Domain: Civil Engineering
Topic: Design Thinking application in Civil Engineering

1. **Think phase**:

Think Phase Question: Assume that You (students) have gone to visit a building construction site. Prepare a list of the objects/processes that you will observe. Identify any two difficulties through use of objects/processes while using by the user/labour.	*Duration* (in minutes): **03**
What will Instructor do: A brief narration of his experience during a building site visit.	
What will students do: Imagine and visualize a building construction site, prepare list of possible difficulties for using objects/processes.	
Deliverable from this Phase: A list of two object/process creating difficulty for the user/labour.	

2. **Pair phase**:

Pair phase question: All students make a comparison of his/her list with the neighbor student. Identify the most common 'difficulty in use' object/process from either of the lists. Discuss the objects that is assumed to be most painful for the labour by identifying pros and cons of each. Workout a remedial measure to reduce the efforts of labour.	Duration (in minutes) **10**
What will Instructor do: Discuss an example of painful/ difficult process/object on site for a labour while working.	
What will students do: Discussions and identification of any one painful objects/ process that is most difficult for user/labour.	
Deliverable from this Phase: One object/process from each group of two students. Considering a class of 60 students, 25 to 30 object/process generating difficulty among labour/user.	

3. **Share phase**:

Write your share phase task here: All student pairs will share their answer found on 'difficult to use object/process on building construction site'	Duration (in minutes) **20**
What will Instructor do: - Preparation of list of difficult to use objects/process as identified by students on writing board. - Marking of differently identified 'difficult to use' object/process at site from previous one.	
What will students do: - Each pair will narrate the identified object/process and discuss the pros-cons briefly among the class.	
Deliverable from this Phase: - List of 'difficult to use' object/process on a building construction site with pros and cons of each.	

4. ***Further discussion:***
   Teacher and students to discuss over how such problems can be verified by minute observations on site. Further to discuss over using observation techniques. Introduces AEIOU framework for conducting Ethnography.

Part 2 (Optional): Refine your TPS activity

Do either or both of the below:

1. Talk to a colleague who is familiar with your topic or the TPS technique. Get feedback on whether:

(i) the statements that you wrote in Part 1 capture what you want students to do in each phase,

(ii) there is a logical connection between your phases, and

(iii) the timings for each phase are ok.

2. Predict the responses that you will get from students in the share phase. Use the space below to write down some predictions and later compare them with what actually happens in your class.

Part 3: Implement your TPS activity

Some guidelines for what to do in class when you implement your TPS activity:

1. Don't panic if no activity happens in the first minute. Students will take time to get started.
2. Do encourage students to write their ideas down, especially during the think phase.
3. Do walk around the class during the pair phase, answer relevant queries, encourage students to talk to their neighbor, and to write down their answers. Keep track of time also.
4. Do discuss a few representative students' solutions in the share phase, and then transition into points that you want to highlight. It is ok if this phase takes 20% more time than you anticipated.
5. Don't expect 100% participation. If 80% of your class is participating, you are doing fine. ☺

Part 4 (Optional): Conduct an education research study

If you are interested in determining the effectiveness of your implementation, beyond informally asking a few students for their opinion, then contact convener.et@iitb.ac.in . Research scholars from the IDP-ET will be happy to work with you to structure an education research study for your TPS activity.

Further Reading:

1. http://olc.spsd.sk.ca/DE/PD/instr/strats/think/
2. http://www1.umn.edu/ohr/teachlearn/tutorials/active/strategies/

Appendix: Examples of Think-Pair-Share activities from CS 101 for specific instructional goals

Instructional goals	Think Pair Share	Example as shown in the slide to students,
Conceptual understanding	*Think* Students write down answer the given question *Pair* Students (i) Identify parts of the answer that they have missed out. (ii) Discuss which answer is better; do pros-cons analysis if there are multiple solutions. *Share* Instructor discusses (i) What are all the essential parts in the answer? (ii) Pros-cons of various solutions given by students	"Consider an unsorted array of N elements. Think: Write the pseudo code for sorting the array Pair: Discuss your answer with yoru neighbor, do pros and cons analysis of your algorithms Share: Follow instructor led discussion of your solutions and others." *This led to a discussion of various sorting algorithms.

Code tracing: Predict the output; Debug/modify the given code	*Think* Students determine and write down the answer.
	Pair Students (i) check each others' solution (ii) discuss change in code to get others' solutions
	Share Instructor (i) executes the program and shows the output (ii) discusses a few modifications based on student answers
		"Predict the output of the following program:
		int a = 1, b = 2, c = 3; int* p, int* q;
		p = &a; q = &b; c = *p; p = q; *p = 13;
		cout << a << b << c << endl; cout << *p << *q << endl;"
		Think: Draw the memory arrangement and predict.
		Pair: Check your neighbor's solution. If you don't agree, discuss and come up with a solution that you both agree upon.
		Share: See demo of above code and modified versions."
		*The example for the outcome "Debug/modify" is similar

Develop programming logic for a problem: Write program.	*Think* Students write down the pseudo-code. *Pair* Students (i) identify missing pieces in each other solutions (ii) write the program. *Share* Instructor (i) shows one possible solution. (ii) Discusses a few representative student solutions.	"Recall your program to reverse a 4 digit number. Extend your solution to arbitrary integers. Think: Write the pseudo-code individually. Pair: Write the C++ code with a partner. Share: Compare your solution with demo10-reverseNum-mod1.cpp"
Design a solution: Write pseudo-code	*Think* Students write down the different parts (structures and functions) of the solution *Pair* Students discuss the pseudo-code for the functions that are required *Share* Instructor discusses a few representative solutions.	"Design a taxi scheduling service for an airport as follows: (i) When a driver arrives, his ID is entered in an array (ii) When a customer arrives the earliest waiting driver is assigned Think: What structures and variables are required? Pair: Discuss the pseudo-code for the functions that are required. Share: Follow instructor led discussion of your solutions and others."

Contribute an appendix of TPS activities for your discipline/course, based on the TPS activities that worked in your class. This will be useful to other instructors who plan to implement TPS. If interested, send mail to convener.et@iitb.ac.in

End of Resource: *Think-Pair-Share Activity constructor*