Some Examples for CO-PO(1-3)Mapping and Corresponding Assessments

-Civil Engineering

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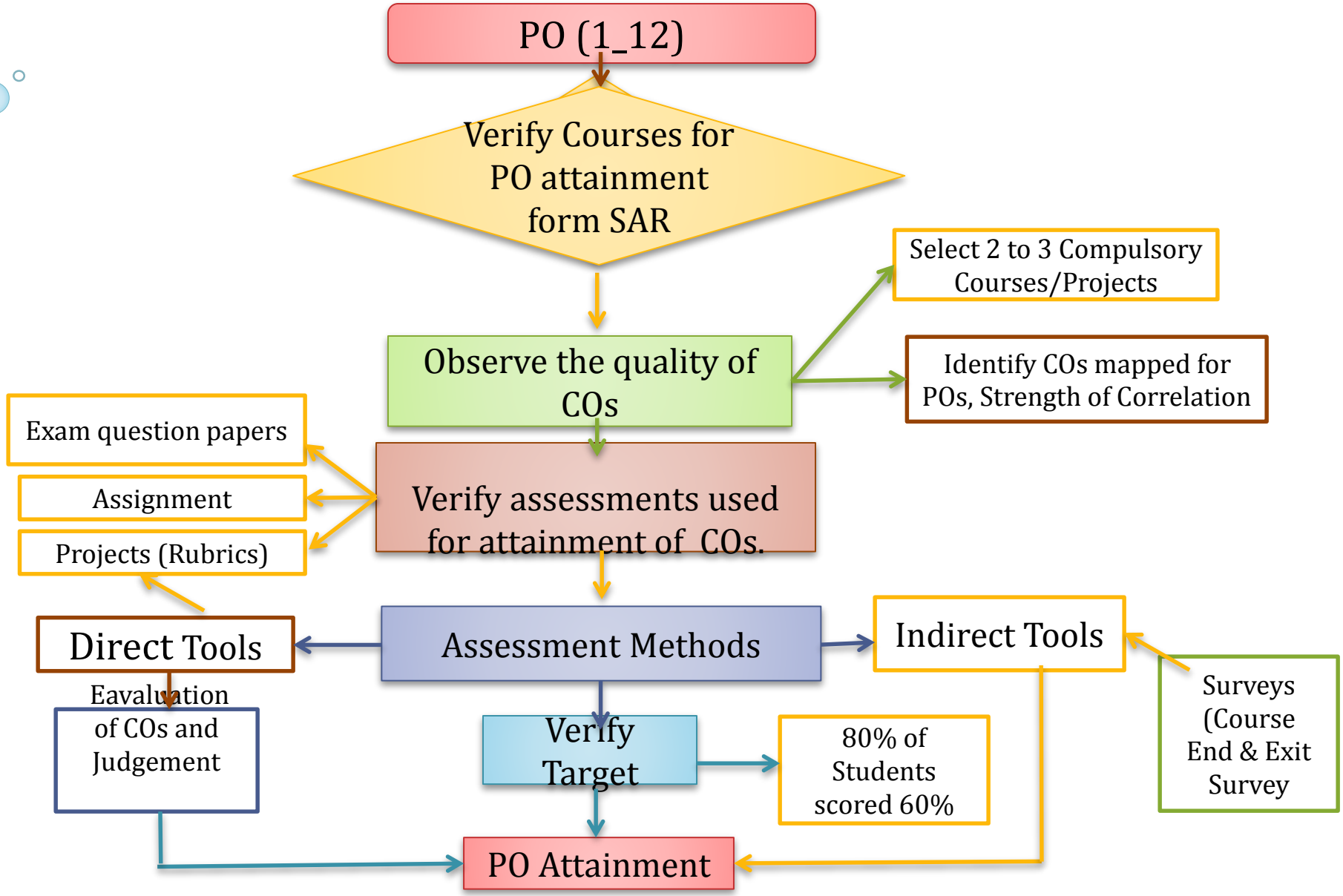
PO Attainment



Course:- Concrete Technology Example-1

Topic: Mix Proportioning

Mix proportioning is a process of arriving at suitable proportions of concrete ingredients based on their characteristics to achieve desired strength and durability characteristics of concrete. Here, students will have the freedom of selecting different types of cements, aggregates, admixtures to arrive at a given grade of concrete say M40.

Contd.,

- To introduce complexity, students can be asked to provide solutions for the same M40 grade concrete but to be used in different field conditions such as Hot weather concreting, Underwater concreting, Mass concreting, High early strength requirement in say 3 days.

PO1: **Engineering Knowledge**: ***Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems***

Example Situation 1:

CO3: Able to understand mix proportioning techniques for field applications.

Assessment for CO3: (Question in Tests)

Briefly explain the various methods of mix proportioning techniques.

- ***Does this CO reflects the intended measurement from PO 1?***
- ***Does the assessment correlates well with the CO?***

Mapping from SAR(say)
CO3- PO1.

- ***In this case, CO does not reflect the intention of measuring application of either science, maths or engineering principles. It can measure only remembrance in this topic.***
- ***Further, the assessment, does not test the requirement of application of engineering principles used in mix proportioning as per PO1. Hence, the correlation between CO-PO is weak.***

PO2:Problem Analysis: *Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.*

Example Situation 2:

CO3: Able to <u>apply</u> mix proportion principles to <u>design</u> a concrete mix for field applications.

Assessment for CO3: (Question in Tests)

Proportion a concrete mix for M40 grade concrete by IS method. Given data: maximum nominal size of aggregate: 20mm; minimum cement content: 340kg/cum; maximum w/c ratio: 0.45; workability: 75mm slump; exposure: very severe; concreting type: pumping mode; quality at site: good; aggregate type: sub-angular; sp. gr of cement – 3.15, aggregate – 2.68, flyash – 2.08, SP 1.08, Design using IS 10026 – 2009.

- ***Is CO reflects the intended measurement from PO 2?***
- ***Does the assessment correlates well with the CO?***

Mapping from SAR(say)
CO3- PO2

In this case, students are expected to apply the mix proportion principles and hence the assessment is in line with the CO and hence to PO1.

The strength of correlation can be considered good for PO1 as engineering principles are used to arrive at mix proportion.

Contd.,

- However, the assessment does not test the students ability to identify, formulate and do some research for arriving at a suitable concrete mix for a given situation nor it challenges a student for design requirement since many variables of the design have already been identified in the problem and hence the strength of mapping of CO3 for PO2 and PO3 in the above example can not be considered good.

PO3: **Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.**

Example Situation 3:

CO3: Able to analyse characteristics of mix constituents and *design* a concrete mix for field applications.

Assessment:/ASIGNMENT/ *ABC Construction Company is entrusted with manufacturing of precast elements for elevated express way. The precast elements are required to attain 40 MPa in 7 days. Design a mix for least cost. The mix should comply with the requirements of IS 10262 and IS 456.*

- ***Is CO reflects the intended measurement from PO 2, PO3 ?***
- ***Does the assessment correlates well with the CO?***

Remarks:
CO2 – PO2, PO3

In this case, students are expected to identify and formulate various design parameters such as type of cement which can be used for early strength gain, water content (W/C), workability required to manufacture such precast elements. They are also required to look for specifications as per the codal provisions and then apply engineering principles to arrive at mix proportions for a least cost.

The assessment correlates well with the CO and hence maps strongly for PO2 and PO3.

COs (Summary)

Example Situation 1:

- **Able to understand mix proportioning techniques for field applications.**

Example Situation 2:

- **Able to apply mix proportion principles to design a concrete mix for field applications.**

Example Situation 3:

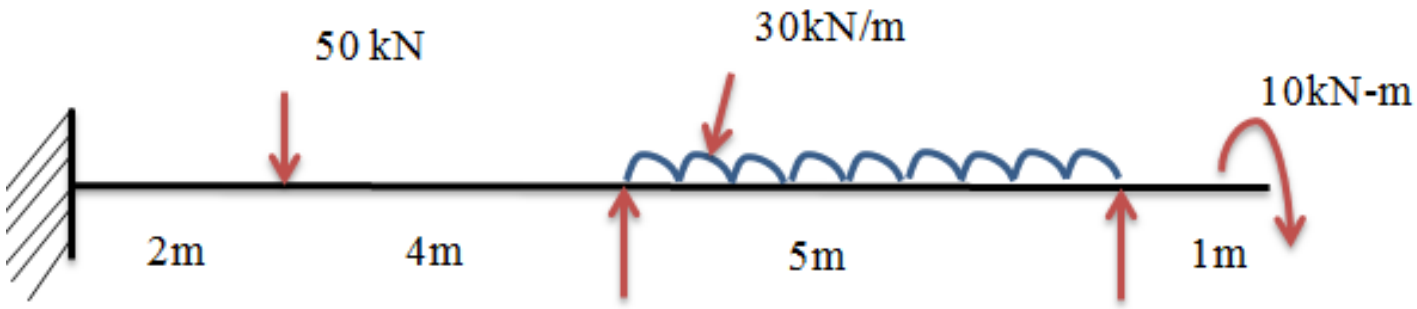
- **Able to analyse characteristics of mix constituents and *design* a concrete mix for field applications.**

- Examples from few more courses..

Course:- Analysis of Structure-II Example-2

CO 1: Able to analyse for SF and BM in framed structure.

Mapping : CO 1- PO1, PO2

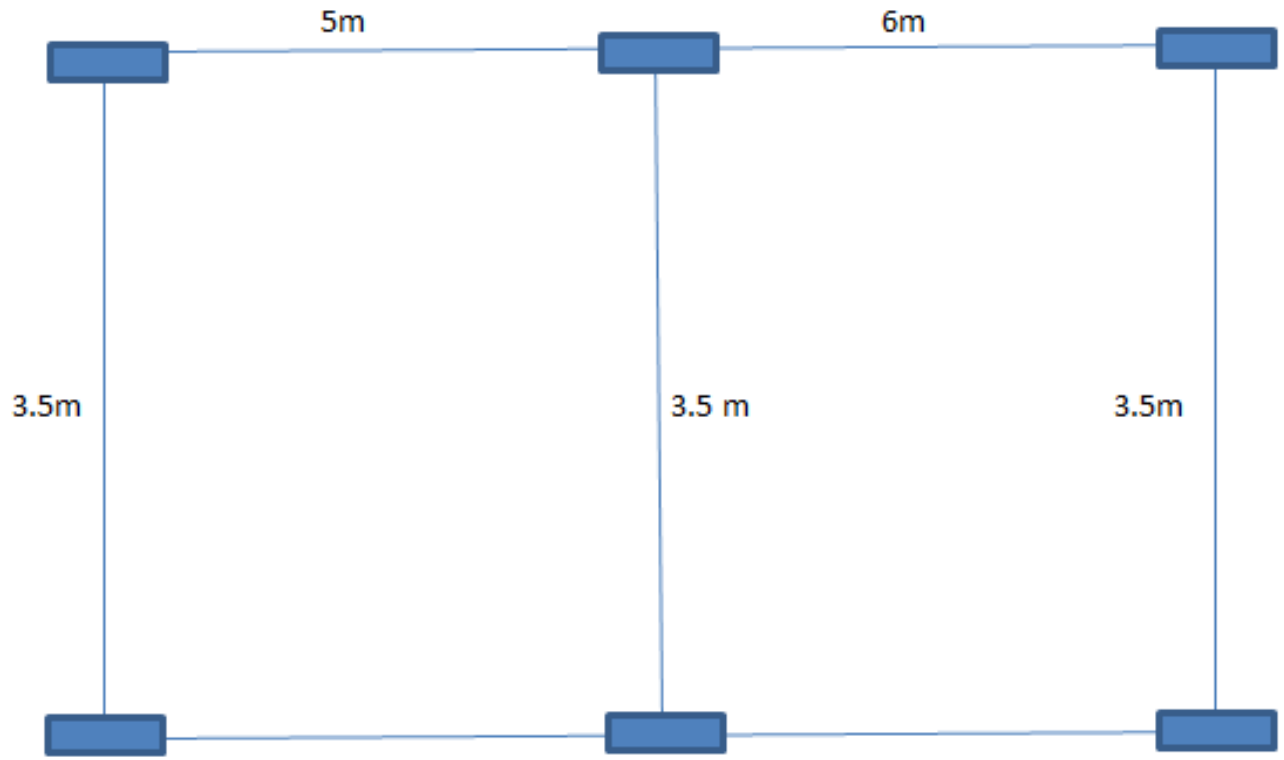


Is it a Complex engineering problem ?

Does it Map well with PO1 and PO2 ?

Course:- Analysis of Structure-II Example-2

A two storey ware house has the column and beam lay out as shown. Assuming sections of beams and columns prepare load diagram and draw of SFD and BMD.



1. A student has to **Identify** end conditions and load distribution pattern
2. Has to **refer** IS 875 for load calculations
3. Has to **formulate** the load diagrams
4. Has to **analyze** the structure using any of the methods like MDM, SDM, Kani's method etc.

- ***Problem can be considered complex..***
- ***Strength of correlation is Good for PO1 &PO2.***

Course:- Environmental Engineering-I Example-3

- Example situation 1:

CO3: Able to Describe basic structure of drinking water supply systems and design the component systems of water treatment facilities

Topic: Disinfection Process

TLO : Able to describe various methods of disinfection process.

CO-PO Mapping in SAR (say)

CO3- PO1, PO2, PO3, PO6 and PO7

Assessment for CO3:

Question in Tests:

a) Briefly explain the various methods of Disinfection process.

b) Briefly explain the various forms of Chlorination.

(In this case, CO does not reflect the intention of measuring application of science, maths or engineering principles. It can measure only remembrance in this topic. Further, the assessment does not test the requirement of application of engineering (subject) fundamentals used in PO1, PO2 and PO3. Hence, the correlation between CO-PO is weak.)

Example Situation 2:

- **CO3:** Describe basic structure of drinking water supply systems and design the component systems of water treatment facilities

TLO : Able to estimate dosage of chlorine required for disinfection of water .

CO-PO Mapping in SAR (say)

CO3 – PO1, PO2, PO3

Assessment for CO3:

Chlorine usage in the treatment of 20000 cubic meter of water per day is 8kg/day. The residual chlorine after 10 minutes contact is 0.2 mg/lt. Calculate the dosage of chlorine after 10 mins contact is 0.2 mg/lt. Calculate the dosage of chlorine in mg/lt and chlorine demand of the water.

-In this case, students are expected to apply the knowledge of Math, Science and subject specialization concepts and hence the assessment is in line with the CO and hence to PO1. The strength of correlation is good as engineering and domain fundamentals are used to arrive solution to the problem.

Contd.,

- However, the assessment does not test the students ability to identify, formulate and do some research for arriving at a suitable design parameters for a given situation nor it challenges a student for design requirement since many variables of the design have already been identified in the problem and hence the strength of mapping of CO3 for PO2 and PO3 in the above example cannot be considered good.

Example Situation 3:

CO3: Describe basic structure of drinking water supply systems and design the component systems of water treatment facilities

TLO : Able to estimate chlorine demand and residual chlorine content for a given water sample through lab experiments.

CO-PO Mapping in SAR (say)

CO3 – PO1, PO2, PO3, PO6 and PO7

Assessment for CO3: (Assignment)

A part of the town name Vajarahalli has been served water with nearby surface water source. The estimated population for the same area is 50,000 with water demand of 135 lpcd. Estimate the quantity of bleaching powder required per year to disinfect the desired quantity of water by collecting the sample from the source. Submit the analysis report along with solution to problem.

Contd.,

- ***-The report should contain the details on Available Chlorine, Chlorine Demand and Residual Chlorine for given water sample along with break point chlorination graph.***
- ***-Residual Chlorine content should meet IS 10500 drinking water standards. Also provide the list of Codes/manual which is referred to perform the test at laboratory.***

In this case, students are expected to identify and formulate the problem by collecting the sample from the said location and by conducting experiment at laboratory.

This assignment question also calls for analysis and interpretation of experimental data to arrive solution to the problem.

Contd.,

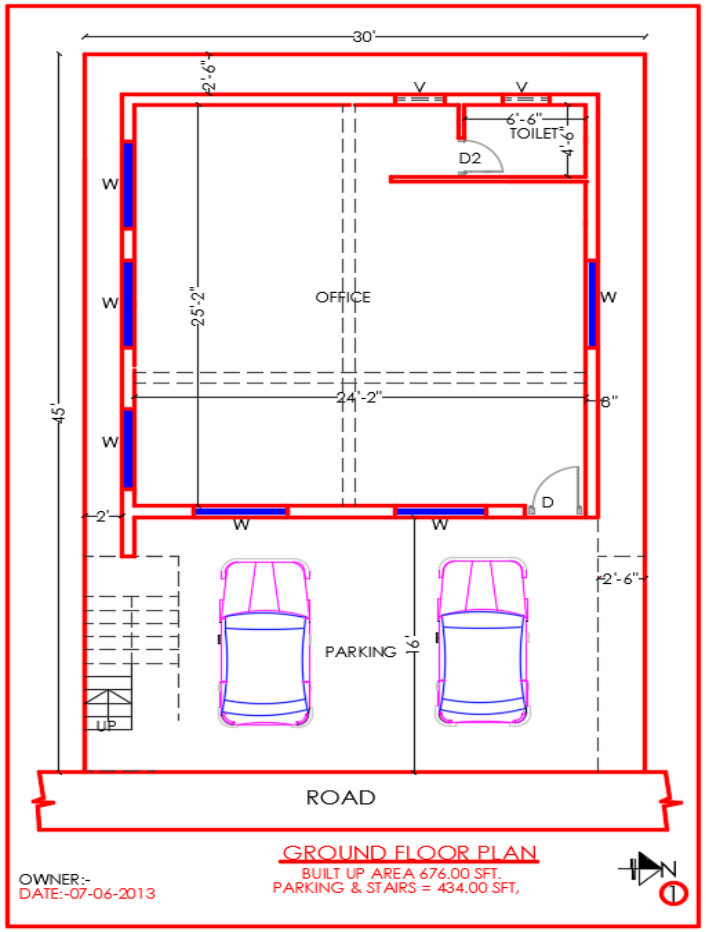
- To carry out the experiments students have to carry out literature work to know the procedure prescribed by manual/codes.
- Since the student at the end of the experiment ensures the potability of the water to the public, the same problem correlates to PO2, PO4 and also to PO6.

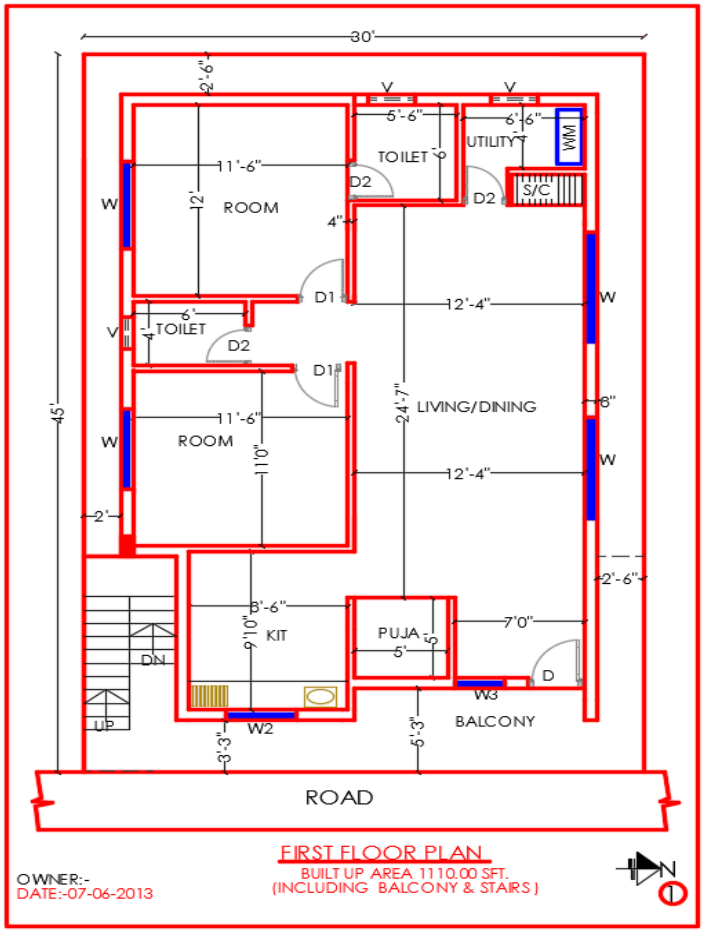
Course:- Reinforced Concrete Design Example-4

A Residential building comprising of ground +3 upper floors has been proposed using a RCC framed structure infilled with 200mm thick cement concrete block masonry wall as main walls and 100mm thick cement concrete block masonry walls as partition walls. Propose a suitable slab-beam and column layout. Analyse and design an interior slab, an interior beam, an interior column stairs and column footing. The floor plans are attached.

Note:

1. The design should conform to BIS codes of practice.
2. Consider locally available materials.
3. Second and third floor plans are identical to first floor plan.
4. The dimensions of RC elements should match with the construction practices prevailing in your city.
5. The toilet slabs are to sink by 200 mm.

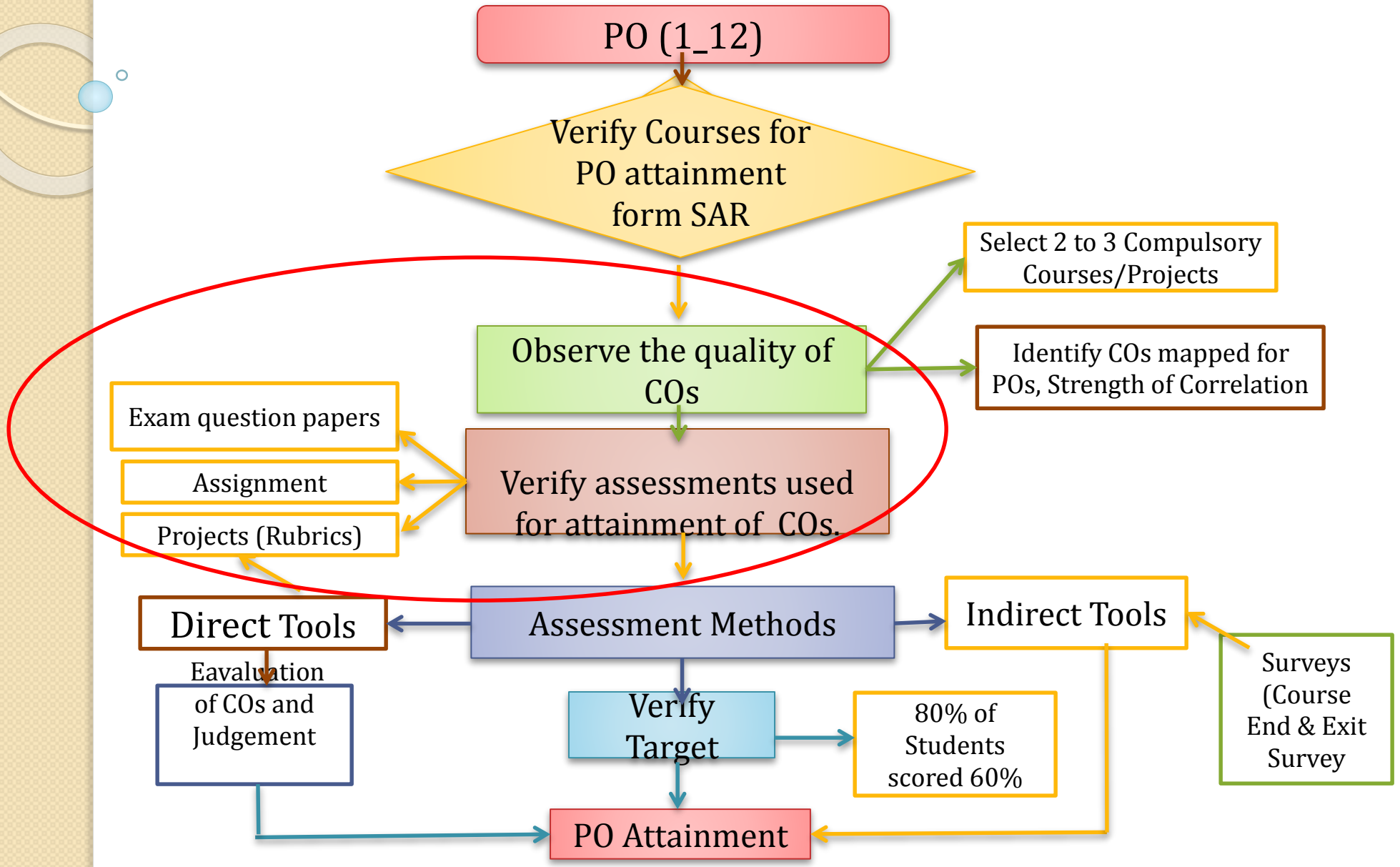




This is a typical identify, analyse and design problem..

Strength of correlation is good for PO2 and PO3

PO Attainment



Course Name :	Design of steel structures
Course Code :	10CV6DCDSS
Session of Course	FEB 2011-JUNE 2011
L : T : P -	3 : 2 : 0
Semester :	VI
Credits :	4
Batch :	2008

Grading Scale	
SCORE : < 40%	1
40% - < 60%	2
> =60%	3

COs	T1	T2	T3	QUIZ 1	QUIZ 2	LAB
CO1	Q1	-	-	√	√	-
CO2	Q2	Q1,Q2	-	-	-	-
CO3	-	-	-	-	-	-
CO4	Q3, Q4	Q3, Q4	-	-	-	-

Max Marks	12.5	12.5	12.5	12.5	50				
Course Outcomes	CO4				TOTAL OBTAINED	TOTAL MARKS ATTEMPTED	PERCENT, %	SCORES OR GRADING BASED ON SCALE OF 3	Target > =60%
Name	T1-Q3	T1-Q4	T2-Q3	T2-Q4					
N. Madhukar (VTU)	5		10	10	25	37.5	66.67%	3	Y
Bickey Gurung	7		12	12	31	37.5	82.67%	3	Y
Mustafa Rashid	10		12	12	34	37.5	90.67%	3	Y
Adarsh P Nayak	6		12	12	30	37.5	80.00%	3	Y
Naveen Kumar (VTU)	10		9	10	29	37.5	77.33%	3	Y
Vijay Kumar (VTU)	1	1	12	12	26	50	52.00%	2	
Akash Koppa	9	8	10	10	37	50	74.00%	3	Y
Anush K C	9	9	11	11	40	50	80.00%	3	Y
Ashwin Thammaiah. K	9	8	10	10	37	50	74.00%	3	Y
Balachandhar K.R	9	7	10	10	36	50	72.00%	3	Y
Beena Abraham	8	8	12	12	40	50	80.00%	3	Y
Devaraj	8	8	10	10	36	50	72.00%	3	Y

Prashanth. H.S			10	10	20	25	80.00%	3	Y
Pratheek. K.R	10	5	12	11	38	50	76.00%	3	Y
Prathyusha. M Naik	4	2	12	10	28	50	56.00%	2	
Priyanka. B.P	8	8	12	12	40	50	80.00%	3	Y
Punith M	8		11	11	30	37.5	80.00%	3	Y
Rathod Ravi Vsudev	1	1	12.5	12.5	27	50	54.00%	2	
Ritesh. S.A	5		12	12	29	37.5	77.33%	3	Y
Rubaina Anjum	7		10	10	27	37.5	72.00%	3	Y
S. Nishanth	6		12	12	30	37.5	80.00%	3	Y
Sachin Shet. M	2		10	10	22	37.5	58.67%	2	
Sandeep N.A	1		11	12	24	37.5	64.00%	3	Y
Santosh. J	8	9	11	11	39	50	78.00%	3	Y
Shalini. B	8	8	12	11	39	50	78.00%	3	Y
Shridhar Tille	4	1	12	12	29	50	58.00%	2	
Srikara. P	8	8	11	11	38	50	76.00%	3	Y
Swarup Shetty	9	9	10	8	36	50	72.00%	3	Y
Vignesh. P	8	8	10	10	36	50	72.00%	3	Y
Vinay. M.L	9	5	10	10	34	50	68.00%	3	Y
Vinay Teja T.K	8	8	10	10	36	50	72.00%	3	Y
Vinod .H.V			1	2	3	25	12.00%	1	

Vinod Kumar. M	1		12	7	20	37.5	53.33%	2	
Vivekananda .K.S	8	8	10	10	36	50	72.00%	3	Y
Yash J Ahuja			10	10	20	25	80.00%	3	Y
Yashaswini. B.K	5		9	9	23	37.5	61.33%	3	Y
Sushanth Darshan			12	11	23	25	92.00%	3	Y
Amarnath Reddy (DIP)	10	9	8	9	36	50	72.00%	3	Y
Chikanna. T (DIP)	5	5	12	11	33	50	66.00%	3	Y
Kiran. T.N. (DIP)	8	5	10		23	37.5	61.33%	3	Y
Krupachandra (DIP)			1	1	2	25	8.00%	1	
Lokesh.M (DIP)	7	4	12	12	35	50	70.00%	3	Y
Umesh Kumar. B (DIP)	2	1	12	12	27	50	54.00%	2	
							SUM	154	46
						AVG GRADING		2.80	

Example of CO-attainment for a course

TARGET :-60% STUDENTS MUST ACHIEVE 60% AND ABOVE

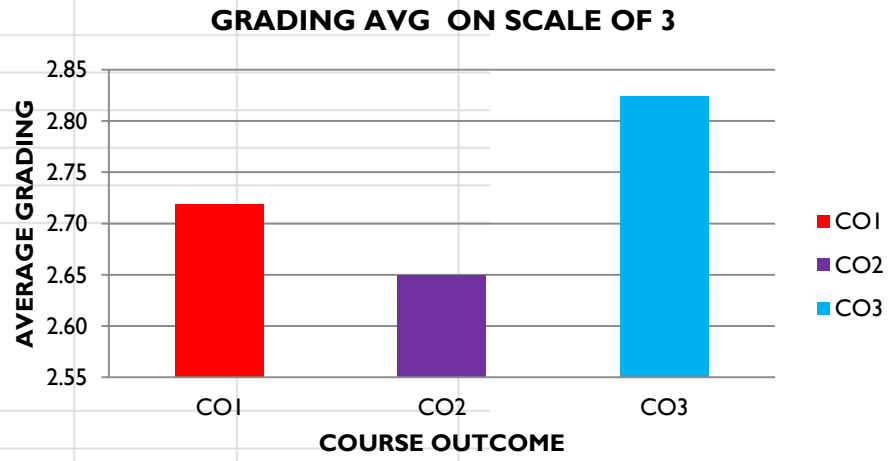
Total No. of Students for Batch				57
COURSE OUTCOMES	GRADING AVG ON SCALE OF 3	DISTRIBUTION %		
		3	2	1
CO1	2.72	49 / 57 = 85.96%	0 / 57 = 0%	8 / 57 = 14.03%
CO2	2.65	44 / 57 = 77.19%	6 / 57 = 10.52%	7 / 57 = 12.28%
CO3	2.82	52 / 57 = 91.22%	0 / 57 = 0%	5 / 57 = 8.77%

More than 60% of Students Must Achieve 60% Marks

PO AND CO SCALE	3	Strongly Related
	2	Moderate
	1	Low

NUMBER OF STUDENTS SCORING > =60%

COURSE OUTCOMES	% OF STUDENTS ACHIEVED CO	CO RESULT
CO1	85.96%	Y
CO2	77.19%	Y
CO3	91.23%	Y



Results of Attainment of POs

Course Name	COs	CO Attainment, %	CO Result	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Analysis of Structures-II	CO1	86.00%	YES	86%	86%	-	-	-	-	-	-	-	-	-	-
	CO2	78.00%	YES	78%	78%	-	-	-	-	-	-	-	-	-	-
Environmental Engineering-I	CO1	85.96%	YES	86%	57%	29%	86%	-	86%	86%	86%	-	57%	-	-
	CO2	77.19%	YES	77%	77%	26%	77%	-	77%	77%	51%	-	77%	-	-
	CO3	91.23%	YES	91%	91%	91%	-	-	-	91%	91%	-	91%	-	-
Geotechnical Engineering-II	CO1	70.00%	YES	70%	70%	-	-	-	-	-	-	-	-	-	-
	CO2	74.00%	YES	74%	74%	-	-	-	-	-	-	-	-	-	-
	CO3	100.00%	YES	100 %	100 %	-	-	-	-	-	-	-	-	-	-
	CO4	75.00%	YES	75%	75%	50%	-	-	75%	-	-	-	-	-	-
Highway Engineering	CO1	89.00%	YES	89%	89%	59%	-	-	-	-	-	-	-	-	-
	CO2	100.00%	YES	100 %	100 %	100 %	100 %	-	100 %	-	67%	-	100%	-	-
	CO3	21.00%	NO	-	-	-	-	-	-	-	-	-	-	-	-
	CO4	75.00%	YES	75%	75%	-	-	-	-	-	-	-	-	-	-
Hydrology & Water Resources	CO1	63.00%	YES	63%	63%	-	-	-	-	-	-	-	-	-	-
	CO2	68.00%	YES	68%	68%	-	-	-	-	-	-	-	-	-	-
	CO3	72.00%	YES	72%	72%	-	-	-	-	-	-	-	-	-	-
	CO4	60.00%	YES	60%	60%	-	-	-	-	-	-	-	-	-	-
	CO5	72.00%	YES	72%	72%	-	-	-	-	-	-	-	-	-	-
Software Applications	CO1	77.00%	YES	-	-	-	-	77%	-	-	-	-	-	-	77%
	CO2	77.00%	YES	-	-	-	-	77%	-	-	-	-	-	-	77%
	CO3	77.00%	YES	-	26%	51%	77%	77%	-	-	-	-	51%	-	77%

Contd...

Course Name	COs	CO Attainment, %	CO Result	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Quantity Surveying and Costing	CO1	95.00%	YES	95%	95%	-	32%	-	-	-	-	-	-	-	-
	CO2	35.00%	NO	-	-	-	-	-	-	-	-	-	-	-	-
	CO3	89.00%	YES	89%	89%	-	-	-	-	-	-	-	-	-	-
	CO4	24.00%	NO	-	-	-	-	-	-	-	-	-	-	-	-
Alternate Building Materials & Technology	CO1	75.00%	YES	50%	50%	-	-	-	-	75%	50%	-	-	-	25%
	CO2	75.00%	YES	50%	50%	-	-	-	-	75%	50%	-	-	-	75%
	CO3	75.00%	YES	50%	-	-	-	50%	-	75%	50%	-	-	-	50%
	CO4	75.00%	YES	75%	75%	75%	-	50%	-	50%	75%	-	-	-	-
Major Project Phase - II	CO1	100.00%	YES	-	-	-	-	-	-	100%	-	100%	-	-	-
	CO2	100.00%	YES	100%	100%	100%	100%	-	-	-	100%	100%	-	-	100%
	CO3	100.00%	YES	-	-	-	-	100%	-	-	-	100%	-	-	-
	CO4	100.00%	YES	-	-	-	-	-	-	-	-	100%	100 %	-	-
			PO Attainment	**80%**	**78%**	**72%**	**84%**	**72%**	**83 %**	**71%**	**69%**	**98%**	**84%**	**75%**	**82%**

EXIT SURVEY DATA ANALYSIS

PO No.	PO Description	Exist Survey Questions	Ratings						Total	Weighted Average	Percentage Attainment
			0 (Not At All)	1	2	3	4	5 To a Great Extent			
PO1	An ability to apply the knowledge of mathematics, science, and engineering fundamentals to the solution of Civil Engineering problems.	To what level you are able to apply science and engineering concepts to problem solving	0	0	2	3	14	6	25	3.96	76%
		To what extent you are able to support technical problem solving	0	0	5	4	11	5	25	3.64	
PO2	An ability to identify and analyse Civil Engineering problems for meaningful solutions to form the basis for design of Civil Engineering system components.	To what extent you are able to analyse Civil Engineering problems	0	0	2	5	14	4	25	3.8	76%
PO3	An ability to design solutions for Civil Engineering problems and design system components.	To what extent you are able to design Civil Engineering components	0	1	4	7	10	3	25	3.4	68%
		To what extent you are able to design Civil Engineering systems (such as buildings, structures, roads etc.)	1	1	1	11	7	4	25	3.36	
PO4	An ability to conduct experiments, analyse and interpret data to provide valid conclusions.	To what extent you are able to analysis and interpret data	0	1	1	4	13	6	25	3.88	78%
PO5	An ability to apply appropriate techniques and	To what extent you are able to use state of art tools for	0	0	5	5	11	4	25	3.56	71%

Results of attainment of POs through Semester End Exam (SEE) results,

Sl. no.	Course								marks (%)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1.	Analysis of Structures-II								59%												
2.	Environmental Engineering-I								81%	81%	81%	81%	81%		81%	81%	81%		81%		
3.	Geotechnical Engineering - II								56%												
4.	Highway Engineering								72%	72%	72%	72%	72%		72%		72%		72%		
5.	Hydrology & Water Resources								60%												
6.	Software Applications								75%		75%	75%	75%	75%					75%		75%
7.	Minor Project/Industrial Visit								86%										86%		86%
8.	Design of Steel Structures								56%												
9.	Environmental Engineering-II								70%	70%	70%	70%			70%	70%					
10.	Extensive Survey Project								86%	86%	86%	86%	86%	86%			86%	86%	86%		86%
11.	Pre Stressed Concrete								62%	62%	62%	62%					62%				
12.	Transportation Systems &								68%	68%	68%	68%			68%						

Example Weightages for PO Attainment

Summary of Results of attainment of POs

PO No.	Method of Assessment / Weightage / PO Description	Direct Assessment (CIE)	Student Exit Survey	Course End Survey	Faculty Survey	Semester End Examination (SEE)	PO Attainment, %
	Weightage	50%	10%	5%	5%	30%	
PO1	An ability to apply the knowledge of mathematics, science, and engineering fundamentals to the solution of Civil Engineering problems.	40%	8%	4%	4%	22%	77%
PO2	An ability to identify and analyse Civil Engineering problems for meaningful solutions to form the basis for design of Civil Engineering system components.	39%	8%	4%	4%	22%	77%
PO3	An ability to design solutions for Civil Engineering problems and design system components.	36%	7%	3%	3%	23%	72%
PO4	An ability to conduct experiments, analyse and interpret data to provide valid conclusions.	42%	8%	4%	3%	24%	81%
PO5	An ability to apply appropriate techniques and use modern engineering tools to Civil Engineering systems.	36%	7%	4%	4%	24%	75%
PO6	An ability to assess safety and legal issues and the consequent responsibilities relevant to the professional Civil Engineering practice.	42%	7%	3%	3%	22%	76%
PO7	An ability to understand the impact of the professional Civil Engineering solutions in relations to societal needs, environmental concerns and sustainable development.	36%	7%	2%	4%	24%	73%

PO Attainment

- All POs need to be adequately addressed through the selection of core courses/value added courses and their COs
- Attainable targets need to be selected for each of the CO.
- If assessment is in alignment with COs the performance of the students indicates the CO attainment.
- These measurements provide the basis for continuous improvement in the quality of learning.(Judgement for Evaluators)

Continuous Improvement

- Closing the loop at course level, programme level and Institute level ensures quality assurance for stake holders.
- All attainment analysis is made to provide continuous improvement through either in course delivery, assessment and curriculum (Essence of OBE)

THANK YOU