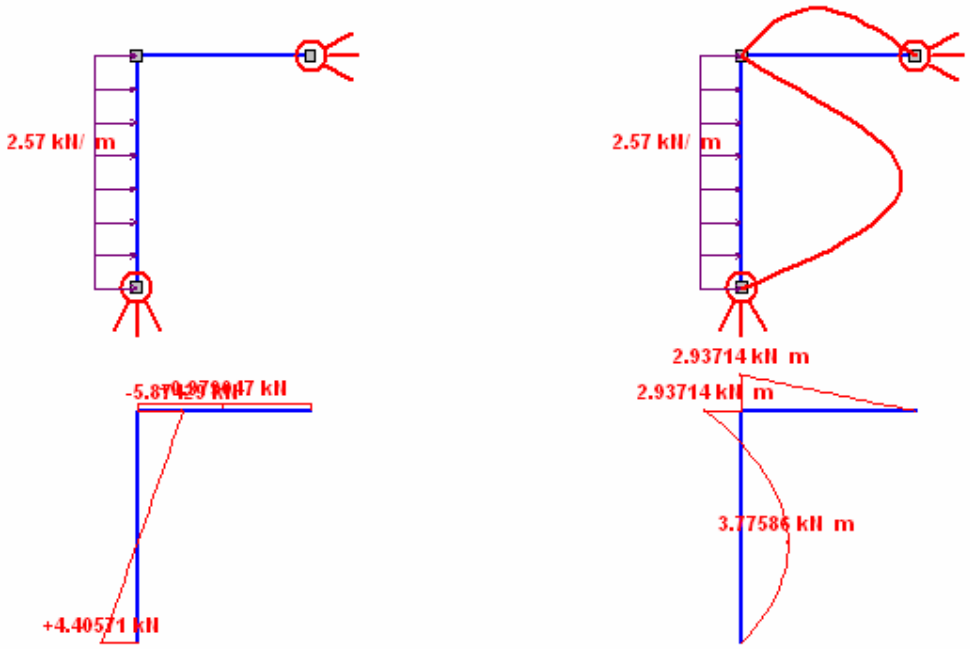
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT086		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT086**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Half portal frame (hinged) with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT086		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT086**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000		-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 2. Load case # 1	9.7905e+002	Th	9.7905e+002	**-8.1583e-004**	**-0.0001**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-9.3132e-010	**-9.3132e-010**	**-0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	-2.9371e+006	Th	-2.9371e+006	**2.4475e+000**	**-0.0001**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	4.6566e-010	**4.6566e-010**	**0.0000**

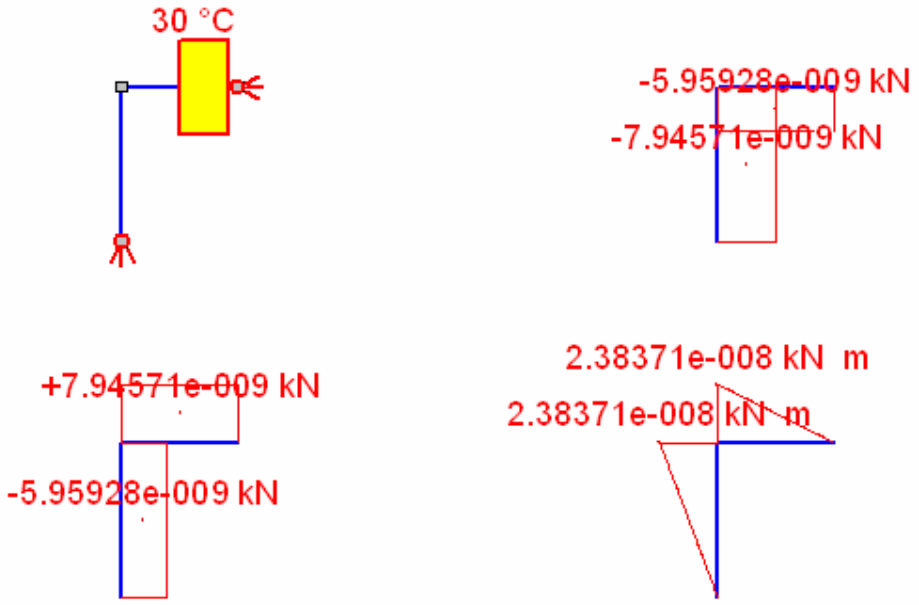
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT087		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT087**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Half portal frame (hinge) with temperature increase

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that’s why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT087		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT087**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
temperature	3.000e+001	Only Transverse
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-5.9593e-006	Th	-5.9593e-006	**5.6889e-012**	**-0.0001**
Shear T3, J extreme. Beam # 2. Load case # 1	-7.9457e-006	Th	-7.9457e-006	**-2.4148e-012**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	-1.7347e-017	**-1.7347e-017**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	2.3837e-002	Th	2.3837e-002	**-2.7556e-009**	**-0.0000**

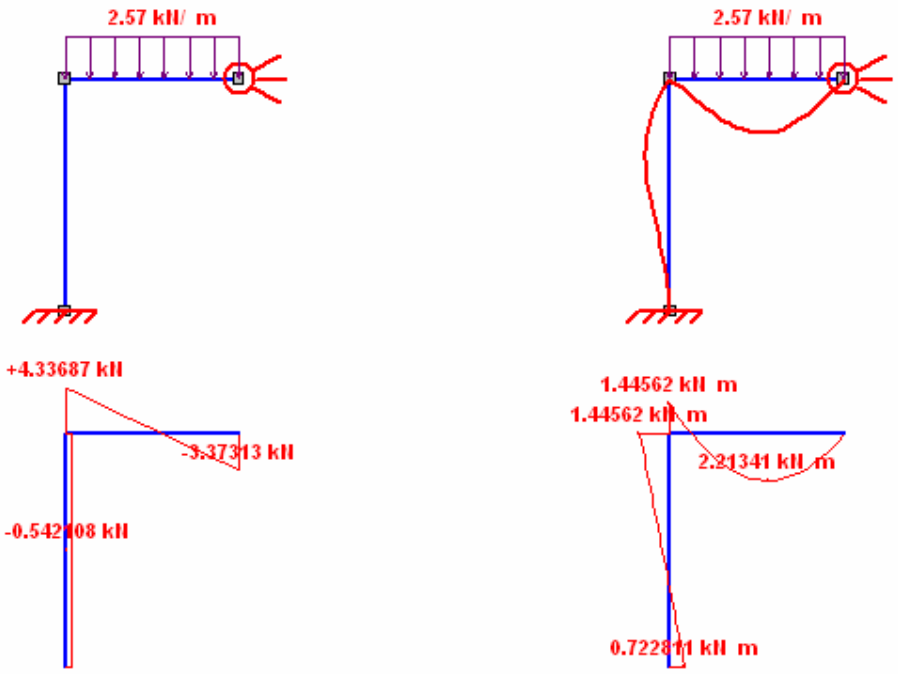
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT088		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT088**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Half portal frame (clamped-hinge) with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT088		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT088**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-5.4211e+002	Th	-5.4211e+002	**1.2748e-003**	**-0.0002**
Bending M2, I extreme. Beam # 1. Load case # 1	7.2281e+005	Th	7.2281e+005	**-1.9030e+000**	**-0.0003**
Bending M2, I extreme. Beam # 2. Load case # 1	-1.4456e+006	Th	-1.4456e+006	**3.1962e+000**	**-0.0002**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**

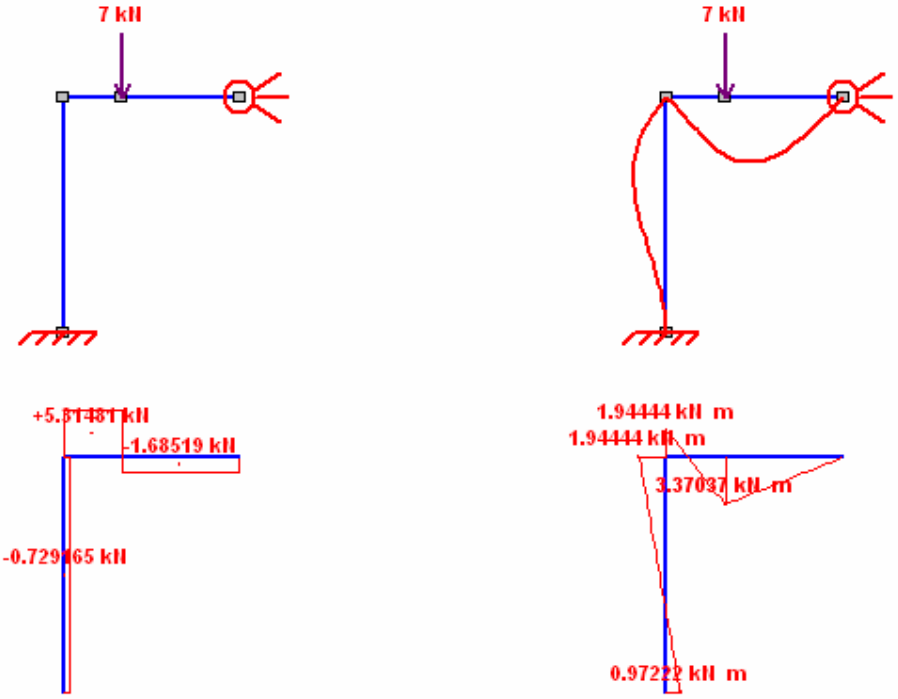
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT089		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT089**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Half portal frame (clamped-hinge) frame with shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT089		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT089**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]	Dx1 [mm]		Constraints
3000	4000	1000	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	Dx1
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-7.2917e+002	Th	-7.2917e+002	**1.5851e-003**	**-0.0002**
Bending M2, J extreme. Beam # 1. Load case # 1	1.9444e+006	Th	1.9444e+006	**-3.9529e+000**	**-0.0002**
Bending M2, I extreme. Beam # 1. Load case # 1	9.7222e+005	Th	9.7222e+005	**-2.3868e+000**	**-0.0002**
Bending M2, J extreme. Beam # 3. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**

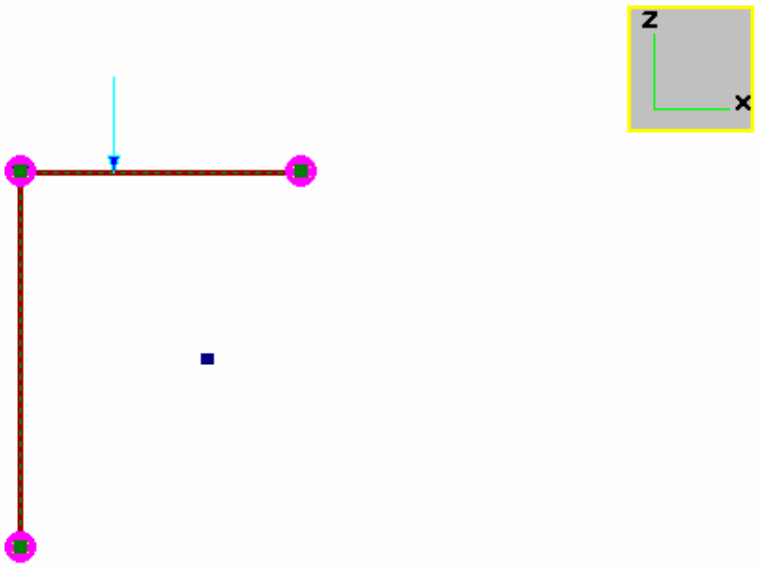
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT089BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT089BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Half portal frame (clamped-hinge) with shear force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT089BIS		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT089BIS**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS

Full Length [mm]	Full Height [mm]	Dx1 [mm]		Constraints
3000	4000	1000	-	As shown

LOAD

Type	Value	Point of application
force concentrated	7.000e+003	Dx1
		-
		-
		-

MATERIAL **Fe360**

f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION **Sezione1**

A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-7.2917e+002	Th	-7.2917e+002	**1.6070e-003**	**-0.0002**
Bending M2, J extreme. Beam # 1. Load case # 1	1.9444e+006	Th	1.9444e+006	**-4.0113e+000**	**-0.0002**
Bending M2, I extreme. Beam # 1. Load case # 1	9.7222e+005	Th	9.7222e+005	**-2.4160e+000**	**-0.0002**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-6.9849e-010	**-6.9849e-010**	**-0.0000**

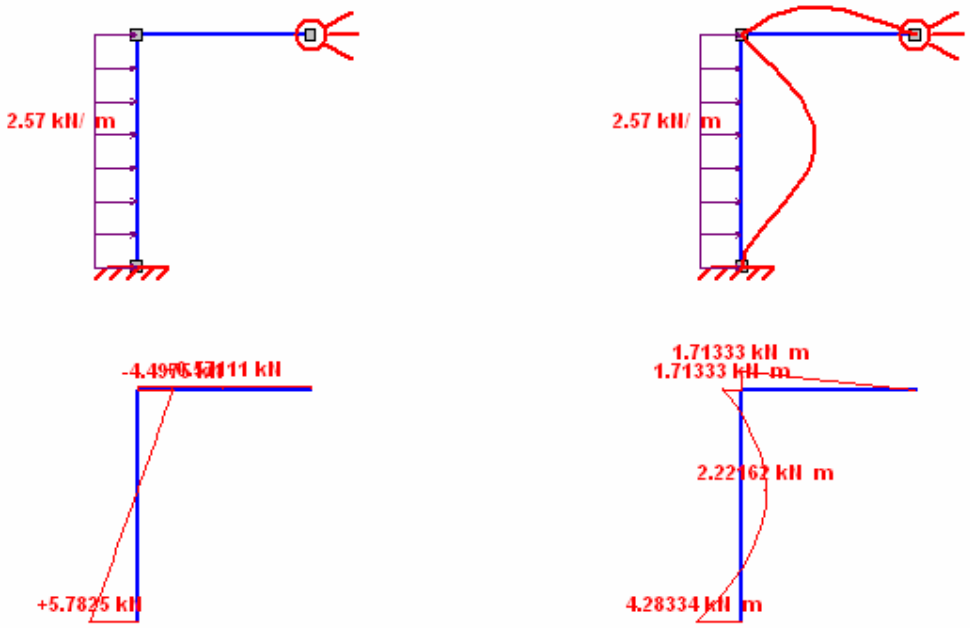
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT090		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT090**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Half portal frame (clamped-hinge) with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT090		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT090**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	5.7825e+003	Th	5.7825e+003	**1.7239e-003**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-4.2833e+006	Th	-4.2833e+006	**-3.9855e+000**	**0.0001**
Bending M2, J extreme. Beam # 1. Load case # 1	1.7133e+006	Th	1.7133e+006	**-2.9102e+000**	**-0.0002**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**

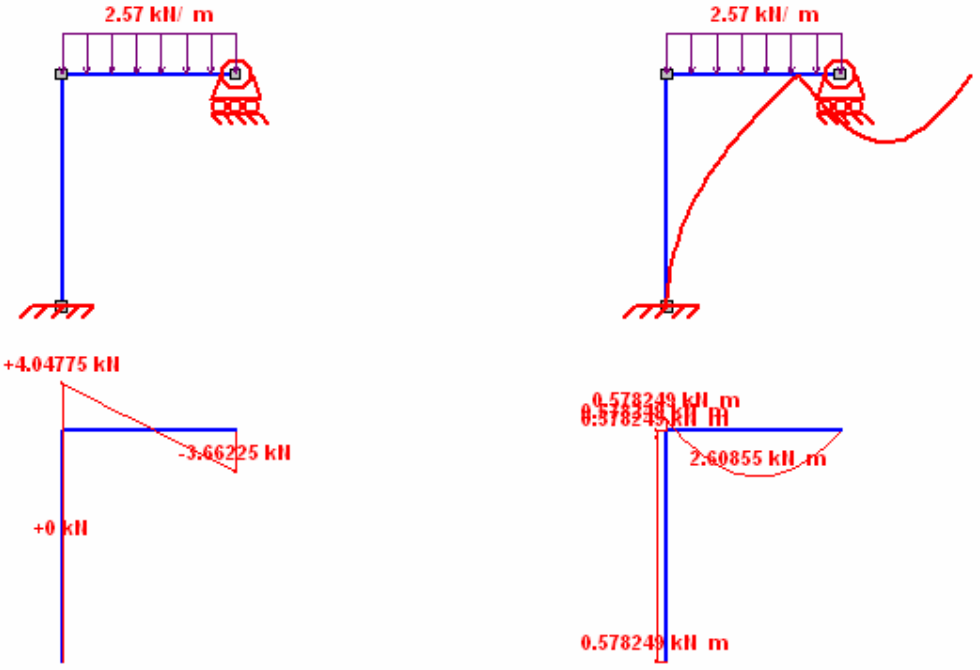
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT091		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT091**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Half portal frame (clamped, support) with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT091		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT091**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	2.7517e-007	**2.7517e-007**	**0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-5.7825e+005	Th	-5.7825e+005	**1.0787e+000**	**-0.0002**
Bending M2, I extreme. Beam # 2. Load case # 1	-5.7825e+005	Th	-5.7825e+005	**1.0798e+000**	**-0.0002**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-4.6566e-010	**-4.6566e-010**	**-0.0000**

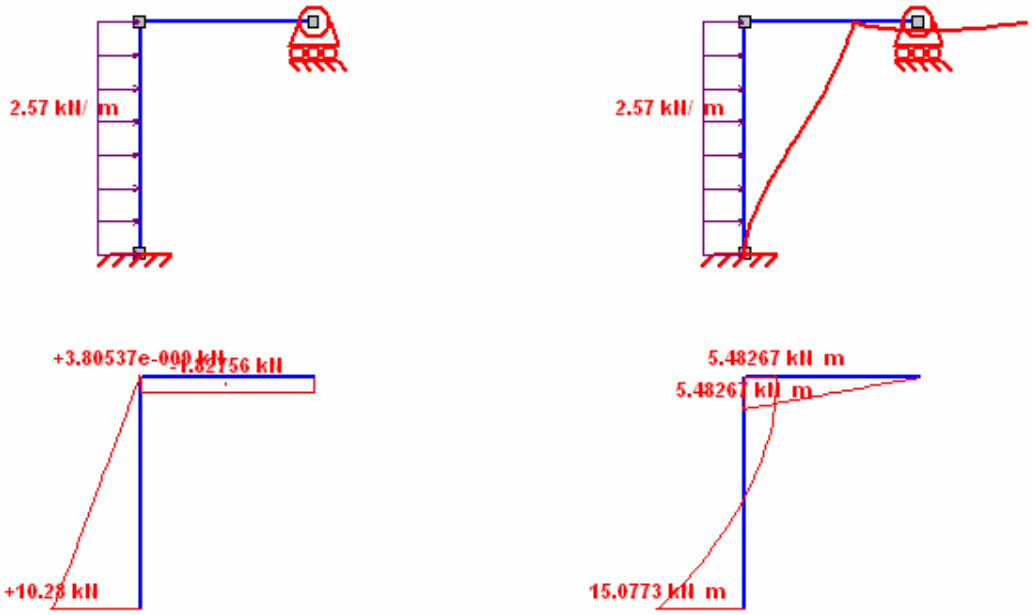
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT092		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT092**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Half portal frame (clamped, support) with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that’s why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT092		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT092**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	1.0280e+004	Th	1.0280e+004	**2.2829e-006**	**0.0000**
Shear T3, J extreme. Beam # 2. Load case # 1	1.8276e+003	Th	1.8276e+003	**-1.6168e-004**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.5077e+007	Th	-1.5077e+007	**-4.9616e-001**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-5.4827e+006	Th	-5.4827e+006	**4.8403e-001**	**-0.0000**

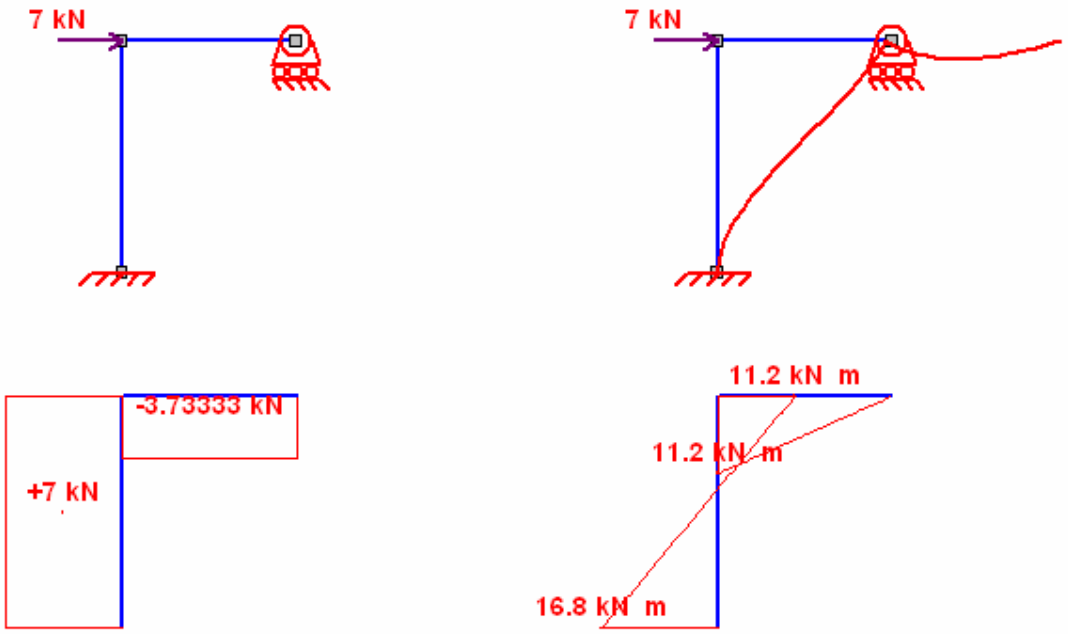
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT093		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT093**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Half portal frame (clamped, support) with horizontal force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where "theoretical" values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that's why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT093		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT093**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	7.0000e+003	Th	7.0000e+003	**3.5532e-006**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-1.1200e+007	Th	-1.1200e+007	**9.8987e-001**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	-1.6800e+007	Th	-1.6800e+007	**-1.0041e+000**	**0.0000**
Bending M2, J extreme. Beam # 2. Load case # 1	0.0000e+000	Th	-9.3132e-010	**-9.3132e-010**	**-0.0000**

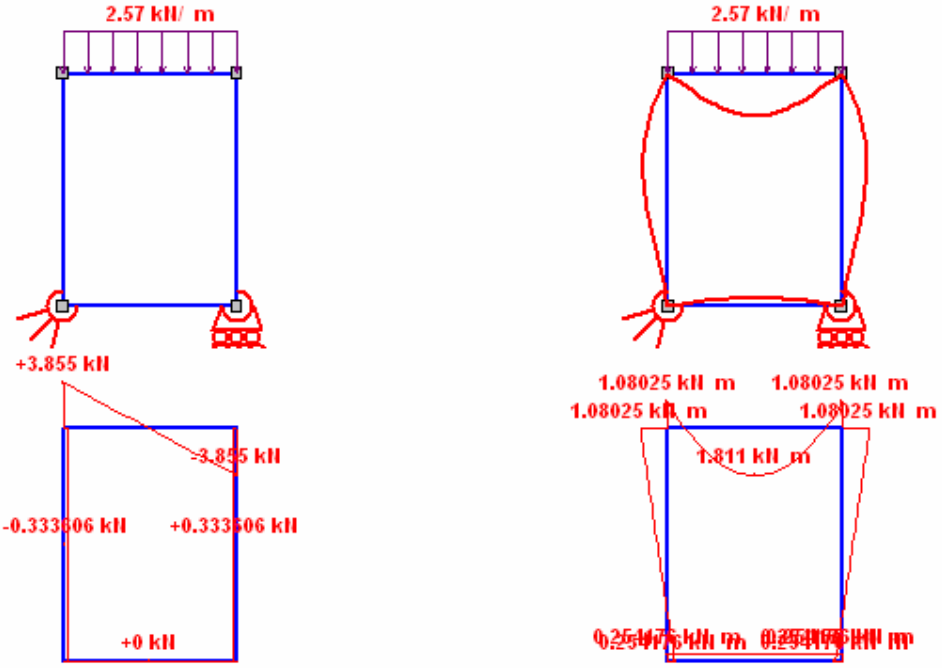
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT094		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT094**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Closed rectangular Frame with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

Pictures are from program CESCOPLUS, a plane frame program by Castalia srl. CESCOPLUS uses its own solver to compute displacement and stresses. Target values are based on theoretical values, cross check values or accepted values. Where “theoretical” values are used, target values have been computed using well known formulae and/or published results, they have absolutely *not* been taken equal to those shown in pictures, which have been obtained by CESCOPLUS (since this schedule tests Sargon, the check would have otherwise been a cross check between CESCOPLUS and SARGON). Target values equalness with picture values – if shown - is thus a consequence of CESCOPLUS precision, the assessment of which is not the main goal of this schedule. CESCOPLUS results are shown to easy the careful cheking of stress state and the understanding of the test itself. Since Sargon is a 3D program its graphical conventions about constraints are not as easy to understand as those of CESCOPLUS, that’s why CESCOPLUS pictures have been used to describe the problem.

Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT094		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT094**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 2. Load case # 1	3.8550e+003	Th	3.8550e+003	**-9.0949e-013**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	2.5418e+005	Th	2.5418e+005	**-1.1550e-001**	**-0.0000**
Bending M2, I extreme. Beam # 3. Load case # 1	-2.5418e+005	Th	-2.5418e+005	**1.1550e-001**	**-0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	-1.0802e+006	Th	-1.0802e+006	**1.1573e-001**	**-0.0000**

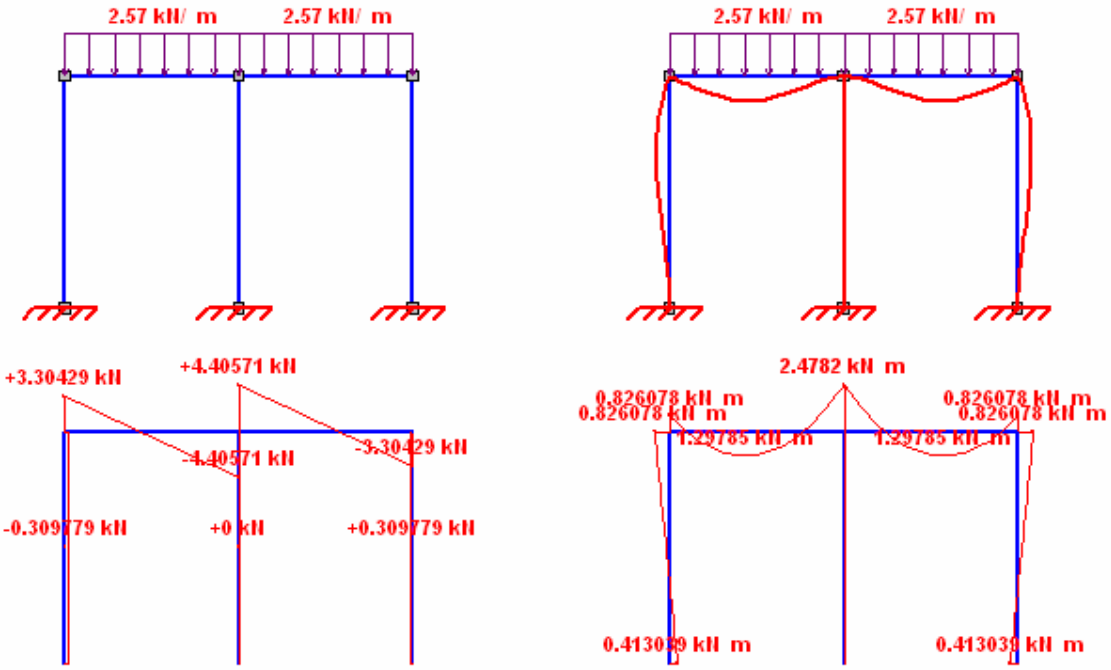
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT095		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT095**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Two-spans frame with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT095		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT095**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
6000=3000+3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**Sezione1**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-3.0978e+002	Th	-3.0978e+002	**-2.2420e-003**	**0.0007**
Bending M2, I extreme. Beam # 5. Load case # 1	0.0000e+000	Th	-2.3548e-010	**-2.3548e-010**	**-0.0000**
Bending M2, I extreme. Beam # 1. Load case # 1	4.1304e+005	Th	4.1304e+005	**2.8731e+000**	**0.0007**
Bending M2, J extreme. Beam # 1. Load case # 1	8.2607e+005	Th	8.2608e+005	**6.0947e+000**	**0.0007**

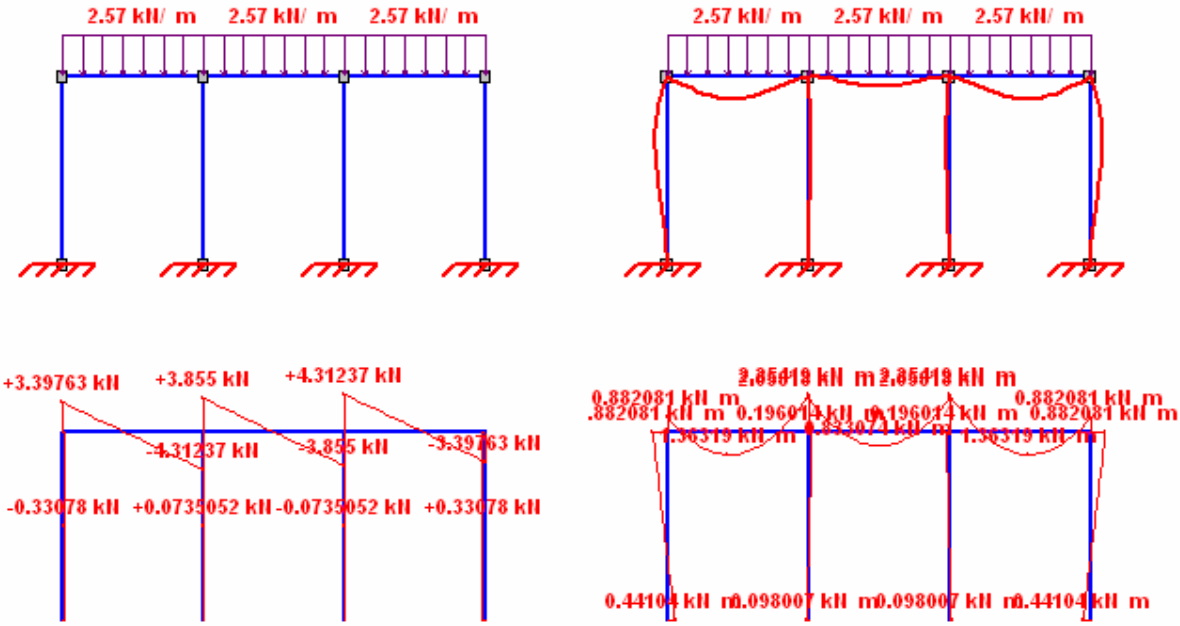
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT096		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT096**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Three-spans frame with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT096		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT096**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
9000=3x3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**Sezione1**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 7. Load case # 1	3.3078e+002	Th	3.3078e+002	**1.5225e-003**	**0.0005**
Bending M2, J extreme. Beam # 4. Load case # 1	8.8208e+005	Th	8.8208e+005	**4.2322e+000**	**0.0005**
Bending M2, I extreme. Beam # 1. Load case # 1	4.4104e+005	Th	4.4104e+005	**1.8577e+000**	**0.0004**
Bending M2, J extreme. Beam # 1. Load case # 1	8.8208e+005	Th	8.8208e+005	**4.2322e+000**	**0.0005**

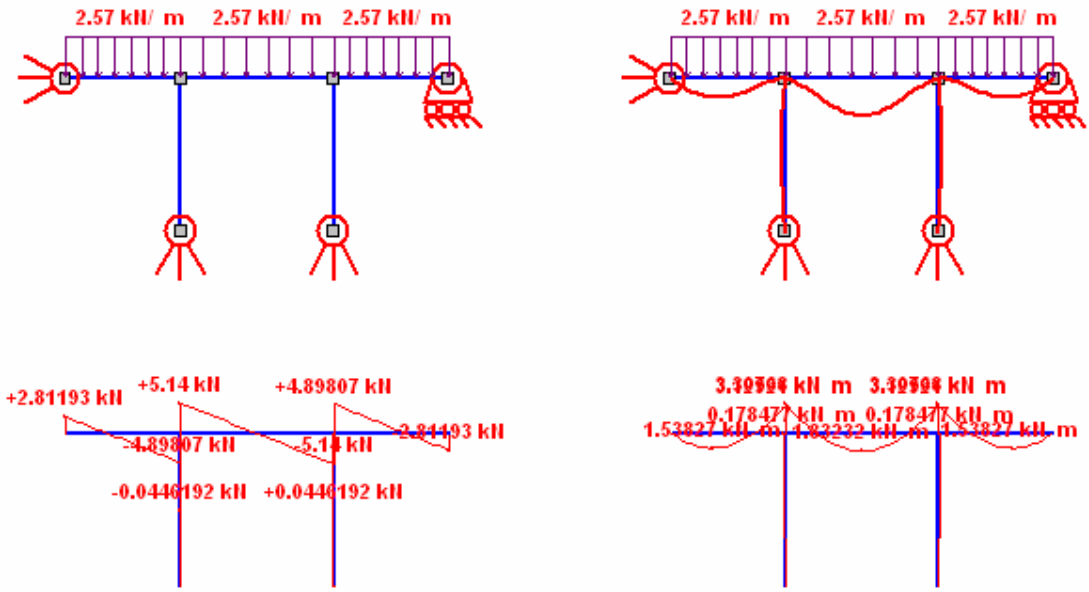
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT097		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT097**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Hinged portal frame, double supported cantilever, distributed constant load.

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT097		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT097**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
9000=3x3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**Sezione1**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 4. Load case # 1	-4.4618e+001	Th	-4.4619e+001	**-1.1158e-003**	**0.0025**
Bending M2, I extreme. Beam # 1. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	3.1292e+006	Th	3.1292e+006	**-7.4334e+000**	**-0.0002**
Bending M2, I extreme. Beam # 2. Load case # 1	-3.3077e+006	Th	-3.3077e+006	**2.9701e+000**	**-0.0001**

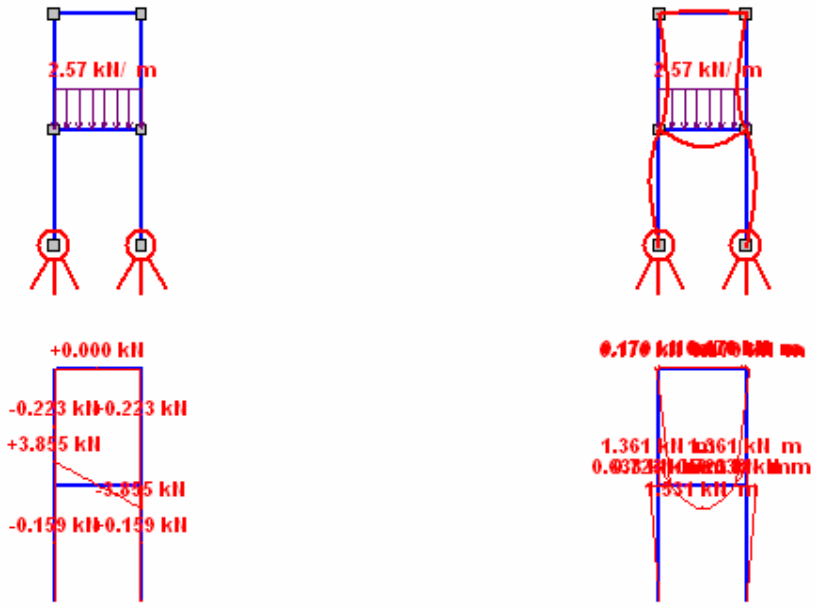
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT098		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT098**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Two-floors frame with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT098		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT098**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	8000=4000+4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**Sezione1**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-1.5944e+002	Th	-1.5944e+002	**-1.2372e-005**	**0.0000**
Bending M2, I extreme. Beam # 2. Load case # 1	7.2281e+005	Th	7.2281e+005	**-7.7355e-002**	**-0.0000**
Bending M2, I extreme. Beam # 5. Load case # 1	0.0000e+000	Th	0.0000e+000	**0.0000e+000**	**0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	6.3778e+005	Th	6.3778e+005	**4.9388e-002**	**0.0000**

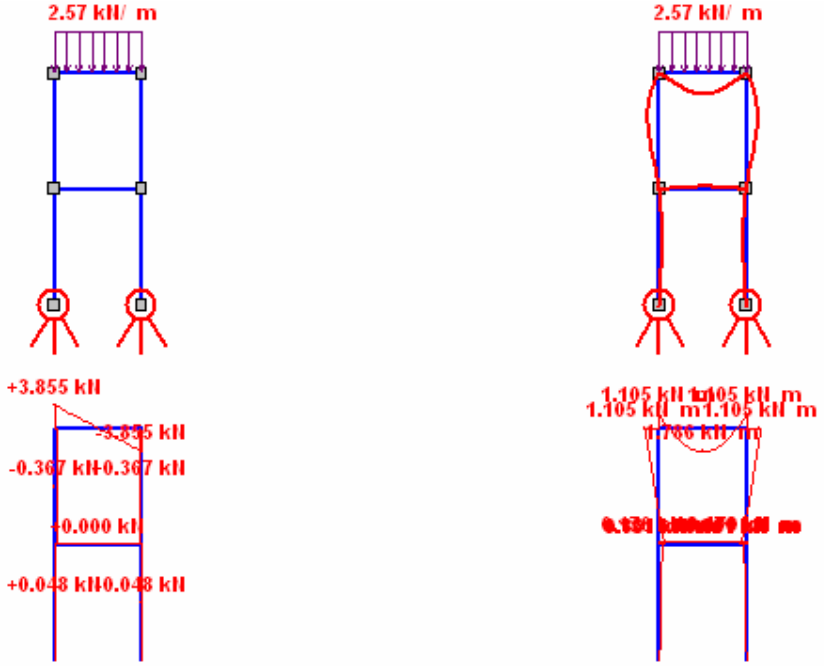
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT099		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT099**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

Two-floors frame with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT099		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT099**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	8000=4000+4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						**Fe360**
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	*v*	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					**Sezione1**
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	4.7833e+001	Th	4.7833e+001	**-4.4954e-005**	**-0.0001**
Bending M2, I extreme. Beam # 2. Load case # 1	3.6141e+005	Th	3.6141e+005	**-2.3599e-001**	**-0.0001**
Bending M2, I extreme. Beam # 5. Load case # 1	0.0000e+000	Th	-1.4552e-011	**-1.4552e-011**	**-0.0000**
Bending M2, J extreme. Beam # 1. Load case # 1	-1.9133e+005	Th	-1.9133e+005	**1.7981e-001**	**-0.0001**

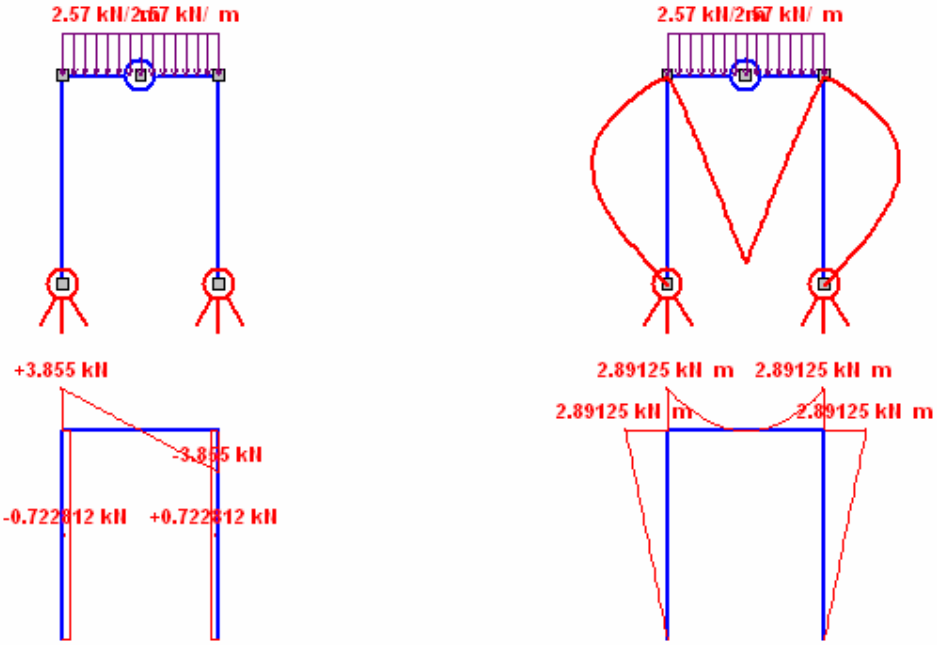
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT100		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT100**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

3 hinges portal with distributed constant load

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

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Note:

Shear area is not used, that is shear energy neglected. Dxi and Dzi are the offsets from lower Z alignment leftmost available node.

TEST SCHEDULE CASTALIA_STAT100		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT100**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
force distributed	2.570e+000	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	v	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	-7.2281e+002	Th	-7.2281e+002	**4.5475e-013**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	3.8550e+003	Th	3.8550e+003	**-3.6380e-012**	**-0.0000**
Bending M2, I extreme. Beam # 3. Load case # 1	0.0000e+000	Th	-2.3283e-010	**-2.3283e-010**	**-0.0000**
Bending M2, J extreme. Beam # 4. Load case # 1	2.8913e+006	Th	2.8912e+006	**-9.3132e-010**	**-0.0000**

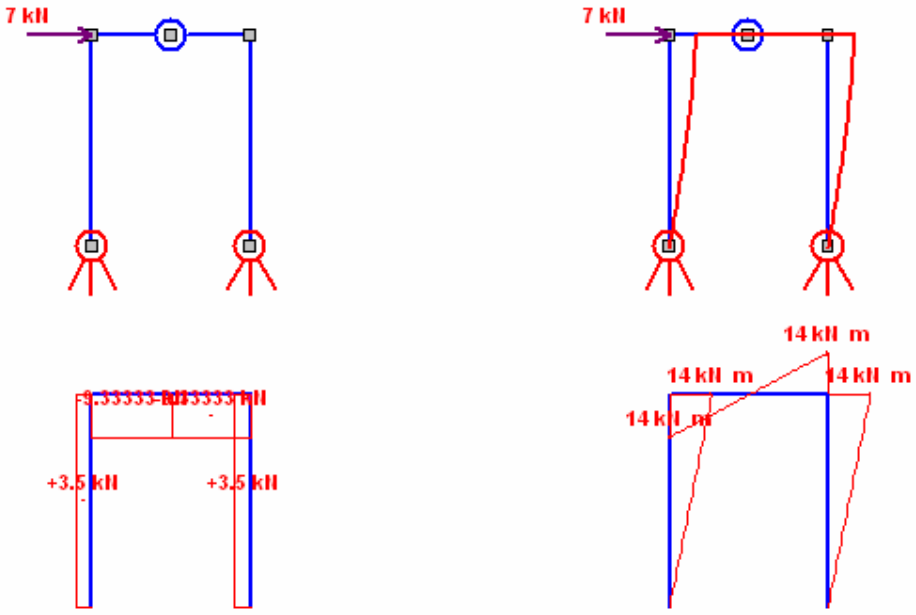
Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.

TEST SCHEDULE CASTALIA_STAT101		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT101**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**



Problem description:

3 hinges portal with horizontal force

Keywords (english): validation, benchmark, statics, finite elements, fem, solver, precision, reliability, quality control, beam, error measure

Keywords (italian): validazione, benchmark, statica, elementi finiti, fem, solutore, precisione, affidabilità, controllo qualità, travi, misura di errore

Editorial note:

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Note:

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TEST SCHEDULE CASTALIA_STAT101		
SOLVING	BEAM PROBLEM	**SOL.SAR.STAT101**
FINITE ELEMENT	SOLVER	**CLEVER (SARGON ©)**

GEOMETRY & CONSTRAINTS				
Full Length [mm]	Full Height [mm]			Constraints
3000	4000	-	-	As shown

LOAD

Type	Value	Point of application
NODAL FORCE	7.000e+003	-
		-
		-
		-

MATERIAL						Fe360
f_y [N/mm^2]	f_u [N/mm^2]	E [N/mm^2]	ν	α		
2.350e+002	3.600e+002	2.060e+005	3.000e-001	1.200e-005		

CROSS-SECTION					Sezione1
A [mm^2]	J_2[mm^4]	J_3 [mm^4]	J_t [mm^4]	W_2 [mm^3]	W_3 [mm^3]
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000
W_{pl2} [mm^3]	W_{pl3} [mm^3]	i_2 [mm]	i_3 [mm]	i_t [mm]	
1.000e+000	1.000e+000	1.000e+000	1.000e+000	1.000e+000	

OTHER DATA

TARGET VALUES vs COMPUTED VALUES

Description	T_v	T_{vK}	C_v	$(C_v - T_v)$	$100\frac{T_v - C_v}{C_v}$
Shear T3, I extreme. Beam # 1. Load case # 1	3.5000e+003	Th	3.5000e+003	**-5.2418e-006**	**-0.0000**
Shear T3, I extreme. Beam # 2. Load case # 1	-9.3333e+003	Th	-9.3333e+003	**1.3645e-005**	**-0.0000**
Bending M2, I extreme. Beam # 3. Load case # 1	0.0000e+000	Th	4.6566e-010	**4.6566e-010**	**0.0000**
Bending M2, J extreme. Beam # 4. Load case # 1	1.4000e+007	Th	1.4000e+007	**-2.0967e-002**	**-0.0000**

Cv computed value
Tv target value
TvK target value kind (theoretical, cross check, accepted).
- Th theoretical value
- Cr cross check value (theoretical target value is not known, results obtained with a different program are used as target values).
- Ac accepted value (a value which, on the basis of some argument, can be considered acceptable).

100(Tv – Cv) / Cv relative error percentage

Computational notes:

Authors: Ing. Marco Croci, Ing. Paolo Rugarli
Computed errors: checksolvers.exe, by Castalia srl.