



Univerza v Mariboru

Fakulteta za strojništvo

Boštjan Harl, Nenad Gubelj, Marko Kegl, Jozef Predan, Primož Štefane

DEVELOPMENT OF COURSEWARE MODULES FOR ENGINEERING MECHANICS EDUCATION

Education model

Our model involve ASDN system and LAB-3D module.

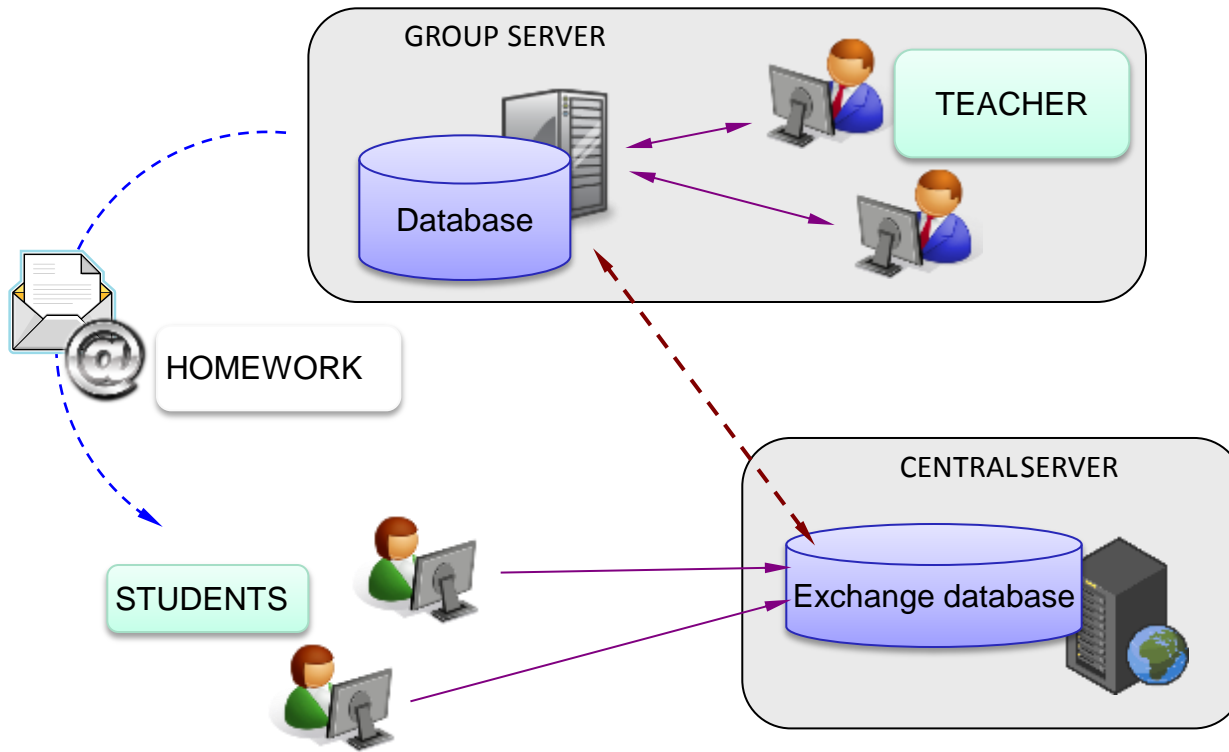
ASDN system enables:

- ❑ automatic generation of individual assignments,
- ❑ their distribution via e-mail,
- ❑ automatic collecting and processing of results.

LAB-3D module was developed for a better understanding of the numerical tasks involved in homework. This module enables web access to accompanying prerecorded laboratory experiments, in order to get a good visualization of the physical process under consideration.

ASDN system

Functional scheme of the ASDN system



ASDN system

The main window of the *ASDNManager* application

ASDNManager - pcloms05.uni-mb.si - HMWManagerBaza-KeglHarl.hmw

Prikjuči | Shrani | Odpri | Orodja | [Boštjan Harl : bh : bostjan.harl@uni-mb.si] | Verzija 01:2009-04-27 | Testni predmet

Upravljanje | Evidence | Vzdrževanje

PREDMETI | Podatki | Uvoz

OznakaP	Ime	SteIzdNalog	DatZadIzdaje
U019	Mehanika III - S2,UN-B	9	16. 1. 2009 ...
0160	Mehanika konstrukcij - S4,...	0	
U032	Mehanika za mehatronike ...	0	
0174-0626	Mehanizmi - S3,E4,UNI - Mhz	5	23. 5. 2009 ...
0060	Mehanizmi - T1 INT - Staro	0	

Študenti predmeta | 005

Ime	Ime	VpisnaSt	EEmail	Leto	Prijava	Aktiven
HARL	BOŠTJAN	789	bostjan.harl@uni-mb.si	2008	1	<input checked="" type="checkbox"/>
KEGL	MARKO	123	marko.kegl@uni-mb.si	2008	2	<input checked="" type="checkbox"/>
KEGL	BREDA	456	breda.kegl@uni-mb.si	2008	1	<input checked="" type="checkbox"/>
KOVAČ	MARKO	111	marko.kovac@triera.net	2008	1	<input checked="" type="checkbox"/>
VESENJAK	MATEJ	342	m.vesenj@uni-mb.si	2008		<input checked="" type="checkbox"/>

Domače naloge predmeta | Podatki

OznakaDN	Skupina	Opis	SteTock	Aktiven
MhzSeminarA...	0	Seminar2007	0	<input checked="" type="checkbox"/>
MehIII01A-Test	0		3	<input checked="" type="checkbox"/>
MehIII01B-Test	0		3	<input checked="" type="checkbox"/>
MehI01A-Test	0		2	<input checked="" type="checkbox"/>
MehIII02A-Test	0		2	<input checked="" type="checkbox"/>

Domače naloge

Rok za oddajo domačih nalog
ponedeljek 15. junij 2009, 23:00

Številka skupine naloge: 1

Generiraj kode nalog

Generiraj kodo študentu

Sestavi in razpošlji naloge

Ura | Zapis o procesu ali dogodku

11:34	Zagon programa ASDNManager
-------	----------------------------

ASDN system

Window of the *ASDNUporabnik* application

ASDNUporabnik

Verzija 01:2009-02-16 Prijava napak

Odpri Shrani Prijava Pomoč

Predmet:	Testni predmet
Študent:	KEGL MARKO; 1234
Število točk:	0
Rok oddaje:	sobota, 27. september 2008, 22:00

Podatki

Opis	Vrednost
1. Komp. obrem. F_y , [N]	-3000
2. Dimenzija a , [m]	1
3. Dimenzija b , [m]	2

Rešitve

Opis	Vrednost	Pravilno
1. Komp. reak. F_{Ay} , [N]		<input type="checkbox"/>
2. Komp. reak. F_{By} , [N]		<input type="checkbox"/>

Za pridobitev točk:

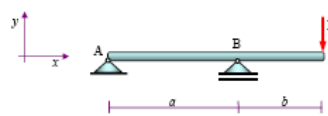
- Nalogo natisni in reši (ročno na papir - izdelek je treba v roku oddati asistentu ali učitelju)
- Rešitve vneseš v tabelo in preveri njihovo pravilnost
- Kodo pravilne rešitve:

1 / 1 48%

Find

ASDNDialoga

Nosilec je v točki C obremenjen s silo F kot kaže slika. Izračunaj vertikalne komponente reakcijskih sil v podporah A in B.



Podatki

1. Komp. obrem. F_y , [N]
2. Dimenzija a , [m]
3. Dimenzija b , [m]

Rešitve

1. Komp. reak. F_{Ay} , [N]
2. Komp. reak. F_{By} , [N]

Preparing a homework

The homework assignment preparation consists basically of two steps:

- ❑ preparation of the PDF file of the assignment and
- ❑ coding of the solution algorithm with *Mathematica - AceGen* .

Mathematica \Rightarrow *AceGen* \Rightarrow *C#koda* \Rightarrow *ASDNSolver*

```
<< AceGen`
modul = "MehIII01A";
SMSInitialize[modul, "VectorLength" -> 100];
SMSModule[modul];
p = Array[SMSReal[p$$[#]] &, 6];
{a, b, c, d, x, y} = p;
eyy = SMSD[uy, y];
exy =  $\frac{1}{2}$  (SMSD[ux, y] + SMSD[uy, x]);
e2 =  $\frac{\epsilon_{xx} + \epsilon_{yy}}{2} - \sqrt{\left(\frac{\epsilon_{xx} - \epsilon_{yy}}{2}\right)^2 + \epsilon_{xy}^2}$ ;
sistem = {{exx - e1, exy}, {exy, eyy - e1}}.{ex, ey};
r = {exx, eyy, exy, e1, e2, e1x, e1y, e2x, e2y, a1};
SMSExport[r, r$$];
SMSWrite[];
```


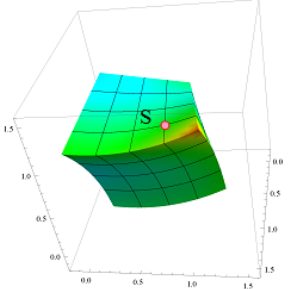
```
/******
* AceGen 2.111 Windows (20 Sep 08) *
* Co. J. Korelc 2007 23 Oct 08 10:05:22*
*****
User : Full professional version
Evaluation time : 1 s Mode : Optimal
Number of formulae : 12 Method: Automatic
Subroutine : MehIII01A size :227
Total size of Mathematica code : 227 subexpressions
Total size of C# code : 637 bytes*/

private double Power(double a, double b){return Math.Pow(a,b);}

/****** SUBROUTINE *****/
void MehIII01A(ref double[] v)
{
v[12]=Math.Sin(2e0*p[4]*p[5]);
v[27]=p[0]-2e0*p[1]*v[12];
v[10]=p[5]*v[27];
```

Preparing a homework

Example of the ASDN assignment

Priimek:	Ime:	Vpisna št.:
		
<p>V točki S konstrukcijskega dela, ki ga postopoma obremenjujemo, so trenutne deformacije enake $\varepsilon_{xx} = a$, $\varepsilon_{yy} = 0.002$, $\varepsilon_{zz} = b$, $\varepsilon_{xy} = c$, $\varepsilon_{yz} = d$ in $\varepsilon_{zx} = -0.001$, kjer so a, b, c in d znane konstante. Elastični modul materiala je $E = 70$ GPa, Poissonov količnik pa je enak $\nu = 0.3$. Izračunaj:</p>		
<ul style="list-style-type: none">• Volumski σ_v in deviatorični σ_d del tenzorja napetosti.• Drugo invarianto I_{d2} deviatoričnega tenzorja napetosti σ_d.• Začetno napetost tečenja σ_{y0}, če se je material v danem trenutku ravno začel plastificirati.		
		
Podatki		Rešitve
1. Par. a , [-]		1. Komp. σ_{vxx} , [MPa]
2. Par. b , [-]		2. Komp. σ_{dxx} , [MPa]
3. Par. c , [-]		3. Komp. $\sigma_{d'xx}$, [MPa]
4. Par. d , [-]		4. Inv. I_{d2} , [MPa ²]
		5. Nap. σ_{y0} , [MPa]

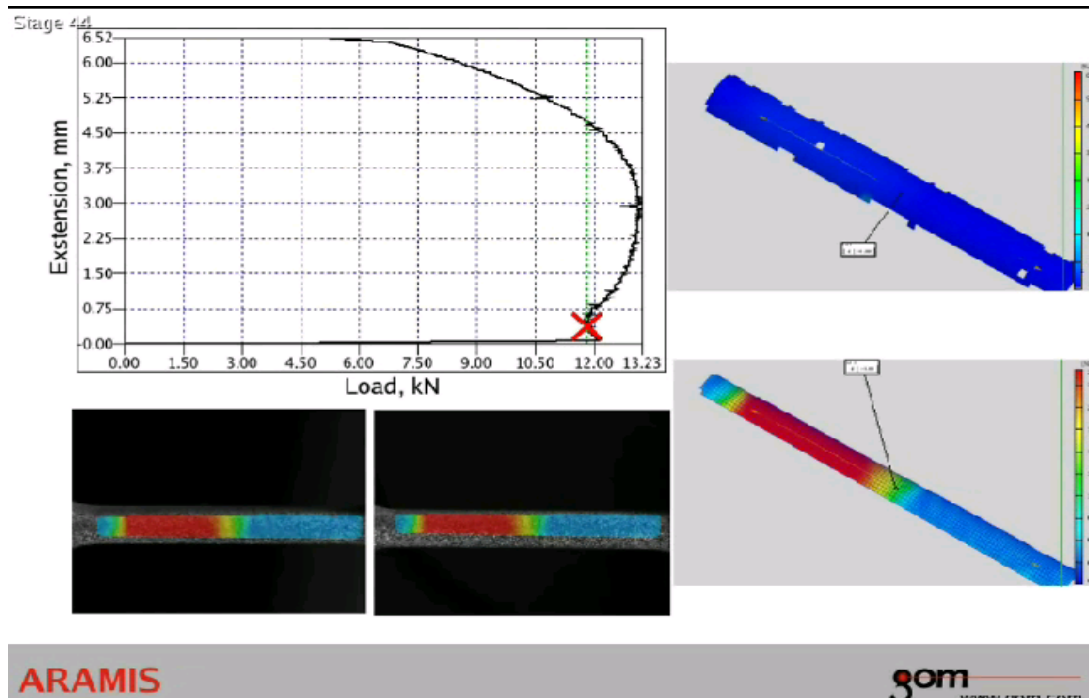
LAB-3D system

To provoke learners' interest in engineering mechanics as well as to enhance their understanding of the topics, the theoretical work is enriched by 3D video clips.



LAB-3D system

Additional explanation of stress-strain behavior is given by the application of the ARAMIS testing system. This test was done separately with two CCD cameras. The whole test was recorded and saved as an additional video clip file.



Conclusion

The pilot course focuses on regular and moderately complex homework assignments that are generated, distributed and analyzed fully automatically, requiring a minimal amount of work of the teacher.

The only serious work that has to be done is the code development for the solution algorithms.

Along with the system for homework assignments, another system was developed that enables virtual experimental work in the laboratory. This system comprises video materials for all interesting phases of the experimental work, short explanations, analysis and for comparison numerical analysis done by using commercial engineering programs.