CAREER EPISODE 1

a) Introduction:

1.1 The first career episode is the description of my roles and responsibilities as a Structural Engineer in the project called "Construction of the Qatar Academy Sidra School". The construction of this project was started in 2017 and it is still in progress. In this project, CEG International (Qatar) was selected to perform all structural designing, drawing, and construction activities of the school as per Qatar Engineering Standards.

b) Background:

1.2 CEG International is a leading international engineering practice that offers services in architecture, interior design, master planning, landscape, urban design, and building consultancy in both Asian countries and the Middle East.

1.3 The Qatar academy Sidra School's approximate worksite area is 74,402 square meters. The whole building of the school construction on the North-West Super Block with an entire area of the North-2 West Super Block is 423,126 sm for the infrastructure and landscape package. Thus, Qatar Academy Sidra School has an approximate GFA of 31,200 m^2 to accommo date a total number of 1,800 students. Moreover, the school is consisting of the following components:

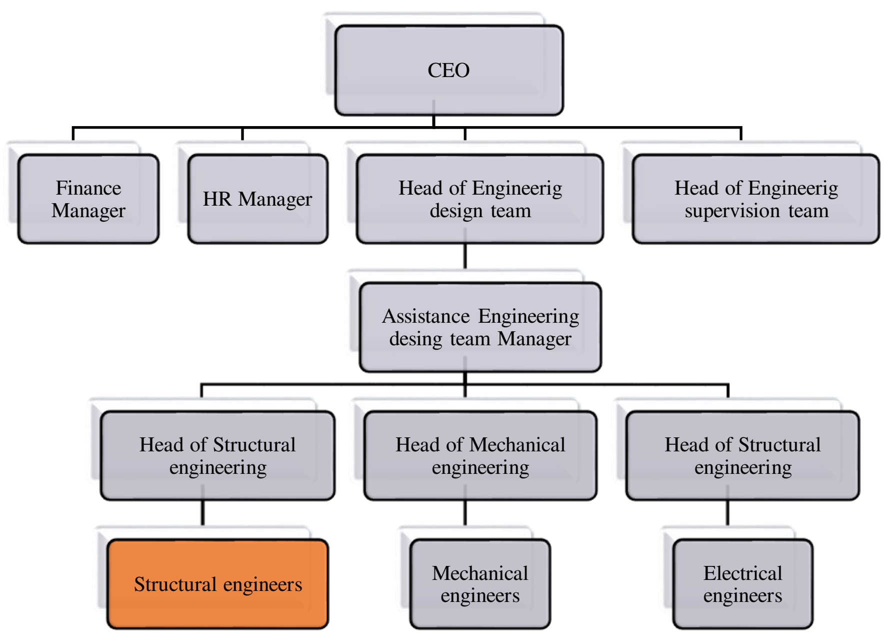
(a) Kindergarten: KG3, KG4, and KG5.
(b) Primary School: Grade 1 to Grade 6.
(c) Middle School: Grade 7 to Grade 9.
(d) High School: Grade 10 to Grade 12.

1.4 The infrastructure and landscape design was proposed for the entire North West Super Block site. The package consists of identifying the scope of the construction contract together with all other disciplines and interfaces, allowing the Qatar Foundation-appointed construction contractor to build all infrastructures (including all utilities) and landscape works without any need to perform design work, except for the review of essential temporary work arrangements and typically required drawings.

1.5 I was involved in the following construction activities:

- Studied engineering & architectural drawings to thoroughly read the technical specifications and then decided on the most suitable framing system for the construction.
- Used AutoCAD software to prepare the structural drawings.
- Worked on the ETAB software to prepare the framing plan and overall design of the structural elements.
- Performing design checks by comparing manual calculations and software results.
- Performing calculations to verify the dimensions of different sections.
- Resolving the technical problems and designing the deep beam in the sp wall software.
- Monitoring all structural design changes and assessing the impact of these changes on the overall design of the other elements.
- Analyzing structural systems for the school.

1.6 I made the following structure to represent my position:



c) Personal Engineering Activities:

1.7 In the beginning, I studied the architectural, mechanical, and electrical systems to decide which framing system would be suitable for the school. In this regard, I called a technical kick-off meeting with the junior engineers and engineering design team to thoroughly study the systems along with their technical details to propose the best framing structure for the building. During the meeting, I proposed some drafts for framing systems and submitted them to get approval from other disciplines, and then it was sent to the client for final approval. The imposed floor from the ASCE-07 code, and the dead loads and other loads were stated in the specifications file of the project. I have developed the framing system based on dividing the school into six sections which will be connected by a construction joint on the site. I designed each section of the framing structure and analyzed them separately for each dead load and live load, however for the wind and earthquake loads, Ichecked the whole building as a whole. Also, I reviewed different engineering design manuals and building construction books to keep myself updated.

1.8 To draw the framing system, I used AutoCAD software to prepare the drawings of the beams, columns, and slabs' boundaries. Then, I saved them as a DXF file so that I can import them to ETABS software. I applied this technical strategy to ease the structural work as I was able to obtain the exact coordinates for my structural elements in one click. Then, I worked on the ETAB software, I did not have to define the materials and the sections as most engineers do in the beginning as I had my own saved library where I gathered the sizes of the most common sections and the most used materials in the construction sector in Qatar, Through this way, I was able to save a lot of time.

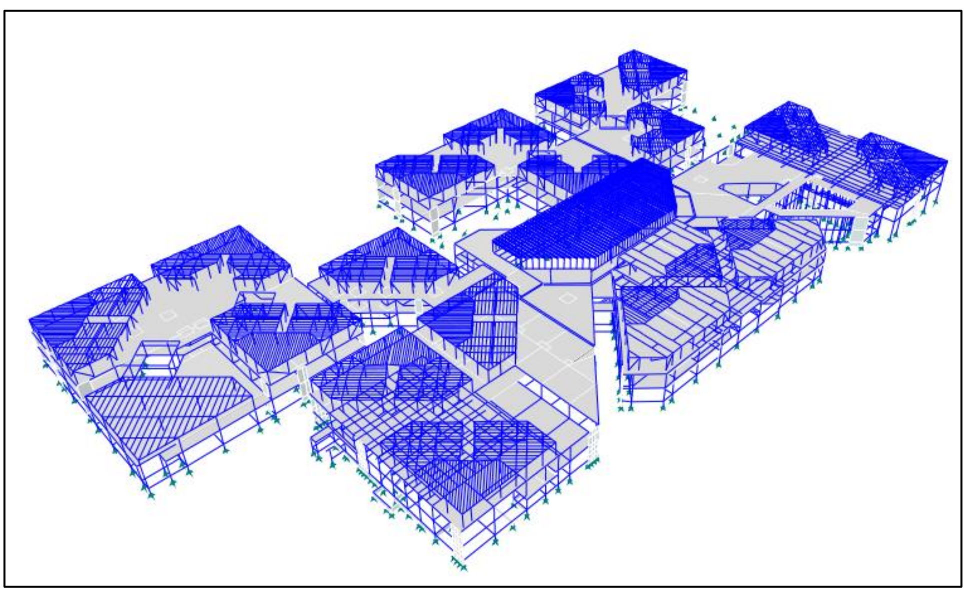


Figure 1 Structural Framing Plans in ETABS Software.

1.9 After this, I started preparing the drawings of the columns and then connecting the beams between their nodes depending on the framing system. I designed the columns as per the desirable reinforcement requirement and I checked the adequacy of the design in the ETABS software (Reinforcement to be Checked Option) instead of getting the required reinforcement from the ETABS, I decided to apply a safety check on the columns for the sway, capacity ratio, and the non-sway moment magnification factor. The next step was to design the slabs which were made counterclockwise because there was a possibility that it would affect the shape of the moment after applying load. The slab thicknesses varied between 150, 200, and 250 mm and the slabs on grade were 300, 320, and 350 mm, depending on the applied load on it and its dimensions. Following that, I double-checked to ensure that I had chosen the adequate sections and that their materials are assigned correctly. Next, I imposed the loads i.e. dead, live, and wind loads, i.e. I calculated the dead load based on the materials' density, as per ASCE-07. Moreover, I assumed the live load for Qatar academy Sidra School to be 1.92 kN/m^2 for the classrooms, 3.83 for the corridors above the first floor, and 4.79 for the first-floor corridors. Also, I calculated the wind load based on a wind speed of 100 km/h following QCS 2014 and BS-6399 Part-2.

1.10 Next to that, I designed the beams and checked the reinforcement. In this case, I first chose the preliminary beams sections based on two aspects, i.e.

1. The width was based on the architectural drawings so that the beams stay within the wall width and cannot exceed it for aesthetic purposes.
2. For the thickness of the beams, I used the beam minimum thickness from table 9.5 (a) in ACI 318-14 code.

Then, I designed the beams' reinforcement based on the maximum ultimate positive and negative moment to obtain the bottom and top reinforcement values, respectively. For the shear design, I used the maximum shear force to get the required stirrups reinforcement. Following that, I checked the beams for torsion. The following figure illustrates the beam's typical detailing.

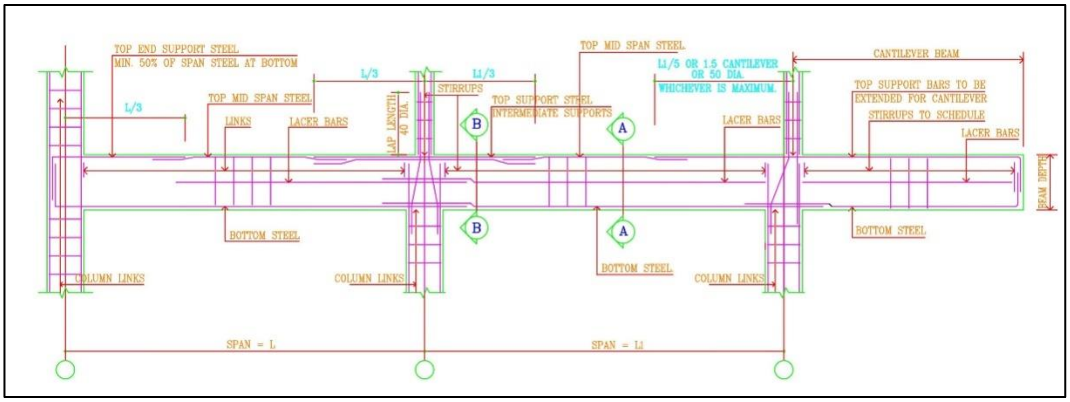


Figure 2 Typical elevation of the continuous beam with cantilever end.

The last step was to design the slabs and the footings (thickness of 600 mm)and I checked the deflection, and the overturning, respectively using the Safe software.

1.11 After completing the software design work, I verified the software design results by selecting randomly some elements and designing them manually or by an excel spreadsheet. The following is an example for checking a design of a beam, i.e. I first checked the loads on the beam by considering the value of maximum Mu (negative) and Mu (positive) to be 229.353 kN.m and 115.4805kN.m respectively. Hence, I obtained the overall moment of the beam as 350x 750 which is an accurate result as per building requirements. Then, I performed the below calculations for beam design flexure (bending)-design for the max negative moment = 229.353 kN. m

- $d' = \text{Clear Cover} + d \text{ stirrup} + \frac{db}{2} = 40 + 10 + \frac{25}{2} = 62.5\text{mm}$
- $\frac{Mu}{\Phi_b * b * d^2} = \frac{229.353*10^6}{0.9*350*687.5^2} = 1.54\text{N/mm}^2$
- $\therefore \rho = 0.003744$

After these computations, I determined the area of the steel (As) which was obtained as 901mm^2. Based on it, I decided to use two bars of 2φ25. I also verified the reinforcement values by comparing the Asmin and Amax which is as follows:

$$BAs_{\min} = 960.81\text{mm}^2 < As = 981.8\text{mm}^2 < As_{\max} = 6623.2\text{mm}^2(\text{ok})$$

1.12 Then, for the negative moment design work, I compared the results of both Mc and Mu(negative), which showed the section is adequate. Thus, I concluded that for the negative moment, design for the maximum positive moment= $115.4805 kN \cdot m$. Next, I repeated the same calculations steps for positive moment by assuming the value of db to be 25 mm, d' to be

62.5mm, and d to be 687.5mm. The results shown that the section is adequate for the Positive moment as well.

1.13 Afterward, I verified the shear design by considering the dimensions as: b = 350 mm, d = 687.5 mm, and maximum shear force (Vu) – 165 kN. Then, I did the following manual computations.

- $Vn = \frac{Vu}{0.75} = \frac{165}{0.75} = 220\text{kN}$
- $Vc = \frac{1}{6} * \sqrt{f'c} * b * d * 10^{-3} = \frac{1}{6} * \sqrt{45} * 350 * 687.5 * 10^{-3} = 269.027\text{kN}$
- Section Adequacy
- $Vn < 5Vc$
- $220 < 5 * 269.027 = 1345kN$ - Section is Adequate for shear

1.14 I did the following final design checks and then I developed the comparison table to show the results of both manual and software calculations.

- $\mathrm{M}_{c1-1} = 249.429\text{kN}.m > M$ (Negative) $= 156.33$ kN. m
- $\mathrm{M}_{c2-2} = 249.429\text{kN. m} > Mu($ Positive $) = 114.99$ kN. m
- $\mathrm{M}_{c3-3} = 249.429$ kN. $m > Mu($ Negative $) = 229.394$ kN. m
- $\mathrm{M}_{c4-4} = 249.429\text{kN} \cdot \text{m} > Mu$ (Positive) $= 115.8$ kN. m
- $\mathrm{M}_{c5-5} = 249.429$ kN. $m > Mu($ Negative $) = 228.22$ kN. m
- $\mathrm{M}_{c6-6} = 249.429\text{kN. m} > Mu($ Positive $) = 115$ kN. m
- $\mathrm{M}_{c7-7} = 249.429\text{kN}.m > Mu($ Negative $) = 154.94$ kN. m

From the results, I indicated that the values of all sections are adequate.

Manual Calculation	Bottom Steel Area= 981.8mm^2	**$2\phi25$**
Software (ETABS)	Bottom Steel Area= 961mm^2	**$2\phi25$**
Manual Calculation	Top Steel Area= $BAs_{\min} = 961\text{mm}^2$	**$2\phi25$**
Software (ETABS)	Top Steel Area= 961mm^2	**$2\phi25$**

1.15 During the design phase, I faced a problem with the design of a particular beam where the load was not distributed rationally to it because of the section modifiers coefficient, the reinforcement was underestimated by the ETABS software. I had to resolve this issue because an inadequate design of the beam will lead to a failure once the loads are applied after construction. After analyzing the issue, I noticed that the proposed beam was a deep beam thus it had to be designed through the Strut-and-Tie method (STM) or based on the nonlinear distribution of strain. Therefore, I suggested to re-design the deep beam using sp wall software by taking into account the nonlinear distribution of strain.

1.16 Based on the architectural requirements for the gymnasium & swim center and also for the auditorium, no columns were allowed to be present in the middle which created a large area with a huge load coming on the top slab of those buildings. Due to this problem, I had to install heavy reinforcement with a huge slab thickness, however architectural demands for the aesthetic look of these areas were within the budget. Therefore, as a solution, I decided to install a hollow core slab system to cover up the long-span floor. This idea was approved by the architecture and it looked aesthetically good.

1.17 I performed structural designing work by following engineering standards, i.e.

1) QCS 2014: Reference Standard
2) ACI 318-14: Reinforced Concrete Design
3) AISC 360-05: Steel Design
4) IBC 2012/ASCE 7-05/ASCE 7-10: Design Load Calculation

1.18 During this construction project, I had to work with many individuals belonging to different departments to develop the structural drawings with their approval. Moreover, I also worked along with the senior structural engineers which helped me a lot in completing design work and calculations as per engineering codes. I always took their guidance and feedback before submitting the final work to the project manager. I valued their suggestions because they broaden my knowledge of structural designing and load calculations in the software.

1.19 I attended daily meetings to check the progress of the work done by the junior engineers and planned our next milestone. Then, I submitted a written explanation of our work to the senior engineers. In addition, I also participated in weekly and sometimes fortnightly meetings with the architectural and mechanical departments to get their updated requirements and reflect them on our design.

1.20 Before starting any work, I familiarized myself with the engineering standards, guidelines, and company regulations to avoid penalties. I also understood the ethical work regulations to maintain a good relationship with all members without any discrimination and kept all details confidential. Moreover, I always planned my work to avoid work clashes that might affect deadlines and because of it, I submitted my work on time.

d) Summary:

1.21 This project challenges me beyond my expertise to develop complex structures using SAFE, ETAB, and AutoCAD software. I researched to understand current construction methods and applied them to achieve the best results by staying within the budget. I learned how to tackle complex issues using limited resources and how to work under the supervision of senior engineers.

CAREER EPISODE 2

a) Introduction:

2.1 The second episode is the description of another construction project named "Construction of Double Tree Hotel Apartment". In this project, I was designed as a Structural Engineer by CEG International (Qatar). The construction work was started in January 2019 and it is still in progress.

b) Background:

2.2 The project is aimed to develop the Hotel Apartment Building comprising of 2B+G+M+9+P, on a plot with PIN 48080011 having an area of 4,940 sqm, located corner C-Ring Road & Umm Suwab Street, Umm Ghuwailina area. The proposed building will have a total built-up area of 34,596 sqm with details, as follows:

Basement – 2 area	4,098.00 sqm
Basement – 1 area	4,098.00 sqm
Ground Floor area	2,071.00 sqm
Mezzanine Floor area	1,626.00 sqm
1st Floor area	2,433.00 sqm
2nd to 8th Floor area *(Typical floor area 2,433 sqm)*	17,031.00 sqm

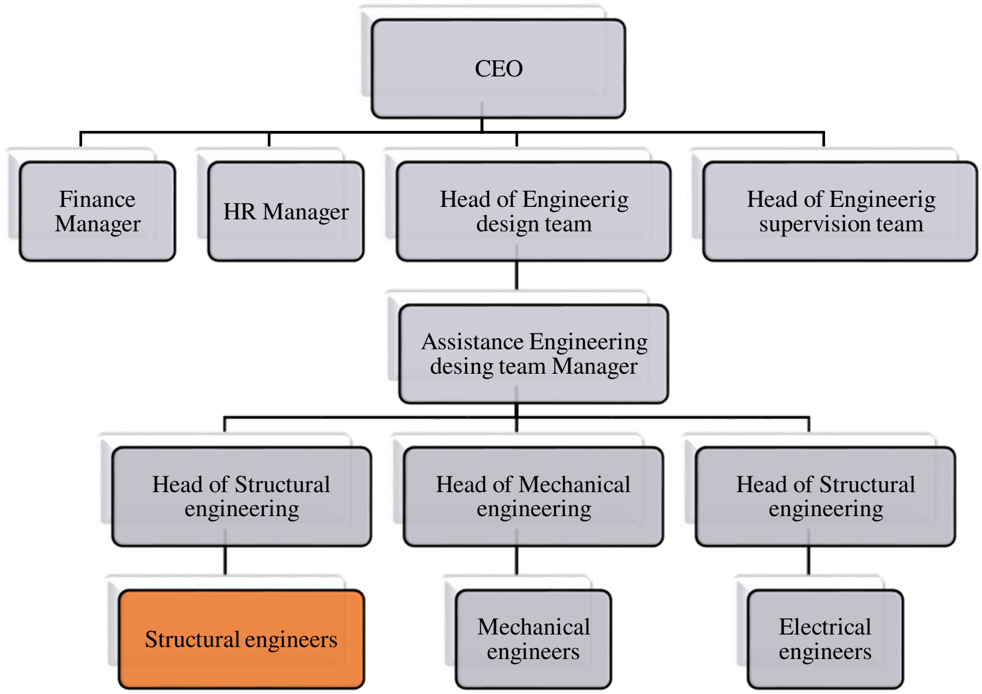
9th Floor area	2,433.00 sqm
Penthouse Floor area	684.00 sqm
Roof Deck area	122.00 sqm
Total Area (BUA)	**34,596.00 sqm**

2.3 The company was hired to design the building by consideringthe highest standards of comfort and convenience. It was decided to design all sections, such as main hotel apartments, entry, lobby, etc. following engineering standards with support spaces for technical rooms, security, underground water storage, pump-room, substation, and MEP systems (electrical, Ooredoo, generator, HVAC, fire-fighting, plumbing, etc.) which were sized in such a way to ensure efficient and safe operations. Whenever possible, state-of-the-art building technology will be specified to reduce operational costs, guarantee the highest level of service, and provide flexibility for future changes.

2.4 I was responsible to work on the following design activities:

- Developing a structural framing system after studying the architectural, mechanical, and electrical drawings.
- Creating a material specification sheet for the mechanical properties of the materials used for the construction.
- Deciding the suitable structural codes for the analyses and design processes.
- Creating different options for the building plot to satisfy the client's requirements.
- Coordination with the architectural, mechanical, and electrical departments to have updated drawings and information that is crucial for the structural design.
- Creating progress reports to submit to the management department.
- Analyzing and designing the structural elements using the structural software following the codes.
- Analyzing and designing the foundation system (substructure) based on loads of the superstructure.
- Create the design drawings and get them certified and to be issued for construction (IFC).
- Reviewing the shop drawings created by the contractor.

2.5 I made the following hierarchy to show my designation:



c) Personal Engineering Activities:

2.6 In the planning phase, I attended the meetings along with engineers belonging to other departments to discuss the overall designing criteria, client's requirements, scope of the work, timeline, budget, etc. Being a structural engineer, I have experience in multiple construction projects, so I also participated in these technical meetings by providing innovative designing strategies to build safe structural elements without any failures. Moreover, I also communicated with the junior engineers to make a project plan containing software relating to work, manual calculations, technical designing tasks, etc. I described each activity so that the department head can understand my working strategies.

2.7 After I reviewed the architectural, mechanical, and electrical drawings and made the plan, I designed the structural system by suggesting two different options for the typical flooring plan (first to the eighth floor) to accommodate the owner's request, i.e. I decided to use the ETABS software to design the beams, columns, and shear walls, slabs, and footingswhereas SAFE software for checkingboth the immediate and long term deflection for the footings and the slabs. The below figures shows the plan generated by using different software:

2.8 Then, I design the structural drawings of the building in the ETAB software, which is shown below:

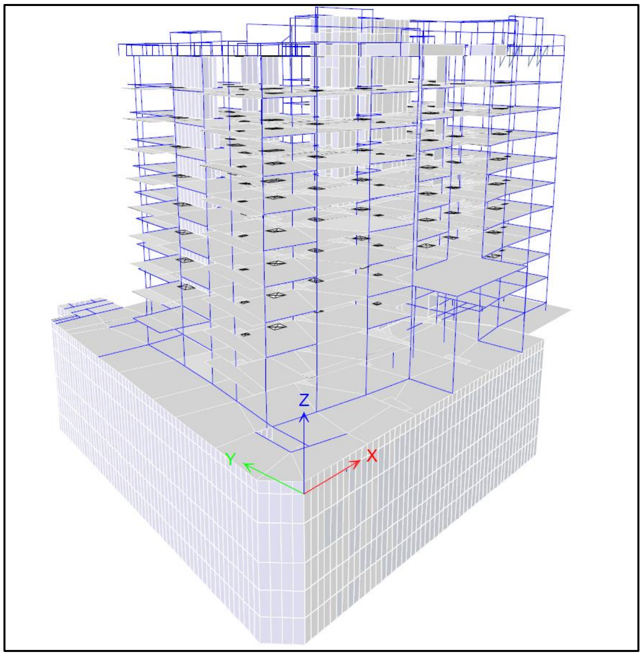


Figure 3 Double Tree Hotel ETABS 3D model.

Figure 4Double Tree Hotel Structural Ground Floor Plan.

2.9 For a high-rise building such as a double tree hotel apartment, I checked the wind load manually and compared it to the software calculation by following the ASCE 7-10. The hotel building lies in a Category II building, therefore, according to QCS (2010) clause 17.2.1.9.4, I considered the basic wind speed in Qatar equal to 100mph and the factor of K_d as 0.85. Then, I selected the exposure category based on its location, i.e. hotel is located in an urban area so Exposure B was selected with a topographical factor (Kzt) of 1. After this, I had to determine whether our hotel is a rigid or flexible structure so that I can calculate the gust factor, if it is a rigid structure then the gust factor will be equal to 0.85 and if it is flexible then I need to calculate the gust factor by the equation that is provided in the ASCE 7-10. In this case, I calculated the natural frequency, if it is less than 1 Hz it is a flexible building and if it is more than 1Hz then it is considered a rigid building.Thus, using the following equation provided by ASCE 7-10: $T = C_T h_W^{3/4}$. Where; T = time period, $C_T = 0.049$, and Hw = height.

2.10 Based on the obtained value, I considered that the building is flexible, therefore, I calculated the gust factor. Next, I also determined the gust factor in the x-direction and y-direction of the building. Now for the building type, firstly, I assumed the building to be Open, so the value of importance factor (I) was 1.00. Afterward, I determined the wind load on the building with the following equation:

$$q_z = 0.00256 * K_z * K_{zt} * K_d * V * 2 * I$$

Then the pressure on the building was obtained using the following equation and represented in table 5

$P = qz(G)(Cp)$

2.11 While designing the first framing system, Isuggested a framing system which was slab beam system but some of the columns in the car parking levels had to be in the driveway which will obstruct the driver's path. This issue was encountered due to the locations of the walls, beams, and column location which was not suitable as per architectural drawings. Because of this issue, the required lane width for the vehicle in the driveway was affected by the columns that were required to have a slab beam framing system. As a solution, I decided to change the framing system to a flat slab system which will eliminate a lot of the internal columns, i.e. I reduced the number of columns which lead to an increment in the length and width of the bays therefore, a slightly thicker flat slab was required with drop panels at the location of the columns.

2.12 I noticed that the total story drift exceeded the allowable drift of Δ= H/500 (as per ASCE 7-10) where H is the height of the building. It leads to a heard noise and felt movement in the building, especially in the stories where there is an excessive drift which will be uncomfortable for the occupants of a reputable hotel such as the double tree. After root cause analysis, I came across that this issue is due to horizontal loads such as the wind and the earthquake loads which are responsible for the excessive drift. As a solution, I increased the moment of inertia of the beams and columns by increasing their cross-sections (sectional dimensions).

2.13 At the beginning of the project, I along with my structural team arranged meetings with the owner's representative to understand all requirements, especially for the typical floor planning. Later, I discussed these details with the junior engineers to develop design strategies necessary to meet the requirements. I also created a work plan along with a description of each to make it easy for each member to understand the nature of the work.

2.14 Additionally, I arranged daily basis meetings with the structural engineers and the drafting personnel to review the accomplished work and discussed design issues and make suggestions to improve the model. Moreover, I communicated with the structural team by arranging a short meeting to establish our daily goal which was a great strategy because it allowed each individual to remain focused on their daily tasks and it increased work productivity with zero hazards and errors.

2.15 I prepared the calculation sheet for the structural elements in addition to the ETABS modeling report. Moreover, I provided technical guidance to the drafter in drafting on AutoCAD and reviewing his drawings. Also, I had fortnightly meetings with the different departments such as mechanical, electrical, and most importantly the architectural team as they were having the highest number of changes that had to be addressed in my structural modeling.

d) Summary:

2.16 I reviewed the software results and compared them with the manual calculations to ensure the accuracy of my work and I ensured all safety design checks fulfilled the requirement. I learned how to use ETAB software to develop 3D models which were approved by the senior engineers.

CAREER EPISODE 3

a) Introduction:

3.1 The report defines the project's operations by investigating the strength of the bond between the reinforced concrete and basalt fiber-reinforced polymer (BFRP). The project was part of my assessment for the course in structural engineering at Qatar University. I commenced my work on Month/Year and completed it in Month/Year.

b) Background

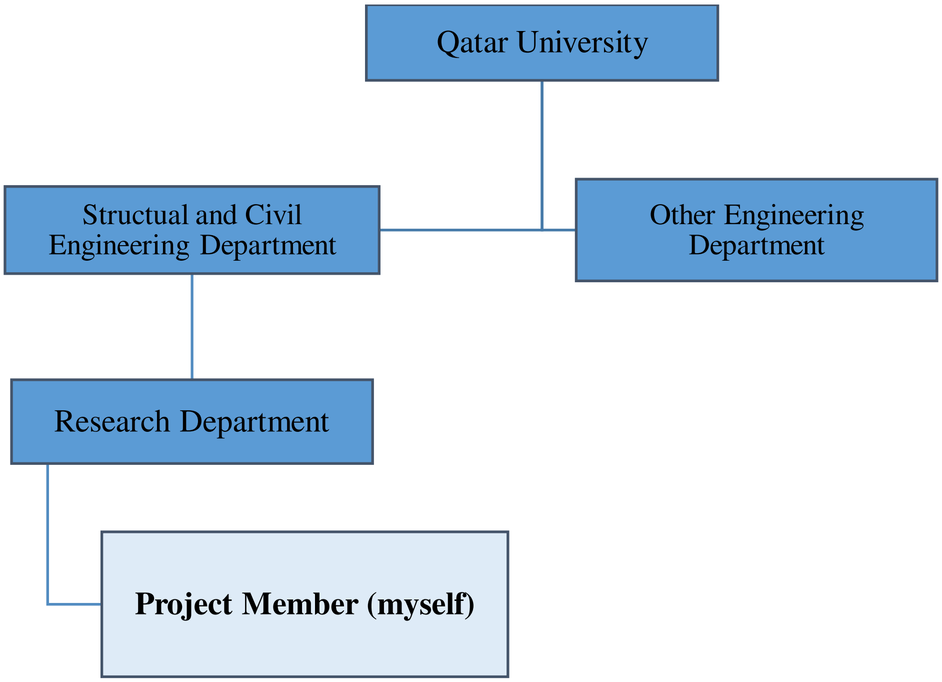
3.2 The project was a joint effort of individuals with similar civil and architectural engineering skills at different universities. To successfully investigate the resulting bond and various parameters were investigated, including BFRP diameter, splice length, and bar texture length. The investigation results would demonstrate that the flexibility capacities of SC-BFRP bars are similar to those supported with HW-BFRP. Various codes and standards were applied in the investigation and authenticated the guidelines to be followed in the experimental processes.

3.3 The resulting study resulted from increased corrosion of steel structures, causing deteriorating conditions for the reinforced concrete (RC) structures. As researchers, we were motivated to craft designs to investigate the possibility of using an alternative polymer, fiber-reinforced polymers (FRP), in RC structures. Several tests were done to investigate the specific qualities that would authenticate the irreplaceability of steel in the reinforcing of concrete in mechanical performance. The particular focus of the investigation possibility of the replacement of steel with fiber concrete in the structures of reinforced concrete.

3.4 My duties as a team leader are as follows:

- Investigating the parameters determining the type of bond between the suggested fiber and reinforced concrete.
- Considering the various codes that would govern the investigation in terms of the procedures and equipment used.
- Experimental investigation of the replaceability of steel as the reinforcing material in reinforced concrete structures.
- Determining the specific parameters of the test materials that would achieve the desired results.
- Evaluating the extent to which the parameters of the test materials were relevant in achieving the defined results, even in a large-scale setting.

3.5 My position is shown in the below figure:



c) Personal Engineering Activity:

3.6 The investigation started by setting up an experimental program that involved various steps. For this purpose, I fabricated test specimens by designing large-scale beams. The beams were grouped into SC-BFRP longitudinal bars and HW-BFRP bars. In the designing process, I ensured that the bars had a resultant failure to make sure that the bars would fail in tension before the concrete broke during the compression process. This test setup was done sequentially considering the designated four times loading processes till failure. The automatic acquisition system collected the designated load, deflection, and strain measurements. The gauges were placed longitudinally describing the multiple directions of the beams.

3.7 Then, I selected the material for the project in the standard designation for the preparation of the components of construction relevant to a specific activity. The mixing was in relation to the required output of the study and was defined in the procedures. The vitality of the experimental program was in ensuring that the setup specimens were within the designated parameters and achieved the controlled results of the investigation.

Table 1shows the various groups of test matrix

Specimen ID	Bar surface	No. and size of BFRP main bars	Reinforcement ratio, ρ_f	Splice length (mm)	Effective depth, d (mm)
Group 1					
SC-D10-SL400	Sand-coated	2–10 M	0.33 ρ_{fb}	400	395
SC-D10-SL600				600	
SC-D10-SL850				850	
SC-D12-SL500	Sand-coated	2–12 M	0.45 ρ_{fb}	500	394
SC-D12-SL700				700	
SC-D16-SL600	Sand-coated	2–16 M	0.74 ρ_{fb}	600	392
SC-D16-SL900				900	
SC-D16-SL1200				1200	
Group 2					
HW-D10-SL400	Helically wrapped	2–10 M	0.33 ρ_{fb}	400	395
HW-D10-SL600				600	

ρ_{bf} is the balanced reinforcement ratio.

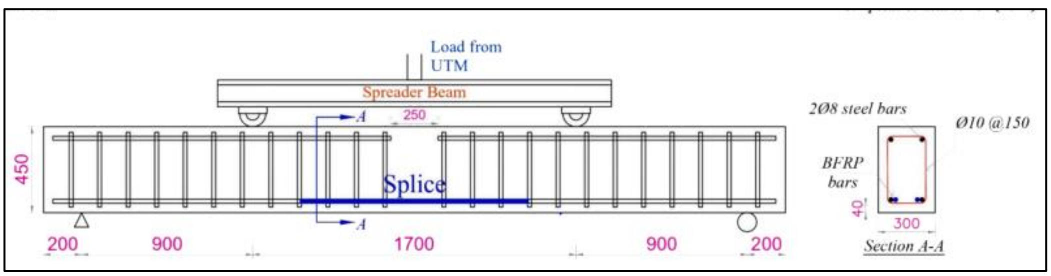


Figure 5shows the aspects of the beam.

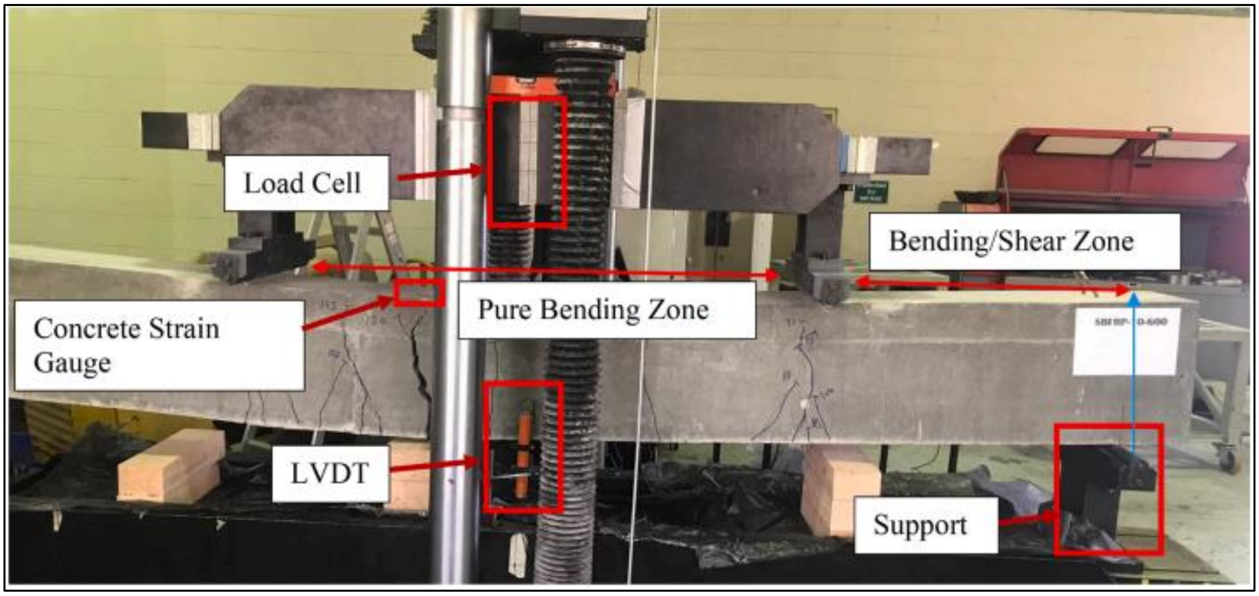


Figure 6the experimental set-up

3.8 After designing the beam, I proceeded to the evaluation of the RC beam test result which was a crucial step of the investigation. Here, I investigated several parameters were the load-deflection response, which was evaluated to be a definitive behavior of linear orientation which is steep till when the first crack is formed, and not considering the diameter of the bar or the length of the splice. The cracks widened as the load application was increased, and eventually, the degradation of the beams' stiffness. The load-carrying capacity was concerning the flexural extent recorded for the specimen beams. The longitudinal reinforced ratio considerably affected the beam's flexural ability. The failure results observed two modes; BFRP/concrete de-bounding, and BFRP rapture, which resulted from the inadequate splice length of the beam. For the load-strain response, I noticed stress measured was at the relative end of the bar.

3.9 Afterward, I also observed that the significant strain at the end limited the normal actions of the tensile strain at the center which is often translated and transmitted to the tips of the designated fiber bar. From the further results, I depicted that the increase in the length of the splice increased the ultimate strain of the BFRP bars. Regarding the texture, I evaluated the SC bars depicted a higher ability to resist stress than HW bars regardless of the size of the beam. The bond strength assessment results evaluated the governing tensile force between the spliced bars. The consideration of the obtained values for critical evaluation of the tensile properties of the fiber was close to the theoretically obtained values obtained in a different calculation of similar ideas. Also, the maximum strain and splice length were related theoretically by an equation given by the standards of the investigation. The evaluation of the experiments' results was fundamental in assessing the influence of the bond strength of the different parameters of the investigation.

Table 2The results for the different parameters

Bond strengths, modes of failure, and experimental to predicted flexural capacities ratios for the tested beams.

Beam Identification	$M_{u,exp}$ (kN.m)	CSA-S806-12 [34]		ACI-440.1–15 [35]				
		$M_{u,pred}$ (kN.m)	$\frac{M_{u,pred}}{M_{u,exp}}$	$M_{u,pred}$ (kN.m)	$\frac{M_{u,pred}}{M_{u,exp}}$	Mean bond strength (MPa)	Mean bond stress* (MPa)	Mode of failure
SC-D10-SL400	65.1	55	1.18	40	1.63	6.7	–	Debonding
SC-D10-SL600	67.3	55	1.22	40	1.68	4.6	–	Debonding
SC-D10-SL850	76.8	55	1.40	40	1.92	–	3.7	Rupture
SC-D12-SL500	99.28	78	1.27	56	1.77	6.8	–	Debonding
SC-D12-SL700	116.34	78	1.49	56	2.10	5.7	–	Debonding
SC-D16-SL600	142.19	126	1.13	93	1.53	6.2	–	Debonding
SC-D16-SL900	146.06	126	1.16	93	1.57	4.2	–	Debonding
SC-D16-SL1200	165.24	126	1.31	93	1.78	–	3.6	Rupture
HW-D10-SL400	65.25	50	1.31	36	1.82	6.6	–	Debonding
HW-D10-SL600	65.5	50	1.31	36	1.82	–	4.4	Rupture
Mean			1.28		1.76			
SD			0.11		0.16			
COV%			11.38		8.50			

* (at time of rupture)

$M_{u,exp}$ = Experimental ultimate moment; $M_{u,pred}$ = Predicted ultimate moment

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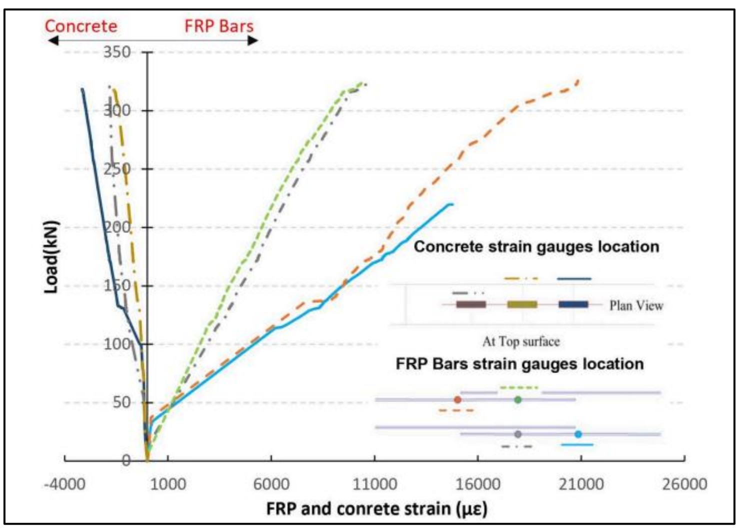

Figure 7Representation of the response to a strain due to load.

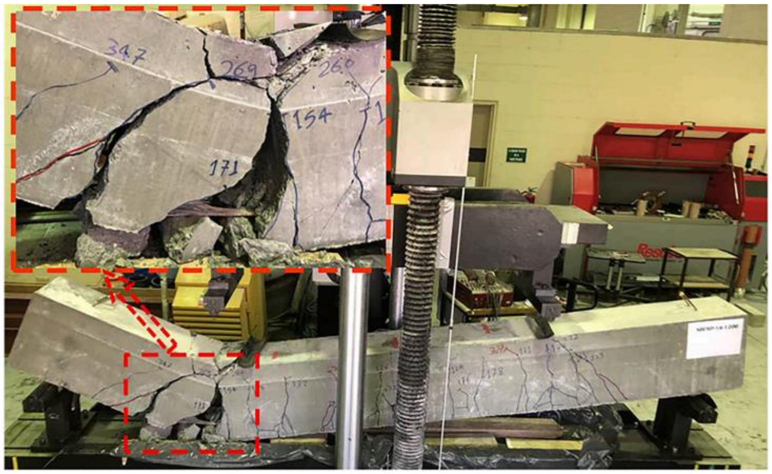

Figure 8Mode of failure and tensile rapture

3.10 After the analysis of the results of the investigation, I used the data to predict the resultant values relevant to the strength in the flexibility of the bars and the length of the splice under which the parameters were investigated. The activity in the estimation for the flexural strength considered designing the beams with a tension-controlled failure. The predictions relied on the provisions of the standard ACI.440.1-15 that used theoretical values of the standard in designing the beams. Further, the forecast used the provisions of standard CSA S806-12 that guided the hypothetical resultant forces due to the exerted load. The prediction for the critical splice length considered the developmental length, which is designated to be among the experiment designation of the splice required.

3.11 The codes and standards provisions used for the developmental length of the FRP bars gave the designated equations necessary for the prediction. The essentiality of the forecast was in the graphical and actualization of the provided values from the investigation and subjecting them to known standards.

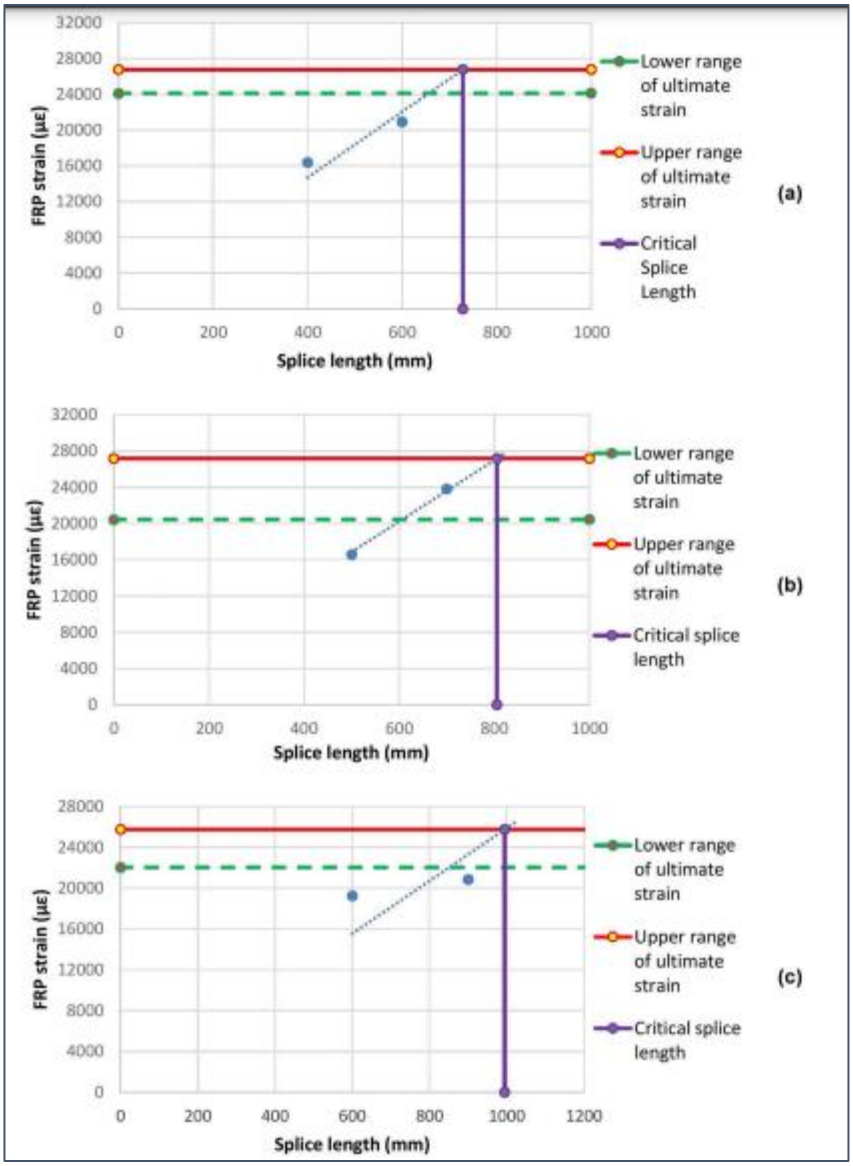

Figure 9variation of the length of the splice for the different textures of the different bar's diameter designation of the experiment.

3.12 The provision of the standards and codes was vital in enabling the completion of the investigation and facilitating the comparative derivation of various parameters of the study. Therefore, I used standards, such as ACI-440.1-15 for calculating the developmental length and CSA S806-12 theoretical flexural capacities for critical splice length prediction and determining flexural strength. During experimental operations, I also adhered to various ISO codes. Among them was the ISO 12573; 2016, which designated and simplified the design of structural reinforced concrete. The codes assigned the guidelines and the consideration of the specific material of operations dealing with concrete. The adherence to the code and standard for the materials used also ensured the obtained equipment and materials were of the designated quality.

3.13 After casting the large-scale beams, I reached the phase of testing them in the structural lab of Qatar university, but because of the heavy weight of the beams, as each beam weight is equal to the density of concrete multiples by the volume of the beam, in numbers that were equivalent to $2400\ kg/m^3 * 3.9\ m * 0.3\ m * 0.45\ m = 1263.6\ kg \approx 1270\ kg$, and it was not possible to set up the beams on the universal testing machine inside the lab using the available machinery. The flexural testing of the beams was delayed, which affected the final submission of my thesis. The lack of an automatic forklift inside the lab prevented setting up the beams to be tested, as the available manual forklifts could not slide the beam inside the machine. I designed two movable steel stands (shown in the figure below) and ordered them to be welded so that I could move the beams inside the workshop and set them up for testing.

3.14 I completed the study due to numerous insights from the prepared literature review. The source materials include online materials of books, journals, and articles related to the subject. I also studied books and magazines by visiting the school library and proved to be resourceful in providing insights essential for the completion of the project.

3.15 Before starting the research work, I arranged the various discussions meetings held for the project and facilitated the exchange of ideas relevant to the investigation's different issues. The views were incorporated in the literature review. I also consulted with our supervisor bettered our knowledge on the subject and was essential in clarifying the other matters whenever we were stuck.

3.16 I used different software to execute other activities of the investigation, such as STAAD enabled the fabrication of the beams and the bars to be used. In this regard, I used calculating software such as ETABS Pro to deal with complex procedures that would only delay the project's performance. The obtained values were compared to values of provisions of the various codes and standards of the process. Furthermore, I used Microsoft software, i.e. excel and MS-word for basic calculation and drafting of the reports that would document the execution of procedures and the guidelines used. Moreover, I used the MS Excel program in designing the graphs and tables that represented the parametrical distribution of factors of the subject.

3.17 In this project, the budget overruns required evaluating financial decisions regarding various entities and activities of the experiment. I drafted a budget sheet for evaluating the cost of each activity and the associated portion of the full designation. Budgeting was essential in ensuring the accorded resources were utilized to the maximum without waste. The drafting process considered the cost of the required material and equipment for several local stores and compared them to obtain cost-effective materials hence saving on the budget.

3.18 I kept the documents confidential and discussed the details only with the concerned persons to avoid leakage of significant details which is the main condition of the client. Moreover, I obeyed the ethical policies explained in the contract document and make assure that every individual are familiar with these policies. Also, I followed the relevant safety legislation applicable to keep the environment safe from carbon footprints.

3.19 During my entire activities of the project, I demonstrated the effectiveness of teamwork. I handled each move as a team that promoted the sharing of ideas essential in tackling different issues of the experiment. I also collaborated by doing regular consultations with the project supervisor, who adequately handled each case and presented it with ultimate professionalism. I was a role player in the teamwork, ensuring the roles accorded to me were performed flawlessly. Collaboration was also vital since the project's activities could be distributed equally to the individuals in the group, which reduced the period of the project.

3.20 The entire activity increased my skill set for various activities. The designing and drafting of the budget heightened my skills in managing resources and their utilization to ensure adequate designation and allocation of limited funds to several actions. At times, I was assigned the role of the group leader which refined my skills in the management of performance of activities and supervision. The relations and integration in the process performance of activities created connections vital for the project and the entire engineering profession.

3.21 I was able to finish the project on time due to a well-crafted working schedule. Since the project was a group effort, the working schedule could assign and list the activity designation of the different individuals in the group. The allocated time span of the activities facilitated the timely performance of the assignment of each individual. The working schedule allowed for the timely execution of the activities within the project's time frame as directed by the supervisor. The work budget was also essential in tracking the performance of duties in an orderly manner and ensuring none of the activities were left.

3.22 I adhered to the safety measures and ensured no interruption of the investigation. I used protective gear such as helmets, overalls, and the proper mechanical shoes. I also adhered to the workshop stipulation on the various safety precautions. The workshop equipped a first aid kit to provide immediate care in accidents.

d) Summary

3.23 The project was a success, having demonstrated the bond strength between the BFRP and the RC in structures. The results showed that the FRP could be a viable replacement for steel in RC structures. The material has high durability, demonstrates flexibility and strength, and does not corrode easily. This makes it a preferable material to reinforce concrete in beams, columns, and structures that require strengthening.

PROFESSIONAL ENGINEER

Summary Statement

Competency Element	A brief summary of how you have applied the element	Paragraph in the career episode(s) where the element is addressed
PE1 KNOWLEDGE AND SKILL BASE		
PE1.1 Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	I was involved in the different construction projects where I applied fundamental key concepts to provide suggestions to develop the safe structure. Also, I implemented current industrial standards and methods to perform structural analysis and manual calculations. Furthermore, my knowledge consisting of successfully investigatig the resulting bond and various parameters realting to determining structual strengt.	1.8, 1.9, 1.10, 2.7, 2.8, 2.9, 2.10, 3.6, 3.7, 3.8, 3.9
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	I performed calculations to verify the dimensions of different sections.	1.9, 1.11, 1.12, 1.13, 1.14
	I checked the wind load manually and compared it to the software calculation by following the ASCE 7-10	2.9, 2.10, 2.12`

	I performed calculationsof developmental length and CSA S806-12 theoretical flexural capacities for critical splice length prediction and determining flexural strength.	3.12
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	I utilized my concepts to prepare the drawings of the beams, columns, and slabs' boundaries.	1.8
	I design the structural drawings of the building in the ETAB software	2.8
	I evaluated the RC beam test result by doing several parameters.	3.8
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	I reviewed different engineering design manuals and building construction books to keep myself updated	1.7
	I did literature review by using source materials include online materials of books, journals, and articles related to the subject	3.14, 3.15
PE1.5 Knowledge of contextual factors impacting the engineering discipline	I designed the components in the software and then I performed safety checks to ensure on the columns for the sway, capacity ratio, and the non-sway moment magnification factor	1.9
	I performed wind load calculations to design the safe building	2.9
	I developed the experimental set-up by by designing large-scale beams	3.6, 3.7

PE1.6 Understanding of the scope, principles, norms, accountabilities, and bounds of contemporary engineering practice in the specific discipline	I calculated the wind load based on a wind speed of 100 km/h following QCS 2014 and BS-6399 Part-2.	1.9
	I used the beam minimum thickness from table 9.5 (a) in ACI 318-14 code.	1.10
	I performed structural designing work by following engineering standards	1.17
	I need to calculate the gust factor by the equation that is provided in the ASCE 7-10	2.9
	I followed ACI-440.1-15 for calculating the developmental length and CSA S806-12 theoretical flexural capacities for critical splice length prediction and determining flexural strength	3.12
PE2 ENGINEERING APPLICATION ABILITY		
PE2.1 Application of established engineering methods to complex engineering problem solving	I faced a problem with the design of a particular beam where the load was not distributed rationally to it	1.15
	I encountered due to the locations of the walls, beams, and column location which was not suitable as per architectural drawings	2.11
	I noticed a noise and felt movement in the building, As a solution, I increased the moment of inertia of the beams and columns by increasing their cross-sections	2.12

	I was not possible to set up the beams on the universal testing machine inside the lab using the available machinery	3.13
PE2.2 Fluent application of engineering techniques, tools, and resources	I checked the deflection, and the overturning, respectively using the Safe software.	1.10
	I used AutoCAD software to prepare the drawings of the beams, columns, and slabs' boundaries.	1.8
	I decided to use the ETABS software to design the beams, columns, and shear walls, slabs, and footings whereas SAFE software for checking both the immediate and long term deflection for the footings	2.7
	I design the structural drawings of the building in the ETAB software	2.8

	I used different software to execute other activities of the investigation, i.e. ETAB, STAAD, Microsoft	3.16
PE2.3 Application of systematic engineering synthesis and design processes	I was involved in the construction of the Qatar Academy Sidra School	1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14
	I was responsible for construction of Double Tree Hotel Apartment	2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13
	I performed a research work by designing RC beam and investigating it.	3.6, 3.7, 3.8, 3.9, 3.10, 3.11
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	I performed drawing study in the initial phase to understand the client's requirements and proposed the frame structures.	1.7,
	In the planning phase, I communicated with the junior engineers to make a project plan containing software relating to work, manual calculations, technical designing tasks, etc.	2.6
	I handled the project budgets for evaluating the cost of each activity and the associated portion of the full designation	3.17
PE3 PROFESSIONAL AND PERSONAL ATTRIBUTES		
PE3.1 Ethical conduct and professional accountability	I understood the ethical work regulations to maintain a good relationship with all members without any discrimination and kept	1.20

	all details confidential	
	I obeyed the ethical policies explained in the contract document and make assure that every individual are familiar with these policies	3.18
PE3.2 Effective oral and written communication in professional and lay domains	I called a technical kick-off meeting with the junior engineers and engineering design team to thoroughly study the systems along with their technical details	1.7, 2.13, 3.15
	I also arranged weekly and fortnightly meetings to discuss my work progress and to communicate the details.	1.19, 2.14
	I developed reports to explain my designing work to other members.	2.15
PE3.3 Creative innovative and proactive demeanor	I compared the results both software analysis and manual to ensure safe design.	1.11, 1.12, 1.13, 1.14
	I designed the structural system by suggesting two different options for the typical flooring plan (first to the eighth floor) to accommodate the owner's request.	2.7
	The designing and drafting of the budget heightened my skills in managing resources and their utilization to ensure adequate designation and allocation of limited funds to several actions	3.20
PE3.4 Professional use and management of information	I studied contract documents and drawings to propose the framing	1.7, 2.7

	system	
	I managed the information by preparing reports and calculations sheets to include all details.	2.15,
, PE3.5 Orderly management of self, and professional conduct	I planned my work to avoid work clashes that might affect deadlines and because of it, I submitted my work on time.	1.20
	I made the plan to develop drawings and design work	2.7
	I was able to finish the project on time due to a well-crafted working schedule	3.21
PE3.6 Effective team membership and team leadership	I arranged meetings with the junior engineers to discuss the work	1.18, 1.19
	I communicated with the structural team by arranging a short meeting to establish our daily goal which was a great strategy	2.14
	I demonstrated the effectiveness of teamwork. I handled each move as a team that promoted the sharing of ideas essential in tackling different issues of the experiment	3.19