

HYPNEU MODELING OF 1250KN HYDRAULIC FORMING PRESS

Introduction:

This illustrates the use of HyPneu in developing a model for a typical hydraulic press used in the metal forming operation. The selection of major hydraulic components is done based on the equipment specification and as shown below.

<u>Capacity</u>	<u>Bed length</u>	<u>Stroke length</u>	<u>Stroke/min</u>	<u>Mat/ thickness</u>
1250KN/140ton	30 inches	6 inches	15	Steel/1/4"

Hydraulic Actuator :

$$\text{Cyl area} = \text{Force/pressure}$$

There are two actuators sharing the total load(1250KN) and working at maximum system pressure of 3000psi. Therefore, the effective piston area will be 3.224 square inches. Accordingly, the cylinder dimensions can be as follows.

$$\text{cyl bore: } 2'' \text{ ; cyl rod: } 1'' \text{ ; stroke length= } 6''$$

However, the actual load can be calculated based on actual length, thickness and shear strength of the material used. There are some empirical equations that can be used for computation of the load. One such equation is given below.

$$\text{Force} = (3500 \times \text{length} \times \text{thickness}) \text{ lbf}$$

Hydraulic pump :

The pump capacity is computed based on the maximum strokes required per minute that is speed of the actuator. In the above example, to perform 15 strokes/in the actuator should extend with in 2sec and hence the flow required can be calculated as follows.

$$\text{flow} = (3.224 \times 6)/2 = 9.672 \text{ cubic in/sec/actuator}$$

$$\text{Therefore, } Q = (9.672 \times 60/231) \times 2 = 5.02 \text{ gpm}$$

Assuming the volumetric efficiency of 90%@3000 psi the pump flow rate should be about 5.6 gpm. Hence, for a motor rpm of 1800, the pump displacement should be 0.716 cubic in/rev.

Control Elements :

Control elements are chosen based on the type of control needed in the circuit. In the above hydraulic system, the actuator is expected to approach fast and then do the forming operation at much slower speed. This is accomplished by using the amplified signal of the actuator position to control the different servo valves.

HyPneu Model :

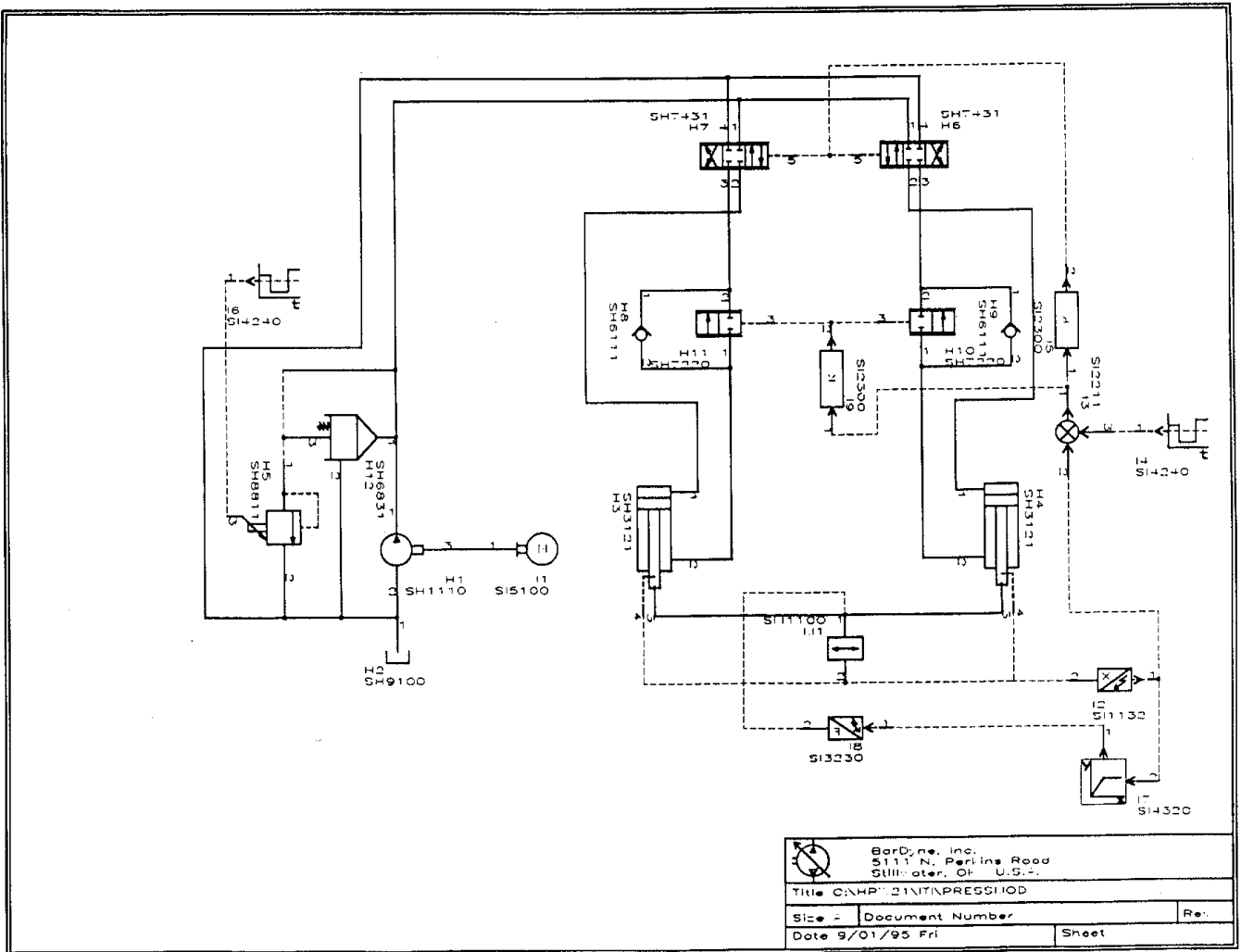
The HyPneu schematic of a basic configuration of a hydraulic press is shown below. The following table gives the functional description of various icons used to represent the components as well as their critical parametric values.

<u>HyPneu Icon</u>	<u>Function</u>	<u>Component data</u>
SH3111	Hydraulic cylinder for linear actuation	Bore 2", rod 1" , Stroke length 6"
SH1110	Hydraulic pump	Displacement 0.75 cu in/rev
SI5100	Electric motor	rpm 1800
SH4111	Relief valve	Pcr 3000 psi ; Max flow 10 gpm
SH9100	tank	Ref. pressure 0 psi
SH8811	Proportionate pressure control valve	Pcr 200 to 1500 psi; flow 2 gpm
SH7431	Closed center, 4 port, 3 position servo valve	press-flow coeff kv 1; linear flow gain
SH6111	free bypass check valve	Max flow 10 gpm @ 10 psi
SH7220	closed center, 2 port, 2 position servo valve to function as a metering out valve for the cylinder	kv 1; linear flow gain
SM1110	Total moving mass attached to the cylinder rod including the self wt.	500 LB
SI1132	Actuator position transducer	gain 1;
SI4320	loading ramp as a function of cylinder displacement	ramp 4" to 6" end of stroke; total load 150000
SI3230	force vector takes amplitude from the ramp and gives the direction of application	
SI2211	signal summer to generate error signal	gain +1 @ port2 & -1 @port 3
SI4240	reference signal for actuator position	max stroke length 6 @0sec

Simulation Result & Discussion :

The simulation result of the above system has been plotted and shown below for discussion. The displacement plot indicates the fast approach and slow pressing operation. The application of pressure and corresponding change in pressure is also shown in the separate graph. With the above model it is possible to analyze the system performance at any given speed and load condition.

12 IN HYDRAULIC PRESS



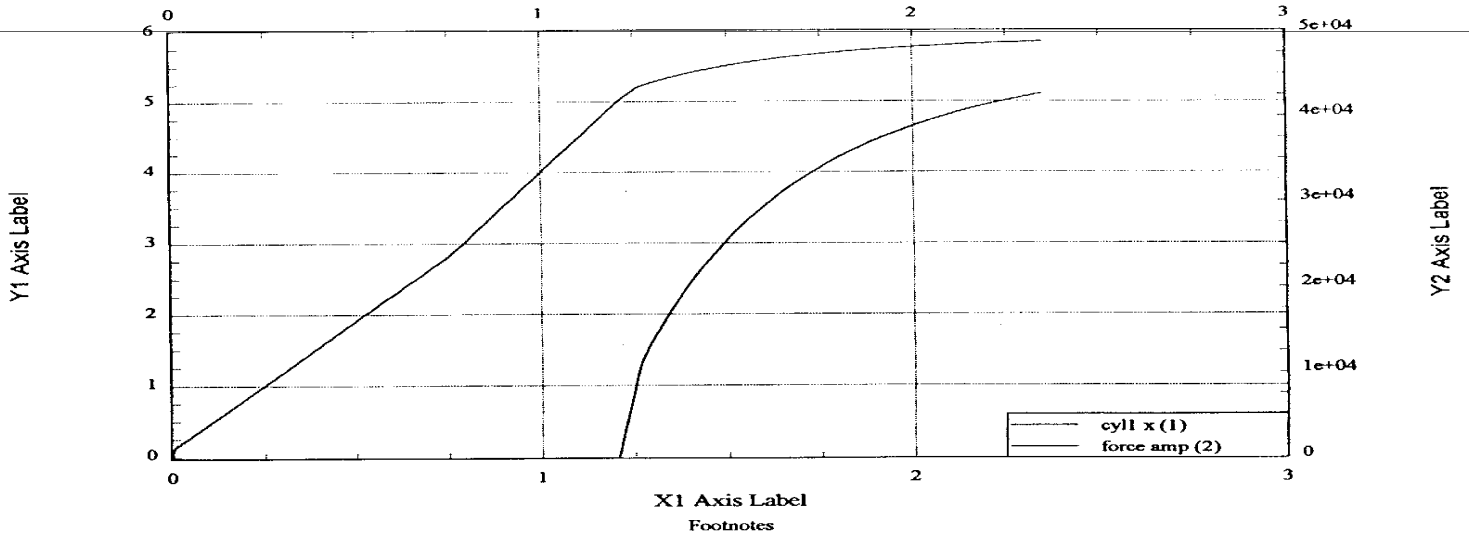
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Footnotes

