Securing Multi-Tier Application Deployment on Kubernetes with WordPress + MySQL | Secrets | RBAC | Rolling Updates

In today's cloud-native world, deploying secure and scalable applications is critical. I recently worked on a Kubernetes-based multi-tier application deployment using WordPress (frontend) and MySQL (backend), while ensuring security, modularity, and zero-downtime deployments.

This project covered:

✓ Kubernetes Secrets for sensitive data

✓ Role-Based Access Control (RBAC)

✓ ClusterIP for internal communication

✓ Rolling update strategy

✓ Secure MySQL and WordPress deployment

The Challenge: Hardcoded Credentials in YAML

In collaborative projects, it's tempting to embed database passwords directly in YAML files for convenience. But that compromises security, especially when only the manager should know the credentials.

Summary of What I Did

- Deployed a multi-tier application using WordPress (frontend) and MySQL (backend) on Kubernetes.
- Managed database credentials securely using Kubernetes Secrets, avoiding hardcoded passwords in YAML.
- Implemented RBAC (Role-Based Access Control) to restrict access to sensitive data only to authorized users.
- Used ClusterIP to expose the database service privately within the cluster for enhanced security.
- Leveraged the rolling update strategy for zero-downtime deployments.
- Generated deployment manifests using --dry-run and -o yaml for clean and reusable configurations.
- Ensured seamless application setup, security, and scalability in a collaborative team environment.

Final Integration & Setup

Once the WordPress service is exposed:

- Access the frontend via browser.
- Provide the database host as the MySQL ClusterIP.
- Enter DB credentials (fetched via secret).
- Complete the WordPress installation wizard.

OUTPUTS:

C:\Windows\System32\cmd.exe

```
C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl apply -f deployment_mysql.yml
deployment.apps/mysqldb created

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get deployments
NAME      READY   UP-TO-DATE   AVAILABLE   AGE
mysqldb   0/1     1            0           13s

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get svc
NAME         TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)   AGE
kubernetes   ClusterIP   10.96.0.1    <none>        443/TCP   53m

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get po
NAME                       READY   STATUS              RESTARTS   AGE
mysqldb-759cffc696-cd7z7   0/1     ContainerCreating   0          82s

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl describe po
Name:             mysqldb-759cffc696-cd7z7
Namespace:        default
Priority:         0
Service Account:  default
Node:             minikube/192.168.59.113
Start Time:       Wed, 07 May 2025 19:39:28 +0530
Labels:           pod-template-hash=759cffc696
                  team=prod
Annotations:      <none>
Status:           Pending
IP:
IPs:              <none>
Controlled By:    ReplicaSet/mysqldb-759cffc696
Containers:
  container1:
    Container ID:
    Image:          mysql:latest
    Image ID:
    Port:           <none>
    Host Port:      <none>
    State:          Waiting
      Reason:       ContainerCreating
    Ready:          False
    Restart Count:  0
    Environment:
      MYSQL_ROOT_PASSWORD:  mysecretbox ------->  p
      MYSQL_DATABASE:       tejdb
```

deployment_mysql.yml - Notepad

File Edit Format View Help

```
  selector:
    matchLabels:
      team: prod
  template:
    metadata:
      labels:
        team: prod
    spec:
      containers:
      - name: container1
        image: "mysql:latest"
        env:
        - name: MYSQL_ROOT_PASSWORD
          valueFrom:
             secretKeyRef:
               name: mysecretbox
               key: p
        - name: MYSQL_DATABASE
          value: tejdb
        - name: MYSQL_USER
          valueFrom:
             secretKeyRef:
               name: mysecretbox
               key: u
        - name: MYSQL_PASSWORD
          valueFrom:
             secretKeyRef:
               name: mysecretbox
               key: p
```

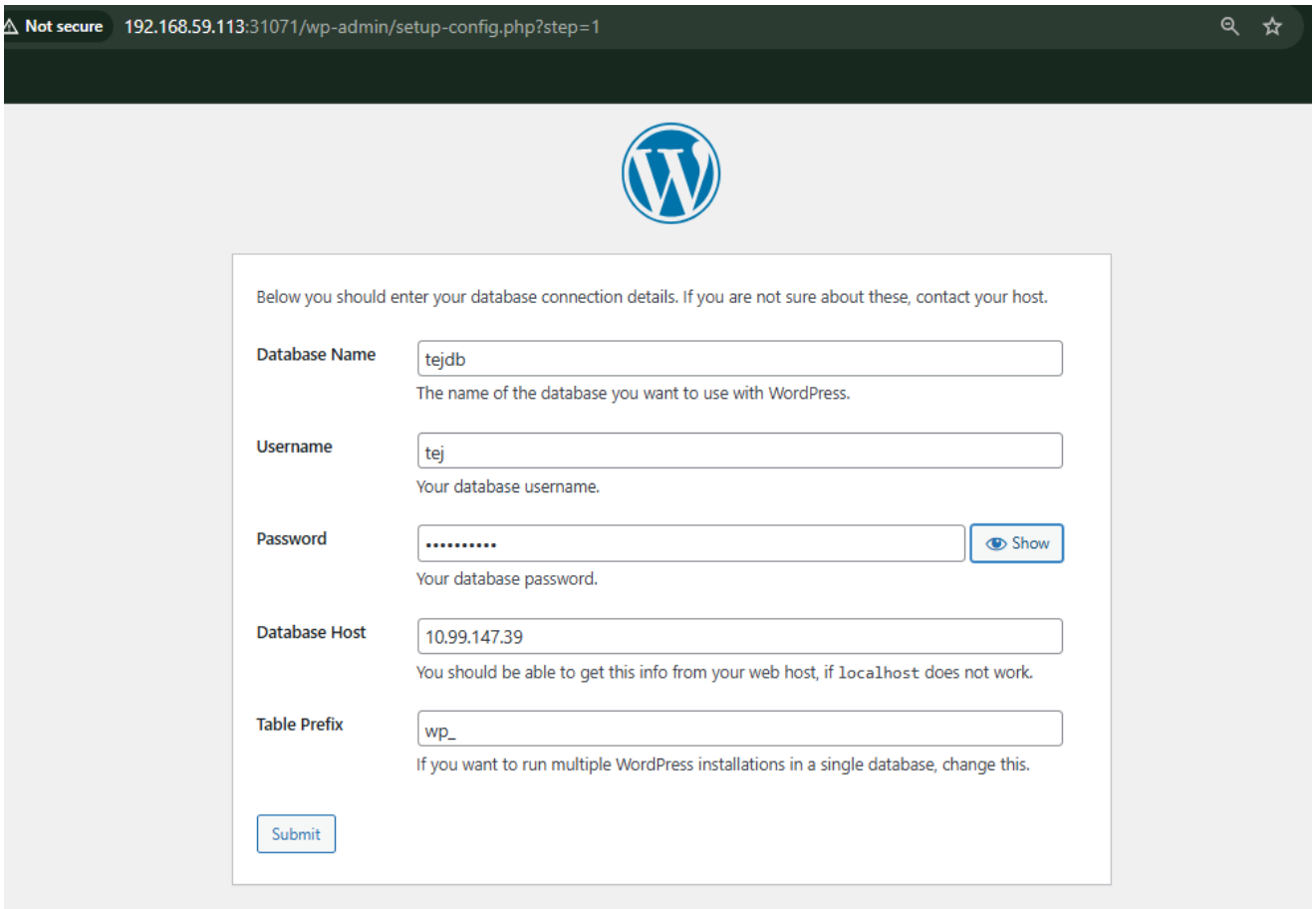
Ln 37, Col 22 | 100% | Windows (CRLF) | UTF-8

Select C:\Windows\System32\cmd.exe

```
    Port:           <none>
    Host Port:      <none>
    State:          Running
      Started:      Wed, 07 May 2025 19:42:02 +0530
    Ready:          True
    Restart Count:  0
    Environment:
      MYSQL_ROOT_PASSWORD:  mysecretbox ------->  p
      MYSQL_DATABASE:       tejdb
      MYSQL_USER:           mysecretbox ------->  p
      MYSQL_PASSWORD:       mysecretbox ------->  p
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-8dkkd (ro)
Conditions:
  Type                        Status
  PodReadyToStartContainers   True
  Initialized                 True
  Ready                       True
  ContainersReady             True
  PodScheduled                True
Volumes:
  kube-api-access-8dkkd:
    Type:                    Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds:  3607
    ConfigMapName:           kube-root-ca.crt
    ConfigMapOptional:       <nil>
    DownwardAPI:             true
QoS Class:                   BestEffort
Node-Selectors:              <none>
Tolerations:                 node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
                             node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type    Reason     Age    From               Message
  ----    ------     ----   ----               -------
  Normal  Scheduled  2m35s  default-scheduler  Successfully assigned default/mysqldb-759cffc696-cd7z7 to minikube
  Normal  Pulling    2m34s  kubelet            Pulling image "mysql:latest"
  Normal  Pulled     2s     kubelet            Successfully pulled image "mysql:latest" in 2m32.279s (2m32.279s i
  Normal  Created    1s     kubelet            Created container: container1
  Normal  Started    1s     kubelet            Started container container1

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get po
NAME                       READY   STATUS    RESTARTS   AGE
mysqldb-759cffc696-cd7z7   1/1     Running   0          2m40s
```

C:\Windows\System32\cmd.exe

```
Events:
  Type    Reason     Age   From               Message
  ----    ------     ----  ----               -------
  Normal  Scheduled  2m7s  default-scheduler  Successfully assigned default/mysqldb-6bdfb78cb7-jwsf7 to minikube
  Normal  Pulling    2m5s  kubelet            Pulling image "mysql:latest"
  Normal  Pulled     2m3s  kubelet            Successfully pulled image "mysql:latest" in 2.356s (2.356s including waiting). Image size: 859083525 bytes.
  Normal  Created    2m3s  kubelet            Created container: container1
  Normal  Started    2m2s  kubelet            Started container container1

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl describe secrets
Name:         mysecretbox
Namespace:    default
Labels:       <none>
Annotations:  <none>

Type:  Opaque

Data
====
p:  10 bytes
u:  3 bytes

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get secret myswcretbox
Error from server (NotFound): secrets "myswcretbox" not found

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get secret mysecretbox
NAME          TYPE     DATA   AGE
mysecretbox   Opaque   2      145m

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get secret mysecretbox -o yaml
apiVersion: v1
data:
  p: bXlwYXNzd29yZA==
  u: dGVq
kind: Secret
metadata:
  creationTimestamp: "2025-05-07T14:16:15Z"
  name: mysecretbox
  namespace: default
  resourceVersion: "3282"
  uid: 46d81158-9e0c-43c3-8bb4-5a5f6ec9091e
type: Opaque
```



```
C:\Windows\System32\cmd.exe

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl create secret generic mysecretbox --from-literal=u=tej --from-literal=p=mypassword
error: failed to create secret secrets "mysecretbox" already exists

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get secrets
NAME          TYPE     DATA   AGE
mysecretbox   Opaque   2      170m

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get secret
NAME          TYPE     DATA   AGE
mysecretbox   Opaque   2      170m

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl apply -f deployment_mysql.yml
deployment.apps/mysqldb configured

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get deploy
NAME      READY   UP-TO-DATE   AVAILABLE   AGE
mysqldb   1/1     1            1           3h

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl expose deployment mysqldb --type ClusterIP --port 3306 --dry-run   -o yaml
W0507 22:41:13.187615    5448 helpers.go:702] --dry-run is deprecated and can be replaced with --dry-run=client.
apiVersion: v1
kind: Service
metadata:
  creationTimestamp: null
  name: mysqldb
spec:
  ports:
  - port: 3306
    protocol: TCP
    targetPort: 3306
  selector:
    team: prod
  type: ClusterIP
status:
  loadBalancer: {}

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl expose deployment mysqldb --type ClusterIP --port 3306 --dry-run   -o yaml >> deployment_mysql.yml
W0507 22:42:55.110070    6480 helpers.go:702] --dry-run is deprecated and can be replaced with --dry-run=client.
```

```
C:\Windows\System32\cmd.exe
C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl expose deployment mysqldb --type ClusterIP --port 3306 --dry-run   -o yaml
W0507 22:41:13.187615    5448 helpers.go:702] --dry-run is deprecated and can be replaced with --dry-run=client.
apiVersion: v1
kind: Service
metadata:
  creationTimestamp: null
  name: mysqldb
spec:
  ports:
  - port: 3306
    protocol: TCP
    targetPort: 3306
  selector:
    team: prod
  type: ClusterIP
status:
  loadBalancer: {}

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl expose deployment mysqldb --type ClusterIP --port 3306 --dry-run   -o yaml >> deployment_mysql.yml
W0507 22:42:55.110070    6480 helpers.go:702] --dry-run is deprecated and can be replaced with --dry-run=client.

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>notepad deployment_mysql.yml

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl apply -f deployment_mysql.yml
deployment.apps/mysqldb configured
error: error when retrieving current configuration of:
Resource: "/v1, Resource=services", GroupVersionKind: "/v1, Kind=Service"
Name: "", Namespace: "default"
from server for: "deployment_mysql.yml": resource name may not be empty

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl apply -f deployment_mysql.yml
deployment.apps/mysqldb configured
service/mysqldb created

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get deploy
NAME      READY   UP-TO-DATE   AVAILABLE   AGE
mysqldb   1/1     1            1           3h8m
```

C:\Windows\System32\cmd.exe

```
C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get svc
NAME         TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)    AGE
kubernetes   ClusterIP   10.96.0.1       <none>        443/TCP    4h1m
mysqldb      ClusterIP   10.103.161.20   <none>        3306/TCP   21s

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl create deployment wpapp --image=wordpress:latest --dry-run -o yaml
W0507 22:50:50.586571   11960 helpers.go:702] --dry-run is deprecated and can be replaced with --dry-run=client.
apiVersion: apps/v1
kind: Deployment
metadata:
  creationTimestamp: null
  labels:
    app: wpapp
  name: wpapp
spec:
  replicas: 1
  selector:
    matchLabels:
      app: wpapp
  strategy: {}
  template:
    metadata:
      creationTimestamp: null
      labels:
        app: wpapp
    spec:
      containers:
      - image: wordpress:latest
        name: wordpress
        resources: {}
status: {}

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl create deployment wpapp --image=wordpress:latest --dry-run -o yaml > wp_deployment.yml
W0507 22:51:36.148313    7272 helpers.go:702] --dry-run is deprecated and can be replaced with --dry-run=client.

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl create -f wp_deployment.yml
deployment.apps/wpapp created

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get deploy
NAME      READY   UP-TO-DATE   AVAILABLE   AGE
mysqldb   1/1     1            1           3h14m
wpapp     0/1     1            0           58s
```

C:\Windows\System32\cmd.exe

```
C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get po
NAME                      READY   STATUS              RESTARTS   AGE
mysqldb-6bdfb78cb7-jwsf7  1/1     Running             0          3h
wpapp-5c6f6f558-vzwlv     0/1     ContainerCreating   0          68s

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl expose deployment wpapp --type NodePort --port=80 --dry-run -o yaml
W0507 22:55:29.014895   11412 helpers.go:702] --dry-run is deprecated and can be replaced with --dry-run=client.
apiVersion: v1
kind: Service
metadata:
  creationTimestamp: null
  labels:
    app: wpapp
  name: wpapp
spec:
  ports:
  - port: 80
    protocol: TCP
    targetPort: 80
  selector:
    app: wpapp
  type: NodePort
status:
  loadBalancer: {}

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl expose deployment wpapp --type NodePort --port=80 --dry-run -o yaml >> wp_deployment.yml
W0507 22:56:22.832469   11564 helpers.go:702] --dry-run is deprecated and can be replaced with --dry-run=client.

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>notepad wp_deployment.yml

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl apply -f  wp_deployment.yml
Warning: resource deployments/wpapp is missing the kubectl.kubernetes.io/last-applied-configuration annotation which is required by kubectl apply. kubectl apply should
only be used on resources created declaratively by either kubectl create --save-config or kubectl apply. The missing annotation will be patched automatically.
deployment.apps/wpapp configured
service/wpapp created

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get deploy
NAME      READY   UP-TO-DATE   AVAILABLE   AGE
mysqldb   1/1     1            1           3h20m
wpapp     1/1     1            1           7m29s
```

C:\Windows\System32\cmd.exe

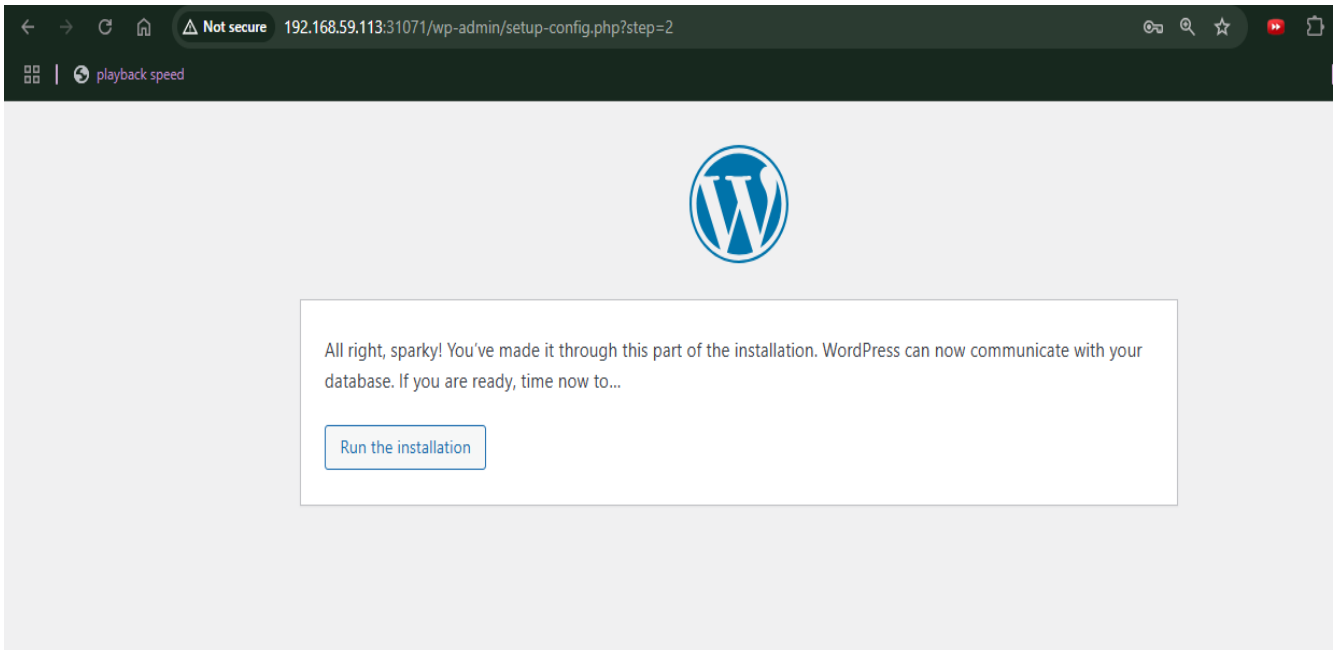
```
C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>kubectl get svc
NAME         TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)        AGE
kubernetes   ClusterIP   10.96.0.1       <none>        443/TCP        4h14m
mysqldb      ClusterIP   10.103.161.20   <none>        3306/TCP       12m
wpapp        NodePort    10.99.147.39    <none>        80:31071/TCP   18s

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>minikube ip
192.168.59.113

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>type wp_deployment.yml
apiVersion: apps/v1
kind: Deployment
metadata:
  creationTimestamp: null
  labels:
    app: wpapp
  name: wpapp
spec:
  replicas: 1
  selector:
    matchLabels:
      app: wpapp
  strategy: {}
  template:
    metadata:
      labels:
        app: wpapp
    spec:
      containers:
      - image: wordpress:latest
        name: wordpress
---
apiVersion: v1
kind: Service
metadata:
  labels:
    app: wpapp
  name: wpapp
spec:
  ports:
  - port: 80
    protocol: TCP
    targetPort: 80
```

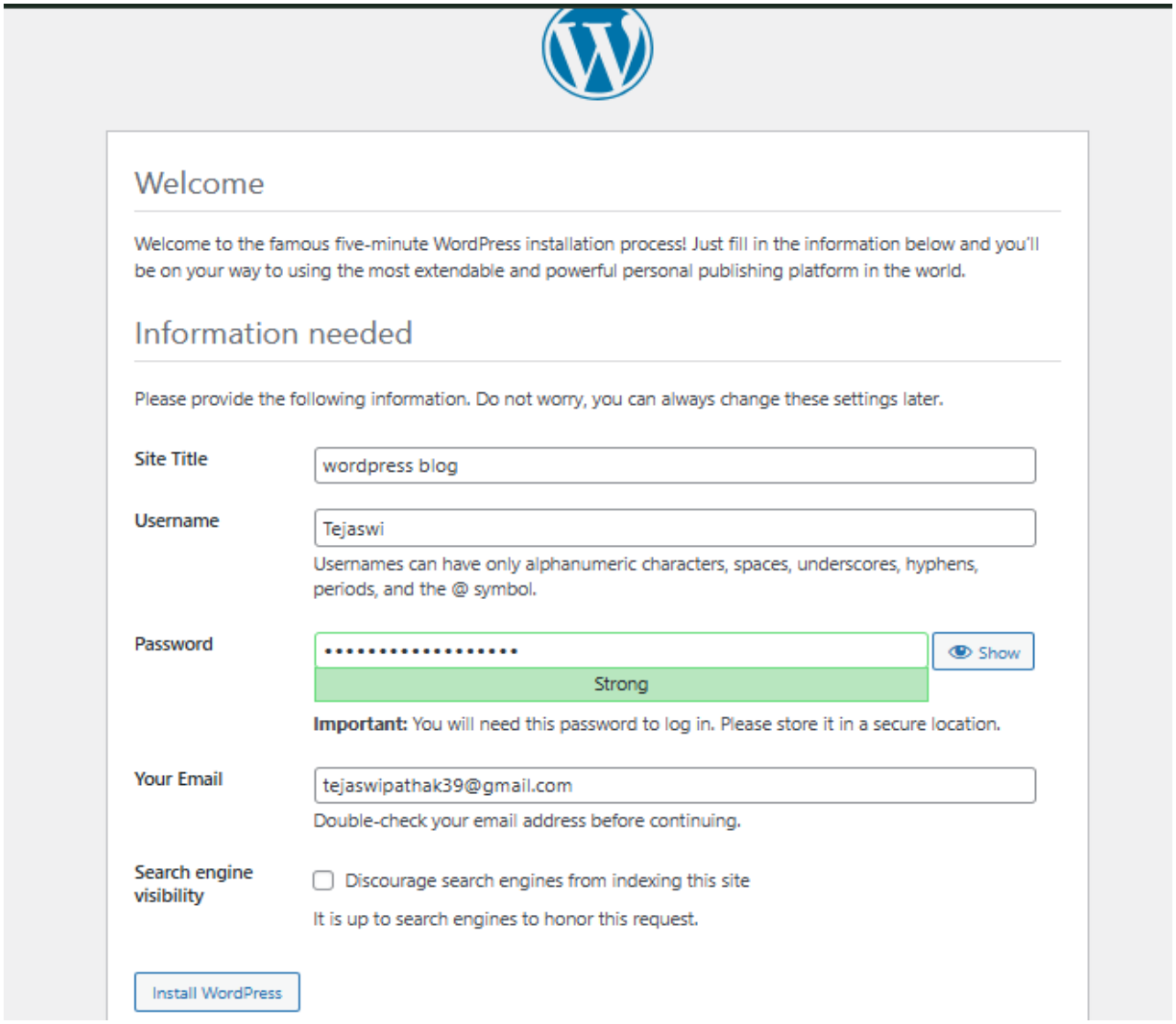
C:\Windows\System32\cmd.exe

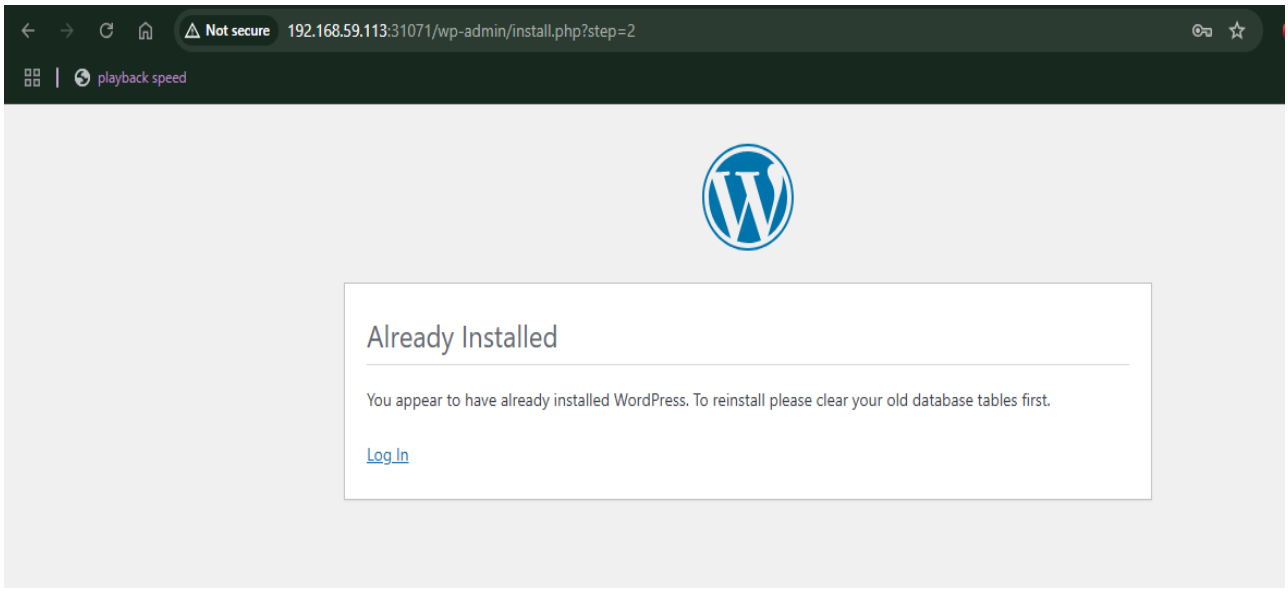
```
    protocol: TCP
    targetPort: 80
  selector:
    app: wpapp
  type: NodePort
C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>dir
 Volume in drive C is OS
 Volume Serial Number is 4E35-0678

 Directory of C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training

07-05-2025  22:51    <DIR>          .
07-05-2025  22:51    <DIR>          ..
07-05-2025  22:47               999 deployment_mysql.yml
05-05-2025  22:54               362 first_deployment.yml
05-05-2025  16:59               531 mysql_rs.yml
05-05-2025  17:19               204 mysql_svc.yml
22-04-2025  15:43               184 pod1.yml
21-04-2025  16:40               340 pod1_rc.yml
02-05-2025  16:21               467 pod1_rs.yml
05-05-2025  15:36               224 service.yml
05-05-2025  15:36               210 service_private.yml
07-05-2025  22:59               526 wp_deployment.yml
              10 File(s)          4,047 bytes
               2 Dir(s)  27,535,253,504 bytes free

C:\Users\Pathak\Documents\Kubernetes\Kubernetes-training>type deployment_mysql.yml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: mysqldb
spec:
  replicas: 1
  strategy:
      type: RollingUpdate
  selector:
    matchLabels:
      team: prod
  template:
    metadata:
      labels:
```

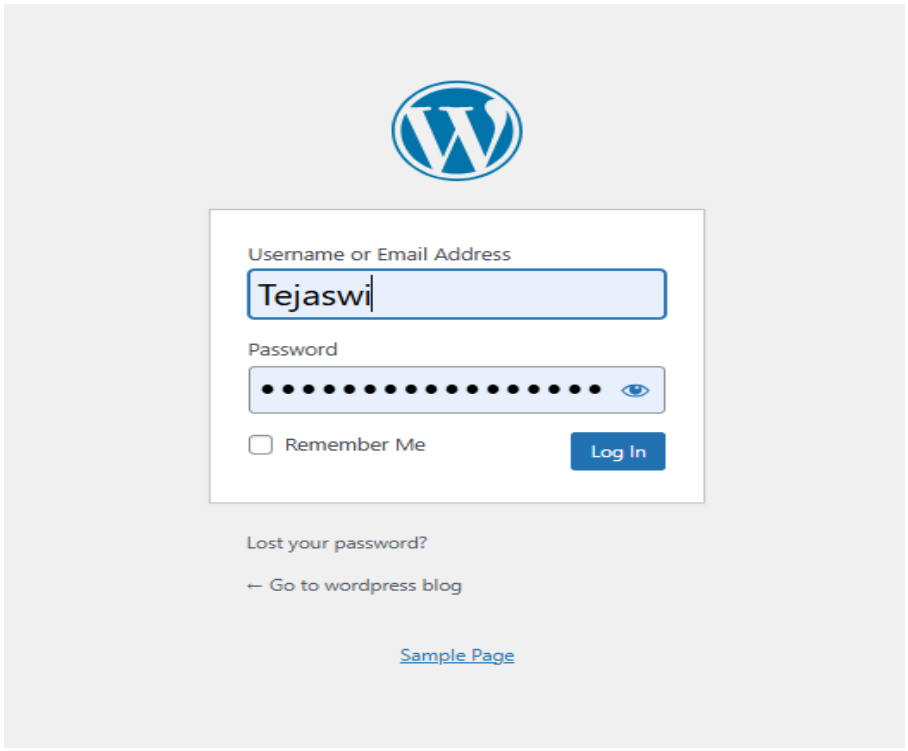
C:\Windows\System32\cmd.exe

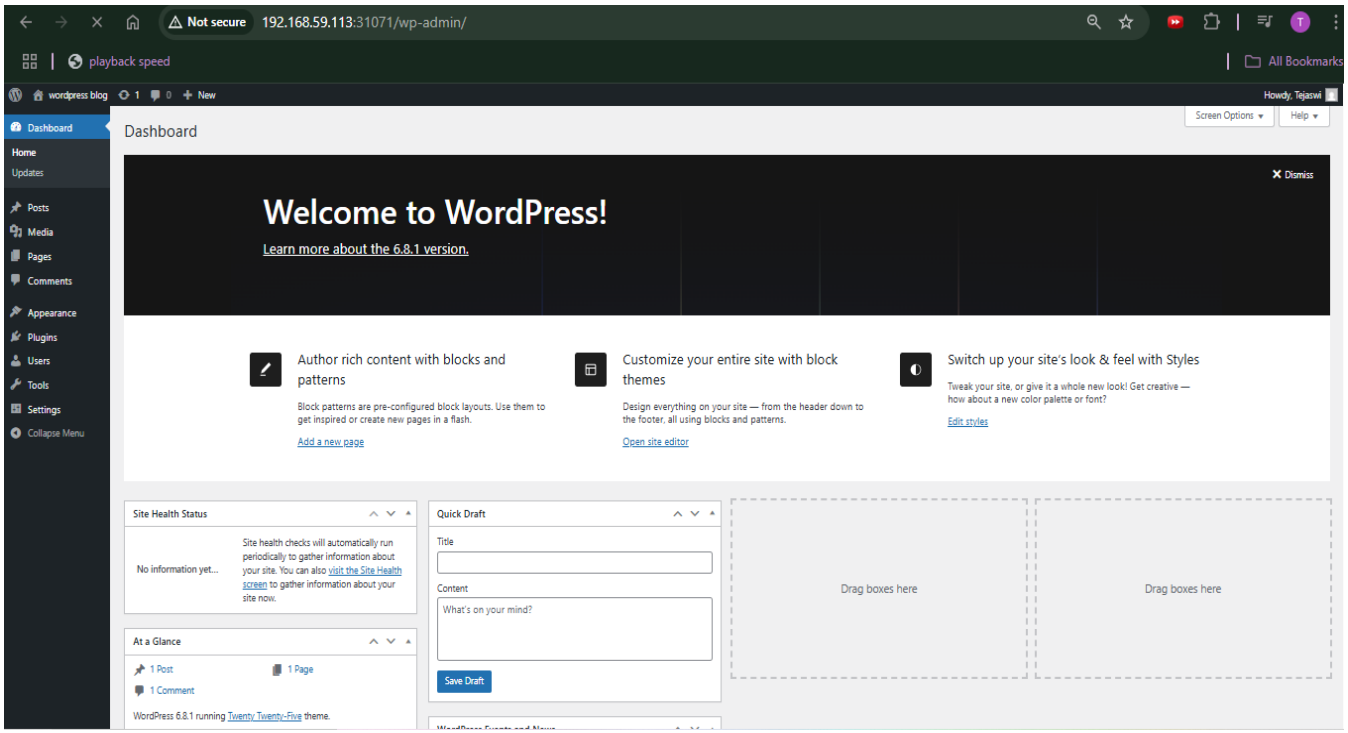
```
    spec:
      containers:
      - name: container1
        image: "mysql:latest"
        env:
        - name: MYSQL_ROOT_PASSWORD
          valueFrom:
             secretKeyRef:
               name: mysecretbox
               key: p
        - name: MYSQL_DATABASE
          value: tejdb
        - name: MYSQL_USER
          valueFrom:
             secretKeyRef:
               name: mysecretbox
               key: u
        - name: MYSQL_PASSWORD
          valueFrom:
             secretKeyRef:
               name: mysecretbox
               key: p
---
apiVersion: v1
kind: Service
metadata:
  name: mysqldb
spec:
  ports:
  - port: 3306
    protocol: TCP
    targetPort: 3306
  selector:
    team: prod
  type: ClusterIP
```

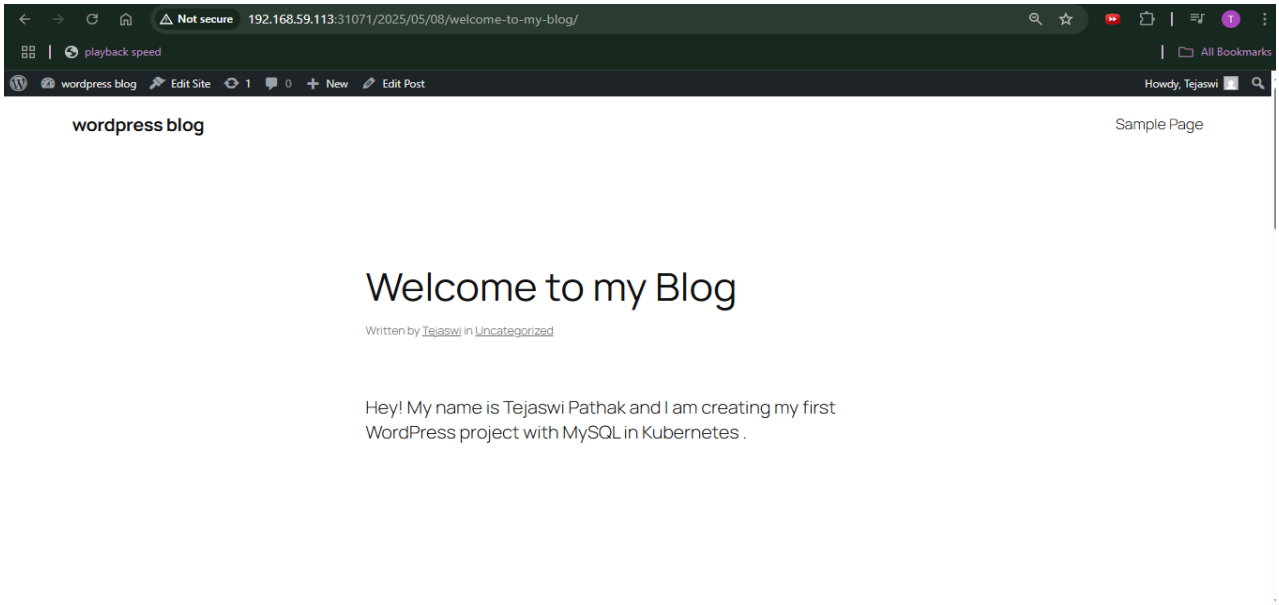


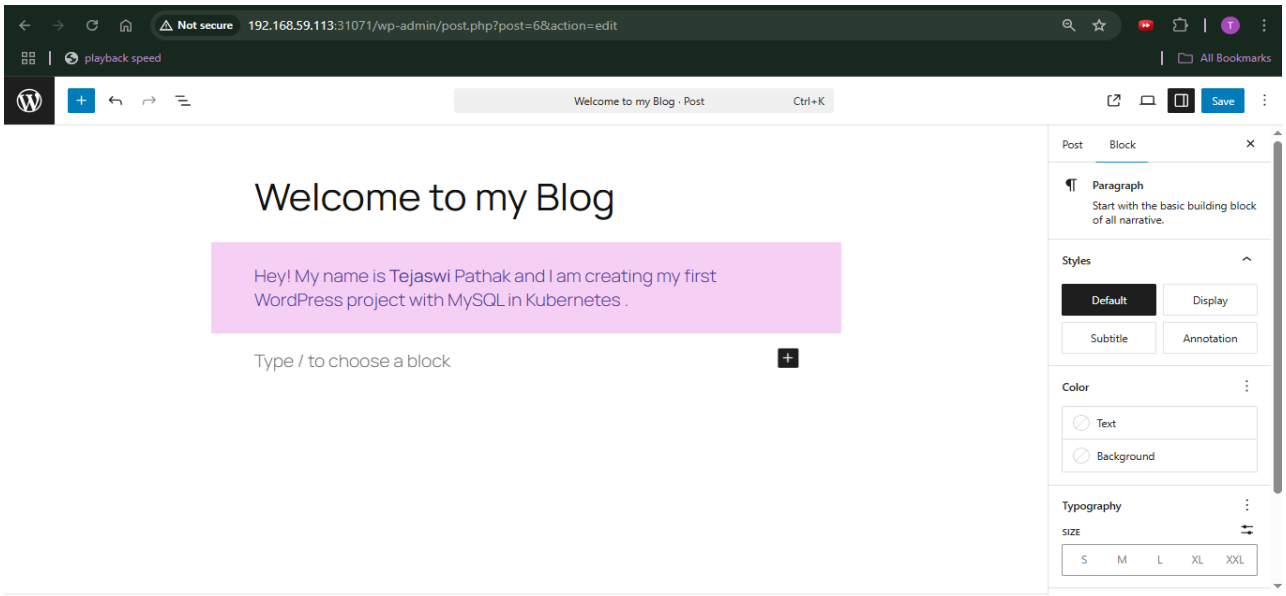

Welcome
Welcome to the famous five-minute WordPress installation process! Just fill in the information below and you'll be on your way to using the most extendable and powerful personal publishing platform in the world.
Information needed
Please provide the following information. Do not worry, you can always change these settings later.
Site Title
wordpress blog
Username
Tejaswi
Usernames can have only alphanumeric characters, spaces, underscores, hyphens, periods, and the @ symbol.
Password
Show
Strong
Important: You will need this password to log in. Please store it in a secure location.
Your Email
tejaswipathak39@gmail.com
Double-check your email address before continuing.
Search engine visibility
Discourage search engines from indexing this site
It is up to search engines to honor this request.
Install WordPress

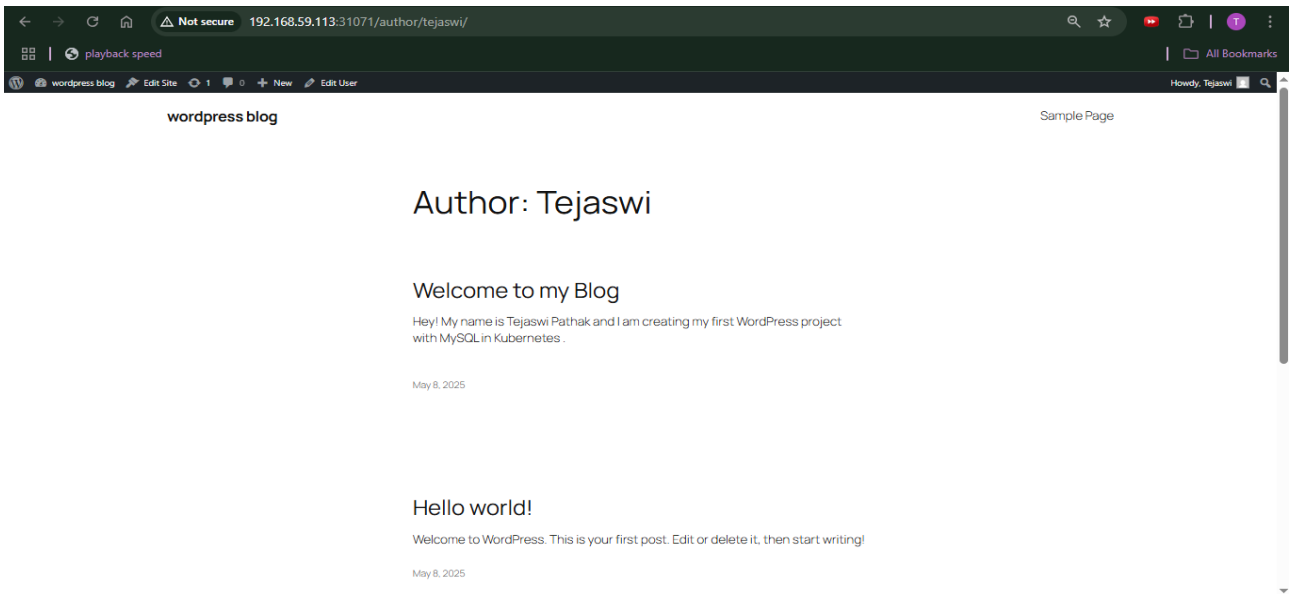

Not secure
192.168.59.113:31071/wp-admin/install.php?step=2
playback speed
Already Installed
You appear to have already installed WordPress. To reinstall please clear your old database tables first.
Log In


Username or Email Address
Tejaswi
Password
Remember Me
Log In
Lost your password?
← Go to wordpress blog
Sample Page


Not secure 192.168.59.113:31071/wp-admin/
playback speed
All Bookmarks
wordpress blog
New
Howdy, Tejaswi
Dashboard
Home
Updates
Posts
Media
Pages
Comments
Appearance
Plugins
Users
Tools
Settings
Collapse Menu
Screen Options
Help
Welcome to WordPress!
Learn more about the 6.8.1 version.
Dismiss
Author rich content with blocks and patterns
Block patterns are pre-configured block layouts. Use them to get inspired or create new pages in a flash.
Add a new page
Customize your entire site with block themes
Design everything on your site — from the header down to the footer, all using blocks and patterns.
Open site editor
Switch up your site's look & feel with Styles
Tweak your site, or give it a whole new look! Get creative — how about a new color palette or font?
Edit styles
Site Health Status
No information yet...
Site health checks will automatically run periodically to gather information about your site. You can also visit the Site Health screen to gather information about your site now.
Quick Draft
Title
Content
What's on your mind?
Save Draft
Drag boxes here
Drag boxes here
At a Glance
1 Post
1 Page
1 Comment
WordPress 6.8.1 running Twenty Twenty-Five theme.


Not secure 192.168.59.113:31071/2025/05/08/welcome-to-my-blog/
playback speed
All Bookmarks
wordpress blog
Edit Site
1
0
New
Edit Post
Howdy, Tejaswi
wordpress blog
Sample Page
Welcome to my Blog
Written by Tejaswi in Uncategorized
Hey! My name is Tejaswi Pathak and I am creating my first WordPress project with MySQL in Kubernetes .


Not secure 192.168.59.113:31071/wp-admin/post.php?post=6&action=edit
playback speed
All Bookmarks
Welcome to my Blog · Post
Ctrl+K
Save
Welcome to my Blog
Hey! My name is Tejaswi Pathak and I am creating my first WordPress project with MySQL in Kubernetes .
Type / to choose a block
Post
Block
Paragraph
Start with the basic building block of all narrative.
Styles
Default
Display
Subtitle
Annotation
Color
Text
Background
Typography
SIZE
S
M
L
XL
XXL
Post › Paragraph


Not secure 192.168.59.113:31071/author/tejaswi/
playback speed
All Bookmarks
wordpress blog
Edit Site
1
0
New
Edit User
Howdy, Tejaswi
wordpress blog
Sample Page
Author: Tejaswi
Welcome to my Blog
Hey! My name is Tejaswi Pathak and I am creating my first WordPress project with MySQL in Kubernetes .
May 8, 2025
Hello world!
Welcome to WordPress. This is your first post. Edit or delete it, then start writing!
May 8, 2025

Outcome

✓ Secure credentials management

✓ Only authorized users can access secrets

✓ Multi-tier app deployed on Kubernetes

✓ Private backend services

✓ Zero downtime with rolling updates.

Conclusion

This project helped me gain hands-on experience in deploying secure, scalable, and production-ready applications on Kubernetes. By combining Kubernetes Secrets, RBAC, rolling updates, and service types like ClusterIP, I ensured that sensitive data remained protected, deployments were smooth, and the architecture was modular and resilient.

In real-world team environments, balancing accessibility and security is crucial. Leveraging Kubernetes-native features allowed me to enforce this balance effectively. This experience has strengthened my understanding of DevOps best practices and the importance of infrastructure security in modern application deployments.