International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 11 | Nov 2021 www.irjet.net p-ISSN: 2395-0072

Prediction of Ultimate Load in CFST Columns Using ANN (Artificial Neural Network) Model

Padma V P[1], Dr N S Kumar[2]

[1]M.Tech, Structural Engineering, Ghousia College of Engineering, Ramanagara, Karnataka, India
[2]Prof & HoD, Former Director (R&D), Dept, of Civil Engineering, Ghousia College of Engineering, Ramagara, Karnataka, India

---***---

Abstract - *A circular concrete filed steel tubes (CFST) has numerous benefits in comparison with reinforced concrete member or hollow steel tube, for the reason that tri-axial kingdom of compression of the concrete infill will increase its power and pressure capacity. In this studies research at the behaviour of self-compacting concrete filled steel tube (CFST) is carried out. Composite round hallow metal tubes with infill of various grades of self-compacting concrete are examined for final load capacity. Modelling is performed the usage of Artificial Neural Network (ANN) method that's a gentle device in MATLAB and consequences have been obtained.*

This research is based on CFST columns, when subjected to bearing capacities, using Artificial Neural Network in MATLAB. Further investigating their capability of connsequences by creating diversity in network properties by altering (Hidden layers, neurons) An Artificial Neural Network (ANN) is an attempt to simulate the network of neurons that make up a human brain so that the computer will be able to learn things and make decicions in a human like manner. ANNs are created by programming regular computers to behave as though they are interconnected brain cells. This paper will provides an introduction to artificial neural network a brief appilicability to problems. Here the predicted results will be compared will experimental results to depict the efficiency of artificial intelligence.

Key Words: **Artificial neural network, MATLAB, concrete filled steel tubular (CFST)**

1.INTRODUCTION

At this contemporary time, CFST columns are broadly speaking utilized in construction. Nowadays, this type of structural elements is favoured in practice because of its small cross-sectional area to load carrying capacity ratio. Hence Mega concrete columns in tall buildings lower floors can be substituted by smaller sections of CFST columns. Moreover, CFST elements can be used as piers for bridges at congested areas. Therefore, such structural factors must be very well investigated earlier than utilized in crucial structures. CFST columns use combine action of steel and concrete when carrying compression loads and moments showing in ideal structural performance. While the steel tube confined the concrete core enhancing its compressive strength, the concrete core prevents the steel section from experiencing local buckling. Due to that, the use of CFST columns has increased, becoming very popular in the last years.

Columns occupy vital area in structural system. Weakness or failure of a column destabilizes the whole structure. Structure and ductility of steel columns need to be ensured through adequate strengthening, repair & rehabilitation techniques to maintain adequate structural performance. One manner of inclusive of specimen irregularities withinside the version is to apply the consequences of the available experiments to predict the behaviour of composite tubes subjected to different loading. The bond between the steel tubes and the concrete core is the integral factor for understanding the behaviour of concrete filled steel tubes columns. Since, steel and concrete are two different materials they have different stress strain properties.

Hence it is difficult to determine the effective structural property. The important parameters affecting the load deformation behaviour, ultimate strength and the failure mechanism of CFT's under a given loading condition are

- The geometric parameters like shape of the cross section, the member size, thickness of steel tube, L/D ratio of the breadth.
- Grades of concrete and steel
- Type and rate of application of loading and boundary conditions

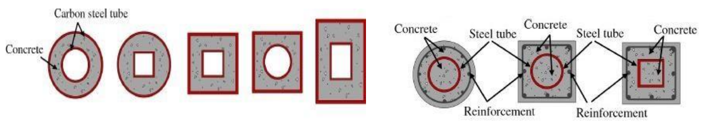


Fig:1
Typical Cross-Sections of Concrete Filled & RCC Filled

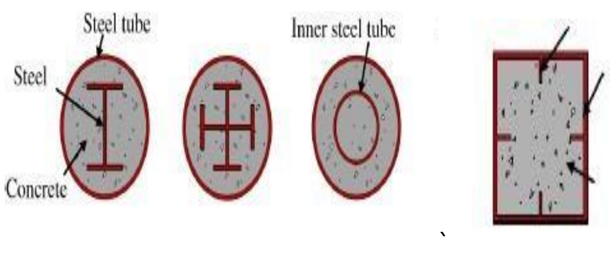


Fig:2 Concrete Encased & Stiffened CFST Columns

1.1 ARTIFICIAL NEURAL NETWORK:

What is a Neural Network?

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurones) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurones. This is true of ANNs as well.

1.2 Historical background

Neural network simulations appear like a current development. However, this area became mounted earlier than the arrival of computers, and has survived at the least one foremost setback and numerous eras. Many critical advances had been boosted with the aid of using the usage of cheaper pc emulations. Following an preliminary length of enthusiasm, the sector survived a length of frustration and disrepute. During this era whilst investment and expert guide became minimal, critical advances have been made with the aid of using rather few reserchers. These pioneers have been capable of broaden convincing era which exceeded the restrictions diagnosed with the aid of using Minsky and Papert. Minsky and Papert, posted a book (in 1969) wherein they summed up a standard feeling of frustration (towards neural networks) amongst researchers, and became hence established with the aid of using maximum with out similarly analysis. Currently, the neural network area enjoys a resurgence of hobby and a corresponding boom in investment.

The first artificial neuron became produced in 1943 with the aid of using the neurophysiologist Warren McCulloch and the philosopher Walter Pits. But the era to be had at that point did now no longer permit them to do too much.

1.3 Why neural networks?

Neural networks, with their incredible cappotential to derive which means from complex or obscure records, may be used to extract styles and locate developments which are too complicated to be observed via way of means of both human beings or different pc techniques. A educated neural community may be idea of as an "professional" withinside the class of records it's been given to analyse. This professional can then be used to offer projections given new conditions of hobby and answer "what if" questions. Other benefits include:

1. Adaptive mastering: An cappotential to discover ways to do responsibilities primarily based totally at the records given for schooling or preliminary experience.
2. Self-Organisation: An ANN can create its very own employer or illustration of the records it gets at some point of mastering time.
3. Real Time Operation: ANN computations can be achieved in parallel, and unique hardware gadgets are being designed and synthetic which take benefit of this capability.
4. Fault Tolerance thru Redundant Information Coding: Partial destruction of a community results in the corresponding degradation of performance. However, a few community abilties can be retained in spite of primary community damage.

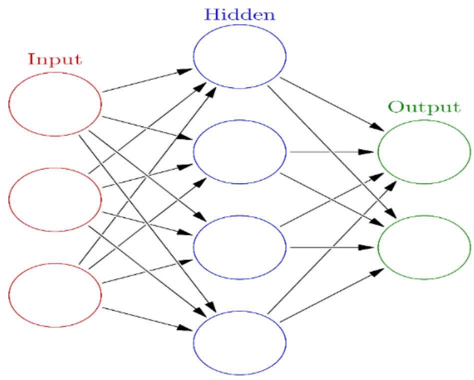


Fig: 3
ARTIFICIAL NEURAL NETWORK

1.4 METHODOLOGY:

Feed-forward networks

Feed-forward network ANNs permit indicators to tour one manner only; from enter to output. There isn't anyt any remarks (loops) i.e. the output of any layer does now no longer have an effect on that identical layer. Feed-forward network ANNs have a tendency to be clear-cut networks that companion inputs with outputs. They are appreciably utilized in sample recognition. This sort of enterprise is likewise called bottom-up or top-down.

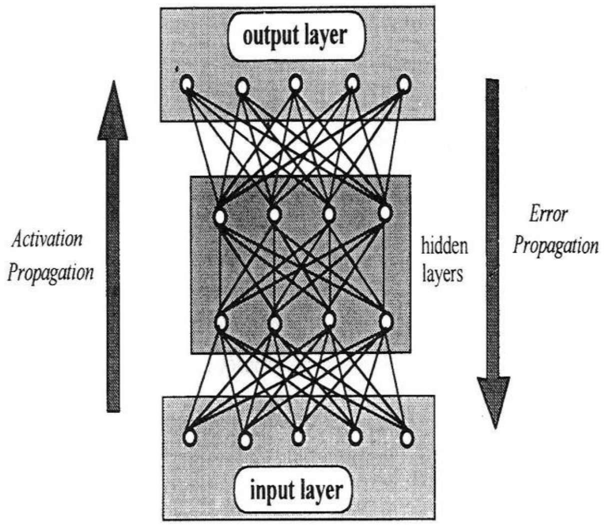


Fig:4
Architecture of a back-propagation neural network

1.5 WORK FLOW:

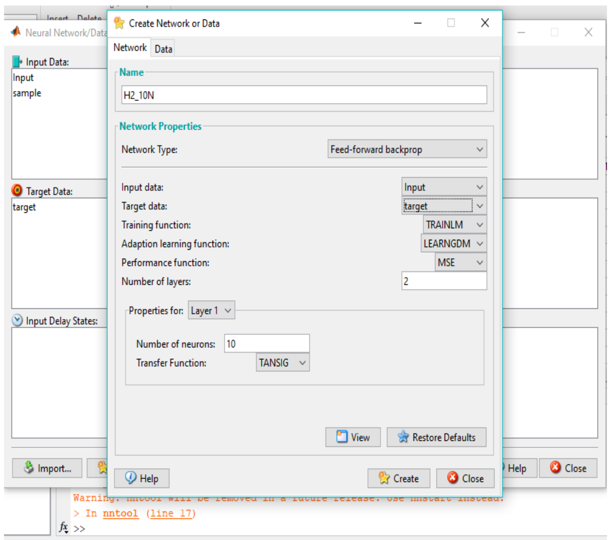
The general procedure of working mechanism of neural network process involves steps are as fallows:

- Collection of data
- network creation (defining network properties)
- configure the created network
- Training of network
- Validation of network, (ie, analysis after training the network)
- Use the network.

EXPERIMENTAL DATA'S:

DATA(1):
Faizan Khan, Dr N S Kumar. et,al (2020)[1]

Year	Grade	Dia (mm)	L (mm)	T (mm)	D/T (mm)	L/D (mm)	Pu Exp KN
2007	Hallow	160	750.4	2.5	64	4.69	361.4
2007	M20	160	750.4	2.5	64	4.69	491.3
2007	M30	160	750.4	2.5	64	4.69	693.3
2010	Hallow	139.6	800	4	34.9	5.73	453.3
2010	M20	139.6	800	4	34.9	5.73	598.6
2010	M30	139.6	800	4	34.9	5.73	712.4
2010	Hallow	139.6	2000	4	34.9	14.32	470.5
2010	M20	139.6	2000	4	34.9	14.32	610.3
2010	M30	139.6	2000	4	34.9	14.32	739
2011	Hallow	11.25	750.4	2.5	44.5	6.75	267.3
2011	M20	11.25	750.4	2.5	44.5	6.75	331.3
2011	M30	11.25	750.4	2.5	44.5	6.75	427.3
2013	Hallow	160	400	2.8	57.14	2.5	261.3
2013	M20	160	400	2.8	57.14	2.5	297.3
2013	M30	160	400	2.8	57.14	2.5	371
2013	Hallow	160	1000	2.8	57.142	6.25	283.3
2013	M20	160	1000	2.8	57.142	6.25	643
2013	M30	160	1000	2.8	57.142	6.25	687
2014	Hallow	60.3	301.5	2.9	20.79	5	99.5
2014	M20	60.3	301.5	2.9	20.79	5	153.7
2014	M30	60.3	301.5	2.9	20.79	5	182.1
2014	Hallow	60.6	422.1	3.6	16.75	7	112.6
2014	M20	60.3	422.1	3.6	16.75	7	168.2
2014	M30	60.3	422.1	3.6	16.75	7	195.6



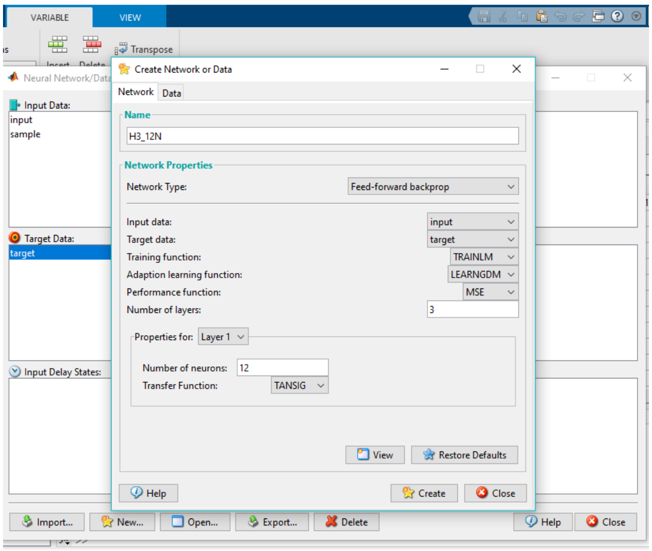


Fig:5 Representation of Network Properties

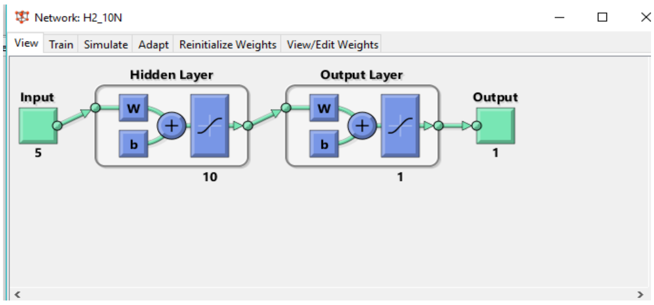


Fig:6 Representation of 2 Hidden layer network

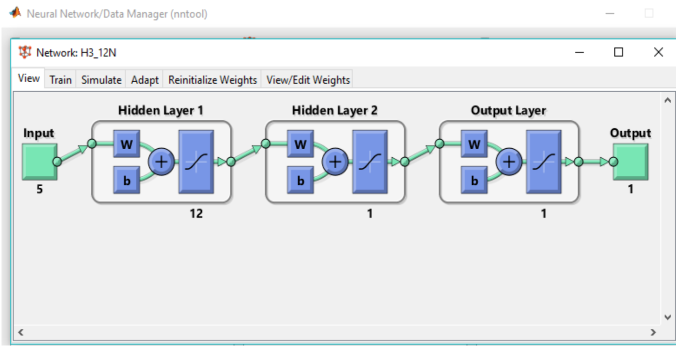


Fig:7 Representation of 3 Hidden layer network

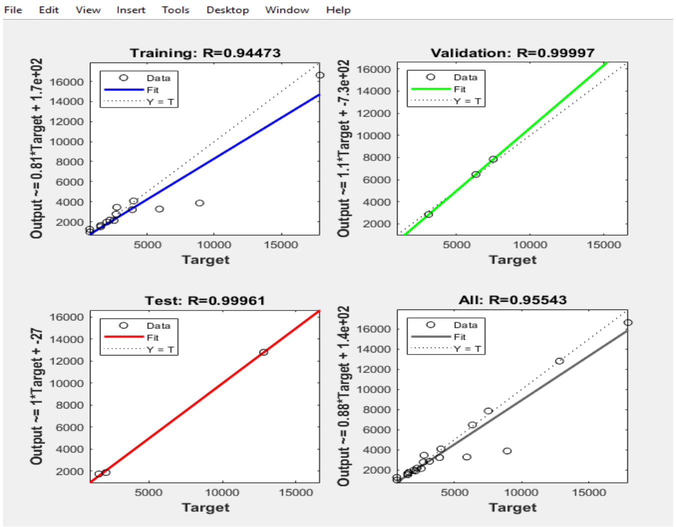


Fig:8 Regression plot for 2 Hidden layer

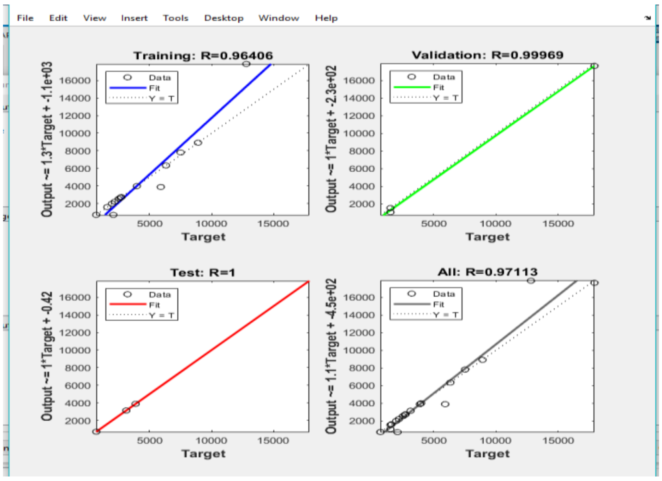


Fig:9 Regression plot for 3 Hidden layer

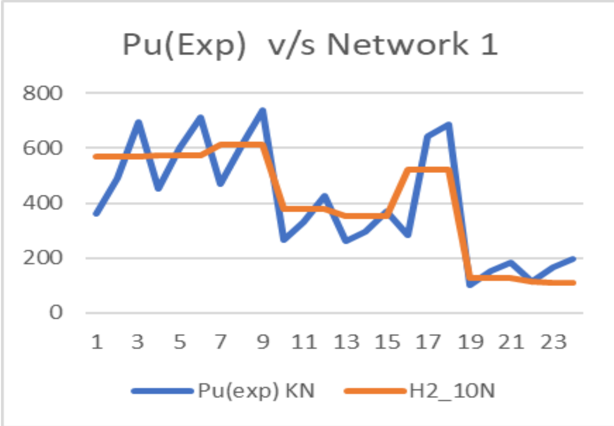
Pattern	Description	Considered as
H2_10N	2 Hidden layer, 10 Neurons	Network 1
H2_13N	2 Hidden layer, 13 Neurons	Network 2
H3_6N	3 Hidden layer, 6 Neurons	Network 3
H3_7N	3 Hidden layer, 7 Neurons	Network 4
H3_12N	3 Hidden layer, 12 Neurons	Network 5

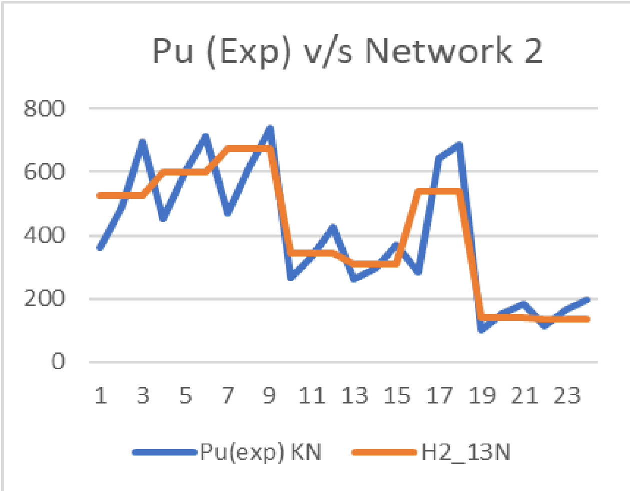
RESULT ANALYSIS (1)

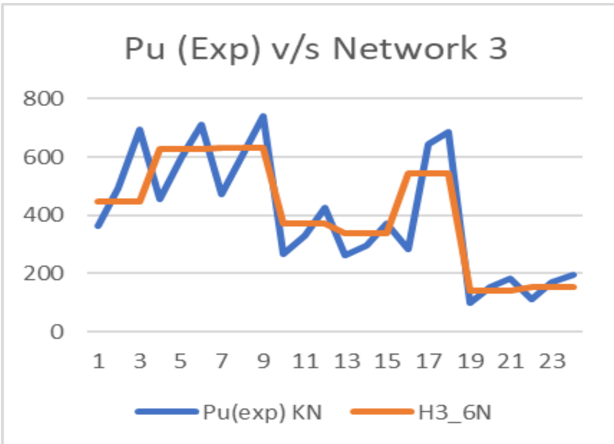
Pu (Exp) KN	H2_10N	H2_13N	H3_6N	H3_7N	H3_12N
361.4	571.1126	526.2905	446.4283	491.2978	566.1621
491.3	571.1126	526.2905	446.4283	491.2978	566.1621
693.3	571.1126	526.2905	446.4283	491.2978	566.1621
453.3	571.4351	597.8206	628.453	582.8501	577.9463
598.6	571.4351	597.8206	628.453	582.8501	577.9463
712.4	571.4351	597.8206	628.453	582.8501	577.9463
470.5	613.8063	674.5555	629.2429	604.75	680.9862
610.3	613.8063	674.5555	629.2429	604.75	680.9862
739	613.8063	674.5555	629.2429	604.75	680.9862
267.3	378.5931	341.9589	369.5346	341.9675	371.1306
331.3	378.5931	341.9589	369.5346	341.9675	371.1306
427.3	378.5931	341.9589	369.5346	341.9675	371.1306
261.3	352.1523	310.5294	337.4255	309.8679	332.0113
297.3	352.1523	310.5294	337.4255	309.8679	332.0113
371	352.1523	310.5294	337.4255	309.8679	332.0113
283.3	523.0951	537.9805	544.5736	537.7671	631.8878
643	523.0951	537.9805	544.5736	537.7671	631.8878
687	523.0951	537.9805	544.5736	537.7671	631.8878
99.5	126.437	141.8546	141.3086	126.6019	155.2574
153.7	126.437	141.8546	141.3086	126.6019	155.2574
182.1	126.437	141.8546	141.3086	126.6019	155.2574
112.6	111.986	135.7558	153.8937	126.5684	155.2572
168.2	111.7361	135.8289	153.941	126.5682	155.2572
195.6	111.7361	135.8289	153.941	126.5682	155.2572

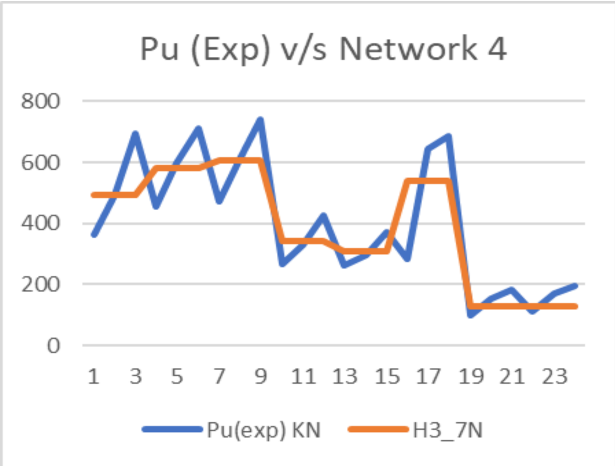
Accuracy	98.60%	98.06%	98.54%	**99.62%**	92.30%
% Error	4.50%	5.96%	7.37%	**1.03%**	14.09%

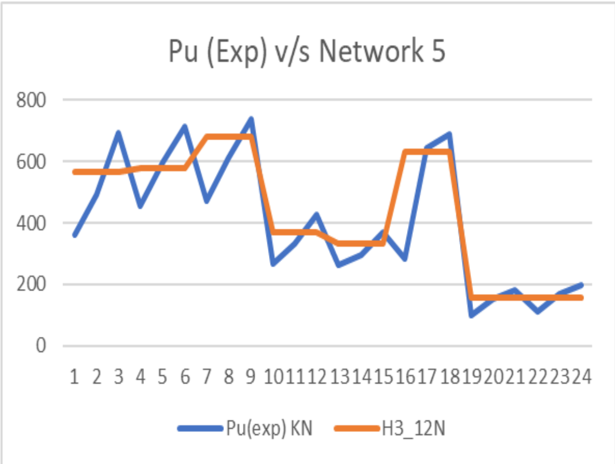
Comparision of graphs between Pu(Exp) & different Network type of data(1)











DATA(2):

Sumalatha H, Dr N S Kumar (2020)[2]

No of specimens	L (mm)	D (mm)	T (mm)	L/D (mm)	D/T (mm)	Pu (Exp)KN
12	360	99.2	4.91	3.62	20.2	2520
	1514	198.99	4.95	7.6	40.2	7506
18	1512	98.87	4.89	15.3	20.2	2087
	3512	200.67	4.95	17.5	40.5	6329
15	450	150	8	3	18.75	5911
	450	150	12.5	3	12	8912
6	600	197	6.1	3.04	32.2	2730
	600	201	10.3	3	19.5	3980
8	1000	101.6	3	9.8	33.8	718
	2700	150	4.5	18	33.33	1516
8	330	110	5	3	22	2203
	570	190	5	3	38	3882
3	750	249.6	3.7	3	67.4	2677
	750	251.1	3.75	3	66.9	3131
2	675	150	3	4.5	50	1516

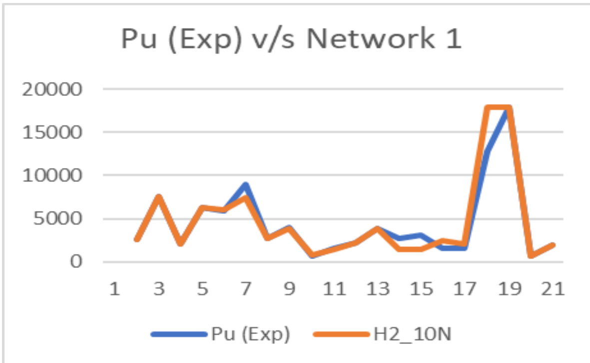
	900	150	3	6	50	1599
4	1230	410	10	3	41	12800
	1500	500	16	3	31.2	17900
10	300	99.9	2.85	3	35.05	705
	450	152	4.9	2.96	1.65	1976

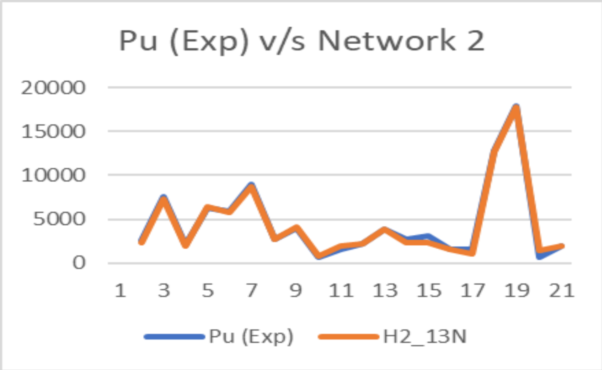
RESULT ANALYSIS (2)

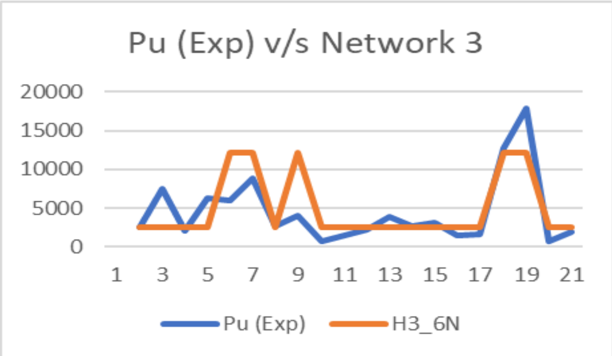
Pu (Exp) KN	H2_10N	H2_13N	H3_6N	H3_7N	H3_12N
2520	2531.6029	2347.9013	2584.4	2461.6859	1183.5629
7506	7605.5173	7285.9699	2584.4	6614.3652	7495.6208
2087	2041.2522	2005.4068	2584.4	893.7946	772.9591
6329	6306.2875	6386.0103	2584.4	6841.4119	6333.7401
5911	6039.1254	5732.5431	12138.5972	6251.6211	7577.7547
8912	7443.9582	8659.3101	12138.5972	9057.5252	8903.5172
2730	2731.5404	2738.5831	2584.4	5413.1357	2729.6081
3980	3865.3118	4092.9385	12138.5972	4176.5826	3976.8525
718	732.5705	750.3829	2584.4	1167.334	748.3182
1516	1478.4497	1907.6109	2584.4	1354.8998	862.0794
2203	2184.0886	2221.7769	2584.4	2847.8705	2174.8473
3882	3902.7301	3830.1381	2584.4	3964.4989	3856.4441
2677	1452.676	2305.0587	2584.4	3452.237	2874.7178
3131	1471.8518	2358.1448	2584.4	3540.6314	2920.3356
1516	2497.3876	1553.4168	2584.4	1650.3375	3005.9877
1599	2095.8751	1004.7163	2584.4	1731.2849	1577.3128
12800	17866.1867	12676.0454	12138.5972	12851.411	12845.1631
17900	17899.7796	17854.2078	12138.5972	17664.0463	17826.7875
705	712.8732	1429.7681	2584.4	1383.6848	918.836
1976	1899.4637	1917.1165	2584.4	2112.481	1977.5883

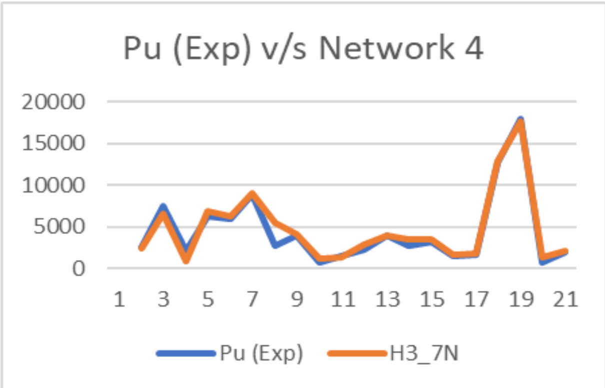
Accuracy	97.67%	99.03%	91.09%	94.93%	**99.73%**
%error	0.76%	1.90%	46.40%	14.60%	**0.04%**

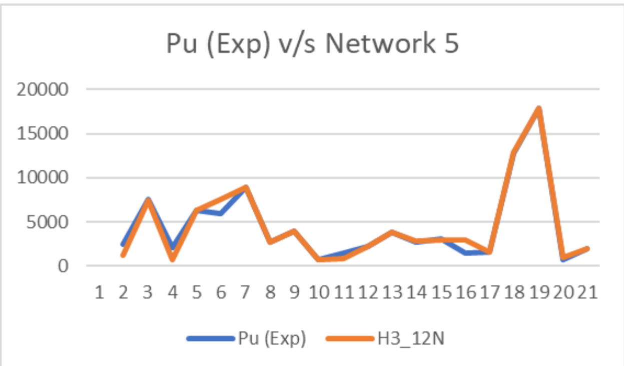
Comparision of graphs between Pu(Exp) & different Network type of data(2)











DATA(3):

Chethan K, Dr N S Kumar (2018)[3]

Year	Grade	D (mm)	L (mm)	T (mm)	D/T (mm)	L/D (mm)	Pu (Exp)
2007	Hallow	160	750.4	2.5	64	4.69	361.4
2007	M20	160	750.4	2.5	64	4.69	491.3
2007	M30	160	750.4	2.5	64	4.69	693.3
2010	Hallow	139.6	800	4	34.9	5.73	453.3
2010	M20	139.6	800	4	34.9	5.73	598.6
2010	M30	139.6	800	4	34.9	5.73	712.4
2010	Hallow	139.6	2000	4	34.9	14.32	470.5
2010	M20	139.6	2000	4	34.9	14.32	610.3
2010	M30	139.6	2000	4	34.9	14.32	739
2011	Hallow	111.25	750.4	2.5	44.5	6.75	267.3
2011	M20	111.25	750.4	2.5	44.5	6.75	331.3
2011	M30	111.25	750.4	2.5	44.5	6.75	427.3
2013	Hallow	160	400	2.8	57.14	2.5	261.3
2013	M20	160	400	2.8	57.14	2.5	297.5
2013	M30	160	400	2.8	57.14	2.5	371
2013	Hallow	160	1000	2.8	57.14	6.25	283.3
2013	M20	160	1000	2.8	57.14	6.25	643
2013	M30	160	1000	2.8	57.14	6.25	687
2014	Hallow	60.3	301.5	2.9	20.79	5	99.5
2014	M20	60.3	301.5	2.9	20.79	5	153.7
2014	M30	60.3	301.5	2.9	20.79	5	182.1
2014	Hallow	60.3	422.1	3.6	16.75	7	112.6
2014	M20	60.3	422.1	3.6	16.75	7	168.2
2014	M30	60.3	422.1	3.6	16.75	7	195.6
2016	Hallow	26.9	215.8	3.2	8.4	8	70
2016	M20	26.9	215.8	3.2	8.4	8	80
2016	M30	26.9	215.8	3.2	8.4	8	90
2016	Hallow	26.9	404.8	3.2	8.4	15	75
2016	M20	26.9	404.8	3.2	8.4	15	88.3

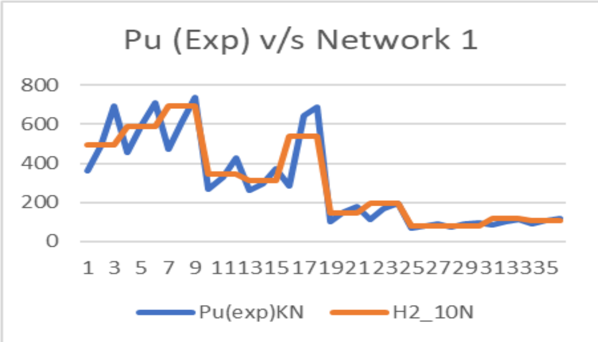
2016	M30	26.9	404.8	3.2	8.4	15	93.7
2016	Hallow	33.7	215.8	3.2	10.53	6.4	84
2016	M20	33.7	215.8	3.2	10.53	6.4	101.7
2016	M30	33.7	215.8	3.2	10.53	6.4	112.3
2016	Hallow	33.7	404.8	3.2	10.53	12	90
2016	M20	33.7	404.8	3.2	10.53	12	110
2016	M30	33.7	404.8	3.2	10.53	12	120

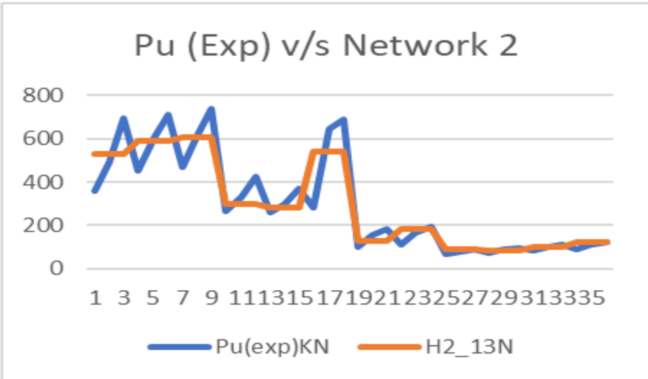
RESULT ANALYSIS (3)

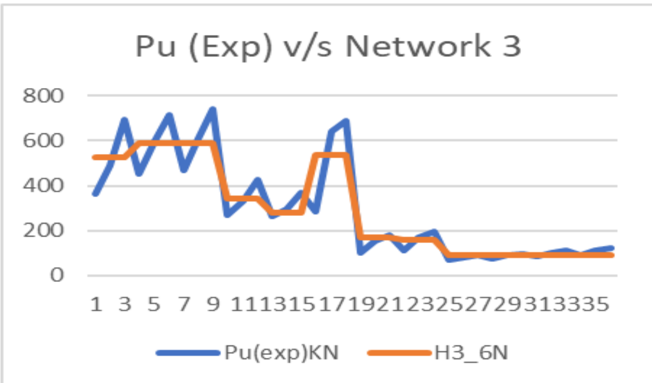
Pu (Exp) KN	H2_10N	H2_13N	H3_6N	H3_7N	H3_12N
361.4	495.2531	527.35	527.35	507.4863	528.1024
491.3	495.2531	527.35	527.35	507.4863	528.1024
693.3	495.2531	527.35	527.35	507.4863	528.1024
453.3	589.2775	588.1	588.1	566.7651	557.6043
598.6	589.2775	588.1	588.1	566.7651	557.6043
712.4	589.2775	588.1	588.1	566.7651	557.6043
470.5	694.9792	606.6	586.485	566.7439	550.6285
610.3	694.9792	606.6	586.485	566.7439	550.6285
739	694.9792	606.6	586.485	566.7439	550.6285
267.3	342.7364	299.3	341.9667	340.6572	299.1479
331.3	342.7364	299.3	341.9667	340.6572	299.1479
427.3	342.7364	299.3	341.9667	340.6572	299.1479
261.3	311.2712	279.4	279.4	334.6206	310.3105
297.5	311.2712	279.4	279.4	334.6206	310.3105
371	311.2712	279.4	279.4	334.6206	310.3105
283.3	537.7023	537.7667	537.7667	536.318	531.569
643	537.7023	537.7667	537.7667	536.318	531.569
687	537.7023	537.7667	537.7667	536.318	531.569
99.5	146.7851	126.6	167.9	148.7571	155.1883
153.7	146.7851	126.6	167.9	148.7571	155.1883
182.1	146.7851	126.6	167.9	148.7571	155.1883
112.6	193.9124	181.9	158.8	189.814	168.4473
168.2	193.9124	181.9	158.8	189.814	168.4473
195.6	193.9124	181.9	158.8	189.814	168.4473
70	81.6342	90	90.125	94.091	90.6826
80	81.6342	90	90.125	94.091	90.6826
90	81.6342	90	90.125	94.091	90.6826
75	82.5592	84.35	90.125	85.4488	90.6785
88.3	82.5592	84.35	90.125	85.4488	90.6785
93.7	82.5592	84.35	90.125	85.4488	90.6785
84	120.1881	99.3333	90.125	107.2018	91.1886
101.7	120.1881	99.3333	90.125	107.2018	91.1886
112.3	120.1881	99.3333	90.125	107.2018	91.1886
90	106.6091	120	90.125	101.402	90.6785
110	106.6091	120	90.125	101.402	90.6785
120	106.6091	120	90.125	101.402	90.6785

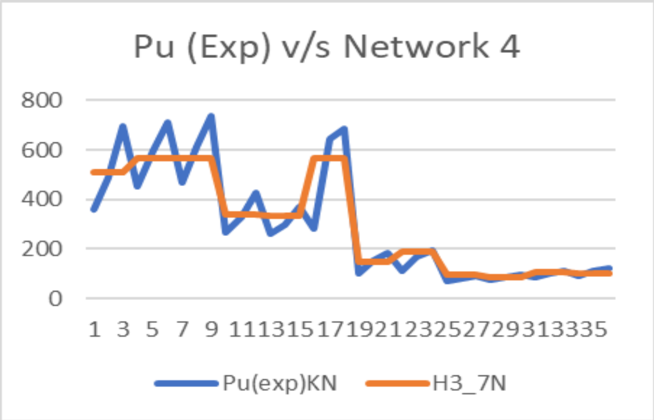
Accuracy	96%	**99.90%**	99.70%	99.00%	99.32%
%error	9.10%	**4.90%**	5.40%	8.50%	5.10%

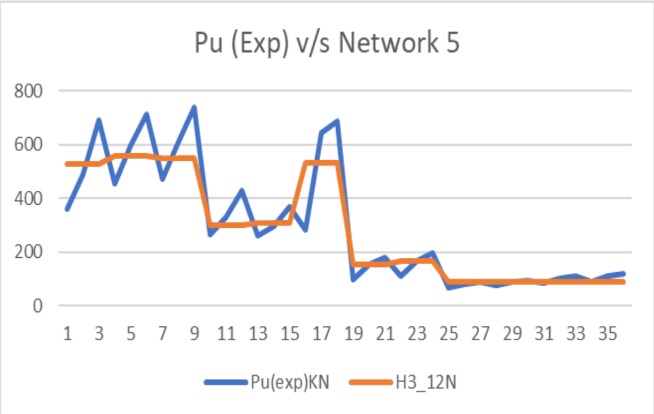
Comparision of graphs between Pu(Exp) & different Network type of data(3)











DATA(4):

Mohammed Jawahar Soufain, Dr N S Kumar. et,al(2017)

Grade	D (mm)	L (mm)	T(mm)	D/T (mm)	L/D (mm)	Pu (Exp)kn
20	60.3	301.5	2.9	20.79	5	199.1
20	60.3	301.5	3.6	16.75	5	224.82
20	60.3	301.5	4.5	13.4	5	250.63
20	60.3	422.1	2.9	20.79	7	194.72
20	60.3	422.1	3.6	16.75	7	206.31
20	60.3	422.1	4.5	13.4	7	230.12
20	60.3	542.7	2.9	20.79	9	179.52
20	60.3	542.7	3.6	16.75	9	199.4
20	60.3	542.7	4.5	13.4	9	219.2
25	60.3	301.5	2.9	20.79	5	207.07
25	60.3	301.5	3.6	16.75	5	232.63
25	60.3	301.5	4.5	13.4	5	259.82
25	60.3	422.1	2.9	20.79	7	204.13
25	60.3	422.1	3.6	16.75	7	220.73
25	60.3	422.1	4.5	13.4	7	248.09
25	60.3	542.7	2.9	20.79	9	200.41
25	60.3	542.7	3.6	16.75	9	208.33
25	60.3	542.7	4.5	13.4	9	229.51
30	60.3	301.5	2.9	20.79	5	221.03
30	60.3	301.5	3.6	16.75	5	233.92
30	60.3	301.5	4.5	13.4	5	268.16
30	60.3	422.1	2.9	20.79	7	213.01
30	60.3	422.1	3.6	16.75	7	230.53
30	60.3	422.1	4.5	13.4	7	259.12
30	60.3	542.7	2.9	20.79	9	207.02
30	60.3	542.7	3.6	16.75	9	214.15
30	60.3	542.7	4.5	13.4	9	236.22

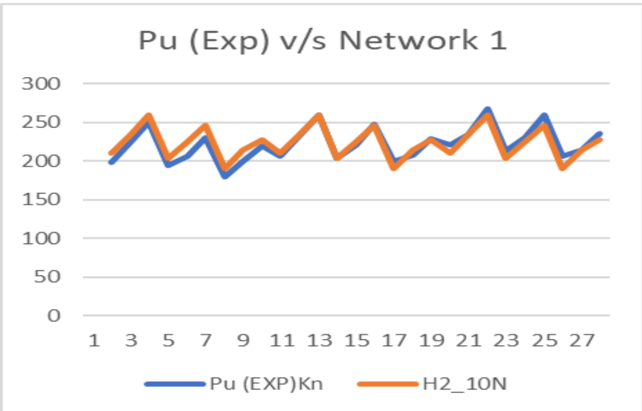
RESULT ANALYSIS (4)

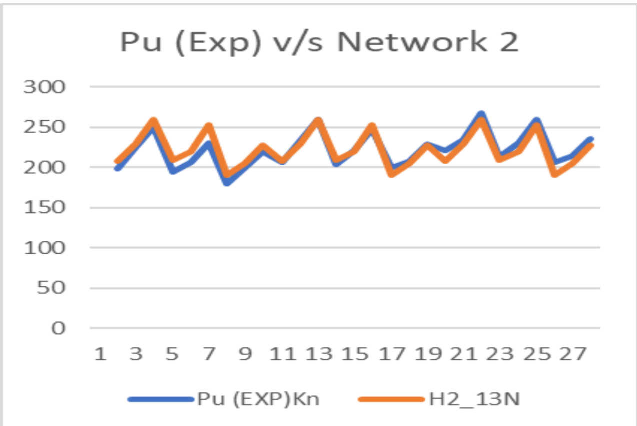
Pu (Exp) KN	H2_10N	H2_13N	H3_6N	H3_7N	H3_12N
199.1	210.0557	207.1382	208.5609	213.5425	220.875
224.82	233.9011	229.2855	228.8262	213.5425	233.9487
250.63	259.4615	259.5814	261.8858	245.088	255.1657
194.72	203.9621	208.8563	204.7938	213.5425	204.0943
206.31	225.6455	219.5703	219.276	213.5425	225.6812
230.12	245.7486	253.1381	244.8911	243.8963	245.7703
179.52	190.1714	190.5183	205.5893	213.5425	193.4246
199.4	214.1616	204.6953	210.3536	213.5425	208.7353
219.2	227.7178	228.1607	228.1829	213.5425	228.1749
207.07	210.0557	207.1382	208.5609	213.5425	220.875
232.63	233.9011	229.2855	228.8262	213.5425	233.9487
259.82	259.4615	259.5814	261.8858	245.088	255.1657
204.13	203.9621	208.8563	204.7938	213.5425	204.0943
220.73	225.6455	219.5703	219.276	213.5425	225.6812
248.09	245.7486	253.1381	244.8911	243.8963	245.7703
200.41	190.1714	190.5183	205.5893	213.5425	193.4246
208.33	214.1616	204.6953	210.3536	213.5425	208.7353

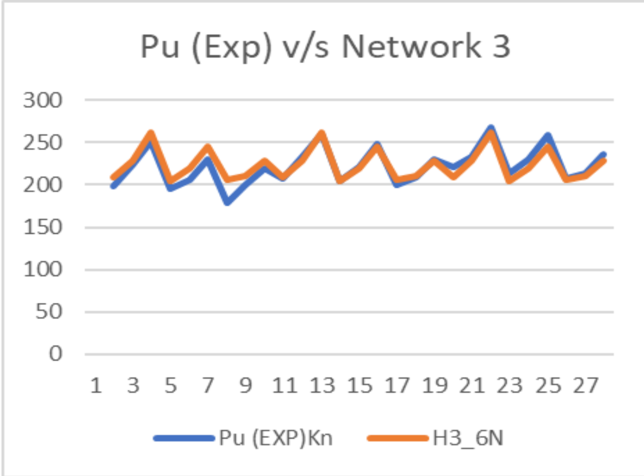
229.51	227.7178	228.1607	228.1829	213.5425	228.1749
221.03	210.0557	207.1382	208.5609	213.5425	220.875
233.92	233.9011	229.2855	228.8262	213.5425	233.9487
268.16	259.4615	259.5814	261.8858	245.088	255.1657
213.01	203.9621	208.8563	204.7938	213.5425	204.0943
230.53	225.6455	219.5703	219.276	213.5425	225.6812
259.12	245.7486	253.1381	244.8911	243.8963	245.7703
207.02	190.1714	190.5183	205.5893	213.5425	193.4246
214.15	214.1616	204.6953	210.3536	213.5425	208.7353
236.22	227.7178	228.1607	228.1829	213.5425	228.1749

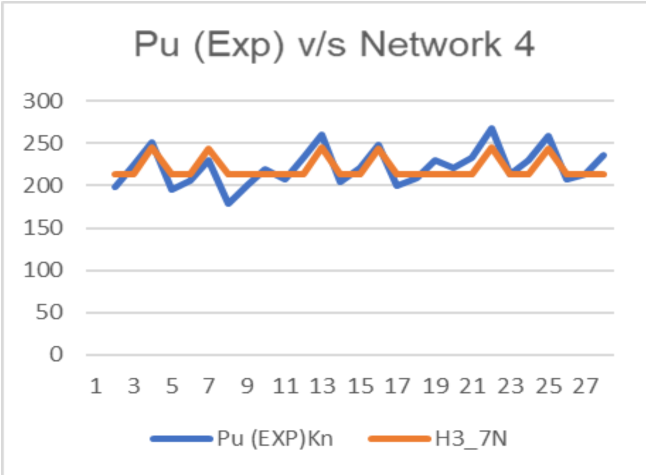
ACCURACY	99.40%	99.10%	99.30%	**99.90%**	99.17%
%ERROR	0.72%	0.18%	0.88%	**0.25%**	1.04%

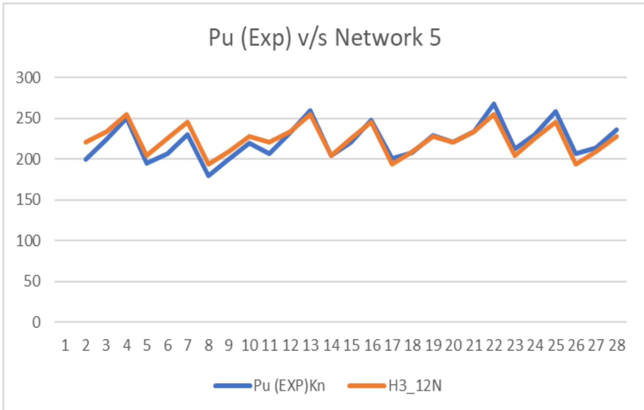
Comparision of graphs between Pu(Exp) & different Network type of data(4)











DATA(5):

Chethan kumar S, Khalid Nayaz khan., Dr N S Kumar(2016)

Grade	D (mm)	T (mm)	L (mm)	L/D (mm)	D/T (mm)	Pu (Exp)
M20	33.4	1.65	135	4	20.24	100
M20	33.4	2.11	201	6	15.82	123
M20	33.4	2.77	268	8	12.05	159
M25	33.4	1.65	135	4	20.24	102
M25	33.4	2.11	201	6	15.82	126
M25	33.4	2.77	268	8	12.05	161

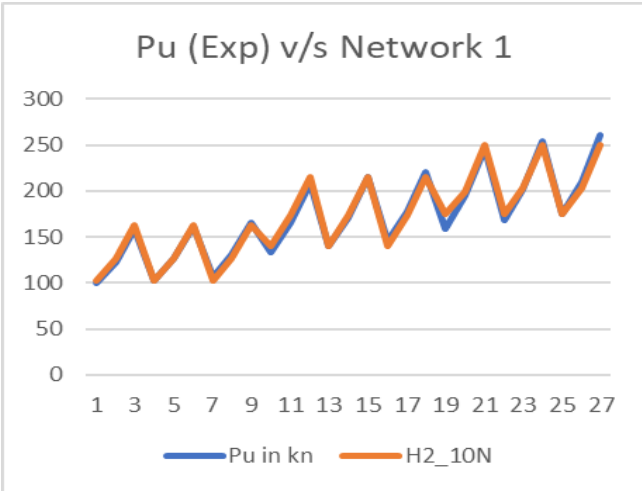
M30	33.4	1.65	135	4	20.24	106
M30	33.4	2.11	201	6	15.82	131
M30	33.4	2.77	268	8	12.05	165
M20	42.2	1.65	170	4	25.57	134
M20	42.2	2.11	254	6	20	165
M20	42.2	2.77	358	8	15.23	209
M25	42.2	1.65	170	4	25.57	140
M25	42.2	2.11	254	6	20	171
M25	42.2	2.77	358	8	15.23	215
M30	42.2	1.65	170	4	25.57	146
M30	42.2	2.11	254	6	20	177
M30	42.2	2.77	358	8	15.23	221
M20	48.3	1.65	194	4	29.27	159
M20	48.3	2.11	290	6	22.8	195
M20	48.3	2.77	387	8	17.43	246
M25	48.3	1.65	194	4	29.27	168
M25	48.3	2.11	290	6	22.89	202
M25	48.3	2.77	387	8	17.43	254
M30	48.3	1.65	194	4	29.27	175
M30	48.3	2.11	290	6	22.89	210
M30	48.3	2.77	387	8	17.4	261

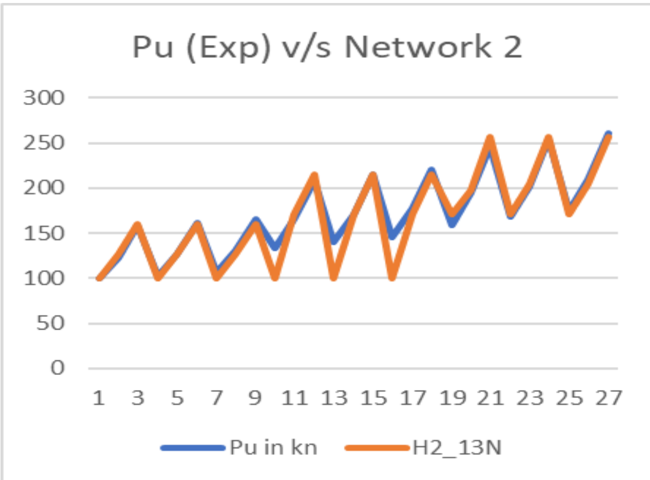
RESULT ANALYSIS (5)

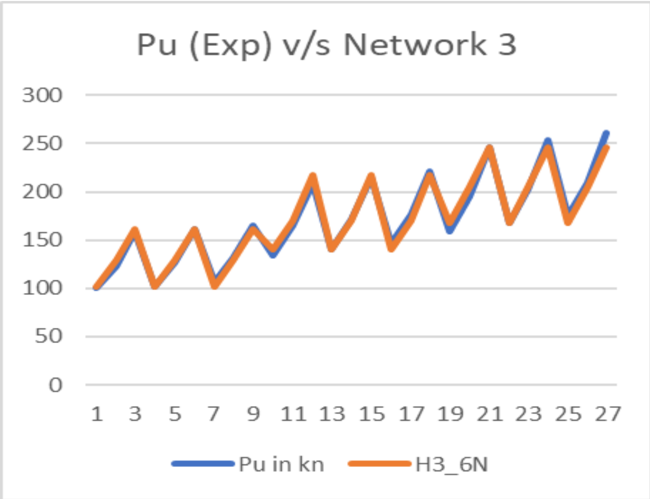
Pu(Exp) KN	H2_10N	H2_13N	H3_6N	H3_7N	H3_12N
100	102.9359	100.0003	101.9658	106.1282	102.0663
123	127.0238	126.1296	128.4159	128.9051	128.5018
159	162.9959	159.8035	161.209	161.7151	161.6554
102	102.9359	100.0003	101.9658	106.1282	102.0663
126	127.0238	126.1296	128.4159	128.9051	128.5018
161	162.9959	159.8035	161.209	161.7151	161.6554
106	102.9359	100.0003	101.9658	106.1282	102.0663
131	127.0238	126.1296	128.4159	128.9051	128.5018
165	162.9959	159.8035	161.209	161.7151	161.6554
134	140.0599	100	139.7726	140.5982	139.9895
165	173.9938	170.4612	170.5388	178.8567	171.0085
209	215.0058	215.5758	216.8789	215.4733	217.9277
140	140.0599	100	139.7726	140.5982	139.9895
171	173.9938	170.4612	170.5388	178.8567	171.0085
215	215.0058	215.5758	216.8789	215.4733	217.9277
146	140.0599	100	139.7726	140.5982	139.9895
177	173.9938	170.4612	170.5388	178.8567	171.0085
221	215.0058	215.5758	216.8789	215.4733	217.9277
159	175.0141	171.3595	167.7217	160.9934	175.0182
195	199.631	197.6076	205.3203	200.3697	201.4946
246	250.0129	256.5815	245.8215	253.8406	253.6735
168	175.0141	171.3595	167.7217	160.9934	175.0182
202	203.6844	203.792	205.3887	201.1309	202.0226
254	250.0129	256.5815	245.8215	253.8406	253.6735
175	175.0141	171.3595	167.7217	160.9934	175.0182
210	203.6844	203.792	205.3887	201.1309	202.0226
261	249.8984	256.4021	245.8208	253.8402	253.6553

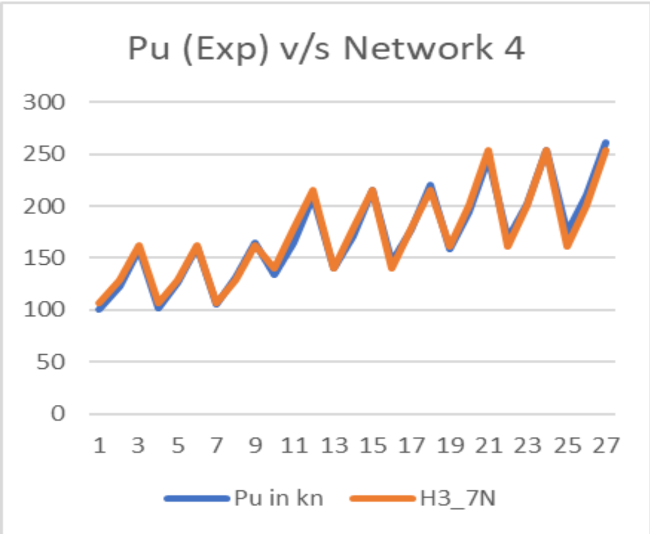
Accuracy	99.41%	97.20%	**99.98%**	99.54%	99.26%
%Error	0.77%	3.21%	**0.02%**	0.74%	0.80%

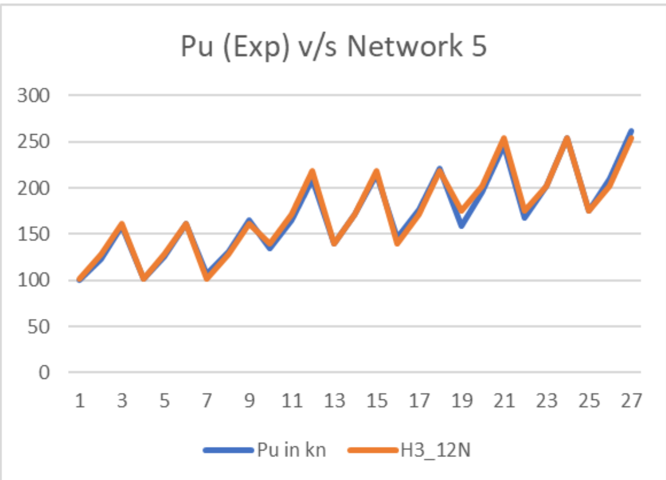
Comparision of graphs between Pu(Exp) & different Network type of data(5)











RESULTS & OBSERVATION:

Hidden layers	Parameter	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5
H2_10N	Accuracy	98.60	97.67	96	99.40	99.41
	%Error	4.50	0.76	9.10	0.72	0.77
H2_13N	Accuracy	98.06	99.03	**99.90**	99.10	97.20
	%Error	5.96	1.90	**4.90**	0.18	3.21
H3_6N	Accuracy	98.54	91.09	99.70	99.30	**99.98**
	%Error	7.37	46.40	5.40	0.88	**0.02**
H3_7N	Accuracy	**99.62**	99.93	99.00	**99.90**	99.54
	%Error	**1.03**	14.60	8.50	**0.25**	0.74
H3_12N	Accuracy	92.30	**99.73**	99.32	99.17	99.26
	% Error	14.09	**0.04**	5.10	1.04	0.80

The above table shows the results of all data's of different hidden layers and no of neurons. The hidden layer which gives the best accuracy & least %error are considered to be the finest.

OBSERVATION:

- For DATA(1), the Network 4, i.e, H3_7N (3 Hidden layers and 7 Neurons) gives the accuracy 99.62% and is considered to be more efficient.
- For DATA (2), the Network 5, i.e, H3_12N (3Hidden layers and 12 Neurons) gives the accuracy 99.73% and is considered to be more efficient.
- For DATA (3), the Network 2, i.e, H2_13N (2 Hidden layers and 13 Neurons) gives the accuracy 99.90% and is considered to be more efficient.
- For DATA (4), the Network 4, i.e, H3_7N (3 Hidden layers and 7 Neurons) gives the accuracy 99.90% and is considered to be more efficient.
- For DATA (5), the Network 3, i.e, H3_6N (3 Hidden layers and 6 Neurons) gives the accuracy 99.98% and is considered to be more efficient.

CONCLUSION:

- To get accuracy above 98%, Hidden layers shall be between two to three.
- Six to thirteen Neurons will yield the accuracy above 98%.

REFRENCES:

[1] Faizan khan, Mohammed Taiyeb, MD Abdullah, MD Khizeer, Dr N S Kumar, "Analysis of CFST using Artificial Neural Network", Solid State Technology, Volume:63 Issue:5, Publication year 2020.

[2] Sumalatha H, Dr N S Kumar, "Analytical Studies on CFST columns (SCC Infilled) using Fuzzy Logic", Journal of emerging technology and innovative research, Volume 7, Issue 4, April 2020.

[3] Chethan k, Dr N S Kumar, "Analytical Investigation on SCC Infilled Composite Steel Tubes Using – Ann

Approach", International Journal of Science and Research, Volume 7, Issue 7, July 2018.

[4] Mohammed Jawahar Soufain, Syed Jawad Sujavandi, Umar Ahad Shariff, Dr N S Kuamr, "A Comparative Study on Different Propagations for Development of Artificial Neural Network Model to Study the Behaviour of CST (composite steel tubes) under Compression", International Journal of Research in Enginnering and Technology, Volume 6, Issue 2, Feb 2017.

[5] Chethan Kumar S, Khalid Nayaz Khan, Dr N S Kumar, "Reliability Study of Concrete Filled Tubes Using Reliability Index Approach", International Journal of Advances in Mehanical and Civil Engineering, ISSN: 2394-2827, Special Issue, Sep-2016.

[6] Shashank Kothari, Deepak k Singh, Pankaj Chamoli, "Comparative Analysis of CFST Columns and RC Columns under Uniaxial Compressive Loads", International Journal of Advanced Research in Engineering and Technology, Volume 11, Issue 8, August 2020.

[7] Sonawane Aishwarya, Kadam Pradnya, Shanikh Sajiya, Pokale Yogita, Kapase Nilesh, "Experimental Study of Compressive Strength of CFST using ANN", International Journal of Creative Research Thoughts, Volume 8, Isssue 7, July2020.

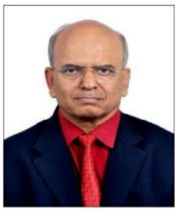
[8] Mohmmad Junaid Wani, Mohit Bhandari, Rajeev, "Performance of a Multi-Storey Complex Building with CFST Columns, International Journal of Innovative Technology and Exploring Engineering, Volume 9, Issue 7, May 2020.

[9] Pandu Ranga Kirankumar T, S V V K Babu, D Aditya Sai Ram, "Comparative Study of Concrete Filled Steel Tube Columns Under Axial Compression", International Journal of Constructive Research in Civil Engineering, ISSN 2454-8693,Volume 2, Issue 2, 2016.

[10] D R Panchal, V P Sheta, "Experimental Study on Circular and Square Concrete Filled Steel Tube Columns Subjected to Axial Compression Loads", International Journal of Research in Engineering and Technology, Volume 5, Issue 5, May 2016.

BIOGRAPHIES

Padma V P, Completed Bachelor degree in Civil Engineering from Rajarajeshwari College of Engineering, Karnataka under VTU in the year 2019. Presently Pursuing M.tech in Structural Engineering in Ghousia College of Engineering, under VTU.



Dr N S Kumar, Graduated in the year 1985 from Mysore University, M.E in Structural Engineering, in the year 1988 from Bangalore University and earned his PhD from Bangalore University during the year 2006 under the guidance of Dr. N Munirudrappa, then Chairman and Prof. UVCE, Faculty of Civil Engineering, Bangalore University. Presently working as Prof & HoD, Department of Civil Engineering, Ghousia College of Engineering, Ramanagara and completed 32 years of teaching and director of R& D for a decade (2010-2020). He is involved in the Research field related to the behaviour of Composite Steel Columns & Nano Materials for more than a decade. To his credit, over 200 publications and travelled abroad Viz., USA, Australia, Canada and China including World Conference. Also, he has guided more than three PhD's and Guiding five more Phd's as on date affiliated to VTU Blagavi. Also, He has Completed Funded Projects worth of 60 Lakhs from VTU, Belagavi and VGST, GoK. Also presently handling more than a crore project sanctioned from IT/BT, GoK. He has also credit of authoring more than Eight books as per the curriculum of Bangalore University and VTU, Belagavi.