

The Experience of the Usage of Electronic Learning in Kolej Universiti Teknologi Tun Hussein Onn (KUiTTHO) - Malaysia

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Abstract

The advance of the computer technology has revolutionized the processes of writing, reading, interactivity, simulation and visualization. Therefore the engineering education takes part of the benefit of this technology to update the method of delivering of the subject to the student. Kolej Universiti Teknologi Tun Hussein ONN (KUiTTHO) has taken part in the plan of the Malaysian Government to use the information and computer technology in enhancing the quality of engineering education. This paper shows the usage of electronic learning in teaching of the fluid power include the facility, the content of multimedia courseware of fluid power and projects related to the fluid power

Introduction

The rapid development in computer technology has given an alternative way to convey learning material efficiently though what is so called e-learning [1],[2] and [3]. The simplest form of e-learning is electronic lecture notes. It can be placed either in a local computer or in a server which can be accessed through the internet. The more advance e-learning incorporates animation to its contents to improve the understanding of the user to the material it conveys. Kolej University Teknologi Tun Hussein Onn (KUiTTHO) makes a strategy to promote the application of the E-Learning in the process of teaching and learning by buying the available e-module in the market, corporating with private company to develop a multimedia courseware based on the books or lecture note of the KUiTTHO's lecture and the lecture develop a multimedia courseware on their own. The lecture classes are equipped with multimedia facility and some of the lecture classes can be connected to the internet on line. KUiTTHO facilitated each lecturer with a laptop and connection to the internet. The Minister of Higher Education of Malaysia inaugurated the application of the E-Learning in KUiTTHO on 18 May, 2005. Multimedia courseware modules for mechanical and electrical engineering bought from the market consist of PLC Technology 1, Fundamental of Ladder Logic, PLC Technology 2, Advanced Ladder Logic Programming, PLC Controlled Pneumatic Systems, Pneumatic Technology 2; Advanced Pneumatic, Pneumatic Technology 3: Fundamental of Electro Pneumatics, Robotics and Material Handling 1, Electronic 1 : Fundamental of Electronics, Electronic 2: Advanced, and Material Testing. Multimedia courseware for civil engineering includes Introduction to Construction Technology, Construction Technology: Bridges, Construction Technology : Fluids, Introduction to Highway Engineering,

Introduction to Wastewater Treatment, Introduction to Water Supply Engineering, Environment Pollution Control, Introduction to Transportation Engineering, Introduction to Environmental Engineering. First author has developed a multimedia courseware of fluid power [4], manufacturing technology [5], and related technique to enhance the quality of the multimedia courseware [6], [7], [8] and [9]. This paper shows the experience of the author to develop the multimedia courseware and the response of the student to the multimedia courseware

Multimedia Courseware of Fluid Power

The multimedia courseware of fluid power is developed by the first author in cooperation with students and under support of the second and third authors in applying the e-module in the class and developing the product. The primary purpose of fluid power technology is to provide the student with a sound background in the fluid power. The available textbook of Fluid Power [10], [11], [12], [13], [14] and the available E-module consists of subjects essential to understanding the working operation of the component. The emphasis is placed on the understanding how and why fluid power system operate and on practical as well. This multimedia courseware of the fluid power is focused on designing a fluid power system [4]. The courseware is designed in such a way in order to create the interest of the student to the subject of the fluid power and to try to give an idea to the student to design a fluid power system on their own. Therefore the multimedia course of the fluid power was developed with, who takes a special assignment to develop animation of the component or fluid power system. The current version of the fluid power system courseware introduce the animation 2 or 3 D and interactive animation related to the working concept of the component (Fig 1), animation of the fluid power system and animation of the assembly of the 3-D Assembly of the fluid power system (Fig 2). The exercise of the determination of the dimension of the component of the fluid system is conducted with the help of the computer program using Matlab and Visual Basic (Fig 3). The students, therefore, can understand the working operation of the component and fluid power system and can determine the dimension of the component or fluid power system in a short time. The design of the system uses a professional software Automation Studio 3D. Automation Studio is a modular simulation package composed of core system to which various simulation modules can be plugged in. The core system handles the function of editing, simulation, file and diagram management and printing. This software can help the user to design the fluid power system. It can be used to test the function of the system by taking animation the system and determine the performance of the

system (Fig 4). KUiTTHO Fluid Power on Line Directory is developed to assist the student to realize their design by surfing of the available component all over the world. The KUiTTHO on Line Directory is intended to assist the user to realize their design into the real product by selecting the component of the system. The manufacture website address was collected and linked to our online directory. On line Directory consist of manufacture directory, distributor directory and product directory all over the world. The understanding of the students is proved by conducting a special project related to the design of fluid power system. The objective of this multimedia course is indicated by eagerness of the students to conduct special assignments, which design a fluid power system and an example of application of the fluid power system.

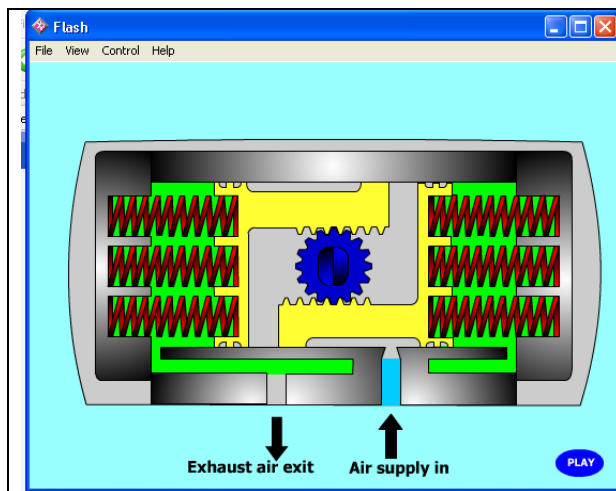


Fig 1. Animation of Fluid power component

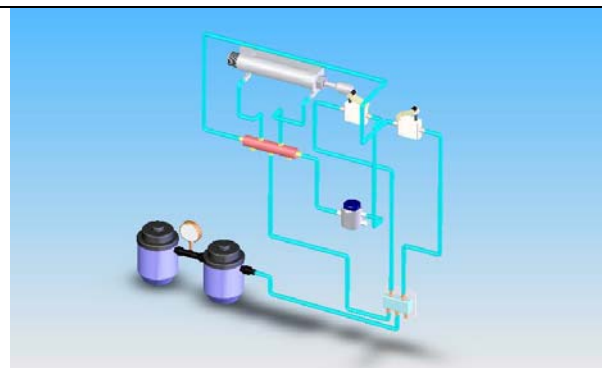


Fig 2 Animation of Fluid power system

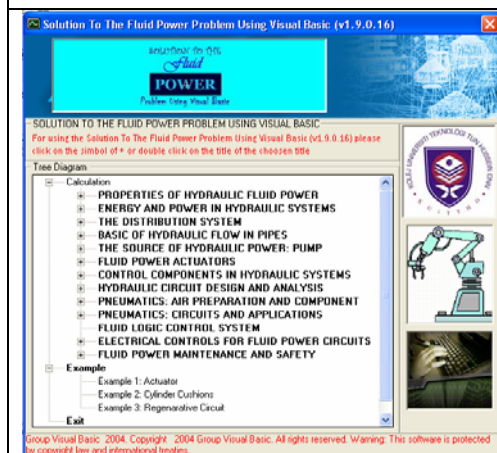


Fig. 3 Visual Basic Computer Program

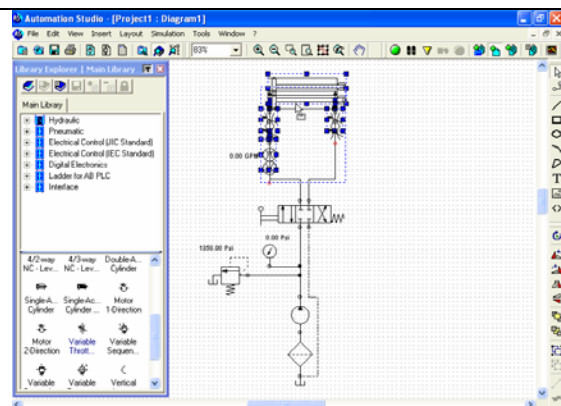


Fig 4. Design of the System using Automation Studio 3D

Example of Student Project

Faculty Mechanical and Manufacturing of KUiTTHO give a choice of doing mid semester test or class project. 15 student group selected to conduct a class assignment related to fluid power system in semester I session 2004/2005. The students are eager to conduct the project with full enthusiastic and responsible. Easy understandings of the fluid power system make it possible the student conduct project based on fluid power system. The project includes the understanding of concept of the product, design the circuit diagram, selection of the component, preliminary design of the product, develop the prototype, test the prototype. Multimedia was used to design and it is used to present each step of the project as well.

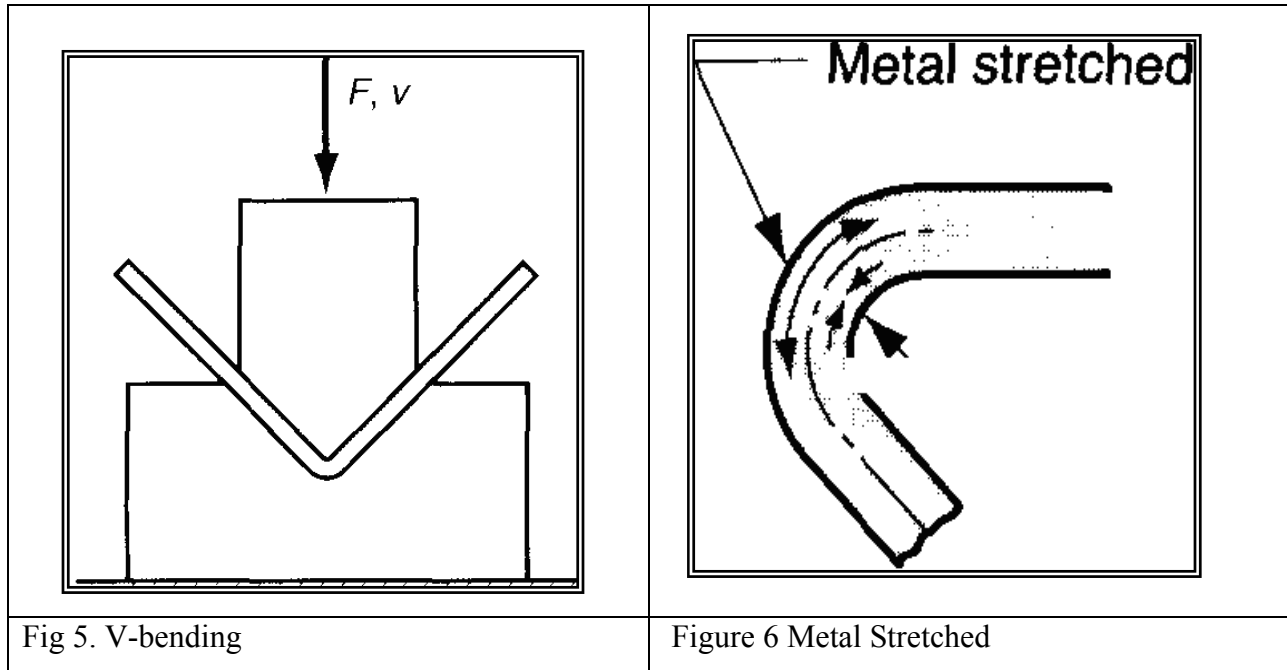
This paper shows a project of the sheet metal bending as an example of the student project in semester 1 session 2004/2005. Sheet metal bending is used to make an angle to the flat sheet metal.

Theory of sheet metal bending

Bending in sheet-metal work is defined as the straining of the metal around a straight axis as in Figure 5. During the bending operation, the metal on the inside of the neutral plane is compressed, while the metal on the outside of the neutral plane is stretched. The strain conditions can be seen in Figure 6. The metal is plastically deformed so the bend takes a permanent set upon removal of the stresses that caused it. Bending produces little or no change in the thickness of the sheet metal.

Bending is a process by which metal can be deformed by plastically deforming the material and changing its shape. The material is stressed beyond the yield strength but below the ultimate tensile strength. The surface area of the material does not change much. Bending usually refers to deformation about one axis. Bending is a flexible process by which many different shapes can be produced. Standard die sets are used to produce a wide variety of shapes. The material is placed on the die, and positioned in place with stops and/or gauges. It is held in place with hold-downs. The upper part of the press, the ram with the appropriately shaped punch descends and forms the v-shaped bend. Bending is done using Press Brakes. Press Brakes normally have a capacity of 20 to 200 tons to accommodate stock from 1m to 4.5m (3 feet to 15 feet). Larger and smaller presses

are used for specialized applications. Bending operations are performed using punch and die tooling.



The two common bending methods and associated tooling are V-bending, performed with a V-die, and edge bending, performed with a wiping die. In *V-bending*, the sheet metal is bent between a V-shaped punch and die. V-bending is generally used for low-production operations. It is often performed on a press brake, and the associated V-dies are relatively simple and inexpensive. Important terms in sheet-metal bending are identified in Fig. 7. The metal of thickness t is bent through an angle called the bend angle A . This results in a sheet-metal part with an included angle A' , where $A + A' = 180^\circ$. The bend radius R is normally specified on the inside of the part, rather than at the neutral axis. This bend radius is determined by the radius on the tooling used to perform the operation. The bend is made over the width of the work piece w

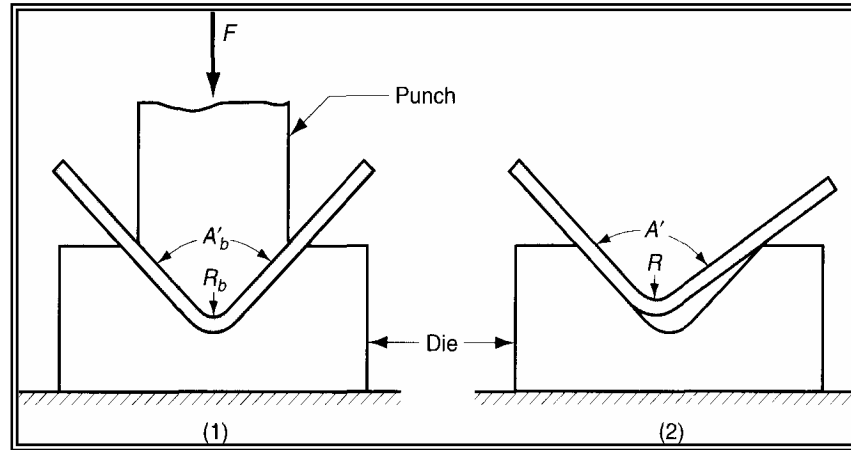


Figure 7 : Springback in bending shows itself as a decrease in bend angle and an increase in bend radius: (1) during the operation, the work is forced to take the radius R and included angle A , determined by the bending tool (punch in V-bending); (2) after the punch is removed, the work springs back to radius R and included angle A .

If the bend radius is small relative to stock thickness, the metal tends to stretch during bending. It is important to be able to estimate the amount of stretching that occurs. So the final part length will match the specified dimension.

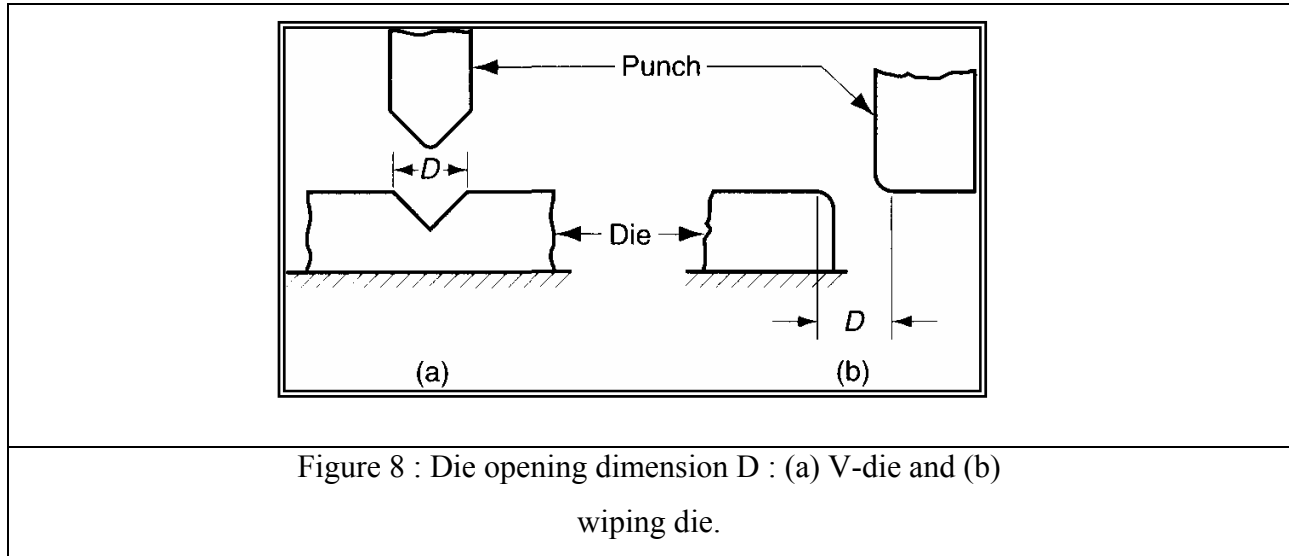
$$BA = 2\pi A(R + K_{ba}t)/360$$

where; BA = Bending allowance, A = Bending Angle, R = Bending radius, T = Stock thickness, K_{ba} = Factor to estimate stretching

The following design values are recommended for K_{ba} [2]: if $R < 2t$, $K_{ba} = 0.33$; and if $R > 2t$ $K_{ba} = 0.50$. The values of K_{ba} predict that stretching occurs only if bend radius is small relative to sheet thickness. When the bending pressure is removed at the end of the deformation operation, elastic energy remains in the bent part, causing it to recover partially toward its original shape. This elastic recovery is called springback, defined as the increase in included angle of the bent part relative to the included angle of the forming tool after the tool is removed. This is illustrated in Fig 8 and is expressed as

$$SB = (A' - A'_b) / A'_b$$

where SB = springback; A' = included angle of the sheet-metal part, degrees; and A'_b = included angle of the bending tool, degrees. Although not as obvious, an increase in the bend radius also occurs due to elastic recovery. The amount of springback increases with the modulus of elasticity E and yield strength Y of the work metal.



The force required to perform bending depends on the geometry of the punch and die and the strength, thickness, and width of the sheet metal. The maximum bending force can be estimated by means of the following equation, based on bending of a simple beam:

$$F = (K_{bf} TS w t^2) / D$$

where F = bending force, lb (N); TS = tensile strength of the sheet metal, lb/in.² (MPa); w = width of part in the direction of the bend axis, in. (mm); t = stock thickness, in. (mm); and D = die opening dimension as defined in Figure 8, in. (mm). The equation is based on bending of a simple beam in mechanics, and K_{bf} is a constant that accounts for differences encountered in an actual bending process. V-bending $K_{bf} = 1.33$

DESIGN OF THE SHEET METAL BENDING

The design of the sheet metal bending and the component is shown in Fig 9 and the component is shown in Fig 10. The animation of the assembly and the component is developed in order to make it clear. To determine the required force and the pressure to bend the sheet metal for different material and thickness a computer program is developed (Fig 11).

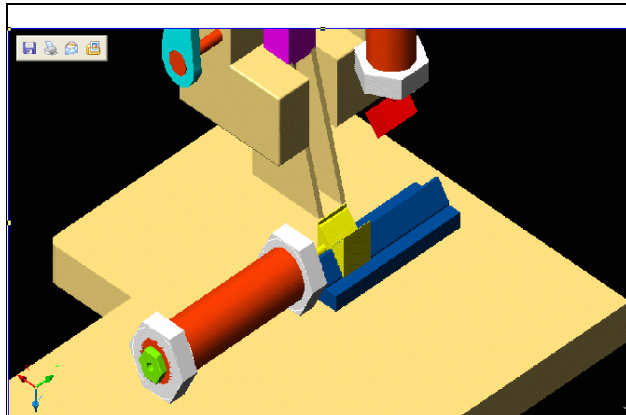


Fig 9. Design of Sheet Metal Bending



Component	Name	Specification																		
	Push button	<table><tr><td>Function</td><td>Sealing valve, direct activation (normally closed)</td></tr><tr><td>Number of routes</td><td>3</td></tr><tr><td>Drive travel</td><td>1.5 mm (basic valve)</td></tr><tr><td>Connection</td><td>1/8" tapped side outlets</td></tr><tr><td>Fluid</td><td>Compressed air, filtered, with or without lubrication</td></tr><tr><td>Operating temperature</td><td>5 to 60°C</td></tr><tr><td>Operating pressure</td><td>0 to 9.9 kgf/cm² (990 kPa)</td></tr><tr><td>Effective section (CV factor)</td><td>2.5 mm² (0.14)</td></tr></table>	Function	Sealing valve, direct activation (normally closed)	Number of routes	3	Drive travel	1.5 mm (basic valve)	Connection	1/8" tapped side outlets	Fluid	Compressed air, filtered, with or without lubrication	Operating temperature	5 to 60°C	Operating pressure	0 to 9.9 kgf/cm ² (990 kPa)	Effective section (CV factor)	2.5 mm ² (0.14)		
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	Regulator	<table><tr><td>Maximum feed pressure</td><td>15 bar</td></tr><tr><td>Maximum running pressure</td><td>10 bar</td></tr><tr><td>Regulation field</td><td>0.5 – 8.5 bar</td></tr><tr><td>Maximum flow rate</td><td>500 Nl/min</td></tr><tr><td>Running temperature</td><td>5 to 60°C</td></tr><tr><td>Filter cartridge</td><td>5 microns</td></tr><tr><td>Recommended oil</td><td>ISO VG32</td></tr><tr><td>Vessel material</td><td>Polycarbonate</td></tr><tr><td>Weight</td><td>660 g</td></tr></table>	Maximum feed pressure	15 bar	Maximum running pressure	10 bar	Regulation field	0.5 – 8.5 bar	Maximum flow rate	500 Nl/min	Running temperature	5 to 60°C	Filter cartridge	5 microns	Recommended oil	ISO VG32	Vessel material	Polycarbonate	Weight	660 g
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Fig 10. Specification of the component

The cascade circuit is used for the sheet metal stamping which contains two double acting cylinders. There are 2 types of movement i.e. for clamping and for stamping/cutting. The first step of designing circuit is to check whether the process of clamping and stamping is really functioned. Then, the component of the circuit is selected and the last step is to design the sequence of the movement. The circuit diagram is shown in Fig 16 completed with full speed or step by step animation

METAL SHEET BENDING CALCULATION

Bend Angle, A	60	degrees
Bend Radius, R	60	mm
Thickness, t	2	mm
A'	45	degrees
A _b	65	degrees
Tensile Strength, TS	12000	Pa (N/m ²)
Width, w	15	mm
Die Opening, D	15	mm
Distance / Stroke	10	mm
Time of Stroke	5	second
Punch Area	0.003	m ²

Force Required		Power and Pressure Required	
BEND ALLOWANCE, BA	: 0.06386734	mm	POWER 0.00012760
SPRINGBACK, SB	: -30.76323	%	PRESSURE 0.0002129
BENDING FORCE THAT	: 0.06384001	N	

Fig 11. Computer Program

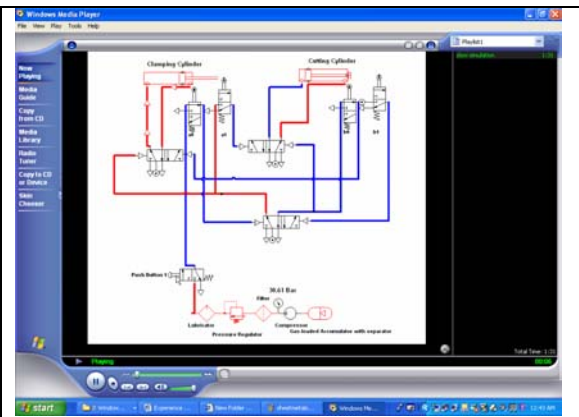


Fig 12. Circuit Diagram

The stress distribution and displacement of the plate is calculated using finite element software. The animation of existed displacement is shown in Fig 13. The sample of the simulation is to demonstrate the effect of force to the sheet metal in stamping process. The reading of forces/strain/stress and deflection can not be used as reference. By this simulation, people can monitor what was happen during the bending and stamping.

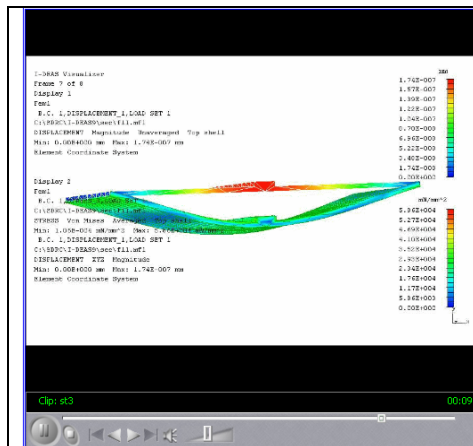


Fig 13. Displacement



Fig 14. Working operation

Each step of the assembly of the component and working operation of the sheet metal bending is recorded using the multimedia of the component is shown using the multimedia. Fig 14 shows the working operation of the sheet metal bending as an example of the whole processes.

Conclusions

The usage of the multi media in process of teaching and learning can assist the creation of student interest to a relevant subject. The usage of multimedia can speed up the understanding of the student to the relevant subject and the students have a time to apply the knowledge to produce the real product.

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